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147 thru 156	Original
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159 thru 168	Original
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170 thru 170B	15 January 1958
171 thru 174	Original
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188 thru 199	Original
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215 thru 217	Original
218 and 219	10 May 1958
220	Original
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222 and 223	Original
*224	15 September 1958
225 thru 234	Original
*235	15 September 1958
236 thru 242	Original
*243	15 September 1958
244 thru 248	Original
*249	15 September 1958
250	15 January 1958
*250A	15 September 1958
250B	15 January 1958
251 thru 258	Original
259	10 May 1958
260	Original
261	15 January 1958
262 thru 263	Original
264	10 May 1958
265	Original
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269 thru 276	Original
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INTRODUCTION

The objective of this handbook is to enable line personnel of operating units to maintain the aircraft at peak efficiency with a minimum expenditure of time. It contains essential servicing and maintenance information covering the airframe, engines, instruments, and accessories. Each item is described briefly and information on routine checks, trouble shooting, minor repairs and parts replacement, cleaning, lubrication and adjustments are presented as they apply. Instructions for overhaul and testing which require shop equipment are not included.

Illustrations, either line drawings or photographs, have been included in the text wherever their use will clarify a discussion or provide additional information not readily translated into words. The illustrations are numbered consecutively within each section and placed as close as possible to the text to which they pertain. A list of illustrations immediately follows the general table of contents.

Certain information which will be needed frequently, or which can be presented to the best advantage in tabular form, has been incorporated in a series of tables, usually grouped at the end of each section. Examples are the Table of Principal Dimensions in Section I, The Power Loading Tables in Section VII and Trouble Shooting Tables for various systems, in the sections to which they apply. The tables are numbered consecutively, with Roman numerals, throughout the handbook. They are listed separately in the general table of contents.

A general table of contents for the entire handbook precedes Section I. This table lists all sections and main paragraph headings with their initial page numbers. A table of contents for each section, listing the section's primary and subordinate headings with their initial page numbers, immediately follows the section heading. An alphabetical index, listing each item discussed, will be found in the back of the handbook.

Information concerning dimensions, access, inspection provisions, ground handling, servicing, lubrication, and special tools which are required to maintain the aircraft, is included in Section I. Section II contains information pertaining to the airframe, landing gear, and control surface movements. Sections III and IX are not applicable to the aircraft. Sections IV, V, VI, VII, and VIII contain information relative to description, trouble shooting, removal, minor repairs and parts replacement, installation, adjustments and testing of each system and component part. When performing any of the above operations the pertinent sections should be referred to. Section X includes complete wiring diagrams with an alphabetical index, for all electrical and radio equipment installed in the aircraft.

TABLE OF CONTENTS

Section		Page
I	GENERAL INFORMATION	1
	1- 1. General Description	1
	1- 3. Principal Dimensions	1
	1- 18. Servicing	14
	1- 33. Torque Values	24
	1- 34. Servicing	24
	1- 35. Tank Capacities	24
	1- 36. Special Tools	24
	1- 38. Equipment	24
	1- 40. Tubing Identification	24
	1- 42. Lubrication	24
	1- 45. Cleaning	24
II	AIRFRAME GROUP	27
	2- 1. General Description	28
	2- 3. Body Group	28
	2- 30. Wing Group	32
	2- 64. Tail Group	43
	2- 85. Surface Control Systems	46
	2-171. Rudder Control System	61
	2-198. Main Landing Gear System	66
	2-256. Tail Gear Assembly	82
	2-285. Landing Gear Retract System	85
III	HYDRAULIC AND PNEUMATIC SYSTEMS	111

TABLE OF CONTENTS (CONT)

Section		Page
IV	UTILITY SYSTEM	111
	4- 1. General Description	111
	4- 3. Heating System	111
	4- 17. Ventilating System	114
	4- 25. Deicing System	114
	4- 39. Fire Extinguisher System	116
	4- 65. Oxygen System	123
	4- 90. Windshield Wiper System	126
	4-103. Anti-Icer System	127
V	POWER PLANT	131
Part I	Preparation and Build Up	131
	1- 1. Removal of Engine from Metal Shipping Container	132
	1- 2. Removal of Engine from Wooden Shipping Container	134
	1- 3. Engine Build Up	134
	1- 4. Installation of Engine	141
	1- 5. Propeller Installation	142
Part II	Depreservation and Run-In	143
	2- 1. Engine Depreservation	143
	2- 2. Depreservation of Engine	143
	2- 3. Pre-Oil	143
	2- 6. Engine Pre-Start Check	144
	2- 7. Power Plant Operation	144
Part III	Power Plant Section	147
	3- 1. Engine	147
	3- 3. Engine Cowl and Mount	147
	3- 4. Ring Cowling	147
	3- 38. Fuel System	157
	3- 90. Primer System	162
	3- 98. Lubrication System	163
	3-119. Oil Dilution System	166
	3-146. Ignition System	169
	3-176. Starting System	176
	3-183. Supercharging, Air Induction and Exhaust Systems	176
	3-209. Deleted	178
	3-220. Propellers	184
Part IV	Reasons for Removal	205
	4- 1. Control of Engine Removal	205
	4- 3. Sudden Stoppage or Sudden Reduction in Speed	205
	4- 9. Metal Particles in Oil	206
	4- 24. In-Service Parts Failures	208
	4- 37. Foreign Material in the Oil System	209
Part V	Power Plant Removal, Stripping and Preservation Procedures	211
	5- 1. Preservation Run	211
	5- 2. Removal of Power Plant	211
	5- 3. Power Plant Stripping	212
	5- 5. Preservation of Interior Surfaces	213
VI	INSTRUMENTS AND RELATED SYSTEMS	217
	6- 1. Instruments	217
	6- 40. Instrument Vacuum System	228
	6- 64. Pitot and Static Pressure System	230
	6- 67. Automatic Pilot	230
VII	ELECTRICAL SYSTEM	243
	7- 1. General Description	244
	7- 3. Battery System	244
	7- 9. Generator System	245
	7- 31. Interior Lighting	248
	7- 48. Exterior Lighting System	249
	7- 65. Anti-Collsion Light	250A
	7- 69. Circuit Protection	250A
	7- 70. Electrical Power Loading	250A

TABLE OF CONTENTS (CONT)

Section		Page
VIII	RADIO SYSTEMS	259
	8- 1. General Description	259
	8- 3. AN/ARC-3 VHF Radio Equipment	259
	8- 17. AN/ARN-7 Radio Compass	261
	8- 29. R-122/ARN-12 Marker Beacon Receiver	262
	8- 36. BC-453-B Range Receiver	263
	8- 45. Interphone System	264
	8- 60. Antenna Installation	265
	8- 75. AN/ARC-27 UHF Radio Equipment	266
IX	PHOTOGRAPHIC	269
X	WIRING DATA	269
	Electrical Equipment List	272
	Radio Equipment List	277
	Index of Wiring Diagrams	279

LIST OF TABLES

Table	Title	Page
I	Principal Dimensions	2A
II	Servicing	17
III	Tank Capacities	17
IV	Control Cable Tension and Surface Travel	102
V	Trouble Shooting, Wing Flap Electrical System	103
VI	Trouble Shooting, Brake System	104
VII	Trouble Shooting, Tail-Wheel Lock and Tail Wheel Lock Control	105
VIII	Trouble Shooting, Landing Gear Motor and Energizing Circuits	105
IX	Trouble Shooting, Landing Gear Position Indicator	107
X	Trouble Shooting, Landing Gear Limit and Safety Switches	107
XI	Trouble Shooting, Landing Gear Malfunction Light and Warning Horn	108
XII	Trouble Shooting, Main Landing Gear Doors	110
XIII	Trouble Shooting (Heating System)	129
XIV	Trouble Shooting (Deicing System)	129
XV	Trouble Shooting (Windshield Wipers)	130
XVI	Trouble Shooting, Anti-Icer System	130
XVII	Engine Trouble Shooting	196
XVIII	Deleted	201
XIX	Deleted	203
XX	Propeller Trouble Shooting (Hamilton Standard Hydromatic)	203
XXI	Trouble Shooting, Engine Instruments	237
XXII	Trouble Shooting, Flight Instruments	238
XXIII	Trouble Shooting, Navigation Instruments	238
XXIV	Trouble Shooting, Miscellaneous Instruments	239
XXV	Trouble Shooting, Vacuum System	240
XXVI	Trouble Shooting, Pitot and Static Pressure System	240
XXVII	Trouble Shooting, Automatic Pilot	241
XXVIII	Trouble Shooting, Battery System	255
XXIX	Trouble Shooting, Generator	255
XXX	Trouble Shooting, Interior Lighting	256
XXXI	Trouble Shooting, Position Lights	256
XXXII	Trouble Shooting, Landing Lights	257
XXXIII	Trouble Shooting, AN/ARC-3 VHF Radio Set	268B
XXXIV	Trouble Shooting, R-122/ARN-12 Marker Beacon Receiver	268C
XXXV	Trouble Shooting, Interphone System	268C
XXXVI	Trouble Shooting, AN/ARC-27 Radio Set	267D

LIST OF ILLUSTRATIONS

Figure	Title	Page
1 - 1	Three-Quarter View of Aircraft	x
1 - 2	Dimensional Diagram	3
1 - 3	Stations Diagram	4
1 - 4	Wing Access Doors	5
1 - 5	Fuselage Access Doors	6
1 - 6	Jacking Aircraft	7
1 - 7	Hoisting Aircraft	8
1 - 8	Longitudinal Leveling	9
1 - 9	Lateral Leveling	9
1 -10	Aircraft Mooring	10
1 -11	Aircraft Mooring	10
1 -12	Gross Weight Versus Wind Speed	11
1 -13	Parking Brake	14

LIST OF ILLUSTRATIONS (CONT)

Figure	Title	Page
1 -14	Surface Control Lock	14
1 -15	Towing Aircraft	15
1 -16	Servicing Points	16
1 -17	Main Gear Shock Strut Inflation	18
1 -18	Tail Gear Shock Strut Inflation	18
1 -19	Oxygen Filler Valve	18
1 -20	Battery Access	19
1 -21	Main Wheel Tire Inflation	19
1 -22	Tail Wheel Tire Inflation	19
1 -23	Tire Inflation Chart	20
1 -24	Special Tools	21
1 -25	Lubrication Chart (Sheet 1 of 2 Sheets)	22
1 -25	Lubrication Chart (Sheet 2 of 2 Sheets)	23
1 -26	Tubing Identification Chart	25
2 - 1	Fuselage Compartment Diagram	28
2 - 2	Nose Baggage Compartment Door	29
2 - 3	Tail Compartment Access	29
2 - 4	Tail Cowling	29
2 - 5	Inspection Criteria for Plexiglass Panels (Sheet 1 of 2 Sheets)	30
2 - 5	Inspection Criteria for Plexiglass Panels (Sheet 2 of 2 Sheets)	31
2 - 6	Center Section Wing	33
2 - 7	Outer Wing Panel and Tip	34
2 - 8	Rear Spar Fittings	34
2 - 9	Wing Hinge Bolt, Puller and Nut	34
2 -10	Wing Fittings	35
2 -11	Reaming Aft Wing Spar	35
2 -12	Wing Hinge Reamers	36
2 -13	Temporary Hinge Pin	36
2 -14	Guide Strip In Place	36
2 -15	Tripod Wing Stand	37
2 -16	Reaming Center Section Truss Fittings	37
2 -17	Cross Section of Wing Mounting Bushings and Fittings	38
2 -18	Wing Fitting Dimensions	38
2 -19	Aileron Assembly	40
2 -20	Aileron Hinge Wire Installation	41
2 -21	Aileron Hinge Wire Safety Lug	42
2 -22	Flap Assembly	42
2 -23	Horizontal Stabilizer	43
2 -24	Vertical Stabilizer	44
2 -25	Elevator Assembly	45
2 -26	Rudder Assembly	46
2 -27	Aileron and Aileron Tab Control Systems	47
2 -28	Aileron Control System (Control Column)	48
2 -29	Aileron Travel Check	49
2 -30	Straightedge Installation Control Wheels	49
2 -31	Aileron Tab Cable Stop	50
2 -32	Wing Flap Control System	51
2 -33	Flap Position Switch (C-45G and TC-45G Serials 51-11444 through 51-11911)	52
2 -34	Flap Position Switch (C-45H Serials 52-10539 and After)	52
2 -35	Flap Limit Switch Adjustment	53
2 -36	Flap Dynamic Brake Relay	53
2 -37	Flap 90-Degree Drive	54
2 -38	Flap Motor and Gearbox Assembly	55
2 -39	Flap Overload Clutch Adjustment	55
2 -40	Elevator and Elevator Tab Control Systems	56
2 -41	Elevator Control Bull Wheel	57
2 -42	Elevator Travel Stop Adjustment	58
2 -43	Control Column Neutral Setting	58
2 -44	Elevator Tab Drive	59
2 -45	Elevator Tab Travel Adjustment	61
2 -46	Rudder and Rudder Tab Control Systems	62

LIST OF ILLUSTRATIONS (CONT)

Figure	Title	Page
2 -47	Rudder Travel Adjustment	63
2 -48	Rudder Reduction Pulley Setting	63
2 -49	Rudder Pedal Neutral Setting	64
2 -50	Rudder Tab Hinge Wire Removal	64
2 -51	Rudder Tab Travel Check	65
2 -52	Rudder Tab Travel Adjustment	65
2 -53	Landing Gear Assembly	66
2 -54	Wheel Assembly	67
2 -55	Dismounting Tire	67
2 -56	Removing Retaining Nuts	68
2 -57	Brake Assembly (Key Type)	69
2 -58	Brake Cylinder Packing Nut Adjustment	70
2 -59	Brake Lining Wear Limits	71
2 -60	Brake Assembly (Gear Type)	72
2 -61	Torque Wrench Adapter	73
2 -62	Deleted	73
2 -63	Pedal Adjustment, Gear-Type Brake	73
2 -64	Brake Master Cylinder, C-45H Serials AF 52-10539 and After	74
2 -65	Master Cylinder Linkage Adjustment	75
2 -66	Brake Pedal Adjustment	75
2 -67	Shuttle Valve Mounted on Brake	76
2 -68	Cross Section of Shuttle Valve	76
2 -69	Cross Section of Parking Brake Valve	76
2 -70	Parking Brake Valves	77
2 -71	Brake Bleeding	78
2 -72	Shock Strut Assembly	80
2 -73	Oleo Drag Leg	81
2 -74	Tail Gear Assembly	81
2 -75	Tail Wheel Assembly	81
2 -76	Removal of Rim and Retaining Ring	82
2 -77	Installation of Rim Locking Pin	82
2 -78	Tail Gear Assembly Installation	83
2 -79	Tail Gear Shock Strut Assembly	83
2 -80	Landing Gear Door Adjustment	84
2 -81	Landing Gear Retract System	85
2 -82	Landing Gear Motor and Gearbox Assembly	86
2 -83	Overload Clutch Adjustment	87
2 -84	Clutch Cable Length Adjustment	88
2 -85	Landing Gear Chain Length Check	89
2 -86	Landing Gear Chain Adjustment	89
2 -87	Landing Gear Chain Tension Check	90
2 -88	Slide Tube Marking	92
2 -89	Landing Gear Position Switch and Emergency Release	95
2 -90	Landing Gear Safety Switch	96
2 -91	Landing Gear Safety Switch Adjustment	97
2 -92	Landing Gear Dynamic Brake Relay	97
2 -93	Upper Limit Switch	98
2 -94	Lower Limit Switch	98
2 -95	Upper Position Indicator Switch	99
2 -96	Lower Position Indicator Switch	100
2 -97	Deleted	100
2 -98	Deleted	101
2 -99	Warning Horn Switch Adjustment	101
4 - 1	Heating and Ventilating System	112
4 - 2	Hot Air Control Valve	113
4 - 3	Cabin Exhaust Vent	113
4 - 4	Deicer Control	114
4 - 5	Deicer System	115
4 - 6	Deicer System Relief Valve Adjustment	116
4 - 7	Deicer System Distributor Valve	116
4 - 8	Engine Fire Extinguisher Selector Switch, C-45H	117
4 - 9	Engine Fire Extinguisher System, C-45H	118

LIST OF ILLUSTRATIONS (CONT)

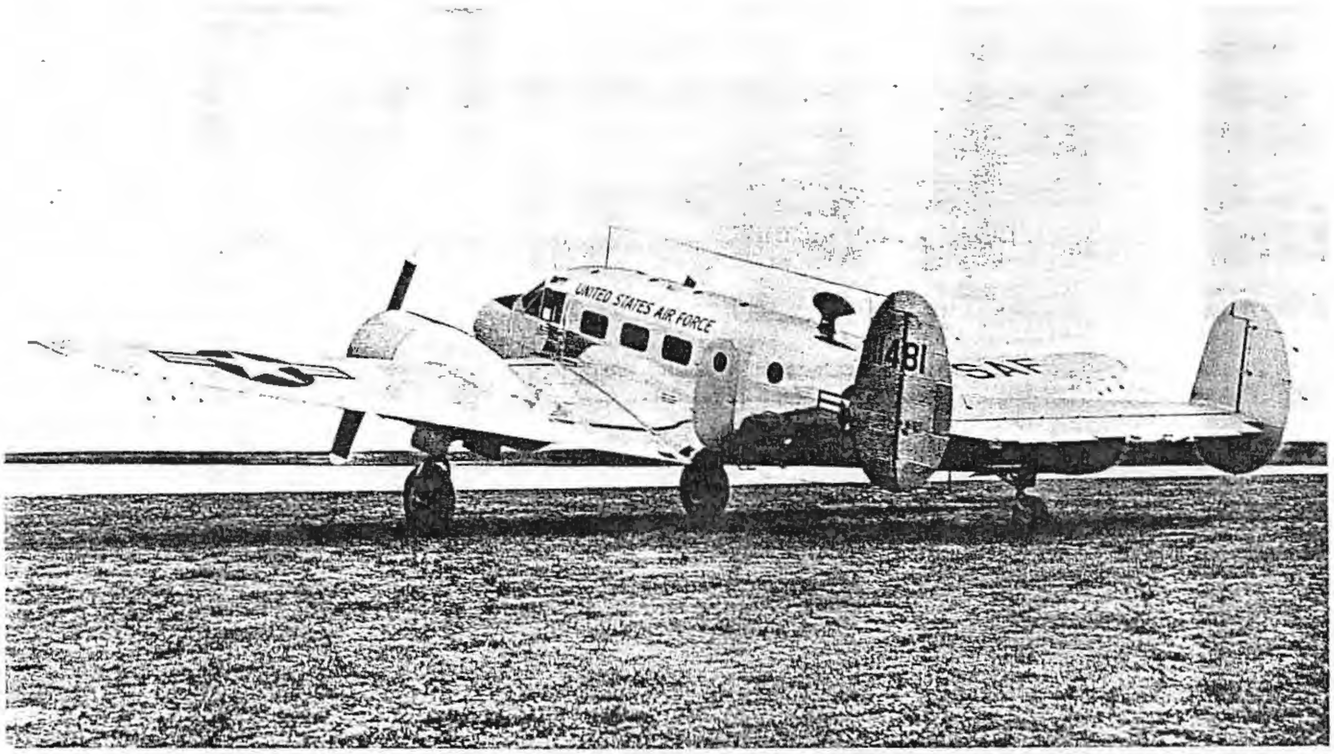
Figure	Title	Page
4 -10	Engine Fire Extinguisher Selector and Release Handle	119
4 -11	Temporary CO_2 System Controls	119
4 -12	CB Control Switches (Covered with Guard)	119
4 -13	Engine Fire Extinguisher System, C-45G and TC-45G	120
4 -14	Hand Fire Extinguisher (Cabin)	121
4 -15	Oxygen System	122
4 -16	Oxygen Filler Valve	123
4 -17	Windshield Wiper System	125
4 -18	Windshield Wiper Motor Mounting	126
4 -19	Windshield Wiper Blade Adjustment	126
4 -20	Anti-Icer System	127
4 -21	Anti-Icer Rheostat Switch	128
4 -22	Anti-Icer Tank Drain	128
4 -23	Anti-Icer Pump	128
5 - 1	Metal Shipping Container	133
5 - 2	Engine Case Flange Bolts	133
5 - 3	Lift Engine Container Cover	133
5 - 4	Lift Engine from Container	133
5 - 5	Avoid Striking Moving Plate Projections	134
5 - 6	Exploded View of Wooden Shipping Container	135
5 - 7	Power Plant Build-Up - Front View (Sheet 1 of 4)	136
5 - 7	Power Plant Build-Up - Rear View (Sheet 2 of 4)	137
5 - 7	Power Plant Build-Up - Three-Quarter View (Right Side) (Sheet 3 of 4)	138
5 - 7	Power Plant Build-Up - Three-Quarter View (Left Side) (Sheet 4 of 4)	139
5 - 8	Hoisting Engine	141
5 - 9	Engine Hoisting Lugs	142
5 -10	Engine Cowl	148
5 -11	Cowl Flap Adjustment	148
5 -12	Engine Mount Assembly	149
5 -13	Propeller and Engine Controls	149
5 -14	Engine Control Phenolic Block	150
5 -15	Reading Obtained on a Cold Cylinder Test	151
5 -16	Cylinder Replacement	153
5 -17	Valve Adjustment	154
5 -18	Fuel System Schematic	155
5 -19	Nose Fuel Tank	156
5 -20	Main Fuel Tank	156
5 -21	Auxiliary Fuel Tank	156
5 -22	Main Fuel Tank Hinge Wire Removal	157
5 -23	Fuel Booster Pump Adjustment	158
5 -24	Liquidometer Adjustment	159
5 -25	Fuel Gage and Tank Selector	159
5 -26	Fuel Pump Adjustment	160
5 -27	Carburetor Mixture and Idle Adjustment	162
5 -28	Primer Switch	162
5 -29	Primer Solenoid	162
5 -30	Oil Tank Installation	163
5 -31	Oil Radiator	163
5 -32	Oil System Schematic	164
5 -33	Removal of Oil Strainer	165
5 -34	Oil Pressure Relief Valve Adjustment	166
5 -35	Oil Dilution Solenoid Valve	166
5 -36	Oil By-Pass Valve	168
5 -37	Oil Drain "Y" Valve	168
5 -38	Induction Vibrator	169
5 -39	Ignition Switches	169
5 -40	Installed Time-Rite Indicator	170A
5 -41	Zeroing the Time-Rite Indicator	171
5 -42	Magneto Timing Marks	171
5 -43	Magneto Drive Coupling	172

LIST OF ILLUSTRATIONS (CONT)

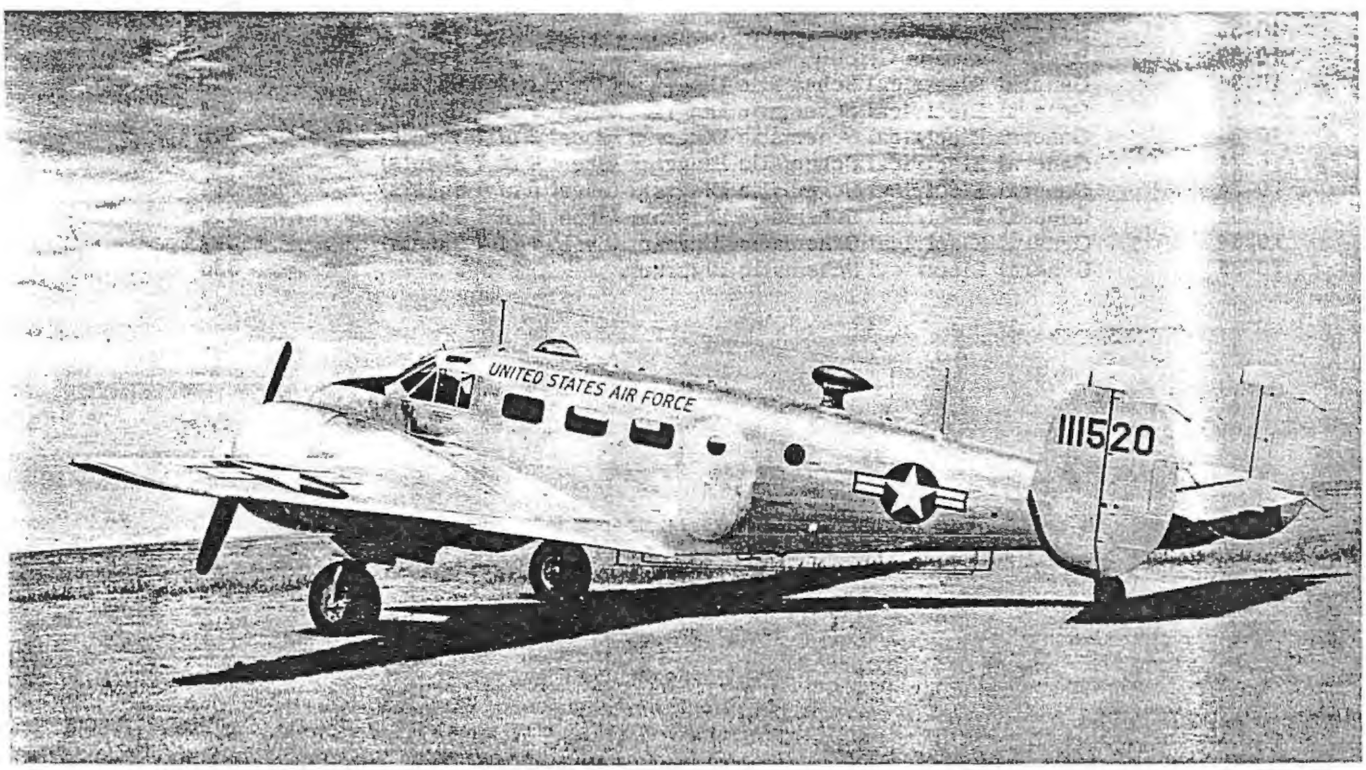
Figure	Title	Page
5 -44	Removing Spark Plug Lead	173
5 -45	Removing Spark Plug Frozen to Bushing	174
5 -46	Effect of Torque Applied to Spark Plugs	175
5 -47	Starter Switch	176
5 -48	Carburetor Cold Air Ducts	177
5 -49	Exhaust Collector Ring	177
5 -50	Deleted	179
5 -51	Deleted	179
5 -52	Deleted	180
5 -53	Deleted	181
5 -54	Deleted	181
5 -55	Deleted	182
5 -56	Typical Nicks and Methods of Removal	185
5 -57	Rework the Leading Edge	186
5 -58	Measuring Depth	186
5 -59	Abrasion Before Rework	187
5 -60	Filing Tool Application	187
5 -61	Emery Cloth Application	187
5 -62	Abrasion Area After Rework	188
5 -63	Propeller Assembly Extended Off Propeller Shaft	188
5 -64	Deicing Device Nozzle Installation	189
5 -65	Inspecting Setting of Low Pitch Stop Ring	191
5 -66	Inspecting Setting of High Pitch Stop Ring	191
5 -67	Assembly Liner and Drive Installed	192
5 -68	Check Freedom of Movement with Flyweight Cup	193
5 -69	Diagram of Body and Base Oil Control Plugging	193
5 -70	Pulley Travel Chart	194
5 -71	Control Shaft Scribe Mark and Pulley Index Numbers	194
5 -72	Checking Backlash with Flyweight Cup	205
5 -73	Checking Propeller Shaft Runout	205
5 -74	Overspeed Tolerances	208
6 - 1	Floating Instrument Panel	218
6 - 2	Instrument Removal Access	219
6 - 3	Floating Instrument Panel (C-45H)	221
6 - 4	Control Pedestal (C-45H)	222
6 - 5	Subpanels (C-45H)	223
6 - 6	Control Pedestal and Subpanels	224
6 - 7	Instrument Vacuum System (TC-45G)	225
6 - 8	Instrument Vacuum System (C-45G)	226
6 - 9	Instrument Vacuum System (C-45H)	227
6 -10	Suction Relief Valve Adjustment	228
6 -11	Automatic Pilot System (C-45G and TC-45G)	231
6 -12	Automatic Pilot Control and Follow-Up Cables	233
6 -13	Instrument Limitations Markings (Sheet 1 of 2 Sheets)	235
6 -13	Instrument Limitations Markings (Sheet 2 of 2 Sheets)	236
7 - 1	Battery Vent System	244
7 - 2	Voltage Regulator Adjustment	245
7 - 3	Installation of 100-Amp Generator	246
7 - 4	Instrument Lamp Replacement	249
7 - 5	Landing Light Extension Measurement	250
7 - 6	Landing Light Adjustable Contact	250
8 - 1	Radio Location Diagram	260
8 - 2	Overhead Radio Panel	261
8 - 3	Cabin Jack Box, Serials 52-10539 and Subsequent	264
8 - 4	Receiver - Transmitter RT-178/ARC-27	267
8 - 5	Radio Set Control C-626/ARC-27	268
8 - 6	Radio Set Control Unit C-628/ARC-27	268A
10- 1	Electrical Symbols (Sheet 1 of 2 Sheets)	270
10- 1	Electrical Symbols (Sheet 2 of 2 Sheets)	271

LIST OF ILLUSTRATIONS (CONT)

Figure	Title	Page
10- 2	Flap Motor, Flap Indicator, and Elevator Tab Indicator Circuits	280
10- 3	Landing Gear Circuits	281
10- 4	Landing Gear Circuits	282
10- 5	Engine Fire Extinguisher Circuits	283
10- 6	Windshield Wiper, Anti-Icer and Deicer Circuits	284
10- 7	Fuel Quantity Indicator Circuits	285
10- 8	Starter, Primer, Booster, Ignition and Battery Circuits	286
10- 9	Tachometer Circuit	287
10-10	Propeller Feathering Circuit	288
10-11	Temperature Indicator Circuits	289
10-12	Fuel Pressure Warning and Vacuum Warning Light Circuits	290
10-13	Oil Dilution and Pitot Heat Circuits	291
10-14	Gyrosyn Compass Circuit	292
10-15	Electric Turn-and-Bank Indicator Circuits	293
10-16	B-3 Driftmeter Circuit	294
10-17	Generator Circuit (100 Amp)	295
10-18	Interior Lighting Circuit	296
10-19	Interior Lighting Circuit	297
10-20	Instrument Lighting Circuit	298
10-21	Navigator's Instrument Lighting and Table Light Circuit	299
10-22	Navigation, Taxi and Passing Light Circuits	300
10-23	Landing Lights Circuit	301
10-23A	Anit-Collision Light Circuit	302
10-24	Marker Beacon Receiver Circuit	302A
10-25	VHF Receiver and Transmitter Circuits	303
10-26	Low Frequency Range Receiver Circuit	304
10-27	AN/ARC-27 Wiring Diagram	305
10-28	Interphone Circuit	306
10-29	Radio Compass Circuit	307
10-30	Interphone Circuit	309
10-31	ARN-14 Radio Circuit	310
10-32	Interphone Circuit	311
10-33	Radio Compass Circuit	312
10-34	General Electrical Schematic Diagram (Sheet 1 of 7 Sheets)	313
10-34	General Electrical Schematic Diagram (Sheet 2 of 7 Sheets)	314
10-34	General Electrical Schematic Diagram (Sheet 3 of 7 Sheets)	315
10-34	General Electrical Schematic Diagram (Sheet 4 of 7 Sheets)	316
10-34	General Electrical Schematic Diagram (Sheet 5 of 7 Sheets)	317
10-34	General Electrical Schematic Diagram (Sheet 6 of 7 Sheets)	318
10-34	General Electrical Schematic Diagram (Sheet 7 of 7 Sheets)	319
10-35	General Electrical Schematic Diagram	320

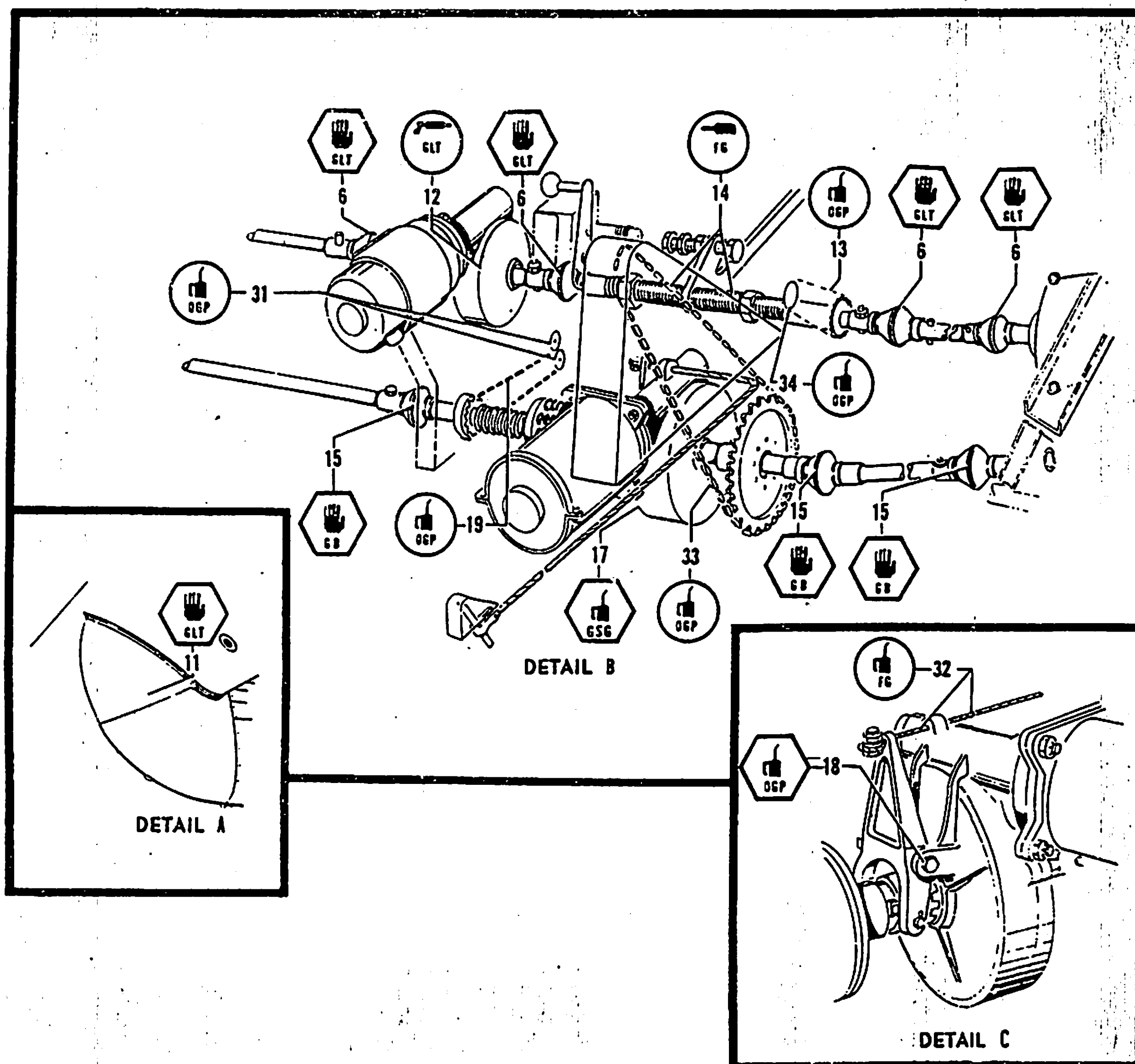


Transport C-45G and C-45H



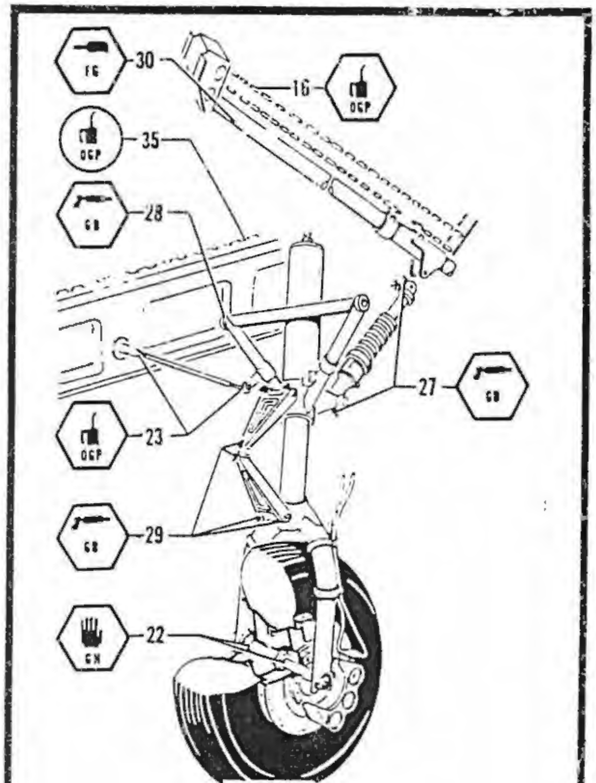
Navigational Trainer, TC-45G

Figure 1-1. Three-Quarter View of Aircraft

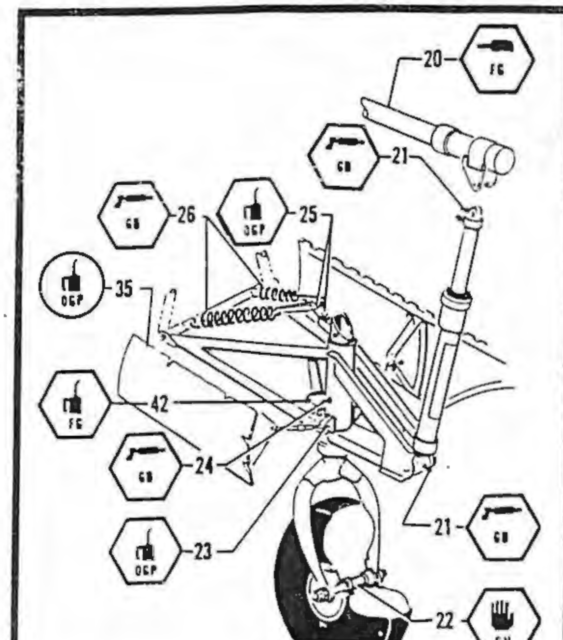


23. Main and Tail Gear Door Linkage (Note e)--Postflight nearest 50 hrs.
24. Tail Wheel Swivel (Note d)--Postflight nearest 50 hrs.
25. Tail Wheel Return Spring Brackets--Postflight nearest 50 hrs.
26. Tail Gear Forward Hinge Points--Postflight nearest 50 hrs.
27. Landing Gear Drag Leg--Postflight nearest 50 hrs.
28. Landing Gear Truss Hinge Point (Note d)--Postflight nearest 50 hrs.
29. Main Landing Gear Torque Knees--Postflight nearest 50 hrs.
30. Main Landing Gear Slide Tube (Note a)--Postflight nearest 50 hrs.
31. Tail Wheel Retract Chain Idler Sprockets.
32. Landing Gear Clutch Release Cable Housing (Note a).
33. Landing Gear Emergency Chain.
34. Flap Emergency Chain Idler Sprocket.
35. Landing Gear Door Hinges (Note e).
36. Elevator Tab Chain Idler Sprocket--Postflight nearest 50 hrs.
37. Brake Master Cylinder Linkage and Cross Shaft-- Every 2nd periodic.
38. Cabin Door Emergency Release Mechanism (Note a)--Every 2nd periodic.
39. Cabin Window Emergency Exit Mechanism (Note a)--Every 2nd periodic.
40. Tab Hinge Wires (Note a).
41. Aileron Tab Control Wheel Shaft Bushing--Every 5th periodic.
42. Tail Wheel Lock Plunger and Pivot Bolt (Note a)--Postflight nearest 25 hrs.

Figure 1-25. Lubrication Chart (Sheet 2 of 2)



DETAIL D



DETAIL E

LEGEND			
FREQUENCY OF APPLICATION	TYPE OF LUBRICANT		METHOD OF APPLICATION
	IDENTIFYING SYMBOL	MILITARY SPECIFICATION	
Periodic	GLT Grease	MIL-G-3278	Grease Gun
	FG Graphite	MIL-G-6711	Handpack
	GSG Grease	MIL-G-7118	
Special	GB Grease	MIL-L-7711	Oil Can
	GH Grease	MIL-L-3545	
	OGP Oil	MIL-L-7870	Brush

SPECIAL LUBRICATION REQUIREMENTS

(a) Mix powdered graphite with quick evaporating liquid (Naphtha, Federal Specification TT-N-95).
(b) Flap shaft universals with torn or ruptured rubber boots must be repacked with Grease, Specification MIL-G-3278. Landing gear torque shaft universals with torn or ruptured rubber boots must be repacked with Grease, Specification MIL-L-7711. Replace the rubber boot with a leather boot when the universals are repacked.
(c) Re-fill, if necessary to the level of the filler plug hole.
(d) Apply a thin coat of grease.
(e) No tail gear doors are used on C-45H aircraft. Fixed Tail-gear used on C-45H.

1-33. TORQUE VALUES. Torque values are listed in applicable sections.

1-34. SERVICING. See Table II.

1-35. TANK CAPACITIES. See Table III.

1-36. SPECIAL TOOLS.

1-37. Special tools and equipment listed below and on the chart (figure 1-24) were supplied with earlier airplanes for maintenance and service and are available at all repair and overhaul stations.

a. (Deleted).

b. Hydromatic propeller tools.

HSP-294	Wrench - Cam
HSP-339	Wrench - Dome, Strap
HSP-346	Wrench - Dome, Retaining Nut
HSP-1482	Wrench - Valve Housing
HSP-1483	Wrench - Socket, Propeller Retaining Nut
9BMD-36D4556	Beam Assembly, Blade (2 each)
HSP-1682 8220-616600	Sling - Propeller Hoisting
7900-571600	Protractor Bubble
HSP-1827	Blade Checking Indicator

c. Shock Strut Wrench (No. 180130): a double-end wrench about 12 inches long; the small end is used to turn the packing nut on the tail shock absorber units.

d. Landing Gear Clutch Wrench (No. 180131): a spanner wrench for the adjustment plate on the landing gear overload clutch.

e. Wing Spar Bolt Puller (No. 182061) and Wrench Adapter: a special tool to remove the tapered spar bolts which attach the outer wing panel to the center section. The wrench adapter also may be used to remove the nuts from the spar bolts.

f. Jack Pads and Bolts (No. 84-180930). Two jack pads with mounting bolts provide means of attaching lifting jacks to the airplane.

g. Hoisting Lug Bolts (No. 18087), Hoisting Lug (No. 18091) and Hoisting Eye Bolt (No. 18092). These fittings are required in the hoisting procedure.

1-38. EQUIPMENT.

1-39. The equipment listed immediately below is supplied with the airplane.

a. Airplane mooring kit (Type D-1).
b. Complete set of keys for the airplane.
c. "G" File.
d. Pitot tube covers.
e. Six cardboard containers.
f. Load Adjuster.
g. Wiring diagram, electrical.
h. Radio wiring diagram.

1-40. TUBING IDENTIFICATION.

1-41. The Tubing Identification Chart (figure 1-26) lists the color codes which identify the various systems of the airplane. Individual tubes in the system are marked at both ends near the fittings. Replacement tubes should be properly coded.

1-42. LUBRICATION.

1-43. Parts requiring the most frequent lubrication are landing gear, landing gear retract mechanism, flap mechanism and propellers. Many of the moving parts on the airplane require dry lubrication and special care must be taken to keep these parts clean. Cleanliness is essential throughout the lubrication procedure. The grease fittings or parts must be wiped clean to make sure that no dirt is carried into the part when lubricated. Lubricant always should be applied sparingly, but with assurance that the bearing surfaces are adequately covered. Excess lubricant must be wiped off to prevent accumulation of dirt. The lubrication periods and correct lubricants for the airplane are shown in figure 1-25. On C-45H airplanes, Serials 52-10539 and after, the tail wheel is locked in the down position. The tail wheel retract chain and cable have been removed; therefore, no lubrication to these items will be required. Lubricate the tail wheel slide with a coat of corrosion preventive compound (paralketone), Specification MIL-C-11796. This will protect the tail wheel slide so it may be used again.

1-44. SPECIAL LUBRICATION NOTES.

a. All control system pulleys are sealed and require no lubrication. Pulleys should be kept clean to prevent sticky operation and resulting wear.

b. The exposed portion of the landing gear shock struts should be cleaned daily with a clean rag saturated in alcohol or clean hydraulic oil. Never use unleaded gasoline or other solvents. After cleaning piston, lubricate with a thin coating of clean hydraulic oil, Specification MIL-O-5606.

c. To lubricate piano type hinges, mix powdered graphite with naphtha and apply with a brush.

1-45. CLEANING.

1-46. Wash the airplane regularly. Keep it clean at all times to maintain airworthiness, aerodynamic smoothness, to reduce corrosion, and to eliminate fire hazards. Frequent washings are required particularly where mud or other extreme conditions are encountered. When washing the airplane protect the wheel bearings with suitable waterproof covers installed over each wheel. If there is any evidence that the wheel bearings have been exposed to water, solvent or detergent, remove the bearings from the wheels, then clean, inspect and relubricate them. Refer to Section II, paragraph 2-202.

CAUTION

Use only approved cleaning material and compounds in cleaning the airplane. Refer to Technical Order 1-1-1, Cleaning of Aeronautical Equipment, for the cleaning procedures and materials.

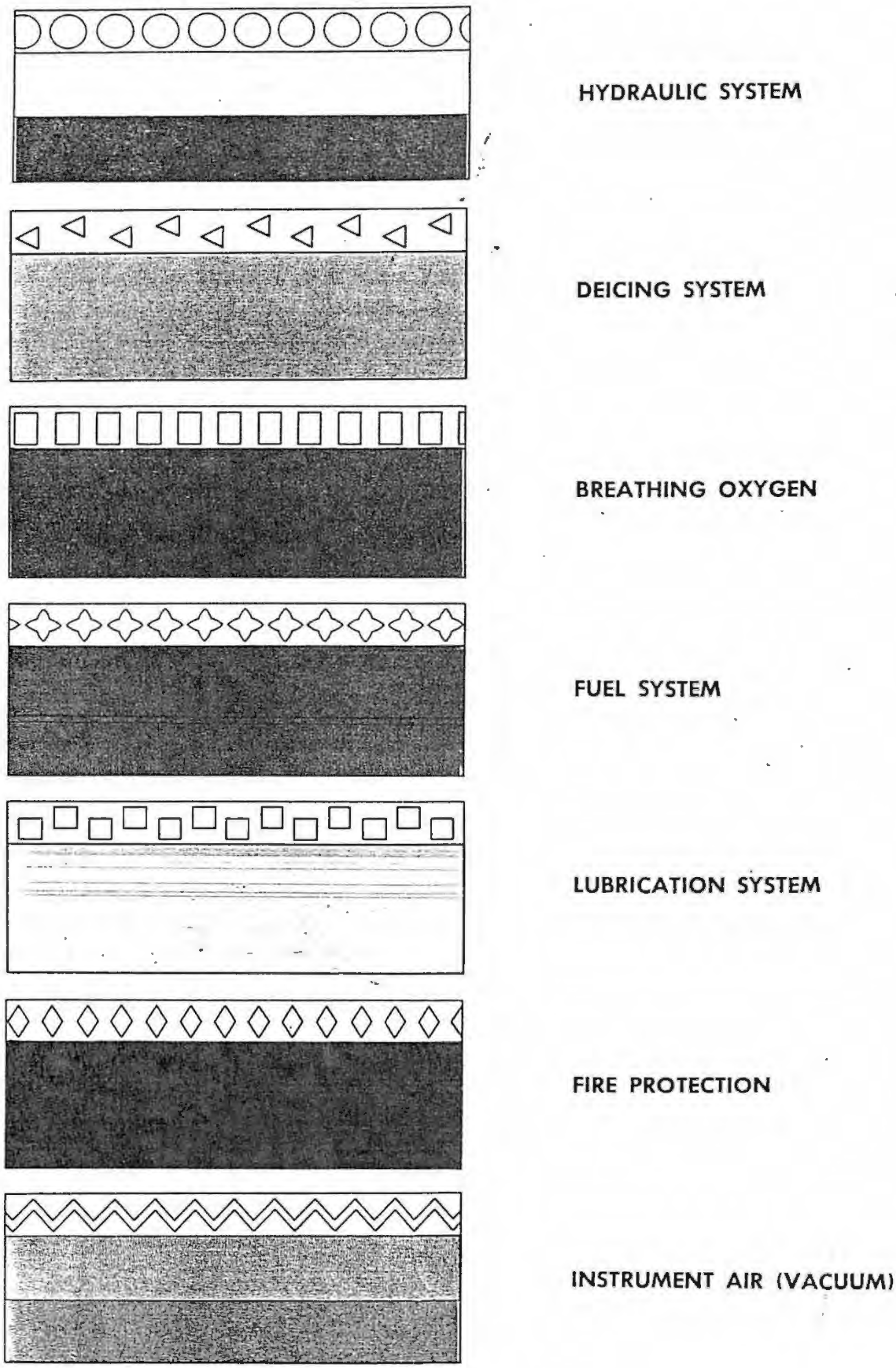


Figure 1-26. Tubing Identification Chart

SECTION I

GENERAL INFORMATION

TABLE OF CONTENTS

Paragraph		Page
1- 1.	General Description	1
1- 3.	Principal Dimensions	1
1- 4.	Access and Inspection Provisions	1
1- 6.	Jacking	7
1- 7.	Hoisting	7
1-11.	Leveling	7
1-12.	Ground Handling	9
1-13.	Parking and Mooring	12
1-14.	Tie-Down Accessories	13
1-15.	Parking Brake Operation	14
1-16.	Surface Control Lock	14
1-17.	Towing	14
1-18.	Servicing	14
1-20.	Main, Auxiliary, and Nose Fuel Tanks	16A
1-21.	Oil Tanks	16A
1-22.	Automatic-Pilot Hydraulic Reservoir	16A
1-23.	Brake Fluid Reservoir	17
1-24.	Anti-Icing Fluid Tank	18
1-25.	Servicing Landing-Gear Shock Struts	18
1-26.	Servicing Tail Gear Shock Strut	18
1-27.	Servicing Oleo Drag Leg	18A
1-28.	Oxygen System	19
1-29.	Oxygen Regulator Replacement	19
1-30.	Battery Servicing	20
1-32.	Tire Inflation	20
1-33.	Torque Values	24
1-34.	Servicing	24
1-35.	Tank Capacities	24
1-36.	Special Tools	24
1-38.	Equipment	24
1-40.	Tubing Identification	24
1-42.	Lubrication	24
1-44.	Special Lubrication Notes	24
1-45.	Cleaning	24

1-1. GENERAL DESCRIPTION.

1-2. The C-45G, TC-45G and C-45H are twin-engine low-wing, land monoplanes. The fuselage is of all-metal, semimonocoque construction. The wings are all metal; the control surfaces are metal structure, covered with fabric. The power plant consists of two Pratt and Whitney R985 air-cooled radial engines of 450 horsepower each. Hamilton-Standard Hydromatic full-feathering propellers, Model 22D30-313, are used on all models. The primary structure of the center section is a triangular spar of welded steel tubing, which carries fittings for the engine mounts, landing gear and outer wing panel main spars. The secondary structure of the center section consists of a shear-beam rear spar, ribs, bulkheads, stringers and aluminum alloy skin. The cabin door on the left side of the fuselage provides access to the cabin and pilots' compartment. The C-45G and C-45H are designed as utility transports, but may be converted to other uses. The TC-45G is designed for use as a navigational trainer and is equipped with an astrodome and navigational training equipment.

1-3. PRINCIPAL DIMENSIONS. See Table I.

1-4. ACCESS AND INSPECTION PROVISIONS.

1-5. The locations of the access doors and plates are shown in figures 1-4 and 1-5. The major unit serviced or inspected through each opening is listed numerically under the illustration and is identified by the index number. The access doors and plates provide openings for all normal servicing and inspection of the airplane. Applicable sections of this manual explain other uses of these openings.

1-5A. AERODYNAMIC MAINTENANCE.

a. Aerodynamic Maintenance is the process of keeping the airplane aerodynamically clean, that is, the elimination of bumps, dents, projections and roughness of finish in order to present the least possible resistance or drag to the airplane in flight. Aerodynamic smoothness of skin surfaces is extremely important, and the manner of its maintenance or lack of it may provide definite effects on the flight of the airplane and its mission. Allowing an airplane to become aerodynamically rough has a vital effect on fuel consumption, speed, range and performance.

b. When an airplane is new, it is as clean aerodynamically as the designers can possibly make it. With continued use, however, any or all of the deficiencies noted in the following sub-paragraphs may exist. None of the items would cause a large drag individually, but collectively the ability of the airplane is materially lessened. Some of the deficiencies which may exist and create penalty drag are as follows:

1. Airplane dirty and smeared with oil.
2. Outside skin patches used instead of flush patches.
3. Cowling panels, fairing, fillets, and inspection doors poorly fitted and out of shape.
4. Cowling fasteners and screws missing.
5. Dents in the leading edges of wings, stabilizers, cowling and air intake.
6. Tail wheel and main landing gear doors and fairings not closing or fitting flush with the under surfaces.
7. Cabin door, nose compartment door, escape hatch and cockpit windows not properly fitted.
8. Paint scratched, chipped, rough or edges not feathered.
9. Improperly fitted wing and stabilizer tips.
10. Top surfaces of wings scratched and dented from walking on them with improper type shoes, walking on "No Step" areas and careless handling of refueling equipment.
11. Fuselage and wings scratched and dented from careless handling of ground equipment.
12. Faces of propeller blades rough and leading edges of blades nicked.
13. Chipped, pitted and rough airfoil surfaces due to deterioration and errosion of the putty or surfaces applied to smoothen defects and irregularities.
14. Drain and vent lines protruding beyond the length of original installation.

c. Too much emphasis cannot be placed on keeping the airplane aerodynamically clean. Check the airplane carefully to locate and correct defects listed in preceding sub-paragraphs b.1. thru 14. Elimination of all irregularities, roughness or projections that are exposed to the airstream is important. Those which are located in the forward one-fourth to one-third of any streamlined element (wings, tail surfaces, engine cowlings, fuselage, etc.) are extremely important and should be given particular attention. To prevent penalty drag items from becoming a serious problem as airplane accumulates ground and flight time, good maintenance practices must be constantly observed by all maintenance personnel.

TABLE I. PRINCIPAL DIMENSIONS

NOTE

All dimensions are given in level flight unless otherwise specified.

GENERAL	
Span	47 ft. 8 in.
Length (over all)	34 ft. 2.41 in.
Height	9 ft. 11.5 in.
Height (tail wheel on ground, propeller blade vertical at top)	9 ft. 2.5 in.
Propeller ground clearance	11 in.
Design gross weight	9300 lbs.
Maximum alternate gross weight	9300 lbs.
WINGS	
Type	Low Wing
Airfoil section at root	Modified NACA 23020
Airfoil section at tip	Modified NACA 23012
Chord at root (theoretical at center line of fuselage)	135.116 in.
Chord at tip (theoretical at outer end of tip 23 ft. 9 in.)	42 in.
Incidence at root	3.92 degrees
Incidence at tip	1.0 degrees
Dihedral	6 degrees
Sweepback at 25 percent chord	8 degrees 23 min.
Aspect ratio	6.5
STABILIZER	
Span	14 ft. 11.6 in.
Maximum chord	5 ft. 10 in.
Incidence, normal	-2 degrees
Dihedral	0 degrees
FUSELAGE	
Width (maximum)	56 in.
Height (maximum)	63.75 in.
Length	34 ft. 2 in.
Height of door level above ground (static)	31 in.
Door dimensions	44.5 x 24.5 in.
Total cubic foot stowage space available for baggage, cargo, etc	49.5 cu. ft.
AREAS	
Wings (less ailerons)	326.4 sq. ft.
Wings (with flaps extended)	326.4 sq. ft.
Ailerons (total)	26.6 sq. ft.
Aileron tab	0.424 sq. ft.
Flaps (total)	37.6 sq. ft.
Horizontal stabilizer (including elevator)	65.4 sq. ft.
Elevator (including tabs)	27.22 sq. ft.
Elevator trim tabs (total)	2.22 sq. ft.
Vertical fins	16.30 sq. ft.
Rudders (including tab)	17.28 sq. ft.
Rudder trim tab	0.85 sq. ft.

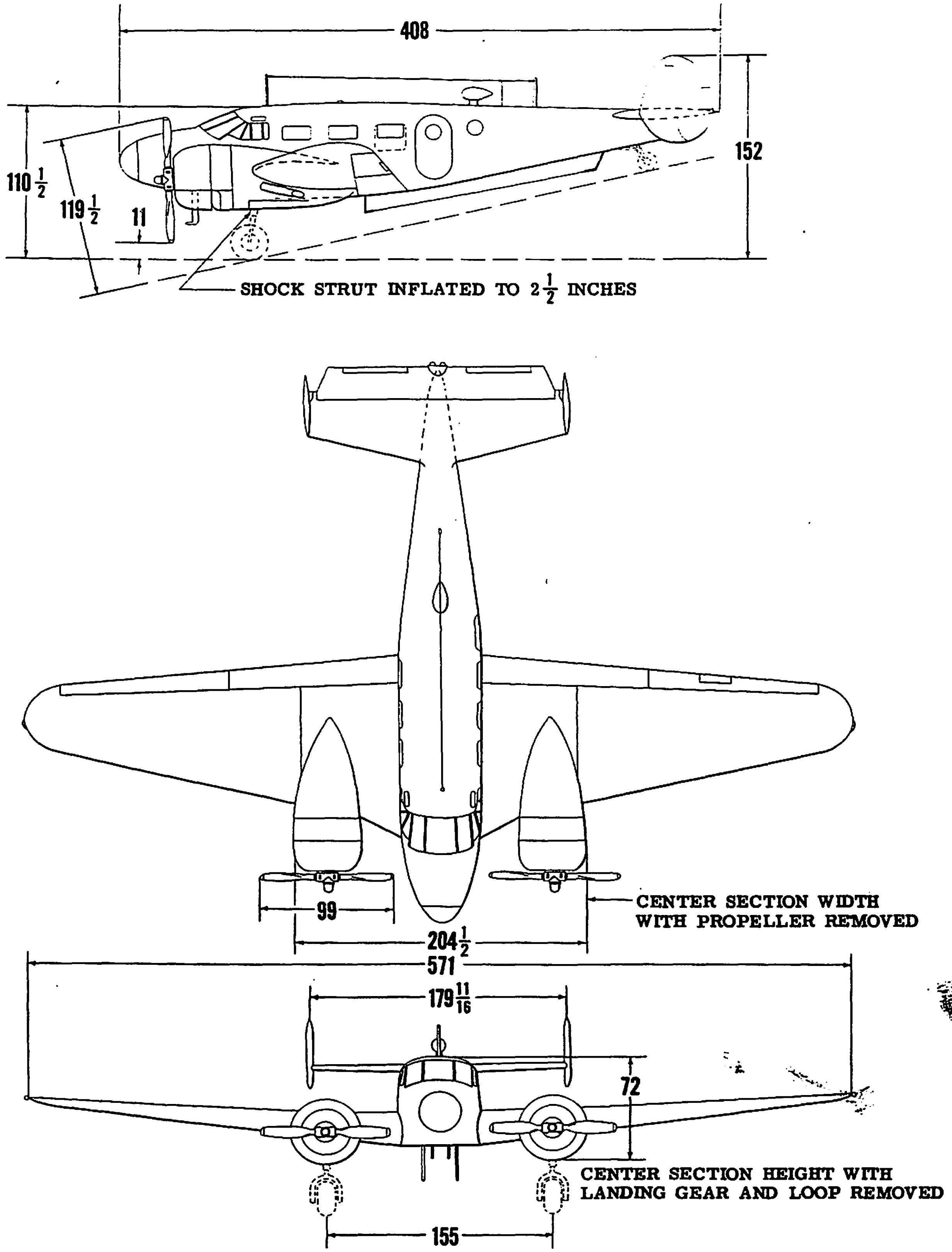
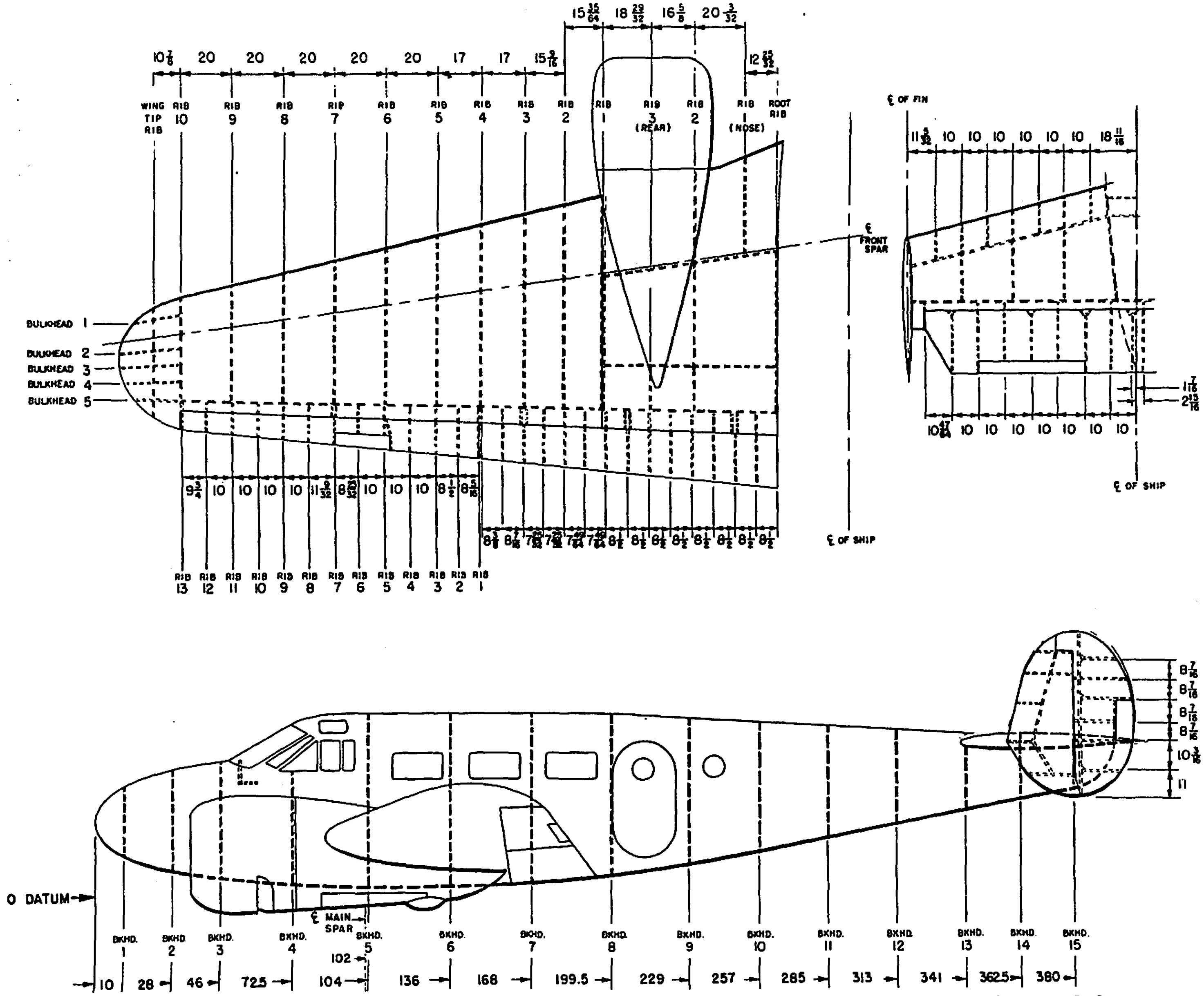


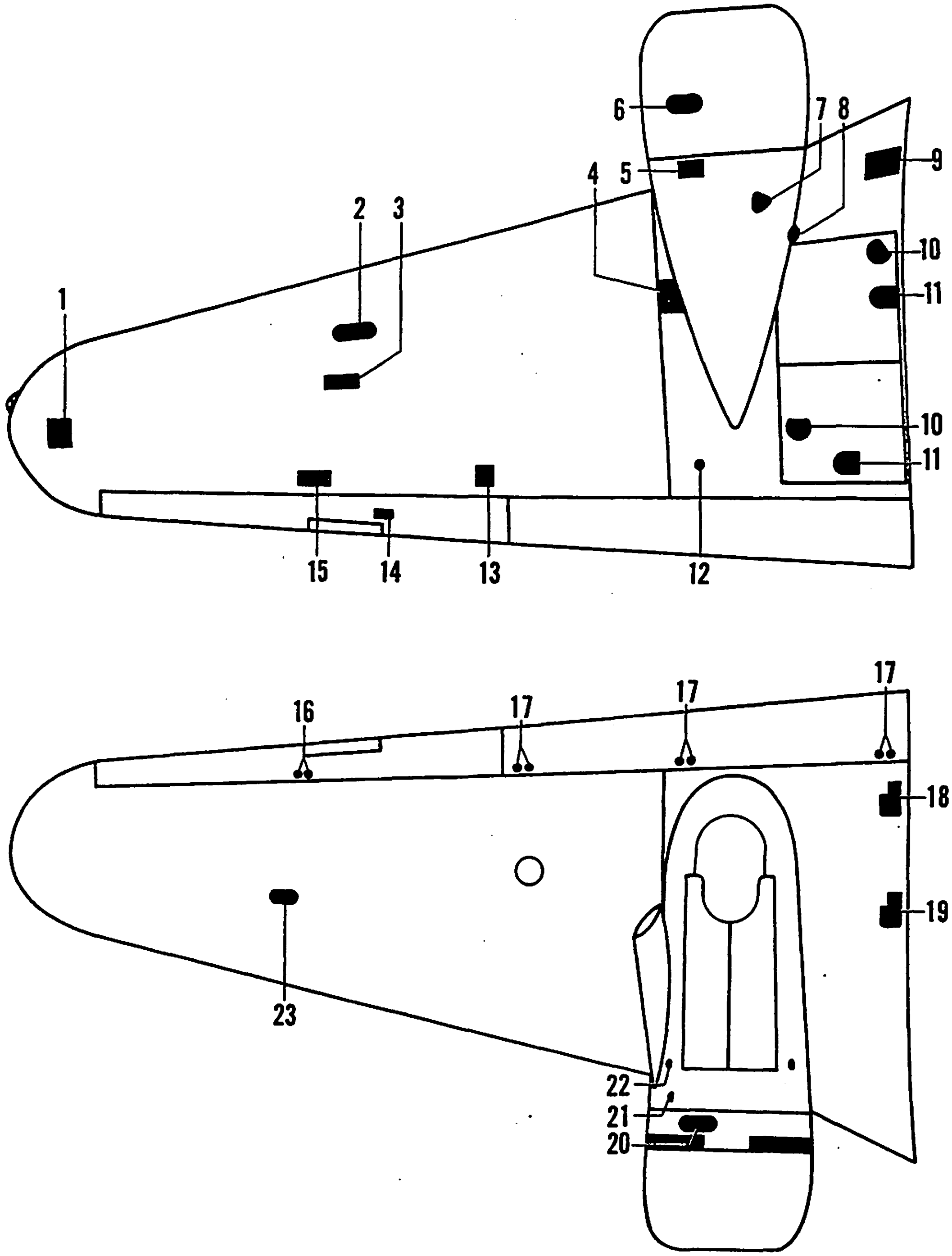
Figure 1-2. Dimensional Diagram



NOTE- 0 DATUM MAY BE LOCATED BY MEASURING 102 INCHES FORWARD FROM CENTER LINE OF MAIN SPAR. PLATE ATTACHED TO BELLY LOCATES CENTER LINE OF MAIN SPAR.

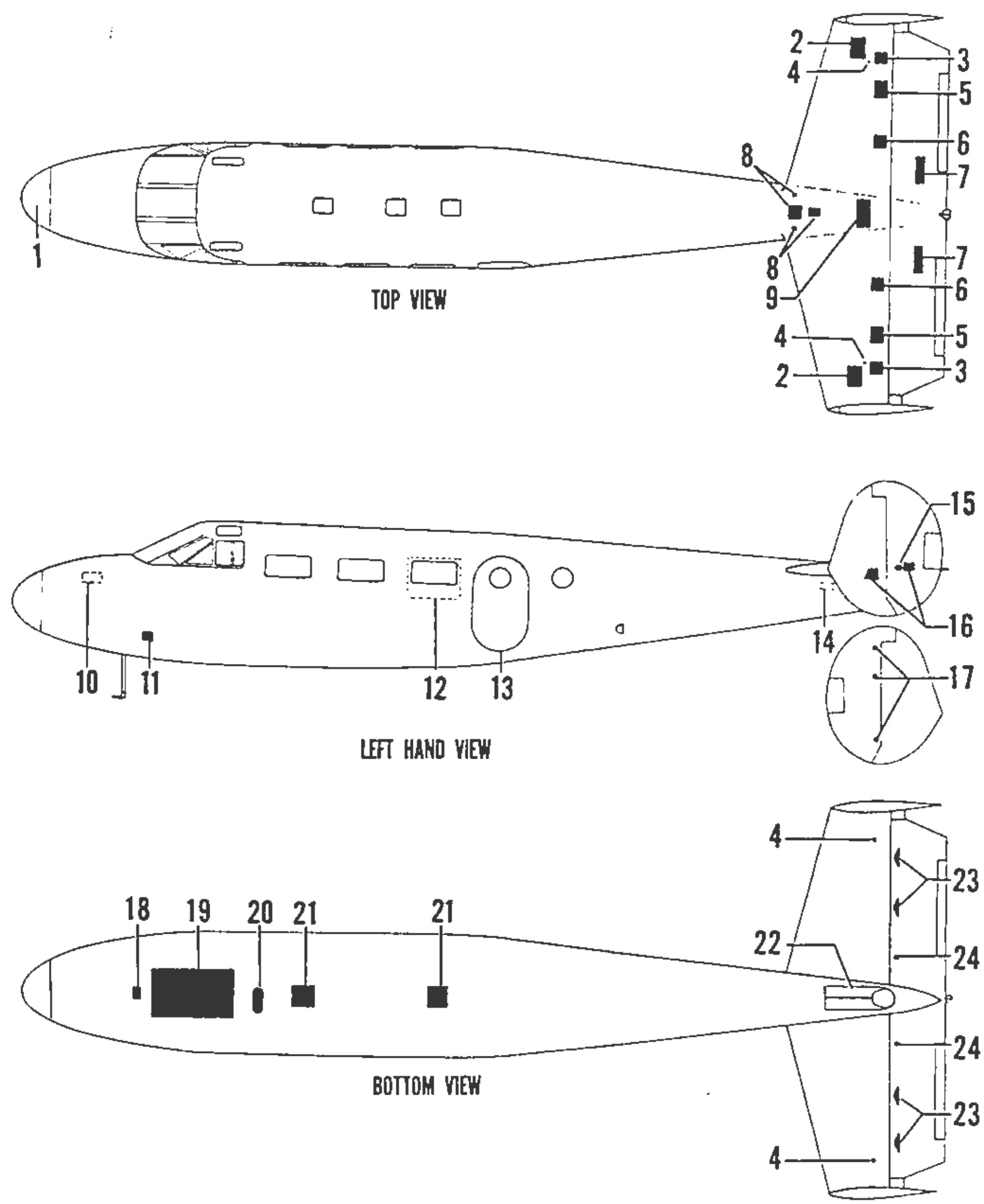
STATIONS DIAGRAM

Figure 1-3. Stations Diagram



1. Remote Compass Transmitter (Right Wing Only)
2. Aileron Cables
3. Aileron Pulleys
4. Wing Hinge Pin
5. Oil Dilution Solenoid Valve
6. Automatic Pilot Reservoir (Right Wing Only)
7. Oil Tank Filler Neck
8. Hoisting Lug Attachment
9. Battery Compartment
10. Fuel Tank Filler Neck
11. Liquidometer Adjustment
12. Flap Drive Oil Hole
13. Aileron Tab Mechanism (Left Wing Only)
14. Aileron Tab Actuator
15. Aileron Bell Crank
16. Actuating Link Attachment
17. Flap Attachment
18. Fuel Tank Sump and Drain
19. Fuel Booster Pump and Sump
20. Fuel Strainer
21. External Power Receptacle
22. Landing Gear Hinge Bolts
23. Internal Wing Inspection

Figure 1-4. Wing Access Doors



1. Nose Compartment Door
2. Rudder Bell Crank
3. Rudder Travel Adjustment
4. Rudder Bell Crank Retaining Bolt Access Hole
5. Rudder Cable Turnbuckles
6. Rudder Cable Inspection
7. Elevator Tab Mechanism
8. Stabilizer Attachment
9. Rudder Pulleys
10. Nose Fuel Tank Filler Neck (Right Side)
11. Rudder Pedal Shaft and Linkage Assembly
12. Emergency Exit (Right Side)
13. Cabin Entrance (Left Side)
14. Tail Gear Oleo (Right Side)
15. Rudder Tab Mechanism Inspection
16. Rudder Tab Mechanism
17. Rudder Attachment
18. Nose Fuel Tank Sump Drain
19. Belly Inspection
20. Control Cable Pulley Inspection
21. Rudder Cable Inspection
22. Tail Wheel Well
23. Elevator Attachment
24. Elevator Tab Mechanism

Figure 1-5. Fuselage Access Doors

1-6. JACKING. The main jacking points are located on the lower surface of the wing center section between the fuselage and each nacelle (figure 1-6), and on the bottom of the fuselage at Bulkhead 15. The rubber plugs must be removed from each wing jack point and the jack pads (part 84-180930) installed. The wing jack pads are attached to the aircraft by three bolts furnished with each jack pad. The tail jack point is a permanently attached and exposed fixture. Jack pads are also provided on each main wheel fork for individual wheel jacking.

WARNING

When hoisting or jacking the airplane, always place a minimum ballast of 200 pounds on the horizontal stabilizer to prevent the airplane from nosing over. The ballast should be placed over the front spar near the fuselage and a felt or canvas pad should be used to protect the skin surface. If the landing gear is to be operated while airplane is on jacks, the tail must be placed on jacks also.

CAUTION

When using a wheel jack, take care to prevent the airplane from slipping off the jack. Only one side should be raised at a time.

NOTE

Accidents can be avoided or minimized by observing existing safety standards and recognized maintenance procedures. Injury to personnel, damaged or lost aircraft and materiel can quickly occur as a result of carelessness or insufficient knowledge of equipment. Be alert and observant. The applicable handbooks and pertinent Air Force Directives should be read and studied for familiarization and general overall knowledge when handling, servicing, and maintenance is accomplished.

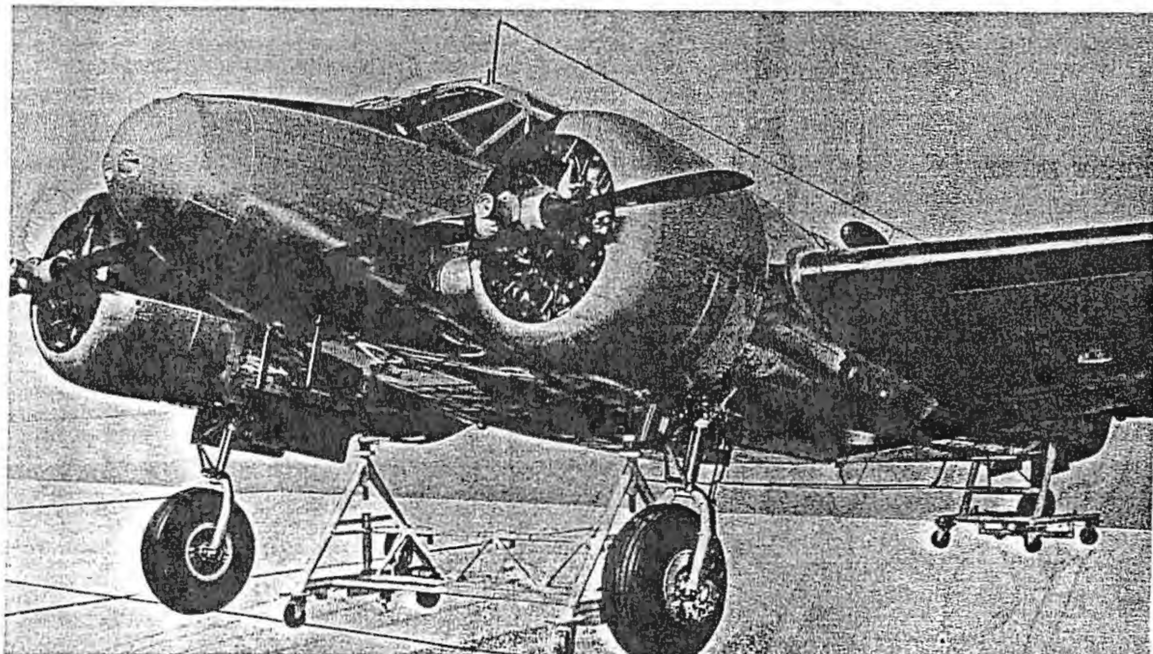
1-7. HOISTING.

1-8. The airplane may be hoisted with a single hoist and sling or with two hoists (figure 1-7).

1-9. When using a single hoist, it should have a minimum capacity of five tons. Remove the fabric patches over the hoisting bracket attaching holes and install the hoisting brackets. The hoisting sling should be long enough to clear the fuselage cabin top by approximately two inches.

1-10. When using two hoists, each should have a minimum capacity of three tons. Remove fabric patches over hoisting-lug attaching holes, install the special hoisting eye bolts, and attach the hoists to the airplane. They must be spaced so the pull is directly in line with the center line of the hoisting eye bolt shank.

1-11. LEVELING. The longitudinal leveling points are located on top of the fuselage ahead of the cabin door on Bulkheads 6 and 7 (figure 1-8). The lateral leveling points are located on the bottom of the fuselage at Bulkhead 6 (figure 1-9). Optional leveling check may be made on the pilot's floor board.



JACKING CLEARANCES

MAIN LANDING GEAR - Three Point Position
Tire Flat, Shock Strut Collapsed: 35 in.
Tire Clear 2 in., Shock Strut Extended: 56-3/4 in.
MAIN LANDING GEAR - Flight Position
Tire Clear 2 in., Shock Strut Extended: 59 in.

TAIL GEAR - Three Point Position
Tire Flat, Shock Strut Collapsed:
Rear Jack Point, 10-3/4 in; rear lift fitting, 31 in.
Tire Clear 2 in., Shock Strut Extended:
Rear Jack Point, 24 in., rear lift fitting, 31 in.
TAIL GEAR - Flight Position, Main Gear Clear 2 in.
At rear lift fitting, 92 in.

Figure 1-6. Jacking Aircraft

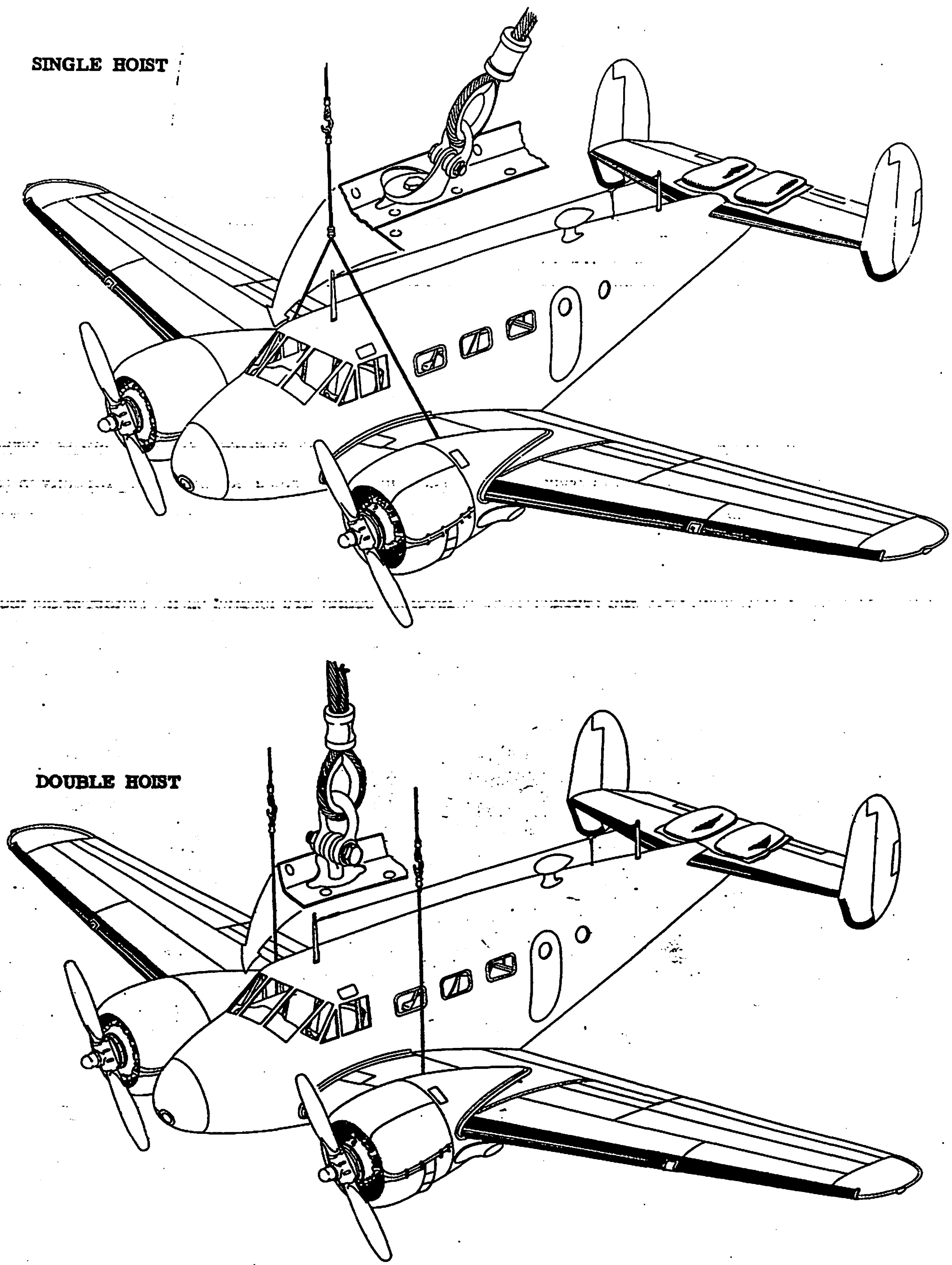


Figure 1-7. Hoisting Aircraft

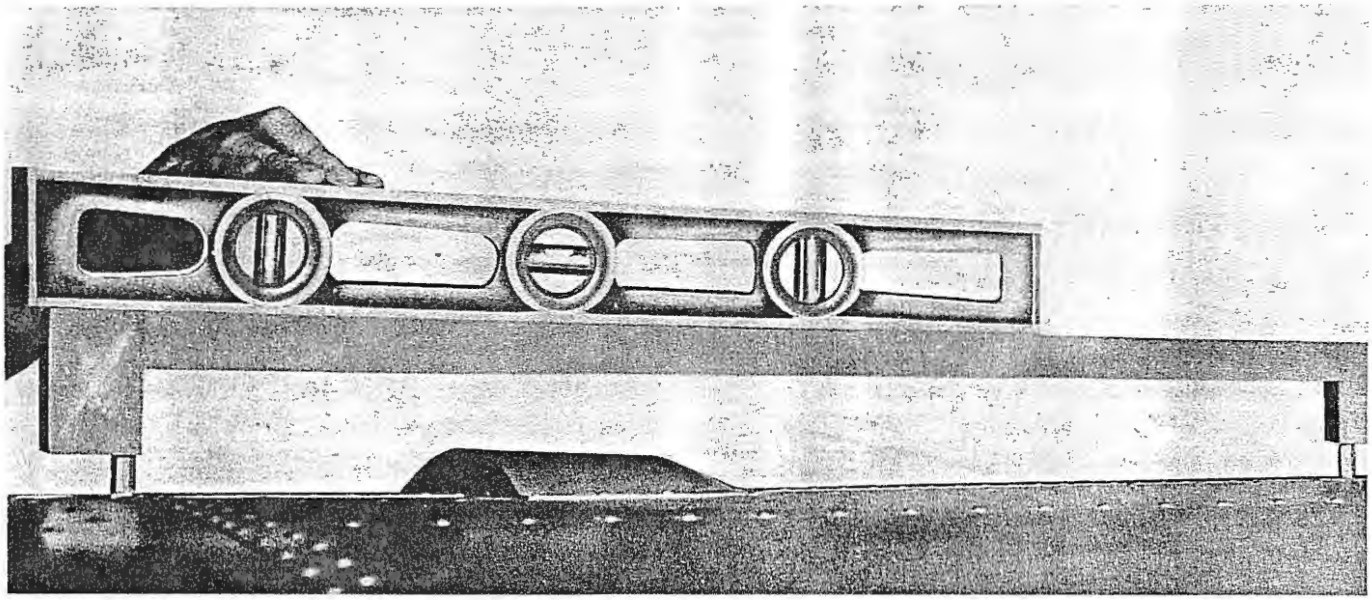


Figure 1-8. Longitudinal Leveling

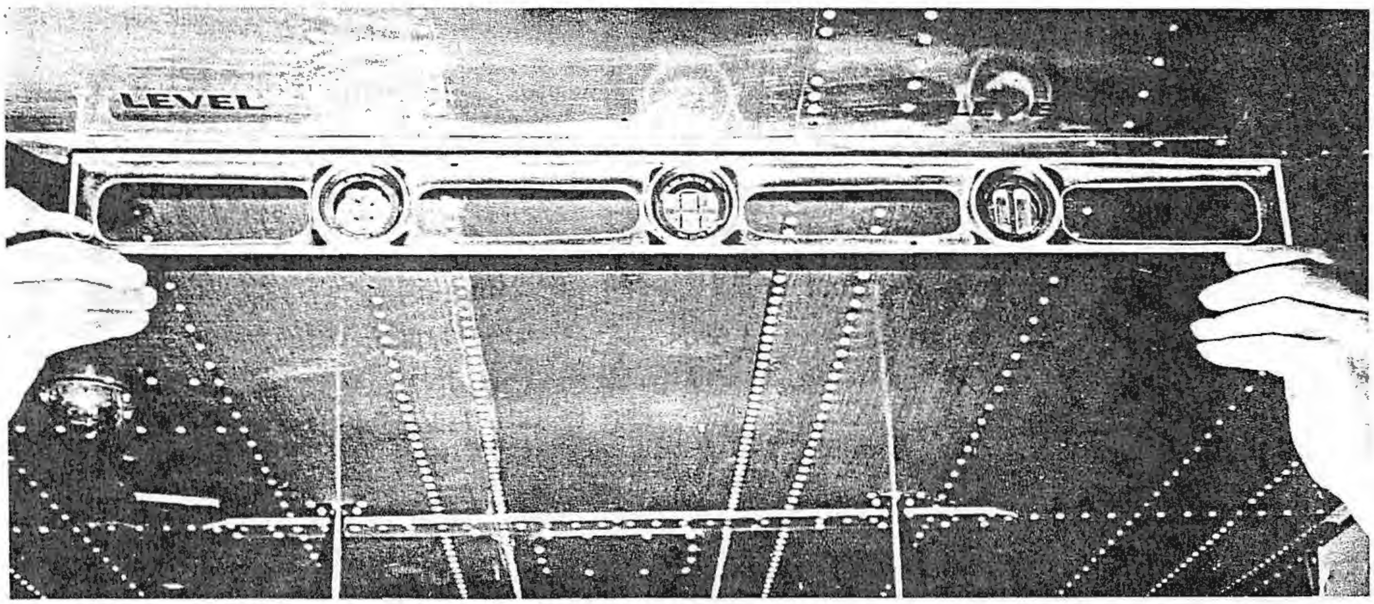


Figure 1-9. Lateral Leveling

1-12. GROUND HANDLING. The following general information should be observed when ground handling the airplane:

a. Engine will not be run with the surface controls in a locked position. Autopilot (when applicable) will be in the "OFF" position except during operational check.

b. Control surfaces will not be locked while towing or taxiing. When high or gusty winds are present do not unlock controls until properly attended, as control surfaces may be damaged by buffeting.

c. Engines will not be run while towing equipment is attached to the aircraft or when the aircraft is tied down.

d. Check tail wheel position; if it is not in the fore and aft or straight ahead position, avoid running engines at high rpm.

e. Approved type wheel chocks will be used during time of engine run prior to taxiing.

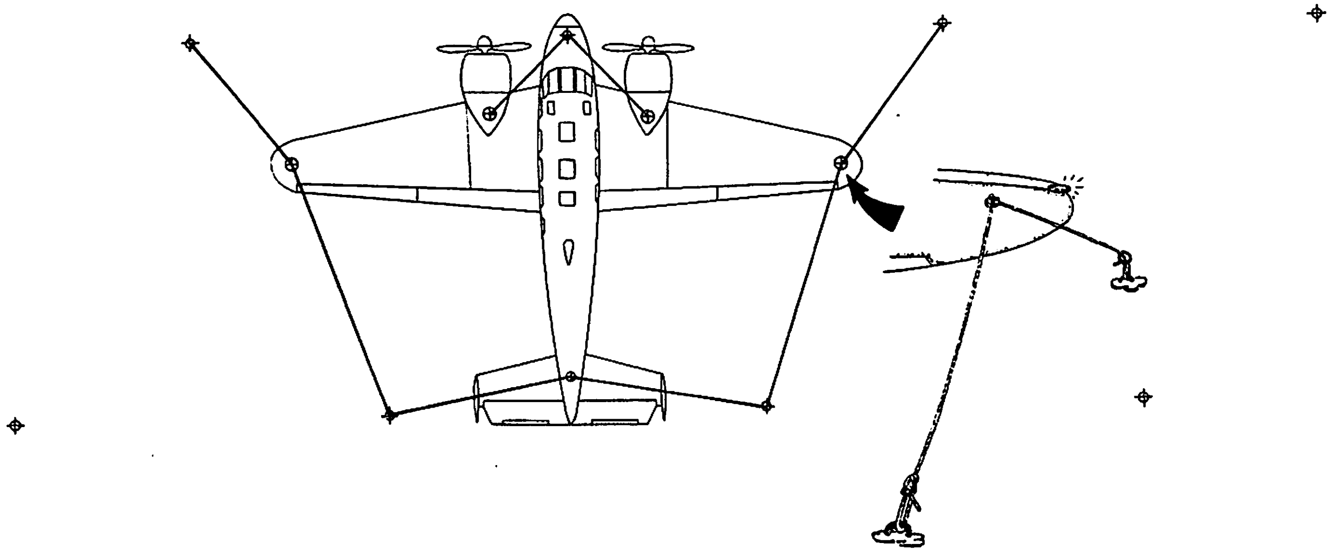
f. Control surfaces should be held in the full climb or nose-up position when engines are run at high rpm.

NOTE

It must be borne in mind that the holding force of a set of wheel chocks, even when properly placed in front of the main gear wheels will not withstand the force exerted by engine or engines at acceleration speeds without application of brakes.

CAUTION

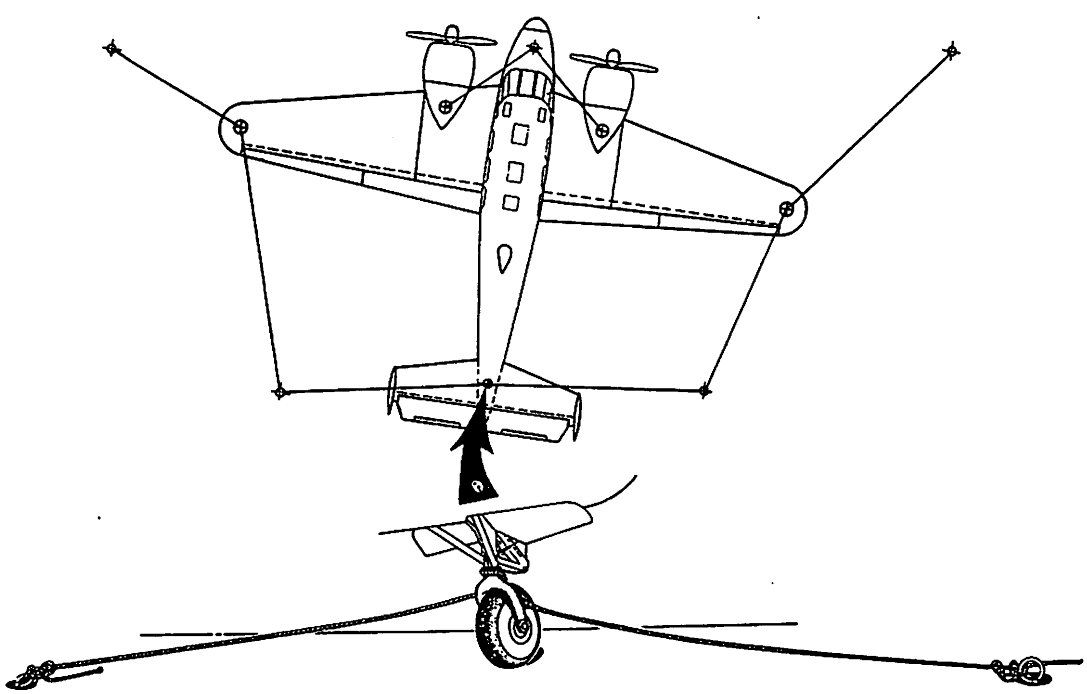
Do not set the parking brakes under the following conditions: during low temperatures,



NOTE: MOORING POINT PATTERN SHOWN IS AIR FORCE STANDARD. IN THE EVENT NON-STANDARD MOORING POINT PATTERN EXISTS, ADHERE AS CLOSELY AS POSSIBLE TO THIS FIGURE.

LEGEND
⊕ = GROUND MOORING POINT
⊕ = AIRPLANE MOORING POINT

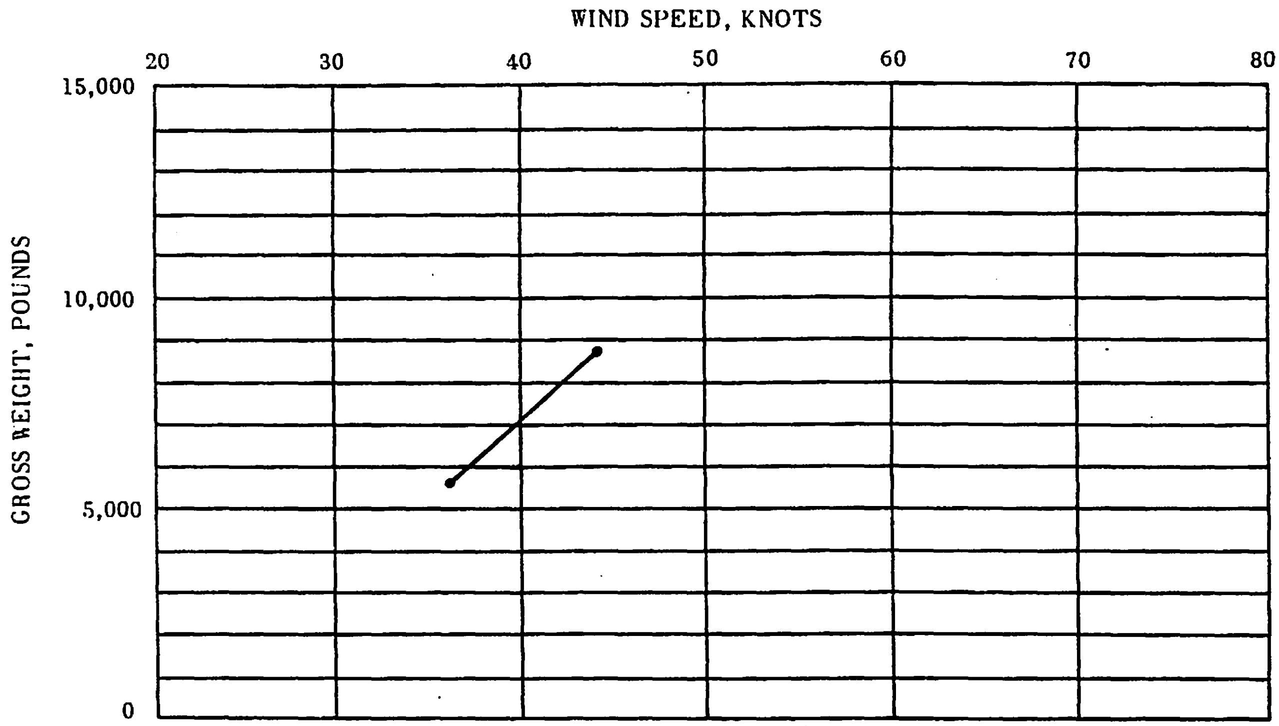
Figure 1-10. Aircraft Mooring



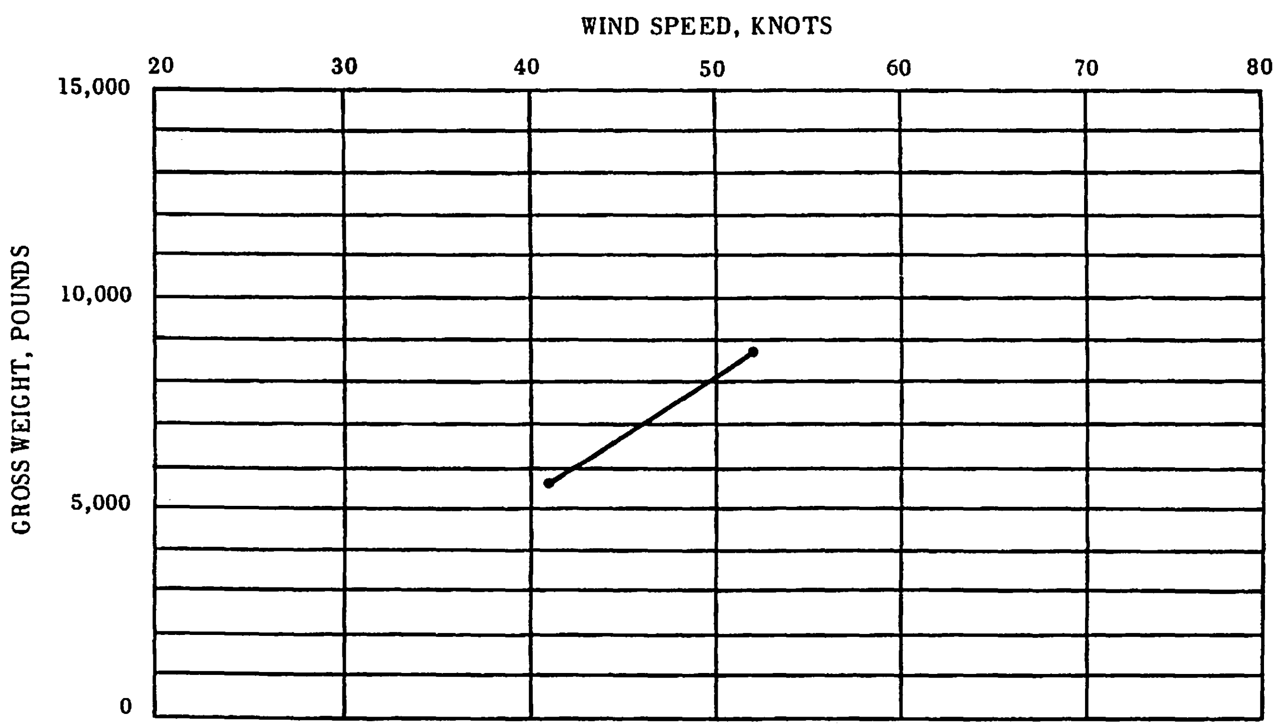
NOTE: MOORING POINT PATTERN SHOWN IS AIR FORCE STANDARD. IN THE EVENT NON-STANDARD MOORING POINT PATTERN EXISTS, ADHERE AS CLOSELY AS POSSIBLE TO THIS FIGURE.

LEGEND
⊕ = GROUND MOORING POINT
⊕ = AIRPLANE MOORING POINT

Figure 1-11. Aircraft Mooring



CONDITION A



CONDITION B

Figure 1-12. Gross Weight Versus Wind Speed

when an accumulation of moisture may cause the brakes to freeze, or when the brakes have received undue use and are hot.

g. Whenever control surfaces are caught by wind or propeller blast sufficient to cause violent movement against their stops or abruptly to the limit of their travel under any condition, A SPECIAL PREFLIGHT INSPECTION will be made before the aircraft is flown. In this case, all surfaces so subjected will be inspected for cracks or evidence of failure, i.e., hinges, hinge brackets, control horns, attachment of surfaces to torque tubes, etc., paying particular attention to the possibility that rivets and bolts might have been sheared or loosened. Necessary corrective action will be taken BEFORE the aircraft is flown.

1-13. PARKING AND MOORING.

a. Parking.

Parking is defined as the condition under which the aircraft will be secured on the ground. This condition is based on the gross weight of the aircraft and corresponding surface wind velocity or gusts shown in figure 1-12. The procedures under "Condition A" will apply when the wind velocity or gusts attain or exceed the values shown in figure 1-12. When "Condition A" procedures are followed, it is necessary that sufficient personnel and facilities are or can be made available for timely evacuation, inside storage, or security in accordance with provisions contained in "Condition B". The procedures under "Condition B" will apply when velocities of surface winds or gusts are forecast or prevail, which attain or exceed the values shown in figure 1-12, or when it is anticipated that personnel or facilities will not be readily available to adequately secure the aircraft under these conditions.

NOTE

All maintenance stands, cowling, loose equipment, etc., will be suitably secured at all times when left in an unattended condition.

b. Mooring.

1 "Condition A."

(a) After the aircraft is properly located, the tail wheel will be locked in the fore and aft position. The direction in which the aircraft is to be parked will be determined by the prevailing or forecast wind direction. When practicable, the aircraft will be headed into the wind.

(b) Approved type wheel chocks will be placed fore and aft of each main gear wheel and will be tied together with rope or by nailing wooden cleats from chock to chock on each side of wheels. Ice-grip chocks will be used when practicable. Sandbags may be used in lieu of chocks when aircraft is parked on steel matting.

(c) Control surfaces will be locked and trim tab controls will be placed in the neutral or streamlined position. Wing flaps will be in the retracted or "UP" position. Engine cowl flaps will be in the "CLOSED" position.

(d) The requirement for installation of dust excluders and canopy covers will be left to the discretion of the responsible maintenance officer or pilot of transient aircraft.

(e) Aircraft tie-down will be accomplished by attaching mooring lines to the two lower wing tie-down points located approximately 45 inches inboard from the wing tips (see figure 1-10). The tail wheel will be secured by a line around the tail wheel fork (see figure 1-11). Make tie-down of 1/4-inch aircraft cable, using wire rope clips, Class 29, Stock No. 6700-195150 or equivalent, and/or chain, 3000-pound pull test, and bolts. Use 3/4-inch manila rope or larger if cable or chain is not available. In the event tie-down rings are not available on hard surface areas, the aircraft will be moved to an area where mooring kits, Part No. AN8015-2, Stock No. 8200-416300, Class 19-A, and/or fixed mooring anchors can be used. Slip knots will not be used in tying mooring ropes. Anti-slip knots, such as the square or bow line, will be used.

(f) To use the mooring kit, Part No. AN8015-2, the anchor rod, Part No. 36A4468, is screwed into the arrow, Part No. 36A4467, and the driving rod, Part No. 36B4466, slipped over the anchor rod and into the socket of the arrow. The cam of the driving rod must be turned so that the prongs of the arrow will not be spread while driving. If the ground is hard, the surface will be broken first by using the ground breaking pin, Part No. 38B3323. Care must be taken to align the rod with the point of attachment on the aircraft. The arrow will be driven into the ground until the driving rod handle is within 3 inches of the ground and then rotated 90 degrees and the driving rod given a sharp blow to spread the prongs of the arrow. The driving rod is then returned to the "DRIVING" position and withdrawn from the ground. The squared socket of the eye assembly, Part No. 36A4469, will then be aligned with the squared end of the anchor rod, fitted into place, and the knurled nut screwed down tight. When properly assembled, the squared end of the anchor rod will extend through the squared socket of the eye approximately 1/8-inch. The tie-down will then be attached to the eye assembly and given an upward pull to set the arrow prongs. The mooring cable, rope and/or chain will then be secured in accordance with preceding instructions. To withdraw the rods, the mooring lines are detached and the anchor rods unscrewed by turning the ring of the eye assemblies counterclockwise, leaving the arrows in the ground.

NOTE

Mooring of aircraft will NOT be accomplished by attaching mooring or tie-down facilities to steel mats.

2 "Condition B" (Mooring for High Winds).

(a) The secure installation of proper size wheel chocks is of the utmost value in mooring an aircraft for high velocity winds. Therefore, when mooring C-45 aircraft, use wheel chocks, Part No. 42D6594-2, Stock No. 8200-159001, Class 19-A, for normal use. For ice or snow, use metal collapsible ice-grip chocks, Part No. 50D6602, Stock No. 8200-159006, Class 19-A. Sandbags may be used in lieu of chocks when aircraft are moored on steel mats. Another important factor is the weight of the aircraft. Figure 1-12 denotes aircraft weights and relative wind velocities that make varied tie-down procedures necessary. To make use of this figure, it is advisable to know the approximate weight of the aircraft in its various configurations, such as fully loaded or just returned from a mission. During emergencies, knowledge of this information is especially useful in selecting the aircraft that should be tied down first.

CAUTION

Structural damage can occur from high velocity winds. Therefore, if at all possible and deemed advisable, the aircraft should be evacuated to safe weather area if a tornado, hurricane, typhoon, or wind above 75 knots is expected. However, if aircraft have been subjected to wind velocities attaining or exceeding those shown in figure 1-12, control surfaces, hinge points, attachment fittings, etc., will be inspected and/or repaired as directed in paragraph 1-12.g.

(b) After aircraft is properly located, lock the tail wheel in the fore and aft position. The direction in which the aircraft is to be parked WILL be determined by prevailing or forecast wind direction. The aircraft will be headed into the wind, or as nearly as possible, depending upon the locations of fixed ramp mooring rings. Where necessary, a 45-degree variation of direction is considered to be satisfactory. Each aircraft will be located slightly more than a wing-span distance from other aircraft.
(c) All fuel tanks will be filled to capacity, if time permits.
(d) The main landing gear struts will be deflated.
(e) Approved type wheel chocks will be placed fore and aft of each main gear wheel and each pair of chocks (wood) will be tied together with rope or by nailing wooden cleats from chock to chock on each side of wheels. Ice-grip chocks will be tied together with rope. Sandbags may be used in lieu of chocks when the aircraft is moored on steel mats. The parking brake will be set as applicable. See paragraph 1-15 for parking brake operation.
(f) Aircraft parked on hard surface areas that are fitted with tie-down rings will utilize the rings to tie down the aircraft at the two lower wing points (see figure 1-10), the tail wheel position (see figure 1-11), and the two main gear struts. The tie-downs for the main gear struts will be affixed above the oleos to prevent "bouncing". Make tie-down of 1/4-inch aircraft cable, using two wire rope clips, Class 29, Stock No. 6700-195150 or equivalent, at each tie point, and/or chain, 3000-pound pull test, and bolts. Tie-downs will be attached in such a manner as to remove all slack. Use 3/4-inch manila rope or larger, if cable or chain tie-down is unavailable. In event rope is used for tie-down, slip knots will not be used. Anti-slip knots, such as the square or bowline, will be used. In event tie-down rings are unavailable on hard surface areas, the aircraft will be moved to an area where anchor kits, Part No. AN8015-2, can be used. A minimum of 10 ground anchor points will be used and will consist of 2 for the tail point, 2 for each wing point, and 2 for each main gear point. When anchor kits are unavailable, metal stakes or "dead-man" type anchors may be used providing a 3000-pound minimum pull is sustained without failure of such installed anchors. In event the tie-downs are considered to be doubtful due to the existing soil condition, additional anchor rods will be driven expressly at the wing and tail positions.
(g) Surface controls will be locked and trim tab controls will be placed in the neutral or streamlined position. Wing flaps will be in the retracted or "UP" position. External surface control locks will be used when available.
(h) The requirement for dust excluders, canopy covers, and taping of openings will be left to the discretion of the responsible maintenance officer or pilot of transient aircraft.
(i) Propellers will be placed in the "FULL FEATHERED" position.
(j) Batteries will be disconnected.

NOTE

Where typhoon conditions exist, it is to be remembered that the storm appears to pass two times, each time with a different wind direction, which will necessitate turning of the airplane after the first passing.

(k) After high winds, the aircraft will be inspected for visible signs of structural damage and for evidence of damage from flying objects. Landing gear struts will be serviced and batteries will be reconnected. Do not tow or taxi aircraft with deflated struts.

1-14. TIE-DOWN ACCESSORIES.

QTY	STOCK NO.	PART NO.	NOMENCLATURE	CLASS	SOURCE
As reqd	6590-800035-325		Cable - Aircraft	29-1	AF Stock
As reqd	6700-195150		Clip - Wire Rope	29	AF Stock
As reqd	6590-106400		Chain	29-1	AF Stock
As reqd	8200-416300	AN8015-2	Kit - Mooring	19-A	AF Stock

QTY	STOCK NO.	PART NO.	NOMENCLATURE	CLASS	SOURCE
As reqd	7100-693500		Rope - Manila	21-A	AF Stock
As reqd	8200-159001	42D6594-2	Chock-Wheel,Wood	19-A	AF Stock
As reqd	8200-159006	50D6602	Chock-Wheel,Ice-grip	19-A	AF Stock

1-15. PARKING BRAKE OPERATION. C-45G, TC-45G and C-45H aircraft have a parking brake handle located on the lower part of the control pedestal (figure 1-13). This parking brake handle operates a valve in the brake line to hold pressure built up with the brake pedals. To set the parking brakes depress the pilot's toe pedals and hold; pull out the parking brake handle and hold until toe pedals are released. To release parking brake depress pilot's toe pedals and release or push in parking brake handle.

1-16. SURFACE CONTROL LOCK. The surface control lock is secured at its aft end by a leather strap and stowed on the floor board forward of the pilot's seat. Effective on Serials 51-11501 and after, with the exception of 51-11504 through 51-11533, the control lock is modified to incorporate the use of a clevis and "Heim Unibal" bearing to assist in adjusting the control lock. Lock the control surfaces as follows:

a. Unfasten strap; raise forward end of lock assembly.
b. Pinch pins together and place between rudder pedals, allowing pins to enter holes in the rudder pedals (figure 1-14).
c. Raise aft end of control lock and place "U" clamp around vertical control column (do not tighten clamp).
d. Insert thumb screw into hole in column behind wheel, then tighten "U" clamp and thumb screw.

NOTE

External control locks should be used if the airplane may be subjected to strong changeable winds.

1-17. TOWING.

a. Towing lugs are provided on the inboard side of the main landing gear forks (figure 1-15).
b. A qualified man will be in the cockpit when the aircraft is being towed to insure that the tailwheel is unlocked, the parking brake is off, and to operate the brake if required. A man will also be at each wing tip when maneuvering aircraft near hangars or other aircraft obstacles.
c. When towing lines are necessary use ropes long enough to clear nose by at least 15 feet.
d. Towing speeds will be slow, avoiding sudden starts and stops, especially over snow, ice, rough, soggy, or muddy terrain. Avoid short turns and always keep inside wheel turning during towing operations.

1-18. SERVICING.

1-19. The following precautions will be observed when servicing aircraft:

a. Aircraft will be serviced in all possible cases with "cold soaked fuel", reference T.O. 42B1-1-9.
b. Aircraft will be refueled as soon as possible after landing.
c. Fuel servicing nozzles will be maintained free of snow, water and mud at all times.
d. Snow, water and ice will be carefully removed from aircraft fuel filler cap wells before removing the fuel filler cap. Only one aircraft tank filler cap should be removed at one time, and should be replaced immediately after the servicing operation is completed.

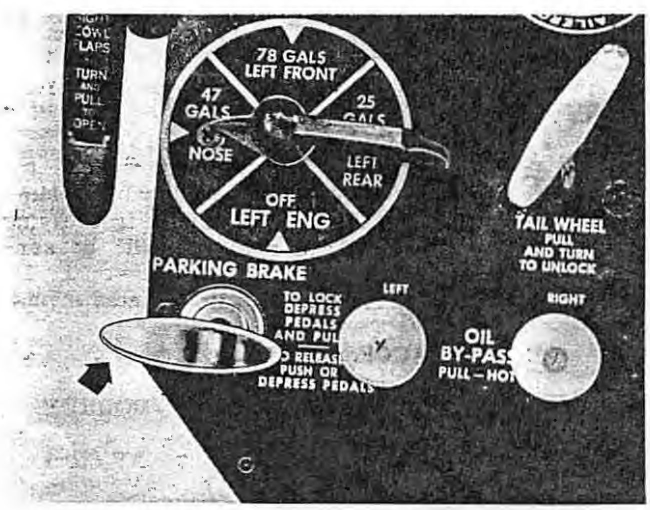


Figure 1-13. Parking Brake

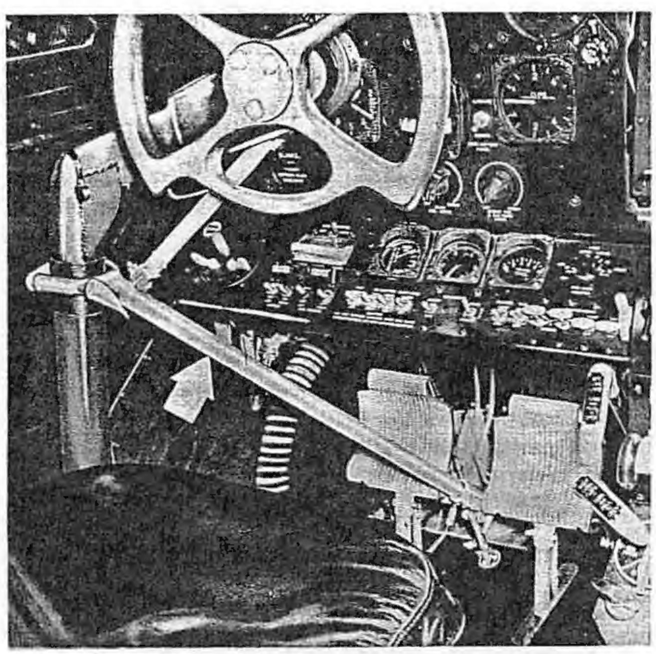


Figure 1-14. Surface Control Lock

equivalent quick smothering agent, will be strategically placed in the immediate vicinity of the aircraft during fueling or defueling operations.

c. "NO SMOKING" precautions will be observed during ALL fueling and defueling operations.

d. In the event that fuel must be handled in emergency during airborne radar operating period, personnel servicing the equipment will request radar operating personnel to remove the PLATE VOLTAGE or suspend radar operation within a radius of three hundred (300) feet, during fueling operation. Special precautions are necessary for those bases at which radar set AN/FPS-6 or the mobile version AN/MPS-14 is installed. For locations at which either the AN/FPS-6 or AN/MPS-14 radar set is installed, no aircraft fueling operations will be conducted within two thousand (2000) feet. Aircraft fueling operations may be accomplished at distances less than two thousand (2000) feet providing the depression node angle of radar sets AN/FPS-6 or AN/MPS-14 are restricted so that beam center does not directly illuminate the fueling facility.

e. Aircraft will be serviced in all possible cases with "cold soaked fuel", reference T.O. 42B1-1-9.

f. Aircraft will be refueled as soon as possible after landing.

g. Fuel servicing nozzles will be maintained free of snow, water and mud at all times.

h. Snow, water and ice will be carefully removed from aircraft fuel filler cap wells before removing the fuel filler cap. Only one aircraft tank filler cap should be removed at one time, and should be replaced immediately after the servicing operation is completed.

i. Frosted fuel filler necks will be wiped clean before servicing.

j. Fuel tank, filter cases and pumps will be drained 15 minutes after each servicing, 30 minutes after each removal from heated shelter, and immediately after each flight. Preheat will be used, when required, to insure free fuel drainage. A minimum of one-half gallon of fuel will be drained from each drain point. The fuel samples will be drained into a clean metal container grounded to the aircraft. Immediately after draining, the fuel will be transferred into a clear plastic or glass container and inspected for the presence of water and other contaminants.

NOTE

Transfer of fuel from the metal to the plastic or glass container will be made away from the aircraft.

CAUTION

The skin structure over the wing fuel tank area is not designed for personnel to walk on. Use protective cover, stock number 2000-627400 and suitable stands while refueling to prevent damage to skin.

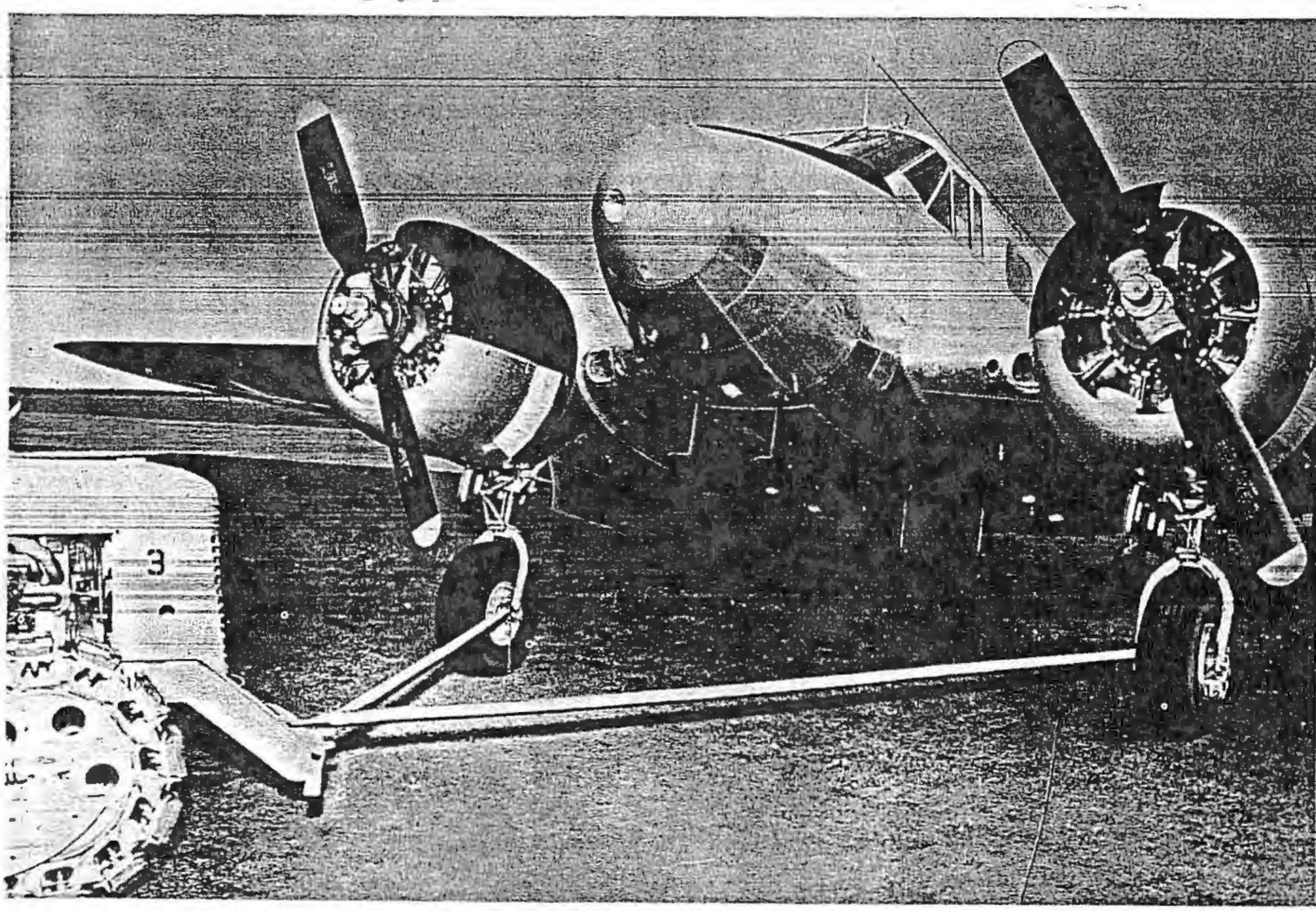
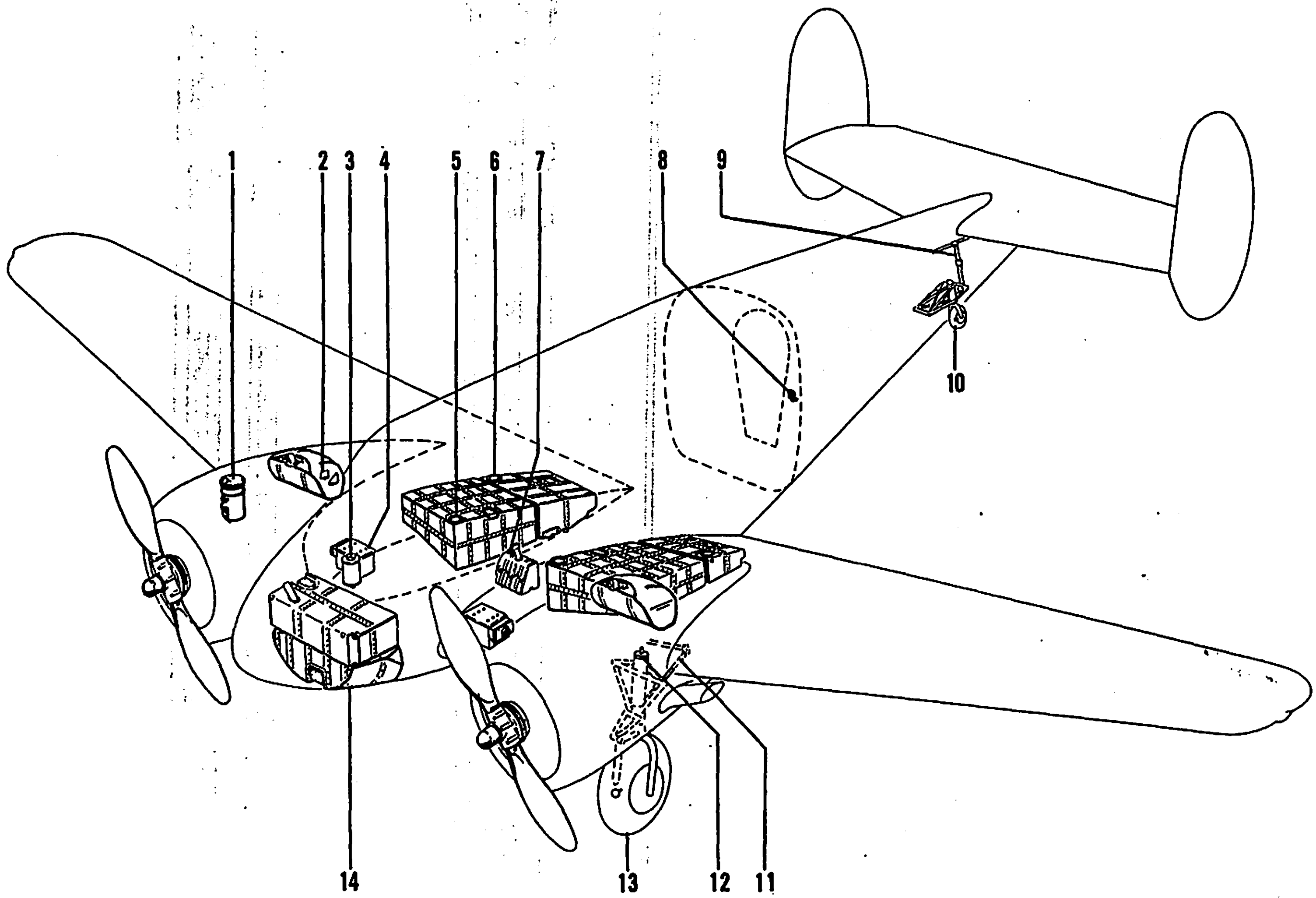


Figure 1-15. Towing Aircraft



1. Auto Pilot Reservoir
2. Oil Tank
3. Brake Hydraulic Reservoir
4. Battery
5. Main Fuel Tank
6. Auxiliary Fuel Tank
7. Anti-Icer Tank
8. Oxygen Filler Valve
9. Tail Wheel Shock Strut
10. Tail Wheel Tire
11. Main Gear Oleo
12. Main Gear Shock Strut
13. Main Gear Tire
14. Nose Fuel Tank

Figure 1-16. Servicing Points

VOIR. The automatic-pilot hydraulic reservoir is located on the outboard forward side of the right engine firewall (figure 1-16). The reservoir is serviced through an access plate (figure 1-4) on the upper outboard side of the right engine cowling. The fluid level should be maintained within the limits shown on the fluid level sight gage by adding hydraulic oil, Specification MIL-O-5606. The drain plug is accessible by removing the right engine outboard wrapper sheet.

1-23. BRAKE FLUID RESERVOIR. The brake fluid reservoir is mounted on the pilot's side of the cross brace on Bulkhead 3 below and forward of the instrument panel (figure 1-16). The fluid level should be maintained approximately 2 inches below the top of the filler neck with hydraulic oil, Specification MIL-O-5606. The reservoir can be drained by removing a bleeder plug from one of the main wheel brake assemblies and pumping the oil out with the brake pedal.

TABLE II. SERVICING

UNIT TO BE SERVICED	QUANTITY US	QUANTITY IMPERIAL	LITERS	TYPE OF MATERIAL TO BE USED
1. FRONT MAIN FUEL TANKS (2)	78 gal	64.9 gal	295.2	GASOLINE 91/96 OCTANE SPECIFICATION MIL-F-5572
2. REAR AUXILIARY TANKS (2)	25 gal	20.8 gal	94.6	GASOLINE 91/96 OCTANE SPECIFICATION MIL-F-5572
3. NOSE TANKS	47 gal	39.1 gal	177.9	GASOLINE 91/96 OCTANE SPECIFICATION MIL-F-5572
4. OIL TANKS RIGHT	8 gal	6.6 gal	30.2	ENGINE OIL SPECIFICATION MIL-L-6082 GRADE 1100 SUMMER AND WINTER
LEFT	8 gal	6.6 gal	30.2	ENGINE OIL SPECIFICATION MIL-L-6082 GRADE 1100 SUMMER AND WINTER

CAUTION

Alcohol will not be added to aviation fuels for use in aircraft by way of fuel tanks or cells regardless of the type of fuel tanks or cells installed.

UNIT TO BE SERVICED	QUANTITY US	QUANTITY IMPERIAL	LITERS	TYPE OF MATERIAL TO BE USED
5. AUTOMATIC PILOT RESERVOIR	FILL TO INDICATOR MARK IN GLASS WINDOW			HYDRAULIC OIL SPECIFICATION MIL-O-5606
6. BRAKE RESERVOIR	FILL TO WITHIN 1-1/2 TO 2 INCHES OF TOP			HYDRAULIC OIL SPECIFICATION MIL-O-5606
7. ANTI-ICER FLUID TANK	3 gal	2.5 gal	11.3	ANTI-ICER FLUID SPECIFICATION MIL-F-5566

TABLE III. TANK CAPACITIES

TANK	EXPANSION VOLUME (gal)	TOTAL CAPACITY (gal)	SUMP CAPACITY (gal)	NET FUEL CAPACITY (gal)
FRONT MAIN (2) (FUEL)	2.3	78	0.3	77.7
REAR AUXILIARY (2) (FUEL)	.8	25	0.2	24.8
NOSE FUEL TANK	1.6	47	0.25	46.75
OIL TANKS	2.5	8	----	8.0
ANTI-ICER	0	3	0	3.0

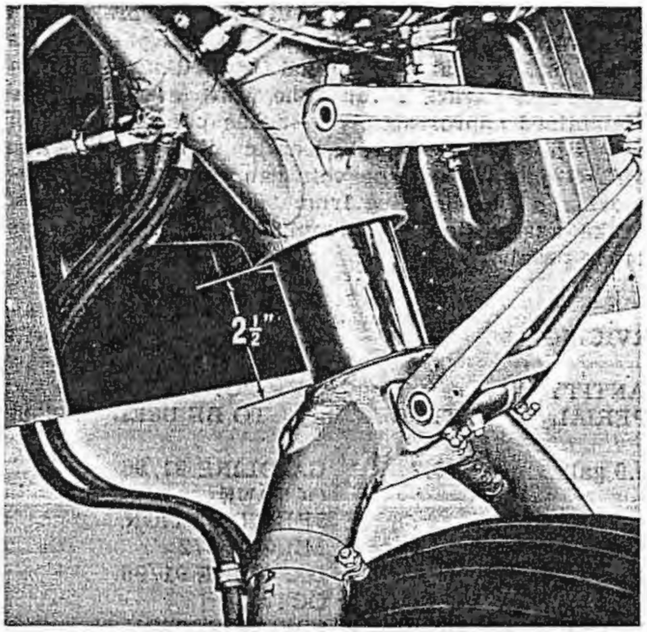


Figure 1-17. Main Gear Shock Strut Inflation

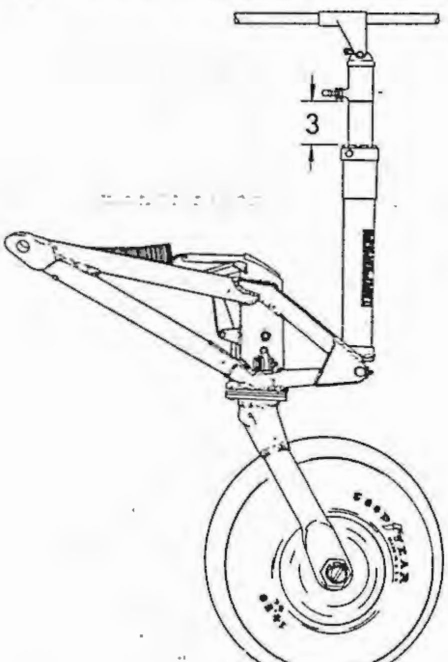


Figure 1-18. Tail Gear Shock Strut Inflation

1-24. ANTI-ICING FLUID TANK. The anti-icing fluid tank, of 3 US gallons capacity, is mounted on the floor boards between the pilot's seat and Bulkhead 5 and is serviced from the pilot's compartment (figure 1-16). The tank should be checked and filled before each flight. See Table II for fluid specification.

1-25. SERVICING LANDING-GEAR SHOCK STRUTS. Clean exposed portions of shock-absorber pistons with alcohol and wipe with clean hydraulic oil daily. Fill main landing gear shock strut with hydraulic oil, Specification MIL-O-5606 as follows:

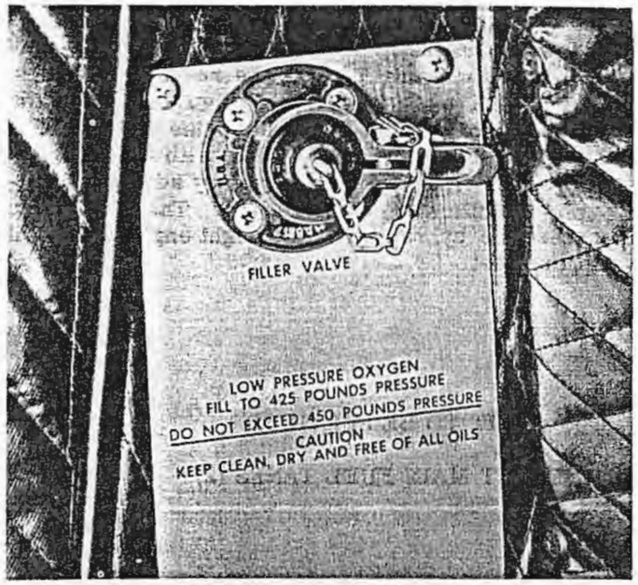


Figure 1-19. Oxygen Filler Valve

a. Jack airplane so that main landing gear wheels are clear of ground.

WARNING

Remove the dust cap prior to loosening the hex swivel nut to release air pressure. The MS28889-1 high pressure air valve is being issued in place of AN6287-1 valve on attrition basis. This valve has a 3/4-inch hex swivel nut and does not have a valve core as a secondary seal.

b. Release air from strut by loosening filler plug on top of strut.
c. Remove filler plug and compress strut so that only 3/4-inch of the piston is exposed. A 3/4-inch block may be placed between the torque knees to obtain this setting.
d. Fill strut to over-flowing with hydraulic oil, remove block, and compress strut.
e. Replace filler plug loosely. Extend and compress strut several times to remove surplus hydraulic oil and trapped air.
f. Compress strut and remove filler plug, check fluid level, replace filler plug, and tighten securely. Inflate strut until 2-1/2 inches of the piston is exposed with the airplane on the ground (figure 1-17).

1-26. SERVICING TAIL GEAR SHOCK STRUT. Fill tail wheel shock strut with hydraulic oil, as follows:
a. Jack tail of airplane so that tail wheel is clear of ground.

WARNING

Remove the dust cap prior to loosening the hex swivel nut to release air pressure. The MS28889-1 high pressure air valve is being issued in place of AN6287-1 valve on attrition basis. This valve has a 3/4-inch hex swivel nut and does not have a valve core as a secondary seal.

b. Release air from strut by loosening filler plug.
c. Remove filler plug and fully compress strut.
d. Fill compressed strut to overflowing with hydraulic oil.
e. Slowly extend and compress strut several times to remove trapped air.
f. Compress strut and add more oil if it is not level with filler hole.
g. Replace filler plug, tighten securely, and inflate strut to 3 inches. See figure 1-18.

1-27. SERVICING OLEO DRAG LEG. Fill oleo drag leg with hydraulic oil as follows: (See figure 1-16.)
a. Release air from strut by loosening air filler valve, remove filler valve and fill with hydraulic oil.

b. Replace air filler valve and inflate strut to 50 pounds per square inch air pressure.

1-28. OXYGEN SYSTEM. On C-45G and TC-45G airplanes, Serials 51-11444 through 51-11911, the oxygen system should be checked daily for proper regulator operation and full tanks. C-45H airplanes, Serials 52-10539 and after, do not have an oxygen system. The tanks are on the right side of the cabin, between Bulkheads 8 and 9; there is an outlet at each seat and in the lavatory compartment. The charging valve is on the bulkhead just aft of the cabin door.

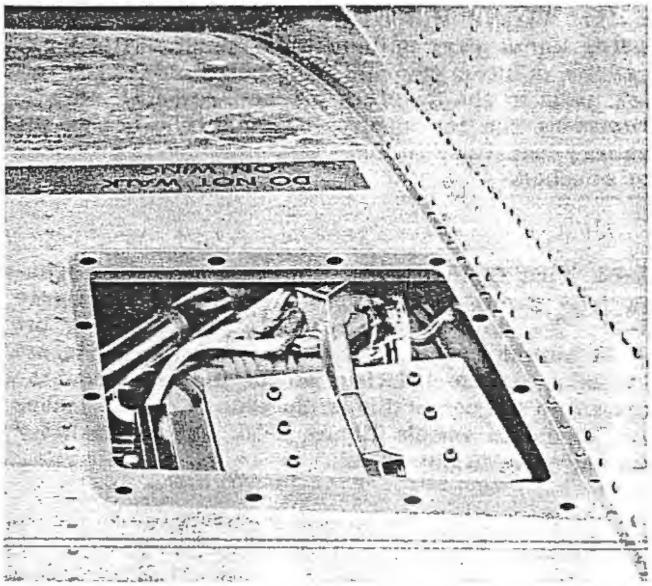


Figure 1-20. Battery Access

Normal operating pressure is 400 psi; charge the system as follows:

a. Connect the outside source to the filler connection on Bulkhead 9.

b. Turn regulator adjustment screw on supply equipment to FULL OFF then slowly open valves on supply cylinders.

c. Turn adjustment screw until supply pressure gage reads 425 pounds per square inch.

WARNING

Do not attempt to fill airplane oxygen system too quickly. Allow pressure to build up SLOWLY to 425 psi. DO NOT USE OILS or greases on oxygen fittings or attachments.

d. Allow oxygen to flow slowly into the airplane oxygen system until the pressure gage in the pilot's compartment reads 425 pounds per square inch.

NOTE

Charging the system generates heat causing an increase in pressure. After servicing, the system will cool and the resultant contraction of the oxygen will lower the final pressure to approximately 400 pounds per square inch.

e. Turn off the supply valve and disconnect the supply source.

1-29. OXYGEN REGULATOR REPLACEMENT. When replacing oxygen regulators be sure to use the outlet elbow supplied wih the new regulator. The Bendix design A-12 and AN6004-1 regulators have a screen type baffle installed inside the outlet elbow which prevents oxygen syphoning. The elbow with the baffle installed must not be used with any other type or design regulator as it will restrict the oxygen flow.

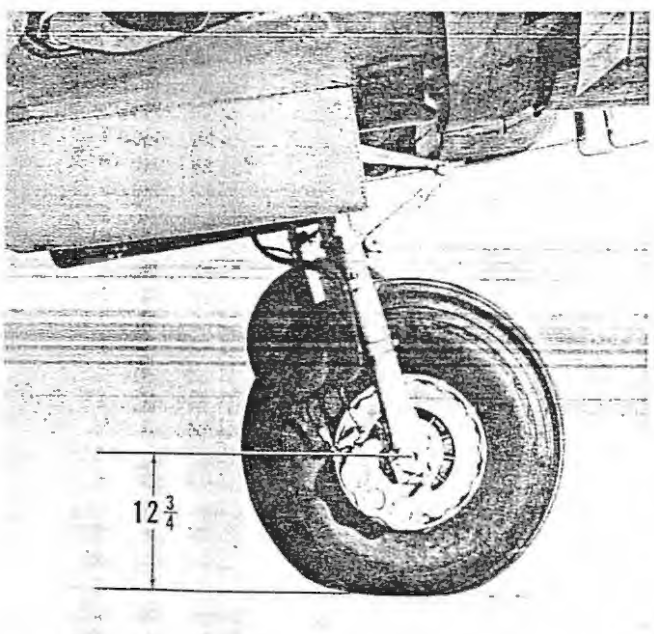


Figure 1-21. Main Wheel Tire Inflation

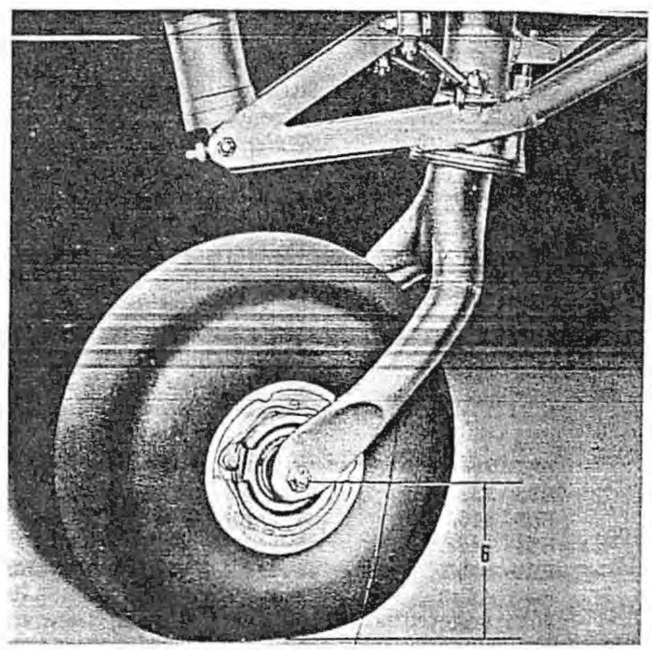


Figure 1-22. Tail Wheel Tire Inflation

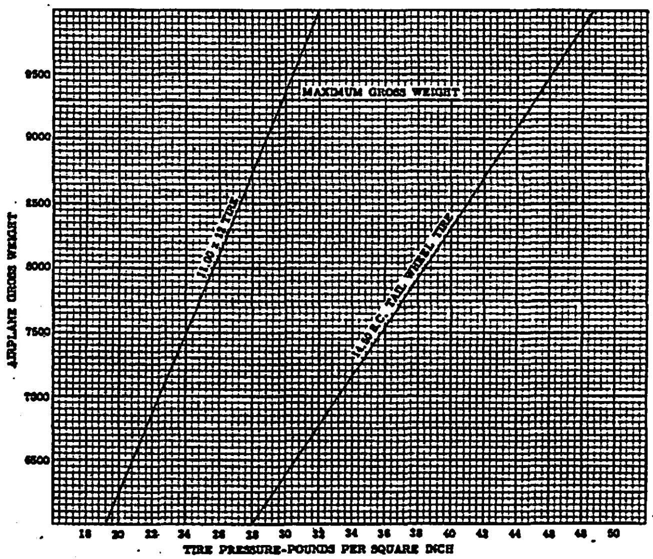


Figure 1-23. Tire Inflation Chart

1-30. BATTERY SERVICING. Access to the batteries is easily obtained through cover plates in the forward center section between the fuselage and engine nacelle (figure 1-20). To service, remove the battery cover and take hydrometer readings of the electrolyte in each cell to determine the battery condition. Readings of 1.260 to 1.310 indicate full charge. If 1.240 or less, the battery must be recharged. (Make temperature corrections to insure accurate readings). In cold weather, keep battery as near full charge as possible or electrolyte may freeze.

1-31. If the specific gravity is satisfactory, add distilled water to each cell as necessary, being careful not to over fill. Avoid spilling electrolyte on the aircraft structure or equipment. Should this occur, immediately neutralize the affected area with a water solution of sodium bicarbonate. When servicing the battery, check the overflow jar for condition of the neutralizing agent. If overflow jar is contaminated, remove jar and clean with warm water. Wash the felt pads in a solution of 3 parts water and 1 part sodium bicarbonate. Allow excessive solution to drain from pads. Place the two felt pads in the overflow jar and reinstall. While replacing the jar check the condition of all the battery vent lines to make sure they are not broken or cracked.

1-32. TIRE INFLATION. The main wheel tire pressure is given by the 11.00 x 12 tire line in figure 1-23. The tail wheel tire inflation is given by the 14.50 smooth contour tire line. If a gauge is not available, inflate the tires so the distance from the ground to the center line of the axle is 12-3/4 inches for the main wheels (figure 1-21) and 6 inches for the tail wheel (figure 1-22).

SPECIAL TOOLS

PART NUMBER	NOMENCLATURE	FIGURE, INDEX NO.
No Number	Reamer, Adjustable Expansion, 15/16 to 1-1/16 inches (Morse Standard-Obtain Locally)	1-24, No. 1
No Number	Reamer, Straight Spiral Fluted, 1 inch (Morse (Standard-Obtain Locally)	1-24, No. 2
TK106	Bar, Main Landing Gear Tow	1-24, No. 3
TS101	Reamer, Spiral, Wing Hinge Joint Finishing	1-24, No. 4
TS101R	Reamer, Spiral, Wing Hinge Joint Roughing	1-24, No. 5
TS588	Wrench, Elevator Jam Nut	1-24, No. 6
TS657	Wrench, Rudder Tab Drive	1-24, No. 7
TS658A	Wrench, Rudder Tab Drive, Open End-1 inch	1-24, No. 8
TS658B	Wrench, Rudder Tab Drive, Open End-7/8 inch	1-24, No. 9
TS669	Pin, Wing Aligning 15/16 x 3-3/8 inches	1-24, No. 10
TS691	Puller, Lord Bushing (Set of 2-Upper and Lower)	1-24, No. 11
TS724	Wrench, Cowl Fastener Hook	1-24, No. 12
TS951	Sling, Engine Hoist	1-24, No. 13
18087	Bolt, Airplane Hoisting	1-24, No. 14
18091	Lug, Airplane Hoisting (Set of 2)	1-24, No. 15
18092	Eyebolt, Airplane Hoisting (Set of 2)	1-24, No. 16
180131	Wrench, Overload Clutch, Landing Gear	1-24, No. 17
180914	Sling, Airplane Hoisting	1-24, No. 18
HSP-294	Wrench, Cam	1-24, No. 19
HSP-339	Wrench, Dome Strap	1-24, No. 20
HSP-346	Wrench, Dome Retaining	1-24, No. 21
HSP-1482	Wrench, Valve Housing	1-24, No. 22
HSP-1483	Socket, Propeller Retaining Nut	1-24, No. 23
84-180930	Pad, Wing Jack LH (84-18930-1 Pad - Wing Jack RH)	1-24, No. 24
404-180891	Wrench, Landing Gear Hinge Pin	1-24, No. 25
404-188035	Wrench, Landing Gear Nut	1-24, No. 26

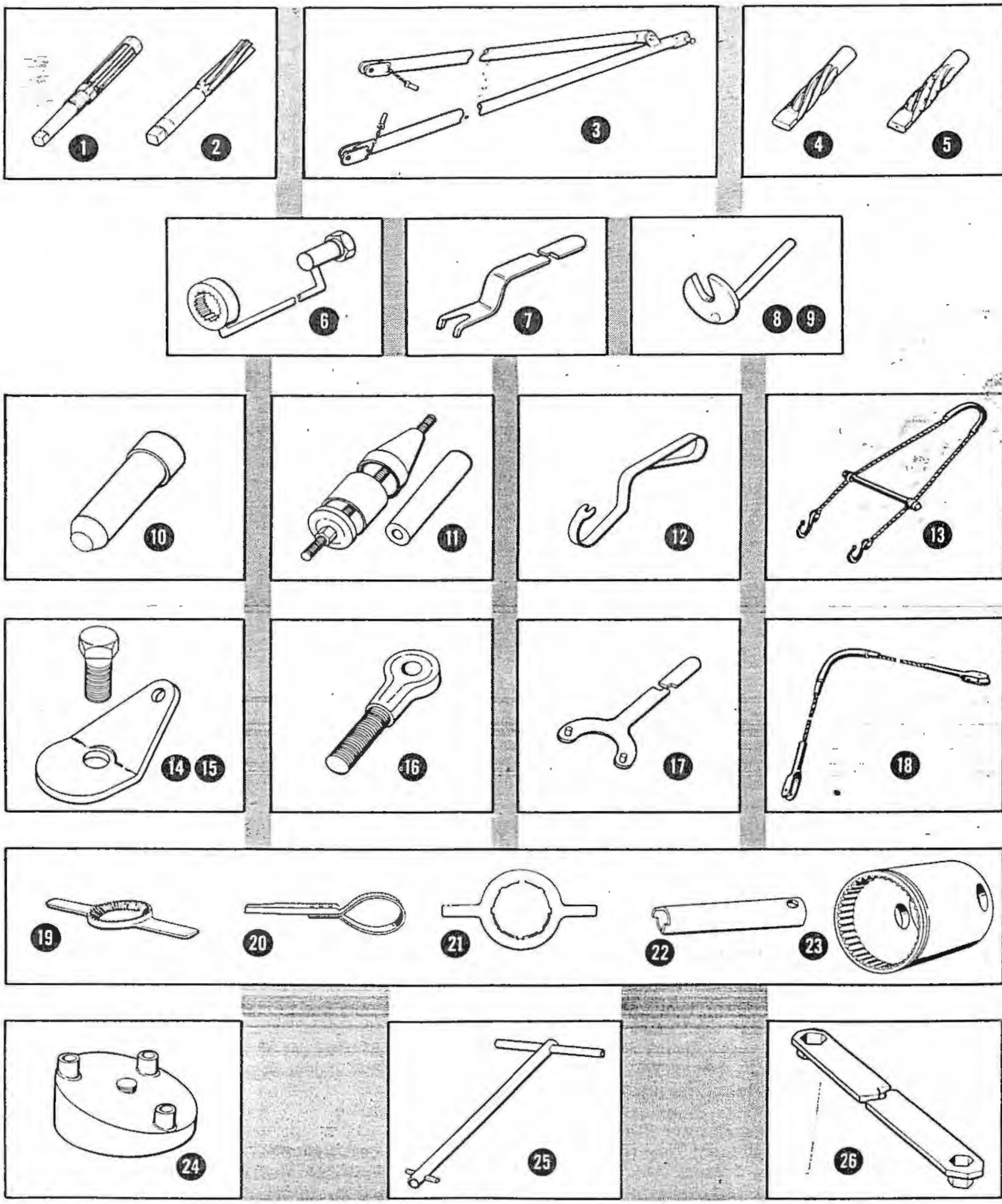
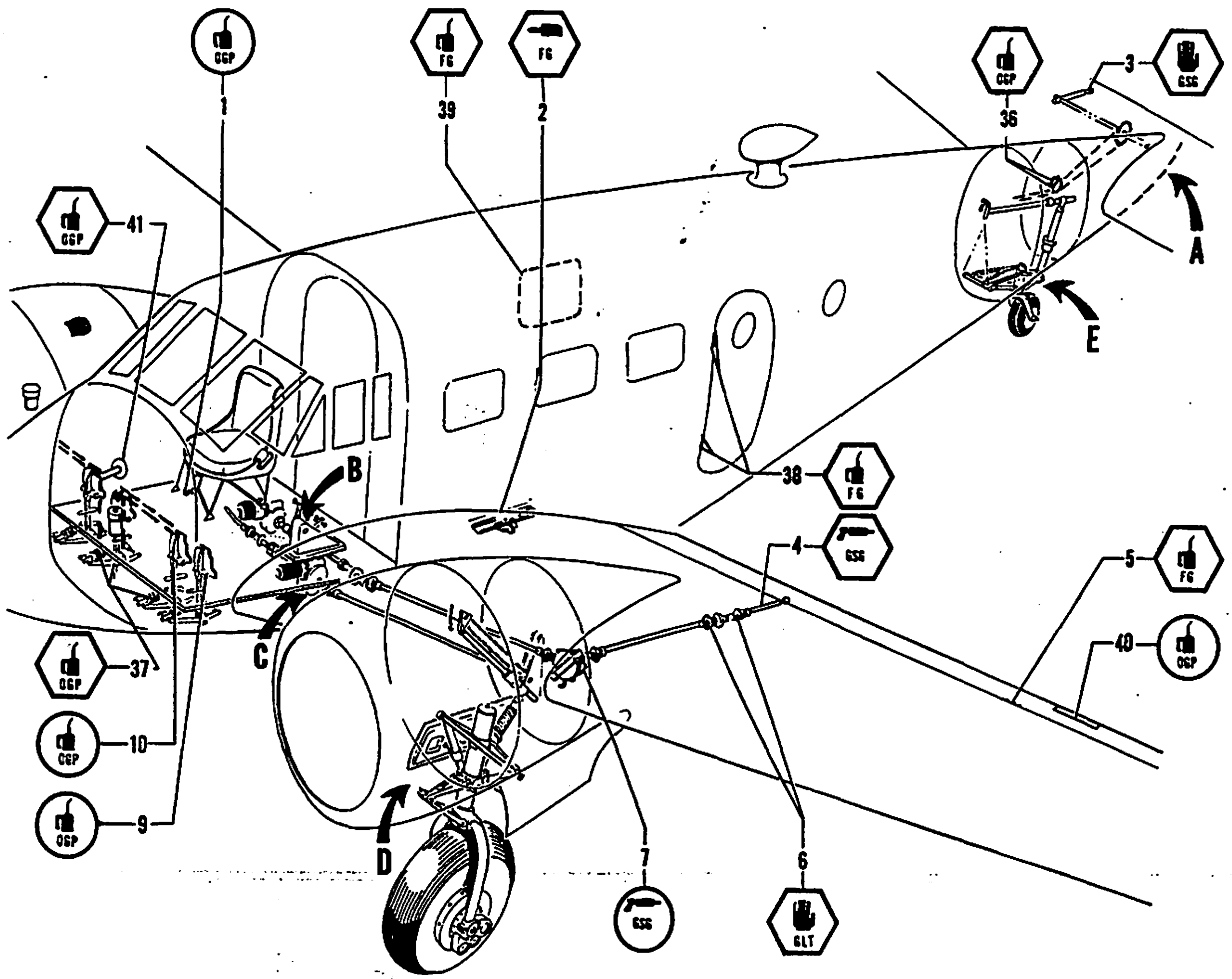


Figure 1-24. Special Tools



1. Pilot's and Copilot's Seat Adjustment.
2. Rudder Reduction Pulley Slides (Note a)--Every 2nd periodic.
3. Elevator Tab Torque Drives and 90° Drives (Stabilizer).
4. Flap Screws--Postflight nearest 50 hrs.
5. Aileron Hinge Wire (Note a)--Every 2nd periodic.
6. Flap Shaft Universals (Note b)--Every 3rd periodic.
7. Flap Gear Boxes (90° drives in nacelle).
8. Deleted.
9. Rudder Pedal Hinge Points.
10. Master Brake Cylinder Actuating Rod.
11. Tail Cowling (Note d)--Postflight nearest 50 hrs.
12. Flap Motor Gearbox.
13. Flap Emergency Chain.
14. Flap Mechanism Cross Shaft (Note a).
15. Landing Gear Torque Shaft Universals (Note b)--Every 2nd periodic.
16. Nacelle Retract Chain--Postflight nearest 50 hrs.
17. Landing Gear Motor Gearbox (Note c)--Postflight nearest 50 hrs. After compliance with TCTO 1C-45-527, check for 1-1/2 to 2 pounds of grease MIL-G-7118 at each gear inspection, 500 hrs.
18. Landing Gear Clutch Release Arm--Every 2nd periodic.
19. Tail Wheel Retract Chain (C-45G & TC-45G).
20. Tail Wheel Slide Tube (C-45G & TC-45G) (Note a)--Postflight nearest 50 hrs.
21. Tail Wheel Shock Absorber Bushings (Upper)--Postflight nearest 50 hrs.
22. Main and Tail Wheel Bearings--2nd periodic inspection, wheel change, tire change or when exposed to contact with steam, solvent, etc., during washing of aircraft.

Figure 1-25. Lubrication Chart (Sheet 1 of 2)

SECTION II

AIRFRAME GROUP

TABLE OF CONTENTS

Paragraph		Page
2- 1.	General Description	28
2- 3.	Body Group	28
2- 4.	Fuselage	28
2- 6.	Nose Compartment	28
2- 8.	Pilot's Compartment	28
2- 10.	Cabin Compartment	28
2- 13A.	Emergency Exit Hatch	28A
2- 14.	Lavatory Compartment	29
2- 16.	Tail Compartment	29
2- 18.	Tail Cowling	29
2- 23.	Pilot's Compartment Sliding Window	32
2- 30.	Wing Group	32
2- 31.	Center Section	32
2- 33.	Engine Nacelles	33
2- 35.	Outer Wing Panel	33
2- 39.	Wing Fitting	35
2- 46.	Installation of Outer Wing Panel After Reaming	39
2- 48.	Wing Tips	40
2- 53.	Ailerons	40
2- 58.	Wing Flap	42
2- 64.	Tail Group	43
2- 65.	Horizontal Stabilizer	43
2- 70.	Vertical Stabilizer	44
2- 75.	Elevator	45
2- 80.	Rudder	46
2- 85.	Surface Control Systems	46
2- 87.	Aileron Control System	46
2- 97.	Aileron Tab Control System	50
2-107.	Wing Flap Control System	52
2-110.	Wing Flap Electrical System	52
2-111.	Flap Position Switch	52
2-120.	Wing Flap Dynamic Brake Relay	53
2-126.	Wing Flap Rheostat	54
2-143.	Elevator Control System	57
2-153.	Elevator Tab Control System	59
2-171.	Rudder Control System	61
2-183.	Rudder Tab Control System	64
2-197A.	Deleted	66
2-198.	Main Landing Gear System	66
2-200.	Wheels, Tires and Tubes	66
2-206.	Hydraulic Brakes (Dual System)	68
2-224.	Master Cylinders	72
2-232.	Shuttle Valves	76
2-237.	Parking Brake Valves	76
2-245.	Shock Absorber Assembly	79
2-250.	Landing Gear Oleo Drag-Leg	80
2-256.	Tail Gear Assembly	82
2-258.	Wheel, Tire and Tube	82
2-265.	Tail Gear Truss Assembly	82
2-272.	Main Landing Gear and Tail Wheel Doors	83
2-278.	Tail Wheel Lock Controls	84
2-285.	Landing Gear Retract System	85
2-287.	Landing Gear Motor	85
2-293.	Landing Gear Motor Gearbox	86
2-298.	Landing Gear Clutch	87
2-303.	Landing Gear Retract Chain	88

TABLE OF CONTENTS (CONT)

Paragraph		Page
2-318.	Slide Tubes	92
2-328.	Landing Gear Slide Assembly	94
2-338.	Landing Gear Electrical System	95
2-345.	Safety Switches	96
2-351.	Landing Gear Position Indicator System	97
2-357.	Dynamic Brake Relay	97
2-364.	Landing Gear Limit Switches	98
2-373.	Position Indicator Switches	100
2-382.	Warning Horn Switches	101

2-1. GENERAL DESCRIPTION.

2-2. The airframe group includes the body group (fuselage and center section), tail group (horizontal and vertical stabilizers) control surfaces (rudders, ailerons and elevator), landing gear and all related parts of these groups. The power plant, electrical systems, instruments and utility systems are discussed in other sections.

2-3. BODY GROUP.

2-4. FUSELAGE.

2-5. DESCRIPTION. The fuselage of C-45G, TC-45G and C-45H aircraft (figure 2-1) is an all-metal semi-monocoque structure, and is of conventional design. Its maximum cross sectional interior dimensions are 52 inches wide 60 inches in height and 403-3/4 inches in length.

2-6. NOSE COMPARTMENT.

2-7. DESCRIPTION. The nose compartment is located between Bulkheads 1 and 3. Access is gained through a round door hinged to the top of Bulkhead 1 (figure 2-2). The nose compartment has a structural capacity of 600 pounds. When an auxiliary fuel tank is used the volume available for baggage is reduced by approximately 30% and the baggage capacity is limited by the weight of the fuel carried in this compartment. Two tie down straps are furnished to secure baggage or cargo from shifting position.

CAUTION

To prevent damage to the locking mechanism, the baggage door must be closed by operating the latch by hand.

2-8. PILOT'S COMPARTMENT.

2-9. DESCRIPTION. The pilot's compartment containing the pilot's and copilot's seats, instrument panel, engine control pedestal, flight controls and the radio control panel, is located between Bulkheads 3 and 5. Access is gained through the cabin compartment.

2-10. CABIN COMPARTMENT.

2-11. DESCRIPTION. The cabin compartment is located between Bulkheads 5 and 9, access is gained through a door on the left side immediately forward of Bulkhead 9. The door is equipped with an emergency release, so that it may be jettisoned in flight if necessary. An emergency escape panel is located on the right side between Bulkheads 7 and 8.

2-12. The C-45G cabin is furnished with bucket seats to accommodate four passengers.

2-13. The TC-45G cabin is furnished with seats and tables to accommodate three student navigators. In the overhead, just aft of Bulkhead 5 is an astrodome. A type B-3 driftmeter is installed at the second navigator's position, and a type B-5 driftmeter is installed at the third navigator's position.

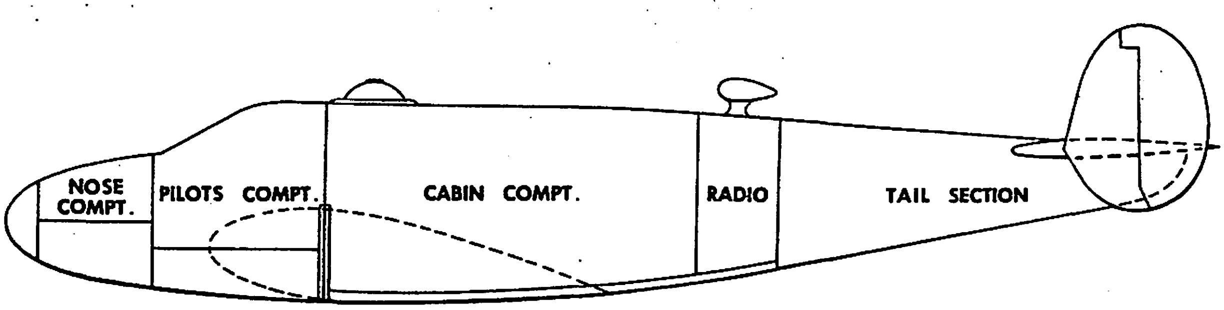


Figure 2-1. Fuselage Compartment Diagram

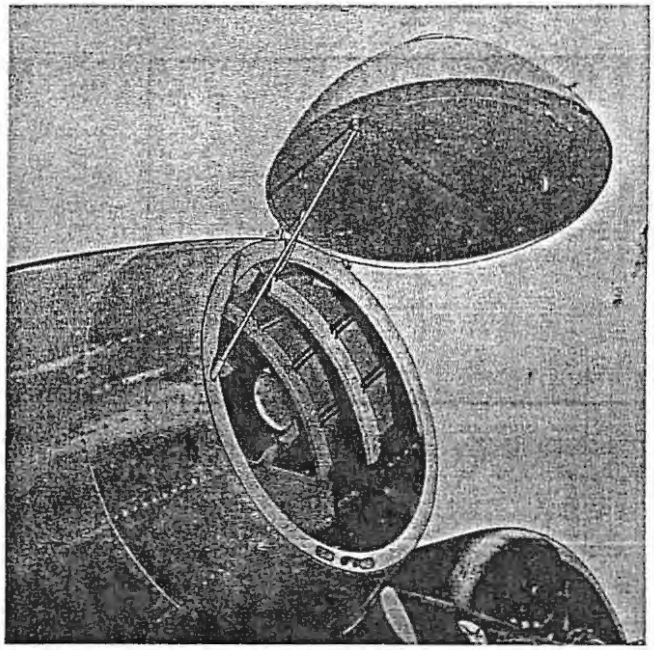


Figure 2-2. Nose Baggage Compartment Door

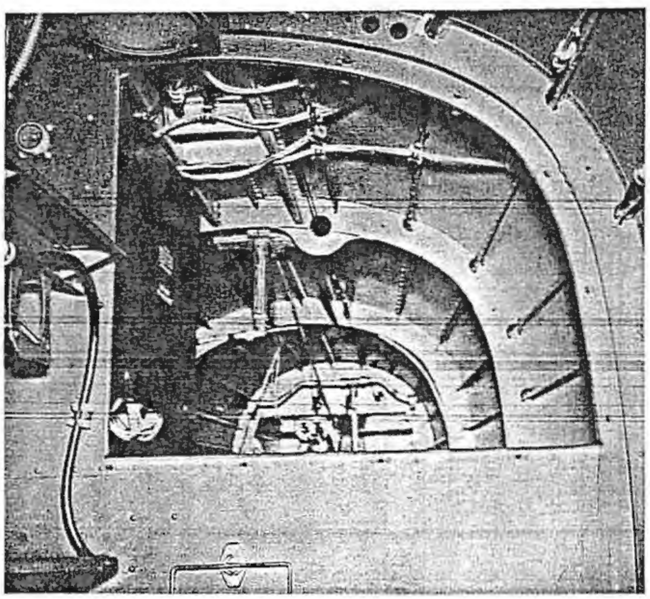


Figure 2-3. Tail Compartment Access

2-14. LAVATORY COMPARTMENT.

2-15. DESCRIPTION. The lavatory compartment is located between Bulkheads 9 and 10. The right side of the compartment contains shelves holding radio equipment. The left side is furnished with a chemical toilet, which is vented through the left side of the airplane. A relief tube is installed in the forward left hand corner of the compartment. Access is gained through a door in Bulkhead 9.

CAUTION

Areas of the skin which are affected by spray from the relief tube venturi must be coated with a clear lacquer (Specification TT-L-58) and shall be rinsed with clean water after each flight.

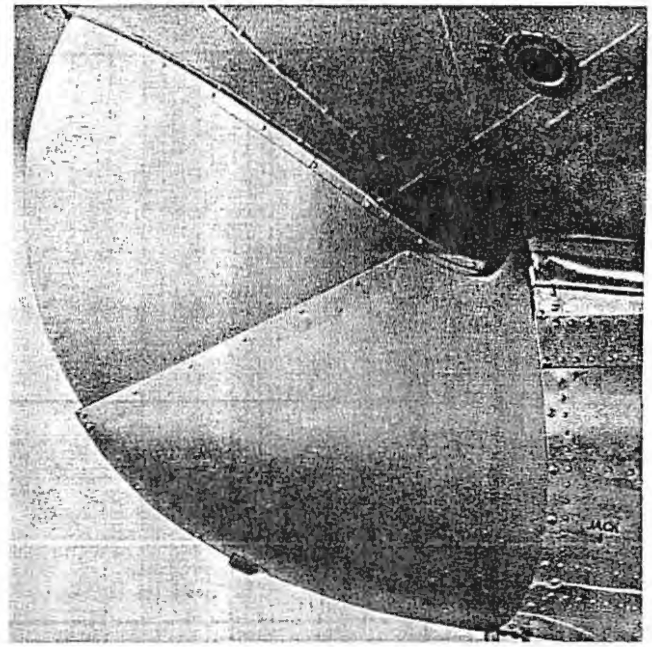


Figure 2-4. Tail Cowling

2-16. TAIL COMPARTMENT.

2-17. DESCRIPTION. The tail compartment extends from Bulkhead 10 to Bulkhead 15. The rear radio junction box is located on the right side of the compartment. The compartment also houses the aft portions of the elevator control cable assembly, elevator tab cables, rudder cable assemblies, rudder tab cables, and tail wheel retract cables. The compartment is large enough to provide room for a workman to perform repairs. A removable panel in the upper half of Bulkhead 10 provides access to the compartment (figure 2-3).

2-18. TAIL COWLING.

2-19. DESCRIPTION. The tail cowling (figure 2-4) consists of an inner and outer cowl, the outer attached to the fuselage, and the inner to the elevator. The tail cowling streamlines the fuselage and covers the elevator bell crank and link rod.

2-20. REMOVAL OF TAIL COWLING.

a. Remove the machine screws holding outer cowl to fuselage and remove cowl.

b. Remove the machine screws holding the inner cowl to the elevator assembly and remove cowl.

2-21. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs consist of replacement of the felt strip around the upper part of the outer cowl. A thin coating of grease (figure 1-25) should be applied to the outer surface of the inner cowl at each postflight nearest 25 hours.

INSPECTION CRITERIA FOR ONE PLY NON-PRESSURIZED PLASTIC PANELS

	CRITICAL VISION AREA		CRITICAL STRESS AREA		SEMI-CRITICAL VISION & STRESS AREA	
DEFECTS	REPARABLE	PERMISSIBLE	REPARABLE	PERMISSIBLE	REPARABLE	PERMISSIBLE
NICKS, DENTS, ETC.	None					
Length		.250 inch max.	.250 inch max.	.125 inch max.	.250 inch max.	.125 inch maximum
Width		.125 inch max.	.100 inch max.	.115 inch max.	.100 inch max.	.016 inch maximum
Depth		.020 inch max.	1/2 Sheet Max. Thickness	.030 inch max.	3/4 Sheet Max. Thickness	.040 inch maximum
Frequency		2 per area max.	2 per sq. ft. area max.	1 per sq. ft. area max.	2 per sq. ft. area max.	1 per sq. ft. of area max.
SCRATCHES	Repair must cause no impairment in optical characteristics.					
Length	5.00 in. per area max.	5.00 per in. max.	10 in. per area max.	.250 in. max.	24 in. max.	24 inch maximum
Width	.02 inch max.	.02 inch max.	.02 in. max.	.020 in. max.	.05 in. max.	.02 inch maximum
Depth	.02 inch max.	.01 inch max.	.05 in. max.	.040 in. max.	.05 in. max.	.01 inch maximum
Frequency	5.00 in. per area max.	1 per area - hairline scratches .001 or less in any amount provided vision is not affected or glare is not increased.	10 in. per area max.	1 per sq. ft. of area max.	20% of total area max.	Total length 3 times longest dimension of area maximum.
CRACKS	None Allowable	None Allowable	None Allowable	None Allowable	All cracks shall be stop drilled	
Length					12 in. max.	2 inch maximum
Frequency					WIDTH .05 in. max. Repaired area 10% area maximum.	.02 in. maximum, 6-2 in. max. length or 12 in. total per area.

Figure 2-5. Inspection Criteria for Plexiglass Panels (Sheet 1 of 2 Sheets)

INSPECTION CRITERIA FOR ONE PLY NON-PRESSURIZED PLASTIC PANELS (CONT)

	CRITICAL VISION AREA		CRITICAL STRESS AREA		SEMI-CRITICAL VISION & STRESS AREA	
DEFECTS	REPARABLE	PERMISSIBLE	REPARABLE	PERMISSIBLE	REPARABLE	PERMISSIBLE
CRAZING	None Allowable	None Allowable	None Allowable	None Allowable	None Allowable	Slight 25% of area maximum. Severe 5% of area maximum.
Area						
DIS-COLORATION	None Allowable (Not Reparable)	May extend 1 in. from entire edge area. Blemishes less than 1 in. dia. or those which don't individually affect vision.	None Allowable (Not Reparable)	May extend 1 in. from entire edge area.	None Allowable (Not Reparable)	May extend 1 inch from the entire edge area.

AREA CRITICAL VISION	DEFINITION
PILOT'S	The entire transparent portion of the windshield front and side panels with the exception of one inch border are considered critical vision areas.
CRITICAL STRESS	The portion of the plastic enclosure that supports or carries the installation load of the assembly. This area includes the region on the transparent assembly directly above the latch or roller position and within a radius of five inches from the top of the edge attachment on a line passing through the latch or roller position and perpendicular to the horizontal through that position.
NON CRITICAL	All areas not designated as critical vision or critical stress areas.
	NOTE In all cases of overlap, the critical vision area has preference over the critical stress and non critical areas; the critical stress area has preference over non critical areas.

Figure 2-5. Inspection Criteria for Plexiglass Panels (Sheet 2 of 2 Sheets)

NOTE

Should it become necessary to replace the felt strips, use AN456AD4-5 rivets, to provide ample clearance between outer and inner cowl. Rivets must be installed with the manufactured heads toward the inner cowl.

2-22. INSTALLATION OF TAIL COWLING.
a. Place inner cowl in position on the elevator assembly and install attaching screws.
b. Fasten the outer cowl to the fuselage with machine screws.
c. Move the elevator up and down to check for binding. If necessary, loosen the machine screws attaching the outer cowl to the fuselage and adjust the cowl slightly to obtain clearance between the two cowls. Re-tighten screws.

2-23. PILOT'S COMPARTMENT SLIDING WINDOW.

2-24. DESCRIPTION. The pilot's compartment sliding windows consist of two glasses, one on the pilot's and one on the copilot's side. Each glass slides in an upper and lower felt channel, and is equipped with a spring-locked latch to hold it in the desired positions.

2-25. REMOVAL OF SLIDING WINDOWS.
a. Remove the lower channel attaching screws.
b. Pull glass and lower channel inward until glass is free of upper channel and remove glass from lower channel.

2-26. INSTALLATION OF SLIDING WINDOWS.
a. Place lower channel on glass. Place upper edge of glass in upper channel and push up and outboard until glass and lower channel are in place.
b. Replace screws and nuts and tighten.
c. If the forward vertical channel seat leaks or becomes damaged, scrape out all old sealer and proceed as follows:
1. Mix 1 part of Minnesota Mining and Manufacturing Company EC 807 Catalyst with 10 parts of EC 755 sealer by weight (Specification MIL-C-2869).

NOTE
The catalyst and sealer must be weighed accurately with a balance. Mix thoroughly to prevent soft spots in the cured finish.

2. Fill vertical channel with cement, packing firmly.
3. Coat front edge and forward sides of window with grease and push glass forward into channel to form groove in sealer.
4. Allow 24 hours for sealer to cure, then trim excess sealer flush with channel and clean window.
d. The latch assembly, or the glass only, may be replaced by first cementing the latch channel onto the glass. Clean channel of old sealer. Use cement as mixed in step c above and proceed as in steps a, b, and c.

2-27. CLEANING AND MAINTENANCE OF ACRYLIC PLASTIC WINDSHIELDS AND WINDOWS.
a. Clean exterior surfaces of the windshield and windows by removing loosely adhering dust and grit by dusting the surface lightly with a soft clean cloth. Do not wipe the surface with a dry cloth.
b. Flush with plenty of water, using the bare hand gently to feel and dislodge any dirt, salt or grit.
c. Wash with a mild soap and water solution. A soft cloth, sponge or chamois may be used in washing, but only as a means of carrying soapy water to the plastic. Go over the surface only with the bare hand so that any dirt or grit can be quickly detected and removed before it scratches the plastic surface. Rinse with clean water.
d. Dry with a clean damp chamois, preferably. However, a soft clean cloth or soft tissue may be used if care is taken not to continue rubbing the plastic after it is dry.
e. Aliphatic Naphtha, Federal Specification TT-N-95 or Shell Solvent T-S-1 shall be used when a petroleum solvent is required for removing tar, grease or wax from transparent plastics.

WARNING

Aliphatic naphtha and most all solvents are highly volatile and flammable; therefore, extreme care shall be exercised in using this material.

f. If after removing dirt and grease, no greater amount of scratching is visible, the plastic should be waxed. The wax will fill in minor scratches and help prevent further scratching. Polishing Wax, Specification MIL-C-18767 should be applied in a thin even coat and brought to a high polish by rubbing lightly with a soft dry cloth, such as canton, outing flannel or flannelette. Cheesecloth is not an acceptable cloth.

2-28. CLEANING INTERIOR SURFACES.
a. Dust the plastic surface lightly with a soft clean cloth. Do not wipe the surface with a dry cloth. After dusting, wipe carefully with a soft damp cloth or sponge. Keep the cloth or sponge free from grit by rinsing frequently in clean water. Dry with damp chamois or soft tissue.
b. Apply wax as required.

2-29. MAINTENANCE AND REPAIR OF ACRYLIC PLASTICS.
a. Maintenance and repair of acrylic plastics will be in accordance with the instructions contained herein and T.O. 1-1A-12.
b. Inspection criteria for acrylic plastics is contained in figure 2-5, Sheet 1 and Sheet 2, and may be used as a guide in the inspection and maintenance of acrylic plexiglass as used in the C-45 series aircraft.

2-30. WING GROUP.

2-31. CENTER SECTION.

2-32. DESCRIPTION. The primary structure of the center section consists of a single, welded tubular truss of heat treated, steel (figure 2-6). It carries the fittings for the landing gear, engine mounts, and outer wing panel main spars. The remainder of the center section structure is composed of aluminum-alloy ribs, bulkheads, stringers, and skin. The rear spar is a shear beam and supports the center and inboard flap hinges. Removable panels are provided for the fuel tank and battery compartments.

NOTE

Due to the stressed skin construction of the airframe and the heat-treated main truss, repairs should be accomplished only at a designated overhaul activity.

2-33. ENGINE NACELLES.

2-34. DESCRIPTION. The engine nacelles house the engine mounting structures and landing gear. They are integral parts of the center section. The bottom part of each nacelle is equipped with automatically-operated doors which enclose the landing gear when it is retracted.

2-35. OUTER WING PANEL.

2-36. DESCRIPTION. The outer wing panels (figure 2-7) are constructed with single, load-carrying front spars. Rear spars transfer the shear load between the upper and lower spar fittings with specially tapered spar bolts and special nuts. A special bolt and nut also secures the wing panel rear spar to the rear spar of the center section wing stub. A fairing strip, riveted to the outer wing panel skin and attached to the center section skin with machine screws and elastic stop nuts, is installed over the gap between the wing panel and center section. A removable cover plate, for easy access to the top forward main spar fittings, is installed on the outer wing panel on the upper surface (figure 1-4).

2-37. REMOVAL OF OUTER WING PANEL.

a. Remove wing flap. Refer to paragraph 2-60.

b. Disconnect aileron control cables at turnbuckles in wheel well and remove clevis pin from aileron pulley brackets mounted on the truss.

CAUTION

Stow aileron cables carefully in order to avoid damage to the wing panel and wing stub when the outer panel is removed.

c. Disconnect aileron tab cables at turnbuckles in rear center section just forward of rear spar (left wing only). Turnbuckles are accessible by removing the fabric patches covering the lightening holes in the rear spar at the inboard section of the wing.

d. Disconnect electrical wiring at the disconnect plug in the outer wing root rib located just forward of the center section truss inside the nacelle.

NOTE

On aircraft equipped with deicer boots, the boots must be removed before removing the wing panel, unless suitable wing dolly is at hand.

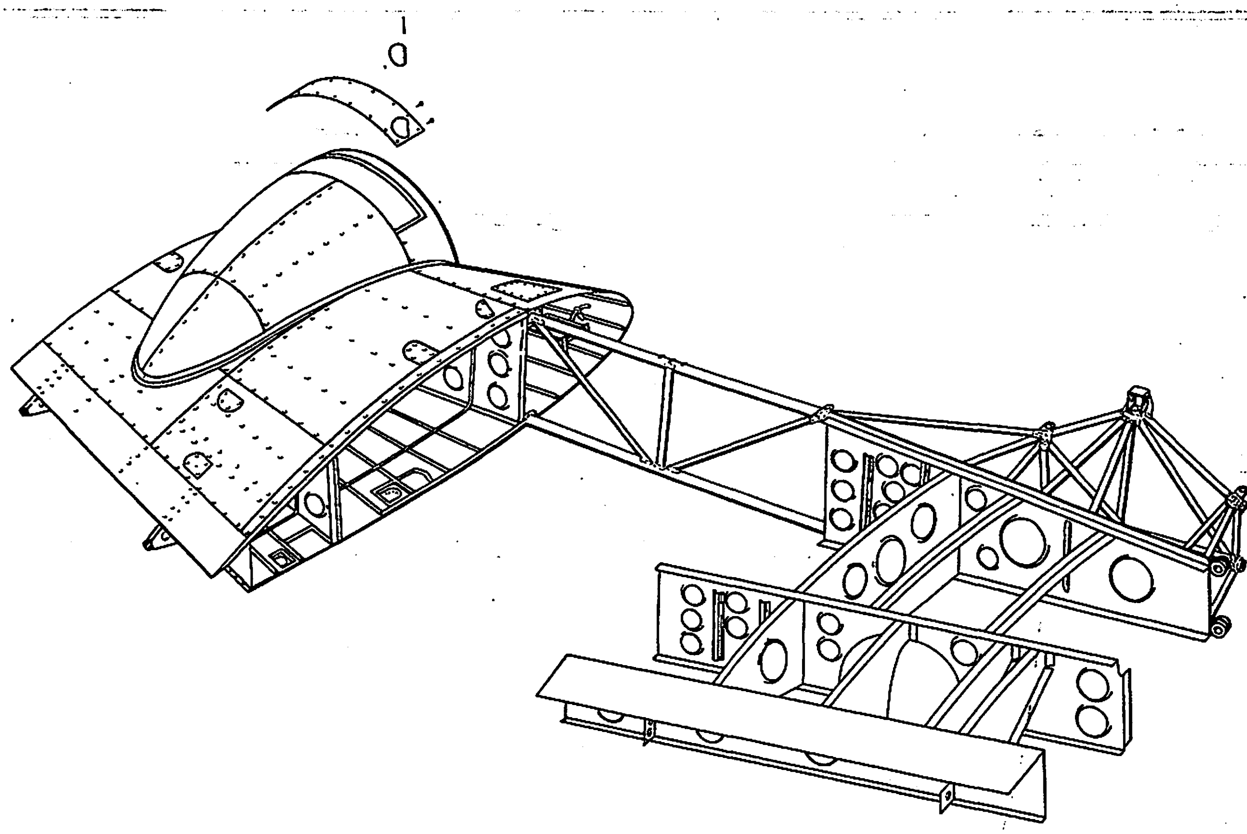


Figure 2-6. Center Section Wing

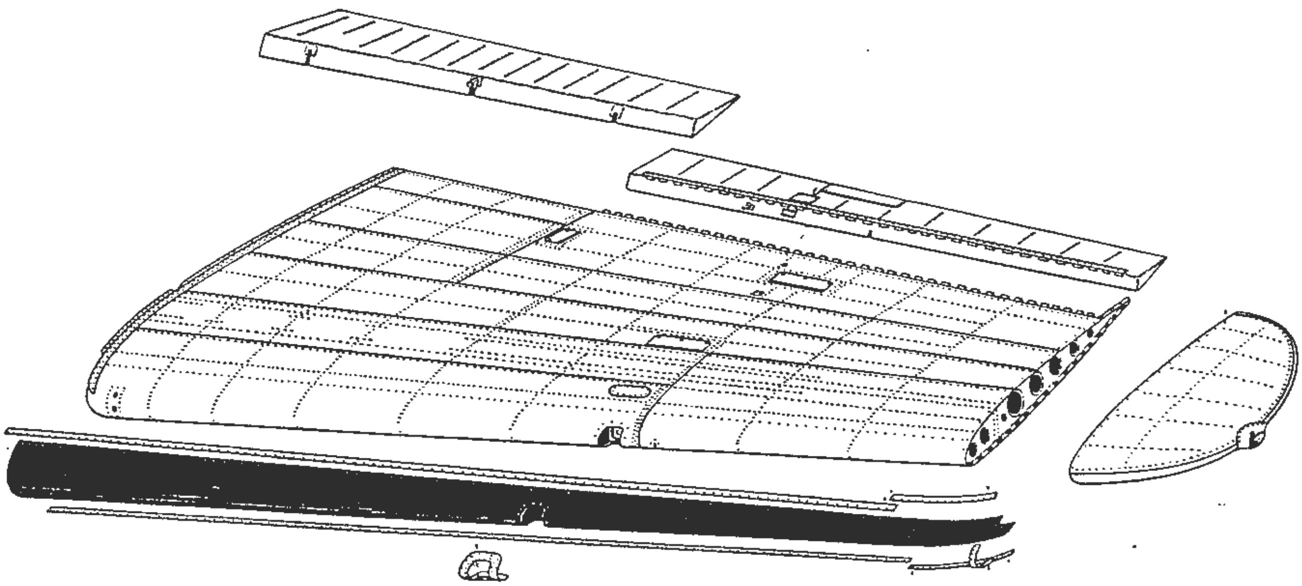


Figure 2-7. Outer Wing Panel and Tip

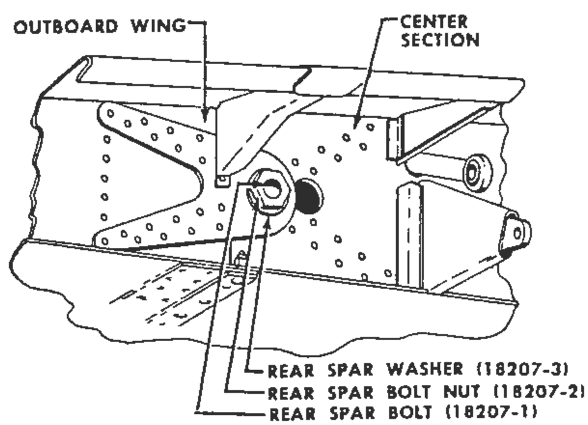


Figure 2-8. Rear Spar Fittings

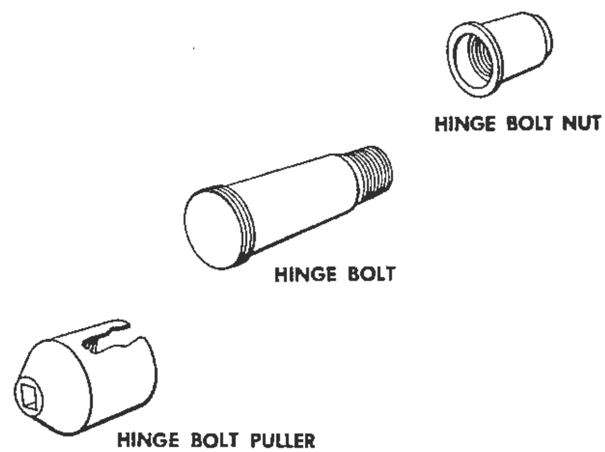


Figure 2-9. Wing Hinge Bolt, Puller and Nut

e. Disconnect deicer boot tube connections in nacelle near aileron pulleys.

f. Remove leading edge fairing by removing the machine screws from outer wing panel and nacelle skin.

g. Remove machine screws from the gap strip between outer wing panel and center section.

CAUTION

Support the outer wing panel prior to removing wing. If wing is to be removed by hand, use no less than five men; two at the wing tip and three at the wing root. If a sling and hoist are used to support the wing, position the sling on the wing ribs to avoid damage to the wing skin.

h. Remove the rear spar bolt and nut. See figure 2-8.

i. Loosen the nuts on the upper and lower front spar bolts, located inside the nacelle. Break loose the spar bolts with a spar bolt puller, Beech Aircraft Part 182061 (figure 2-9), and then remove the nuts.

j. Remove wing by slipping it clear of center section.

NOTE

The front spar bolts pass through replaceable bushings in the center section truss and outer wing spars. The bushings are taper-reamed to a close fit. If it becomes necessary to re-

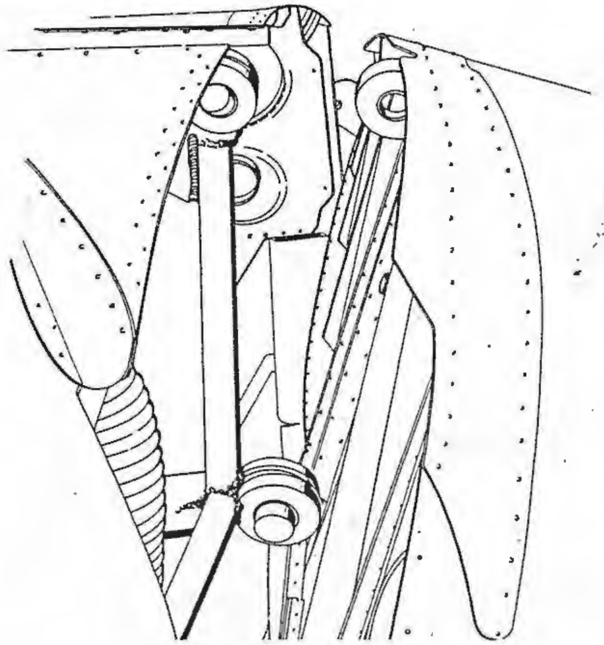


Figure 2-10. Wing Fittings

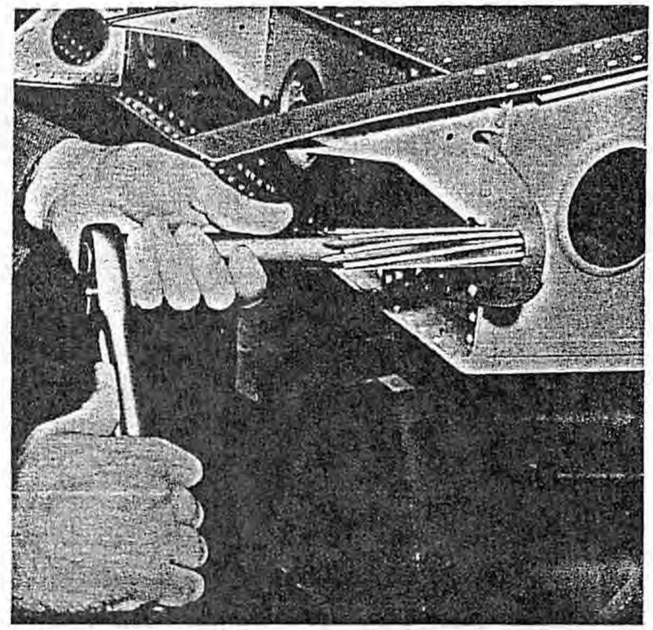


Figure 2-11. Reaming Aft Wing Spar

place the outer wing panel with a new one or if the bushings are damaged and require replacement, the new bushings must be reamed.

2-38. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs only may be made by line personnel. Major repairs to the skin and ribs should be accomplished only at a designated overhaul activity, because of the stressed skin construction of the outer wing panel.

2-39. WING FITTING.

2-40. When a wing is to be installed (figure 2-10) on an aircraft other than the one it was originally on, it will be necessary to replace the bushings in both the center section truss and the main wing spar. Proceed as follows:

a. In the center-section truss, the bushings are press fit and can be driven out. Do not remove the 1/8-inch pin in the fittings. Replace the old bushings with new bushings (Beech Part 184214). These bushings are to be pressed in securely.

b. The bushings in the wing spar are also a press-fit and can be driven out. Replace the old bushings with new ones (Beech Part 181417). After the new bushings are pressed in, relocate the pins used to prevent the bushings from turning while the reaming operations are being performed. This can be done by drilling the No. 31. (0.120) hole in a new location and driving the pin in. The pins are 1/2-inch long and are made from 1/8-inch diameter steel welding rod.

2-41. REAMING OPERATION.

2-42. After the new bushings are installed proceed with reaming operation as follows:

a. Check the distance between the wing spar fittings to see that it agrees, within tolerance, with the distance between the fittings on the center-section truss. The difference must not exceed 1/32-inch or the hole will not completely clean out when reamed and the bushing will have to be replaced again.

b. Before installing the wing, the rear spar bracket should be reamed to fit the rear spar bolts (figure 2-11). Use a 15/16-inch to 1-1/16-inch adjustable reamer (2, figure 2-12) and enlarge the hole just enough to start the straight reamer (1, figure 2-12). Care must be taken not to remove too much metal at one cutting and the reamer must be held steady during the operation, to prevent a rough finish in the hole. With the proper size hand reamer (1, figure 2-12) and taking care to guide it properly, finish reaming the hole so that hinge bolt will fit snugly. The reamer must be turned smoothly and steadily, and fed with an even pressure. If the surface is left rough, vibration will soon necessitate rework.

CAUTION

Take extreme care that the correct size reamer is used and the hole is not reamed too large. An oversize hole will necessitate the replacement of the "V" splices on the rear spar.

CAUTION

Lift only on ribs and spars.

c. Employing no less than five workmen, install the wing in position for reaming. Two workmen should be at the tip of the wing and three at the root end. One of the latter should face the leading edge and one at the trailing edge, both near the root rib, and lift with their hands; the other person at the root end can stoop over, let the wing rest against his back, and

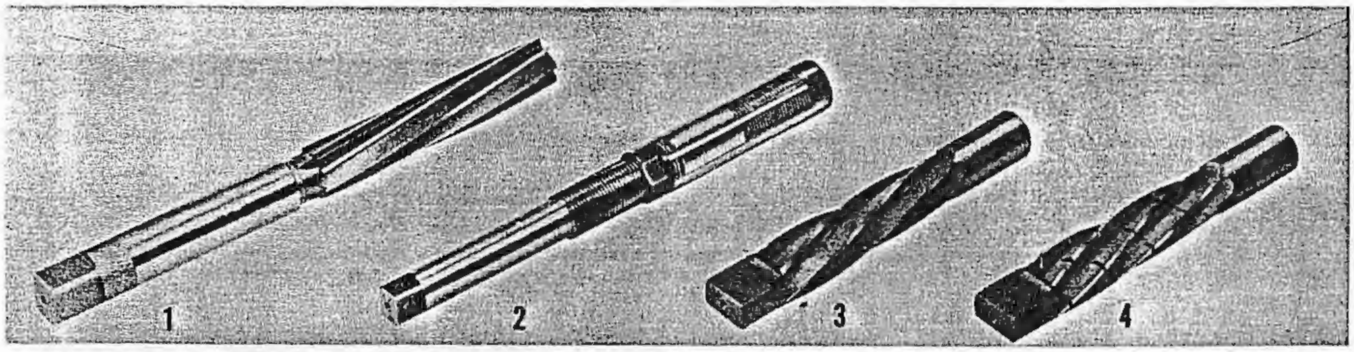


Figure 2-12. Wing Hinge Reamers

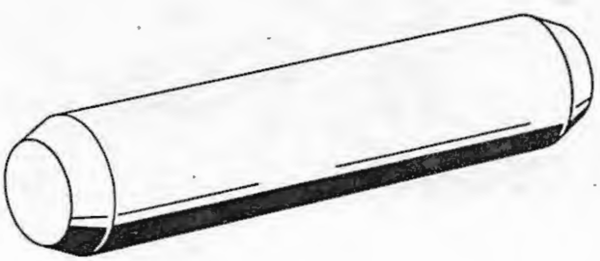


Figure 2-13. Temporary Hinge Pin

lift with his legs and arms by bracing his hands above the knees.

NOTE

When jacking the airplane, use suitable jacks with locking features to prevent creeping. Make sure the airplane is perfectly solid before reaming is started.

d. Align the lower spar fittings and insert the temporary hinge pin (figure 2-13) in lower spar fitting.

NOTE

The temporary pin is 15/16-inch in diameter, beveled at both ends, and can be inserted from inside the nacelle.

e. This pin will now totally support the root end of the wing, allowing the workman at the leading edge to guide the gap strip on the upper surface of the wing over the wing stub skin by inserting a strip of metal about 4 inches wide between the wing stub skin and gap strip (figure 2-14). The workman at the root end trailing edge will, at the same time, help take care of the top guide strip and bottom gap strip. The two workmen at the tip will remain there to raise it in position and the man in the nacelle will remain there to install the upper pin and see that nothing binds or is damaged while the wing is being raised into position.

f. Raise the wing slowly until the upper fittings align, carefully watching the gap strip and rear spar to see that everything is going in its proper place. Remove

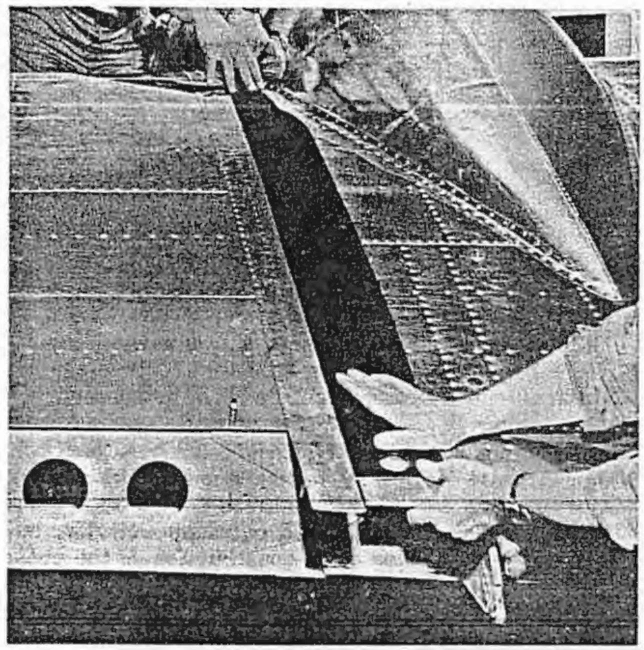


Figure 2-14. Guide Strip In Place

guide strip, install the temporary top pin and the rear spar bolt.

g. Install a tripod wing jack (figure 2-15) or a tall aircraft jack at the mooring lug location on the outer wing panel. Remove the mooring lug and install the jack in its place. Adjust the wing stand so the weight of the wing is resting on it.

h. With the wing stand in position under the wing, remove the lower main spar temporary pin. Re-adjust the wing stand, if necessary, to align the holes as closely as possible. An adjustable reamer, size 15/16-inch to 1-1/16-inch (2, figure 2-12) will be necessary to make the hole large enough to allow the pilot of the tapered reamer to enter. If only minor irregularities are present and if there is not over 1/32-inch misalignment vertically, the hole probably will clean out satisfactorily. This operation will require extreme care, because once a reamer is started improperly due to a misaligned hole, it rarely is possible to straighten it out and make a clean hole.

i. The actual reaming operation is started with a "rough" reamer (4, figure 2-12) which is a reamer, sharpened primarily for cutting and not to produce a smooth finish. The rough reamer is used until the shoulder on the small end of the hinge bolt lacks approximately 1/4-inch of being flush with the front surface of the bushing.

j. Observe the following precautions:

1. It is important that "chatter marks" should not be allowed to develop, since once they occur, the condition tends to become worse. Generally, the best way to remove "chatter marks" is to use more pressure on the reamer and slow steady turning.

2. The air-driven "Power Vane" is preferred to operate the reamer (figure 2-16). A steady pressure is applied to feed the reamer into the work. However, hand methods, using an extension handle on a hand ratchet wrench, with the proper adapter to fit the reamer, will suffice if a "Power Vane" is not available.

3. Keep reamers well lubricated with cutting oil, Specification CC-800.

4. Reamers must be removed to clean cuttings from hole at frequent intervals. Cuttings in the hole will reduce the efficiency of the reamer and slow up reaming operations. Before removing the reamer from the hole, the pressure and speed must be reduced gradually to prevent marking of the bushings.

5. All reaming operations are done from the aft side.

k. Change to the finishing reamer (3, figure 2-11) to give a smooth surface in the hole. This reamer is used until the shoulder on the tapered end of the wing hinge bolt is flush with the front surface of the bushing. The bolt may extend through, past the surface of the fitting as long as there is clearance between the bolt head radius and the bushing. The bolt head radius must not be allowed to bear on the bushing.

l. Clean out the hole, making sure all cutting oil and cuttings are removed. To check the bolt for proper fit and bearing surface, put a very thin coat of Prussian (bearing) blue or similar substance on the surface of the bolt. Then place the bolt in the reamed hole and hit the bolt a solid blow with a rawhide mallet. Remove so as not to disturb the blue coating. The blue coating will show where the bolt came in contact with the spar. If there is less than 85% of the surface touching, additional reaming must be done to provide adequate bearing surface.

NOTE

After proper bearing surface has been obtained remove blueing from bolt by washing in solvent (Specification P-S-661). Blow dry and sprinkle with powdered graphite.

m. If the fit is satisfactory, insert the bolt, install the nut and tighten it snugly to prevent the bolt from accidentally coming out.

n. Repeat steps (i), (j), (k), (l), and (m), on the top wing fitting.

o. Check and mark gap strip and stub skin for the trimming necessary to have the proper clearance between the wing and the stub. The wing root rib must clear the wing stub by approximately 1/8 inch, both top and bottom.

p. Using the 1/4-inch holes in the center section stub as guides, drill 11/64-inch holes through gap strip for installation of screws.

q. Remove the spar bolts and remove the wing. Trim the stub and wing to proper marks, as mentioned in step (o) keeping the proper edge distance in mind.

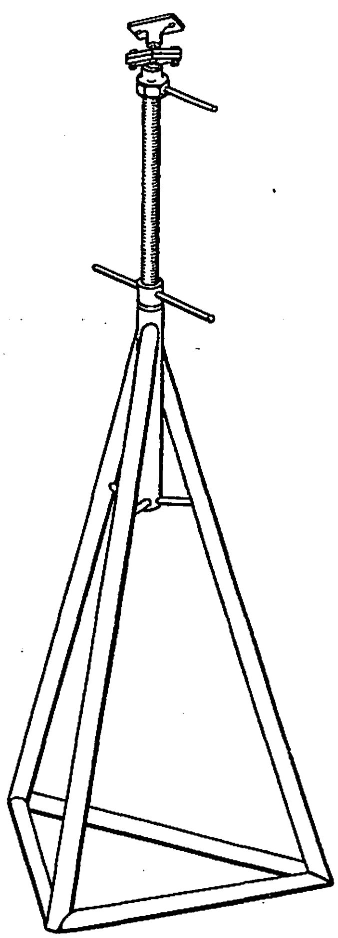


Figure 2-15. Tripod Wing Stand

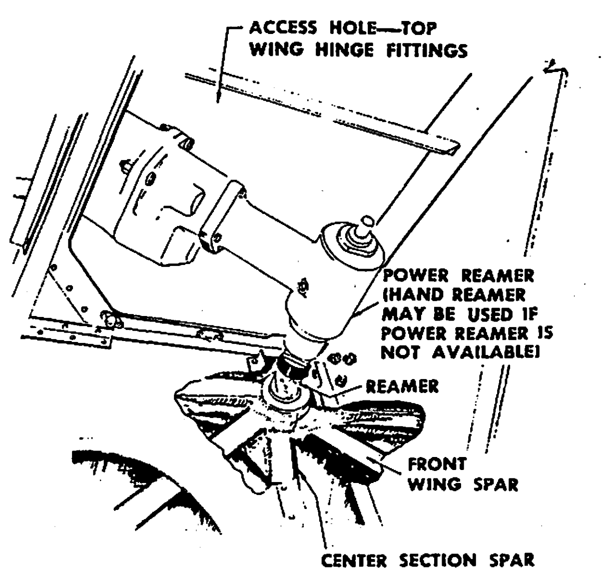


Figure 2-16. Reaming Center Section Truss Fittings

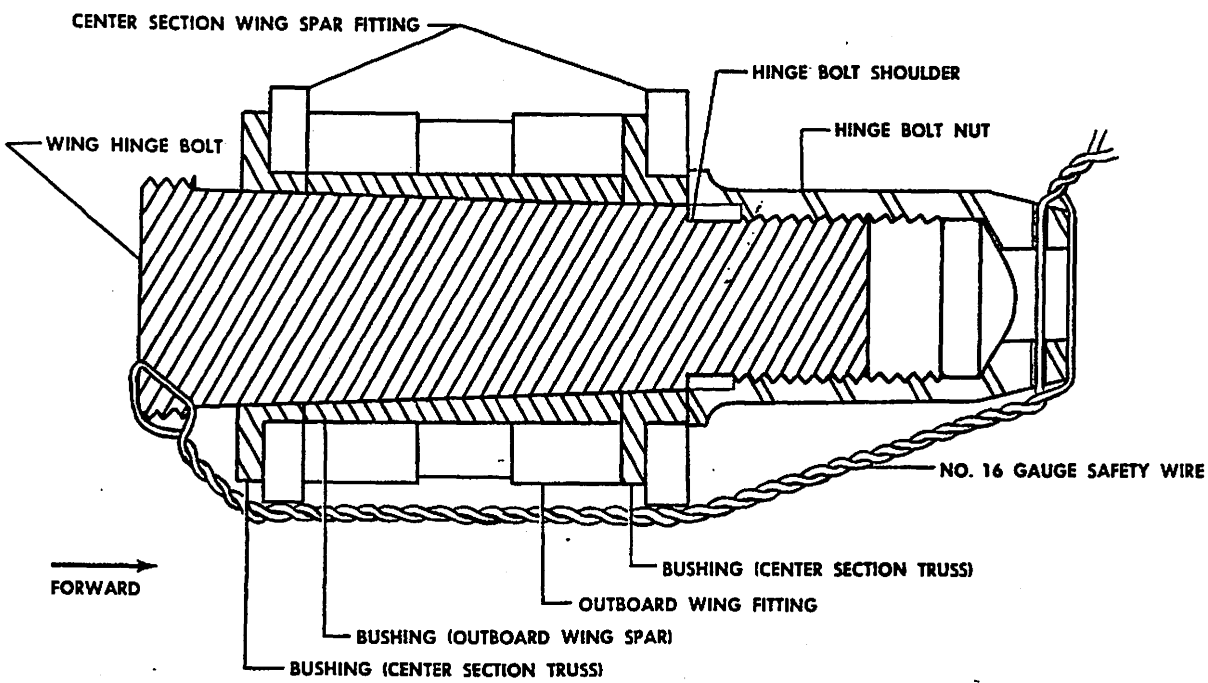


Figure 2-17. Cross Section of Wing Mounting Bushings and Fittings

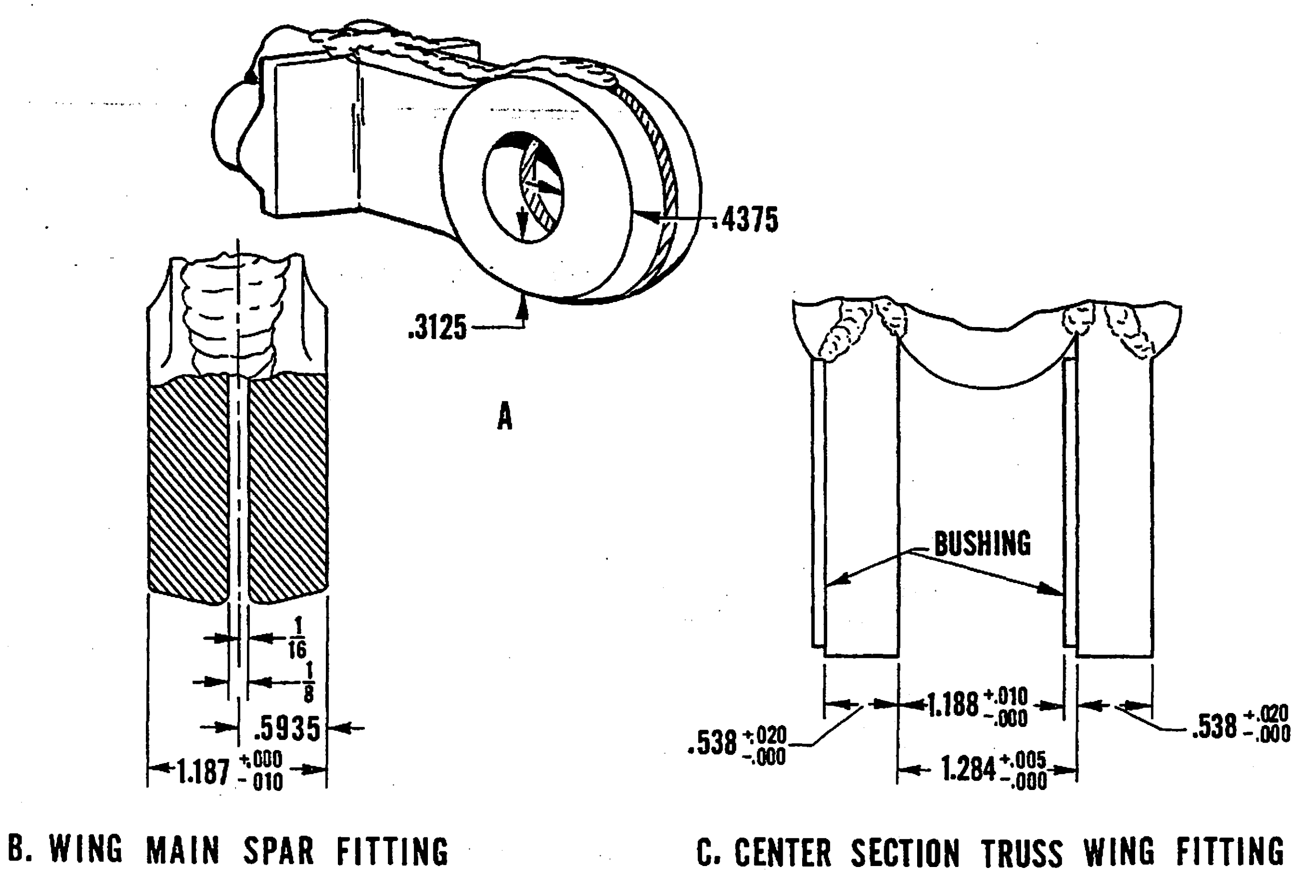


Figure 2-18. Wing Fitting Dimensions

2-43. OVERSIZE BUSHINGS. Upon removal of the outer wing panel, or when it is known or suspected that incorrect or over-reaming may have enlarged the wing fitting holes in the center section truss or outer wing main spar, the old bushings must be removed and the holes checked for enlargement. It is well to remember that these fittings are vital to the safety of the airplane and its occupants; therefore, the following procedures must be strictly adhered to. Special oversize bushings, Parts MRB A24491 and MRB A24492, have been developed as replacements for oversize wing fittings.

2-44. INSTALLATION OF OVERSIZE BUSHING IN CENTER SECTION TRUSS WING FITTING. The following procedure is intended for use on airplanes having center section truss wing fittings of the same dimensions as shown in view C, figure 2-18. Under no condition should this procedure be used on airplanes which have fittings of dimensions less than those shown in view C, unless a thorough stress analysis of the fittings is made. Install the oversize bushing as follows:

a. Check the center section truss fitting to determine if the holes are oversize. Holes over 1.251 inches in diameter are oversize and oversize bushings must be installed.

b. Ream oversize hole to 1.281 plus 0.000 minus 0.001.

c. Check the center section truss fitting wall thickness (0.4375 and 0.3125) (view A, figure 2-18). Note that the outer surface of the wing fitting is forged at an angle. Measure the wall thickness on the side having the lesser thickness.

WARNING

The dimensions (0.4375 and 0.3125) shown in view A, figure 2-18 are extremely critical. If the wall thickness is less than that specified, failure of the wing fitting may occur in flight. If, after reaming, the wall thickness is less than that specified, a thorough stress analysis of the fitting must be made to determine if it can be used. If the fitting is unserviceable the entire outrigger section of the truss must be replaced.

d. If the wall thickness is correct (view A, figure 2-18), install the special oversize bushing, Part MRB A24491.

e. Position the outer wing panel for reaming and ream wing fittings.

f. Remove wing; check the center section truss and outer wing panel main spar fitting holes for correct reaming, following exactly the procedure outlined in paragraph 2-42 steps k and l.

2-45. INSTALLATION OF OVERSIZE BUSHING IN OUTER WING PANEL MAIN SPAR FITTING. The following procedure is intended for use on airplanes having outer wing panel main spar fittings of the same dimensions as shown in view B, figure 2-18. This procedure is not to be attempted on airplanes having fittings of dimensions less than those shown in view B, unless a thorough stress analysis of the fittings is made. Install the oversize bushing as follows:

a. Check the spar fitting holes. Holes over 1.250 inches in diameter are oversize and special oversize bushings must be installed.

b. Ream the oversize hole to 1.273 plus 0.0005 minus 0.001.

c. Check the wing fitting wall thickness (0.4375 and 0.3125) (view A, figure 2-18). Note that the outer surface of the fitting is forged at an angle. Measure the thickness of the fitting on the side having the lesser thickness.

WARNING

The wing fitting dimensions shown in view A, figure 2-18 are extremely critical. If the thickness of the fitting is less than that specified, failure of the fitting may occur in flight. If, after reaming, the wall thickness is less than specified, a thorough stress analysis of the fittings must be made to determine if the fittings can be used. If the fittings are found to be unserviceable, the outer wing panel main spar must be replaced.

d. If the wall thickness is correct (view A, figure 2-18), install the oversize bushing, Part MRB A24492.

e. Position wing for reaming and ream wing.

f. Remove wing and check the holes in the wing panel and center section truss for correct reaming, following exactly the procedure outlined in paragraph 2-42, steps k and l.

2-46. INSTALLATION OF OUTER WING PANEL — AFTER REAMING.

2-47. Thoroughly clean the interior of the wing stub using a vacuum cleaner; check for loose objects that may have been missed by a vacuum cleaner, or other cleaning methods, by shaking the wing. Use no less than five workmen for this operation, two at the tip and three at the root end. Shake the wing up and down a few times, holding the cables taut to prevent their rattling, and listen for loose objects. Be sure lifting pressure to the wing is applied only at the ribs and spars. Then install as follows:

a. Coat the main spar bolts with powdered graphite (Specification MIL-G-6711). Use a small amount of anti-seize compound (Specification JAN-A-669) on the threads of the rear spar bolt.

b. Put the lower wing fitting in place, keeping the wing tip low. With the wing so positioned, the workmen under the spar can get inside the nacelle through the wheel well and install the wing hinge bolt, placing the safety wire hole straight up to facilitate safetying. Strike the bolt solidly with a rawhide mallet so it will stay in place.

c. This bolt will support the root end of the wing, allowing the workmen at the leading edge to guide the gap strip on the upper surface of the wing over the wing stub skin. Insert a strip of metal about 4 inches wide between the wing stub and the gap strip. Raise wing slowly, (constantly watching the gap strip and rear spar to see that everything is going into proper place), until the upper fitting lines up. Remove the guide strip and install the upper hinge bolt

with the safety wire hole down and slightly outboard.
d. Install the rear spar bolt, tighten and safety.
e. Install nuts on the main spar bolts. Tighten them securely and safety. See figure 2-17.
f. Install gap-strip screws. Tighten them and back off one-eighth turn to allow for wing flexing in flight.
g. Install the wing hinge inspection cover and check for a minimum of 1/8-inch clearance between it and the wing root rib.
h. Install the wing nacelle fillet around the leading edge of the wing.
i. Connect deicer boot tubes and connections in nacelle.
j. Connect electrical plugs.
k. Connect and rig aileron cables and aileron tab cables.
l. Replace patches over lightening holes with predoped fabric, Specification MIL-C-5643 using nitrate dope, Specification MIL-D-5554.
m. Install flap and inspect for proper rigging.

2-48. WING TIPS.

2-49. DESCRIPTION. The wing tips (figure 2-7) are of the same general construction as the outer wing panel. They are attached to the outer wing panel by a hinge wire through the front spar and by machine screws through the skin of the wing panel and the wing tip.

2-50. REMOVAL OF WING TIP.
a. Remove wing navigation light. Disconnect electrical wiring at navigation light socket.
b. Remove deicer boot attaching screws on tip and three or four on leading edge of wing and peel the boot back.
c. Remove machine screws which attach the wing tip to the outer wing panel.
d. Remove screws holding wing tip hinge wire cap.
e. While pulling upward on hinge wire, move the wing tip slowly up and down to free the hinge wire.
f. Pull wing tip outward until it is clear of the wing panel.

2-51. MINOR REPAIR AND PARTS REPLACEMENT. Major repairs to the surface and ribs should be accomplished only at a designated overhaul activity, because of the stressed skin construction of the wing tip.

2-52. INSTALLATION OF WING TIP.
a. Place tip into position and mate the hinge at the front spar. Drive hinge wire in, until the bent end of the wire is against the wing skin.
b. Install machine screws through the wing tip.
c. Place cap over hinge wire on wing and install and tighten screws.
d. Connect navigation light wire to socket and install navigation light.
e. Pull deicer boot out on wing tip and install screws removed from outer wing panel and wing tip.

2-53. AILERONS.

2-54. DESCRIPTION. The ailerons (figure 2-19) are constructed of aluminum alloy, with fabric covering. The box type spars are placed as far ahead of the hinge line as possible. The ailerons are attached to the wing with music wire hinge pins.

2-55. REMOVAL OF AILERON.
a. Disconnect the aileron actuating link by removing the bolt attaching the link to the aileron.
b. For the left hand aileron only, disconnect aileron

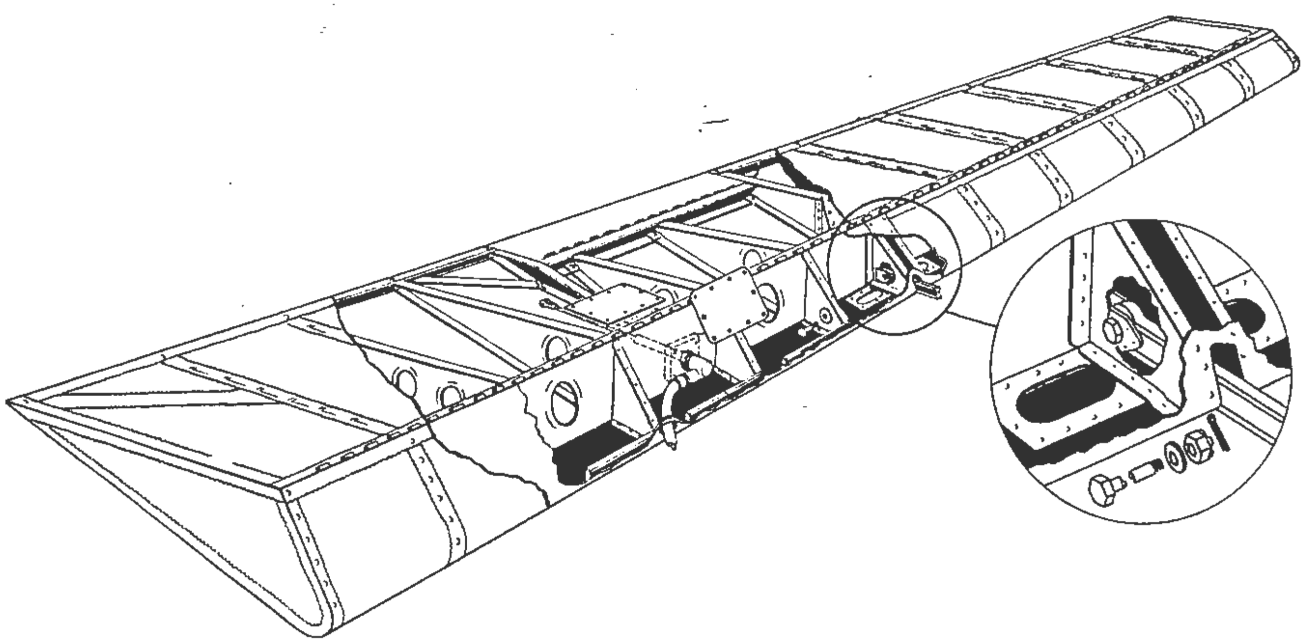


Figure 2-19. Aileron Assembly

tab flexible drive from the 90-degree drive in the wing panel. Detach protective boot from flexible drive.

c. Disconnect bonding straps at the inboard and outboard ends of the aileron.

d. Remove the aileron hinge wire safety lug and remove wire by inserting the end in a drill chuck and rotating and pulling wire at the same time.

e. Remove aileron by slipping it aft until hinges and tab flexible drive are clear of the wing.

2-56. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of replacing the entire aileron assembly and patching small holes or tears in the fabric covering. The patch should be of the same grade fabric, Specification MIL-C-005646, as fabric used to cover the surface and should overlap the edge of the hole or tear a minimum of two inches. Dope patch in place with nitrate dope; Specification MIL-D-5554. Major repairs should be accomplished at a designated overhaul activity.

2-57. INSTALLATION OF AILERON.

NOTE

The steel hinge wires (Specification QQ-W-470) should be used only once. Whenever a hinge wire is removed, a new wire must be used for reassembly. The hinge wires are approximately 116 inches long, and 0.085 inches diameter.

a. Place the aileron in position and mate the hinges.

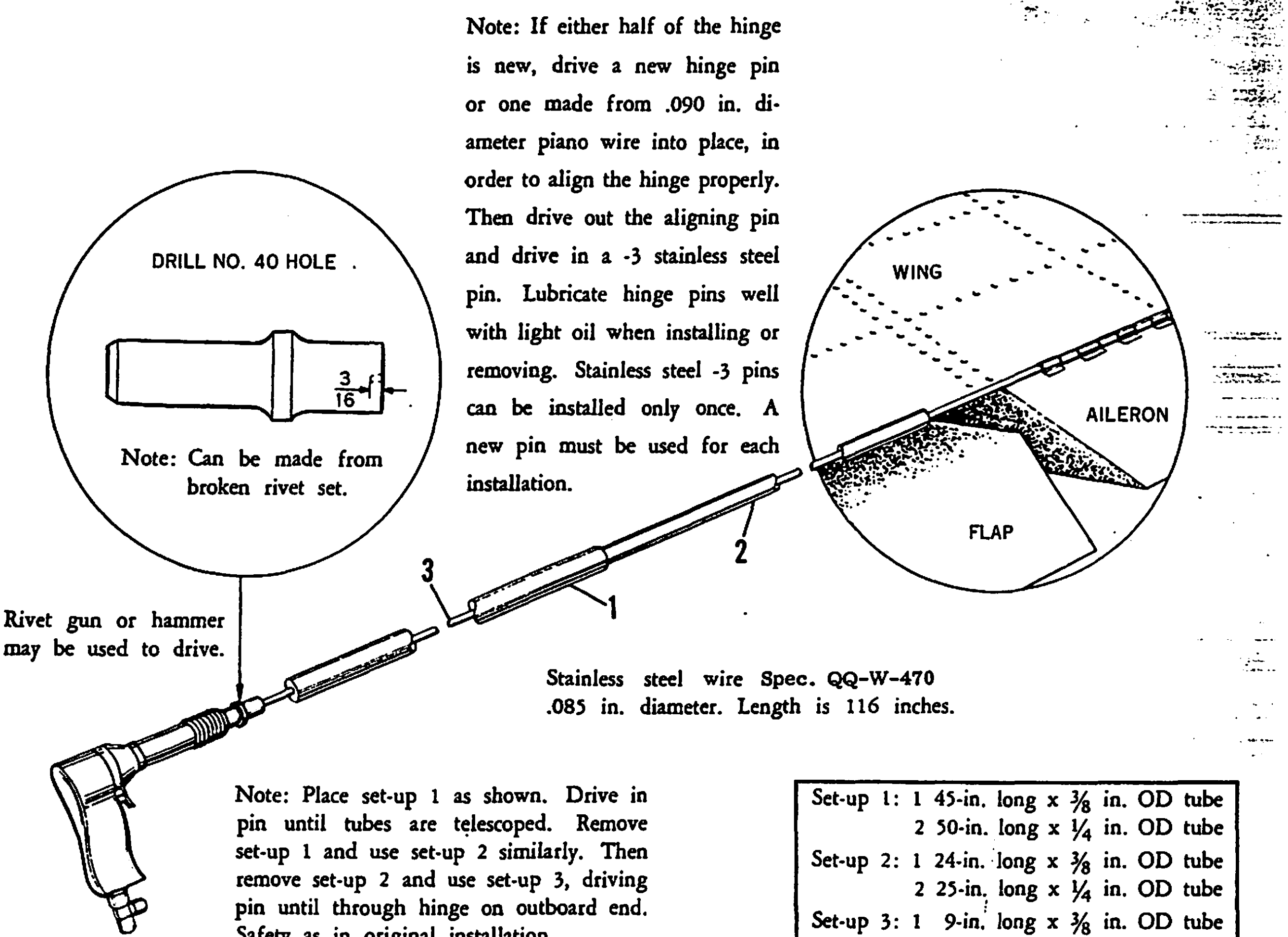
b. Drive in aileron hinge wire using a setup as shown in figure 2-20.

NOTE

If either half of the hinge has been replaced or if a new aileron or wing (or both) has been installed on the airplane, the hinge loops should be spread and aligned by first installing a wire 0.090 inch in diameter, or an old hinge wire. Then remove and install the new hinge wire.

c. Fit hinge wire into outboard hinge loop and squeeze loop together to secure hinge wire. Fit hinge wire into safety lug at inboard end of aileron (figure 2-21).

d. Connect the aileron tab flexible drive shaft to the 90-degree drive in the wing. Raise the left aileron to the full up travel, pull out the chamois skin protective boot and fasten it around the flexible shaft



Set-up 1:	1	45-in. long x 3/8 in. OD tube
	2	50-in. long x 1/4 in. OD tube
Set-up 2:	1	24-in. long x 3/8 in. OD tube
	2	25-in. long x 1/4 in. OD tube
Set-up 3:	1	9-in. long x 3/8 in. OD tube
	2	9-in. long x 1/4 in. OD tube

Note: All tubing to be .035 gauge.

Figure 2-20. Aileron Hinge Wire Installation

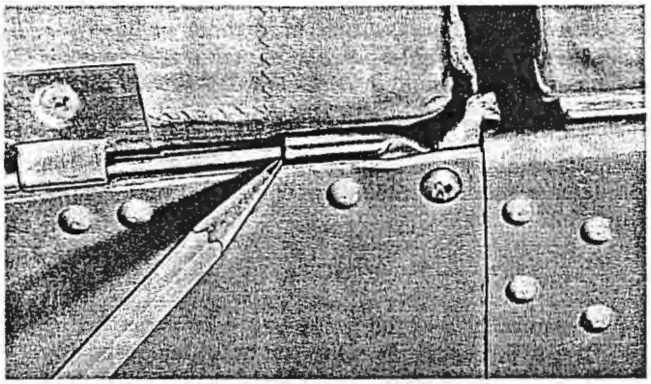


Figure 2-21. Aileron Hinge Wire Safety Lug

with safety wire (0.020-inch diameter). Aileron travel must not be affected by the flexible drive shaft or the boot. Check and set the aileron and aileron tab travel as outlined in paragraphs 2-95 and 2-105.

2-58. WING FLAP.

2-59. DESCRIPTION. The wing flaps (figure 2-22) are constructed of aluminum alloy. The main and nose ribs are attached to a single spar, a rolled section trailing edge, and a metal nose plate. Fabric is used to cover this frame. A metal scuff plate covering the bottom, inboard end of the flap provides protection from exhaust blast and debris thrown by the wheels. The flap extends from the inboard end of the aileron to the fuselage, and is attached to the rear wing spar with three hinge brackets.

2-60. REMOVAL OF WING FLAP.
a. Lower flaps and disconnect actuator.

NOTE

Secure the actuator against accidental turning to prevent throwing the removed flap out of rig with the opposite one.

b. Disconnect bonding straps at inboard and outboard ends of flap by removing attaching screws at the flap.
c. Remove the covers over the bolt access holes on the lower side of the flap and remove the three hinge bolts.
d. Slip flap aft until clear of the aircraft.

2-61. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of replacing the entire flap assembly, flap protector bottom plate assembly, and patching small holes or tears in the fabric covering. The patch should be of the same grade fabric, Specification MIL-C-005646, as fabric used to cover the surface and should overlap the edges of the hole or tear a minimum of two inches. Dope patch in place with nitrate dope, Specification MIL-D-5554. When flap bumper spacers are found missing, apply a new spacer or spacers to the flap rib with EC 870 cement, Minnesota Mining and Mfg. Co, Detroit, Michigan. Major repairs should be accomplished at a designated overhaul activity.

2-62. INSTALLATION OF WING FLAP.
a. Position flap on hinge brackets and insert hinge bolts.
b. Move flap up and down to check alignment and clearance of the brackets with the slots in the flap.
c. If clearance is maintained throughout full travel, install nuts on hinge bolts, tighten and key.
d. Insert bolt attaching the flap actuator screw to the horn on the flap.

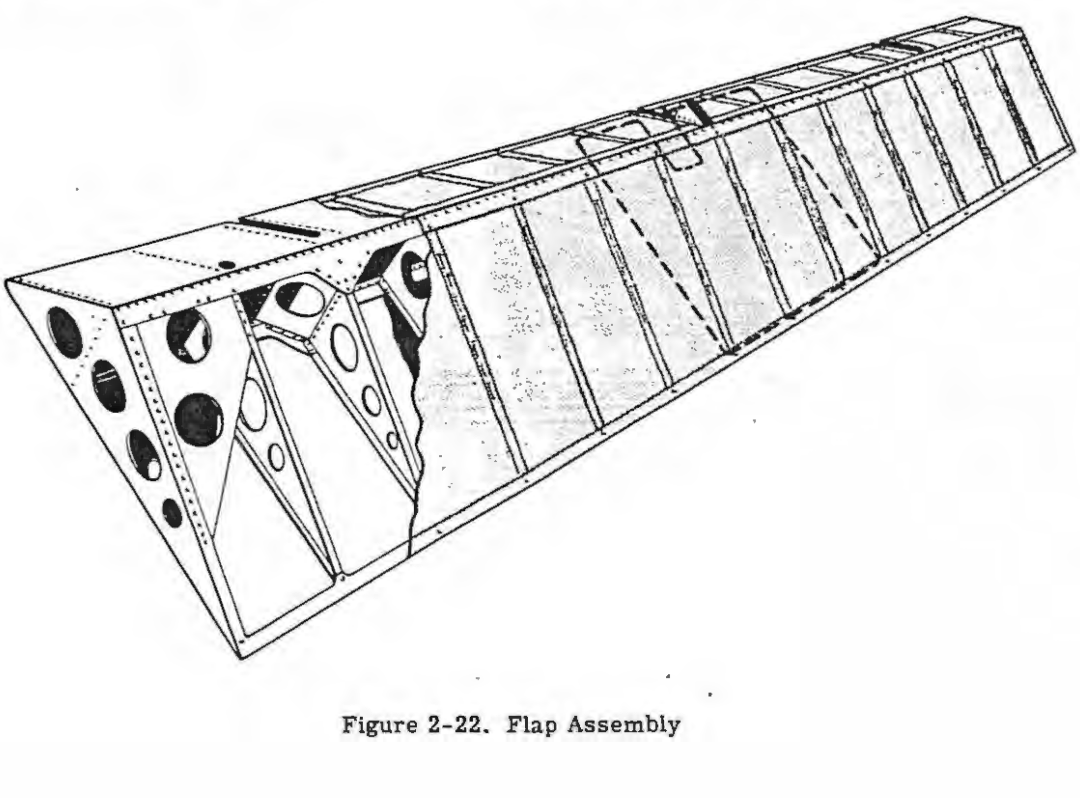


Figure 2-22. Flap Assembly

2-63. RIGGING WING FLAP.

a. Run flap mechanism to the up position with hand crank and then back crank off one-sixth turn.

b. Check the trailing edge of the flap for alignment with the flap fillet at the inboard aft end of the flap and using a contour jig or visually if no jig is available, check for alignment with wing contour.

c. If the flap does not align, adjust actuator screw until flap is in alignment.

CAUTION

Be sure to check actuator screw after adjusting, to make sure it is not bottoming in the actuator or pulling out to the aft end. If evidence of binding can be felt when turning actuator, an adjustment must be made by screwing actuator shaft to relieve the binding and compensating for the change in shaft length.

d. Reinstall actuator bolt. Place a bubble protractor on the flap's surface adjacent to a center rib, and level; run flaps down and check for 45 ± 2 degrees travel.

NOTE

When properly installed and rigged, the flaps in full down position may have a maximum of 1/4-inch play, measured at the inboard, trailing edge of the flap.

e. Install nut and key on actuator bolt, connect bonding straps to inboard and outboard flaps ends, and replace inspection covers, windows and fabricoid patches at the hinge bolts. Apply patches with nitrate dope, Specification MIL-D-5554.

f. Adjust flaps limit switches (see paragraph 2-119).

2-64. TAIL GROUP.

2-65. HORIZONTAL STABILIZER.

2-66. DESCRIPTION. The horizontal stabilizer (figure 2-23) is of a conventional riveted sheet metal construction with two formed sheet metal spars. The elevator hinges are attached to the rear spar, which is reinforced at all hinge attaching points to distribute the hinge loads over a very wide area. The stabilizer is attached to the fuselage by fillister head screws. Two forgings are mounted on the front spar of the stabilizer and matched forgings are mounted on the fuselage. These forgings are bolted together with NAS close tolerance bolts. Fillister head screws go through attaching angles on each side of the fuselage and into fiber gang-nuts mounted in the stabilizer. The front and rear spar of the stabilizer are attached to the fuselage with fillister head screws and stop nuts.

2-67. REMOVAL OF HORIZONTAL STABILIZER.

a. Remove tail cowling. See paragraph 2-20.

b. Disconnect the connecting link between the elevator bell crank and the elevator.

c. Disconnect elevator tab indicator wiring and tail light wiring.

d. Remove the fairings between the fuselage and stabilizer.

e. Detach the upper surface fairing by removing the attaching machine screws.

f. Remove attaching bolts from the stabilizer forgings.

g. Disconnect the elevator tab control cables at the turnbuckles inside the fuselage tail compartment and remove chain idler roller on forward side of Bulkhead 14.

h. Disconnect the rudder tab control cables at the turnbuckles inside the fuselage tail compartment and remove rudder tab pulleys at Bulkhead 13.

i. Remove the elevator tab chain sprockets from the brackets on the forward side of Bulkhead 15. These sprockets are accessible from the tail wheel well.

j. Remove rudder cable pulleys in the horizontal stabilizer. These pulleys are accessible through an inspection door in the top forward part of the stabilizer (figure 1-5).

k. Disconnect the rudder control cables at the turn-

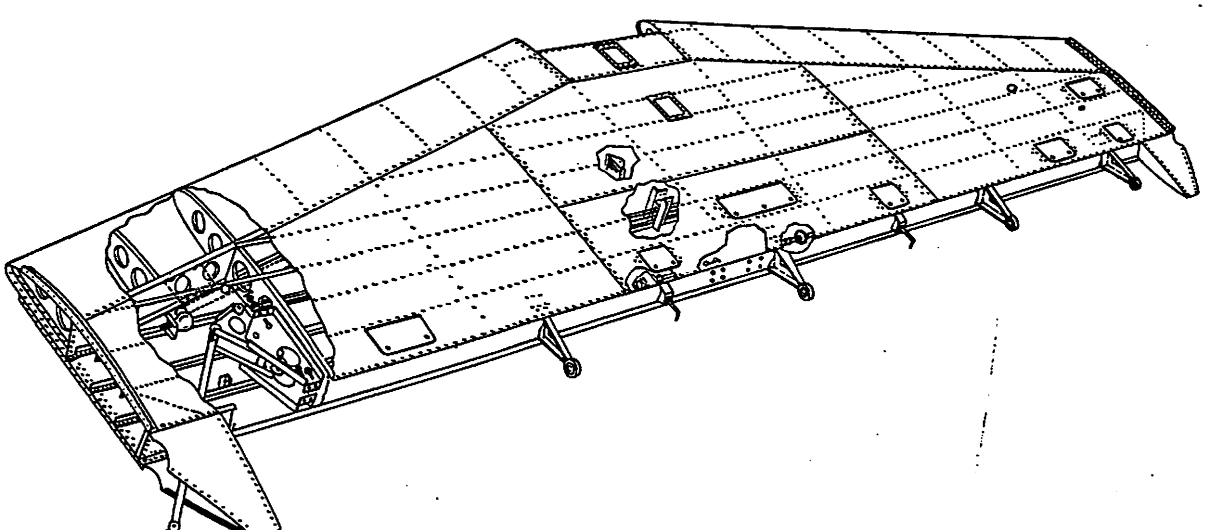


Figure 2-23. Horizontal Stabilizer

buckles in the outboard ends of the stabilizer. Tie a line to each end of the cable before removing to facilitate reinstallation.

NOTE

If, after removal, a suitable supporting rack or dolly to hold the stabilizer off the ground is not available, the vertical stabilizer should be removed. See paragraph 2-72.

l. Remove the fillister head screws attaching the stabilizer to the fuselage mounting angles. Remove fillister head screws at Bulkheads 13 and 15. (Two men required.)
m. Lift the stabilizer until it is clear of the fuselage, allowing the control cables to feed through the stabilizer.

2-68. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs such as replacing bell cranks, cables and pulleys will be made by line personnel. Major repairs to the skin and ribs will be done at a designated overhaul activity.

2-69. INSTALLATION OF HORIZONTAL STABILIZER.
a. Lower horizontal stabilizer into position on the fuselage, feeding the control cables and tab chains into place by means of the attached lines, as the stabilizer is lowered into place.

NOTE

When installing the horizontal stabilizer, there must be a layer of tape, 1/32-inch x 3/4-inch (Specification MIL-T-6841) between the stabilizer and fuselage attaching angle.

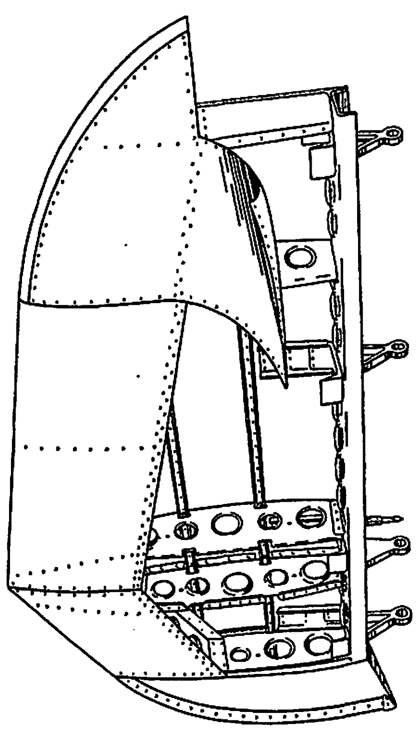


Figure 2-24. Vertical Stabilizer

b. Pull the control cables into the proper position to be attached to the rudder bell crank in the outboard ends of the stabilizer. Remove lead lines.
c. Pull the elevator tab chain, and the rudder tab cables into their proper positions in the fuselage tail compartment. Remove lead lines.
d. Secure the stabilizer on the fuelage mounting angles, by installing the fillister head screws. To facilitate alignment tighten only three screws on each side of the fuselage.
e. Install and tighten the bolts in the stabilizer forgings and install and tighten fillister head screws at Bulkheads 13 and 15.
f. Tighten all fillister head screws in the fuselage mounting angles.
g. Install the main rudder pulleys in the horizontal stabilizer and attach the rudder control cables to the turnbuckles in the outboard ends of the stabilizer.
h. Working through the tail wheel well, install the elevator tab chain sprockets in the bracket located on the forward side of Bulkhead 15.
i. Working from the tail compartment, install the elevator tab chain roller idler at Bulkhead 14.
j. Install the rudder tab pulleys at Bulkhead 13 and connect the rudder tab cables at the turnbuckles in the tail compartment.
k. Connect the elevator tab chain at the turn buckles in the tail compartment.

WARNING

Use extreme care when installing and connecting the cables to see that they are not crossed.

l. Install vertical stabilizers, if they have been removed (see paragraph 2-74).
m. Install the upper surface fairing.
n. Attach the fairing to the fuselage and stabilizer with machine screws.
o. Connect link rod between elevator and bell crank.
p. Connect elevator tab indicator wiring and tail light wiring.
q. Rig rudder control system. See paragraph 2-182.
r. Rig rudder tab control system. See paragraph 2-197.
s. Rig elevator tab control system. See paragraph 2-170.
t. Install tail cowling. See paragraph 2-22.

2-70. VERTICAL STABILIZER.

2-71. DESCRIPTION. The construction of the vertical stabilizer (figure 2-24) is similar to that of the horizontal stabilizer. The vertical stabilizer is attached to the horizontal stabilizer by fillister head screws anchored in the vertical stabilizer by self-locking nuts.

2-72. REMOVAL OF VERTICAL STABILIZER.
a. Remove rudder. See paragraph 2-82.
b. Disconnect the rudder tab control flexible drive shaft from the 90-degree drive fitting located in the left outboard end of the horizontal stabilizer.
c. Remove fairing over joint between the vertical stabilizer and the horizontal stabilizer.

d. Remove the fillister head screws which attach the vertical stabilizer to the horizontal stabilizer.
e. Pull the vertical stabilizer outboard until it is clear of the horizontal stabilizer.

2-73. MINOR REPAIR AND PARTS REPLACEMENT. Minor repair shall consist of the replacement of the abrasion boots, tab actuator and rudder hinges. These repairs may be accomplished by line personnel. Major repairs to the ribs and skin will be made at a designated overhaul activity. The abrasion boots should be coated periodically with No. 93 rubber dressing (Acme Quality Paints Inc. Detroit, Michigan). Apply the rubber dressing in accordance with the following steps.
a. Wash the boot with warm water and a mild detergent.
b. Allow the boot to thoroughly dry.
c. Apply a light coat of No. 93 rubber dressing and allow to dry.

2-74. INSTALLATION OF THE VERTICAL STABILIZER.

NOTE

When installing a vertical stabilizer, there must be a layer of tape 1/32 inch x 3/4 inch (Specification MIL-T-6841) between the vertical and horizontal stabilizer.

a. Carefully place the vertical stabilizer in position on the horizontal stabilizer.
b. Install the fillister head attaching screws.
c. Install fairing which covers joint between vertical and horizontal stabilizer.
d. Connect rudder tab flexible drive shaft to 90 degree drive fitting located in the left outboard end of horizontal stabilizer.
e. Install rudder. See paragraph 2-84.

2-75. ELEVATOR.

2-76. DESCRIPTION. The elevator (figure 2-25) is constructed with an aluminum-alloy main spar, formed ribs, and fabric covering. It is attached to the horizontal stabilizer by five cast aluminum hinge brackets. The elevator is dynamically balanced to prevent fluttering and has two trim tabs on its trailing edge.

2-77. REMOVAL OF ELEVATOR.
a. Remove tail cowling. See paragraph 2-20.
b. Disconnect the elevator control mechanism by removing the bolt at the upper end of the connecting link between the ball crank and the elevator.
c. Disconnect the tab indicator and the tail light wiring on the aft side of Bulkhead 15.
d. Disconnect the bonding straps at the hinge points.
e. Remove the hinge bolts. Access to the bolts is gained by removing the inspection window covers on the under side of the elevator.
f. Pull the elevator directly aft until the tab torque drives are free and elevator clears the stabilizer.

CAUTION

Protect the elevator hinge brackets on the stabilizer when the elevator is removed. Bent or damaged hinge brackets must be replaced.

NOTE

The tab torque drives employ small half-moon Woodruff keys at the connecting joints which are left loose when the drives separate. Care must be taken not to lose these keys.

2-78. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of patching small holes or tears in the fabric covering and the replacing of the entire elevator control surface. Other repairs will be done at a designated overhaul activity.

2-79. INSTALLATION OF ELEVATOR.
a. Move the elevator forward into position, making certain the tab torque drives are engaged properly.

CAUTION

Half-moon Woodruff keys must be installed in the elevator tab drive shafts.

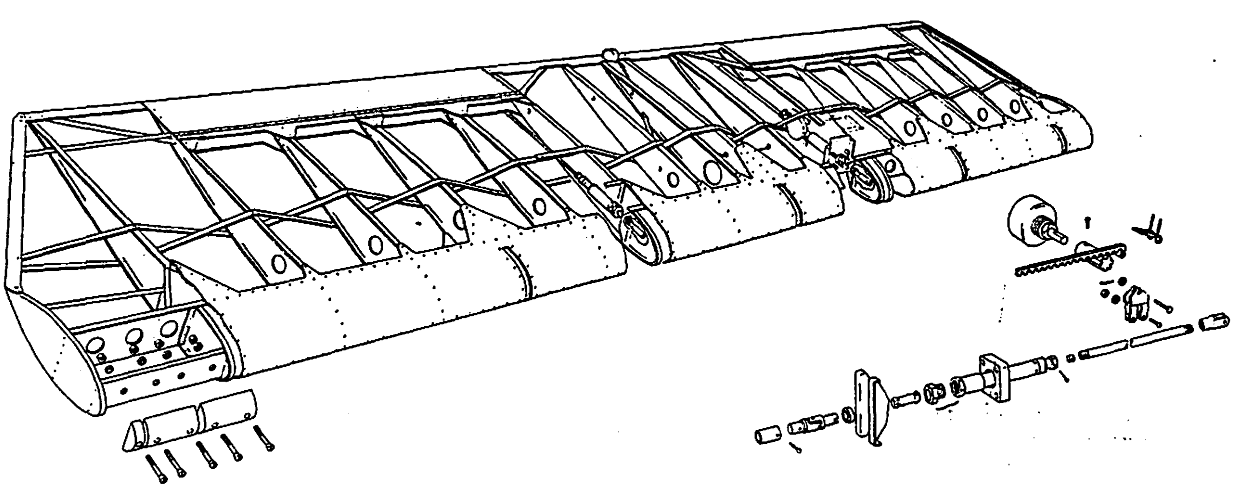


Figure 2-25. Elevator Assembly

b. Install the elevator hinge bolts, install nuts and cotter keys.
c. Connect the bonding straps at the hinge points.
d. Connect the tab indicator and the tail light wiring on the aft side of Bulkhead 15.
e. Connect the elevator control mechanism by installing the bolt at the upper end of the connecting link between bell crank and elevator.
f. Connect the tab actuators.
g. Install tail cowling. See paragraph 2-22.

2-80. RUDDER.

2-81. DESCRIPTION. The two rudders (figure 2-26) are similar to the elevator in construction. They are attached to the vertical stabilizers by four cast-aluminum hinge brackets. The left rudder has a trim tab attached with a hinge wire. The rudders are statically and dynamically balanced.

2-82. REMOVAL OF RUDDER.
a. Detach outer rudder horn box from the horizontal stabilizer.
b. Detach inner rudder horn box from the rudder.
c. Disconnect the rudder control mechanism at the rudder horn connection.
d. Disconnect rudder tab actuator.
e. Remove rudder hinge bolts. These bolts are accessible by removing the inspection window covers on the rudder.

CAUTION

Do not allow bolts, washers or other parts to drop into the rudder.

f. Pull the rudder directly aft until the tab torque drive is free and the rudder is clear of the vertical stabilizer.

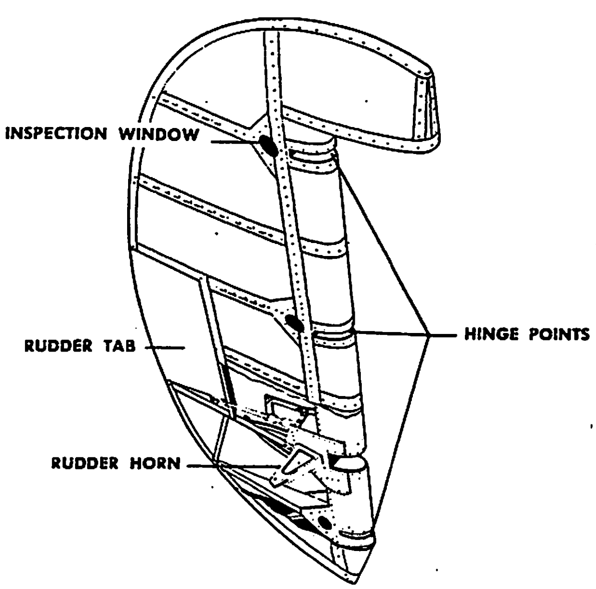


Figure 2-26. Rudder Assembly

NOTE

The tab torque drive employs a small half-moon Woodruff key at the connecting joint which is left loose when the drive is disconnected. Care must be taken not to lose the key.

2-83. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of patching small holes or tears in the fabric covering and replacing the entire rudder control surface. All other repairs must be done at a designated overhaul activity.

2-84. INSTALLATION OF RUDDER.
a. Move rudder forward into position. Care must be taken that the tab torque drive is properly engaged.

CAUTION

Half-moon Woodruff key must be installed in the tab drive shaft. Do not allow bolts, washers, or other parts to drop into rudder.

b. Install the rudder hinge bolts, nuts and key.
c. Connect the rudder control mechanism at the rudder horn.
d. Connect rudder tab actuator.
e. Install inner rudder horn box.
f. Install outer rudder horn box.
g. Reinstall the inspection window covers.
h. Check rudder tab travel.

2-85. SURFACE CONTROL SYSTEMS.

2-86. DESCRIPTION. All flight control surfaces except the flaps are operated by cable systems attached to controls in the pilot's compartment. The main control cables are made of 7 x 19 preformed extra flexible, corrosion-resistant steel. The rudder and aileron cables are 1/8 inch diameter and the elevator cables are 3/16 inch and 5/32 inch diameter. All trim tab cables are 3/32 inch diameter. Anti-friction, prelubricated pulleys and bearings are used throughout the systems. Turnbuckles are provided at access points to facilitate installation, adjustment, and removal of the cables. The bell cranks are castings of aluminum-alloy as is the elevator bull wheel. Phenolic fairleads are used throughout the systems. The flap control system is described in paragraph 2-107.

2-87. AILERON CONTROL SYSTEM.

2-88. DESCRIPTION. The aileron control system (figure 2-27) is controlled by the wheels on each control column in the pilot's compartment. Each wheel is mounted on a shaft which runs through the top of the control column, which in turn is keyed to a sprocket inside the column. A removable cover at the top of the control column provides access to the sprocket. Chains are routed over the sprockets to short cables running down through the control columns and aft under the pilot's compartment floorboards. They are then routed inboard at Bulkhead 5 to connect with the main aileron control cables. The main aileron control cables run laterally through the center section and outer wing panel to a point just inboard the sev-

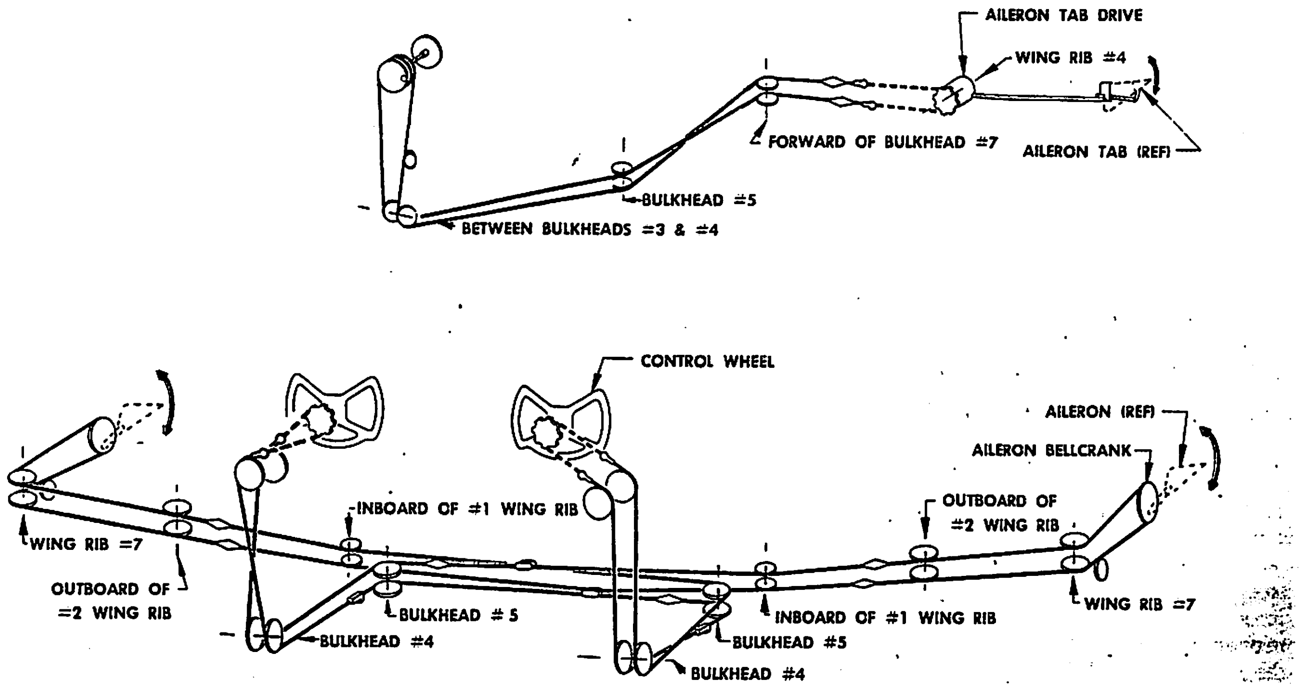


Figure 2-27. Aileron and Aileron Tab Control Systems

enth rib from the outer panel root. At this point they turn aft and attach to the aileron bell cranks. A link rod connects the bell crank to the aileron.

2-89. REMOVAL OF OUTER WING PANEL AILERON CONTROL SYSTEM.

a. Disconnect the actuating link rod from the aileron and from the bell crank in the wing.

b. Remove the clevis pins which hold the cables in position on the pulleys in the nacelle and outer wing panel.

c. Disconnect aileron cables at the turnbuckles in the nacelle.

d. Remove the bell crank from the wing rib.

e. Remove the bolt which attaches the cable to the bell crank.

f. Fasten a length of safety wire or strong cord long enough to reach from the bell crank to the nacelle, to the cable where it attaches to the bell crank. The wire or cord will be used in pulling a new cable through the wing.

g. Pull the cable out of the wing through the nacelle opening. Remove the cable carefully to prevent damage to the wing structure.

2-90. MINOR REPAIR AND PARTS REPLACEMENT. Cables which are rusted or corroded are not considered serviceable and must be replaced. Cables which do not have more than six broken strands in any one inch are considered serviceable. Defective control cables cannot be repaired and must be replaced.

2-91. INSTALLATION OF OUTER WING PANEL AILERON CONTROL SYSTEM.

a. By means of the previously installed cord or wire, pull new cable assembly into the wing. After new cable is in proper place, remove the attached line. The cable has a permanent 3/16-inch radius formed at the point where it attaches to the bell crank. If a cable is to be installed in the right wing, it must be installed so the longer length of the cable passes under the bell crank, and the shorter length over the top of the bell crank. In the left wing install the longer length of the cable over the bell crank and shorter length under the bell crank. A piece of tape should be wrapped around the longer length of cable for identification before it is pulled into the wing.

b. Attach the cable to the bell crank.

c. Attach the bell crank to the wing rib.

d. Install clevis pins at the pulleys in the nacelle and at the pulleys in the outer wing panel.

e. Connect the actuating link rod to the aileron and to the bell crank in the wing.

WARNING

Take great care when installing the cables to see that they are not crossed.

2-92. REMOVAL OF CENTER SECTION AILERON CONTROL SYSTEM.

a. Release tension on the automatic pilot aileron servo cable at turnbuckle in nose compartment.

b. Remove jam nuts on end of servo cable at the attachment fitting on the aileron balance cable in the belly and disconnect cable.

c. Remove the inspection plates on the aft side of Bulkhead 5 near the floor.
d. Relieve tension on aileron balance cables at the turnbuckles on aft side of Bulkhead 5. Turnbuckles are accessible through the outboard openings.
e. Disconnect main aileron control cables and balance cables at connecting links in Bulkhead 5. Connecting links are accessible through center inspection opening on the aft side of Bulkhead 5.

CAUTION

Take care not to lose the bushings which are installed in the connecting link.

f. Remove batteries. See Section VII, paragraph 7-6.
g. Remove clevis pin which holds the cables in position on the pulleys in the battery compartment.
h. Remove the main aileron control cables by pulling them through the wing stub into the nacelle. Remove the cable carefully to prevent damage to the center section structure.
i. Remove the pulleys from the control column and the floor channel bracket. The bolt retaining the pulleys in the base of the control column may be removed through a hole in the fuselage skin (accessible through the battery compartment). The bolt attaching the pulleys to the floor channel bracket may be removed through a small access opening in the pilot's compartment floorboards, located just forward of Bulkhead 5 near the outboard edge.
j. Remove cover over sprocket on top of control column. With the control wheels in neutral position, mark with paint a link of the chain and its matching sprocket tooth. Secure chain back out of the way.
k. Remove the nut from the end of the control wheel shaft. Remove the control wheel, shaft and the rear bearing. Spacer and key will fall free.
l. Press the front bearing from the control column and remove sprocket.
m. Attach a length of safety wire or strong cord to the chain and lower chain and cable assembly from the control column.
n. Remove chain and cable assembly.

2-93. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of replacing cables, chains that are badly rusted or corroded, cables that have six or more broken strands in one inch and the replacing of the control column sprocket, wheel and control wheel shaft bearing.

2-94. INSTALLATION OF CENTER SECTION AILERON CONTROL SYSTEM.
a. Using the cord or wire previously installed, pull chain and cable assembly up into control column.

NOTE

The chain and cable assemblies from the right-hand and left-hand control columns are not interchangeable. The cables must be routed as shown in figure 2-28 to assure proper operation of the aileron control system.

b. Install chain and cable assembly in the left control column by routing end of chain to which the short cable is attached under the control wheel sprocket, to go over the forward pulley at the top of the control column and around the inboard pulley at the base of the control column. Route the chain to which the long end of the cable is attached over the control wheel sprocket, over rear pulley in top of control column and around the outboard pulley at the base of the control column.

NOTE

For both the right and left hand control columns, the chain should be installed on the sprocket so that when the control wheels are in neutral position, the ends of the chain will be of equal length.

c. Position chain in correct position on control column sprocket (see note following step b). If new chain is to be installed count the links of the old chain from one end to the link marked with paint and

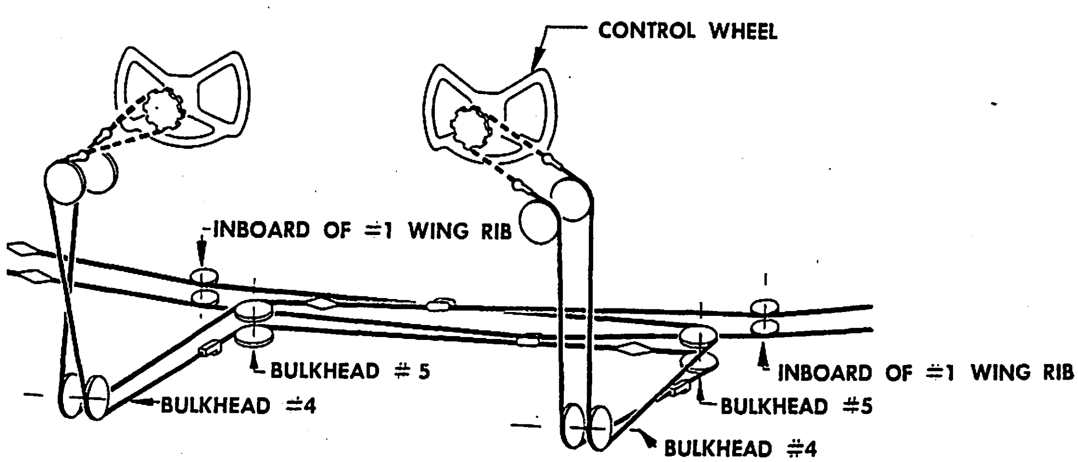


Figure 2-28. Aileron Control System (Control Column)

install the matching link of new chain on tooth of sprocket which is marked.

d. Press the rear bearing into the control column.

e. Insert key in shaft. Slide shaft through spacer and sprocket, install nut and key. Press front bearing into control column.

f. Stake in both front and rear bearing. Install cap over top of control column.

WARNING

Take extreme care that the cables are not crossed inside the control column.

g. Using great care to assure the cables are in correct position, install pulleys in the top and bottom of the control column. Insert bolts, tighten nuts securely and key.

h. Route the longer length of cable aft to Bulkhead 5 and position it to go around the top pulley in the floor channel bracket.

i. Route the short end to go around the lower pulley.

j. Take care to hold the cables in their correct positions and install pulleys. Insert bolt, tighten nut securely and key.

k. Install chain and cable assembly in the right control column by routing end of chain to which the long cable is attached under the control wheel sprocket, over the forward pulley at the top of the control column and around the inboard pulley at the base of the control column. Route the end of the chain to which the shorter length cable is attached over the control wheel sprocket to go over the rear pulley at the top of the control column and around the outboard pulley at the base of the control column.

l. Using great care to assure the cables are in the correct position, install the pulleys in the top and base of the control column, insert bolts, tighten nuts securely and key.

m. Route the shorter length of cable aft to bulkhead 5 and position it to go around the top pulley in the floor channel bracket. Route the longer cable to go around the bottom pulley in the floor channel bracket.

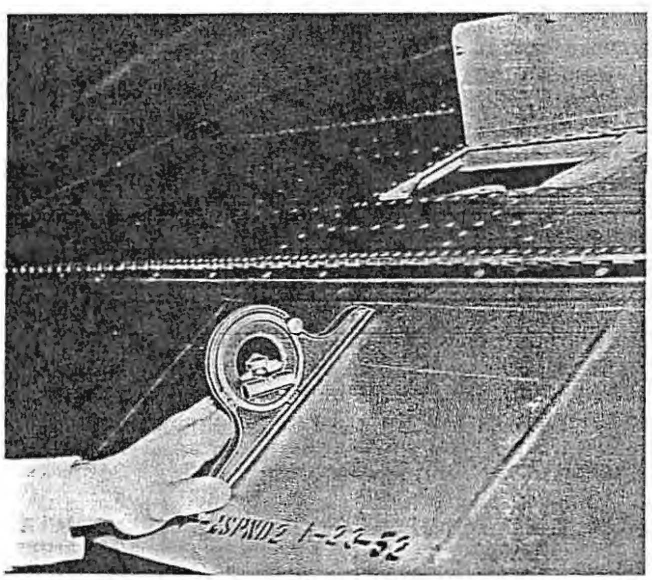


Figure 2-29. Aileron Travel Check

n. Carefully hold cables in their correct positions and install pulleys. Insert bolt, tighten nut securely and key.

o. Attach long cable on the left side and the short cable on the right side to the opposite ends of the upper connecting link.

p. Attach the short cable on the left side and the long cable on the right side to the opposite ends of the lower connecting link.

q. Pull the main aileron cables through the wing stub taking care not to damage the center section structure.

r. Install the right-hand long cable on the upper connecting link and install the short right-hand cable on the lower connecting link.

s. Install the left-hand short cable on the opposite end of the upper connecting link and the left-hand long cable on the opposite end of the lower connecting link. Install nuts on bolts in connecting links, tighten securely and key.

CAUTION

Be sure that the bushings are installed in the connecting links.

t. Position cables over correct pulleys in battery compartment, making sure the cables are not crossed. Install clevis pin.

u. Install batteries. See Section VII, paragraph 7-7.

2-95. ADJUSTMENT OF AILERON. The aileron travel can be adjusted by changing the position of the eccentric stop located on the wing rib adjacent to the bell crank. The aileron travel should be set 38° up and 20° down. See figure 2-29.

2-96. RIGGING OF THE AILERON CONTROL SYSTEM.

a. Attach a straight edge across the control column wheels (figure 2-30) to hold them in neutral position.

b. Adjust the balance cable turnbuckles in Bulkhead 5 until both cables are rigged to 35 ± 5 pounds.

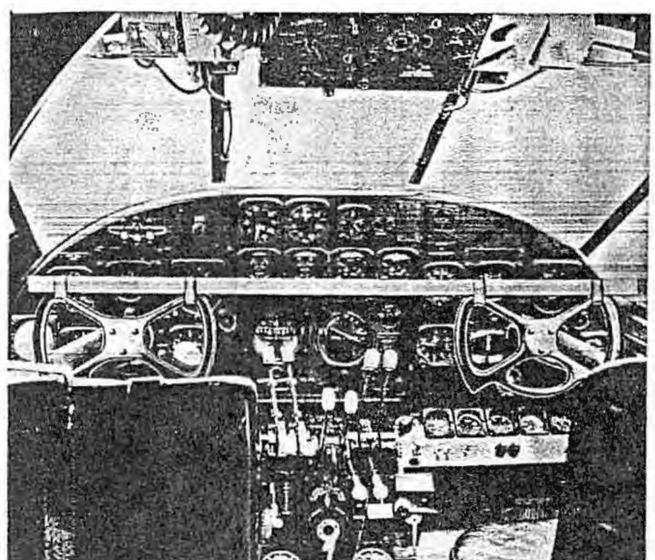


Figure 2-30. Straightedge Installation Control Wheels

c. Connect outboard wing panel aileron cables to wing stub cables in nacelle.

WARNING

When connecting cables, take extreme care not to cross the cables.

d. Rig outer wing panel aileron cables to 50 ± 10 pounds maintaining neutral position of the ailerons.
e. Remove straight edge on control wheels.
f. Safety all turnbuckles.

2-97. AILERON TAB CONTROL SYSTEM.

2-98. DESCRIPTION. A flight-adjustable trim tab on the left aileron is operated by a control wheel on the lower center of the control pedestal; the position of the tab is registered by a mechanical indicator just above the control wheel. The tab control cables pass around a pulley on the control shaft and down to pulleys in the belly, then angle to the left and aft to Bulkhead 5. They run aft to Bulkhead 7 and turn outboard through the center section. Just aft of the fuel tank well the cables pass through a block which acts as a stop to limit travel (figure 2-31) and attach to the ends of a chain from the sprocket on a 90-degree drive at wing rib 4. The 90-degree drive is connected to the tab actuator by a flexible shaft. A ground-adjustable tab is installed on the trailing edge of each aileron on Serials 51-11501 and after, except Serials 51-11504 through 51-11582.

2-99. REMOVAL OF AILERON TAB AND AILERON TAB ACTUATOR FROM AILERON.
a. Disconnect the left aileron from the bell crank actuating link.
b. Remove the inspection plate from the leading edge of the aileron.
c. Disconnect the tab actuator from the horn.
d. Disconnect the flexible drive shaft from the actuator.
e. Loosen locknut and back off the setscrew securing the actuator in the mounting bracket.

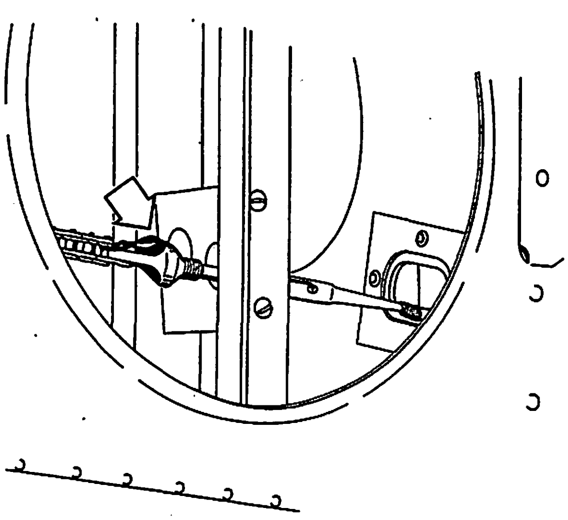


Figure 2-31. Aileron Tab Cable Stop

f. Lift the actuator out of the aileron through inspection opening.
g. Remove hinge wire from tab and remove tab.

2-100. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of replacing excessively worn actuators, adjusting setscrew in mounting bracket and replacement of aileron tab. All other repairs must be accomplished at a designated overhaul activity.

2-101. INSTALLATION OF AILERON AND AILERON TAB ACTUATOR IN AILERON.
a. Insert actuator in aileron through inspection opening.
b. Move actuator into position in mounting bracket. Install setscrew and tighten. Actuator mechanism must pivot about setscrew freely but have no play.
c. Connect flexible drive to tab actuator.
d. Lift tab into position and install hinge wire. The special steel hinge wire may be slowly and carefully driven into the hinge with a rawhide mallet. A new hinge wire must be installed each time the tab is removed.
e. Move aileron tab control to neutral. The ends of the aileron tab chain will be even when the tab control is in the neutral position. Adjust tab actuating screw until tab is aligned with the aileron trailing edge. Install connecting bolt and safety.
f. Safety all connections and install inspection covers.

2-102. REMOVAL OF THE TAB CHAIN DRIVE, CABLES AND CONTROL KNOB ASSEMBLY.
a. Set tab in neutral (trailing edge of tab aligned with trailing edge of aileron).
b. Disconnect tab flexible drive from 90-degree drive in the wing.
c. Disconnect aileron tab cables at turnbuckles in trailing edge of wing stub (remove patch on second lightening hole from outboard end of wing stub). Completely remove turnbuckle barrels. Attach lead lines to both cables and chain, to facilitate reinstallation.
d. Remove the nuts attaching the 90-degree drive to the wing rib and left drive and chain from wing.
e. Remove sheave from control shaft in pedestal and disconnect cables.
f. Remove the tab indicator spiral actuator from control shaft and pull control knob and shaft from pedestal.
g. Remove clevis pins from tab pulley brackets on floor channel directly under pedestal.
h. Remove pulleys on truss under Bulkhead 5 and under cabin floorboards on forward side of Bulkhead 7.
i. Remove cables, drawing lead line into position.

2-103. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs consist of replacing cables and chains that are badly rusted or corroded, cables with six or more broken strands to an inch and tab chain drives and flexible shafts that are worn or rusted. Lubricate the tab chain, the flexible shafts as required and the control knob to prevent binding.

2-104. INSTALLATION OF TAB CONTROL KNOB ASSEMBLY, CABLES AND CHAIN DRIVE.
a. Insert control knob and shaft in pedestal. Install the tab indicator spiral actuator, placing the tip of

the actuator link in the groove of the actuator. Pin the actuator to the shaft with clevis pin and cotter key. Set the indicator in neutral position.

b. Install cables on control sheave, wrapping each from the outside to center and install sheave on shaft with taper pin.

NOTE

If a new sheave or shaft is installed, it must be drilled and reamed for a taper pin. Be sure the tab indicator is in neutral. Place the sheave on the shaft with the cable notches in the rim in line with the actuator link and drill and ream the sheave and shaft together. Then remove the sheave and install cables, as above.

c. Route cables around pulleys on floor channels beneath pedestal and install clevis pins in brackets.

d. Route cables aft to Bulkhead 5 and through pulley bracket on truss. Install pulleys.

e. Route cables aft under cabin floorboards to pulley bracket on Bulkhead 7. Install pulleys.

f. Attach cables to lead lines and draw through wing stub. Set turnbuckles opposite each other and detach lead lines.

g. Route tab drive chain around sprocket on 90-degree drive. Install drive in wing but do not connect flexible drive.

h. Using lead line previously installed, pull chain through wing and connect to tab drive cables. Tighten and safety turnbuckles (see Table IV for correct cable tension) and check neutral setting of indicator.

i. Check tab for neutral setting. Tab must be in neutral position before connecting flexible drive.

j. Recheck tab indicator. If necessary, indicator may be set by withdrawing tip of actuator link from groove in spiral actuator and moving tip one or more grooves to either side.

2-105. ADJUSTMENT OF TAB CHAIN DRIVE, CABLES AND CONTROL KNOB.

a. Turn control knob until the turnbuckles in the wing are directly over each other and accessible at a lightening hole in the rear spar of the center section.

b. Remove bolt connecting actuator to the tab.

c. Adjust the actuator so the trailing edges of the tab and aileron are aligned.

d. The tab then should move 20 degrees each way. These measurements have a 0° tolerance. Travel may be checked with a bubble protractor.

e. The tab travel, if a bubble protractor is not available, may be checked with a scale. The tab must move 1-3/8 inches up and 1-3/8 inches down. Measure from the inboard trailing edge of the tab to trailing edge of the aileron.

f. Tighten turnbuckles in accordance with Table IV.

2-106. FIXED AILERON TAB ADJUSTMENT. To correct a right wing-heavy flight attitude, bend the left tab down or the right tab up; for a left wing-heavy attitude, bend the left tab up or the right tab down. Do not exceed 20 degrees total deflection, up or down.

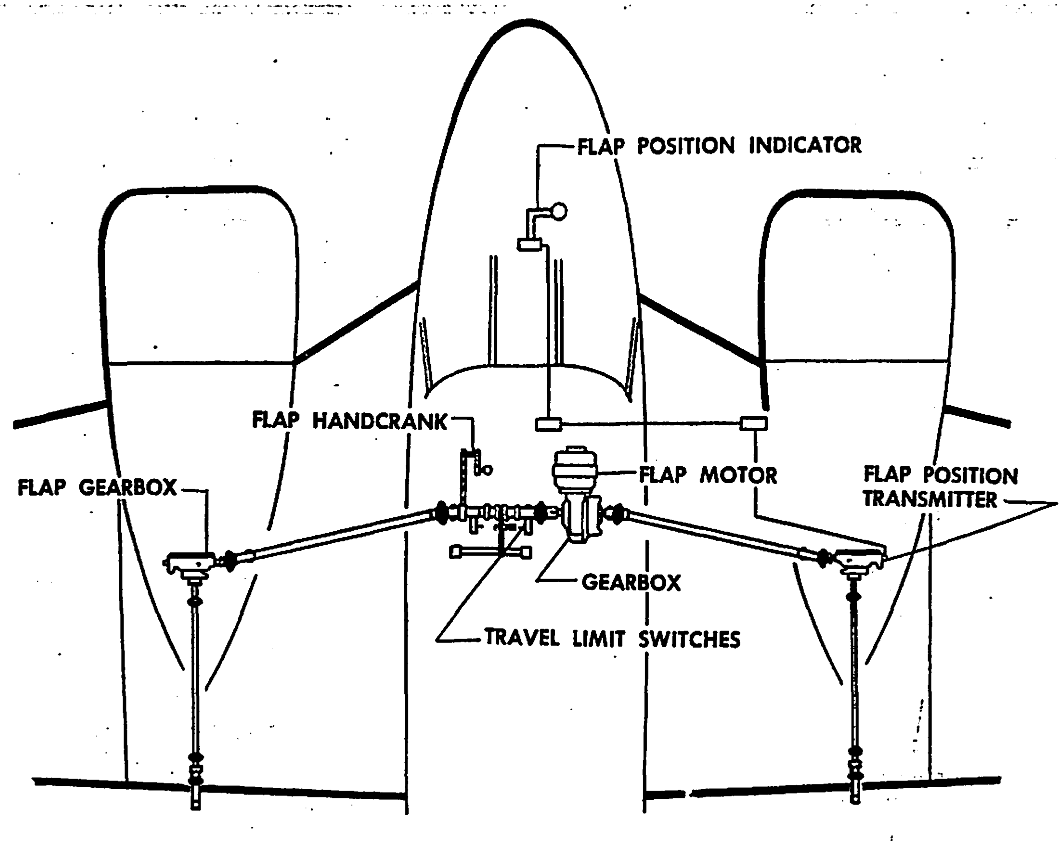


Figure 2-32. Wing Flap Control System

2-107. WING FLAP CONTROL SYSTEM.

2-108. DESCRIPTION. The wing flaps are operated by an electric motor installed near the center of the floor structure under the pilot's compartment floorboards. The flap motor is controlled by the flap position switch and a dynamic brake relay. The motor connects through a worm gear to a cross torque shaft. There are 90-degree drive assemblies connected to the ends of the shaft which turn the flap actuator screws. In the flap drive mechanism is a cone-type overload clutch. The center part of the drive shaft has a threaded section on which a traveling arm moves to actuate the flap limit switches. In emergencies, the flap system (figure 2-32) may be operated with the hand crank. The hand crank is pushed toward the pilot's seat to engage the flap mechanism. A double spline drive on the shaft of the hand crank makes it possible for the crank to operate either the landing gear or flaps. The position indicator is operated by a rheostat located on the flap 90-degree drive in the right wheel well.

2-109. TROUBLE SHOOTING. See Table V.

2-110. WING FLAP ELECTRICAL SYSTEM. The flap position switch controls the flap motor located below the floorboard. Travel is governed by limit switches (figure 2-35) and a dynamic brake. Position is registered by an indicator on the copilot's subpanel. The indicator is connected to a rheostat on the 90-degree drive in the right nacelle.

2-111. FLAP POSITION SWITCH.

2-112. DESCRIPTION. The flap position switch (figure 2-33) similar to a miniature flap, is located on the right hand side of the pedestal. The switch consists of two micro switches and operates in three positions. The center position is neutral, the down position lowers the flaps and the up position raises the flaps. On aircraft, serials AF 52-10539 and after, a new flap switch is used. This switch (figure 2-34) consists of a lever pivot arm, with a handle similar to a miniature flap, a cross shaft with two aluminum cams attached and two micro switches. When the position switch lever pivot arm is raised or lowered it rotates the two cams which in turn actuate the two micro switches. The flap position switch operates in three positions. The center position is neutral, the down position lowers the flaps and the up position raises the flaps. The flap position switch is located on the right hand side of the pedestal. Attached to the lever pivot arm is a leaf spring which holds the switch lever arm in the detents after the desired position has been selected. The amount of force needed to over-come the spring tension is between 5 and 10 pounds.

2-113. REMOVAL OF FLAP POSITION SWITCH.

a. Remove the five screws which attach the cover plate to the pedestal.
b. Remove the three screws on the right-hand side of the pedestal which attach the switch mounting bracket to the inside wall of the pedestal.
c. Remove the switch assembly by pulling it aft until it is clear of the pedestal.
d. Remove terminal screws on the micro switches and disconnect the electrical wiring.
e. Remove switch assembly from the airplane.
f. Remove the screws which hold the micro switches in the mounting bracket.

2-114. MINOR REPAIR AND PARTS REPLACEMENT. Repairs will consist of the removal and replacement of defective micro switches, the tightening of screws and the repair or replacement of electrical wiring.

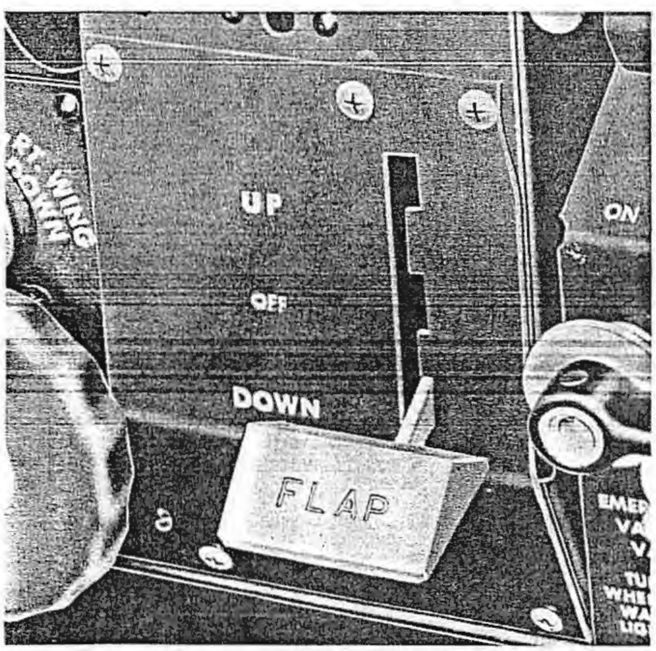


Figure 2-33. Flap Position Switch (C-45G and TC-45G Serials 51-11444 through 51-11911)

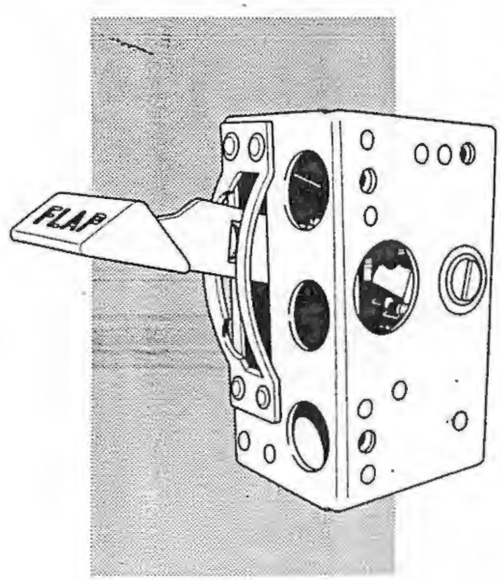


Figure 2-34. Flap Position Switch (C-45H Serials 52-10539 and After)

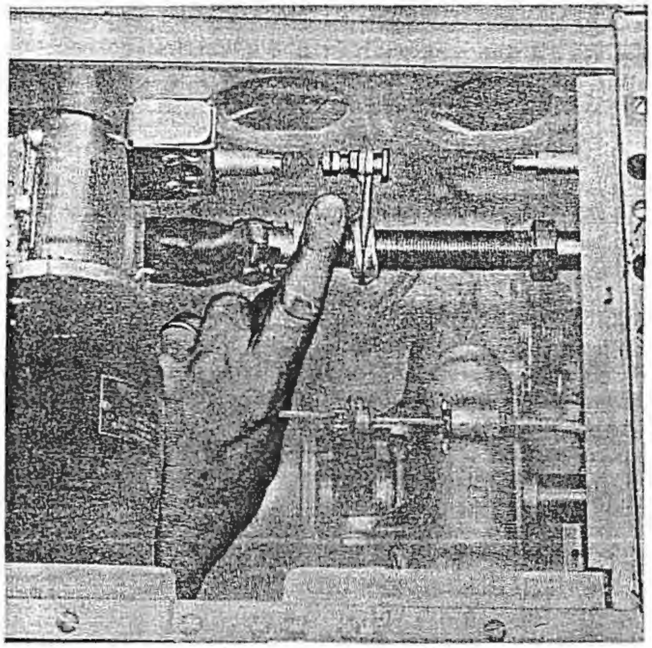


Figure 2-35. Flap Limit Switch Adjustment

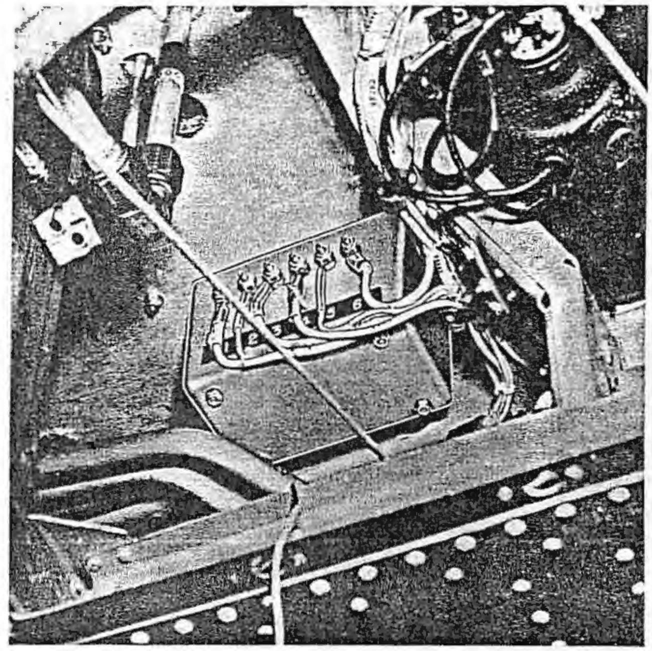


Figure 2-36. Flap Dynamic Brake Relay

2-115. INSTALLATION OF FLAP POSITION SWITCH.
a. Install micro switches in mounting bracket.
b. Make the correct electrical connections to the switches (see appropriate wiring diagram in Section X).
c. Insert the switch assembly in the opening in the pedestal and install attaching screws. Tighten securely.
d. Install cover plate over opening on the aft side of the pedestal.

2-116. REMOVAL OF FLAP LIMIT SWITCHES.
a. Remove mounting screws which are installed through mounting brackets and switches. (Screws are accessible through pilot's floorboard inspection door just forward of Bulkhead 5 in pilot's compartment.)
b. Pull switches up and forward and disconnect electrical wiring.
c. Remove switches from airplane.

2-117. MINOR REPAIR AND PARTS REPLACEMENT. Repairs will consist of the removal and replacement of defective switches, tightening screws and the repair or removal of the electrical wiring.

2-118. INSTALLATION OF FLAP LIMIT SWITCHES.
a. Make the correct electrical connections to the switches. See appropriate wiring diagram in Section X.
b. Position the switch in the mounting bracket and insert mounting screws.
c. Install switch and mounting bracket.

2-119. ADJUSTMENT OF FLAP LIMIT SWITCHES. Adjustment of the flap limit switches (figure 2-35) is made by changing the position of the adjustable actuator bolt located on the traveling arm. The bolt is adjusted to actuate the limit switches and stop the motor at a distance of one-sixth turn of the hand crank from the down stop and one-half turn from the up stop. This setting must be maintained. If the stops are contacted before the limit switches are actuated, excessive strain will be put on the system. Premature failure will result. The limit switches are accessible through the inspection door in the pilot's compartment floorboard. Loosen jam nuts on the actuator bolts and change their length as required.

2-120. WING FLAP DYNAMIC BRAKE RELAY.

2-121. DESCRIPTION. The dynamic brake relay (figure 2-36) is so arranged that when the adjustable actuator bolt on the traveling arm (figure 2-35) opens the control circuit (by actuating the limit switches), it establishes a dynamic braking circuit through either the forward or reverse contactors of the relay. Contour voltage induced in the armature, while the motor is running, returns to ground through the opposite field and the relay, thereby braking the armature. A selector switch selects for braking, the opposite field from the last one used for operating the system. The relay is mounted on the under side of the pilot's compartment floorboards in the right-hand rear section of the belly.

2-122. REMOVAL OF WING FLAP DYNAMIC BRAKE RELAY.
a. Disconnect electrical wiring on the forward side of the box.
b. Remove screws holding box to floorboards (two men required).
c. Remove relay from box.

2-123. MINOR REPAIR AND PARTS REPLACEMENT. Do not attempt to adjust or repair the dynamic brake relay. If the unit is malfunctioning, return to a designated overhaul activity. Only authorized personnel with the proper equipment will adjust

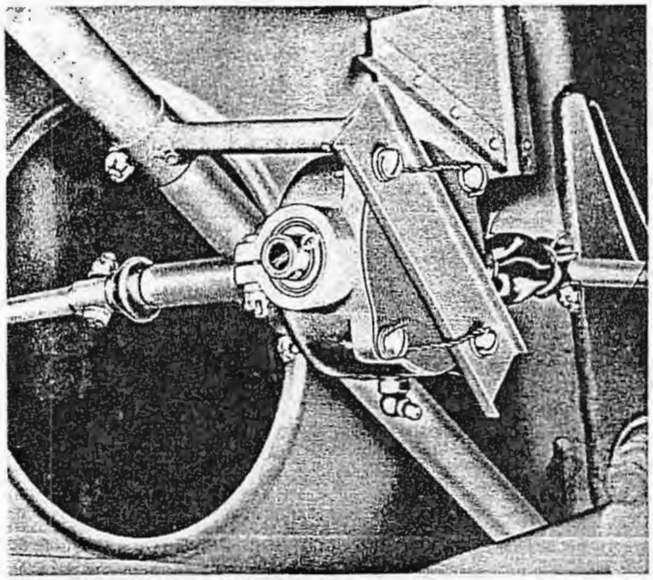


Figure 2-37. Flap 90-Degree Drive

or repair the relay. Line maintenance will consist of checking the electrical and ground connections.

2-124. INSTALLATION OF WING FLAP DYNAMIC BRAKE RELAY.
a. Install relay in box assembly.
b. Install box assembly on floorboard.
c. Make correct electrical connections to box assembly. See appropriate wiring diagram in Section X.

2-125. TESTING FLAP DYNAMIC BRAKE RELAY.
a. Remove inspection door in pilot's floorboard.
b. Turn battery switch "ON."
c. Place flap position switch in "DOWN" position and actuate the down limit switch by hand or with a screwdriver. Note whether the flap motor stops instantly or coasts to a stop. If the motor stops instantly, the dynamic brake is functioning properly.
d. Place the flap position switch in the "UP" position and actuate the limit switch, noting whether the motor is coasting or stops instantly.

2-126. WING FLAP RHEOSTAT.

2-127. DESCRIPTION. The wing flap rheostat is completely encased in an aluminum alloy casting attached to the 90-degree drive in the right-hand nacelle. A slotted fitting on the rheostat shaft fits over a matching fitting on the 90-degree drive. As the 90-degree drive rotates, it moves the rheostat and transmits a signal which changes the reading of the position indicator mounted on the right subpanel. The flap rheostat and the position indicator are calibrated in matched sets, and should be replaced as such.

2-128. REMOVAL OF FLAP RHEOSTAT.
a. Disconnect electrical wiring.
b. Loosen bolt which attaches rheostat to casting and the 90-degree drive assembly.
c. Remove casting and rheostat.

2-129. MINOR REPAIR AND PARTS REPLACEMENT. If the rheostat is not operating correctly, the entire assembly must be removed and forwarded to a designated overhaul activity.

NOTE

Only qualified personnel with proper equipment may repair or adjust the rheostat or position indicator.

2-130. INSTALLATION OF THE FLAP RHEOSTAT.
a. Run flaps to up position.
b. Connect electrical wiring to rheostat (see appropriate wiring diagram in Section X) and turn rheostat drive clockwise by hand until the mechanism contacts the stop.
c. Attach casting and rheostat to 90-degree drive and tighten attaching bolt.

2-131. ADJUSTMENT OF FLAP RHEOSTAT AND FLAP POSITION INDICATOR.
a. Run flaps to full up position.
b. Remove rheostat in right nacelle. Do not remove electrical wiring.
c. Ground case of rheostat against framework of aircraft.
d. Move rheostat shaft until the position indicator in pilot's compartment reads "UP."
e. Install rheostat.

2-132. REMOVAL OF FLAP MOTOR AND GEARBOX.
a. Remove the flap chain guard.
b. Remove the bolt attaching the traveling arm guide rod to the bracket and slip the rod endwise until it clears the traveling arm.
c. Remove the flap chain idler sprocket.
d. Remove the bolts attaching the torque shafts to the universals at the flap motor assembly.
e. Loosen the bolts attaching the 90-degree drive bracket to the truss member in the left nacelle and move the bracket on the truss until the torque shaft is free.
f. Remove the bearing retaining cap supporting the left end of the flap motor shaft.
g. Disconnect the electrical wiring and remove the screws attaching the flap motor to the supporting bracket.
h. Remove the flap motor assembly (figure 2-38). If necessary, disconnect the flap chain to obtain enough slack to remove it from the sprocket. The repair link must be removed to disconnect the chain.

2-133. MINOR REPAIR AND PARTS REPLACEMENT. Minor repair shall consist of replacing worn brushes or brush springs, cleaning dirty commutators with #000 sandpaper, replacing the complete motor, checking gearbox for proper grease level, and replacing the complete gearbox assembly. Other repairs to the flap motor or gearbox must be done at a designated overhaul activity.

2-134. INSTALLATION OF FLAP MOTOR AND GEARBOX.
a. Place flap motor and gear box assembly in position on the bracket and install mounting bolts. Safety.

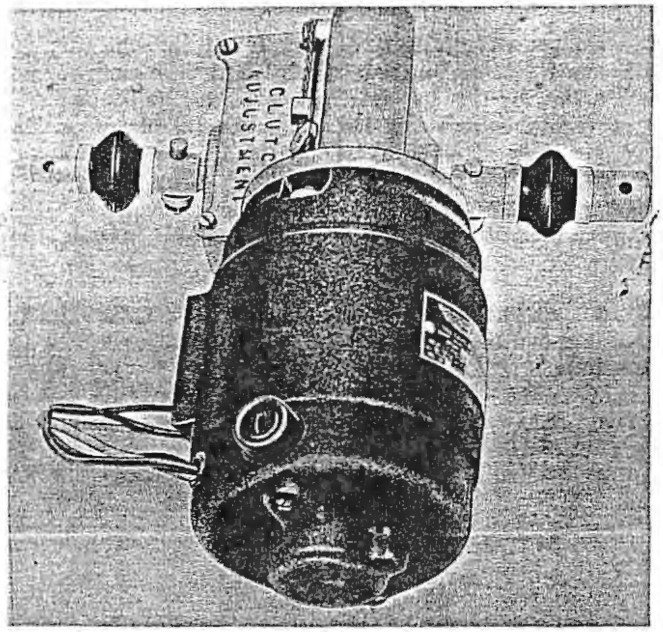


Figure 2-38. Flap Motor and Gearbox Assembly

b. Install bearing retaining cap on the left end of the flap motor shaft.
c. Move the torque shaft into position on the flap motor universal. Tighten clamps holding the 90-degree drive to the bracket in the left nacelle.
d. Install the flap chain idler sprocket.
e. Install the traveling arm guide rod.
f. Check operation of flap limit switches.

2-135. CHECKING FLAP OVERLOAD CLUTCH.
a. Run the flaps up electrically and pull out the circuit breaker.
b. Connect the leads of an ammeter to each side of the circuit breaker.
c. Slip the flap clutch by engaging and holding the hand crank and running the flaps down electrically. The ammeter should show a reading of 19 amperes with the clutch slipping.
d. Remove the cover plate on the flap motor gearbox.
e. Loosen the lock nut and turn the adjusting nut (figure 2-39) clockwise to increase tension or counterclockwise to decrease tension, as required to obtain a 19 ampere reading.
f. Set the locking nut.
g. Replace cover plate.

2-136. REMOVAL OF FLAP TORQUE SHAFT (CENTER SECTION WING).
a. Disconnect torque shaft from universal in the belly and from the outboard universal at the 90-degree drive mounting bracket to truss member and disengage torque shaft from universal.
b. Loosen bolts attaching 90-degree drive to truss member and disengage torque shaft from universal.
c. Pull torque shaft outboard into the nacelle.
d. Remove patch covering lightening hole, through which main aileron cables are routed.
e. Remove wing tip (see paragraph 2-50).
f. Remove torque shaft by working it outboard through lightening holes in the ribs of the outer wing panel.

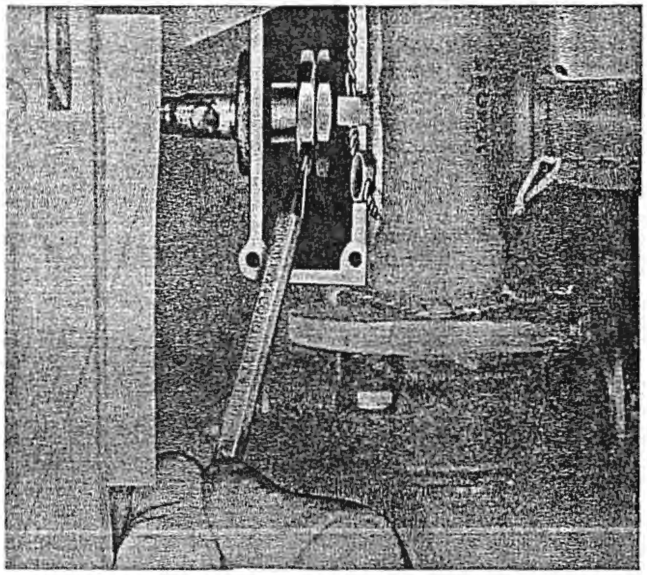


Figure 2-39. Flap Overload Clutch Adjustment

To assist in removing shaft through the wing panel the aileron cable may be used as a guide by tying the shaft to the cable.

2-137. MINOR REPAIR AND PARTS REPLACEMENT. If the torque shaft becomes warped, cracked or bent it must be removed and straightened or replaced.

2-138. INSTALLATION OF FLAP TORQUE SHAFT (CENTER SECTION WING).
a. Work new torque shaft inboard into nacelle through lightening holes in outer wing panel.
b. Work torque shaft through center section wing into belly and install inboard end of the universal.
c. Install outboard end of torque shaft in universal on 90-degree drive, align 90-degree drive with torque shaft and tighten bolts attaching 90-degree drive mounting bracket to truss member.
d. Install fabric patch over lightening hole of root rib outer wing panel.
e. Install wing tip. See paragraph 2-52.
f. Rig flaps. See paragraph 2-63.

2-139. DRILLING 90-DEGREE DRIVE UNIVERSAL. During installation of a new 90-degree drive, the universal collar must be drilled for the bolt through the collar and the old torque shaft. Extreme care must be exercised to avoid elongating the hole in the torque shaft. Drill the torque shaft as follows:
a. Pencil a line approximately 12 inches long on each side of the torque shaft (180 degrees apart) and so each line intersects the center of the hole in the torque shaft.
b. Establish a suitable reference point on the torque shaft and measure the distance from the reference point forward (or outboard) to the center of the hole in the torque shaft.
c. Install the 90-degree drive inserting the torque shaft in the collar. With a straight edge aligned to the marks on the torque shaft (see step a) extend the lines and mark the 90-degree drive collar.

d. From the dimension established in step b, center punch, the location of the center of the hole in the torque shaft on the marks on each side of the collar.

e. With a drill considerably smaller than the size of the hole in the torque shaft, drill through each side of the collar at the center punch dimple.

CAUTION

Keep the penciled marks on the collar and shaft in alignment.

f. Clean out the hole in each side of the collar by gradually increasing the size of the drills.

CAUTION

Do not attempt to drill completely through the shaft. Clean out each hole in the 90-degree drive collar by drilling through the collar from the outside. Do not make the hole too large; bolt should be a tight fit, to prevent backlash in the torque shaft.

g. Insert bolt in collar and shaft; install nut, tighten and key.

2-140. REMOVAL OF FLAP SCREW ASSEMBLY.

a. Remove bolt connecting the flap actuator screw to the flap.

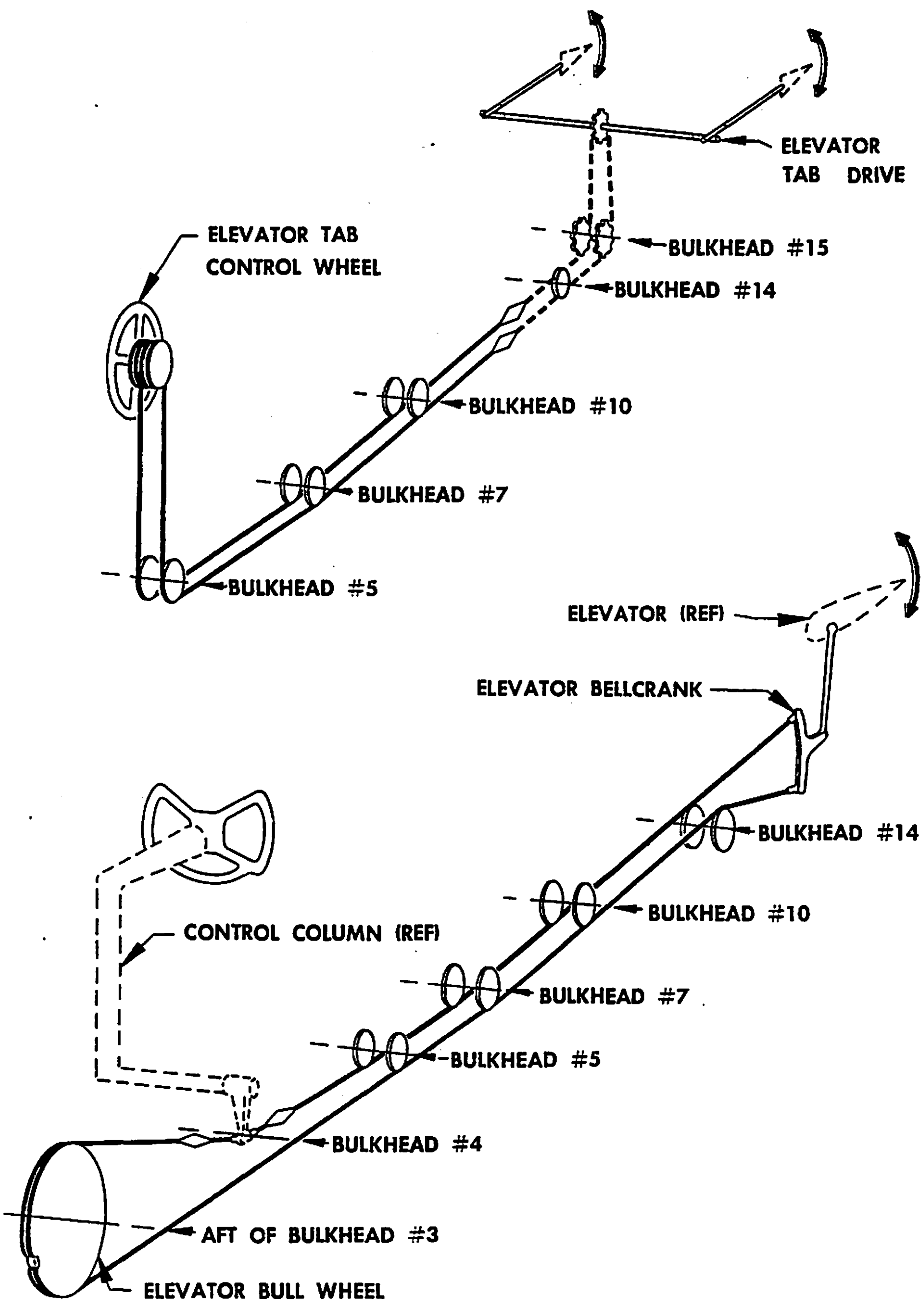


Figure 2-40. Elevator and Elevator Tab Control Systems

b. Remove the bolt from the shaft at the 90-degree drive in the nacelle.
c. Remove patch from lightening hole in the rear spar just inboard from the flap actuator screw.
d. Remove bolts holding bearing block to the mounting bracket just forward of the rear wing spar. Two men will be required for this operation. One man will work from a lightening hole in the aft bulkhead of the nacelle, while the other man will work from the lightening hole in the rear wing spar. Two bolts, fitted with castellated nuts and cotter keys, must be removed from each actuator. On reinstallation of the actuators, the castellated nuts may be replaced with fiber stop nuts, if desired.
e. Move the shafts and the actuator screw aft until it clears the 90-degree drive; then remove it through the nacelle.

2-141. MINOR REPAIR AND PARTS REPLACEMENT. Inspect shafts for cracks and elongated bolt holes. Shafts may be straightened and welded. Cadmium plating is recommended after such repair. Check screw assemblies for excessive wear.

2-142. INSTALLATION OF FLAP SCREW ASSEMBLY (CENTER SECTION WING).
a. Install flap screw assembly into position in the wing through the rear of the nacelle.
b. Working through lightening holes in the rear spar of the wing and in the rear bulkhead of the nacelle, install bolts to hold bearing block in position. Block is installed just forward of the rear wing spar. Two men will be required for the operation.
c. Install bolt in 90-degree drive and torque shaft.
d. Install patch on rear wing spar lightening hole.
e. Connect the flap actuator screw to the flap.
f. Safety all connections.

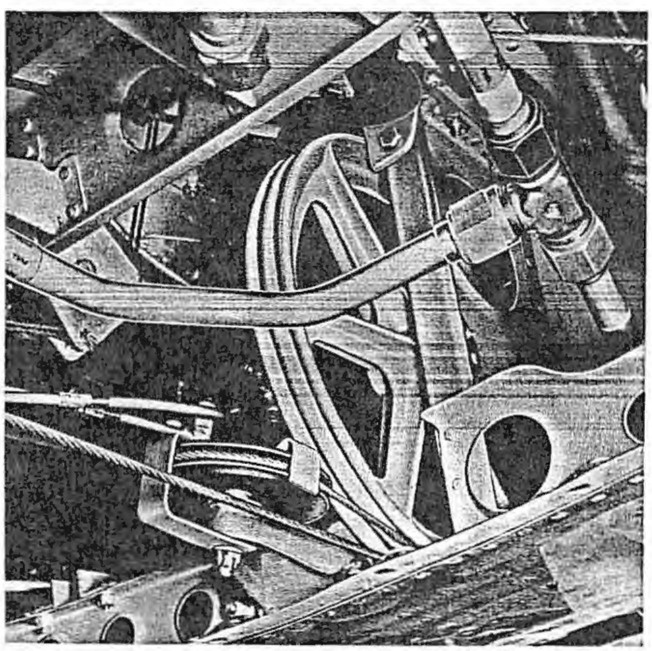


Figure 2-41. Elevator Control Bull Wheel

2-143. ELEVATOR CONTROL SYSTEM: CABLES, PULLEYS, CONTROL COLUMN AND TORQUE SHAFT.

2-144. DESCRIPTION. The elevator is actuated by a link rod and a closed system of cables, pulleys and bell cranks, which connect it to the dual control columns in the pilot's compartment (figure 2-40). Both control columns are pinned to a transverse torque shaft beneath the pilots' compartment floorboards, to the center of which an actuator horn is taper pinned. From the actuator horn, one cable runs aft beneath the cabin center aisle floorboards to Bulkhead 10, then upward and aft, attaching to the upper arm of the elevator bell crank on Bulkhead 15. The second cable runs forward from the actuator horn, around a bull wheel (figure 2-41) in the forward belly section and then aft, paralleling the first cable, and attaching to the lower arm of the elevator bell crank. A link rod connects the center arm of the bell crank to the lower elevator surface, aft of the hinge point. An adjustable stop bolt is mounted on Bulkhead 15, between the bulkhead and each vertical arm of the bell crank. These stop bolts limit travel of the bell crank; therefore adjusting them changes the travel of the elevator.

2-145. REMOVAL OF ELEVATOR CONTROL CABLES AND PULLEYS.
a. Remove the center aisle floorboards.
b. Disconnect elevator cables at the turnbuckles located in the belly of the aircraft.
c. Remove tail cowling. See paragraph 2-20.
d. Remove cables from bell crank.
e. Remove bull wheel in forward section of fuselage in belly, fairleads on "X" brace in tail, pulleys under truss at Bulkhead 5 and pulleys at Bulkheads 7, 10 and 15. Remove cables.
f. Remove lug and bolt which attaches the forward cable to the bull wheel. On Serial 51-11599, the lug and bolt are integral, so the bolt head need not be held while removing the nut. Prior to Serial 51-11599, the bolt head must be held with a 45-degree box end wrench and the nut removed from the bolt separately so as to release the cables from the bull wheel.

2-146. MINOR REPAIR AND PARTS REPLACEMENT. Minor repair and parts replacement will consist of replacing cables, pulleys and bell cranks that are badly worn. Cables that are corroded, rusted or have six or more broken strands to an inch must be replaced.

2-147. INSTALLATION OF ELEVATOR CONTROLS.
a. Position the 5/32-inch diameter cable in the left-hand groove of the bull wheel. Install the cable on the bull wheel so the point of attachment is 20-1/2 inches from the end of the swaged terminal sleeve.
b. Install bull wheel, insert bolt, tighten nut securely and key.
c. Connect the longer cable (5/32-inch diameter) to the front of the actuating horn on the torque shaft.
d. Attach the shorter cable (3/16-inch diameter) to the aft side of horn then route both cables aft under the floorboards.
e. Install all pulleys, fairleads and cable retaining clevis pins.

WARNING

Be sure cables are not crossed.

f. Connect the cables to the bell crank on Bulkhead 15. The 5/32-inch diameter cable should be connected to the lower arm of the bell crank. Connect the 3/16-inch diameter cable to the upper arm.
g. Rig cables. See paragraph 2-149.
h. Install center aisle floorboards.
i. Install tail cowling. See paragraph 2-22.

2-148. ADJUSTMENT OF ELEVATOR. The travel of the elevator is controlled by the adjustable stop bolts at Bulkhead 15 (see figure 2-42). The bolt may be screwed in to increase travel and screwed out to decrease travel. Set elevator travel 35 ± 2 degrees up and 25 ± 2 degrees down.

2-149. RIGGING OF ELEVATOR CONTROL SYSTEM.
a. Install elevator contour jig, or provide other means to hold elevator in neutral position.
b. Adjust cable turnbuckles alternately until both cables have 120 ± 10 pounds tension and control column position is from 11-1/2 to 11-3/4 inches from the instrument panel stationary mounting (figure 2-43).
c. Remove contour jig and check system for ease and smoothness of operation.
d. Recheck cable tension. Safety all turnbuckles.

2-150. REMOVAL OF CONTROL COLUMN AND TORQUE SHAFT.
a. Release tension on elevator cables and disconnect cables from the control horn in the belly.
b. Release tension on aileron cables in nacelle openings and disconnect control column cables at turnbuckles and connecting links in Bulkhead 5.
c. Remove pulleys in floor channel brackets at Bulkhead 5 (aft outboard section of belly).

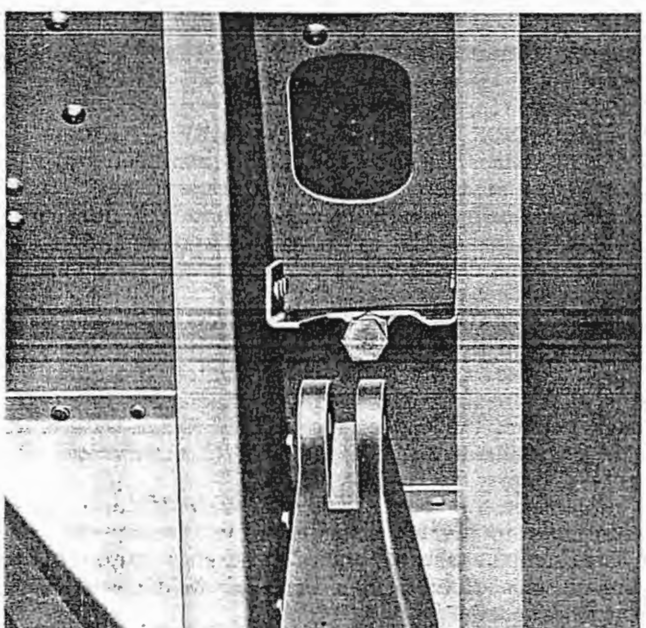


Figure 2-42. Elevator Travel Stop Adjustment

d. Remove connecting bolts from the universal joints and remove the center section of the torque shaft.
e. Remove taper pins holding control column to the torque shaft. Taper pins may be reinstalled if the threads are not damaged. Install reused pins in the same holes from which they were removed.
f. Remove the bolts securing the bearing retainer collars to the torque shaft.

NOTE

Remove paint from torque shaft to aid in the removal of the retainer collars. Mark the bearing retainer collars before their removal as an aid to installing them in the same position on the torque shaft.

g. Working with one control column torque shaft, pull the torque shaft toward the center of the airplane until the control column is free.
h. Remove control column.
i. Continue to pull the torque shaft toward the center of the airplane until the retainer collars may be removed.

NOTE

Mark retainer collars to aid in reinstallation.

j. Remove the inboard bearing, to allow the torque shaft to drop down far enough to clear the torque shaft on the opposite side of the aircraft.
k. Remove the torque shaft. Repeat steps (g) through (k) to remove the opposite torque shaft.

2-151. MINOR REPAIR AND PARTS REPLACEMENT. Minor repair and parts replacement will consist of removal and replacement of the entire torque shaft assembly, torque shaft bearings, and the vibration damper washers in the universal joint.

2-152. INSTALLATION OF CONTROL COLUMN AND TORQUE SHAFT.

CAUTION

Taper pins must be reinstalled in the same holes from which they were removed, or new pins installed.

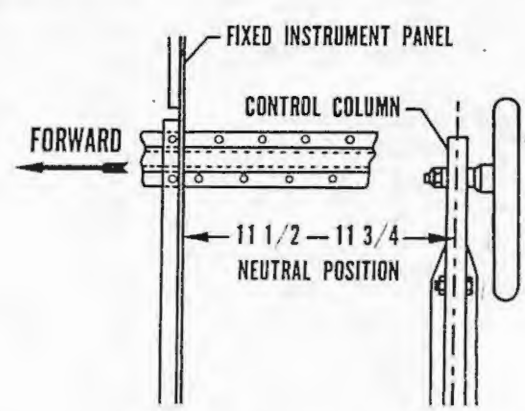


Figure 2-43. Control Column Neutral Setting

a. Work torque shaft into place.
b. Install bearing and slide retainer collars into place.
c. Lower control column into place and slide torque shaft outboard into column until the taper pin holes align. Install taper pins and safety.
d. Place retainer rings in place. Install bolts and safety.
e. Repeat steps (a) through (d) to install opposite torque shaft.
f. Install center section of torque shaft, install bolts and safety.
g. Install pulleys in floor channel bracket (see paragraph 2-94, steps (m) and (n).
h. Connect aileron balance cables and main aileron cables and rig to proper tension (see paragraph 2-96).
i. Connect elevator cables to elevator horn in belly and rig to proper tension (see paragraph 2-149).

2-153. ELEVATOR TAB CONTROL SYSTEM.

2-154. DESCRIPTION. The elevator is trimmed by two tabs, one on each side of the elevator centerline. They are operated simultaneously by a control wheel in the pilot's compartment. The control wheel is mounted on Bulkhead 5 immediately to the right and rear of the pilot's chair. A rheostat in the elevator operates a position indicator, located on the left subpanel. The indicator registers the position of the tabs. The control cables are anchored around a sheave on the control wheel shaft. From the sheave the cables are routed down through the pilot's floorboard and aft under the center aisle floorboards to Bulkhead 10. From this point they angle upward and aft and connect to a chain. The chain passes around a guide and stop block in Bulkhead 14 and up to a drive sprocket in the horizontal stabilizer (figure 2-40). A cross shaft extends from the sprocket in each direction and connects to 90-degree torque drives. Universal joints connect each of these drives with actuators in the elevator (figure 2-44) which in turn operate the tabs. (See figure 2-40 for tab control cable routing.)

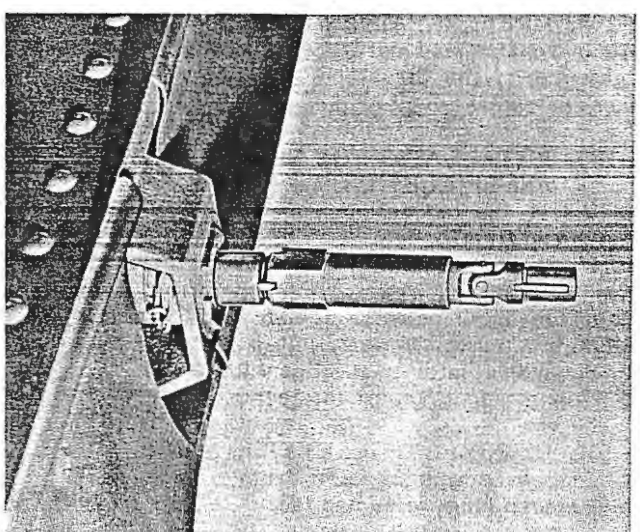


Figure 2-44. Elevator Tab Drive

2-155. REMOVAL OF ELEVATOR TAB CONTROL WHEEL.
a. Release tension from cable.
b. Working in the pilot's compartment, remove cover from cable sheave and remove bearing caps.

NOTE

The bearing caps are not interchangeable. Keep shims and caps so they may be reinstalled in the same position they were before they were removed.

c. Disconnect and remove cables from sheave.
d. Remove control wheel and sheave.

2-156. MINOR REPAIR AND PARTS REPLACEMENT. Minor repair and parts replacement will consist of replacing badly worn cable sheaves, bearings, caps and shafts.

2-157. INSTALLATION OF ELEVATOR TAB CONTROL WHEEL.
a. Working in the pilot's compartment, connect the cable, that comes through the forward hole in the floorboard, to the sheave attaching point nearest the control wheel.
b. Wrap around the sheave four turns. Secure with tape.
c. Connect the cable that comes through the aft hole in the floorboard to the sheave attaching point furthest from the control wheel.
d. Wrap around the sheave three turns. Secure with tape.
e. Mount control wheel and sheave assembly.
f. Install bearing caps and safety.
g. Rig cables to approximately 5 pounds.
h. Remove tape holding cables to sheave.
i. Install the cable sheave cover.
j. Rig cables, (paragraph 2-170) to proper tension.

2-158. REMOVAL OF ELEVATOR TAB CHAIN AND CABLE.
a. Jack up tail of airplane.
b. Working from the tail compartment, disconnect the chain and cables at the clevises.
c. File off the end of the pin holding the stop to the chain on the lower end. Remove pin and stop. (If new chain is to be installed, the pin in both ends of the chain should be removed.)
d. Disconnect actuators from tabs.
e. Pull chain through pulleys and sprocket and remove. A new chain can be installed easily by connecting it to the old chain. The new chain will be drawn into position as the old chain is removed.
f. Remove center-aisle floorboards and remove the pulleys for the elevator tab cables at Bulkhead 7.
g. Remove elevator tab pulleys at Bulkheads 5 and 10.
h. Disconnect cables from sheave in pilot's compartment and remove cables from airplane by pulling them out through the pilot's compartment.

2-159. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs and parts replacement will consist of replacing overly rusted or corroded cables and chains. Cables that have six or more broken strands to an inch will be replaced.

2-160. INSTALLATION OF CHAIN AND CABLE (ELEVATOR TAB).

a. If the old chain is to be reinstalled, begin with end of chain from which the stop has been removed and install as follows: Run chain over the top of the pulley on Bulkhead 14, under the top sprocket on Bulkhead 15, over and around the drive sprocket in the horizontal stabilizer, and under the lower sprocket on Bulkhead 14. See figure 2-40 for tab cable routing.

NOTE

If a new chain is to be installed, the new chain should be attached to the end of the old chain and installed as the old chain is removed.

b. Install stop on end of chain so that the corner of the stop is down. The stop must be installed in this manner for correct operation of the tab.
c. Install cables on sheave in pilot's compartment (see paragraph 2-157, step a) and route cables aft under floorboards. Install pulleys at Bulkheads 5, 7, and 10.
d. Connect actuators to tabs and rig cables. See Table IV for correct cable tension.
e. Set elevator tab indicator (see paragraph 2-170).
f. Install center-aisle floorboards.

2-161. REMOVAL OF ELEVATOR TAB MECHANISM (HORIZONTAL STABILIZER).

a. Remove elevator (see paragraph 2-77).
b. Remove the horizontal stabilizer spar fairing strips on either side of the 90-degree drive assembly.
c. Loosen the jam nut on the underside of the drive assembly bracket.
d. Unscrew the torque-tube drive from the thrust nut.
e. Unscrew the thrust nut which holds the 90-degree drive assembly to the phenolic block.
f. Remove the nut connecting the cross-shaft to the 90-degree drive and remove the drive.
g. Remove the taper pin from the collar at the right end of the cross-shaft and remove the collar.
h. Working from the tail-wheel well, remove the taper pin holding the sprocket to the shaft. Drive the shaft out of the sprocket from right to left.

2-162. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs and parts replacement will consist of replacing the elevator tab 90-degree drive if play or wear is excessive, and lubricating as required.

2-163. INSTALLATION OF ELEVATOR TAB MECHANISM (HORIZONTAL STABILIZER).

a. Place sprocket in position in the bracket and push the shaft from left to right through the sprocket until the pin holes in the shaft and sprocket are in line.

NOTE

Two men are needed for this operation. One man works from the tail-wheel well and holds the sprocket in position while the other installs the shaft.

b. Install pin through sprocket and shaft.

CAUTION

The elevator tab 90-degree drives are left and right hand parts, and are not interchangeable.

c. Attach 90-degree drives to each end of shaft and install pins.
d. Insert slotted drive pin and threaded thrust nut.
e. Insert jam nut between thrust nut and top of bracket and screw collar through the bracket and jam nut into the thrust nut.
f. Tighten thrust nut until the 90-degree drive moves freely but with no lost motion, then safety.
g. Install the stabilizer spar fairing strips on either side of the 90-degree drive assembly.
h. Install elevator. See paragraph 2-79.

2-164. REMOVAL OF ELEVATOR TAB MECHANISM (ELEVATOR).

a. Disconnect actuator from elevator tab.
b. Working through the elevator tab inspection door remove four bolts holding the actuator support to the elevator.

NOTE

If the necessary tools are not available for this operation, loosen the lock nut on the side of the support and back off the setscrew. This will release actuator from the support bracket.

c. Pull actuator aft until it clears the bracket, then remove it through the inspection door.

CAUTION

Care must be used on the left elevator tab actuator to avoid damaging the rheostat mechanism as the actuator is removed. The elevator tab control drive between the bearing and the actuator will drop free as actuator is removed.

2-165. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs and parts replacement will consist of tightening of the thrust nut in the event of excessive play and replacement of the actuator.

2-166. INSTALLATION OF ELEVATOR TAB MECHANISM (ELEVATOR).

a. Insert the tab actuator through inspection door, clevis end first.
b. Move the actuator aft until it clears mounting bracket and then forward into position. Insert elevator tab drive between actuator and bearing as the actuator is moved forward into position.
c. Secure actuator in position with bolts.
d. Connect the actuator to elevator tab.

2-167. REMOVAL OF ELEVATOR TAB.

a. Disconnect actuator arm from tab horn.
b. Remove hinge wire and tab.

2-168. MINOR REPAIR AND PARTS REPLACEMENT. Minor repair and parts replacement will consist of removal and replacement of worn hinge wires. If hinge is worn, repair will be made at a designated overhaul activity.

2-169. INSTALLATION OF ELEVATOR TAB.
a. Place tab in position and install new stainless steel hinge wire.

NOTE

A new wire must be installed each time the tab is removed.

b. Connect actuator arm to horn. Check travel with bubble protractor.

2-170. ADJUSTMENT OF ELEVATOR TABS.
a. Set the trailing edge of the tabs even with the trailing edge of the elevator.
b. Adjust the turnbuckles in the tail compartment.
c. Check tab travel and adjust to 20 ± 2 degrees up, 14 ± 2 degrees down (figure 2-45).
d. Loosen the clamps holding the rack to the tab actuator and move rack until it is centered on the rheostat gear.
e. Move the tab to the extreme position and check the rheostat rack to see that it does not travel too far. Return tab to neutral position.
f. Lift rack and move the rheostat gear until the indicator in the pilot's compartment reads zero (rack is on the left side only).

2-171. RUDDER CONTROL SYSTEM.

2-172. DESCRIPTION. Rudder movement is controlled by dual sets of pedals, mounted on separate shafts. The shafts operate through slots in the cockpit floorboards. A rudder control balance cable connects the copilot's rudder pedals. Cables from the pilot's and copilot's pedals converge at pulleys on the center section truss and run aft where they are connected to the reduction pulleys. These pulleys reduce cable movements at the rudder pedals to one-half that of the rudder control bell cranks. The long rudder cables are routed around these pulleys. One end is attached to Bulkhead 6, the other end runs aft to the rudder bell cranks in the stabilizer. The bell cranks are connected by two balance cables running laterally through the horizontal stabilizer. Link rods connect the bell cranks to the actuating horns on the rudders (figure 2-46). Rudder travel is limited by the bell cranks contacting the stops (figure 2-47).

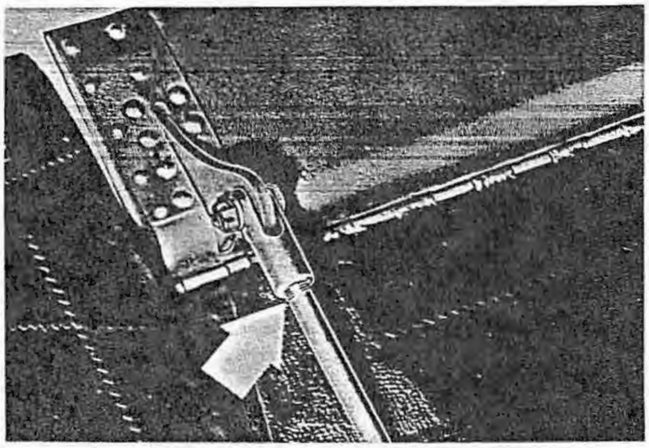


Figure 2-45. Elevator Tab Travel Adjustment

2-173. REMOVAL OF RUDDER CONTROL SYSTEM (AFT OF BULKHEAD 6).
a. Remove the phenolic spacer between the long reduction cables and rear balance cable. (The spacers and cables are accessible through inspection doors on the top surface of the horizontal stabilizer.)
b. Disconnect rudder cables at turnbuckles in the horizontal stabilizer.
c. Relieve the tension on the balance cables by loosening the turnbuckle on the rear balance cable.
d. Disconnect balance cables from bell crank. (Attach a length of safety wire or strong cord to the cables and pull through the stabilizer as cables are removed.)
e. Remove the rear reduction pulleys in aft center of the horizontal stabilizer.
f. Remove pulleys from Bulkheads 10 and 13. (The pulleys are accessible from inside tail compartment.)
g. Remove center aisle and main floorboards in cabin.
h. Remove front reduction pulleys and guide pins between Bulkheads 5 and 6.
i. Disconnect long rudder cables from Bulkhead 6 and remove pulleys at Bulkhead 7.
j. Attach a length of safety wire or strong cord to the cables and pull through the stabilizer as the cables are removed.

2-174. MINOR REPAIR AND PARTS REPLACEMENT. Minor repair will consist of replacing badly rusted or corroded cables or cables that have six or more broken strands in one inch. Check rudder reduction pulleys and pulley slides for excessive wear, grooving, rough bearings and dirt or grit.

2-175. INSTALLATION OF RUDDER CONTROL SYSTEM (AFT OF BULKHEAD 6).
a. Attach balance cables to the previously installed wire or cord. Pull cables into stabilizer and attach to bell crank.
b. Attach the long rudder cables to the previously installed wire or cord and pull into position through the stabilizer. Attach to the turnbuckles in horizontal stabilizer, after the lead line is removed.
c. Place the long rudder cables in correct position in fuselage and install the pulleys and guide pins for the pulleys at Bulkheads 7, 10 and 13.
d. Install the main pulleys and guide pins for the pulleys in the horizontal stabilizer.
e. Adjust turnbuckles on forward ends of rudder reduction cables until all threads are covered. Safety turnbuckles and attach to Bulkhead 6.
f. Install front reduction pulleys and pins between Bulkheads 5 and 6.
g. Rig rudder cable system. See paragraph 2-182.
h. Install the phenolic spacer between the long cables from the reduction pulleys and the rear balance cable in the horizontal stabilizer.
i. Install floor boards after entire system is rigged.

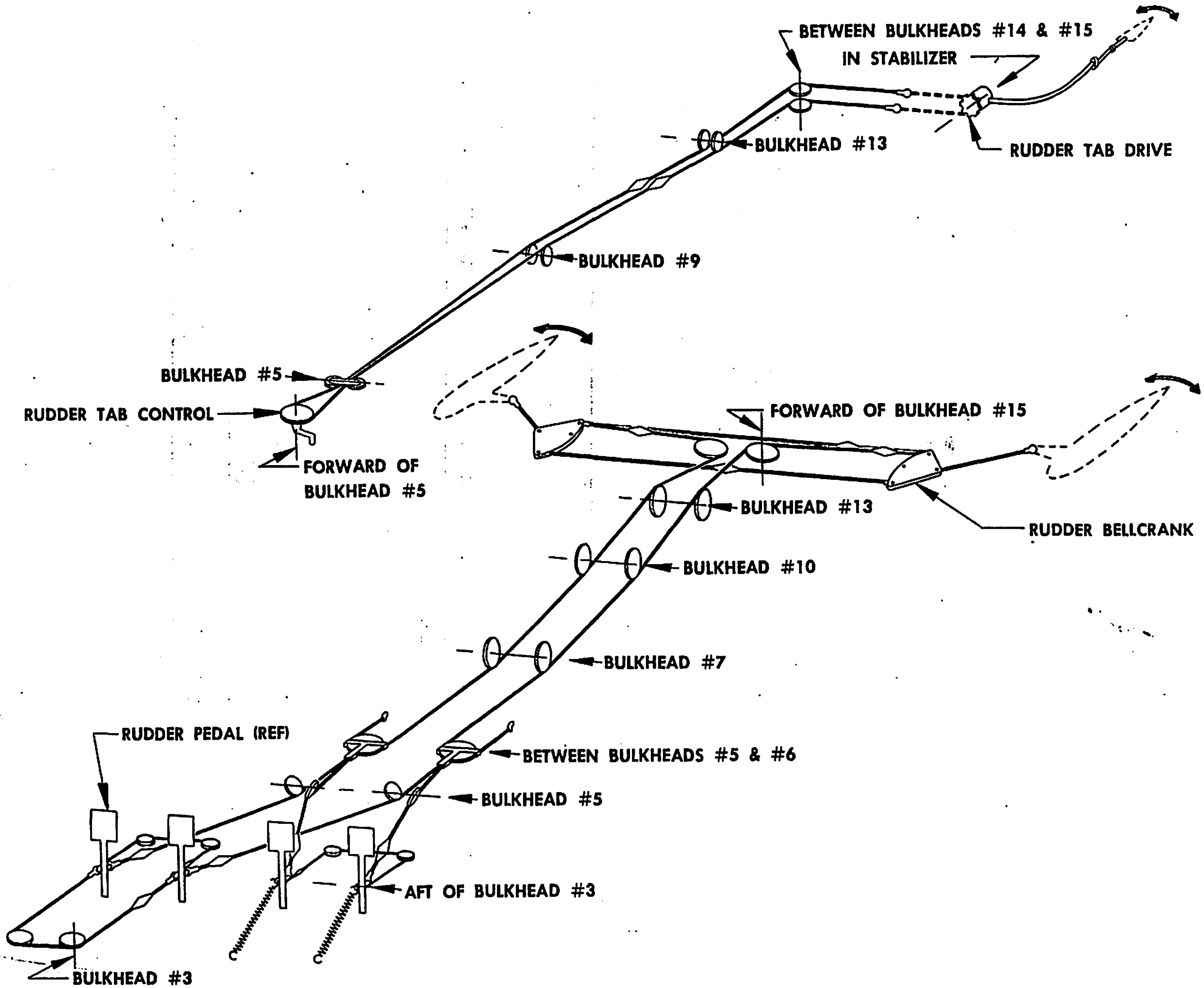


Figure 2-46. Rudder and Rudder Tab Control Systems

2-176. REMOVAL OF RUDDER CONTROL SYSTEM (FORWARD OF BULKHEAD 6).

a. Release tension on rudder cables in belly at turnbuckles just aft of rudder pedals.
b. Remove rudder pulleys under truss at Bulkhead 5.
c. Remove center-aisle floorboards.
d. Disconnect rudder cables from reduction pulleys between Bulkheads 5 and 6.
e. Remove bolts which attach cables to rudder pedal sockets on cross shaft.
f. Remove fairlead at left-hand center of belly through which cable is routed and remove cables.
g. Release tension on both balance cables.
h. Remove bolts which attach balance cables to pedals.
i. Remove balance cable pulleys.
j. Remove cables.

2-177. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs and parts replacement will consist of the removal and replacement of pulleys which are excessively grooved, pulleys which are rough or sticky in operation and cables which are corroded or have six or more broken strands in any one inch of cable.

2-178. INSTALLATION OF RUDDER CONTROL SYSTEM (FORWARD OF BULKHEAD 6).

a. Route balance cable in position in pulley brackets and install pulleys.
b. Attach balance cables to rudder pedals.
c. Route rudder cables in belly in their correct position under the truss at Bulkhead 5 and install pulleys.
d. Attach cables to reduction pulleys at Bulkhead 6.
e. Place center-aisle floorboards in position. Do not install until entire rudder cable system has been rigged.
f. Attach cables in the belly to rudder pedal sockets.
g. Install fairlead at left-hand center of belly in mounting bracket.
h. Rig cables. See paragraph 2-182.

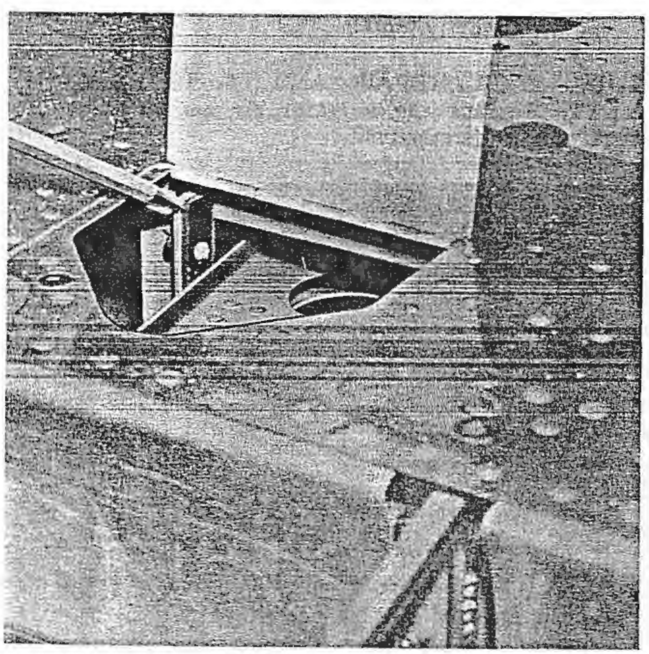


Figure 2-47. Rudder Travel Adjustment

2-179. REMOVAL OF RUDDER PEDALS.

a. Relieve tension from balance cables and disconnect them from the pedals.
b. Remove pin from collar at bottom of pedal shaft.
c. Disconnect toe brake rod and remove the pedal.

2-180. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs and parts replacement will consist of the replacement of the entire rudder pedal assembly.

2-181. INSTALLATION OF RUDDER PEDALS.

a. Slip pedal shaft into collar on shaft and install pin.
b. Connect toe brake rod to pedal.
c. Attach cables to rudder pedal shaft and rig. See paragraph 2-182.

2-182. RUDDER CABLE RIGGING AND ADJUSTMENTS.

a. Tighten turnbuckle barrel on the forward end of each reduction cable until all the threads on the terminals are covered.
b. Set the aft end of each reduction pulley 5/32 inch from the end of the slot in the slide (figure 2-48).
c. Secure pulleys in this position with a C-clamp.
d. Set rudders in neutral position.
e. Through inspection doors in horizontal stabilizer, set tension on reduction cables to 50 ± 10 pounds, on rear balance cable to 30 ± 10 pounds and on front balance cable to 80 ± 10 pounds. Maintain neutral setting.
f. Set pilot's and copilot's pedals in neutral; place a pin the same size as the opening in the pedals between each set of pedals to hold them in neutral (figure 2-49).
g. Set pilot's pedals 11-1/2 inches and copilot's pedals 12-1/4 inches from forward edge of floorboards (figure 2-49).

NOTE

On all airplanes with gear-type brakes, Serials 51-11593 and after, except 51-11733 through 51-11743, both sets of brake toe pedals can be positioned 1-1/8 inches forward of their original setting, or 10-3/8 inches aft of M/L Bulkhead 3. See figure 2-63. Both the push rod clevis and the master brake cylinder linkage

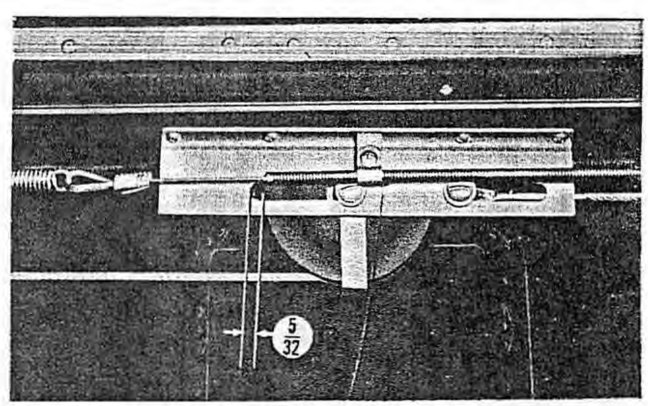


Figure 2-48. Rudder Reduction Pulley Setting

must be adjusted to obtain this setting, which permits the pilot a more relaxed position. The gear-type brake requires a smaller fluid displacement, making this setting possible.

h. Adjust brake and pedal balance cables on copilot's pedals to hold rudder pedal neutral setting.
i. Adjust cables from copilot's pedals to reduction pulleys with sufficient tension to maintain the 5/32-inch measurement at reduction pulleys with C-clamps removed. While adjusting these cables, alter the adjustment of the pedal balance cable in order to maintain the 12-1/4 inch pedal neutral setting.
j. Adjust slack out of copilot's brake balance cable.
k. Adjust slack out of cables from pilot's pedals to reduction pulleys. Adjust enough tension in these cables to hold the 11-1/2 inch neutral setting.
l. Adjust slack out of pilot's brake balance cable.

NOTE

The rudder cables and brake balance cable on the pilot's pedals will have very light tension due to the spring balance used in place of a balance cable on pilot's pedals.

m. With servo piston in the center of travel and rudder pedals in neutral setting, adjust servo cables to 35 pounds ± 5 pounds. Safety all turnbuckles.

2-183. RUDDER TAB CONTROL SYSTEM.

2-184. DESCRIPTION. The single trim tab on the left rudder is positioned by a hand crank on the overhead between the pilot's and copilot's seats; the position of the tab is indicated by an indicator beside the crank. On C-45G and TC-45G airplanes, the indicator is operated by a friction drive; on the C-45H, a gear drive is used. The tab control cable runs aft from the crank pulley to a point near the center of the horizontal stabilizer, where it angles left and ends in a chain which turns a 90-degree drive. A flexible shaft connects the 90 degree drive and the tab actuator.

2-185. REMOVAL OF RUDDER TAB.
a. Disconnect actuator from tab.
b. Remove tab hinge wire and remove tab (figure 2-50).

NOTE

A new hinge wire must be installed each time tab is removed and reinstalled.

2-186. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of checking the hinge for excessive wear. If play is evident, install a new hinge wire. Should this fail to eliminate play, replace hinge.

2-187. INSTALLATION OF RUDDER TAB.
a. Place tab into position on the rudder and install new hinge wire. Hinge wire may be installed by slowly tapping in place with a rawhide mallet.
b. Connect actuator to control horn.

2-188. REMOVAL OF RUDDER TAB ACTUATOR (RUDDER).
a. Disconnect tab actuator arm from horn.
b. Remove nuts attaching actuator mount to rib in the rudder.

NOTE
If tools are not available for this operation, the actuator may be removed by loosening lock nut and backing off set screw on the side of the mounting bracket.

c. Pull actuator mechanism aft until it clears and then remove it through the inspection opening.

CAUTION

As actuator is moved aft, the rudder tab control drive will drop free. This is a small part and easily lost.

2-189. MINOR REPAIR AND PARTS REPLACEMENT. Replace the actuator mechanism when excessive wear is apparent.

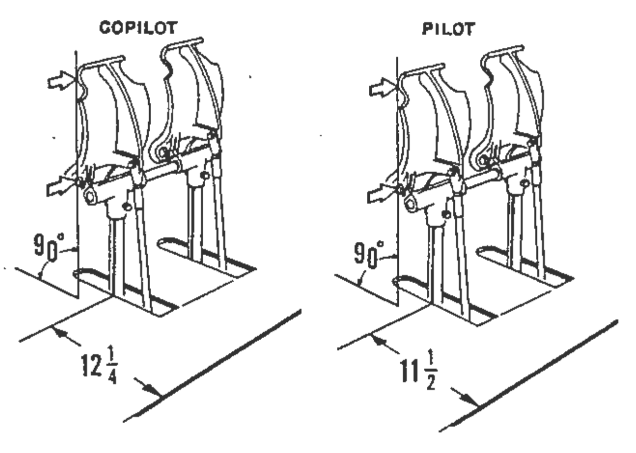


Figure 2-49. Rudder Pedal Neutral Setting

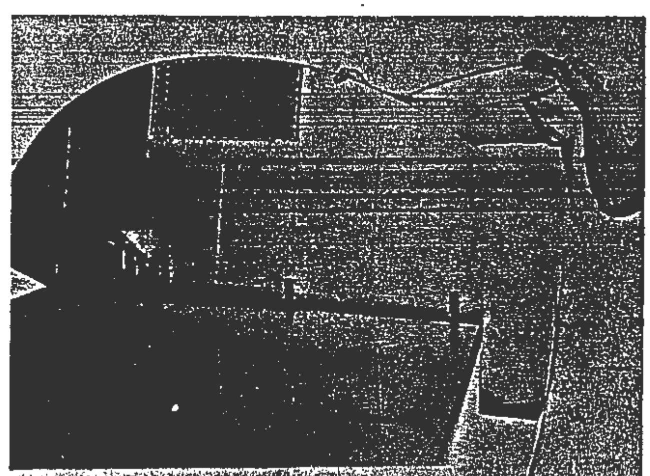


Figure 2-50. Rudder Tab Hinge Wire Removal

2-190. INSTALLATION OF RUDDER TAB ACTUATOR (RUDDER).

a. Slip actuator mechanism into inspection opening in the rudder, clevis end first, move it aft until it clears the rib and then up into position.

CAUTION

When the actuator mechanism is moved up into position, be sure to replace the drive connecting the actuator with the universal joint fitting at the bearing.

b. Install nuts or setscrew and tighten. Safety the nuts or setscrews.

c. Connect actuator arm to horn and safety.

2-191. REMOVAL OF 90-DEGREE DRIVE AND CHAIN (HORIZONTAL STABILIZER).

a. Disconnect rudder tab cables in aft section of fuselage approximately at Bulkhead 12.

b. Remove clevis pin from pulleys at Bulkhead 13 and in the horizontal stabilizer approximately Bulkhead 14.

c. Disconnect flexible drive shaft from the 90-degree drive. (Flexible drive is accessible through the rudder tab inspection cover on the horizontal stabilizer, figure 1-5.)

d. Remove the bolts holding the 90-degree drive to the stabilizer spar.

e. Remove the chain guard from the 90-degree drive and remove drive.

f. Attach a lead line to the cables in side of the fuselage and pull the lead line through the stabilizer as the chain and cables are removed.

2-192. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of replacing cables with six or more broken strands, chains that are rusted or damaged and replacement of the 90-degree drive.

2-193. INSTALLATION OF THE 90-DEGREE DRIVE AND CHAIN (HORIZONTAL STABILIZER).

a. Install cables and chains into position by previously installed lead lines.

b. Install chain on sprocket of the 90-degree drive and install chain guard.

c. Install the drive on the stabilizer spar and safety.

d. Position chains and cables in place, making sure they are not crossed, and install clevis pin.

e. Connect cables in aft section of fuselage and rig to proper tension. See Table IV.

2-194. REMOVAL OF RUDDER TAB CABLES (CABIN COMPARTMENT).

a. Disconnect rudder tab cables in aft section of fuselage approximately at Bulkhead 12.

b. Cut fitting off one end of the cable and pull out.

NOTE

The old cable and the new cable should be joined. Draw the new cable into position as the old one is removed. The connection should be no larger than the cables.

2-195. MINOR REPAIR AND PARTS REPLACEMENT. Cables which have more than six broken strands in any one inch of cable or cables which are rusted or corroded must be removed and replaced. Check condition of all pulleys.

2-196. INSTALLATION OF RUDDER TAB CABLES (CABIN COMPARTMENT).

a. If a new cable is needed it must be installed as the old cable is removed.

b. Cut cable fitting off one end of the old cable.

c. Connect the cut end of the old cable and the end of the new cable which does not have a fitting. Make the connecting joint no larger than the cables or difficulty will be encountered when the new cable is drawn through the fairleads and pulleys.

d. Remove the old cable and draw the new cable into position at the same time.

2-197. ADJUSTMENT OF RUDDER TAB CONTROL SYSTEM.

a. Rig rudder tab cables to a tension of 10 ± 2 pounds.

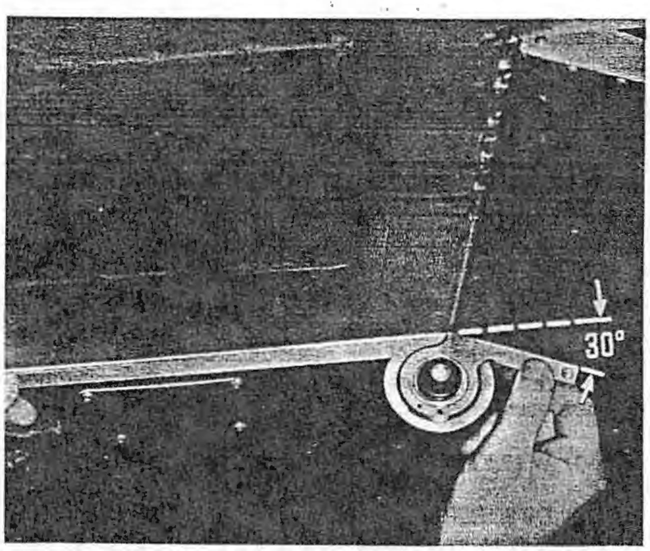


Figure 2-51. Rudder Tab Travel Check

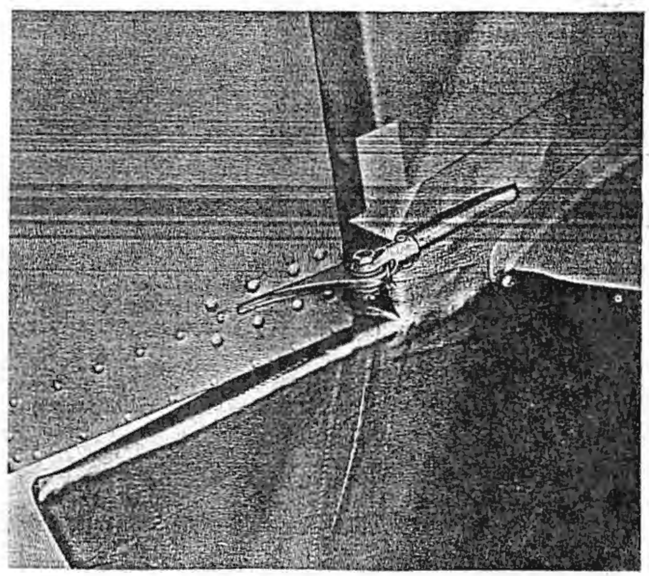


Figure 2-52. Rudder Tab Travel Adjustment

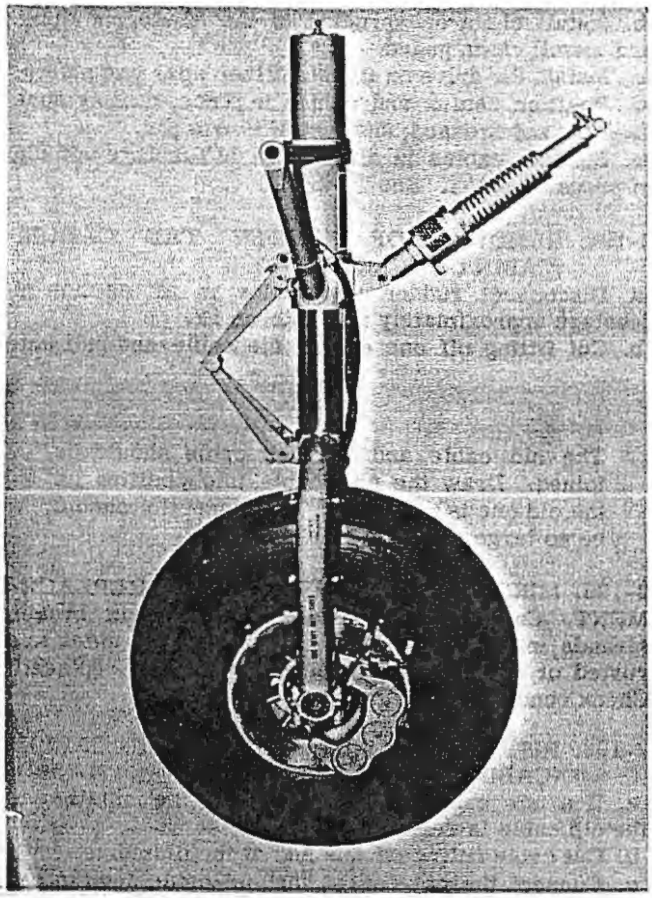


Figure 2-53. Landing Gear Assembly

b. Turn the tab either right or left until it hits the stop.
c. Disconnect the actuator from the tab horn.
d. Using a protractor (figure 2-51) set the tab at 30 degrees ± 2 degrees.
e. Adjust the actuator rod so it will connect to the tab horn in this position (figure 2-52).
f. Check the tab for 30 degrees ± 2 degrees travel each way.
g. Safety all connections.

2-197A. (Deleted).

(Deleted)

2-198. MAIN LANDING GEAR SYSTEM.

2-199. DESCRIPTION. The main landing gear (figure 2-53) incorporates an air-oil shock absorber, with self-compensating rebound control. The shock absorber piston is integral with the wheel fork, while the cylinder (upper portion of the strut) is mounted in a V-brace pivoted on bolts through bushings in the center section truss. Beginning with Serial 51-11656, the fibre stop nuts on the hinge bolts were replaced with thinner nuts; spacers in conjunction with the fibre stop nuts allow more threads on the hinge bolts to extend through the nuts. The gear is drawn up and back by the oleo drag leg, which also dampens longitudinal loads in taxiing. The drag leg is connected to a chain-driven retract slide which moves on a slide tube running forward and upward in the nacelle and secured to the center section truss. The retract chains are driven through torque shafts from the landing gear motor and gearbox in the belly. A switch on the control pedestal starts the motor in either direction, through a dynamic brake relay; limit switches actuated by the slide in the left nacelle stop the motor at the end of travel. In conjunction with the limit switches, similar switches in the right nacelle and tail wheel well control the position switch lever warning light and the position indicator. To prevent accidental retraction of the gear on the ground, a solenoid latch in the position switch is actuated by switches on each torque knee.

2-200. WHEELS, TIRES AND TUBES.

2-201. DESCRIPTION. Each main landing gear is equipped with a twelve-inch split wheel (figure 2-54). Twelve bolts and nuts hold the two balanced sections of the wheel together. Each section is statically balanced independently of the other and, for maintenance purposes, may be replaced separately. The outboard half is provided with an extended flange equipped with hardened steel drive keys to accommodate the slots in the brake disc. The tapered roller bearings are seated in hardened steel cones.

2-202. The main landing gear wheel bearings, tail wheel bearings and grease seals shall be cleaned and relubricated as specified in the applicable -6 Handbook of Inspection Requirements, at each wheel change, tire change or when exposed to steam, solvent, etc. during washing of aircraft, and may be accomplished as follows:

a. Remove main landing gear wheels as directed in paragraph 2-203.a. through i.

b. Remove tail wheel as directed in paragraph 2-260. a. through c.

c. Clean wheel bearings with solvent, Specification P-S-661, to dissolve the grease and remove contamination from the bearings.

CAUTION

Solvent should be handled in Underwriter's approved type containers. Protective equipment (gloves, aprons and barrier creams) should also be used when washing bearings or grease seals in solvent.

d. Repack serviceable bearings with grease, Specification MIL-L-3545, before installation, except in the event the aircraft is operating in extremely low temperature. The use of grease, Specification MIL-G-3278, is then permissible.

e. Clean felt seals with solvent, Specification P-S-661. Dry seals thoroughly, using moisture free air or absorbent solvent with a lint free cloth, then let dry in free air.

f. After drying, oil the seals with light machine oil, No. 10, Specification MIL-L-7870, before reinstallation.

g. Remove felt seals from service if after normal cleaning (1) seals are still imbedded with foreign matter (2) the felt material is not pliable and (3) the material is broken or does not retain the necessary shape to afford proper sealing. Install serviceable seals.

h. Clean the axles, wheel hub interiors and bearing cups, using Solvent, P-S-661 or kerosene, dry thoroughly with a lint free cloth.

i. Lightly coat the surfaces of the axles, wheel hub

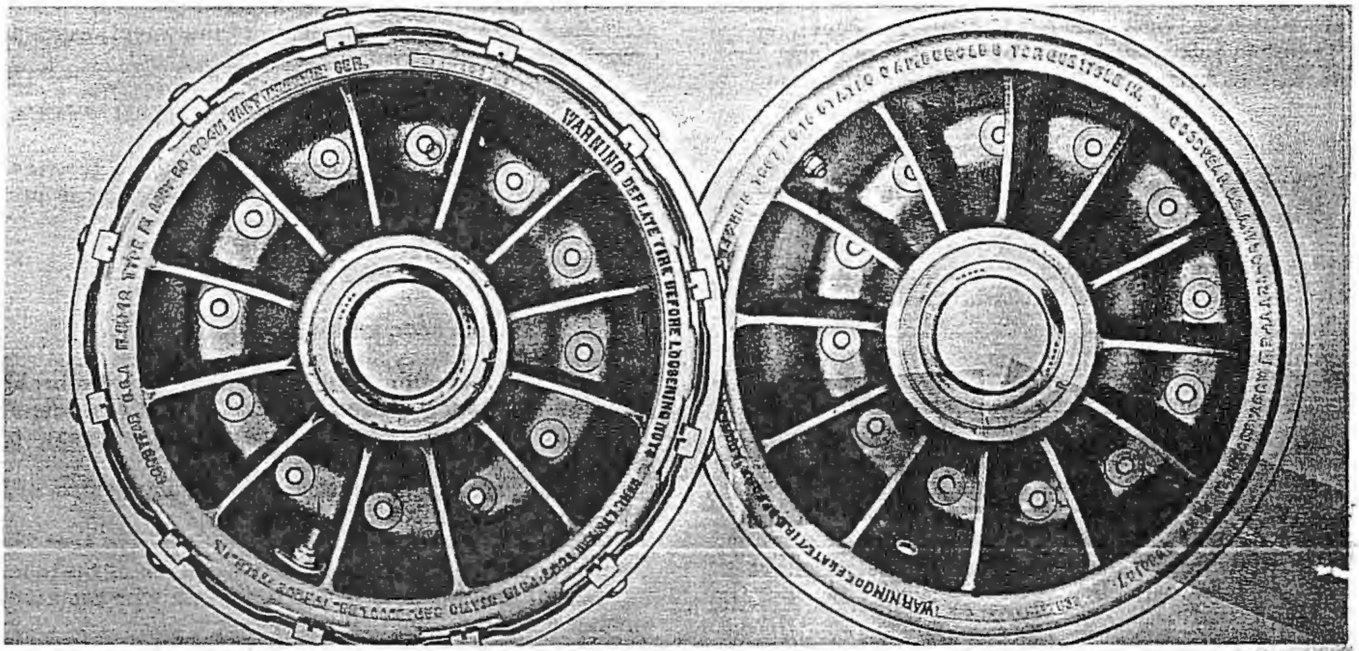


Figure 2-54. Wheel Assembly

interiors and bearing cups with grease, Specification MIL-L-3545.

j. Reinstall wheels using reverse procedure for removal. Tighten the axle nuts until all side play is eliminated and the bearings are properly seated. Make the necessary adjustments to eliminate any brake drag. (Wheel drag should not be confused with drag encountered in some disc type brake conditions.)

k. Back off the axle nut slightly, then rotate the wheel by hand and retighten the axle nut until a slight bearing drag is felt at the wheel.

l. If the cotter pin hole lines up at this position, insert cotter pin and safety without backing off adjustment nut. If necessary to move adjustment nut in order to insert cotter pin, back adjustment nut off to the closest point or castellation to line up hole, insert cotter pin and safety.

m. After wheels are reinstalled, and using a lint free cloth, remove all contamination surrounding the external surfaces of the bearings to prevent possible collection of sand, dirt or grit.

2-203. REMOVAL OF LANDING GEAR WHEEL.

a. Deflate shock absorber from which wheel is to be removed, until strut lacks approximately one inch from being fully deflated.

b. Secure torque knees in this position with strong wire or other suitable securing method.

c. Place a jack in position at the jack point on the side of the airplane from which the wheel is to be removed.

d. Jack aircraft up slowly until wheel is clear.

e. Identify bearing caps as to position and mating with paint or grease pencil.

CAUTION

The bearing caps securing the axle to the strut fork are not interchangeable or reversible.

f. Remove clamps holding brake lines to fork assembly.

g. Remove safety wire and nuts holding bearing caps in place.

h. Remove the bearing caps and carefully lower wheel to the ground. To avoid disconnecting brake lines, mount one end of axle back in the fork assembly and replace bearing cap. This will eliminate the necessity of bleeding the brakes and provide a suitable means for supporting the wheel assembly for the following steps.

i. Remove clevis pin from axle nut, unscrew nut with a landing gear nut wrench (figure 1-24) and re-

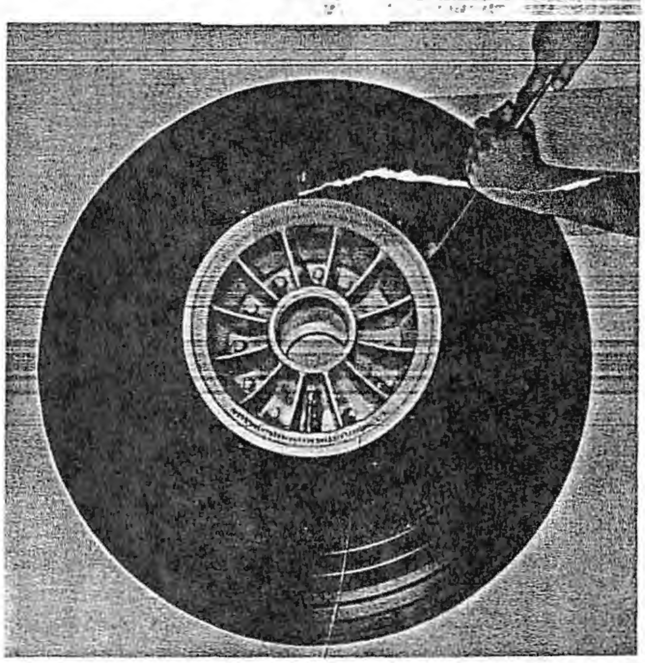


Figure 2-55. Dismounting Tire

move axle and brake assembly from the wheel.
j. Remove valve core and fully deflate the tube.
k. Lay tire flat.

WARNING

Make sure the tire is fully deflated before disassembling wheel.

l. Break bead loose from rim with a suitable set of tire tools and a rubber mallet (figure 2-55).

NOTE

Even with approved tools, extreme care should be exercised not to injure the beads of the tires or the relatively soft metal of the wheels.

m. Remove the twelve bolts and nuts and pull out both halves of the wheel (figure 2-56).
n. Deflate tube as much as possible and remove it.

NOTE

Use Dow No. 1 Chrome Pickle Specification MIL-M-3171 on the wheel after the area has been cleared of nicks and burrs. Allow the solution to remain two to three minutes then wash off with clean water. Apply two mist coats of zinc chromate primer, Specification MIL-P-6889. Dry. Then apply two coats of aluminum lacquer. (Specification MIL-L-7178 and Federal Specification TT-A-468.)

2-204. MINOR REPAIR AND PARTS REPLACEMENT. Before mounting tire on the wheel make sure there are no cracked or damaged parts. Burrs or nicks in the wheel should be removed with a file to prevent possible damage to the tire or tube. The tire and tube should be carefully inspected for damage or signs of potential failure. Use no lubricant on the tire beads or on the bead seats of the wheel, since it may result in the tire slipping on the wheel.

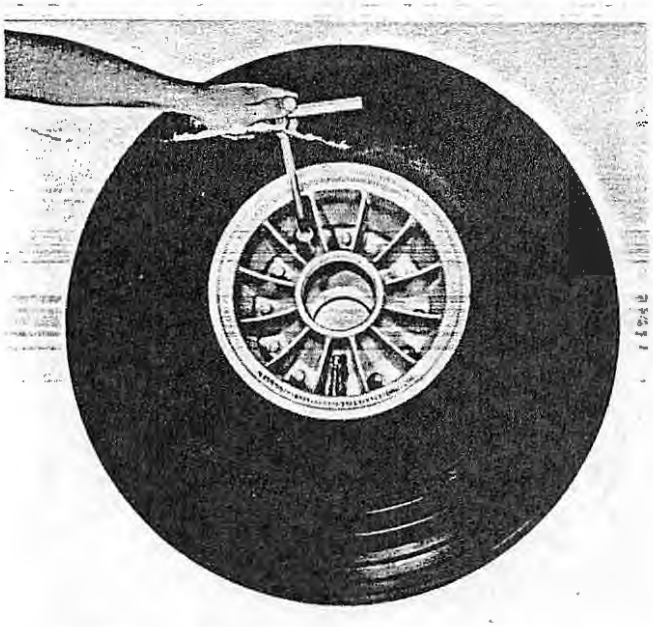


Figure 2-56. Removing Retaining Nuts

2-205. INSTALLATION OF LANDING GEAR WHEEL, TIRE AND TUBE.
a. Insert the tube, completely deflated, in the tire. Install valve core and inflate until the tube is just rounded out.

NOTE

Align balance marks on tube and tire.

b. Place the section of the wheel without the brake in the tire. Insert valve stem to valve hole in wheel.
c. With valve in position, insert the other half of wheel. Take care not to pinch the tube.
d. Install bolts and retaining nuts. Tighten to 175 inch-pounds.
e. Inflate and deflate tube several times to seat the beads, remove wrinkles and prevent pinching the tube.
f. Install the wheel and brake assembly on the axle; install axle, nut, clevis pin and key.
g. Place wheel in fork. Install bearing caps. Tighten nuts to specific torque as noted in paragraph 2-222, and safety.

CAUTION

Do not interchange or reverse the bearing caps.

h. Inflate tire, remove jack and inflate shock strut.

2-206. HYDRAULIC BRAKES (DUAL SYSTEM).

2-207. GENERAL. C-45G, TC-45G and C-45H airplanes incorporate dual brake systems. The toe brake pedals are connected to the cross shaft linkage by means of push pull rods and bell cranks. The brake pedal push rods used on Serial 51-11840 and after, are fabricated of heavier material than those used formerly to preclude the possibility of the push rod failing under an excessive braking load. The end fittings of the push rods were changed accordingly. The brake master cylinder bell crank (Part No. 734-187927) is now replaced with an improved type (Part No. 694-187927) which has a greater wall thickness and uses no oilite bushing. A return spring is attached by a clip in the forward hole in each bell crank and anchored to the underside of the floorboards. These springs aid in returning the brake pedal to the neutral position upon release of the pressure on the brake pedal. The cross shaft linkage actuates the master brake cylinders mounted in the belly compartment. A control, installed in the lower pedestal, operates parking brake valves located in the belly. Shuttle valves, mounted on each wheel brake casting, incorporate small pistons which slide over internal openings in the valve and determine which part of the system (pilot's or copilot's) is used. Beginning with Serial 51-11605, the 90-degree elbow in the bottom of the parking brake valve casting has been replaced with a nipple. New lines are fabricated and routed in a slightly different manner in order to attach to the nipple. Effective with Serial 51-11535 a steel support bracket is welded to top horizontal member of landing gear V-brace. Two bulkhead fittings are installed in holes drilled through bracket and serve as a connection between flexible brake lines and 1/4-inch rigid brake lines. The brake lines were formerly held in place by clamps installed on inboard hinge bolt retaining bolt.

2-208. TROUBLE SHOOTING. See Table VI.

2-209. WHEEL BRAKE ASSEMBLY (KEY TYPE). The single-disc, key-type brake assembly (figure 2-57) located on each main landing gear consists of two main parts, the housing assembly attached to the axle and the disc driven by the wheel. The housing assembly contains three pressure cylinders, each equipped with a piston assembly and movable circular lining segments. As the brake pedals are depressed, the hydraulic fluid pressurizes the cylinders simultaneously, causing the pistons in the cylinders to press the linings against the disc. The disc is forced laterally against stationary lining segments on opposite side of housing, causing braking action on disc.

2-210. REMOVAL OF WHEEL BRAKE ASSEMBLY (KEY TYPE).

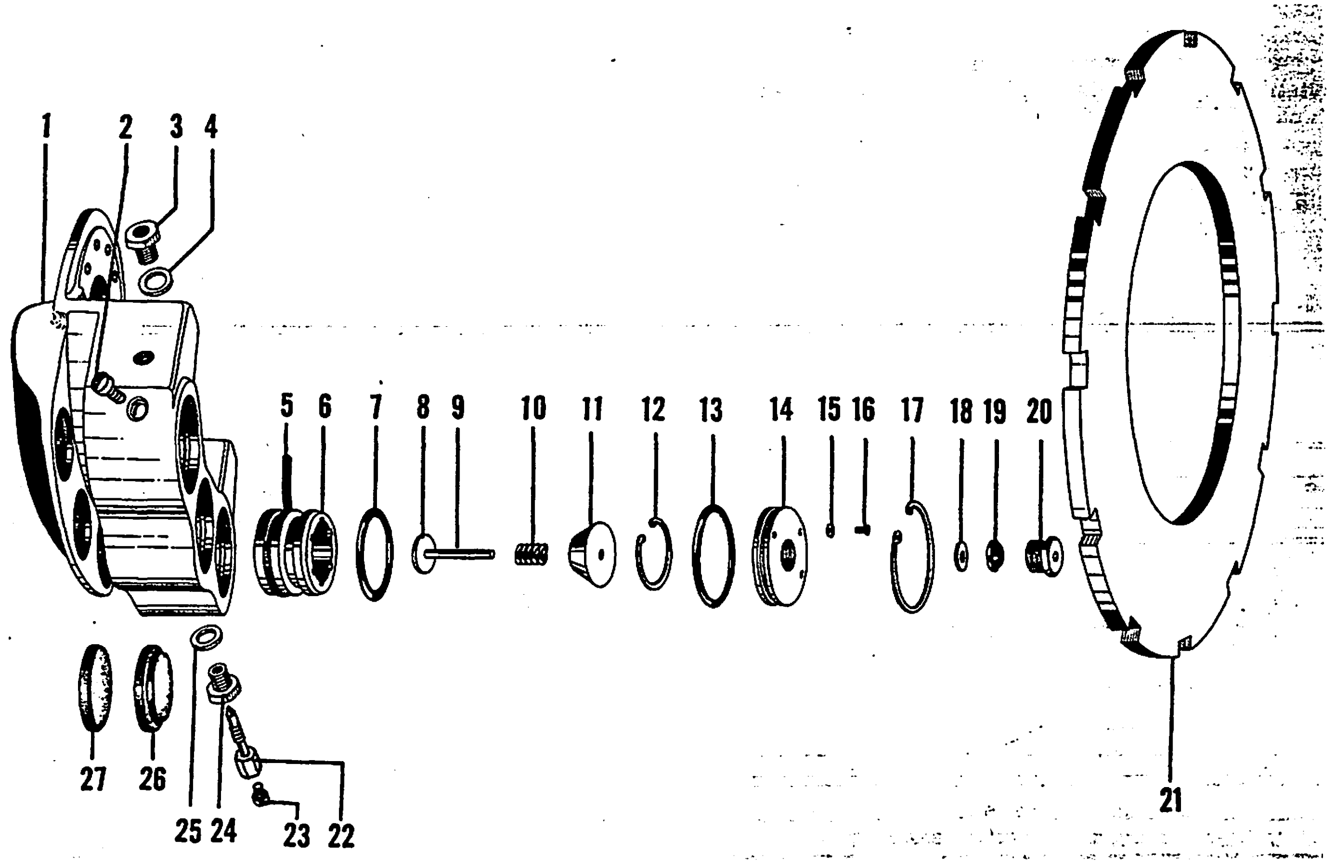
a. Support the airplane on jacks.

b. Disconnect the flexible brake hoses at the shuttle valve on the brake casting and drain the brake system. Do not disconnect brake lines at casting if only brake lining or lining segment is to be replaced. The system should be drained when disassembly of entire brake assembly is to be accomplished.

c. Remove wheel assembly from landing gear fork.

CAUTION

Mark axle bearing caps with grease pencil or paint as an aid to reinstalling them correctly.



1. Brake Housing
2. Upper Bleed Screw
3. Shuttle Valve Reducer
4. Reducer Seal
5. Dust Seal
6. Piston
7. Piston O-Ring
8. Return Spring Movable Plate
9. Adjusting Pin
10. Return Spring
11. Return Spring Stationary Plate
12. Lock Ring (Tru-Arc)
13. Cylinder Head O-Ring
14. Cylinder Head
15. Wheel Cylinder Bleed Screw Seal
16. Wheel Cylinder Bleed Screw
17. Cylinder Head Lock Ring
18. Adjusting Pin Packing Gasket Washer
19. Adjusting Pin Packing Gasket
20. Adjusting Nut
21. Brake Disc
22. Lower Bleed Port
23. Lower Bleed Screw
24. Lower Bleed Port Reducer
25. Reducer Seal
26. Outboard Lining Segment
27. Inboard Lining Segment

Figure 2-57. Brake Assembly (Key Type)

d. Remove the brake axle from the wheel by removing the axle nut and washer and pulling the brake assembly and disc away from the wheel.

2-211. DISASSEMBLY OF WHEEL BRAKE ASSEMBLY (KEY TYPE).

a. Remove lock wire from bleeder screw on top and bottom of brake casting.

b. Remove lock wire from adjusting pin packing nut and back off adjusting nut.

c. Remove lock ring from brake casting and pull piston assembly from casting.

d. Remove spring return plate lock ring.

e. Remove spring return plate, piston return spring and piston adjusting pin.

f. Remove brake piston O-ring from cylinder head.

2-212. MINOR REPAIR AND PARTS REPLACEMENT. Replace brake lining segments if face is worn to a minimum thickness of 1/16 inch. If the adjusting pin is flush with adjusting pin nut and/or the gap between the outboard housing and the center of the disc face exceeds 0.438 inches, as shown in figure 2-59, with brakes applied, linings should be checked for excessive wear and replaced if necessary. Glazed brake linings, if worn only slightly, are considered serviceable. Replace brake linings in complete sets. Do not mix new and used linings. Replace the brake disc when it becomes warped, dished or when the thickness is 0.360 inches or below, measured at its thinnest section. Damaged seals and O-rings should be replaced.

2-213. ASSEMBLY OF WHEEL BRAKE ASSEMBLY (KEY TYPE).

a. Use hydraulic oil, Specification MIL-O-5606, and lubricate the cylinder walls and all parts to be installed.

b. Install the O-ring and dust seal felt strip on the piston assembly.

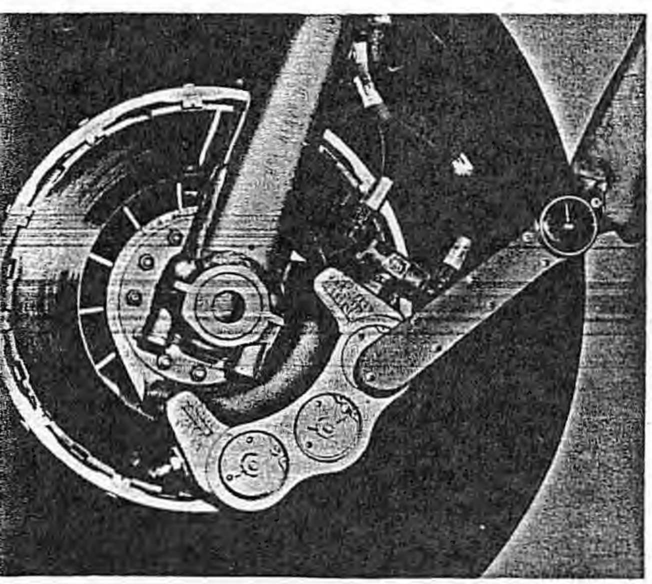


Figure 2-58. Brake Cylinder Packing Nut Adjustment

c. Install piston adjusting pin, piston return spring, spring return plate and spring plate lock spring.

d. Insert piston assembly into brake casting cylinder.

e. Install O-ring on piston assembly and insert piston into brake casting. Install lock ring.

f. Install washer gasket, packing screw adjusting nut gasket and adjusting nut on adjusting pin.

2-214. INSTALLATION OF WHEEL BRAKE ASSEMBLY (KEY TYPE).

a. Install the lining segments in piston side of cavities.

b. Install the lining segment in the stationary side of the brake housing.

c. Hold the lining segments apart, slip the steel disc between them and insert the axle in the wheel.

d. Slide the slots of the brake disc into the wheel keys.

e. Tighten the bearing retaining nut until the axle no longer will turn, then back off the nut until the axle will turn freely. Safety the axle nut.

f. Install the wheel on the landing gear fork. Install the axle bearing caps which are held in place by the internal wrenching retaining nuts. Tighten nuts as noted in paragraph 2-222, and safety.

CAUTION

The axle bearing caps are not interchangeable and must be installed in the same position from which they were removed.

g. Connect the flexible hoses at the shuttle valves and bleed brakes (paragraph 2-242).

h. Remove the airplane from the jacks.

2-215. ADJUSTMENT OF WHEEL BRAKE ASSEMBLY (KEY TYPE). The single-disc brake is self-compensating and requires no lining clearance adjustment. An increased volume of fluid between the cylinder head and the piston compensates for lining wear during the life of the brake lining. The brake pedal setting requires no adjustment and remains constant regardless of the lining wear. Brake pedal setting can be changed at attaching brake rod clevis. If fluid leakage is noted around adjusting pin, check adjusting pin nut for proper torque (figure 2-58). Torque the adjusting pin nut to 25 foot-pounds (300 inch-pounds). If leakage continues, replace adjusting pin packing gasket. Do not over torque adjusting pin nut to stop leakage. Safety wire the adjusting pin nut after torqueing.

2-216. WHEEL BRAKE ASSEMBLY (GEAR TYPE). On C-45G and TC-45G airplanes, Serials 51-11501, 51-11502, 51-11503 and Serial 51-11596 and after, the key type brake and wheel assembly is replaced with a more durable brake and wheel assembly incorporating gear type teeth providing a more positive linkage between the floating brake disc and wheel assembly. The floating brake disc utilizes gear type teeth milled around the outer edge of the disc instead of the slots originally used. Matching teeth on the extended flange of the wheel assembly intermesh with those on the brake disc. The brake cylinder pistons, formerly held in place by snap rings (Tru-arc), now incorporate a threaded cap which screws into the brake cylinder. The internal assembly of the brake cylinder and piston remains basically the same.

2-217. REMOVAL OF WHEEL BRAKE ASSEMBLY (GEAR TYPE).

a. Support airplane on jacks.

NOTE

Do not disconnect the brake lines at the shuttle valve if only the brake lining or lining segment is to be replaced. The system should be drained when disassembly of the brake unit is to be accomplished.

b. Disconnect brake lines at the shuttle valve and drain the brake system.
c. Remove the wheel assembly from the landing gear fork.

CAUTION

Mark the axle bearing caps with a grease pencil or paint as an aid to reinstalling them correctly.

d. Remove the brake axle from the wheel by removing the axle nut and washer and pulling the brake assembly and disc away from the wheel.
e. Remove the floating steel disc by holding the lining segments apart and pulling the disc free.

2-218. DISASSEMBLY OF BRAKE ASSEMBLY (GEAR TYPE).

a. Remove lock wire from bleeder screw on top and bottom of brake casting.
b. Remove lock wire from adjusting pin packing nut and back off adjusting nut.
c. Unscrew cylinder head from brake casting and pull piston assembly from brake casting.

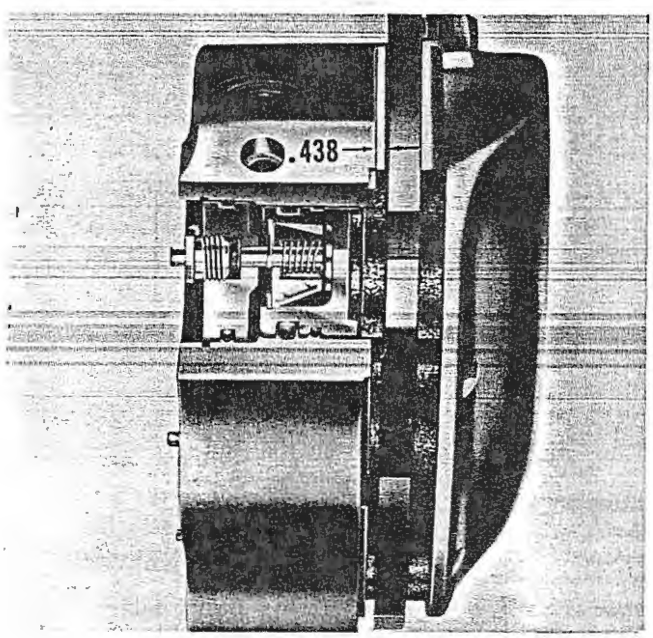


Figure 2-59. Brake Lining Wear Limits

d. Remove spring return plate lock ring.
e. Remove spring return plate, piston return spring and piston adjusting pin.
f. Remove brake piston O-ring and dust seal.
g. Remove O-ring from cylinder head.

2-219. MINOR REPAIR AND PARTS REPLACEMENT. Replace brake linings if face surface is worn to 1/16 inch or below. Glazed brake linings, if only slightly worn, are considered serviceable. When adjusting pin has receded to approximately 1/8 inch within the adjusting pin nut and/or 0.438 inch or more clearance exists between the outboard housing and the disc face with brakes applied (see figure 2-59), the brake linings should be checked for excessive wear and replaced if necessary. Replace brake linings as a complete set. Do not mix new and used linings. Replace brake disc if dished or warped or if disc thickness is 0.360 inch or less measured at the thinnest section. Seals and O-rings, if damaged, shrunk or leaking, should be replaced.

NOTE

The steel disc used with the gear type brake is not chrome plated. When placed in service, the disc will first turn bluish in color and eventually turn to a straw color. After turning to a straw color, the discs have less tendency to rust and will give better service. This discoloration (straw color) will not affect braking action.

2-220. ASSEMBLY OF BRAKE ASSEMBLY (GEAR TYPE).

a. Use hydraulic oil, Specification MIL-O-5606, and lubricate the cylinder walls and all parts to be assembled.
b. Install O-ring and dust seal on piston assembly.
c. Install piston adjusting pin, piston return spring, spring return plate and spring plate lock ring.
d. Insert piston assembly into brake casting cylinder.
e. Install O-ring on cylinder head and screw cylinder head into brake casting cylinder.
f. Install brake washer gasket, packing screw adjusting nut gasket and adjusting nut on piston adjusting pin.

2-221. INSTALLATION OF WHEEL BRAKE ASSEMBLY (GEAR TYPE).

a. Install the lining segment in the piston side of the cavities.
b. Install the lining segment in the stationary side of the brake housing.
c. Hold the lining segments apart, slip the steel disc between them and insert the axle in the wheel.
d. Intermesh the teeth of the brake disc with the teeth in the extended flange of the wheel.
e. Tighten the bearing retaining nut until the axle no longer will turn, then back off the nut until the axle will turn freely.
f. Safety axle nut.
g. Place wheel in fork. Install bearing caps. Tighten nuts to specific torque as noted in paragraph 2-222 and safety.

CAUTION

The axle bearing caps are not interchangeable and must be installed in the same position from which they were removed.

h. Torque piston assembly cap to 75 foot-pounds. Torque packing screw adjusting nut to 25 foot-pounds.
i. Connect brake lines and bleed brakes.
j. Remove airplane from jacks.

2-222. TORQUE VALUES.

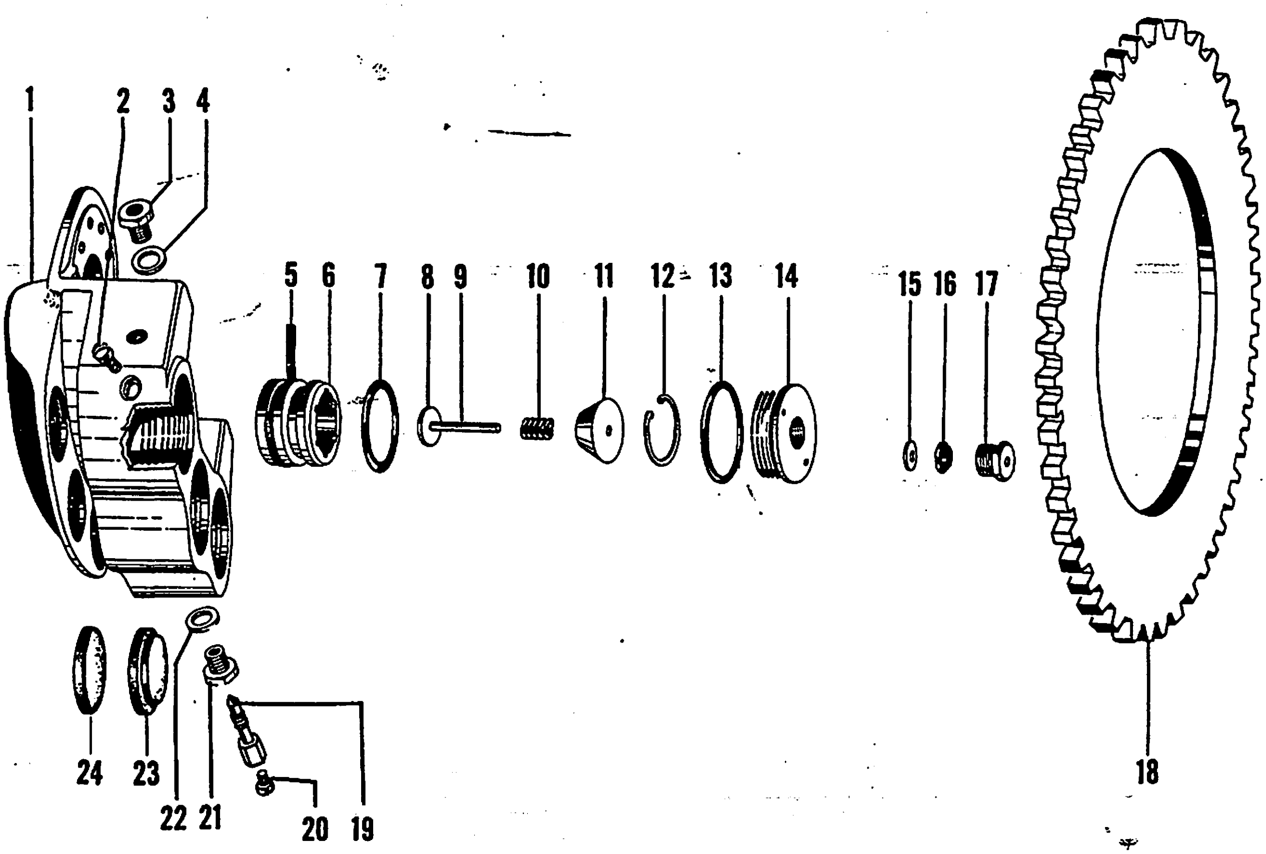
9/16 inch (outboard)	800-1000 inch-pounds
3/8 inch (inboard)	160-190 inch-pounds

A 12-inch torque wrench must be used in conjunction with an adapter (figure 2-61) to arrive at the proper torque on aft outboard nut on each wheel.

2-223. ADJUSTMENT OF WHEEL BRAKE ASSEMBLY (GEAR TYPE). The single-disc brake is self-compensating and requires no lining clearance adjustment. An increased volume of oil between the cylinder head and the piston compensates for lining wear during the life of the brake lining. Brake pedals require no adjustment and remain constant regardless of the lining wear. Brake pedal setting can be changed at the attaching brake rod clevis. If oil leakage is noted around the adjusting pin, check the torque on the packing nut (15 foot-pounds). If leakage continues, replace the packing gasket.

2-224. MASTER CYLINDERS.

2-225. DESCRIPTION. The master cylinders are of the compensating barrel type designed to maintain constant and correct volume of oil in the system (figure 2-62). Small amounts of oil lost through leakage are automatically replaced. The piston, when actuated, pressurizes the oil in the chamber, brake lines and wheel brake cylinders. Seals in the master cylinder insure positive oil pressure and prevent leakage. A spring in each master cylinder returns



1. Brake Housing
2. Upper Bleed Screw
3. Shuttle Valve Reducer
4. Reducer Seal
5. Dust Seal
6. Piston
7. Piston O-Ring
8. Return Spring Movable Plate
9. Adjusting Pin
10. Return Spring
11. Return Spring Stationary Plate
12. Lock Ring (Tru-Arc)
13. Cylinder Head O-Ring
14. Cylinder Head Cap
15. Packing Gasket Washer
16. Adjusting Pin Packing Gasket
17. Adjusting Nut
18. Brake Disc
19. Lower Bleed Port
20. Lower Bleed Screw
21. Lower Bleed Port Reducer
22. Reducer Seal
23. Outboard Lining Segment
24. Inboard Lining Segment

Figure 2-60. Brake Assembly (Gear Type)

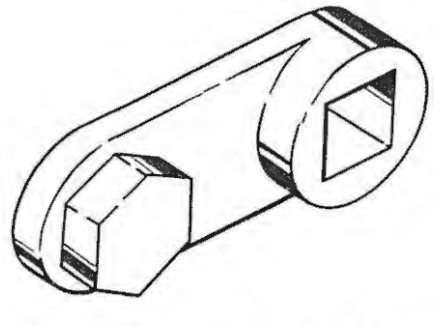
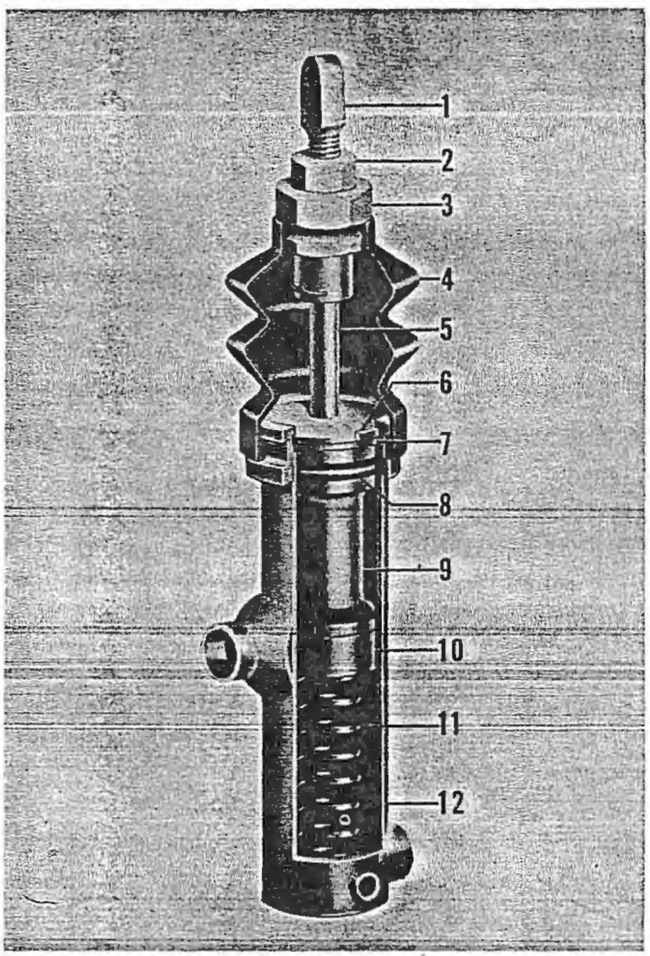


Figure 2-61. Torque Wrench Adapter



1. Brake Master Cylinder End Terminal
2. Jam Nut
3. Coupling
4. Piston Rod Rubber Boot
5. Brake Master Cylinder Piston Rod
6. Retainer Ring
7. Washer
8. O-Ring Seal
9. Brake Master Cylinder Piston
10. Piston Front Cup
11. Brake Master Cylinder Spring
12. Brake Master Cylinder

Figure 2-62. Brake Master Cylinder
Serials 51-11444 through 51-11911

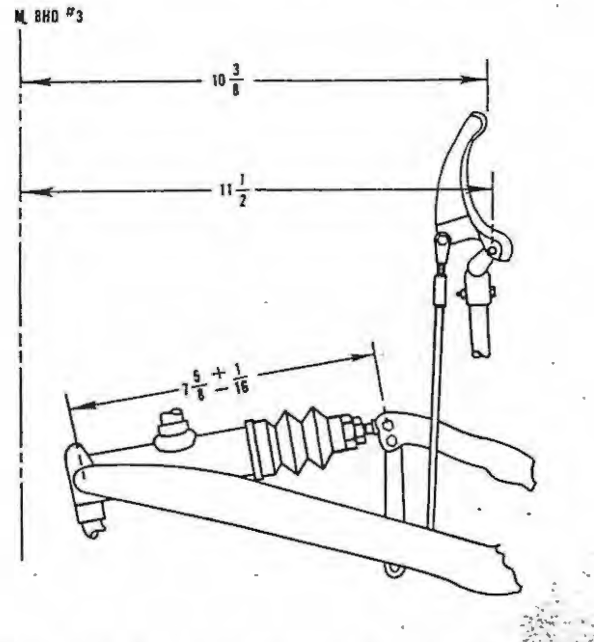


Figure 2-63. Pedal Adjustment, Gear-Type Brake

the piston. The cylinders are actuated by the toggle action linkages below the pilot's compartment floor boards. They receive a direct supply of hydraulic oil from a reservoir tank located on the aft side of Bulkhead 3. C-45H aircraft, Serial 52-10539 and after have new designed master brake cylinders (figure 2-64) installed, incorporating a rubber cup and a poppet valve. The force of the back pressure of the oil as the brakes are applied, seats the poppet valve. This prevents the flow of oil from the system to the reservoir. Upon releasing pressure from the toe pedal, the springs force the piston aft, the poppet valve stem in turn is forced against a pin protruding through the sleeve, thus forcing the poppet valve off its seat allowing the excess oil to return to the reservoir through the hollow piston and around the sleeve to the inlet port. A spacer is incorporated in the forward portion of the cylinder to prevent stacking of the forward spring. The rubber cup never extends aft far enough to engage the inlet port, thus preventing galling of the cup lips. Master brake cylinders with the poppet valve installed have a green dot painted on the housing near the piston rod coupling.

2-226. REMOVAL OF MASTER CYLINDER.

a. Drain the system.

b. Disconnect lines leading to cylinder.

c. Disconnect the cylinder from the rear toggle linkage.

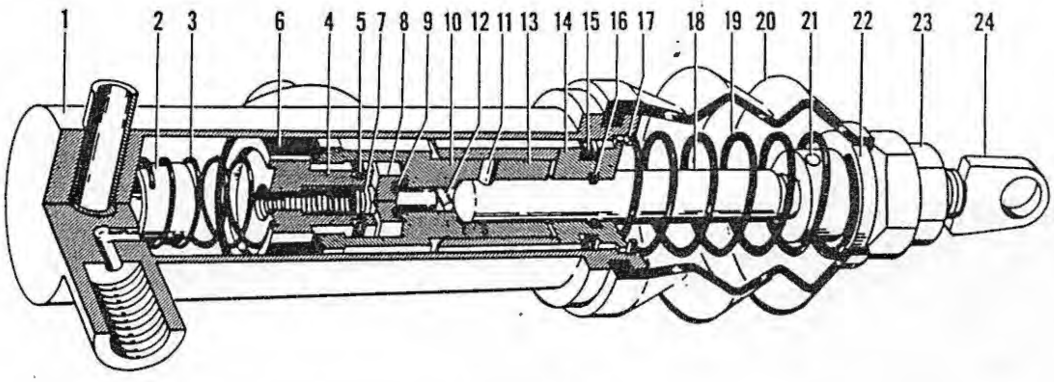
d. Remove bolt attaching cylinder to forward toggle linkage.

e. Remove cylinder from airplane.

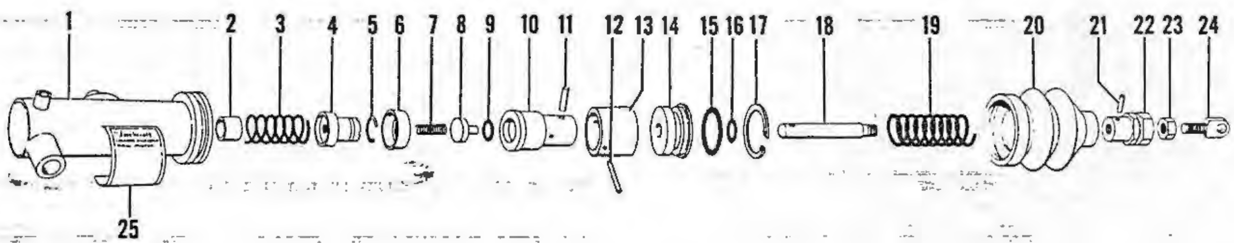
2-227. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs shall consist of replacing the seals, springs, cups and all component parts of the cylinder.

2-228. INSTALLATION OF MASTER CYLINDER.

a. Insert bolt to attach the master cylinder to the



Cutaway View



Exploded View

1. Housing
2. Spacer
3. Spring
4. Retainer
5. Lock Ring
6. Cup
7. Spring
8. Poppet Valve
9. O-Ring
10. Piston
11. Pin
12. Pin
13. Sleeve
14. Cap
15. O-Ring
16. O-Ring
17. Retainer
18. Rod
19. Spring
20. Dust Boot
21. Pin
22. Coupling
23. Jam Nut
24. Terminal Rod End

Figure 2-64. Brake Master Cylinder, C-45H Serials AF 52-10539 and After

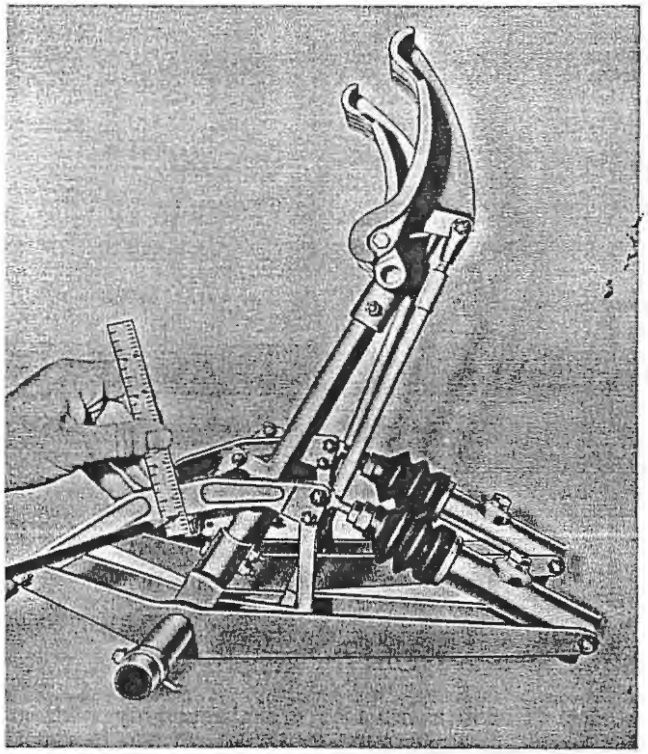


Figure 2-65. Master Cylinder Linkage Adjustment

forward toggle linkage. Install nut, tighten securely and key.

b. Connect lines leading to the cylinder.

c. Connect cylinder to rear toggle linkage.

d. Adjust the linkage to the master cylinder so the piston cup in the cylinder will clear the compensating port, when in full back position.

WARNING

Do not adjust the master cylinder linkage to exceed seven threads showing aft of the jam nut.

e. Tighten jam nut securely.

f. Bleed brakes and check for correct pedal action. See paragraph 2-242.

2-229. ADJUSTMENT OF MASTER CYLINDER.

a. Set rudder pedals in neutral position (figure 2-49).

b. Adjust master cylinder to obtain full travel of piston in the cylinder. This adjustment is made on the piston shaft by loosening the jam nut; removing the cotter key, nut and bolt, and adjusting terminal clockwise to increase travel or counterclockwise to decrease travel.

c. Adjust linkage at brake pedal to set the pedal at 90 degrees to the floorboards (figure 2-66) with the rudder pedal in neutral position.

CAUTION

The master cylinder linkage (figure 2-65) and the brake pedal push rod (figure 2-66) utilize connecting joints in which no grip bushings are used. Whenever it is found necessary to re-

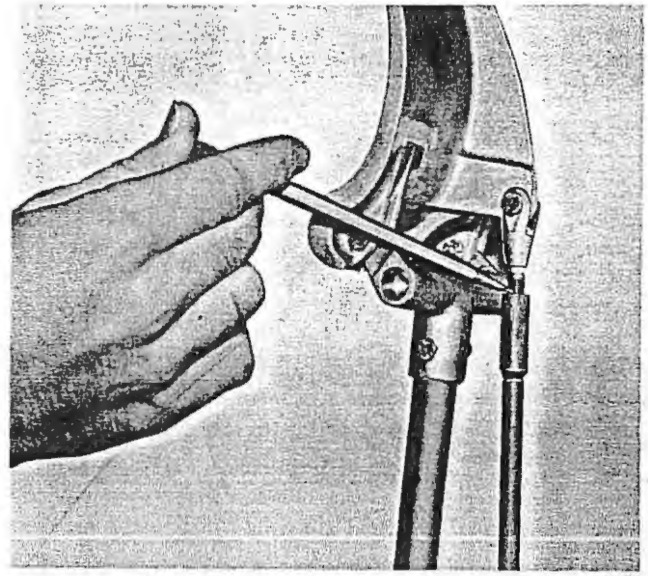


Figure 2-66. Brake Pedal Adjustment

move the linkage connecting bolts for adjustment of the linkage or any other reason, upon reinstallation of the bolts tighten them only finger tight. Overtightening of the bolts will cause a sluggish return of the brake pedal and in some cases may freeze the pedals and cause loss of airplane control.

d. Set stop (figure 2-65) at 1/2 inch to prevent over travel and bottoming of the master cylinder.

2-230. ADJUSTMENT OF BRAKE PEDALS (KEY-TYPE BRAKES).

a. Set rudder pedals in neutral position (figure 2-49).

b. Adjust the brake balance cables to position the pilot's and the copilot's brake pedals 11-1/2 inches and 12-1/4 inches, respectively, from the M/L Bulkhead 3 with pedals in neutral position.

c. Adjust brake push rod clevis to set pedals 90 degrees to the floorboards. See figure 2-49. When installing bolt attaching clevis to brake pedal, do not overtighten. Tighten only finger tight.

NOTE

With the brake pedals set at 90 degrees to the floorboards and in neutral position, if proper pedal action is not obtained, adjustments must be made at the master brake cylinders as outlined in paragraph 2-229.

2-231. ADJUSTMENT OF BRAKE PEDALS (GEAR-TYPE BRAKES). On all airplanes utilizing the gear type brake, the pilot's and co-pilot's brake toe pedals can be positioned 1-1/8 inches forward of their original setting given in adjustment of brake pedals (key-type brake) or 10-3/8 inches aft of M/L Bulkhead 3 (figure 2-63). It will be necessary to combine the adjustments of the brake push rod clevis and the master brake cylinder linkage to obtain the correct setting. The gear type brake requires less oil displacement than the key type to obtain the same braking effect. By adjusting the linkage, it is pos-

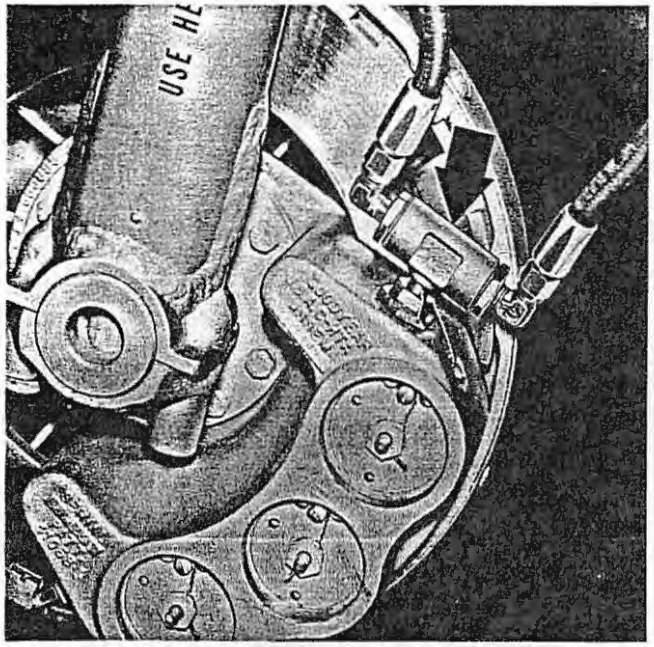


Figure 2-67. Shuttle Valve Mounted On Brake

sible to take advantage of the reduced displacement and set the brake pedals so that the pilot can sit in a more relaxed position.

2-232. SHUTTLE VALVES.

2-233. DESCRIPTION. The shuttle valves, one mounted on each wheel brake assembly (figure 2-67) shuttle the brake operation between the pilot's and copilot's brake systems. Small pistons which slide back and forth in the shuttle valves permit the flow of oil to the brake cylinders from only one set of brakes at one time. Effective AF 51-11766 and after, the shuttle valve is replaced by a redesigned valve assembly which is strengthened by enlarging the thread stem which screws directly into the brake casting.

2-234. REMOVAL OF SHUTTLE VALVE.

CAUTION

Extreme care should be exercised to prevent breaking of the shuttle valve when removing or installing the 90-degree fittings.

a. Drain brake system.
b. Disconnect flexible lines connected to shuttle valve.
c. Remove 90-degree fittings from shuttle valve.
d. Loosen jam nut and remove shuttle valve.

2-235. MINOR REPAIR AND PARTS REPLACEMENT. There shall be no minor repairs accomplished in the field; however, all parts involved may be replaced.

2-236. INSTALLATION OF SHUTTLE VALVE.

CAUTION

Extreme care should be exercised to prevent

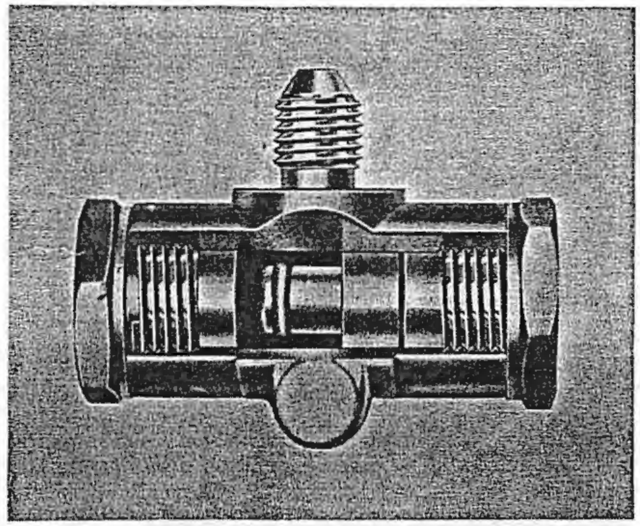


Figure 2-68. Cross Section of Shuttle Valve

breaking of the shuttle valve when installing the 90-degree fittings.

a. Install shuttle valve on brake assembly casting.
b. Screw 90-degree fittings in valve. The fittings, when tight, must point up.
c. Tighten jam nut which locks the valve assembly to the brake casting.
d. Install flexible lines to the shuttle valve fittings.
e. Bleed brake system. See paragraph 2-242.

2-237. PARKING BRAKE VALVES.

2-238. DESCRIPTION. Two lever-type valves (figure 2-70) are located below the pilot's floorboards to the right of the pilot's master cylinder linkage and directly alongside the elevator bull wheel. Both valves are closed simultaneously by pulling out on

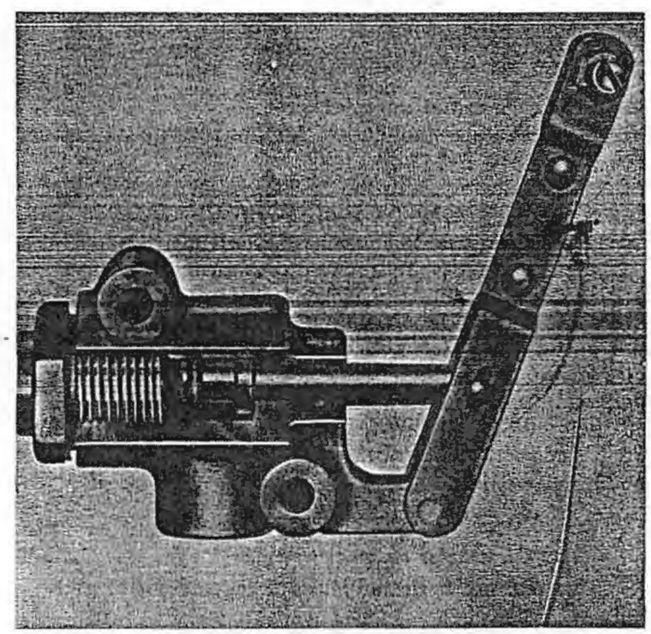


Figure 2-69. Cross Section of Parking Brake Valve

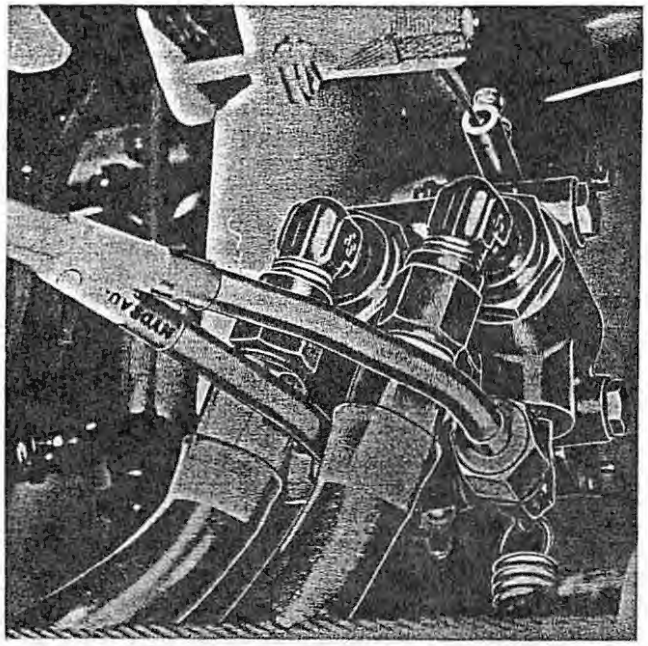


Figure 2-70. Parking Brake Valves

the parking brake handle. Closing the valves retains the pressure pumped up in the pilot's brake lines.

NOTE

The parking brakes cannot be applied by using the copilot's brake pedals.

2-239. REMOVAL OF PARKING BRAKE VALVES.

a. Drain system.

b. Disconnect inlet and outlet lines.

c. Disconnect the return spring.

d. Remove set screws securing actuator levers to control wire.

e. Remove bolts securing valves to mounting structure.

2-240. INSTALLATION OF PARKING BRAKE VALVES.

a. Place valves in position on mounting structure and install bolts.

b. Install and safety the set screws securing actuator levers to control wire.

c. Connect return spring.

d. Connect inlet and outlet lines.

e. Bleed brakes. See paragraph 2-242.

2-241. ADJUSTMENT OF PARKING BRAKE CONTROL. When a parking brake valve has been replaced, it is of great importance that full travel of the parking brake valve arm be maintained. The adjustment of the parking brake valve arm travel is accomplished by loosening the clamp or phenolic block bolts and re-positioning the outer housing of the parking brake control in the clamp or phenolic block. Clearance between the end of the outer housing and the parking brake valve arm should be 1/8 ± 1/16 inch. If the inner control wire of the parking brake control becomes broken, it will be necessary to replace the entire parking brake control. When a new control assembly is to be installed, cut the inner control wire to the upper length as follows:

a. Make certain the parking brake control handle is all the way in. This may be accomplished by pushing in on the handle or pulling on the protruding end of the inner wire.

b. Cut the protruding end of the wire at a point 2-3/4 inches from the third coil of the outer housing to the end of the wire.

c. Bend 1/16 inch of the protruding inner wire at a 90° angle. This 1/16-inch leg hooks into a small hole in the parking brake valve arm assembly as an additional safety measure.

d. Adjust parking brake valve control arm for correct travel as outlined above. Sharp bends should be avoided in routing and installation of control.

2-242. BRAKE BLEEDING.

2-243. Two men and the following pieces of equipment are needed for bleeding the brake system:

A pressure pot of two or three gallons capacity, a oil supply hose approximately 10 feet long, and a flat drain pan for each brake casting of about 1 gallon capacity (figure 2-71). Fill pressure pot with hydraulic oil (see Table II). Charge pot with air and maintain pressure of 50 psi. Proceed as follows:

a. Disconnect brake supply line at the reservoir and connect the pressure pot supply line to the brake supply line.

b. Place drain pan beneath brake casting on each wheel.

c. Loosen both brake lines, at the shuttle valve, on each wheel. To prevent excessive oil flow the lines should not be disconnected. Loosening two full turns should be sufficient.

d. Turn on oil at the pressure pot. Allow to flow until oil is being discharged in a steady stream with no apparent air bubbles.

e. Pump the pilot's brake pedals in slow strokes, maintaining as nearly as possible a constant pressure. In operating the brake pedals, they should be fully depressed and then allowed to return to the limit of their travel range. The speed of operation should be such that not more than 12 complete cycles are accomplished per minute.

f. The bleeding operation may be checked at each wheel by observing the surge of oil as the pedal is depressed. After no air appears in the discharging oil, the pumping should be stopped and the copilot's brakes should then be pumped out in the same manner as the pilot's brakes.

g. Pull parking brake handle out, and tighten the connections of the flexible lines at the shuttle valves.

NOTE

The brake system may be bled satisfactorily with the parking brake handle in. However, with the handle pulled out all the oil in the system flows through the copilot's lines. This decreases the possibility of the shuttle valve piston sticking in an intermediate position. When such a situation is present, little or no oil will flow from the brake cylinder bleeder ports. If the piston is stuck in an intermediate position, remove bleed screw at extreme forward lower portion of brake casting and open bleed valve. Loosen the pilot's flexible line at the shuttle valve and tap the valve lightly with a rubber mallet until the normal flow of fluid is observed to come from the bleeder port, tighten flexible hose connection. If the normal flow of oil cannot be obtained in this manner, the oil should be shut off at the pressure pot and the shuttle valve replaced. C-45 Series aircraft, prior to AF 52-10539, utilized a coupling installed in the floorboard adjacent to the vertical stiffener at Bulkhead 3, which was restricted to a 1/16 inch opening. On C-45H aircraft, Serials AF 52-10539 and after, this 1/16 inch restricted coupling, is replaced with a coupling having a 1/4 inch opening. The restriction of the original coupling did not allow a sufficient flow of oil to wash the lines free of air bubbles.

NOTE

In order to prevent excessive loss of oil, the bleeder port at the extreme lower forward portion of the brake cylinder casting should be opened, before attempting to remove the bleeder screws in the upper portion of the brake cylinders. With this port opened, excessive pressure will be released into the drain pan.

h. Remove bleeder screw at the extreme lower, forward portion of the brake casting. Open bleeder port and allow oil to flow. This will relieve pressure in the brake cylinders while the bleeder screws are being removed.

NOTE

Cylinder heads should be turned so the bleeder screws are at top dead center with the air-

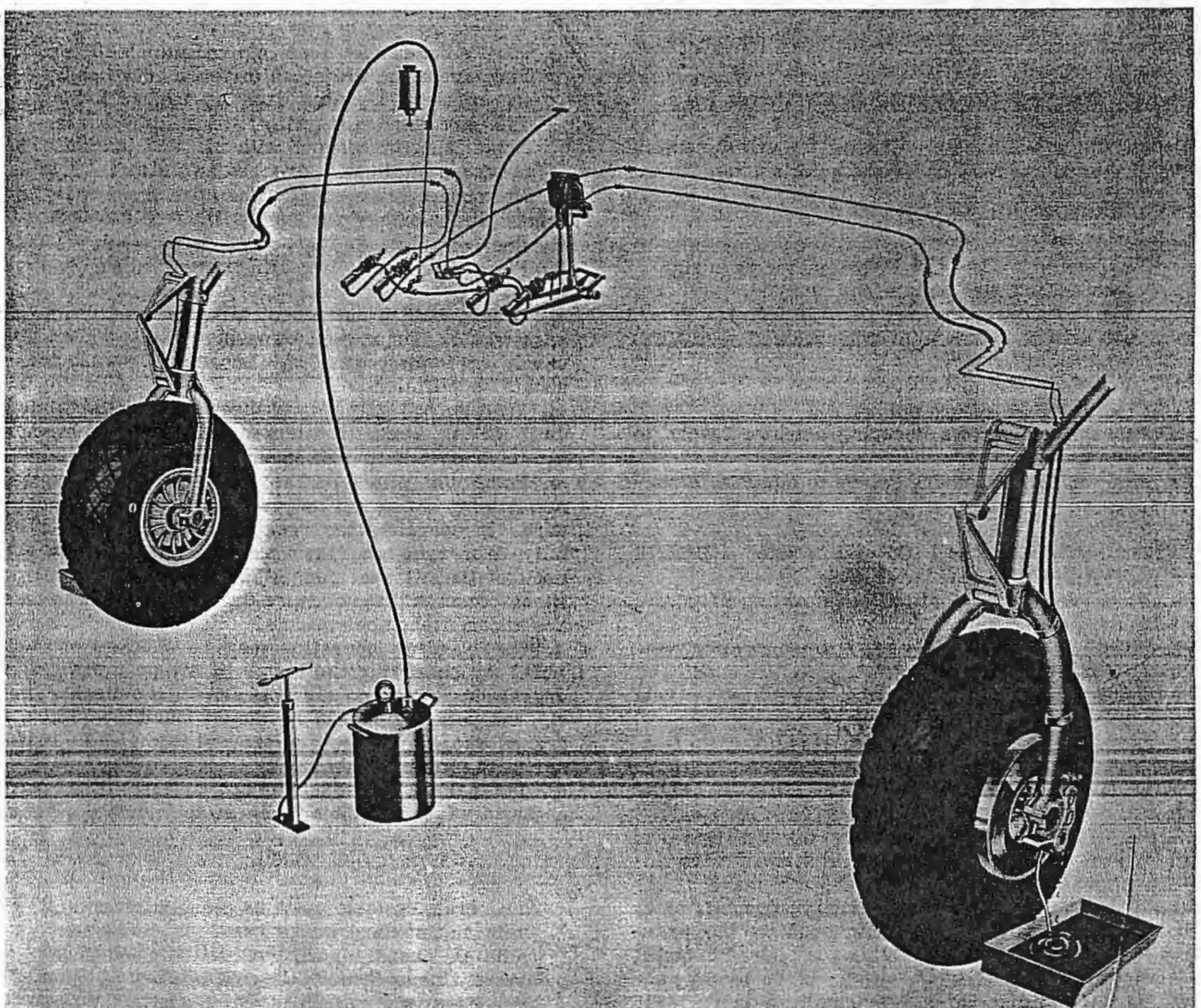


Figure 2-71. Brake Bleeding

plane in three point attitude. Bleed each individual actuating cylinder, beginning with the lower and progressing upward.

i. Remove bleeder screw from lower brake cylinder and close the bleeder port at the extreme lower forward portion of the casting. Place the thumb over the open bleeder port and close off flow of oil by pressing down firmly. Raise the thumb and release the oil, noting to see if air is being carried out by the stream of oil. If air still comes out in the oil stream, close the port again by the thumb and release the oil. Continue until no air is noted coming out in the stream of fluid. When certain that no air remains in the brake cylinder, open the bleeder port at the extreme lower forward portion of the brake casting. With this port open, the bleeder screw may be installed in the lower brake cylinder. Install lower brake cylinder bleed screw tightly and close bleeder port at the bottom of the brake casting.
j. Repeat step i for the two remaining wheel brake cylinders.
k. Repeat steps i and j for the opposite wheel.
l. Securely close the lower bleeder port at the extreme forward lower portion of the brake casting and install bleeder screw tightly.

NOTE

Do not overtighten lower bleeder port; it can be twisted off if too much pressure is applied.

m. Remove bleeder screw on top of brake casting directly aft of shuttle valve and check flow. If no air is present in the oil flow, reinstall bleed screw.
n. Open flexible line connections at the shuttle valves (left and right). Push the parking brake handle in and pump the pilot's pedals through their entire travel at least five times. Repeat for the copilot's pedals.
o. Close the connections at the shuttle valves. Pump pilot's pedals up until quite hard. Keep pedals depressed and pull out parking brake handle.
p. Check entire system for evidence of leaking.
q. Close shut-off valve on pressure pot and release pressure on the pot. When pressure is entirely gone, open shut-off valve to allow pressure in the oil supply line to flow into the pot. Close shut-off valve.
r. Check brake operation. The wheels should hold firmly and evenly; the pedals should be firm and require equal operating pressure. Adjust pedal travel for full braking pressure at the master cylinder linkage; loosen jam nut on the piston rod terminal and screw adjusting nut counterclockwise to increase travel or clockwise to decrease travel. Five to seven threads showing on the rod aft of the jam nut is normal.

WARNING

Seven complete threads showing is the maximum setting.

s. Tighten jam nut and connect fluid reservoir line. Fill reservoir until oil level is approximately 1-1/2 to 2 inches from top of reservoir.

2-244. GEAR-TYPE BRAKE BLEEDING. The same equipment is used for bleeding both key-type and gear-type brakes. The gear-type brake has no bleeder ports in the wheel cylinders; air in the system is released by removing the bleeder screws at the top and bottom of the brake casting, opening the bottom bleeder port and pumping the brake pedals.

2-245. SHOCK ABSORBER ASSEMBLY.

2-246. DESCRIPTION. The main landing-gear shock absorber is equipped with a self-compensating rebound control mechanism. It consists of a cylinder mounted in a V-brace pivoted to the center section truss and a piston which carries the wheel in a yoke type strut. Torque knees, interconnecting the cylinder and piston, hold the main wheels in alignment (figure 2-72).

2-247. REMOVAL OF MAIN LANDING GEAR SHOCK ABSORBER ASSEMBLY.
a. Support airplane on jacks.

WARNING

When hoisting or jacking the aircraft, always place a minimum ballast of 200 pounds on the horizontal stabilizer to prevent the aircraft from nosing over. A felt or canvas pad should be used to protect the horizontal stabilizer and the ballast should be placed over the front spar near the fuselage.

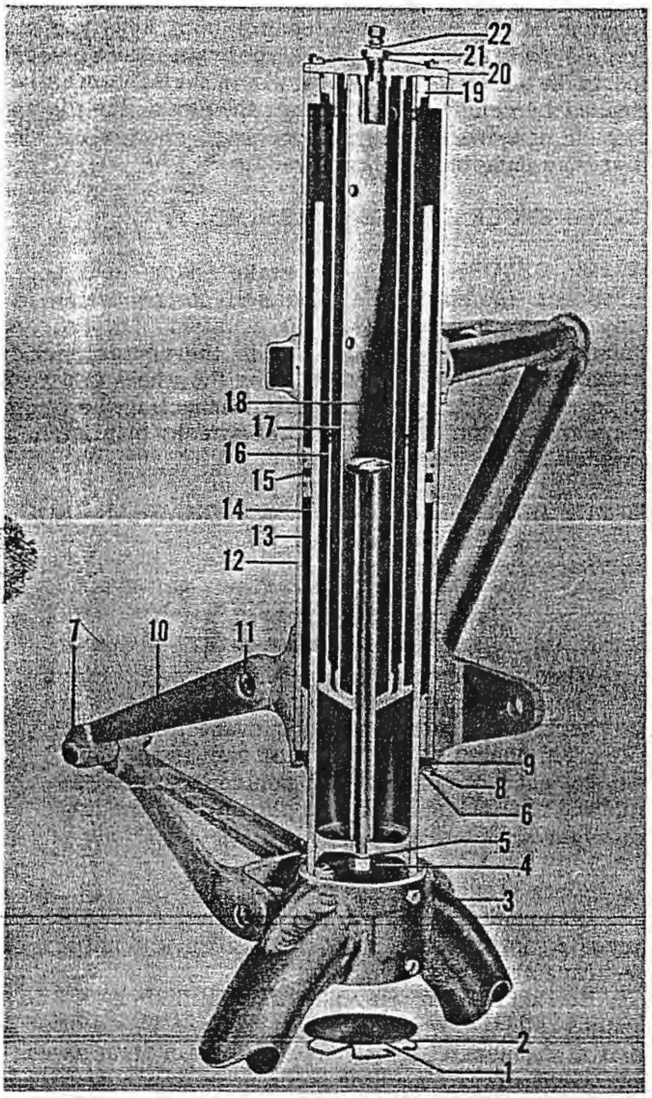
b. Drain brake system.
c. Disconnect the short flexible lines at the inboard truss fitting and the rigid lines from the fittings on V-brace assembly.
d. Retract landing gear manually until slide is 3 to 4 inches off the bottom stop. Remove bungee cords and disconnect drag leg from the main strut assembly at the lower attaching point.
e. Disconnect flexible lines and remove safety switch assembly (do not remove mounting bracket) and wiring from shock absorber and V-brace assembly.
f. Disconnect landing gear door actuator rods from brackets on V-brace assembly.
g. Remove screws and plate covering landing gear hinge bolt openings at inboard and outboard sides of nacelle.
h. Remove retaining bolts securing hinge bolts inside the nacelle.
i. Use special tool 404-180891 to remove the nuts from the hinge bolts and remove the bolts.

CAUTION

Support gear as hinge bolts are being removed. Severe damage to the nacelle may occur if gear is allowed to fall.

j. Remove gear from nacelle.
k. Remove axle and wheel from fork. See paragraph 2-203.

2-248. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs shall consist of replacing the bushings in the torque knees or the main hinge points



1. Lower Piston Seal Plate
2. Piston Plate Lock Ring
3. Landing Gear Fork
4. Extension Stop Nut
5. Extension Stop Seal
6. Piston Scraper Ring
7. Center Torque Knee Bolt
8. Piston Scraper Snap Ring
9. Piston Wiper Ring
10. Torque Knee
11. Torque Knee Pin
12. Cylinder
13. Felt Wiper
14. Piston
15. Piston O-Ring Packing
16. Inner Cylinder
17. Inner Cylinder Control
18. Piston Extension Stop
19. Cylinder Cap Seal
20. Cylinder Cap
21. Air Valve
22. Lock Ring

Figure 2-72. Shock Strut Assembly

and replacing the complete landing gear shock assembly. All other repairs shall be accomplished at a designated overhaul activity.

2-249. INSTALLATION OF MAIN LANDING GEAR SHOCK ABSORBER ASSEMBLY.

a. Install wheel and axle and brake assembly. See paragraph 2-205.
b. Place landing gear in position and install hinge bolts.
c. Install nuts on hinge bolts and tighten, aligning holes for hinge bolt retaining bolts in V-brace. Do not overtighten or gear will bind.
d. Install the outboard hinge bolt retaining bolt. Install nut, tighten securely, and key. Nut should not be installed on inboard bolt until hydraulic lines are in place.
e. Install safety-switch assembly and all wiring and clamps.
f. Connect rigid hydraulic lines to fitting on V-brace.
g. Secure the hydraulic lines to the inboard hinge bolt retaining bolt. Install nut, tighten securely and key.
h. Connect the long flexible lines to the fitting on V-brace and connect the short flexible lines to the inboard truss fittings.
i. Install lower drag leg attaching bolt.
j. Install bungee cords and attach landing gear door actuator rods to the brackets on V-brace.
k. Adjust safety switch. See paragraph 2-350.
l. Bleed brakes. See paragraph 2-242.
m. Remove jacks from under airplane.
n. Inflate main shock struts (figure 1-17).

2-250. LANDING GEAR OLEO DRAG LEG.

2-251. DESCRIPTION. The oleo drag leg (figure 2-73) consists of a piston, coil spring, lower housing, seals and packing. It is a double acting hydraulic unit containing both air and hydraulic oil.

2-252. REMOVAL OF OLEO DRAG LEG.

a. Support the airplane on wing and tail jacks and retract the landing gear until the slides are two or three inches off the lower stop.
b. Disconnect bungee cords and remove upper and lower attaching bolts. Remove drag leg.

2-253. MINOR REPAIR AND PARTS REPLACEMENT. Repairs in the field will be limited to replacing bushings, servicing and cleaning. All other repairs are considered major repairs and must be accomplished at a designated overhaul activity.

2-254. SERVICING OLEO DRAG LEG.

a. Remove air valve and with strut held at an angle of 30 degrees, which is approximately the position it is installed on the airplane, fill with hydraulic oil, Specification MIL-O-5606.
b. Install the air valve, tighten and apply 50 pounds of air pressure to strut.
c. Lay strut in a horizontal position with the lower drain plug up. Loosen lower drain plug and allow trapped air to escape. Tighten plug as soon as air is released.
d. Place strut in position as described in step (a); remove air valve and refill strut.

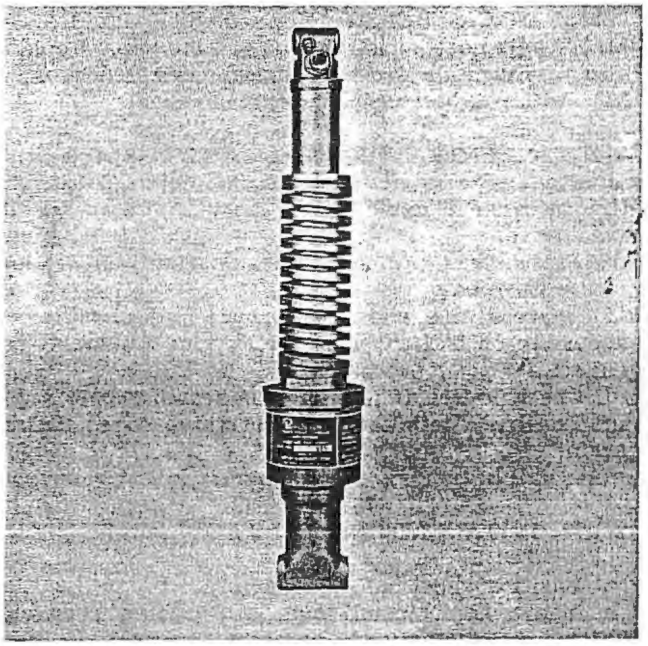


Figure 2-73. Oleo Drag Leg

NOTE

An oil control tube is provided in the piston assembly to preclude possibility of overfilling strut if oil is added with strut held in proper position.

e. Install air valve, tighten and add 50 pounds of air pressure. This air pressure is used to avoid an air lock in the top of the strut and is not required to extend the strut, which is spring actuated.

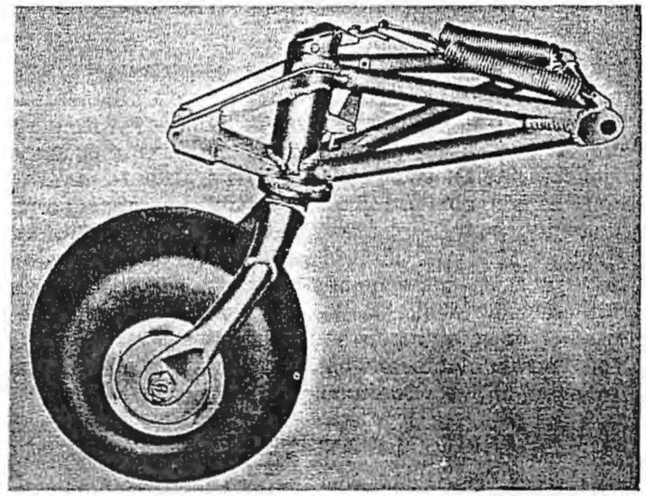


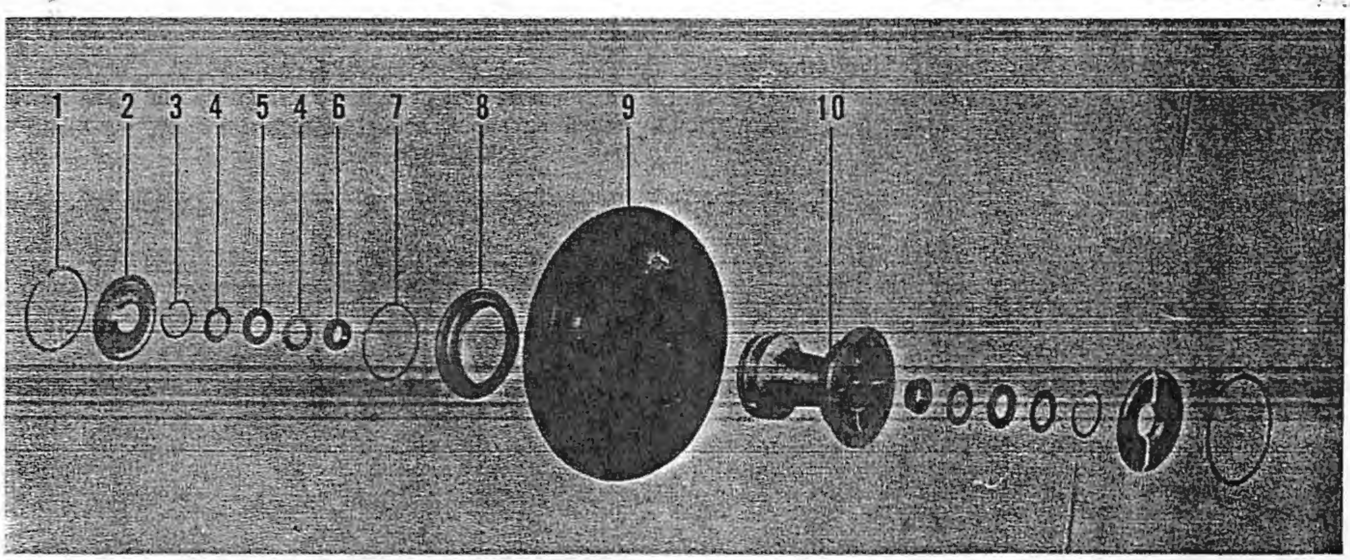
Figure 2-74. Tail Gear Assembly

NOTE

The above instructions are for filling empty struts. If a small amount of oil is required to replace service loss, the strut may be refilled on the airplane. Remove the air valve and fill to top of filler opening with hydraulic oil. Reinstall air valve, tighten and apply 50 pounds air pressure.

2-255. INSTALLATION OF LANDING GEAR OLEO DRAG LEG.

a. Install upper attaching bolt.
b. Install lower attaching bolt.
c. Install bungee cords, tighten upper and lower nuts securely and key.



1. Lock Ring
2. Dust Shield
3. Lock Ring
4. Felt Retainer Ring
5. Felt Seal
6. Bearing
7. Side Ring Retaining Ring
8. Tail Wheel Side Ring
9. Tail Wheel Tire
10. Tail Wheel

Figure 2-75. Tail Wheel Assembly

2-256. TAIL GEAR ASSEMBLY.

2-257. DESCRIPTION. The tail gear assembly (figure 2-74) is a welded steel tube truss hinged at its forward end to the fuselage, with a full-swiveling fork and an air-oil shock absorber. The shock absorber connects the aft end of the truss to a slide for retraction. A pin controlled from the pilot's compartment locks the swivel for take-off and landing. On C-45H airplanes Serials 52-10539 and after, the tail wheel is locked down permanently by a short cable from the aft end of the retract slide over a pulley to a bracket on a stringer on the aft side of Bulkhead 12. The retract cable and chain are omitted and a clamp is placed on the slide tube ahead of the slide.

2-258. WHEEL, TIRE AND TUBE.

2-259. DESCRIPTION. The wheel assembly consists of a split hub assembly mounting a 14.50 smooth tire and tube (figure 2-75). It is supported on the axle by two tapered roller bearings.

2-260. REMOVAL OF WHEEL, TIRE AND TUBE.
a. Place tail of airplane on jack and raise tail so wheel will clear the ground.
b. Remove cotter keys and axle nuts.
c. Remove axle and slide wheel out of the fork.

2-261. DISASSEMBLY OF WHEEL, TIRE AND TUBE.

WARNING

Deflate tire before disassembling wheel.

a. Deflate tire..
b. Remove dust covers.
c. Remove all bearings, retainer rings and pins.
d. Depress tire and split hub (figure 2-76).
e. Remove tire and tube from hub assembly.

Figure 2-76. Removal of Rim and Retaining Ring

2-262. MINOR REPAIR AND PARTS REPLACEMENT. Remove nicks or burrs in the hub. Replace sticky, rough or frozen bearings, cracked hubs or hubs with rough or cracked bearing races.

2-263. ASSEMBLY OF WHEEL, TIRE AND TUBE.
a. Place tube in tire and inflate it until it fills the tire in order to remove the wrinkles. Do not install valve core.
b. Place large half of split hub assembly in tire and locate valve hole.
c. Depress tire and place small half of split hub assembly on hub and insert lock ring and safety pin (figure 2-77).
d. Check to see if lock ring is seated properly and inflate tire. Deflate and insert valve core. Inflate again.
e. Install bearing, grease retainers, and dust covers.

2-264. INSTALLATION OF WHEEL, TIRE AND TUBE.
a. Position wheel in fork assembly.
b. Insert axle, install nuts and tighten securely. Safety nuts with cotter keys.
c. Inflate tire and remove jack.

2-265. TAIL GEAR TRUSS ASSEMBLY.

2-266. DESCRIPTION. The tail gear truss assembly (figure 2-78) is a welded steel tube structure. It supports the swivel fork, wheel assembly and tail wheel locking assembly. It is hinged to the fuselage at its forward end and supported at the aft end by an air-oil shock absorber, which attaches to the tail wheel slide.

2-267. REMOVAL OF TAIL GEAR TRUSS ASSEMBLY.
a. Raise aircraft at tail jack point.
b. Disconnect tail wheel door actuator rods from the swivel housing.
c. Disconnect tail wheel lock cable.
d. Support tail gear truss assembly and remove bolt attaching shock absorber to truss assembly at lower end of shock absorber.

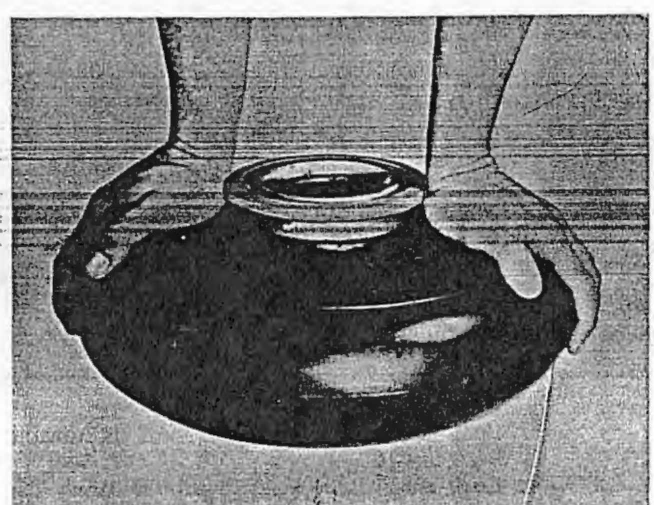


Figure 2-77. Installation of Rim Locking Pin

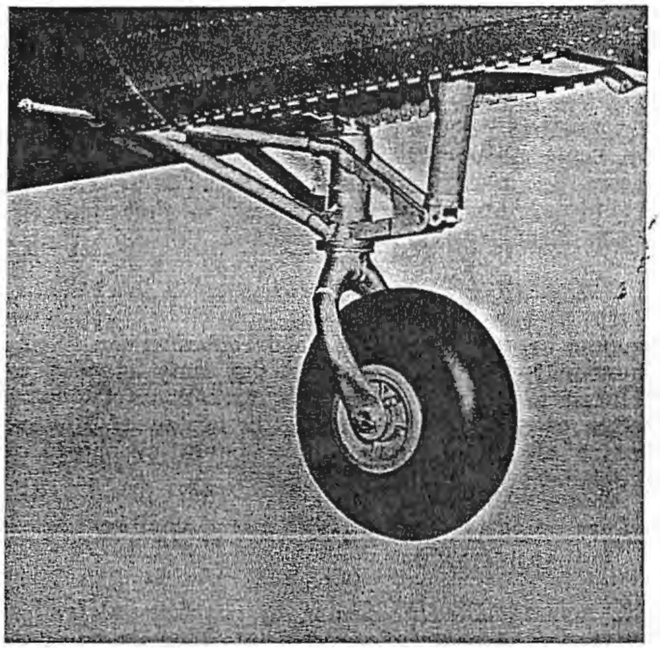


Figure 2-78. Tail Gear Assembly Installation

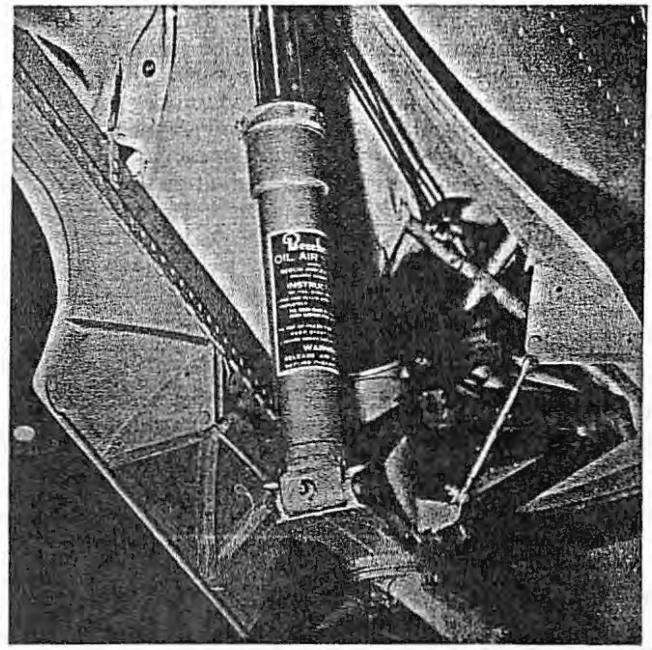


Figure 2-79. Tail Gear Shock Strut Assembly

e. Remove through hinge bolt at forward attaching point.
f. Lower assembly away from fuselage.

2-268. INSTALLATION OF TAIL GEAR TRUSS ASSEMBLY.
a. With aircraft on jacks, raise tail wheel truss assembly into position and install hinge bolt through tail gear at forward attaching point (figure 2-78).
b. Install bolt through lower end of shock assembly.
c. Connect tail wheel lock cable.
d. Connect tail wheel door actuator rods.
e. Safety all bolts.

2-269. REMOVAL OF TAIL GEAR SHOCK ABSORBER ASSEMBLY.
a. Raise aircraft at tail wheel jack point.
b. Support tail wheel truss assembly and remove bolt from lower attaching point.
c. Remove bolt from upper attaching point.
d. Remove shock absorber.

2-270. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will be limited to servicing and replacing of bushings and component parts.

2-271. INSTALLATION OF TAIL GEAR SHOCK ABSORBER ASSEMBLY.
a. Attach shock absorber to slide assembly at upper attaching point. Safety the attaching bolt.
b. Attach shock absorber lower attaching point to truss assembly. Safety bolt and remove jack.
c. Inflate strut, with weight of aircraft on gear, so that 3 inches of piston are showing.

2-272. MAIN LANDING GEAR AND TAIL WHEEL DOORS.

2-273. DESCRIPTION. The main landing gear and tail wheel doors are heat-treated aluminum alloy skin, formed to the contour of the nacelle and fuselage and riveted and spot welded to a die-formed stiffener. The doors are hinged to the aircraft structure by piano-type hinges, one half of the hinge being riveted to the door and the other half to the nacelle or fuselage skin. The hinges are joined with stainless steel hinge wires. Actuating rods, attached to the landing gear (figure 2-80) and tail gear, open and close the doors as the gear is lowered and raised. When the gear is retracted, the doors cover the wheel well openings. The doors should operate freely and fit snugly enough when closed to avoid excessive vibration. C-45H airplanes, Serials 52-10539 and after, have no tail wheel doors, since their tail wheels do not retract.

2-274. REMOVAL OF MAIN LANDING GEAR AND TAIL WHEEL DOORS. Disconnect actuator rods from the door assembly and remove hinge wire. Door will fall free.

2-275. MINOR REPAIR AND PARTS REPLACEMENT. Inspect the door for spotwelds which have broken loose. Repair by adding a rivet on each side of the broken spotweld. Small cracks may be stop drilled. Distorted doors must be removed and replaced.

2-276. INSTALLATION OF MAIN LANDING GEAR AND TAIL WHEEL DOORS. Position door on hinge and insert hinge wire. Attach actuator rods to door assembly.

2-277. ADJUSTMENT OF MAIN LANDING GEAR AND TAIL WHEEL DOORS. The landing gear doors are adjusted by varying the length of the actuating rods which connect the doors to the shock strut. Properly adjusted, the doors will fit snugly with approximately 1/8 inch clearance between them. This will eliminate vibration in flight. The bolts in the attaching linkage should not be drawn up so tightly that free action of the linkage will be impaired. The tail wheel doors are adjusted by varying the length of the turnbuckles which connect the doors to the tail wheel truss assembly. Adjust the turnbuckles so when the doors are closed, they will fit snugly with a slight bow. With the doors properly adjusted there should be approximately a 1/16-inch gap between the doors when closed. When adjusting the doors, care should be exercised to maintain clearance between the axle retaining nut and the reinforcing angle on the door.

2-278. TAIL WHEEL LOCK CONTROLS.

2-279. DESCRIPTION. The tail wheel lock consists of a spring loaded plunger, which locks the tail wheel in a straight position. The lock control is located on the pedestal and overcomes the spring tension through a cable linkage to unlock the tail wheel.

2-280. TROUBLE SHOOTING. See Table VII.

2-281. REMOVAL OF TAIL WHEEL LOCK CONTROLS.

a. Remove center aisle floorboards.
b. Disconnect the 1/16-inch cable from the control.
c. Remove housing mounting bracket at truss assembly.
d. Remove screws attaching control handle to pedestal, and remove all clamps on the housing in belly.
e. Pull housing forward into belly and remove bushing and nut securing truss mounting bracket to housing.

NOTE

Measure the distance the housing extends aft through the bushings as an aid in installing a new housing in correct position.

f. Remove housing by pulling it up and out through pilot's compartment.
g. Remove spring assembly between Bulkheads 5 and 6 from cable.
h. Remove pulleys at Bulkhead 7 and Bulkhead 10.
i. Disconnect cable from locking pin at the tail wheel truss assembly and remove cable. Remove cable carefully to prevent damage to phenolic fairleads through which cable is routed.

2-282. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of replacing rusted or corroded cables and replacing the spring assembly. If the housing in the belly is bent or kinked to such an extent that it restricts the operation of the control, it should be replaced. Pulleys which are frozen or sticky in operation should be replaced.

2-283. INSTALLATION OF TAIL WHEEL LOCK CONTROLS.

a. Insert cable in opening of phenolic fairlead at Bulkhead 14 and pull forward into correct position.
b. Install clevis fitting on cable to locking pin on tail wheel truss assembly. Insert bolt, tighten nut snugly and key.
c. Install pulleys at Bulkheads 7 and 10.
d. Insert new control and housing assembly through opening in pedestal and pull into position through belly. Install screws holding control handle to pedestal.
e. Install bushing, mounting bracket and nut, in that order, in correct position on the housing.

NOTE

Correct measurement should have been noted on old housing before removal of the bushing.

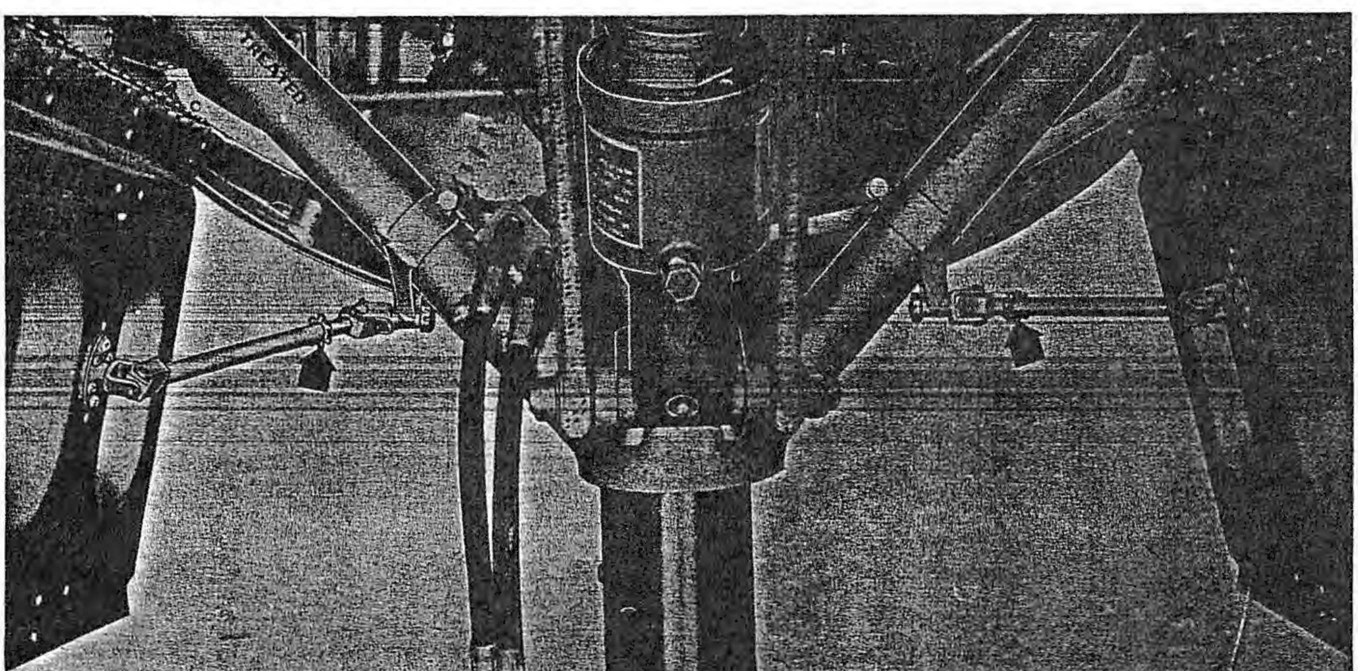


Figure 2-80. Landing Gear Door Adjustment

f. Route housing aft under truss and install mounting bracket to truss assembly.
g. Connect stainless steel control wire to spring assembly, and the cable to the opposite end of spring assembly.
h. Install all attaching clamps.
i. Rig cable (paragraph 2-284) and safety turnbuckle. Check system for smooth operation and for correct locking action of the tail wheel.
j. Install center aisle floorboards.

2-284. ADJUSTMENT OF TAIL WHEEL LOCK CONTROL. The tail wheel lock cable should have enough tension to keep it from dragging on bulkheads and the locking mechanism should be kept clean for free and easy movement.

WARNING

Do not overtighten the lock cable; excessive tension will prevent full engagement of the pin.

2-285. LANDING GEAR RETRACT SYSTEM.

2-286. DESCRIPTION. The landing gear retracting system is electrically-driven, with a manual clutch to release the motor and a hand crank for emergency operation. Torque shafts connect the motor and gearbox in the belly to the chain-driven retract slides in the nacelles. The motor and gearbox are protected against overload and the shock of starting and stopping by a spring-loaded disc clutch.

(Deleted)

2-287. LANDING GEAR MOTOR.

2-288. DESCRIPTION. The landing gear motor (figure 2-82) is located in the center section underneath the pilot's floorboards. It drives the landing gear mechanism through a worm-gear drive enclosed in a gearbox. On one side of the gearbox is located a large sprocket which connects by chain to the hand crank in the pilot's compartment. On the other side of the gearbox is a small sprocket, a clutch and clutch release arm. The clutch release arm, when operated from the pilot's compartment, releases the clutch, disconnecting the landing gear motor and gearbox from the other parts of the system.

2-289. TROUBLE SHOOTING. See Table VIII.

2-290. REMOVAL OF LANDING GEAR MOTOR.
a. Support the aircraft on jacks.

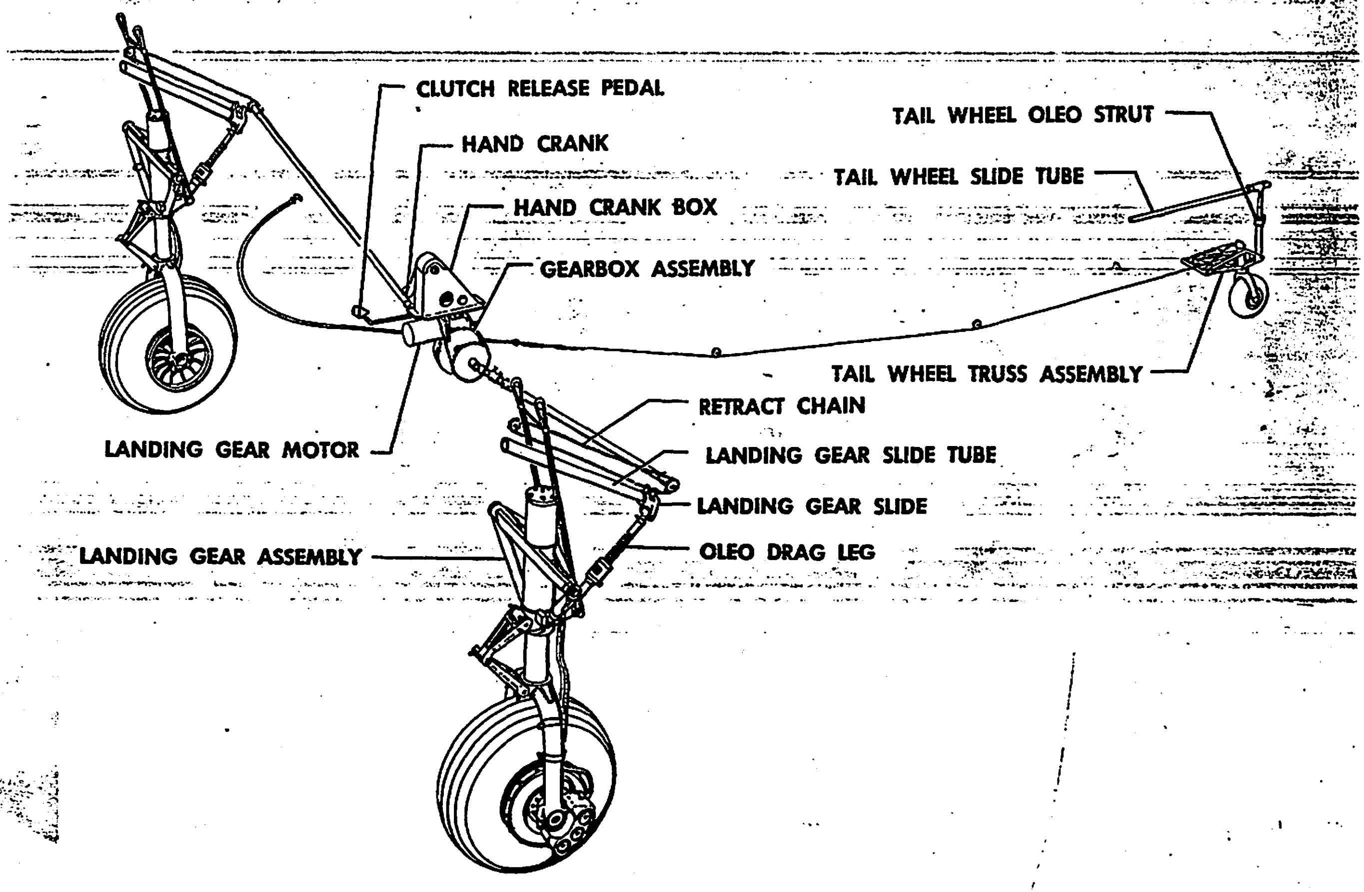


Figure 2-81. Landing Gear Retract System

WARNING

When hoisting or jacking the aircraft, always place a minimum ballast of 200 pounds on the horizontal stabilizer to prevent the aircraft from nosing over. Use a pad to protect the stabilizer.

b. Put battery switches in "OFF" position.
c. Disconnect all electrical leads to the motor.
d. Disconnect and remove the clutch release cable and cable housing from mounting bracket on gearbox assembly.
e. Remove supporting clamp from forward end of the motor.
f. Remove four bolts attaching motor to gearbox housing.
g. Depress clutch release arm on gearbox assembly.
h. Tilt gearbox assembly down and pull motor forward until worm on the motor shaft is clear of the housing.

2-291. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of replacing brushes that are worn to a minimum length of 7/16 inch; installing new springs when used springs have less than two pounds tension; cleaning dirty commutators with cleaning solvent, Federal Specification P-S-661b, or equal, and polishing with No. 4/0 sandpaper.

NOTE

For repairs other than those listed above, the motor shall be removed and sent to a designated overhaul activity.

2-292. INSTALLATION OF LANDING GEAR MOTOR.
a. Install motor in position on gearbox making sure the gears are properly meshed. Coat the surface between the motor and the gearbox housing with Permatex #2 Form-A-Gasket.
b. Install four bolts mounting motor to gearbox housing.
c. Install support clamp at forward end of motor.
d. Install clutch cable and cable housing to bracket on gearbox assembly. Adjust cable in accordance with paragraph 2-302.
e. Connect electrical leads.

CAUTION

After installing new motor check for up and down dynamic braking action.

2-293. LANDING GEAR MOTOR GEARBOX.

2-294. DESCRIPTION. The landing gear motor gearbox is a magnesium casting which houses the motor worm gear and the torque shaft drive gear. Check these parts for excessive wear. Check regularly to maintain the lubricant at the level of the filler plug (figure 1-25).

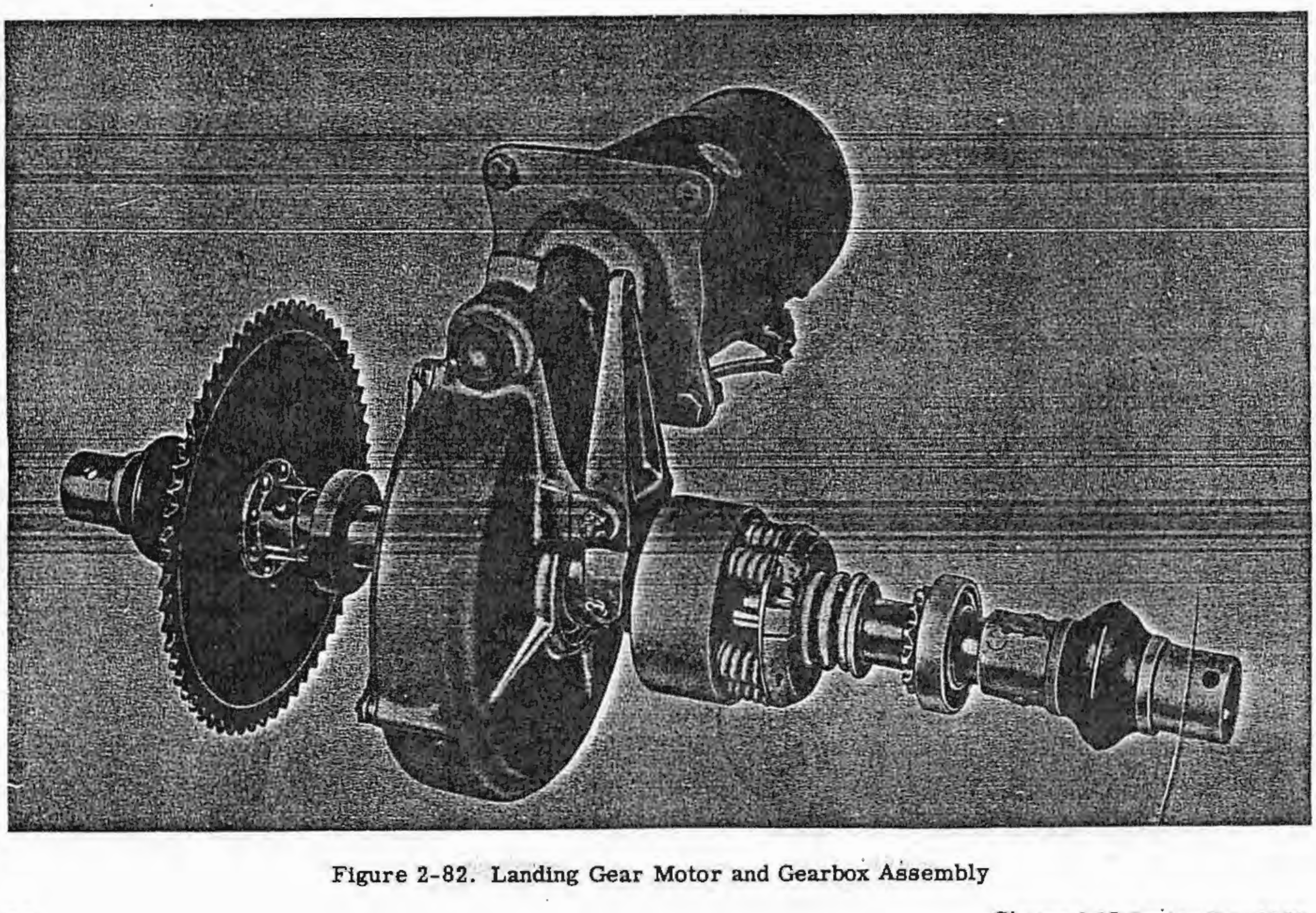


Figure 2-82. Landing Gear Motor and Gearbox Assembly

2-295. REMOVAL OF LANDING GEAR MOTOR GEARBOX.

a. Place the aircraft on jacks so the wheels are off the floor.

WARNING

When hoisting or jacking the aircraft, always place a minimum ballast of 200 pounds on the horizontal stabilizer to prevent the aircraft from nosing over. Use a felt or canvas pad to protect the horizontal stabilizer.

b. Crank the landing gear slides full against the down stop and with no tension on torque shaft scribe aligning marks with pencil or paint on the landing gear shaft and cross shaft collar in the belly.
c. Remove the four taper pins that attach the collar to the torque shaft.
d. Slide the collar outboard letting the short end of the shaft fall free.
e. Remove the two attaching bolts on the universal joint and remove the short shaft.

NOTE

Mark the shaft separately for positive identification and ease in assembling.

f. Remove the clutch release cable and housing from the bracket on the gearbox housing.
g. Disassemble the repair link in the emergency hand crank chain and lay chain aside.
h. Remove guard on tail wheel sprocket in belly.
i. Remove mounting clamp at forward end of landing gear motor and disconnect all electrical wiring.
j. Remove the two shaft bearing block halves and work gearbox and shaft assembly free of the fuselage.

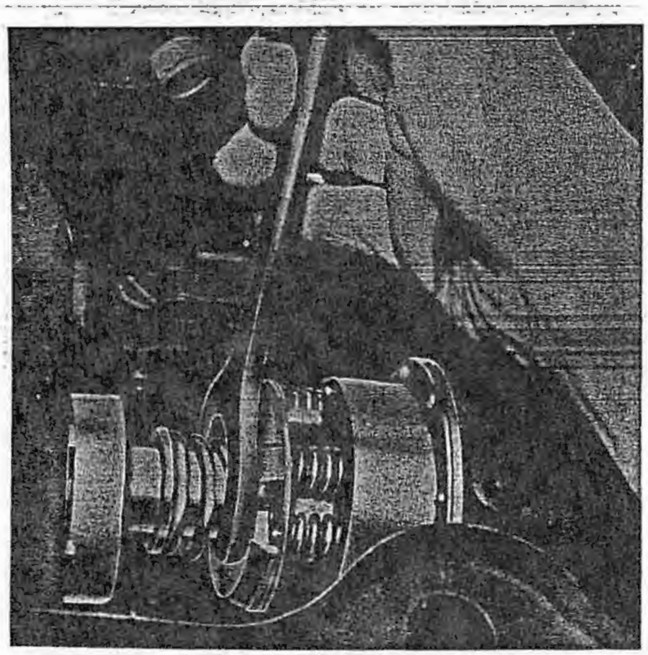


Figure 2-83. Overload Clutch Adjustment

2-296. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of checking the bronze gear for wear at intervals specified in the handbook of inspection requirements. Allowable wear on gear teeth is a maximum of 0.031. The lubricant should be checked as specified in figure 1-25. Repairs to the gearbox and shaft should be done at a designated overhaul activity.

2-297. INSTALLATION OF LANDING GEAR MOTOR GEARBOX.

a. Work gearbox and shaft assembly into position.
b. Install the shaft bearing block halves.
c. Install guard on tail wheel sprocket.
d. Reassemble the hand crank chain on the sprocket.
e. Install the supporting clamp at forward end of motor.
f. Attach the previously marked short cross shaft to the universal with the two attaching bolts.
g. Place the short shaft in line with the collar and slip the collar inboard, lining up the proper holes that were previously marked. Install four tapered pins and safety.
h. Install the clutch release cable and housing. Adjust to proper setting. See paragraph 2-302.
i. Install all electrical wiring on motor and check alignment of previous scribe marks, making sure the landing gear slides in the nacelle wheel well have not moved.
j. Operate gears manually. Check retract system for proper rigging. The landing gear slides must synchronize.
k. Remove jacks from under airplane.

2-298. LANDING GEAR CLUTCH.

2-299. DESCRIPTION. The landing gear clutch is a friction clutch which will slip under an overload in excess of 130 ± 10 pounds. It may be disengaged by depressing the pedal on the left hand side of the pedestal on the floorboard.

NOTE

On aircraft serials AF 52-10732 and after, a heavier landing gear clutch engaging spring is used, to prevent the possibility of partial separation of the landing gear clutch teeth during retraction cycle. To check for clutch teeth separation see paragraph 2-301, step e.

2-300. ADJUSTMENT.

a. Remove the wrap-lock clamp and friction tape holding the clutch dust cover in place and remove the cover.
b. Loosen the lock screw on the tension nut (figure 2-83).

NOTE

It may be necessary to spread the tension nut before it can be loosened. Care must be used to avoid damaging the nut and threads.

c. Use Beech Spanner Wrench 180131, tighten nut to increase tension or loosen nut to decrease tension.
d. Tighten lock screw on the tension nut and safety.

e. Replace dust cover and wrap with friction tape.
f. Install wrap-lock clamp.

2-301. TESTING LANDING GEAR CLUTCH.
a. Place aircraft on jacks.
b. Disengage clutch and raise gear approximately halfway with the hand crank. Re-engage clutch.
c. Set hand crank parallel to floorboard with the teeth engaged.
d. Attach a spring scale to the handle and pull up at 90° to handle. The clutch must slip at 130 ± 10 pounds.
e. Retract landing gear electrically to approximately halfway. Check clutch teeth for partial separation. If a separation of 1/16 inch or more is noted, the clutch spring must be replaced.

2-302. CLUTCH RELEASE CABLE ADJUSTMENT.
a. Hold the clutch pedal in the extreme aft position.
b. Pull the top of the clutch arm outboard, fully engaging the clutch.
c. Tighten bolt on the cable to give 1/16-inch plus or minus 1/32-inch clearance between the bolt and clutch arm (figure 2-84).
d. Operate clutch pedal several times and check release arm for sufficient travel or slippage of bolt.

2-303. LANDING GEAR RETRACT CHAIN.

2-304. DESCRIPTION. The landing gear retract chains are of highly tempered, corrosion resistant steel. The double link chains are routed around two double tooth sprockets in the nacelle. They are fastened to the slide assembly and are provided with a repair link at the ends as an aid in removal or installation.

2-305. REMOVAL OF NACELLE RETRACT CHAIN (LEFT AND RIGHT).
a. Support the aircraft on jacks.

WARNING

When hoisting or jacking the airplane, always place a minimum ballast of 200 pounds on the horizontal stabilizer to prevent the airplane from nosing over. A felt or canvas pad should be used to protect the horizontal stabilizer, and the ballast should be placed over the front spar near the fuselage.

b. Remove the upper attaching bolt and disconnect the oleo drag leg from the slide assembly.
c. Release the tension on the landing gear chain by loosening the lug bolts securing it to the slide.
d. Disconnect both ends of the chain from the slide by removing the safety clips and driving the pins from the repair links.
e. Fasten a length of safety wire or strong cord to the lower end of the chain.
f. Station a man in the pilot's compartment, one in each nacelle. Operate the emergency hand crank VERY SLOWLY in the direction necessary to remove the lower short end of the chain. Hold tension on the long section of the chain by pulling on it. When the short chain reaches the point where it will come from the sprocket tooth, STOP TURNING INSTANTLY. Do not operate system until ready to install chain.

2-306. REMOVAL OF NACELLE RETRACT CHAIN (EITHER LEFT OR RIGHT).
a. Support airplane on jacks.
b. Retract landing gear two or three inches from the lower stop. Mark position of slide on the slide tube as an aid in synchronizing landing gear when chain is reinstalled.
c. Disconnect torque shaft at the universal joint in the belly just outboard of the gearbox assembly.
d. Relieve tension on the chain by loosening the lug bolts securing it to the slide assembly.
e. Disconnect both ends of the chain from the slide by removing the safety clips and driving the pins from the repair links.
f. Pull chain from upper and lower sprocket slowly. Mark with paint the last link of the chain and its matching sprocket tooth. (Lower sprocket.)

2-307. MINOR REPAIR AND PARTS REPLACEMENT. The retract chains should be checked at regular intervals for possible wear. Check the measurement of thirty-six links from center to center of the link pins. The measurement should be 18 to 18-1/8 inches (figure 2-85). If over 18-1/8 inches, the chain should be replaced. Badly rusted or corroded chains should be removed and replaced.

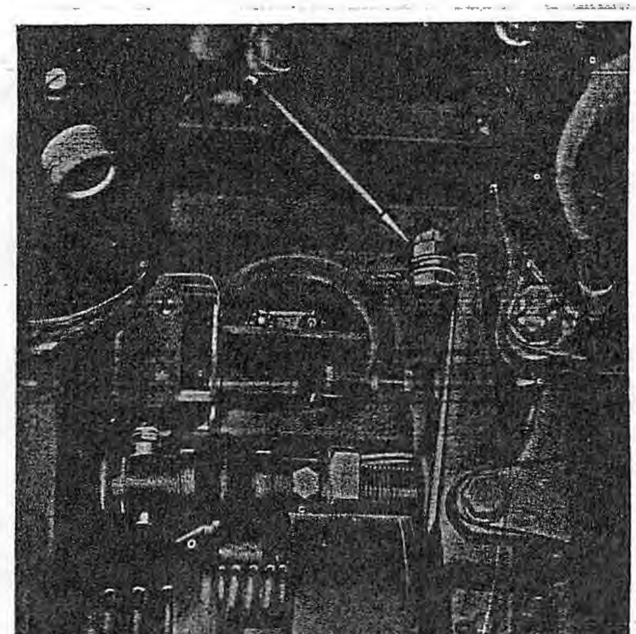


Figure 2-84. Clutch Cable Length Adjustment

2-308. INSTALLATION OF NACELLE RETRACT CHAIN (LEFT AND RIGHT).

a. Attach the previously installed wire or cord to the chain and pull the chain into position so the first link will be on the sprocket tooth from which the last link of the old chain was removed.

b. Install the new chain on the sprocket by cranking it slowly in the opposite direction from which it was removed with the emergency hand crank.

c. Route chain over the top sprocket and install the ends of the chain to the slide assembly.

d. Adjust chains to proper tension. See paragraph 2-310 and figure 2-86.

e. Connect tail wheel retract cables in the tail compartment.

f. Operate gears manually and check slide synchronization. The slides must synchronize.

g. Connect oleo drag leg to slide assembly and check main gears for proper rigging.

h. Rig tail wheel retract cables. See paragraph 2-317.

2-309. INSTALLATION OF NACELLE RETRACT CHAIN (EITHER LEFT OR RIGHT).

a. Place a piece of safety wire approximately two feet long around the lower sprocket and attach one end to the first link of the chain.

b. Install the link of the chain marked with paint on the matching marked tooth of the sprocket.

NOTE

If a new chain is to be installed, mark the link of the new chain to correspond with the marked link of the old chain.

c. Pull the chain around the sprocket by pulling on the safety wire with one hand and turning the torque shaft with the other hand.

d. Install chain on upper sprocket.

e. Connect chain to lug bolts at slide and install safety clips.

f. Adjust chain to proper tension (see paragraph 2-310).

g. Locate slide at position marked on removal of chain and reconnect torque shaft.

h. Check slides for synchronization (see paragraph 2-310).

i. Connect oleo drag leg to slide and check entire retract system for proper rigging.

j. Remove airplane from jacks.

2-310. ADJUSTMENT OF NACELLE RETRACT CHAIN. With the gear retracted enough to raise the slide off of the lower stops, the tension on the retract chain should be 38 to 40 pounds. To set tension, tighten or loosen both adjusting bolts on chain by the same amount. A tension gage, figure 2-87, should be used. If this gage is not available this tension may be approximated by grasping retract chain at about the center and squeezing with thumb and forefinger. If chain can just be squeezed together, tension is satisfactory. Adjust the chain as follows:

a. Support the airplane on jacks so landing gear wheels are clear of floor.

b. Using the emergency hand crank, retract landing gear until the slides in the nacelles are approximately 1/8-inch from the lower stop.

c. If this distance is not the same on both slides, tighten the adjusting bolt in the slide that is farther away from the bottom stop, (to move the slide up), or tighten adjusting bolt in the slide that is closest to the bottom stop, (to move the slide down) (figure 2-86).

d. Recheck slide measurements for synchronization.

NOTE

The chain adjustment will cover approximately 1/4-inch difference of the slide assemblies. If the difference in the position of the slides is greater than 1/4-inch the slides cannot be synchronized by adjusting the chain, and the chains must be relocated on the sprockets. Retract chains should be kept free of dirt, rust and corrosion at all times. Cleaning should be accomplished only with an approved solvent and under no circumstances should rust or corrosion be removed with an acid cleaner. Acid cleaners may embrittle and crack the highly heat treated links. If a retract chain is excessively rusted or corroded to the extent of endangering safe operation, it

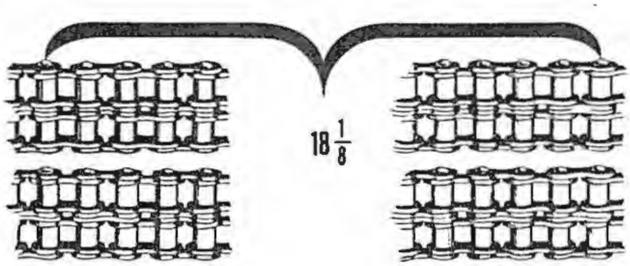


Figure 2-85. Landing Gear Chain Length Check

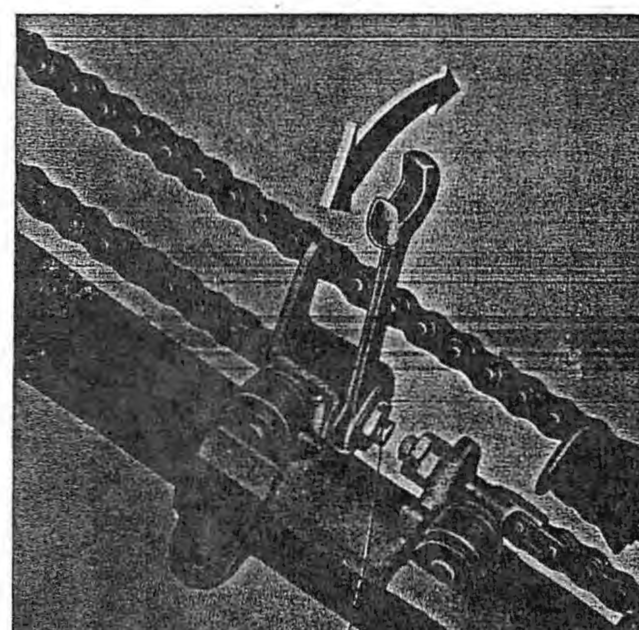


Figure 2-86. Landing Gear Chain Adjustment

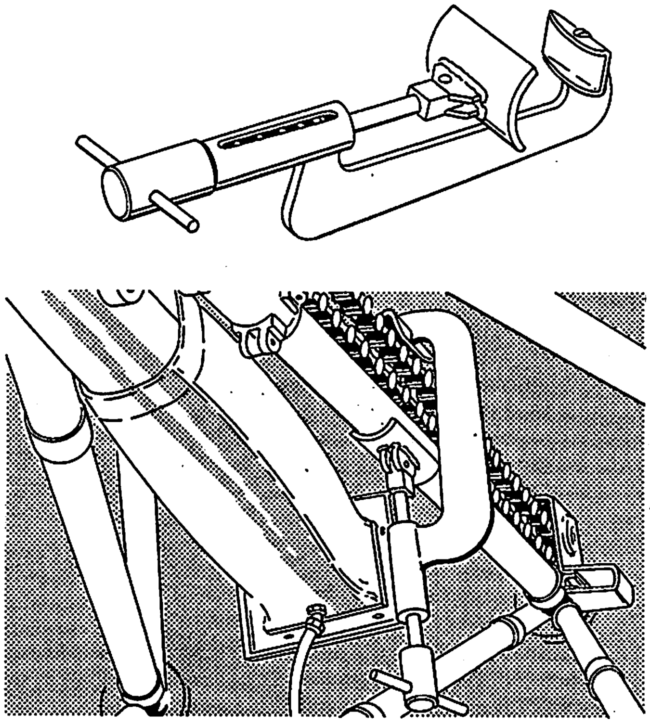


Figure 2-87. Landing Gear Chain Tension Check

should be replaced. Lubricate the retract chains with Specification MIL-L-7870 oil. Consult the lubrication chart for frequency and method of application.

2-311. REMOVAL OF LANDING GEAR TORQUE SHAFT AND RETRACT CHAIN SPROCKET.

a. Support the aircraft on jacks.

WARNING

When hoisting or jacking the airplane always place a minimum ballast of 200 pounds on the horizontal stabilizer to prevent the aircraft from nosing over. Place the ballast over the front spar near the fuselage and use a felt or canvas pad to protect the skin.

b. Crank the landing gear down until the slides rest lightly against the down stop, and with no tension on the torque shaft. Make aligning marks with grease pencil or paint on the landing gear cross shaft and short cross shaft collar in the belly.
c. Remove the taper pins which attach the collar to the torque shaft. Remove the taper pins carefully so they may be reused if necessary. If reuse of the taper pins is anticipated, they should be marked for reinstallation in the holes from which they were removed.

NOTE

If reuse of the taper pins is anticipated, they should be marked for reinstallation in the holes from which they were removed.

d. Slide collar outboard freeing short end of shaft. Slip collar inboard and remove from torque shaft.
e. Relieve tension on retract chain in nacelle by loosening the lug bolts securing it to slide.
f. Disconnect the lower end of the chain by removing safety clips and driving the pins from the repair link.
g. Grasp the torque shaft just inboard of the universal and rotate the shaft slowly to remove the chain from the sprocket. Mark with paint the last link of chain and its matching sprocket tooth.

NOTE

The chain need not be removed from the upper idler sprocket.

h. Remove engine cowling, and remove the plate on inner cowl covering upper end of slide tube.
i. Remove the bolt at each end of the slide tube.
j. Rotate the slide tube with a strap wrench and work the slide upward as far as possible.
k. Slip the landing gear torque shaft inboard until it is free of the universal. Work the torque shaft outboard into the nacelle, into position to be removed and remove it from the nacelle.

CAUTION

Exercise care when removing the torque shaft to prevent losing the keys which are installed in the keyways of the universal.

l. Remove the keys from the universal.
m. Remove the retaining screw which is installed just outboard of the outboard sprocket bearing.
n. Loosen the bolts which maintain the surface friction lock on the bearings.
o. Drive the sprocket inboard and remove sprocket and inboard bearing.
p. Remove outboard bearing by driving it outboard.

2-312. MINOR REPAIR AND PARTS REPLACEMENT. Inspect the sprocket carefully for evidence of cracking, cracks, excessive wear, rust or corrosion. Defective sprockets must be replaced. Check the bearings for excessive wear and rough operation. Bearings, rough or sticky in operation, must be replaced. Check the keys installed in the keyways at the end of the sprocket for square corners and tight fit. If the torque shaft is bent, distorted or rusted, it must be replaced.

2-313. INSTALLATION OF LANDING GEAR TORQUE SHAFT AND RETRACT CHAIN SPROCKET.

a. Install the inboard bearing and sprocket.

NOTE

When installing a new sprocket, mark the tooth of the new sprocket to correspond with the marked tooth of the sprocket which was removed.

b. Install the outboard sprocket bearing and outboard bearing retaining screw.
c. Work the landing gear torque shaft into position

through the nacelle into the wing stub and install torque shaft on the sprocket.

WARNING

Exercise extreme care and make frequent checks, while installing the shaft on the sprocket, to be sure the keys remain engaged in the keyways of the universal.

d. Route a length of safety wire around the sprocket and attach one end to the retract chain to aid in installing the chain on the sprocket.
e. Position the marked link of the chain on the marked sprocket tooth and by slowly turning the torque shaft, install the chain on the sprocket.

CAUTION

Be sure the marked link of chain is positioned on the marked sprocket tooth. If the chain is incorrectly installed on the sprocket teeth, the chain adjustment will not compensate for the difference in position of the slides and the chain will have to be relocated on the sprocket.

f. Work the slide tube down into the lower socket and install upper and lower bolts.
g. Install plate on the inner cowl which covers the upper end of the slide tube. Install cowling.
h. Connect chain to lower lug bolt on the slide and install safety clips.
i. Adjust chain tension. See paragraph 2-310.
j. Position slide against the lower stop and connect the torque shafts in the belly.
k. Operate the retract system manually and check the slides for correct synchronization. Adjust as required. See paragraph 2-310.
l. Tighten the sprocket bearing surface friction locking bolts.
m. Remove airplane from jacks.

2-314. REMOVAL OF TAIL WHEEL RETRACT CHAIN AND CABLES.
a. Release tension and disconnect the tail wheel retract cables in the rear fuselage section.
b. Remove center aisle floorboards.
c. Remove pulleys at Bulkheads 10 and 7. Remove idler sprockets under center section truss at Bulkhead 5 in the belly.
d. Remove guard over sprocket on torque shaft in belly.
e. Mark with paint, or other suitable means, a link of the chain and its matching tooth of the sprocket.
f. Pull chain out through the belly.
g. Remove the pulleys over which the retract cables are routed at the forward end of the tail wheel slide tube (approximately Bulkhead 13).
h. Remove large pulley on aft side of Bulkhead 14 and disconnect the cable from the slide assembly.
i. Remove cable by pulling it out through the tail wheel well.

2-315. MINOR REPAIR AND PARTS REPLACEMENT. If a cable has more than six broken strands in any one inch, it must be replaced. Rusted or corroded chains must be replaced. Replace pulleys which are frozen or sticky in operation.

2-316. INSTALLATION OF TAIL WHEEL RETRACT CHAIN AND CABLES.
a. Install the chain and cable assembly over sprocket tooth and route aft through the fuselage.
b. If the old chain is to be reinstalled, by means of the previously marked chain link, position the marked link over the matching tooth of the sprocket. If a new chain is to be installed, place the corresponding link of the new chain over the marked tooth of the sprocket.
c. Install pulleys at Bulkheads 7 and 10. Install idler sprockets at Bulkhead 5.
d. Pull new cable into position and install large pulleys at the forward end of the tail wheel slide tube (Bulkhead 14).
e. Attach cable to slide assembly.

NOTE

A shear bolt attaches cable to slide assembly. Do not replace with a steel bolt.

f. Make sure cables are in correct position and install pulleys at forward end of tail wheel slide tube (Bulkhead 13).
g. Connect the tail wheel retract cables in the rear fuselage section and adjust to approximate tension.
h. Operate gears MANUALLY and check all the slides for synchronization. All slides must synchronize.
i. Run gears electrically and set lower limit switch.
j. Rig retract cables to correct tension and safety turnbuckles.

2-317. RIGGING TAIL WHEEL RETRACT CABLES.
a. Support airplane on jacks.
b. Station a man in the pilot's compartment, a man in the tail compartment and a man outside the airplane. The man in the pilot's compartment will operate the gear manually and electrically, the man in the tail will adjust the retract cable tension and the man outside will see that the wheel wells are clear each time the gear is operated and check the tail wheel slide for correct travel and synchronization with the main wheel slides.
c. Operate the landing gear system manually and position the main gear slides against the lower stop. Adjust the turnbuckles on the tail wheel retract cables until each has about 50 pounds tension. Make sure the tail wheel slide is against the lower (aft) stop.
d. Operate gear electrically and check the lower limit switch for correct setting. See paragraph 2-372.

CAUTION

Use extreme care when operating the gear electrically. Added inertia in the landing gear, caused by electrical operation, may cause the landing gear slides to contact the lower stops too hard and damage the retract system. Manually operate the gear and make an approximate setting which will make sure the slides will not contact the lower stops too hard in electrical operation, then continue electrical operation and adjustment by trial and error until the correct setting is obtained. Do not rely on a setting obtained by manual operation to stop the gear when it is operated electrically.

e. Adjust retract cables, using a tensiometer, to 70 plus or minus 5 pounds on the top cable and 50 plus or minus 5 pounds on the bottom cable.

NOTE

If the above tensions cannot be obtained with the tail wheel slide against the lower stop and three or fewer threads showing at the retract cable turnbuckles, the chain must be relocated on the idler sprocket in the belly. After chain is relocated, operate gear MANUALLY to check synchronization of the tail wheel slide with the main wheel slides.

f. Fully retract gear, then lower electrically against the lower stop. The man in the tail compartment will listen carefully for a slight impact (barely audible) as the tail wheel slide contacts the lower (aft) stop and the man outside will check through the tail wheel opening to be sure the slide contacts the stop.
g. Recheck cable tension and lower limit switch setting; make minor adjustments if necessary and safety the turnbuckles.
h. Remove airplane from jacks.

WARNING

The tail wheel retract cable is attached to the tail wheel slide with an aluminum alloy shear bolt. NEVER replace this bolt with a steel bolt.

2-318. SLIDE TUBES.

2-319. DESCRIPTION. The slide tubes are constructed from chrome molybdenum, round, seamless steel tubing. Prior to installation, the tubes are cadmium plated on the outer surface to resist rust and corrosion. They are securely attached at each end to the truss assembly and are adequately reinforced to absorb normal stresses applied by landing and take-off. The exterior surface is smooth to permit the slide assembly to travel the entire length of the tube with the least possible drag. There are three slide tubes; one for the left main gear, the right main gear and the tail wheel.

2-320. REMOVAL OF SLIDE TUBE.
a. Remove engine cowling, right-hand section of the exhaust collector ring and heater muff from the left engine. (Remove cowling, left-hand section of the exhaust collector ring and heater muff from the right engine.)
b. Remove generator and cover plates on inner cowl and firewall.
c. Raise the airplane on jacks until wheels are clear of floor.
d. Loosen nuts on the front eye bolt of the retract chain to relieve all tension from the upper bracket.
e. Remove bolt at lower end of slide tube and bolt from the upper bracket.
f. Rotate the tube with a strap wrench and pull out forward.

NOTE

If a strap wrench is not available, install a 1-1/2-inch hose clamp around the tube just above the slide assembly and secure firmly. Disengage clutch and retract gear with hand crank until tube clears lower sockets. If the slide tube is excessively bent, it may be sawed in two, to aid removal and prevent damage to the center section truss.

2-321. MINOR REPAIR AND PARTS REPLACEMENT. Check the slide tube for excessive rust and corrosion. If badly rusted or corroded, the slide tube must be replaced. Badly nicked or pitted slide tubes must be removed and replaced. Slide tubes which become bent enough to bind the slide assembly must be replaced.

2-322. INSTALLATION OF SLIDE TUBE.
a. Insert new slide tube in place through the upper bracket and fit snugly against the shoulder in the lower socket.
b. Mark slide tube to match holes in slide tube sockets with 3/8-inch transfer punch as shown in figure 2-88.
c. Remove slide tube and drill tube with a 23/64-inch drill at points marked with the transfer punch.
d. Line ream these holes to 0.375 ± 0.0005 inch.
e. Remove all burrs and reinstall slide tube.
f. Reinstall bolts in slide tube.
g. Replace generator and cover plates, heater muff, exhaust collector ring and cowling.

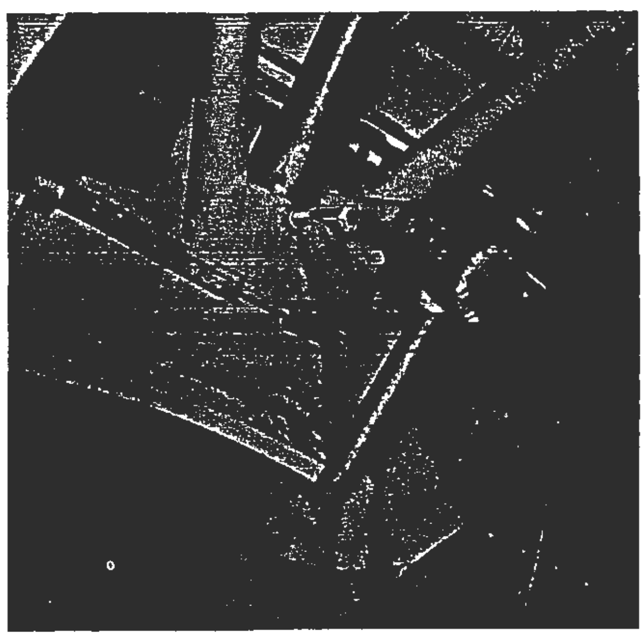


Figure 2-88. Slide Tube Marking

h. Synchronize slides and adjust chain tension. See paragraph 2-310.
i. Check tail wheel synchronization.

2-323. ALTERNATE METHOD FOR CHANGING SLIDE TUBE. If a suitable engine hoist is available it is possible to save time by changing slide tubes in the following manner:
a. Raise airplane on jacks until wheels are clear.

WARNING

When hoisting or jacking the airplane, always place a minimum ballast of 200 pounds on the horizontal stabilizer to prevent the airplane from nosing over. A felt or canvas pad should be used to protect the horizontal stabilizer. The ballast should be placed over the front spar near the fuselage.

b. Place the fuel selector valve and oil shut off valve in the "OFF" position.
c. Remove engine cowling and firewall cover plate.
d. Disconnect exhaust tail pipe from rear hanger and remove heater valve from intensifier tube.
e. Remove firewall section assembly (fairing covering exhaust tail pipe at front of the nacelle).
f. Loosen nuts on the front eye bolt of the retract chain to relieve all tension from the upper bracket.
g. Remove upper and lower slide tube bolts.
h. Disconnect the following plumbing:

NOTE

Drain oil tank. Plug ends of all connections to prevent dirt from entering lines.

1. Oil inlet and return hose connections. (Plug engine outlet to prevent loss of oil.)
2. Oil vent hoses.
3. Fuel primer hose.
4. Oil pressure hose (to indicator).
5. Manifold pressure hose (to indicator).
6. Anti-icer hose.

i. Disconnect clamps holding the magneto leads to the engine mount assembly, also propeller governor controls.
j. Attach hoist sling to eyes on engine crankcase. Eyes are located on each side and aft of No. 1 cylinder.

WARNING

A suitable hoist capable of supporting the entire engine assembly (approximately 1500 pounds capacity) must be used.

k. Tighten the chain hoist to support the engine.

CAUTION

Check hoisting sling to make certain the connections to the hoisting eyes are satisfactory and that the hoisting sling separator bar prevents the cables from damaging the induction pipes.

l. Remove nuts from bolts attaching the two upper engine mount bushings to the center section truss.
m. Loosen nut on lower mount bolt.
n. Remove two upper bolts from engine mounts and bonding strips.
o. With great care, lower the engine down and forward so that it is possible to gain clearance for the removal of the slide tube through the access hole in the firewall.

NOTE

It is necessary for the engine to pivot forward until the distance between the top of the firewall and the top of the inner cowl has increased 3-11/16-inch. This may be done without damage to the tail pipe or nacelle if the work is performed with caution.

p. Rotate slide tube with a strap wrench and pull out forward.

NOTE

If a strap wrench is not available, fasten a 1-1/2-inch hose clamp above the slide and drive it out with a lead hammer or heavy rawhide mallet. In case the slide tube is bent, it is sometimes advisable to saw it in two so that it may be removed without damaging the center section truss assembly.

2-324. INSTALLATION OF SLIDE TUBE.
a. Insert new slide tube into place through the upper bracket and fit snugly against the shoulder in the lower socket.
b. Mark the slide tube to match the holes in the slide tube sockets with a 3/8-inch transfer punch as shown in figure 2-88.
c. Remove the slide tube and drill the tube with a 23/64-inch drill bit at points marked with the punch.
d. Line ream these holes to 0.375 inch ±0.0005 inch.
e. Remove all burrs and reinstall slide tube.
f. Reinstall upper and lower slide tube bolts.
g. Raise engine into position and reinstall mounting bolts, bond strips, plumbing, tail pipe hanger, tail pipe heater valve, firewall section and cowling.
h. Synchronize slide and adjust chains. See paragraph 2-310.
i. Check tail wheel synchronization.
j. Turn fuel selector and oil shut-off valves "ON."
k. Run engine to check plumbing connections.

2-325. REMOVAL OF TAIL WHEEL SLIDE TUBE.
a. With tail on jacks, remove bolt attaching retract cables to the slide assembly.
b. Remove upper attaching bolt and disconnect shock absorber from slide assembly.
c. Remove bolts securing the slide tube to the fuselage.
d. Use a strap wrench and work slide tube out forward through the forward mounting bracket.

2-326. MINOR REPAIR AND PARTS REPLACEMENT. Check the slide tube for excessive rust and corrosion. If badly rusted or corroded, the slide tube must be replaced. Badly nicked or pitted slide tubes must be replaced. Slide tubes bent far enough to bind the slide assembly must be replaced.

2-327. INSTALLATION OF TAIL WHEEL SLIDE TUBE.
a. Insert the new slide tube through the forward mounting bracket and using a strap wrench, work the tube aft until it seats snugly against the rear mounting socket.
b. Mark the slide tube to match the holes in the slide tube sockets with a transfer punch.
c. Remove the slide tube and drill the tube out to 1/4-inch at the forward mounting hole and the rear hole to 3/16-inch.
d. Remove all burrs and reinstall slide tube.
e. Install forward and rear mounting bolts.
f. Connect the tail wheel retract cables and the shock absorber to slide assembly.
g. Remove jacks.

2-328. LANDING GEAR SLIDE ASSEMBLY.

2-329. DESCRIPTION. The main gear slide assemblies consist of steel forgings machined to accommodate six bearings which act as rollers. The bearings are evenly spaced to give a smooth sliding operation. Machined on the forgings are two fittings for the retract chain attachment. The forging is lined with a bronze bushing to assure free action on the slide tube. The tail wheel slide assembly is a steel forging, lined with a bronze bushing and has an integral lug for the retract cable attachment. The forging is lined with a bronze bushing to assure free action on the slide tube.

2-330. REMOVAL OF LANDING GEAR SLIDE ASSEMBLY.
a. Support airplane on jacks.
b. Remove retract chains from the slide assembly.
c. Remove cowling and wrapper sheets.
d. Remove upper and lower slide tube bolts.
e. Remove firewall cover plate over upper end of slide tube.
f. Pull slide tube forward just enough to allow slide assembly to slip off.
g. Remove slide.

2-331. MINOR REPAIR AND PARTS REPLACEMENT. The landing gear slide assembly should be kept clean at all times. If the bronze bushing or bearings are excessively worn or scored, replace slide assembly.

2-332. INSTALLATION OF LANDING GEAR SLIDE ASSEMBLY.
a. Place slide in position on slide tube.
b. Pull slide tube back into place and install upper and lower bolts.
c. Connect retract chains and adjust to correct tension. See paragraph 2-310.
d. Install firewall cover plate, cowling and wrapper sheets.

2-333. REMOVAL OF TAIL WHEEL SLIDE.
a. Support tail of aircraft on jacks.
b. Remove bolts securing the slide tube to forward and rear socket assemblies.
c. Disconnect tail wheel retract cable from slide.
d. Work slide tube forward just far enough to allow slide assembly to drop free.

2-334. MINOR REPAIR AND PARTS REPLACEMENT. Keep the slide assembly clean at all times. If slide is excessively worn or scored, it must be replaced.

2-335. INSTALLATION OF TAIL WHEEL SLIDE.
a. Install slide on slide tube.
b. Work slide tube aft into rear mounting socket, install bolts, tighten securely.
c. Connect retract cables and shock absorber assembly to slide.
d. Remove jacks.

2-336. RIGGING MAIN LANDING GEAR DOORS. The following procedure is to be used only on airplanes with the original landing gear door linkage. It is not to be used on Serials 51-11725 through 51-11799, which have the door linkage shown in figure 2-80.
a. Support airplane on jacks.
b. Check limit switches to be sure they are set correctly. See paragraph 2-372.
c. Disconnect the landing gear door linkage on either left or right wheel, and secure doors back out of the way.
d. Adjust the landing gear door linkage, which has not been disconnected, and set the doors approximately 12 ± 1/2-inch from the landing gear shock strut piston. Measure from the lower forward corner of each door with the scale horizontal. The landing gear door linkage is adjusted by any one or all of the following methods:
1. Rotation of the clamps on the "V" brace.
2. Moving the linkage either up or down on the "V" brace.
3. Adjusting the clevis on the door linkage rod.
e. Station a man in the pilot's compartment to operate the landing gear position switch and another near the gear being rigged to watch the doors closely as the gear retracts and make adjustments as required.
f. With the battery master switches "OFF," put the landing gear position switch in "UP." Using the battery switches intermittently, slowly retract the gear.

WARNING

Before retracting the gear electrically, check both landing gear torque shafts to be sure they will clear all lines, wires and structure. Check batteries for specific gravity; if they are low, use external power for operating the gear.

g. Watch the doors closely as the gear is being retracted to be sure that clearance between the doors and the tire is maintained. If it is apparent that the doors will not clear the fork or tire, run gear down and readjust the door linkage. Maintain the dimension given in step d.

NOTE

A combination of any two or all of the methods for adjusting the door linkages (see step d) may be necessary to maintain the correct door dimension in "down" position and to obtain proper rig and tension of the doors in "up" position. See Trouble Shooting, Table XII.

h. Run gear up slowly, checking carefully to be sure the doors clear the tire and landing gear fork. Maintain 1/4-inch minimum clearance between the door and tire, door and landing gear fork, and door and wheel axle.

WARNING

Accumulative tolerances in the landing gear door linkage and the landing gear door swivel will allow approximately 1/4 to 3/8-inch "play" in the landing gear door. When checking the 1/4-inch minimum clearance, push the door toward the wheel and remove the "play." Maintain 1/4-inch minimum clearance with the "play" removed.

i. Adjust linkage to close doors snugly and cause a bow of approximately 1/16 to 3/32-inch of the nacelle.
j. Check the doors for alignment. A small amount of forming with a rawhide mallet may be necessary to align the edges of the doors. Take care when using the mallet not to strike too hard and distort or damage the doors.
k. Run gears down, tighten and key all bolts. Tighten and lock jam nut.

NOTE

The clevis head bolt attaching the rod end clevis to the door swivel should be tightened only finger tight.

l. Repeat steps d through k for opposite gear.
m. Remove airplane from jacks.

2-337. LANDING GEAR DOOR LINKAGE (UNIVERSAL TYPE). The landing gear door linkage on C-45G airplanes, Serials 51-11721 through 51-11799, incorporate a new swivel-type, door linkage (figure 2-80.) The modified linkage incorporates two full-swiveling universals, one at each end of the link rod instead of the clevis fittings and clevis head bolts used on the original linkage. To adjust the new type linkage, loosen the lock nut on the inboard end of the link rod and shorten or lengthen the link rod. Further adjustment, if necessary, may be obtained by rotating the clamp on the tube of the landing gear V-brace. The clamp assembly is jig located on the tube member at the factory at the time of manufacture and if removed, must be reinstalled at the same location. Do not attempt to change the rigging of the doors by moving the clamp up or down on the tube member. Rotate the clamp and adjust the link rod as necessary to obtain a dimension of 13 to 14-1/2 inches from the shock strut piston to the lower forward corner of the landing gear door. Measure from the closest point of the piston to the corner of the door being rigged.

2-338. LANDING GEAR ELECTRICAL SYSTEM.

2-339. DESCRIPTION. The landing gear electrical system consists of a position switch assembly, two safety switches, position indicator, dynamic brake relay, limit switches, position indicator switches and a warning horn. The landing gear position switch (figure 2-89) consists of a lever with a red plastic knob, in the form of a miniature tire for a handle. A warning light built into the plastic knob is illuminated when the position of the landing gear is out of sequence with the position of the landing gear position switch. When the weight of the airplane is on the wheels, a solenoid, which is built into the landing gear position switch assembly, locks the position switch lever in the "DOWN" position. Four phenolic cams, mounted on the position switch lever horizontal pivot arm, actuate Micro Switches which are mounted vertically, side by side, at the top of the position switch assembly and inside the switch case. A spring holds the switch lever in detent at the extreme limits of up and down travel. The amount of force needed to overcome the spring tension is between five and ten pounds. In emergencies, the switch lever may be placed in the "UP" position by pressing in on a manual release button which is accessible on the left side of the lower part of the pedestal. This emergency release button is shown in figure 2-89. A "PRESS TO TEST" switch, installed on the lower portion of the switch assembly, serves as a means to determine if the bulb, built into the plastic knob, is serviceable or defective.

2-340. REMOVAL OF LANDING GEAR POSITION SWITCH.

a. Place airplane on jacks.
b. Remove screws holding switch cover to pedestal and remove cover.
c. Remove screws which secure switch assembly to the side of the pedestal.
d. Remove electrical wiring from terminal strip.
e. Pull switch assembly out of pedestal and dis-

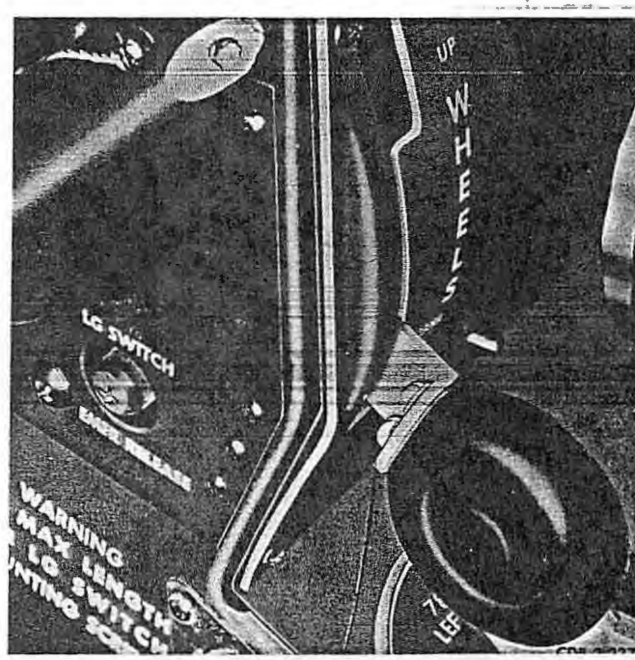


Figure 2-89. Landing Gear Position Switch and Emergency Release

connect wiring from opposite terminal strip.
f. Remove switch.

2-341. DISASSEMBLY OF LANDING GEAR POSITION SWITCH.

NOTE

Disassembly of the entire position switch assembly is not recommended. The following procedure covers only the disassembly necessary to remove the Micro Switches.

a. Remove the solder over the heads of the screws which secure the Micro Switches in the switch bracket.
b. Melt solder and disconnect wires from terminals on the Micro Switches. Note the wire connections as an aid to their correct reinstallation.
c. Remove screws holding the Micro Switches and remove switches.

2-342. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of the replacement of defective Micro Switches and the insulation of bare wires in the event the insulation has been worn off. Remove the cover section of the plastic miniature tire and replace bulb if defective. If other component parts of the switch assembly are defective, tag the switch as defective and forward to a designated overhaul activity.

2-343. ASSEMBLY OF LANDING GEAR POSITION SWITCH.
a. Position the phenolite insulation strips between the Micro Switches and insert screws through the holes provided in the switches.
b. Solder wires to terminals on the switches. See figure 10-3.
c. Tighten screws securely.

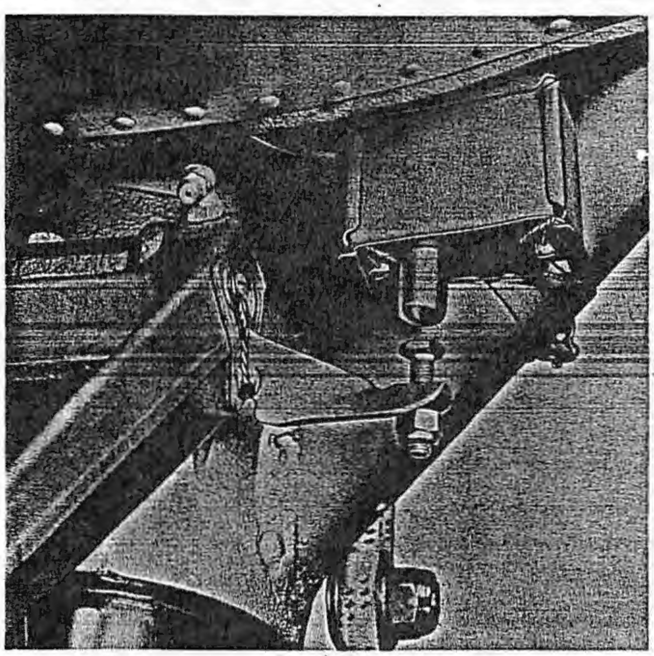


Figure 2-90. Landing Gear Safety Switch

d. Place a small amount of solder over each screw head.

2-344. INSTALLATION OF LANDING GEAR POSITION SWITCH.
a. Insert switch assembly into opening in pedestal and connect electrical wiring to the terminal strip on the forward side of the switch assembly. See figure 10-3.
b. Connect electrical wiring to the terminal strip on the aft side of the switch assembly. See figure 10-3.
c. Position switch against left side of pedestal, insert screws and tighten securely.
d. Place switch cover in position over opening in pedestal and install screws.
e. Check switch for correct operation.
f. Remove airplane from jacks.

2-345. SAFETY SWITCHES.

2-346. DESCRIPTION. The two safety switches (YZ-RQ-41), located on the torque knees of both shock struts (figure 2-90) are actuated by the shock-fork assembly sliding up and down in the barrel of the shock absorber. These switches are wired in series to control a solenoid latching mechanism in the position switch. The latch locks the landing gear switch lever in down position. In an emergency it may be released manually from the pilot's compartment by inserting a finger in a hole in the left side of the pedestal and pressing the release.

2-347. REMOVAL OF SAFETY SWITCH.
a. Cut safety wire securing the dust cover and remove cover.
b. Remove the two mounting screws in the bottom of the switch bracket.
c. Slide dust cover back on wiring and lift switch out.
d. Disconnect electrical wiring and remove switch.

2-348. MINOR REPAIR AND PARTS REPLACEMENT. Keep the switch free from oil and grease. In the event the switch becomes faulty in operation due to the accumulation of oil and grease, it may be cleaned by using solvent, Specification P-S-661. Defective switches must be removed and replaced.

2-349. INSTALLATION OF SAFETY SWITCH.
a. Make proper electrical connections. See appropriate wiring diagram in Section X.
b. Place switch in mounting bracket and install mounting screws.
c. Install dust cover and secure with safety wire.

2-350. ADJUSTMENT OF SAFETY SWITCHES.
a. Support the airplane on jacks to remove the weight from the landing gear.

WARNING

When hoisting or jacking the airplane, always place a minimum ballast of 200 pounds on the horizontal stabilizer to prevent the airplane from nosing over. A felt or canvas pad should be used to protect the horizontal stabilizer and the ballast should be placed over the front spar near the fuselage.

b. Release the air from the shock absorber.
c. Place a small jack under the shock-absorber fork and raise wheel until shock-absorber is compressed 1/2-inch.
d. Adjust actuating bolt until switch clicks.
e. Lower wheel, then raise it carefully to the point where the switch clicks again. Mark this location of shock strut and remove jack from under the fork assembly. The distance from this mark with shock fully extended should be 1/2-inch (figure 2-91).
f. Replace jack and raise wheel again. This simulates the weight of the airplane on the landing gear. Check to see if position switch latch is engaged.
g. Remove jack from under wheel and lower airplane off jacks.
h. Inflate strut 2-1/3 inches.

2-351. LANDING GEAR POSITION INDICATOR SYSTEM.

2-352. DESCRIPTION. The landing gear position indicator, on the upper, left corner of the instrument panel, has a window for each main gear and the tail wheel. The C-45H, which has its tail wheel fixed down, has windows for the main gear only. When the gears are fully retracted, the windows will show "UP;" when they are fully extended, a wheel and strut appear in each window. If the gears are in any position other than fully extended or fully retracted, a series of parallel lines will appear in the indicator windows.

2-353. TROUBLE SHOOTING. See Table IX.

2-354. REMOVAL OF LANDING GEAR POSITION INDICATOR.
a. Remove screws holding instrument panel in vertical position and tilt instrument panel aft and down.

NOTE

Place a pad behind control knobs before lowering panel to avoid damaging instrument faces.

b. Disconnect electrical wiring on the indicator.
c. Remove indicator mounting screws and remove indicator from instrument panel.

2-355. MINOR REPAIR AND PARTS REPLACEMENT. Repairs on this unit are limited to removing defective or malfunctioning indicators. Forward defective unit to a designated overhaul activity.

2-356. INSTALLATION OF LANDING GEAR POSITION INDICATOR.
a. Position indicator unit on instrument panel and install mounting screws.
b. Make the correct electrical connections. See appropriate wiring diagram in Section X.
c. Raise the floating panel to correct position and install retaining screws.

2-357. DYNAMIC BRAKE RELAY.

2-358. DESCRIPTION. The dynamic brake relay, (Cutler-Hammer 6046, H39A, figure 2-92) is mounted on the lower side of the floorboards, underneath the pilot's seat. This relay consists of two solenoid operated double pole double throw contactors. A rocker arm selector switch is situated between the two contactors. This selector switch is actuated mechanically by either of two arms, which are linked to, and operated by the contactors as they are energized. The position of the rocker arm selector switch will alternate when the contactor opposite the one last used is energized.

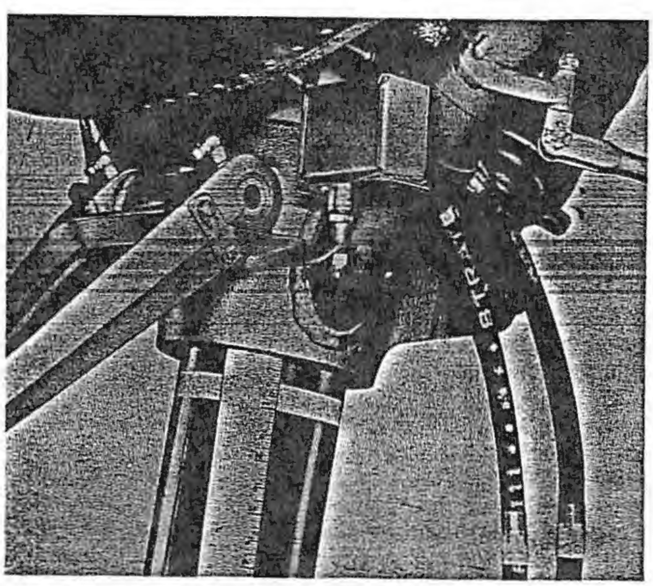


Figure 2-91. Landing Gear Safety Switch Adjustment

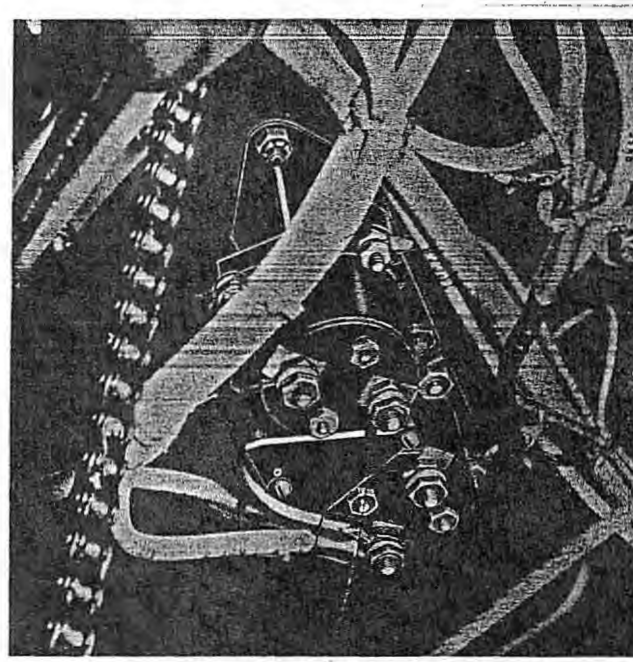


Figure 2-92. Landing Gear Dynamic Brake Relay

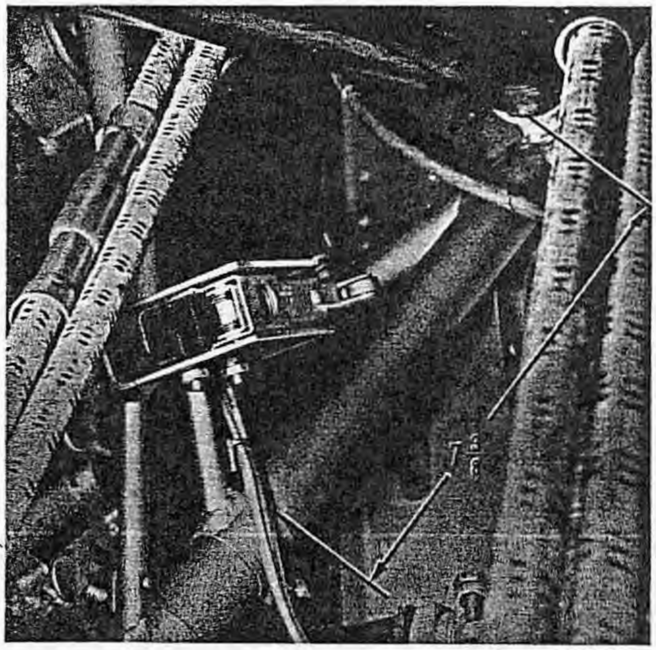


Figure 2-93. Upper Limit Switch

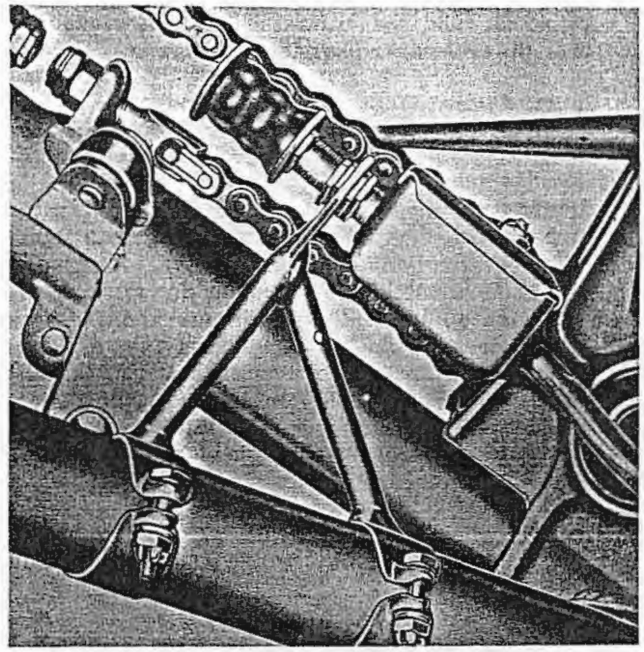


Figure 2-94. Lower Limit Switch

2-359. TROUBLE SHOOTING. See Table VIII.

2-360. FUNCTION. The dynamic brake relay acts as a remote control switch for the landing gear motor. One solenoid contactor, when energized, completes the motor circuit to retract the landing gear. The opposite is used to extend the gear. The rocker arm selector switch is utilized to complete the dynamic braking circuit, thus preventing the landing gear motor from coasting after the retract mechanism has reached the physical limits of its travel.

2-361. REMOVAL OF DYNAMIC BRAKE RELAY.
a. Turn battery switch "OFF."
b. Disconnect all electrical leads. Remove nuts from mounting bolts. Relay will drop free.

2-362. MINOR REPAIR AND PARTS REPLACEMENT.
a. Place unit in position on mounting bolts, install nuts and tighten securely.
b. Make the correct electrical connections. See appropriate wiring diagram in Section X.

2-363. TESTING OF DYNAMIC BRAKE RELAY.

NOTE

If, after running the following test, the relay proves to be malfunctioning, it should be removed and forwarded to a designated overhaul activity.

a. Support airplane on jacks so all wheels are clear of the floor.
b. Disconnect leads at motor and turn on electrical system. (Tape these leads to prevent them from becoming grounded.)
c. Test (with a 24-volt test light) the continuity from the main power terminal in belly of airplane to No. 3 Terminal on the dynamic brake relay.
d. Manually set the landing gear so that both limit switches are clear of the slide assembly actuator and place the landing gear position switch in the "UP" position (for testing up solenoid).
e. Test from Terminal No. 1 of the relay assembly to ground; if the up solenoid contactor is making proper contact, the test light will be on.
f. Holding the position switch in a neutral position, or operating the up limit switch, should cause the test light to go off.
g. Repeat the same test for the down solenoid by placing the position switch in the "DOWN" position and testing from Terminal 2 of the relay assembly to ground. If the down solenoid contactor is making proper contact, the test light will be on.
h. Holding the position switch in a neutral position or operating the down limit switch should cause the light to go off.
i. Connect leads to motor (see appropriate wiring diagram in Section X) and operate gears to assure the proper operation of the relay with the gears in operation.

2-364. LANDING GEAR LIMIT SWITCHES.

2-365. DESCRIPTION. The travel of the landing gear is controlled by two limit switches which are mounted on the truss assembly in the left nacelle. They control the landing gear motor through the dynamic brake relay. The upper limit switch is mounted on the truss tube near the top of the nacelle (figure 2-93). The switch is operated by an actuator wedge mounted on the upper attaching bolt of the oleo drag leg and regulates the travel of the gear as it is being retracted. The lower limit switch is located at the lower end of the left landing gear slide tube (figure 2-94). It is operated by a lug mounted on the slide assembly and controls the travel of the gear as it is being extended.

2-366. TROUBLE SHOOTING. See Table X.

2-367. REMOVAL OF LIMIT SWITCHES (UPPER).
a. Remove switch from the mounting bracket.
b. Disconnect electrical wiring and remove switch. Note the terminal post from which each wire is removed.

2-368. REMOVAL OF LIMIT SWITCH (LOWER).
a. Remove box encasing switch assembly from mounting bracket.
b. Remove screws through the box assembly and lift switch out.
c. Remove electrical wiring from switch. Note the terminal post from which each wire is removed.

2-369. MINOR REPAIR AND PARTS REPLACEMENT. Keep the switch free from oil and grease. In the event the switch or actuator becomes faulty in operation due to the accumulation of oil and grease, it may be cleaned with solvent Specification P-S-661. Defective switches and actuators must be replaced. Lower switch actuators with bent plungers must be replaced.

2-370. INSTALLATION OF LIMIT SWITCHES (LOWER).
a. Insert wiring through hole in box assembly and make correct electrical connections to switch. Insert switch and actuator in box.
b. Install box assembly in mounting bracket. (Position rear lock nut to have approximately five threads between the nut and the box. Maintain 1/16-inch minimum clearance between aft side of box and truss.)

2-371. INSTALLATION OF LIMIT SWITCHES (UPPER).
a. Make the correct electrical connections on switch.
b. Insert switch and actuator in position in the mounting bracket and install screws. Tighten securely.

CAUTION

Make sure that the plunger of the switch and the tab on the actuating lever are aligned before installing the switch and actuator in the bracket.

2-372. ADJUSTMENT OF LIMIT SWITCHES.
a. Support airplane on jacks so wheels are clear of floor.
b. Remove upper attaching bolts from both oleo drag legs and swing drag legs down, free of slide.
c. Position upper limit switch bracket on truss member so the front edge of the forward mounting clamp on the bracket is 7-3/8-inches from the upper stop (figure 2-93). Tighten bolts just sufficiently to secure bracket, so that it will move when struck a firm blow with a rubber or rawhide mallet.
d. Install actuator wedge on upper drag leg bolt and slip bolt into the slide. Do not install drag leg.
e. Retract slide slowly with hand crank.
f. Observe clearance between the actuator wedge and the switch bracket. Maintain 1/16-inch minimum clearance.
g. Position slide 1/8-inch from the upper stop, by rotating the bracket, set the switch lever roller near the center of the actuator wedge. Set the switch so the actuator wedge trips it.
h. Run the slide assembly down manually and position the lower switch so the lug trips the switch 1/8-inch before hitting the lower stop. Tighten bolts snugly, but so the mounting bracket may be readjusted, if necessary.

CAUTION

The 1/8-inch dimensions on the lower switch setting is a temporary setting and must be rechecked when the gears are operated by power.

i. Install the oleo drag legs. Retract gear electrically and check the position of the slide. Maintain the 1/8-inch gap between slide and stop.
j. Make minor adjustment by rotating bracket on the truss.
k. Extend gear electrically to the lower stop. The slide should contact the stop firmly at the bottom of the slide tube, but not with a hard impact.
l. If slide hits stop too hard, retract the gears two or three inches from the lower stop and relocate lower switch mounting bracket slightly forward. If the slide does not hit the stop hard enough, locate the switch aft. Retract gears electrically and check the top switch setting again. Extend gears electrically and check lower switch setting. Continue until switches are set correctly.

CAUTION

DO NOT set the lower limit switch to impose an abnormal stress on the landing gear torque

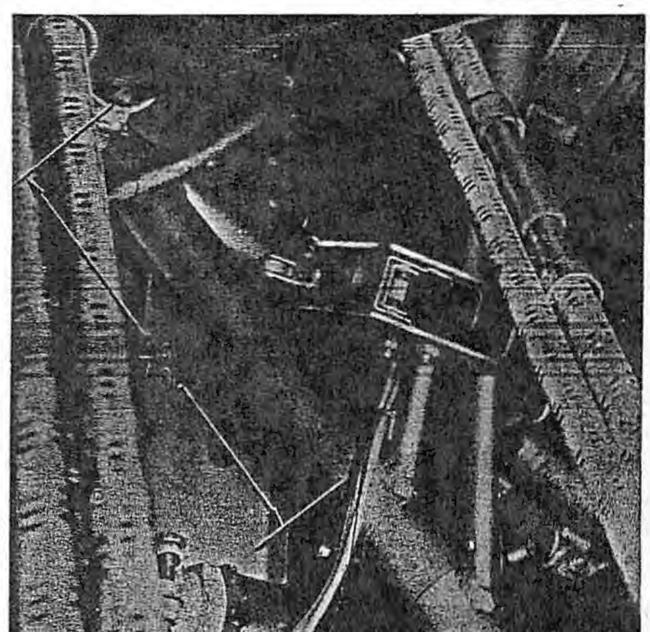


Figure 2-95. Upper Position Indicator Switch

shaft and landing gear motor mechanism. The maximum allowable load is 1/2 tooth "springback" of the landing gear clutch engaging teeth in the belly.

m. Tighten bolts securely in switch mounting brackets and key.

2-373. POSITION INDICATOR SWITCHES.

2-374. DESCRIPTION. The position indicator switches are mounted on the truss assembly in the right nacelle in a position similar to that of the limit switches in the left nacelle (figures 2-95 and 2-96). Two switches mounted in the tail wheel well, are actuated by the tail wheel slide assembly and control the tail wheel position indicator and red warning light (figures 2-97 and 2-98). The position indicator switches work in conjunction with the limit switches to control the position indicator, the red warning light and the warning horn.

2-375. REMOVAL OF POSITION INDICATOR SWITCHES (FORWARD).
a. Remove mounting bolts from bracket and remove mounting bracket and switch from truss member.
b. Remove screws holding switch in bracket and remove switch and actuator.
c. Disconnect electrical wiring and remove switch.

2-376. REMOVAL OF POSITION INDICATOR SWITCH (AFT).
a. Remove mounting bolts from bracket and remove mounting bracket.
b. Remove box assembly from mounting bracket.
c. Remove screws holding switch in the box and remove switch and actuator.
d. Disconnect electrical wiring.

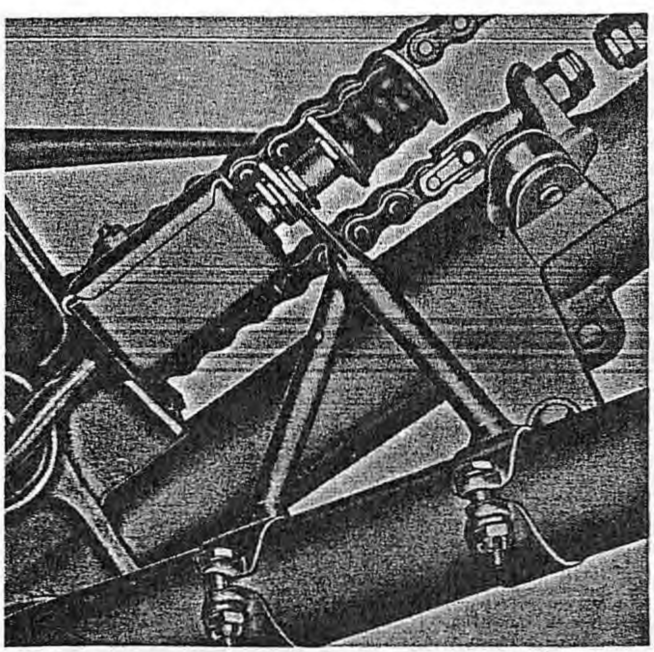


Figure 2-96. Lower Position Indicator Switch

2-377. MINOR REPAIR AND PARTS REPLACEMENT. Keep the switch free from oil and grease. In the event the switch or actuator becomes faulty in operation due to the accumulation of oil and grease, it may be cleaned with solvent Specification P-S-661. Defective switches must be replaced. Lower switch actuators with bent plungers must be replaced.

2-378. INSTALLATION OF POSITION INDICATOR SWITCH (AFT).
a. Insert wiring through hole in back of box and make correct electrical connections to the switch. Insert switch and actuator in box assembly.
b. Install screws through the box assembly, switch and actuator.
c. Install mounting bracket on the truss member.
d. Install switch on mounting bracket. Leave approximately five threads between the aft locking nut and the box.

2-379. INSTALLATION OF POSITION INDICATOR SWITCH (FORWARD).
a. Make correct electrical connections and install switch and actuator in mounting bracket.

CAUTION

Make sure that the plunger of the switch and the tab on the actuating lever are aligned before installing the switch and actuator in the mounting bracket.

b. Position the mounting bracket on the truss assembly and install mounting bolts.

2-380. AJUSTMENT OF POSITION INDICATOR SWITCHES.
a. Support airplane on jacks so wheels are clear of floor.

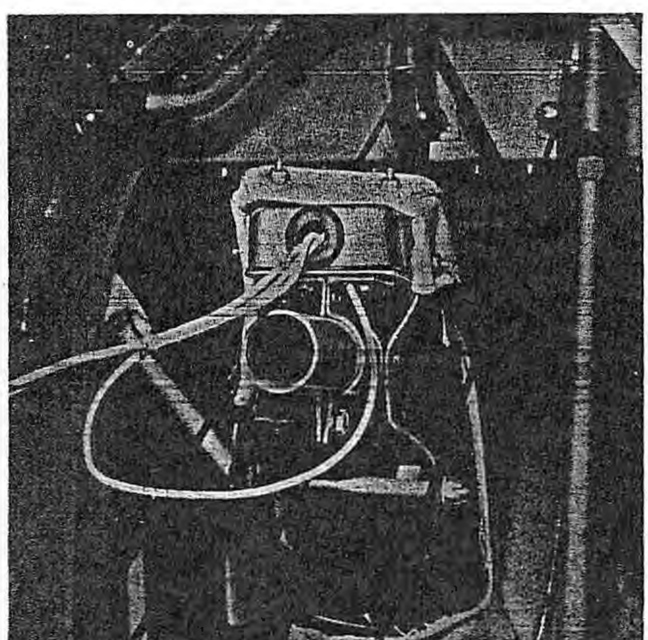


Figure 2-97. Tail Wheel Upper Position Indicator Switch

b. Remove upper attaching bolts from both oleo drag legs and swing drag legs down, free of slide.
c. Position upper position indicator switch bracket on truss member so the front edge of the forward mounting clamp on the bracket is 7-3/8-inches from the upper stop (figure 2-93). Tighten bolts just sufficiently to secure bracket so that it will move when struck a firm blow with a rubber or rawhide mallet.
d. Install actuator wedge on upper drag leg bolt and slip bolt into the slide. Do not install drag leg.
e. Retract slide slowly with hand crank.
f. Observe clearance between the actuator wedge and the switch bracket. Maintain 1/16-inch minimum clearance.
g. Position the slide 5/16-inch from the upper stop and by rotating the bracket, set the switch lever roller near the center of the actuator wedge. Set the switch so the actuator wedge trips it.
h. Crank slide up against the top stop and then back down slowly by hand. Observe the distance between slide and the stop at the point where the switch clicks. Maintain a 5/16-inch clearance.
i. Crank slide to the bottom stop and set the lower switch so the switch is actuated when the slide is retracted 5/16-inch off the bottom stop.
j. Tighten mounting bolts securely and key.

2-381. ADJUSTMENT OF TAIL WHEEL POSITION INDICATOR SWITCHES. Adjust the switches to be actuated when the tail wheel is 1/8-inch from fully extended and fully retracted position.

2-382. WARNING HORN SWITCHES.

2-383. DESCRIPTION. A landing gear warning horn system is controlled by Micro Switches mounted adjacent to the throttle control levers and adjusted so that when the throttles are retarded beyond a preset manifold pressure, without the gear extended, the circuit will be closed causing the warning horn to sound. The red warning light will be illuminated at the same time. To silence this horn and also turn off the red warning light, before either increasing power or lowering the gear, turn horn silencer knob located on top center of control pedestal.

2-384. TROUBLE SHOOTING. See Table XI.

2-385. ADJUSTMENT OF WARNING HORN SWITCHES.
a. Chock wheels, set parking brake and start engines.
b. Advance throttles until gage shows 15 inches of manifold pressure with the propeller in low pitch.
c. Move mixture controls to idle cutoff position. Stop engines, leaving throttles in the same position.
d. Gaining access through the nose section to the throttle switches, loosen clamp holding switches.
e. Move switches in contact with throttles until a click is heard indicating that the switches have closed (figure 2-99).

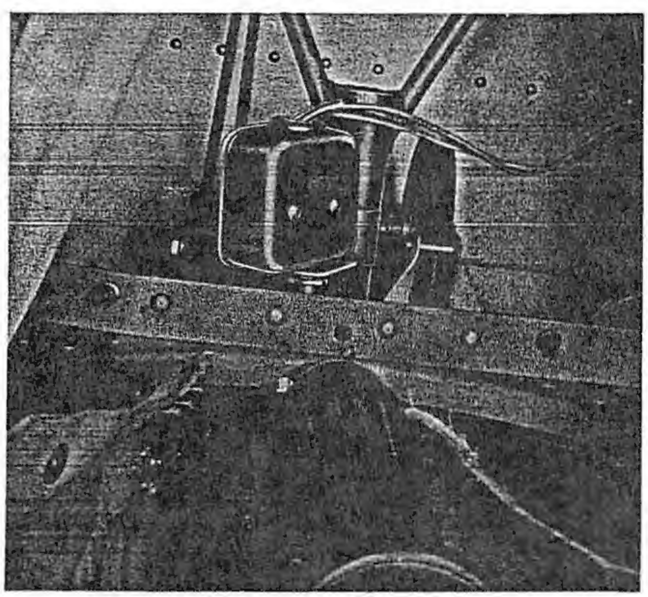


Figure 2-98. Tail Wheel Lower Position Indicator Switch

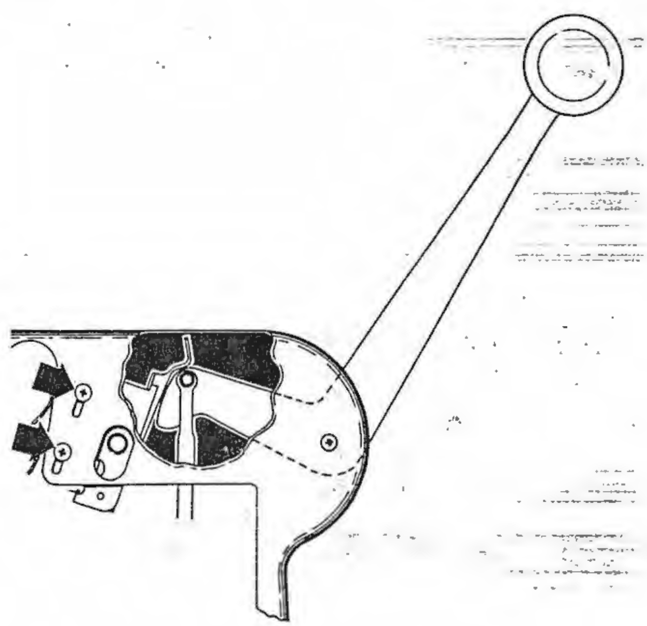


Figure 2-99. Warning Horn Switch Adjustment

TABLE IV

CONTROL CABLE TENSION AND SURFACE TRAVEL

CABLE TENSION

Rudder Cable Back of Reduction Pulleys	50 ± 10 Lbs.
Rudder Front Balance Cable	80 ± 10 Lbs.
Rudder Rear Balance Cable	30 ± 10 Lbs.
Elevator, Upper Cable	120 ± 10 Lbs.
Elevator, Lower Cable	120 ± 10 Lbs.
Control Column Aileron Cables	35 ± 5 Lbs.
Rig Tab Cables so the System Works Smoothly	
Rudder Servo Cables	35 ± 5 Lbs.
Elevator Servo Cables	45 ± 5 Lbs.
Aileron Cables in Wings	50 ± 10 Lbs.
Aileron Servo Cables	35 ± 5 Lbs.

SURFACE TRAVEL

Control Surface	Degrees Right	Degrees Left	Degrees Up	Degrees Down	Inches Inboard	Inches Outboard	Inches Up	Inches Down	Measuring Points
Aileron			38 ± 1	20 ± 1			9-3/8"	5-3/8"	From center line of trailing edge of the aileron to center line of the trailing edge of the flap in "UP" neutral position.
Aileron Tab			20°	20°			1-3/8"	1-3/8"	From center line of tab at inboard end center line of trailing edge at aileron.
Elevator			35°	25°			12-1/2"	8-1/2"	From the neutral setting.
Elevator Tab			20°	14°			1-3/8"	1"	From center line of trailing edge of tab to center line of trailing edge of elevator.
Rudder	25°	25°			5"	5"			From the center line of the rudder counter balance to the center line of the vertical stabilizer.
Rudder Tab	30°	30°			3-1/2"	3-1/2"			From trailing edge center line on top of tab to trailing edge center line of rudder.
Flaps				45°				18"	From trailing edge of flap fillet center line to center line of trailing edge of flap at inboard end.

TABLE V

TROUBLE SHOOTING, WING FLAP ELECTRICAL SYSTEM

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Slow operation of flaps.	a. Dirty commutator.	a. Clean commutator. Replace commutator if necessary.
	b. Worn brushes.	b. Replace brushes.
	c. Gear friction.	c. Check lubricant in torque shaft 90° drives. Check alignment of torque shaft for possible binding.
2. Flaps will not extend. Flaps will not retract.	a. Dirty commutator.	a. Clean commutator. Replace commutator if necessary.
	b. Worn brushes.	b. Replace brushes.
	c. Shorted lead to respective field winding.	c. Check continuity and replace faulty lead.
	d. Stuck limit switch.	d. Clean dirt and grit from switch actuator by washing in naphtha.
	e. Dynamic brake relay control circuit insufficiently grounded.	e. Clean ground making better connection.
3. Continued sticking of limit switches.	a. Dynamic brake relay inoperative. Limit switch actuator out of adjustment.	a. Replace dynamic brake relay and readjust limit switch actuator.
4. Flaps "up" visually indicator reads "down."	a. Lead to rheostat grounded between instrument and rheostat.	a. Check continuity of lead and repair or replace as necessary.
	b. Faulty indicator.	b. Replace indicator and rheostat.
	c. Faulty rheostat.	c. Replace indicator and rheostat.
5. Flaps "down" visually indicator reads "up."	a. Lead to instrument grounded between instrument and circuit breaker.	a. Check continuity of lead and repair or replace as necessary.
	b. Rheostat not properly adjusted for travel.	b. Check travel of rheostat and adjust as necessary.
	c. Faulty indicator.	c. Replace indicator and rheostat.
	d. Rheostat not grounded sufficiently.	d. Clean ground making better connection.
	e. Faulty rheostat.	e. Replace indicator and rheostat.

TABLE VI

TROUBLE SHOOTING, BRAKE SYSTEM

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Brake pedal bottoms.	a. Leaking, broken or unconnected hose, line fitting or bleed port.	a. Repair, replace or connect hose, line fitting or bleed port.
	b. Insufficient brake oil in system.	b. Fill reservoir and bleed system.
	c. Improper bleeding.	c. Bleed system.
	d. O-ring seals in master or actuating cylinders leaking.	d. Replace seals and bleed.
	e. Master cylinder not functioning properly.	e. Repair or replace master cylinder.
	f. Mechanical linkage disconnected.	f. Connect linkage.
	g. Brake disc warped or dished, forcing piston to off position.	g. Replace disc.
2. Insufficient braking action.	a. Brake linings worn out.	a. Replace linings.
	b. New linings just installed.	b. Operate brakes several times while taxiing to condition linings.
	c. Leak in system.	c. Check for leaks. Worn seals should be replaced.
	d. Air in system.	d. Bleed system.
	e. Insufficient oil.	e. Fill reservoir and bleed system.
	f. Loss of oil around automatic adjust pin.	f. Tighten packing nut to 300 inch-pounds torque.
	g. Oil or grease on linings.	g. Clean with carbon tetrachloride or replace linings.
	h. Improper adjustment or interference with pedal linkage.	h. Adjust, or remove the interference.
	i. Vent in supply tank stopped up causing insufficient supply to system.	i. Clean vent.
3. Brakes operate momentarily but lose pressure.	a. Oil leaking past seals in master cylinder.	a. Replace seals.
	b. Oil leaking past seals in shuttle valve.	b. Replace seals.
	c. Slow leak elsewhere.	c. Check entire system.
4. Brakes drag.	a. Foreign particles in system.	a. Clean system and all parts with alcohol.
	b. Adjusting-pin packing nut loose.	b. Torque to 300 inch-pounds.
	c. Disc warped or dished.	c. Replace disc.
	d. Worn return spring in master cylinder.	d. Replace spring.

TABLE VI (CONTINUED)

TROUBLE	PROBABLE CAUSE	CORRECTION
	e. Master cylinder not compensating and locking pressure in system.	e. Clean compensating port or adjust compensating mechanism.
	f. Air trapped in reservoir.	f. Open reservoir vent.
	g. O-ring seals swollen from use of improper oil.	g. Replace seals and flush system.
5. Parking brake will not hold.	a. Lever not properly adjusted.	a. Adjust lever.
	b. Pressure leaking past seals.	b. Replace seals.

TABLE VII

TROUBLE SHOOTING, TAIL WHEEL LOCK AND TAIL WHEEL LOCK CONTROL

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Tail wheel will not lock.	a. Metal fatigue in spring.	a. Replace spring.
	b. Lever distorted and out of alignment.	b. Repair lever.
	c. Tail wheel lock pin damaged.	c. Replace lock pins.
2. Tail wheel will not unlock.	a. Sheared pin in tail wheel lock pin.	a. Replace lock pins.
	b. Lever distorted and out of alignment.	b. Repair or replace lever.
	c. Tail wheel lock pin damaged.	c. Replace lock pin.
3. Pedestal control handle will not lock.	a. Lock control assembly inoperative.	a. Replace lock control assembly.
4. Pedestal control handle will not unlock.	a. Lock control assembly inoperative.	a. Replace lock control assembly.

TABLE VIII

TROUBLE SHOOTING, LANDING GEAR MOTOR AND ENERGIZING CIRCUITS

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Landing gear will not retract or lower.	a. Circuit breaker out.	a. Check circuit breaker in energizing circuit and in motor circuit.
	b. Open circuit due to loose or broken wire.	b. (1) Test continuity from terminal distribution post to subpanel bus bar. (2) Test continuity from terminal distribution post to solenoid switch bus bar (terminal 3 on dynamic brake relay). (3) Test continuity from the circuit breaker in the energizing circuit to the LANDING GEAR POSITION CONTROL SWITCH.

TABLE VIII (CONTINUED)

TROUBLE	PROBABLE CAUSE	CORRECTION
	c. Improper or loose ground connection.	c. Test motor ground lead.
2. Landing gear will lower but not retract.	a. Open circuit between landing gear UP POSITION CONTROL SWITCH and the dynamic brake relay.	a. Check continuity from the LANDING GEAR UP POSITION CONTROL SWITCH through the UP LIMIT, POSITION INDICATOR AND MALFUNCTION LIGHT SWITCH to terminal C-1 of the dynamic brake relay.
	b. Up solenoid switch inoperative.	b. Check operation of the up solenoid switch in the dynamic brake relay.
	c. Open circuit between dynamic brake relay and the motor.	c. Check continuity from terminal 1 on dynamic brake relay to terminal F-1 on the motor.
3. Landing gear will retract but not lower.	a. Open circuit.	a. (1) Check continuity from the LANDING GEAR DOWN POSITION CONTROL SWITCH through the left nacelle junction box and the DOWN LIMIT, POSITION INDICATOR, MALFUNCTION LIGHT AND WARNING HORN SWITCH to the C-2 terminal of the dynamic brake relay. (2) Check continuity from terminal 2 of the dynamic brake relay to the F-3 terminal of the motor.
	b. Down solenoid inoperative.	b. Check operation of the down solenoid in the dynamic brake relay.
4. Circuit breaker tripping in the energizing circuit.	a. Ground in circuit.	a. (1) Test for ground between the POSITION CONTROL SWITCH (up or down) and the corresponding solenoid in the dynamic brake relay. (2) Test for ground between circuit breaker and POSITION CONTROL SWITCH.
5. Circuit breaker in motor circuit tripping.	a. Ground in circuit.	a. (1) Test for ground between terminal distribution post and terminal 3 on the dynamic brake relay. (2) Test for ground in motor leads (leads disconnected from motor).
	b. Mechanical defect in gear overload.	b. Check mechanical operation of the gear.

TABLE IX

TROUBLE SHOOTING, LANDING GEAR POSITION INDICATOR

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Indicator gives no indication.	a. Inoperative instrument.	a. Repair or replace instrument.
	b. Open circuit.	b. Check continuity from circuit breaker to instrument.
2. An indicator fails to indicate in the up position.	a. Open circuit.	a. (1) Check continuity from instrument through the appropriate UP LIMIT POSITION INDICATOR AND MALFUNCTION LIGHT SWITCH to ground. (2) Check for proper operation of switch.
3. An indicator fails to indicate in the down position.	a. Open circuit.	a. (1) Check continuity from instrument through the DOWN LIMIT POSITION INDICATOR, MALFUNCTION LIGHT AND WARNING HORN SWITCH to ground. (2) Check switch for proper functioning.

TABLE X

TROUBLE SHOOTING, LANDING GEAR LIMIT AND SAFETY SWITCHES

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Landing gear motor fails to shut off when gear is retracted.	a. Upper limit switch defective.	a. Replace switch.
	b. Upper limit switch out of adjustment.	b. Adjust switch.
	c. Upper limit switch shorted out of the circuit.	c. With one lead removed from the UP LIMIT, POSITION INDICATOR AND MALFUNCTION LIGHT SWITCH; check for continuity from the GEAR UP POSITION CONTROL SWITCH to terminal C-1 of the dynamic brake relay.
	d. Failure of return spring on dynamic brake relay solenoid.	d. Check for proper operation.
2. Landing gear does not fully retract.	a. Upper limit switch out of adjustment.	a. Adjust limit switch.
3. Landing gear motor fails to shut off when gear is extended or gear hits the stops too hard.	a. Lower limit switch defective.	a. Replace switch.
	b. Lower limit switch out of adjustment.	b. Adjust switch.
	c. Lower limit switch shorted out of the circuit.	c. With one lead removed from the DOWN LIMIT, POSITION INDICATOR, MALFUNCTION LIGHT AND WARNING HORN SWITCH check for continuity from the GEAR DOWN POSITION CONTROL SWITCH to terminal C-2 of the dynamic brake relay.

TABLE X (CONTINUED)

TROUBLE	PROBABLE CAUSE	CORRECTION
	d. Failure of the return spring on the dynamic brake relay solenoid.	d. Check for proper operation.
4. Landing gear does not extend far enough.	a. Lower limit switch out of adjustment.	a. Adjust switch.
	b. Mechanical failure.	b. Check for adjustment or binding of linkage.
5. Landing gear position control switch cannot be placed in the up position without use of the latch emergency release.	a. Open circuit.	a. (1) Check for proper operation of both safety switches. (2) Check for continuity from GEAR UP POSITION CONTROL SWITCH through the latch solenoid to the left safety switch, from the left safety switch to the right safety switch and from the right safety switch to the ground.
6. Landing gear position control switch not latched when the aircraft is on the ground.	a. Circuit grounded.	a. (1) Check for operation and adjustment of safety switches. (2) Check for ground from GEAR UP POSITION CONTROL SWITCH through the latch solenoid, left and right safety switches.

TABLE XI

TROUBLE SHOOTING, LANDING GEAR MALFUNCTION LIGHT AND WARNING HORN

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Malfunction red light fails to operate.	a. Open circuit.	a. (1) Check light and light socket. (2) Check continuity from circuit breaker through light to GEAR DOWN POSITION AND RED LIGHT SWITCH.
2. Malfunction red light fails to operate when gear is retracted.	a. Open circuit.	a. (1) Check for continuity from the GEAR UP POSITION AND RED LIGHT SWITCH: through the UP LIMIT, POSITION INDICATOR AND MALFUNCTION LIGHT SWITCH, on each wheel, to ground. (2) Check for proper operation of all switches in circuit. (3) Check continuity from GEAR DOWN POSITION AND RED LIGHT SWITCH to the GEAR UP POSITION AND RED LIGHT SWITCH.
3. Malfunction red light fails to operate when gear is extended.	a. Open circuit.	a. (1) On each wheel check for continuity from the DOWN POSITION AND RED LIGHT SWITCH through the DOWN LIMIT, POSITION INDICATOR MALFUNCTION LIGHT AND WARNING HORN SWITCH to ground.

TABLE XI (CONTINUED)

TROUBLE	PROBABLE CAUSE	CORRECTION
		(2) Check for proper operation of all switches in circuit.
4. Malfunction red light fails to operate with warning horn.	a. Open circuit.	a. Check continuity from the GEAR DOWN POSITION AND RED LIGHT SWITCH TO THE THROTTLE WARNING HORN SWITCHES.
5. Malfunction red light on continuously.	a. Grounded circuit.	a. Check for ground from indicator light to POSITION AND RED LIGHT SWITCHES, and to THROTTLE WARNING HORN SWITCHES.
6. Malfunction red light fails to go out after retraction.	a. Ground circuit.	a. (1) Check for proper operation of switches in circuit. (2) Check for ground from the UP POSITION AND RED LIGHT SWITCH to the UP LIMIT, POSITION INDICATOR AND MALFUNCTION LIGHT SWITCH on each wheel.
7. Malfunction red light fails to go out after extension.	a. Grounded circuit.	a. (1) Check for proper operation of switches in circuit. (2) Check for ground from the DOWN POSITION AND RED LIGHT SWITCH to the DOWN LIMIT, POSITION INDICATOR, MALFUNCTION LIGHT AND WARNING HORN SWITCH on each wheel.
8. Warning horn fails to operate.	a. Open circuit.	a. (1) Check for proper operation of switches in the circuit. (2) Check for continuity from the circuit breaker through the WARNING HORN, WARNING HORN THROTTLE SWITCHES AND DOWN LIMIT, POSITION INDICATOR MALFUNCTION LIGHT AND WARNING HORN SWITCHES, to ground.
9. Warning horn operates with the gear down.	a. Grounded circuit.	a. (1) Check for proper operation of all switches in the circuit. (2) Check for ground between the WARNING HORN and the DOWN LIMIT, POSITION INDICATOR, MALFUNCTION LIGHT AND WARNING HORN SWITCH, on each wheel.

TABLE XII

TROUBLE SHOOTING, MAIN LANDING GEAR DOORS

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Door is too loose in up position	a. Linkage set too high on "V" brace. b. Clamp rotated too far aft on "V" brace. c. Clevis unscrewed for making rod too long.	a. Lower linkage on "V" brace. b. Rotate clamp forward. c. Shorten rod by screwing clevis in.
2. Door is too tight in up position	a. Linkage set too low on "V" brace. b. Clamp rotated too far forward on "V" brace. c. Clevis screwed in too far making rod too short.	a. Raise linkage. b. Rotate clamp aft. c. Lengthen rod by screwing clevis out.
3. Door dimensions are correct but doors are too tight.	a. Linkage improperly adjusted.	a. Raise linkage on "V" brace and screw clevis in slightly. b. Rotate clamp aft and lengthen rod.
4. Door dimensions are correct, but doors are too loose.	a. Linkage improperly adjusted.	a. Lower clamp on "V" brace or rotate clamp forward and shorten rod.
5. Door dimensions are less than specified dimension and doors are properly rigged.	a. Linkage improperly adjusted	a. Rotate clamp forward slightly and lengthen rod slightly.
6. Door dimensions are greater than specified dimensions and doors are properly rigged.	a. Linkage improperly adjusted.	a. Rotate clamp aft slightly and shorten rod slightly.

SECTION III

HYDRAULIC AND PNEUMATIC SYSTEMS

NOT APPLICABLE.

SECTION IV

UTILITY SYSTEM

TABLE OF CONTENTS

Paragraph		Page
4- 1.	General Description	111
4- 3.	Heating System	111
4- 5.	Intensifier Tubes	112
4- 11.	Hot Air Control Valve	113
4- 17.	Ventilating System	114
4- 19.	Cold Air Control Valves	114
4- 23.	Cabin Air Exhaust System	114
4- 25.	Deicing System	114
4- 34.	Deicer Distributor Valve	116
4- 39.	Fire Extinguisher System	116
4- 40.	Engine Fire Extinguisher System (C-45H)	116
4- 51.	Engine Fire Extinguisher (C-45G, TC-45G)	120
4- 58.	Hand Operated Fire Extinguisher	121
4- 65.	Oxygen System	123
4- 68.	Oxygen Regulators (Demand-Type)	123
4- 75.	Automatic Oxygen Regulators	124
4- 81.	Oxygen Cylinders and Tubing	124
4- 90.	Windshield Wiper System	126
4- 92.	Windshield Wiper Motor	126
4- 98.	Windshield Wiper Converters	126
4-103.	Anti-Icer System	127
4-106.	Anti-Icer Tank	127
4-110.	Anti-Icer Pump Assembly	128
4-115.	Anti-Icer Check Valve	128

4-1. GENERAL DESCRIPTION.

4-2. The utility systems section covers the maintenance, trouble shooting, and repair of special systems used on the airplane for the comfort and safety of the airplane's occupants, or systems that have been installed for operation under specific conditions. The systems covered in this section are heating, ventilating, cabin air exhaust, anti-icing, deicing, fire extinguisher, oxygen, and windshield wipers.

4-3. HEATING SYSTEM.

4-4. DESCRIPTION. The heating system of the airplane utilizes heat from the engine exhaust to warm the cabin and pilot's compartment. Heat is obtained from intensifier tubes inserted inside the exhaust stack on each engine. The intake ports for the intensifier tubes are located on the engine baffles between cylinders 4 and 5, and 7 and 8. Fresh air flows through the intake port into the intensifier tube where it is heated. A two outlet control valve at the aft end of the intensifier tube routes the warm air to the floor of the pilot's compartment and the main cabin when the control in the pilot's compartment is pushed in. If heat is not desired in the airplane, the pilot pulls out the control in the pilot's compartment, to route the air overboard through a by-pass outlet. Heat for the cabin is regulated at the control valve in the intensifier tube, which in turn, is regulated by the control in the pilot's compartment. Heat for the pilot's compartment is controlled by two spherical valves located on the floorboards, one each for pilot and copilot. Heat for defrosting the windshields is furnished from an extension of the conductor tube in the pilot's compartment.

4-5. INTENSIFIER TUBES.

4-6. DESCRIPTION. One intensifier tube of corrosion resistant steel is located in each engine exhaust tail pipe. The forward ends of the intensifier tubes fasten to ducts leading to air intake ports located in the engine baffles between cylinders 4 and 5 and 7 and 8. The intensifier tubes terminate near the aft end of the tail pipes and form the attaching point for the hot air control valves.

4-7. TROUBLE SHOOTING. See Table XIII.

4-8. REMOVAL OF INTENSIFIER TUBE.

a. Remove hot air control valve. See paragraph 4-14.

b. Remove exhaust tail pipe fairing by removing screws in nacelle and forward side of firewall.

c. Remove screws attaching tail pipe shroud and slide shroud back over tail pipe.

d. Remove bolts attaching intensifier tube to air-intake tube and the exhaust collector ring.

e. Remove bolt from tail pipe hanger bracket and exhaust collector ring clamp.

f. Pull tail pipe rearward and remove front deflector ring and intensifier tube.

4-9. MINOR REPAIR AND PARTS REPLACEMENT. Repair will be limited to replacing the entire intensifier tube assembly. If holes develop in the intake ports, they may be stop-drilled with a No. 40 (0.093) drill.

4-10. INSTALLATION OF INTENSIFIER TUBES.

a. Insert intensifier tube in exhaust tail pipe, place tail pipe in position, and slip deflector ring on front end of intensifier tube.

b. Install and safety the bolts attaching tail pipe to exhaust collector ring and rear hanger bracket.

c. Install bolts attaching intensifier tube to air-intake tube and exhaust collector ring.

d. Slide tail pipe shroud into place and install attaching screws.

e. Install exhaust tail pipe fairing.

f. Install hot air control valve. See paragraph 4-15.

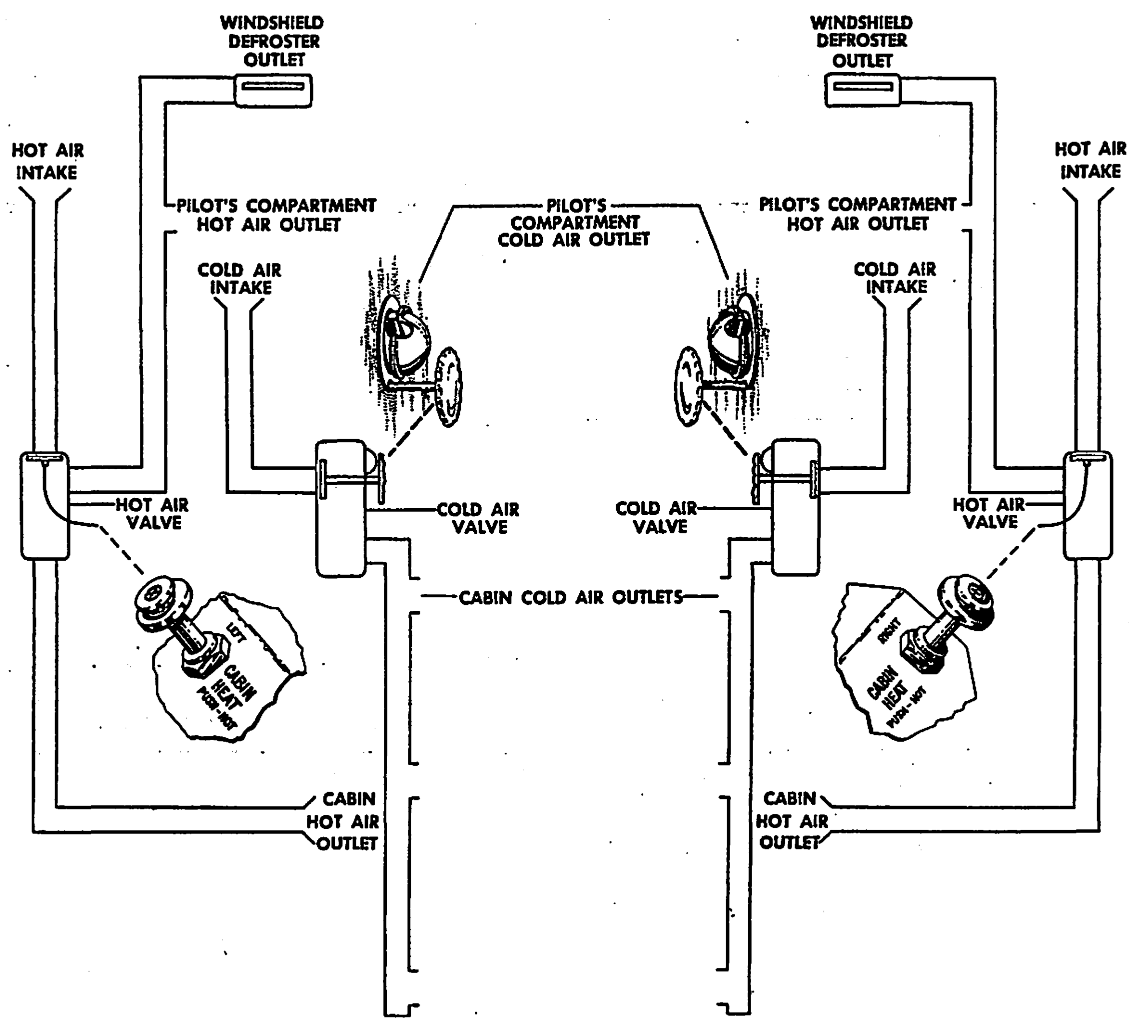


Figure 4-1. Heating and Ventilating System

4-11. HOT AIR CONTROL VALVE.

4-12. DESCRIPTION. A hot air control valve (figure 4-2) is attached to the aft end of each intensifier tube. The valve consists of a cast metal housing containing an inlet and two outlet ports, and a bypass opening to discharge the hot air when heat is not required. Push-pull handles on the control pedestal operate a circular, aluminum, diaphragm type valve which controls the flow of hot air through the valve ports.

4-13. TROUBLE SHOOTING. See Table XIII.

4-14. REMOVAL OF HOT AIR CONTROL VALVE.
a. Remove valve cap.
b. Remove nuts from end of control shaft and remove diaphragm.
c. Remove control housing bushing from valve casting.
d. Remove hose clamps attaching conductor tubes to valve.
e. Remove jam nut on end of control cable.
f. Remove bolt attaching valve to intensifier tube and pull valve away from airplane.
g. Remove deflector ring from end of intensifier tube.

4-15. INSTALLATION OF HOT AIR CONTROL VALVE.
a. Place deflector ring and valve in position and install bolts on intensifier tube.
b. Install control wire and lock housing in place with control housing bushing.
c. Attach conductor tubes and tighten hose clamps.
d. Insert diaphragm and tighten retaining nut on control-wire shaft.
e. Check for full travel of control.
f. Install valve cap with three screws, and safety.

4-16. ADJUSTMENT OF HOT AIR CONTROL VALVE.
a. If valve will not fully open, proceed as follows:
1. Unscrew control housing bushing from valve casting (figure 4-2).
2. Back control housing bushing off a few turns.
3. Push control cable into valve to full "Heat On" position.
4. Push cable approximately 1/4 inch farther forward to provide for 1/4 inch spring-back in the control handle, and install bushing.
5. Check adjustment, readjust if necessary, and safety bushing.
b. If valve will not fully shut off, proceed as follows:
1. Unscrew control housing bushing from valve casting (figure 4-2).
2. Pull control cable out of valve to the full "Heat Off" position.
3. Screw control housing bushing forward and into valve casting.
4. Check adjustment, readjust if necessary, and safety bushing.

NOTE

Be sure that the 1/4-inch spring-back adjustment is made in the control cable as described in part (a), step 4 above.

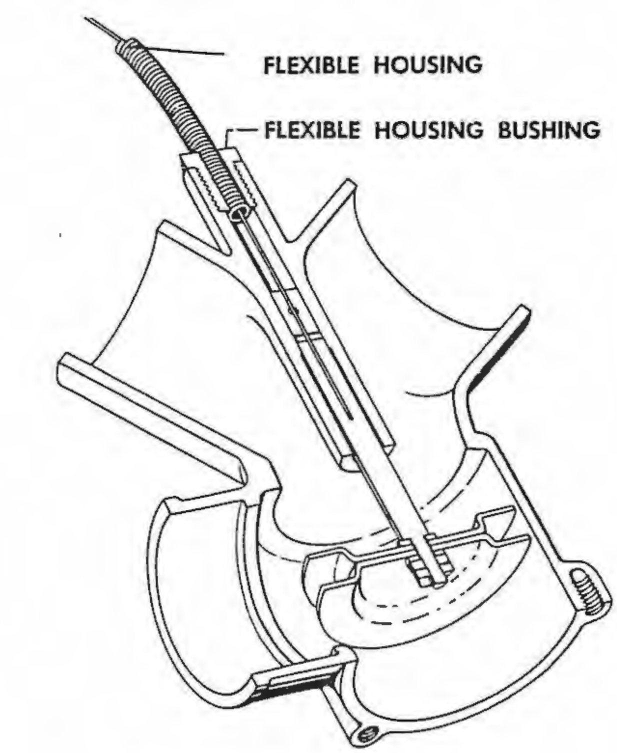


Figure 4-2. Hot Air Control Valve

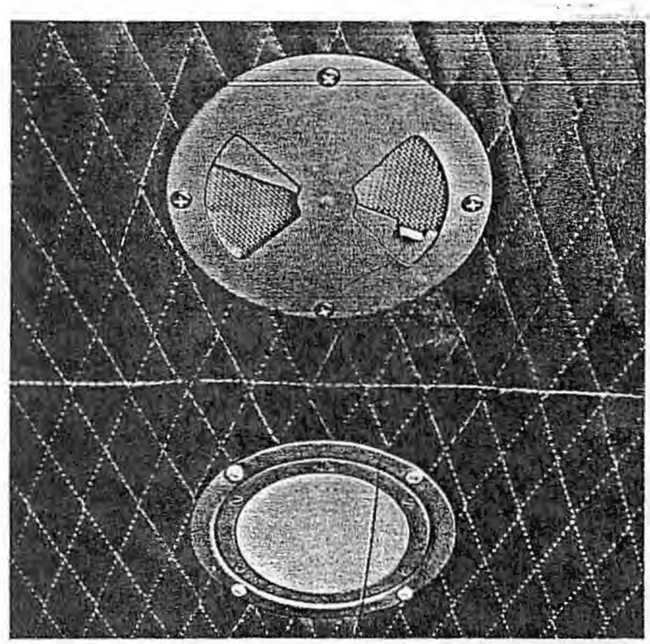


Figure 4-3. Cabin Exhaust Vent

4-17. VENTILATING SYSTEM.

4-18. DESCRIPTION. Outside air enters openings in the leading edge of the center-section wing and passes through conductor tubes of neoprene and glass fiber construction into control valves and distributor boxes on each side of the fuselage. Air from these boxes enters the pilot's compartment through adjustable outlets located on the lower sidewalls by the pilot's and copilot's seats. For cabin ventilation, air passes from the distributor box into ducts inside the cabin where it is released by individually adjustable outlets above each chair.

4-19. COLD AIR CONTROL VALVES.

4-20. DESCRIPTION. Diaphragm type valves are installed at each distributor box to control the flow of air and are operated by handwheels, one on each side near the floor at the rear of the pilot's compartment.

4-21. REMOVAL OF COLD AIR CONTROL VALVE.
a. Remove handwheel from the valve shaft.
b. Remove the battery from the battery well, for access to the cold air valve.
c. Disconnect conductor tube by removing clamp.
d. Remove screws mounting valve to distributor box.
e. Pull valve outboard until handwheel shaft clears fuselage, then lift clear.

4-22. INSTALLATION OF COLD AIR CONTROL VALVE.
a. Place valve in position and install attaching screws.
b. Connect conductor tube and tighten clamp.
c. Install battery in battery well.
d. Attach handwheel to valve shaft.

Figure 4-4. Deicer Control

4-23. CABIN AIR EXHAUST SYSTEM.

4-24. DESCRIPTION. The cabin air exhaust system consists of two formed aluminum ducts, located under the cabin upholstery headliner and riveted to the cabin ceiling. On the lower forward side of each duct is an adjustable opening for the exhaust air to pass out of the cabin. At upper aft end of each duct is a covered opening in the outer fuselage skin. Low pressure behind the discharge covers pulls air out of the cabin.

4-25. DEICING SYSTEM.

4-26. DESCRIPTION. Goodrich deicer boots are fitted on the leading edges of wings and horizontal stabilizer. The boots are inflated by air pressure from exhaust side of the engine-driven vacuum pumps.

CAUTION

The pumps are not interchangeable with those on airplanes not equipped with deicer boots. A defective vacuum pump must be replaced with the same type and model.

4-27. Air lines run from pumps to oil separators located in each engine accessory compartment. From oil separator in each engine section, lines run to a three-way valve. From three-way valve, air is routed through deicing system oil separator to distributor. When deicing system is used, the vacuum pump discharge is directed into system; when not in use, it is directed overboard by a vent line. The three-way valve directing vacuum-pump discharge is operated by a push-pull control located on copilot's right subpanel (figure 4-4). In addition to three-way valve deicer control also actuates distributor valve motor switch, placing distributor valve in operation.

4-28. Boots are inflated in four stages once every 40 seconds by rotation of a distributor valve. All deicer boots are inflated and deflated once each revolution. A pressure relief valve is incorporated in the oil separator in the left nacelle.

4-29. TROUBLE SHOOTING. See Table XIV.

4-30. REMOVAL OF DEICER BOOTS.
a. Remove attaching screws and fairing strips.
b. Remove deicer boots; pull tubes through holes in wings only far enough to disconnect.

4-31. MINOR REPAIR AND PARTS REPLACEMENT. A small puncture or tear in the deicer boot not exceeding 3/4 inch length and not across the direction of stretch may be repaired. Clean the surface, buff, apply rubber cement, and roll on a cold patch after cement is dry.

4-32. INSTALLATION OF DEICER BOOTS.
a. Apply a liberal amount of talcum powder on the inside surface of the boot and on the skin to which the boots are being attached.

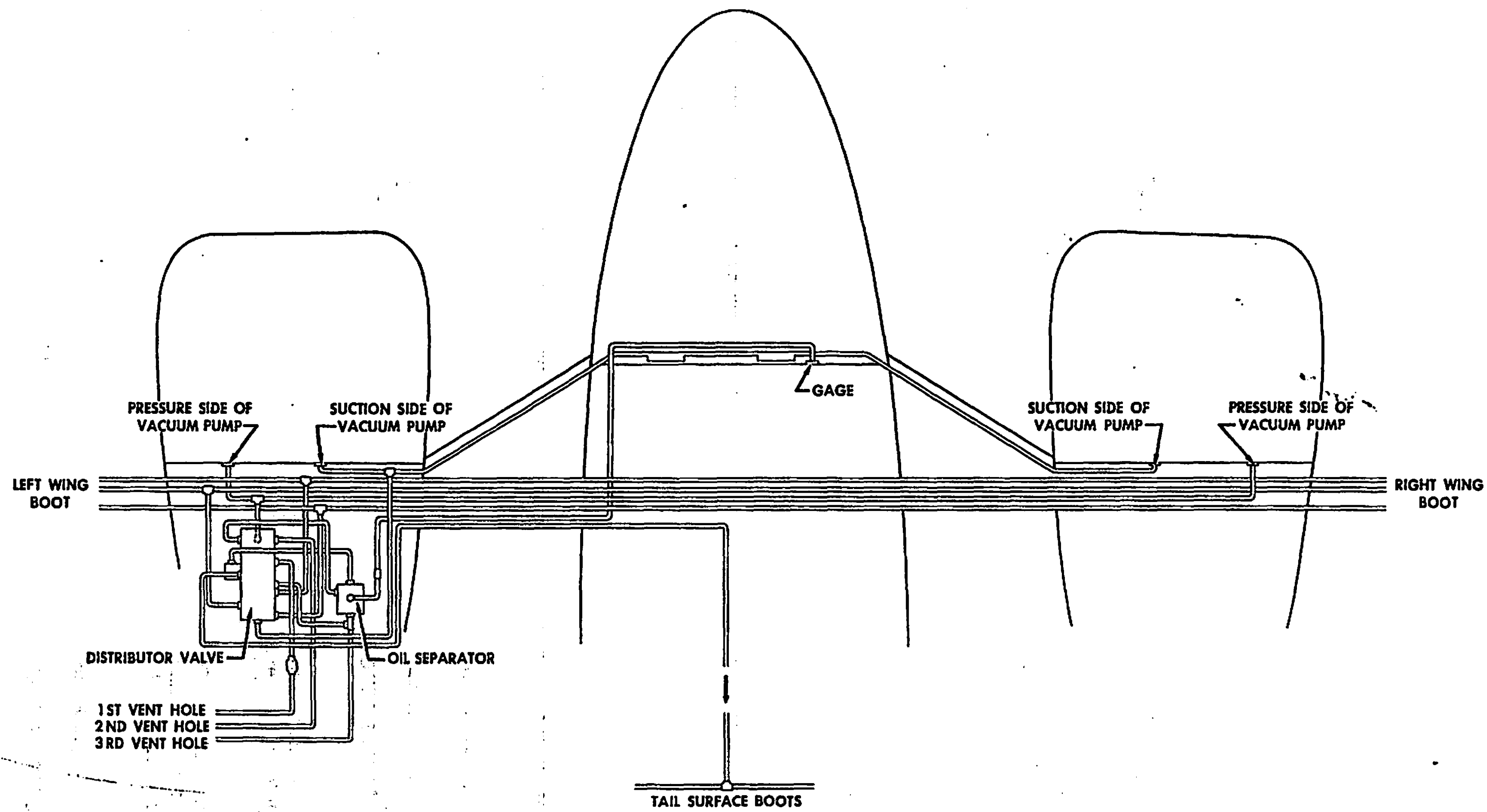


Figure 4-5. Deicer System

NOTE

Do not install deicer boots over painted or corroded surfaces.

b. Attach lower surface of boot to undersurface of the wing or stabilizer with fairing strip and machine screws.
c. Pull tubes in wing through holes and connect to boot.
d. Pull deicer boot over leading edge and apply special pins in every other hole (small end of pin goes into rivnut).
e. Install fairing strips over pins in position on the deicer boot.
f. Install attaching machine screws in open holes, then remove pins one at a time and replace with screws.

4-33. LEAKAGE TEST. Connect an air pressure hose to the "tee" fitting just ahead of the wheel well bulkhead. The fitting is located in the main inlet running from the oil separator to the distributor valve. Place deicing system in operation by pulling deicer control to "ON" position. Turn on outside pressure source and check all connections for leaks and the boots for proper operation.

NOTE

After leakage test, set operating pressure, with the engine running, at 7 psi to 8 psi. The boots should complete one cycle of inflation and deflation each 40 seconds. See paragraph 4-38.

4-34. DEICER DISTRIBUTOR VALVE.

4-35. DESCRIPTION. The deicer distributor valve consists of a motor and two sets of worm reduction gears which drive a rotary valve. The rotary valve functions as a distributor to allow air pressure to flow through five outlet ports, one at a time, simultaneously connecting the remaining ports to the distributor valve exhaust port. This action allows each succeeding deicer boot to inflate while the remaining boots are deflating. One complete cycle of inflation-deflation lasts for 40 seconds. An "ON-OFF" control for the motor is mounted on copilot's right subpanel. When the valve (figure 4-7) is inoperative, all five ports are connected to the exhaust.

4-36. REMOVAL OF DEICER DISTRIBUTOR VALVE.
a. Disconnect all lines at the valve.
b. Remove three bolts which attach the valve to the wheel well bulkhead.
c. Disconnect switch arm.
d. Disconnect wiring from capacitor.

4-37. INSTALLATION OF DEICER DISTRIBUTOR VALVE.
a. Replace three mounting bolts and attach valve to the wheel well bulkhead.
b. Connect all lines to proper outlets on valve.
c. Connect switch arm.
d. Connect wiring to capacitor.

4-38. ADJUSTMENT OF THE DEICER DISTRIBUTOR PRESSURE. The operating pressure for the deicing system is not less than seven psi and not more than eight psi. Adjustment is made at the oil separator mounted near the distributor valve in the left wheel well. See figure 4-6.

4-39. FIRE EXTINGUISHER SYSTEM.

4-40. ENGINE FIRE EXTINGUISHER SYSTEM (C-45H).

4-41. DESCRIPTION. An electrically controlled engine fire extinguisher system discharges bromochloromethane (CB) into each engine accessory compartment, the carburetor alternate air valves and the oil cooler ducts behind the oil radiator (figure 4-9). The supply sphere with its discharge head on the bottom, is mounted on the floorboard beneath the co-

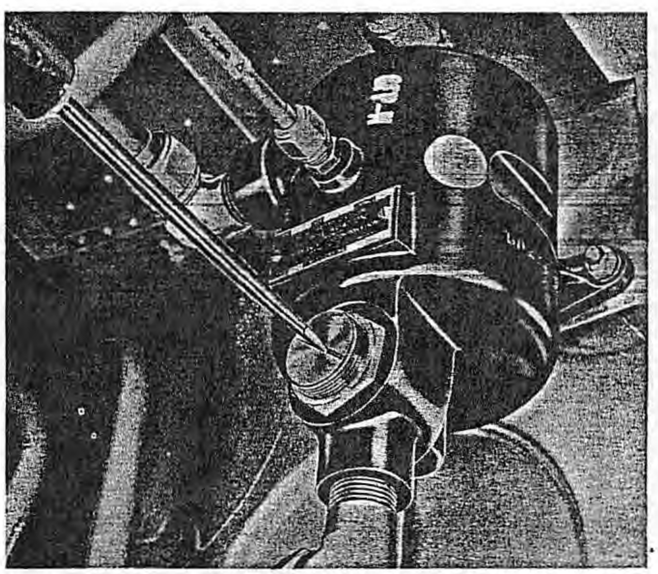


Figure 4-6. Deicer System Relief Valve Adjustment

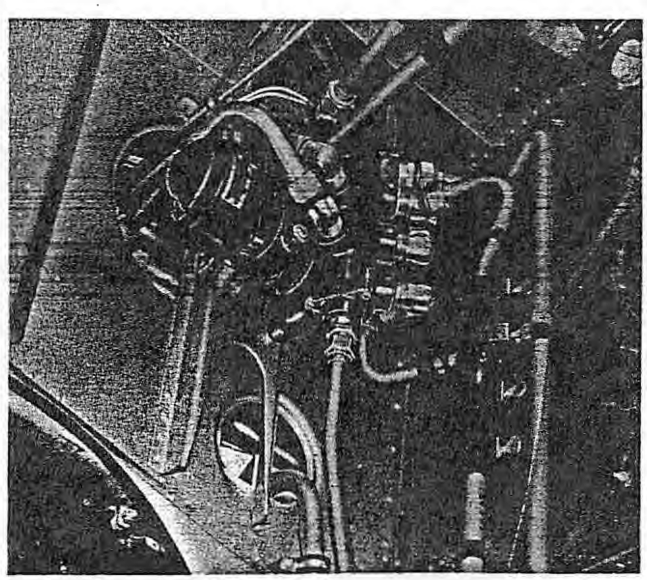


Figure 4-7. Deicer System Distributor Valve

pilot's chair, with an electrically-operated engine selector valve mounted on the copilot's floorboard support channel. A control switch for each engine on the base of the control pedestal (figure 4-8) operates both the selector valve and the discharge head at the same time.

NOTE

The supply sphere will exhaust completely at each discharge. It must be recharged or replaced as soon as possible whenever the system has been used. After discharge, purge tubing and all metal surfaces in affected area with dry compressed air under pressure of at least 200 psi.

WARNING

Bromochloromethane is a volatile liquid and its vapors are toxic. It shall be used with adequate ventilation whenever possible. Avoid exposure to high concentrations of bromochloromethane; staggering, dizziness, incoordination, stupor, confusion, headache, nausea, or unconsciousness may result. If overexposure is noted, leave the area at once; or if this is impossible, use an oxygen or air supplying mask. If breathing has stopped, apply artificial respiration at once. After overexposure, report to First Aid immediately. If material gets into the eyes, flush them thoroughly with running water and report to First Aid immediately. A skin rash may result from prolonged or repeated contact with bromochloromethane. If clothing or shoes become contaminated, they will be promptly removed and allowed to dry completely before they are worn again.

4-42. REMOVAL OF SUPPLY SPHERE.

a. Remove belly inspection door.

b. Working through the belly compartment, disconnect tubing from sphere.

c. Working through pilot's compartment, remove copilot's chair.

d. Remove four mounting bolts securing sphere to floorboard.

e. Lift supply sphere up through floorboard.

4-43. MINOR REPAIR AND PARTS REPLACEMENT. No repairs will be attempted on the supply sphere. If sphere is damaged or shows signs of leakage or corrosion, replace it. Refill empty sphere. Replace the discharge head if it becomes defective or corroded.

NOTE

A discharge cartridge, containing explosive powder, is installed in the discharge head. A new discharge cartridge must be installed in the discharge head each time the system is used. To replace discharge cartridge, remove discharge head from supply sphere; use strap wrench. Remove used cartridge, using 1-inch hex extra deep socket wrench. Remove foreign matter from discharge head and strainer. Install new cartridge, tighten nut securely. Do not remove shipping cap from charged sphere until ready to attach discharge head. Be sure power on airplane is "OFF" before installing new discharge cartridge.

4-44. DISCHARGE CARTRIDGE AGE CHECK. No time limitation is placed on explosive cartridge installed in CB container bonnets; however, no cartridge over 10 years of age should be initially installed. Checking of cartridge continuity is considered sufficient to determine serviceability. In the event unusual conditions seem to warrant, cartridges may be replaced at the discretion of base commander.

4-45. INSTALLATION OF SUPPLY SPHERE.

a. Working through pilot's compartment, place supply sphere in position and install four mounting bolts.

b. Install copilot's chair.

c. Working through belly compartment, connect tubing to sphere. Check connections for tightness.

d. Install belly inspection door.

NOTE

Check supply sphere by removing belly inspection door and checking pressure gage mounted on side of sphere. The needle on the gage should read in the green arc of the scale.

4-46. INSPECTION AFTER SYSTEM DISCHARGE. It is recommended that after system discharge in flight, the following inspection be performed immediately after landing. After system discharge on the ground, the same procedure should be followed immediately after discharge, to prevent rapid and harmful

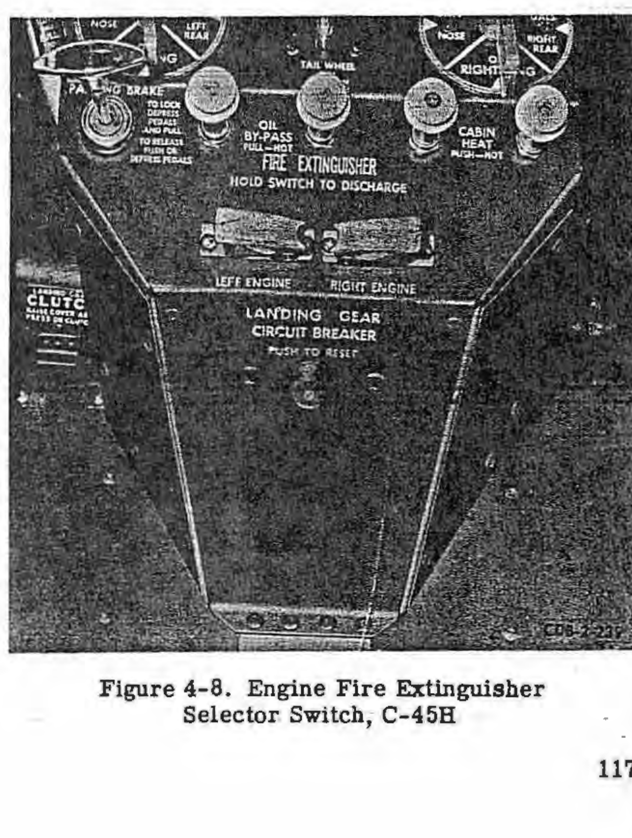


Figure 4-8. Engine Fire Extinguisher Selector Switch, C-45H

corrosive action to all areas subjected to contact with the bromochloromethane (CB).

a. Discharged container or containers and bonnet assemblies should be removed and the system lines disconnected at all low points, and at the fire walls. This will allow drainage of any large amount of liquid trapped in the system.

b. Inspection for corrosion should be performed at all points where the system lines are disconnected. In the event the low point in the system occurs at a location that cannot be readily inspected by visual means, special attention should be given this line, such as removal from the aircraft for closer inspection.

c. Replacement and cleaning of all lines should be accomplished as necessary.

d. Purging should be accomplished with dry air or nitrogen as soon as possible and not later than five hours after discharge. It is recommended that lines be purged using approximately 175-200 psi and delivered through a supply medium having an inside diameter (ID) equivalent of the contaminated lines. This will provide a sufficient volume of air or nitrogen moving through the line to evacuate any residue. The duration of purge should not be less than five minutes.

e. Purging should be accomplished on each disconnected section of the system including the portion of system forward of the fire wall. Any spray nozzle should be removed from end of these lines before purging.

f. Purging or cleaning of the system lines should not be performed with any cleaning fluid or water while installed on the aircraft. If such action is necessary, the affected part should be removed and cleaned.

g. As soon as possible (not later than five hours) after the use of "CB" the area exposed to the liquid, including areas where the liquid may have run, will be hand cleaned using compound, steam cleaning, Specification No. P-S-751, as directed in Technical Order 1-1-1, or steam cleaned, using the compound with standard steam cleaning equipment. After thorough rinsing with water, the area shall be refinished with primer, where the primer has been removed by "CB" action. If corrosion is evident at time of clean-up, or develops at a later time, it shall be processed in accordance with Technical Order 1-1-2.

h. Containers and bonnet assemblies removed should be replaced with like serviceable items.

i. All accessory section and auxiliary power plant electrical components in contact with the extinguishing agent should be removed from the aircraft and

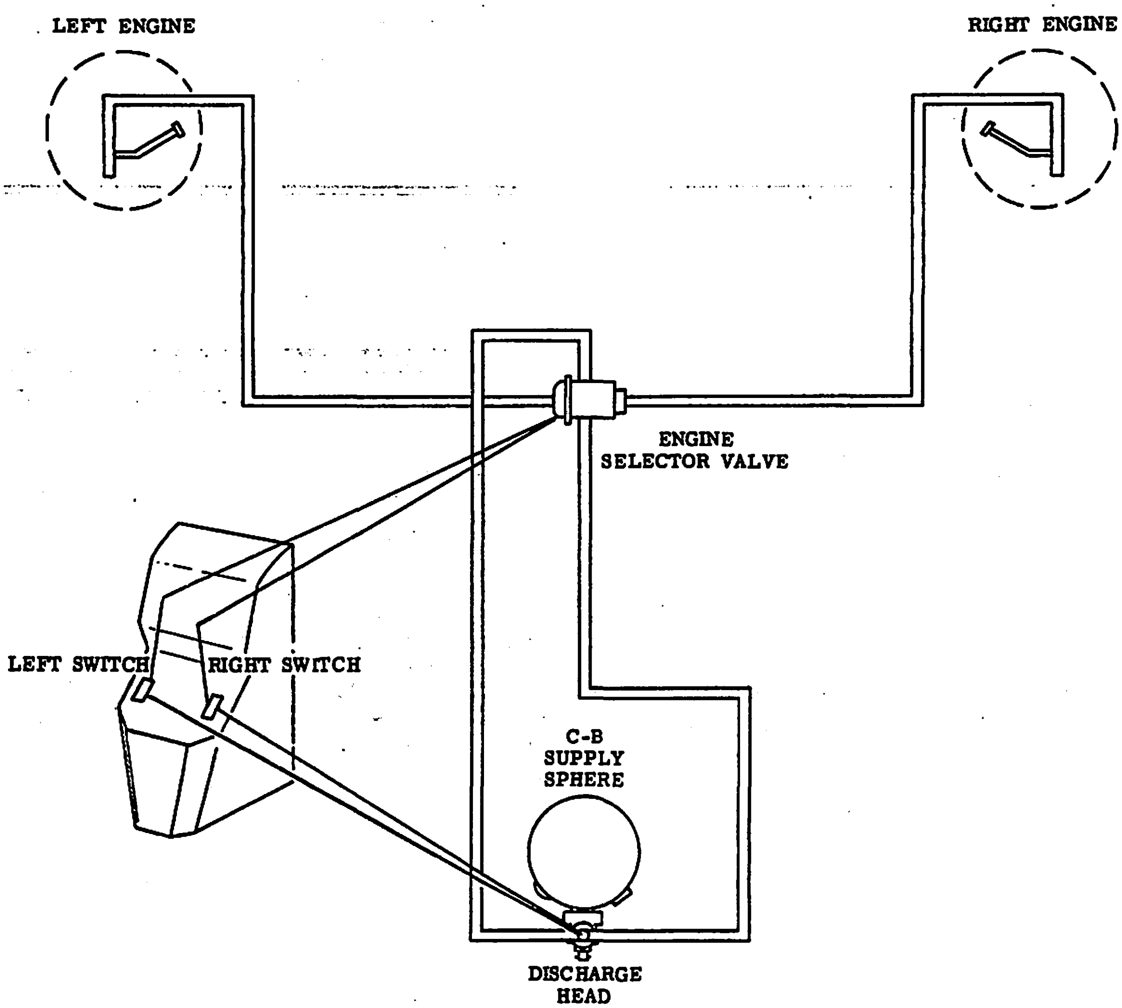


Figure 4-9. Engine Fire Extinguisher System, C-45H

flushed thoroughly with kerosene, or other suitable solvent, air dried and sent to the appropriate overhaul depot for disposition.

j. All electrical wiring and conduits in contact with "CB" should be thoroughly dried with clean cloths and dry air.

WARNING

High concentration of bromochloromethane "CB" will cause nausea, dizziness and unconsciousness. Avoid prolonged and repeated contacts to the skin. An overdose of bromochloromethane may result in death.

4-47. TEST OF DISCHARGE CONTROL CIRCUIT.

NOTE

Two men are required for this test; one stationed at the base of the control pedestal, the other stationed at the "CB" container.

a. Disconnect electrical wiring from the discharge bonnet post.

WARNING

Do not attempt to check cartridge continuity unless cartridge and bonnet are properly installed on the "CB" container and the container is installed on the aircraft. This cartridge is very similar to a pistol cartridge and could cause injury or death to personnel if accidentally fired.

b. Using an ohmmeter, touch one lead to the terminal post on the bottom of the discharge bonnet and the other lead to a ground. If resistance is greater than one ohm, replace cartridge.

NOTE

In continuity testing of the cartridge, no specific voltage value can be given for this test since resistance of cartridge varies. Any voltage, which will cause passage of over one amp in circuit, may detonate the cartridge.

c. The ohmmeter used must limit the current to less than one amp. This permits use of all common ohmmeters.

d. Connect the positive lead of a DC voltmeter to the

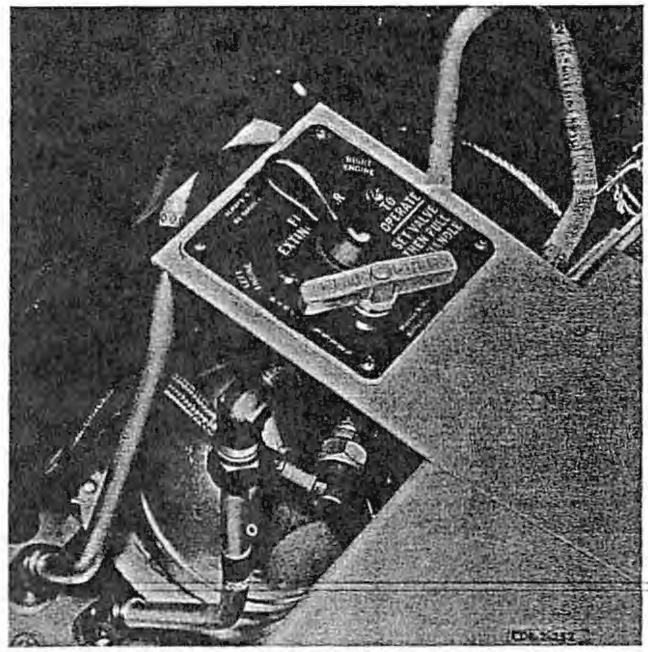


Figure 4-11. Temporary CO_2 System Controls

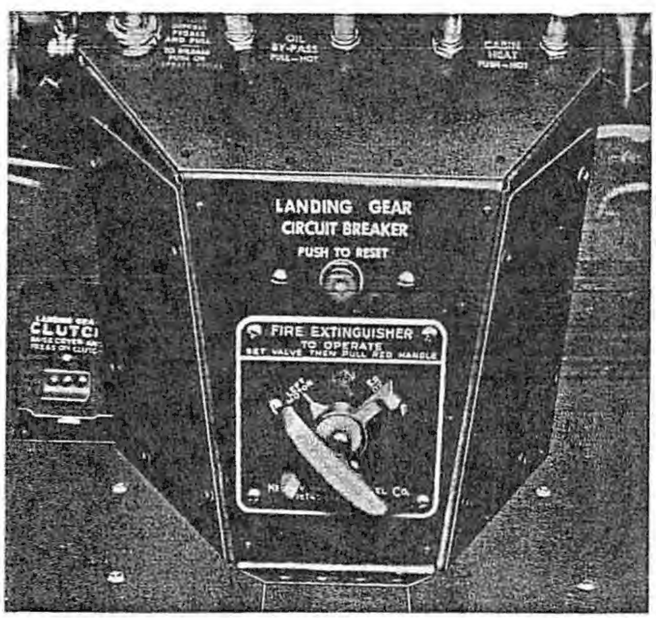


Figure 4-10. Engine Fire Extinguisher Selector and Release Handle

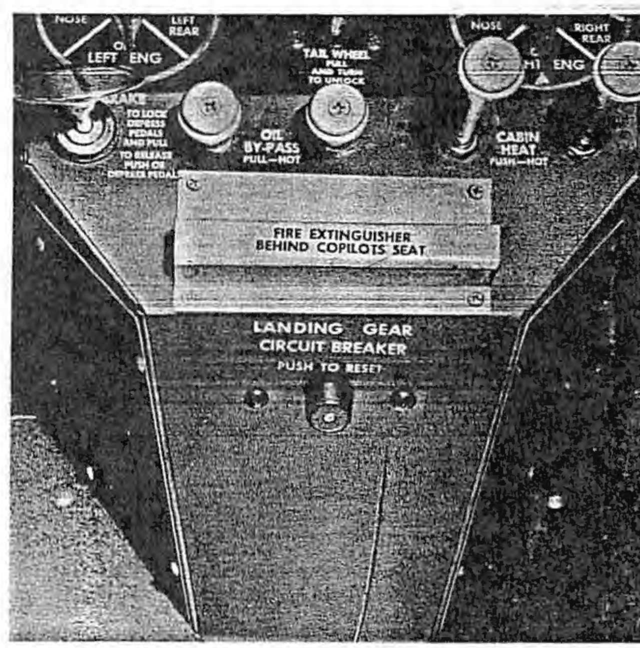


Figure 4-12. CB Control Switches (Covered with Guard)

wire disconnected from the discharge bonnet. Connect the other lead of the voltmeter to a ground. Actuate the right discharge switch and read the voltmeter. The voltmeter should indicate 24 to 28 volts.
e. Repeat step d. for the left discharge switch.
f. Reconnect electrical wiring to discharge bonnet.

4-48. REMOVAL OF ENGINE SELECTOR VALVE.
a. Disconnect tubing from valve.
b. Remove nuts from mounting bolt; valve will fall free. Remove valve.

4-49. MINOR REPAIR AND PARTS REPLACEMENT. No repairs to the selector valve will be authorized by line maintenance personnel. Valves that are defective or inoperative should be removed and forwarded to a designated overhaul activity.

4-50. INSTALLATION OF ENGINE SELECTOR VALVE.
a. Place valve in position and install nuts on mounting bolt.
b. Connect tubing to valve.

4-51. ENGINE FIRE EXTINGUISHER (C-45G, TC-45G).

4-52. DESCRIPTION. Engine fire extinguisher equipment is installed to discharge CO_2 into each engine accessory compartment. A supply cylinder and valve assembly are located in the floorboards under the copilot's seat. Lines lead from the cylinder to an engine selector pull-release hand valve mounted on the pilot's control pedestal. The release handle on the control pedestal is connected by a flexible cable to a valve on the cylinder (figure 4-13). From the engine selector valve a line runs to each engine accessory compartment, and connects to a distributor ring. Another line runs from the supply cylinder to a safety plug outlet on the lower side of the fuselage under the cylinder. Due to the unavailability of parts, the installation of the CB fire extinguisher system, originally intended for all C-45H aircraft, was not made on C-45H serials AF52-10540 through 52-10620. All parts necessary for a quick change-over to the CB system in the field were installed at the time the aircraft were delivered from the factory. A temporary CO_2 system is installed on

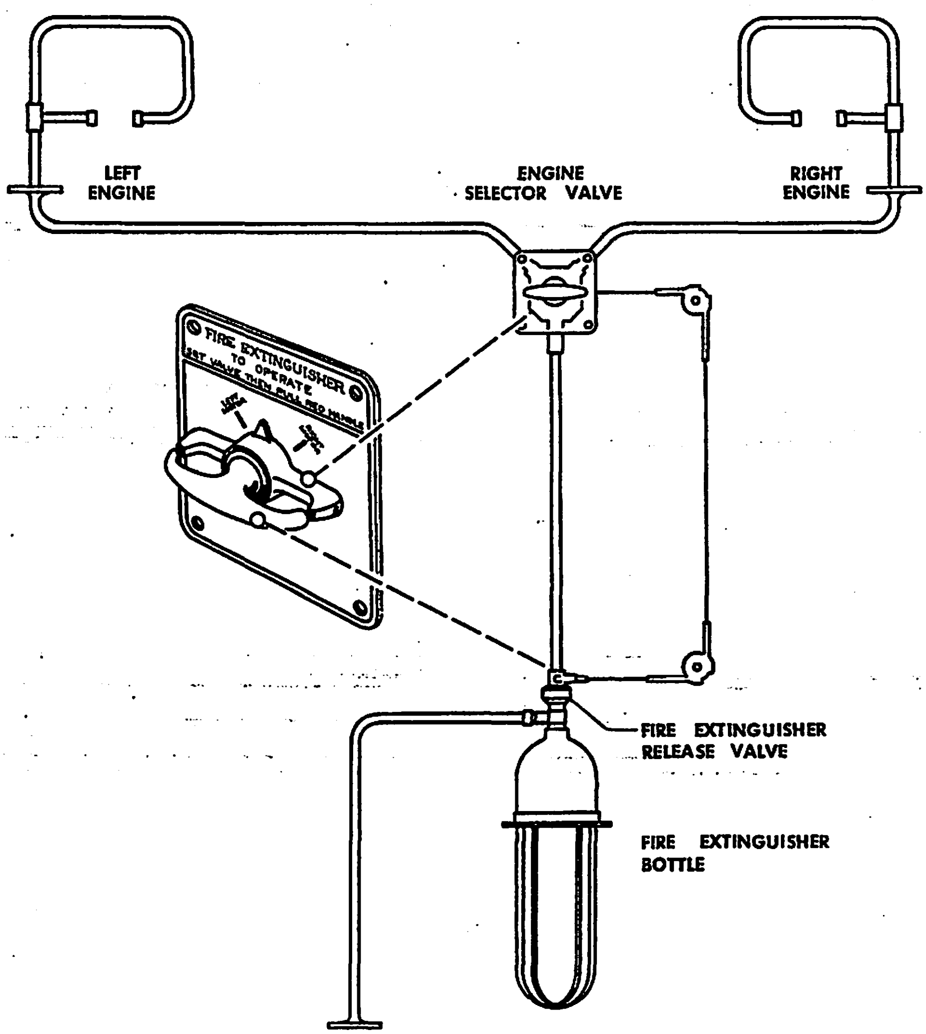


Figure 4-13. Engine Fire Extinguisher System, C-45G and TC-45G

the above mentioned serials as shown in figure 4-11, with temporary controls located on Bulkhead 5. The control switches for the CB system are covered with a guard as shown in figure 4-12. Only upon installation of the CB system should the guard be removed from the switches.

4-53. REMOVAL OF CO_2 BOTTLE.
a. Remove copilot's seat.
b. Disconnect tubing and release cable from valve on CO_2 bottle.
c. Loosen clamp holding bottle to the copilot's floorboards.
d. Lift out bottle.

CAUTION

Extreme care should be taken in removing the release cable from a full bottle to prevent accidental discharge.

4-54. MINOR REPAIR AND PARTS REPLACEMENT. No repairs will be attempted on the CO_2 bottle. Replacement of empty bottles only will be permitted.

4-55. INSTALLATION OF CO_2 BOTTLE.
a. Place bottle in well.
b. Attach tubing and release cable to valve.
c. Replace bolt in clamp holding bottle to floor and tighten.
d. Replace copilot's seat.

CAUTION

Release handle must be safetied with 0.020 copper wire to the screw on the control panel.

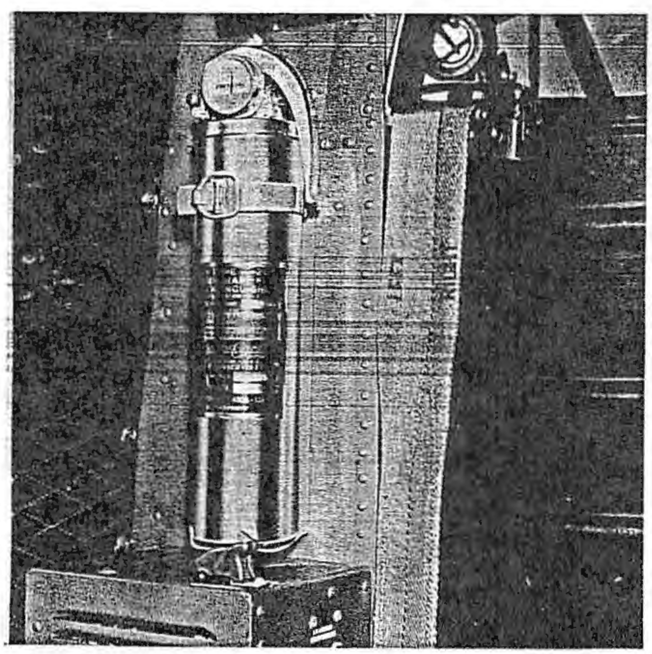


Figure 4-14. Hand Fire Extinguisher (Cabin)

4-56. REMOVAL OF ENGINE SECTION FIRE EXTINGUISHER RING.
(See appropriate paragraph in Section 5.)

4-57. INSTALLATION OF ENGINE SECTION FIRE EXTINGUISHER RING.
(See appropriate paragraph in Section 5.)

4-58. HAND OPERATED FIRE EXTINGUISHER.

4-59. DESCRIPTION. The hand operated fire extinguisher, type A-20, is mounted on the aft left-hand side of Bulkhead 5. The extinguisher contains bromochloromethane which is a volatile, mobile, heavy liquid with a sweet odor resembling chloroform. The extinguishing agent is charged with a pressure of 150 +25, -0 psi of dry air. To operate pull up on the carrying handle. This will break wire seal. Squeeze the operating lever and direct the flow of liquid. The extinguisher is capable of discharging 90% of its volume 20 feet. It can be handled with one hand and will operate from vertical to 15° from horizontal. After each extinguisher discharge, purge all metal surfaces in affected area with dry compressed air under pressure of at least 200 psi. Replace porous materials saturated with bromochloromethane.

WARNING

Bromochloromethane is a volatile liquid and its vapors are toxic. It shall be used with adequate ventilation whenever possible. Avoid exposure to high concentrations of bromochloromethane; staggering, dizziness, incocordination, stupor, confusion, headache, nausea, or unconsciousness may result. If overexposure is noted, leave the area at once; or if this is impossible, use an oxygen or air supplying mask. If breathing has stopped, apply artificial respiration at once. After overexposure, report to First Aid immediately. If material gets into the eyes, flush them thoroughly with running water and report to First Aid immediately. A skin rash may result from prolonged or repeated contact with bromochloromethane. If clothing or shoes become contaminated, they will be promptly removed and allowed to dry completely before they are worn again.

4-60. REMOVAL. The bottle is stowed in a positive, tight fitting, quick release spring steel clamp. Release and lift out.

4-61. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of checking the fittings for leakage, corrosion and the safety wiring. (Leakage or corrosion is cause for replacement.) All other repairs will be handled at an overhaul activity.

4-62. CHARGING OF TYPE A-20 FIRE EXTINGUISHER.
a. Eliminate all pressure by operating the extinguisher in an inverted position and remove filler cap.

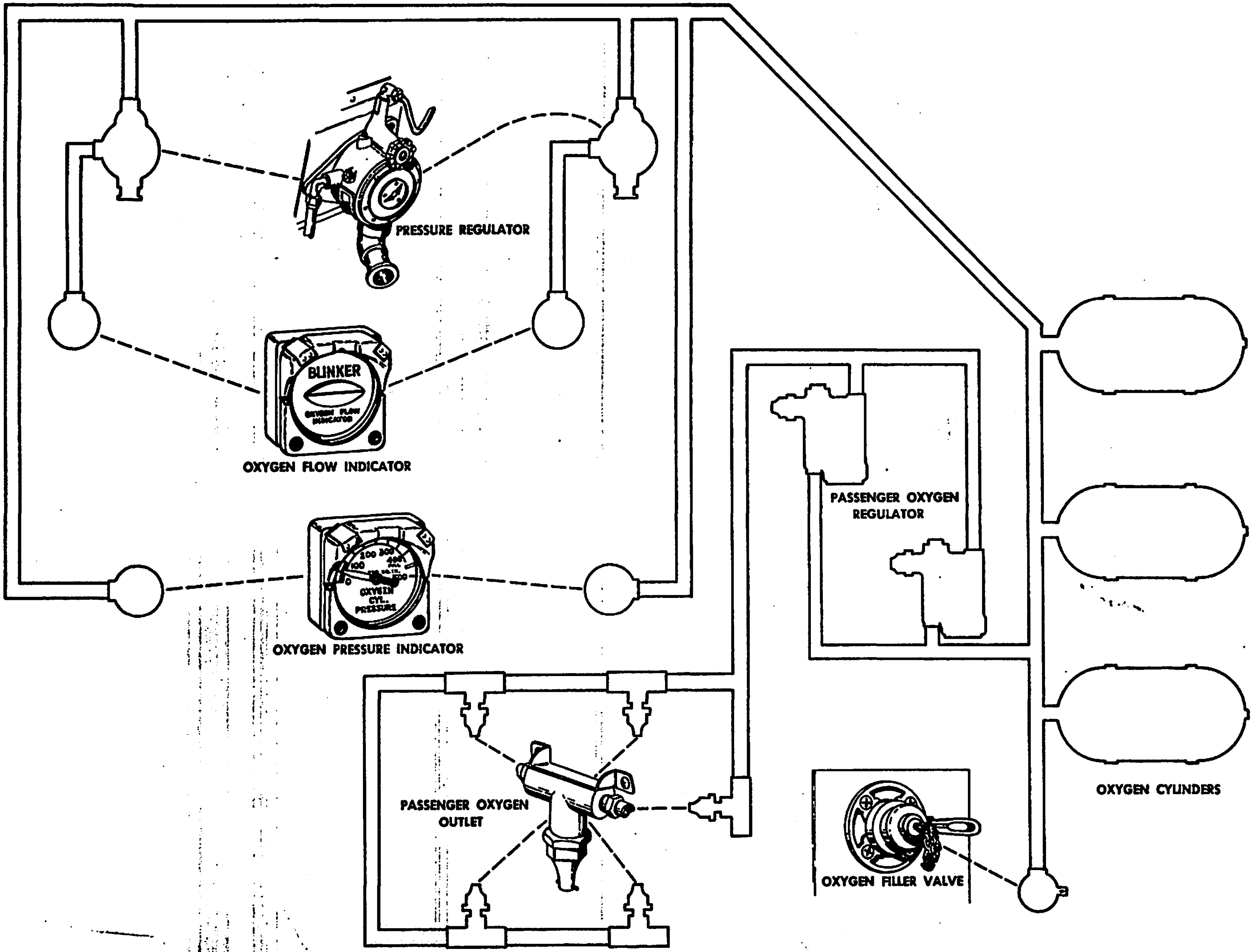


Figure 4-15. Oxygen System

b. Fill with approximately four pounds or one quart of bromochloromethane, Specification MIL-B-4394.

NOTE

Over-filling is prevented by an internal liquid level tube.

c. Replace filler cap and gasket and tighten securely.
d. Place carrying handle in locked position. Press a standard air chuck to the discharge plunger tip. Pull operating lever and charge extinguisher with 150 +25, -0 psi of dry air.
e. Release operating lever and remove air chuck.
f. Shake the extinguisher to assure complete absorption and recharge to the required pressure. Place carrying handle in stowaway position. Attach the seal and tag between the hole in the filler cap and the hole in the handle.
g. Stamp date of charging on tag.

4-63. TROUBLE SHOOTING. Check for leaks around threads or through the discharge plunger tip. Replace extinguisher if this occurs. Make a daily check to keep nozzle clear of foreign matter. Check the safety wiring and keep the pressure at 150 +25, -0 psi of dry air.

4-64. INSTALLATION. Place in mount and clamp tight.

4-65. OXYGEN SYSTEM.

4-66. DESCRIPTION. The C-45G airplane incorporates an oxygen system consisting of three type G-1 oxygen cylinders, seven outlet plugs, two demand-type regulators, two automatic regulators, and one charging valve. The cylinders are mounted on the right side of the cabin fuselage between Bulkheads 8 and 9. Outlet plugs are located on the overhead, by each seat and in the lavatory compartment on the left side of the fuselage near the compartment window. The two demand-type oxygen regulators are located in the discharge lines from the oxygen tanks and are secured to the forward side of Bulkhead 9. See figure 4-15.

4-67. TROUBLE SHOOTING OXYGEN SYSTEM. Due to the nature of the oxygen system, trouble shooting will be limited to locations and replacing defective parts, however, leakage or unaccounted loss of system pressure can be checked at the connecting threads, the regulator "EMERGENCY" valve and filler valve. Secure all connections, using anti-seize sealing compound (Specification MIL-T-5542). The regulator "EMERGENCY" valve must be safety wired in the closed position. The filler valve should be replaced if the seal is not seating correctly.

4-68. OXYGEN REGULATORS (DEMAND-TYPE).

4-69. DESCRIPTION. Two demand-type oxygen regulators, type A-12A, are mounted in the pilot's compartment, one each for the pilot and copilot. Each regulator has a "normal flow-100% oxygen" valve and an emergency valve. Connected to each regulator is a flexible hose to be attached to the oxygen mask.

4-70. TROUBLE SHOOTING. Check the regulator screen for cleanliness periodically. When necessary clean with alcohol. To prevent oxygen leakage from regulator elbow inspect serrated joint and determine if edges are distorted. Replace if necessary. Another source of oxygen loss is the "EMERGENCY" valve. This valve must be safetied in the closed position.

4-71. REMOVAL OF DEMAND-TYPE OXYGEN REGULATOR.

WARNING

Before removing any component part of the oxygen system, the pressure in the system must be bled. Keep all oily substances out of the area when releasing oxygen from the system. Such substances in the presence of pure oxygen present an extreme fire hazard.

a. Remove all oxygen lines.
b. Remove attaching screws from regulator mounting bracket.

4-72. MINOR REPAIR AND PARTS REPLACEMENT. Repairs other than cleaning the filter screens and replacing fittings must be accomplished at a designated overhaul activity. To replenish the supply of oxygen an oxygen filler valve is located on the left forward side of Bulkhead 9. The filler valve may also be used as an outlet valve to release system

Figure 4-16. Oxygen Filler Valve

pressure when removing any part of the system. See figure 4-16.

4-73. INSTALLATION OF DEMAND-TYPE OXYGEN REGULATOR.

WARNING

Use only Specification MIL-T-5542 anti-seize and sealing compound on oxygen system connection threads. Under no circumstances use an oily compound or sealer.

a. Position unit, install attaching screws and tubing.

4-74. OPERATIONAL CHECK OF OXYGEN REGULATOR.

a. Make sure that the outlet elbow is adjusted to a position that suits the user's convenience. If the knurled collar is loose, make sure the gasket is present, and then tighten the knurled collar by hand as tightly as possible. On old regulators in which the outlet elbow is free to turn when the knurled collar is loose, first point the elbow one-half turn from the desired position; next, turn the collar until it just begins to feel tight; then, turn both collar and elbow together one-half turn, so as to tighten the collar securely with the elbow pointed in the right direction.

b. Set the diluter at the position marked "100% OXYGEN" (auto-mix "OFF") and listen carefully for escaping oxygen. There should be no sound of leakage.

c. With the diluter set at "100% OXYGEN," (auto-mix "OFF") place the open end of the mask-to-regulator tubing against your mouth and blow gently into the tubing. There should be positive and continued resistance to blowing. If there is only slight resistance, the diaphragm or some part of the air metering system may be leaking.

CAUTION

Do not blow hard as the relief valve in the regulator will vent.

d. With the diluter set at "NORMAL OXYGEN" (auto-mix "ON") break the wire which safeties the emergency valve and open the valve fully for a moment. A steady flow of oxygen should result and should cease when the valve is turned off. Otherwise, replace the regulator. If the regulator is satisfactory, rewire the emergency valve, using copper annealed, 0.0179-inch diameter wire, class 23-A, Stock No. 6800-295900. Do not use any other kind of wire.

4-75. AUTOMATIC OXYGEN REGULATORS.

4-76. DESCRIPTION. Two automatic oxygen regulators are installed in the discharge lines of the oxygen tanks and are attached to the right forward side of Bulkhead 9. Automatic regulators regulate the oxygen system pressure for the occupants of the cabin and the lavatory compartment. The regulators reduce the tank pressure and route the low pressure flow to the cabin and lavatory outlet.

4-77. TROUBLE SHOOTING. See paragraph 4-67.

4-78. REMOVAL OF AUTOMATIC OXYGEN REGULATORS.

WARNING

Before removing any component part of the oxygen system, the pressure in the system must be bled. Keep all oily substance out of the area when releasing oxygen from the system. Such substances in the presence of pure oxygen present an extreme fire hazard.

a. Disconnect oxygen lines from regulator.
b. Remove four screws from mounting plate on Bulkhead 9 and remove regulator.

4-79. MINOR REPAIR AND PARTS REPLACEMENT. No repairs shall be made to regulators except at a designated overhaul activity.

4-80. INSTALLATION OF AUTOMATIC OXYGEN REGULATORS.

a. Place regulator or mounting plate on Bulkhead 9 and install attaching screws.
b. Attach oxygen lines to regulator.

4-81. OXYGEN CYLINDERS AND TUBING.

4-82. DESCRIPTION. The oxygen system is equipped with three type G-1 oxygen cylinders located on the right side of the cabin fuselage between Bulkheads 8 and 9. The tubing used throughout is 1/4-inch diameter; 52 SO aluminum.

4-83. REMOVAL OF OXYGEN TANK.

a. Remove line plug from end of cylinder, making sure oxygen is expelled from the system.
b. Loosen bolts on clamps and remove clamps.
c. Remove cylinder.

4-84. MINOR REPAIR AND PARTS REPLACEMENT. No repairs are to be made to oxygen cylinder. Replace defective cylinder.

4-85. INSTALLATION OF OXYGEN TANKS.

a. Secure tank in position and secure with mounting clamps.
b. Install line plug to end of tank.

4-86. TESTING. After installation of any component of the oxygen system, the system should be refilled and the valve opened momentarily to clear tubing and regulator of any dust or foreign matter that may have lodged in the system. The system should be checked with soap suds for leaks and possible failure which might occur during flight. Check the demand-type regulators for ease in turning "NORMAL" - "100% OXYGEN" valves and tightness of flexible hose.

NOTE

Before removing any component part of the oxygen system, the system will be depleted of all oxygen by bleeding the system as directed in paragraph 4-74(d). All regulators will be

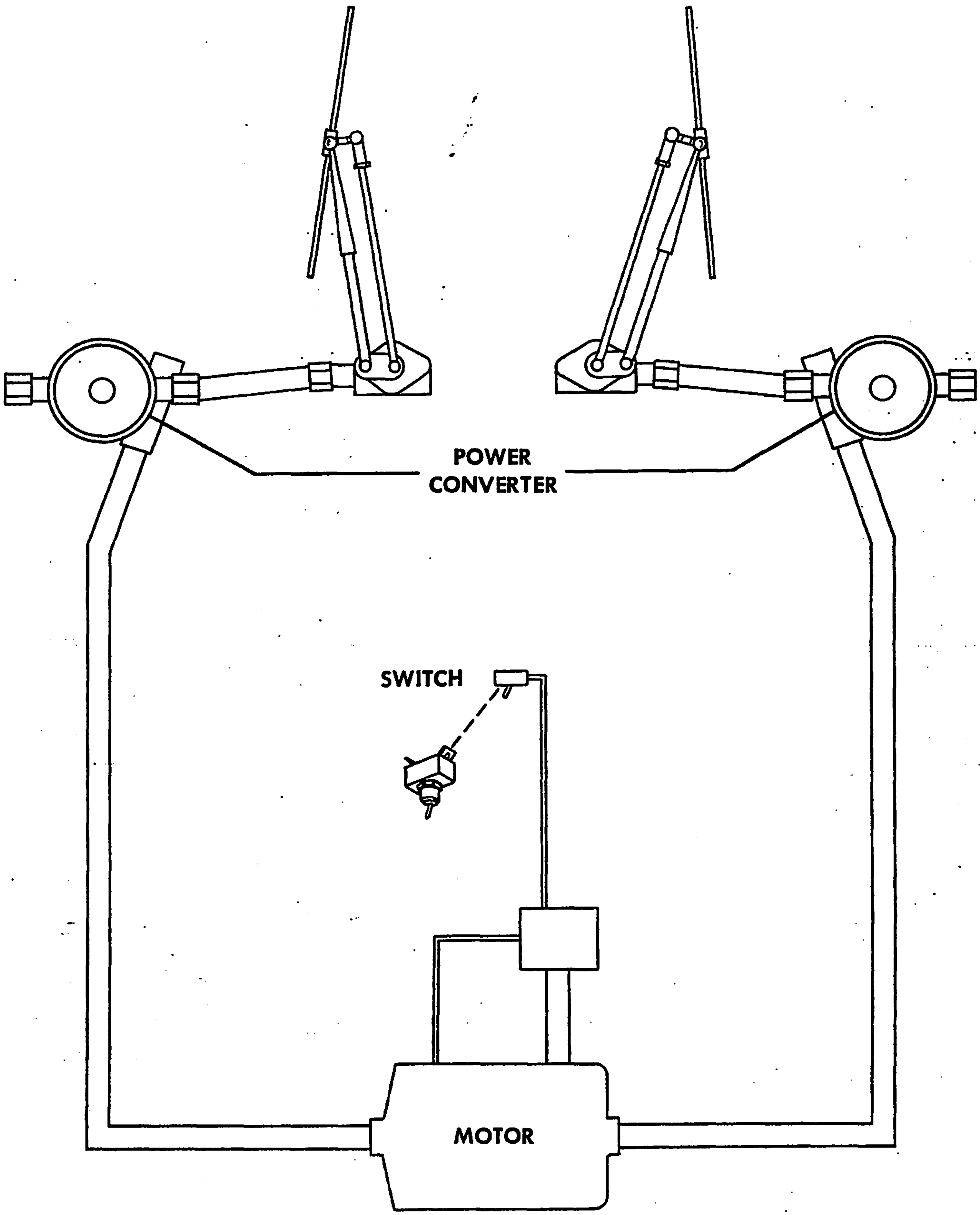


Figure 4-17. Windshield Wiper System

used for bleeding the system. The emergency valves will remain open until the system is empty. The system may also be bled from the filler valve by using adapter AN6027-1.

4-87. When it is necessary to replace oxygen system tubing or other components, consult technical order 1-1A-8, and T.O. 15X-1-1.

4-88. IN NO CASE will cleaning solutions or any other solutions be used inside any part of the oxygen system when it is installed in the aircraft. IN NO CASE will gases other than oxygen be used inside any part of the oxygen system when it is installed in the aircraft.

4-89. When aircraft oxygen systems are opened for replacement of any part in the system, lines and/or components will be plugged or capped to prevent entrance of moisture or foreign matter into the system. If the system has been accidentally left open, the system will be purged by filling and emptying of oxygen at least three times.

NOTE

The use of tape to seal openings or thread-lube containing oil, will not be used on any oxygen equipment either serviceable or repairable.

4-90. WINDSHIELD WIPER SYSTEM.

4-91. DESCRIPTION. The windshield wipers are driven by an electric motor mounted on the overhead of the nose baggage compartment, through flexible shafts and converters. The converters are located on the pilot's and copilot's overhead directly beneath the wiper arm. A three position control switch mounted on the copilot's right subpanel controls the wiper motor (figure 4-17).

4-92. WINDSHIELD WIPER MOTOR.

4-93. DESCRIPTION. The windshield wiper motor is a two speed, 24-volt, one-sixth horsepower motor. Flexible shafts lead to each wiper blade converter and connect to each end of the motor shaft. The motor mounts in the center of the nose compartment forward of the pedestal (figure 4-18).

4-94. TROUBLE SHOOTING. See Table XV.

4-95. REMOVAL OF WINDSHIELD WIPER MOTOR.
a. Remove electrical plug from rear of motor and flexible shafts from each end of motor shaft.
b. Remove mounting bolts and remove motor.

4-96. MINOR REPAIR AND PARTS REPLACEMENT. The minimum brush length is three-eighths inch. Brushes should be replaced when worn to this measurement. Sandpaper (grade 000) may be used to smooth the commutator if badly discolored or nicked.

4-97. INSTALLATION OF WINDSHIELD WIPER MOTOR.
a. Position motor in place and install mounting bolts.
b. Install electrical plug in rear of motor.
c. Install flexible drive shafts.
d. Test motor for operation.

4-98. WINDSHIELD WIPER CONVERTERS.

4-99. DESCRIPTION. Windshield wiper converters are mounted under each wiper blade, one each on the pilot's and copilot's overhead. A flexible drive shaft with a screw-in connection on each end, connects each converter to the windshield wiper motor. The converters transmit the motor rotation into an oscillating movement through the use of an internal gear and cam arrangement. The converters are provided with a drive shaft with a serrated end to match serrations on the wiper blade.

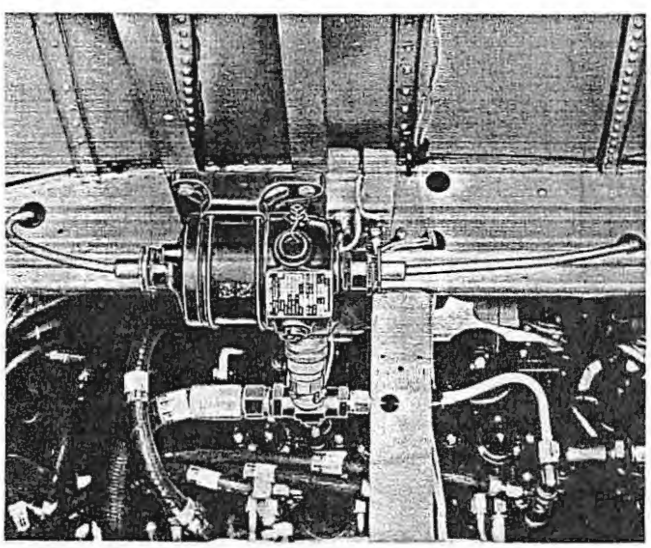


Figure 4-18. Windshield Wiper Motor Mounting

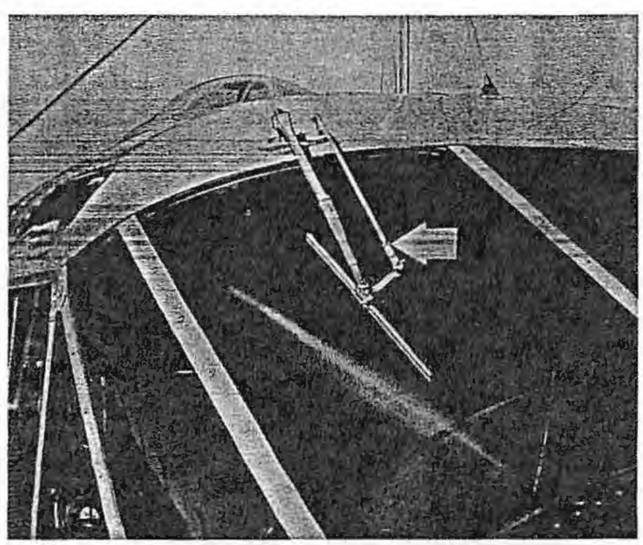


Figure 4-19. Windshield Wiper Blade Adjustment

4-100. REMOVAL OF WINDSHIELD WIPER CONVERTER.

a. Remove flexible drive shaft from gear box.
b. Remove two screws from base of converter.
c. Remove connector from converter to actuating arm assembly and remove converter.

4-101. INSTALLATION OF WINDSHIELD WIPER CONVERTER.

a. Place converter in position and connect actuating arm.
b. Install two screws in base of converter.
c. Connect flexible drive shafts.

4-102. ADJUSTMENTS. In the event that one or both of the wiper blades strike the sides of the windshield, adjustment at the actuating shaft is necessary. Remove the nut holding the wiper arm to the actuator shaft and move one or more serrations away from the point where it was striking. Also remove the cotter pin from the clevis pin of the aligning rod and lengthen or shorten the aligning rod by turning clevis on the shaft to bring the blade in a position parallel to the windshield frame (figure 4-19). Reinstall the aligning rod and safety with a cotter pin. Test the wiper assembly. Repeat the above operation if necessary until the blade clears both side windshield frames.

CAUTION

Do not run windshield wiper when glass is dry. When testing, keep glass wet with a hose or by pouring water from a jar or bucket.

4-103. ANTI-ICER SYSTEM.

4-104. DESCRIPTION. The anti-icer system (figure 4-20) is operated by a motor-driven pump located under the pilot's seat. Anti-icer fluid is pumped from a supply tank into lines extending under the floorboards, through center section and nacelles, and through check valves to each propeller hub. A slinger ring at each hub distributes fluid as the propeller rotates. Speed of the pump motor is controlled by a rheostat switch on the pilot's instrument panel (figure 4-21).

4-105. TROUBLE SHOOTING. See Table XVI.

4-106. ANTI-ICER TANK.

4-107. DESCRIPTION. The anti-icer supply tank is a three-gallon metal tank located beneath the pilot's seat in front of Bulkhead 5. It is secured by metal straps attached to the floorboards.

4-108. REMOVAL OF ANTI-ICER TANK.

a. Drain anti-icer fluid from the system by removing plug on the underside of the fuselage directly below the tank (figure 4-22).
b. Working through belly access opening, disconnect the supply line at the fitting immediately below the tank. Remove nuts and spacers from the forward ends of the tank straps.
c. Remove pilot's seat.
d. Disconnect vent line at the fitting on top of tank.
e. Pull tank straps clear and remove tank.

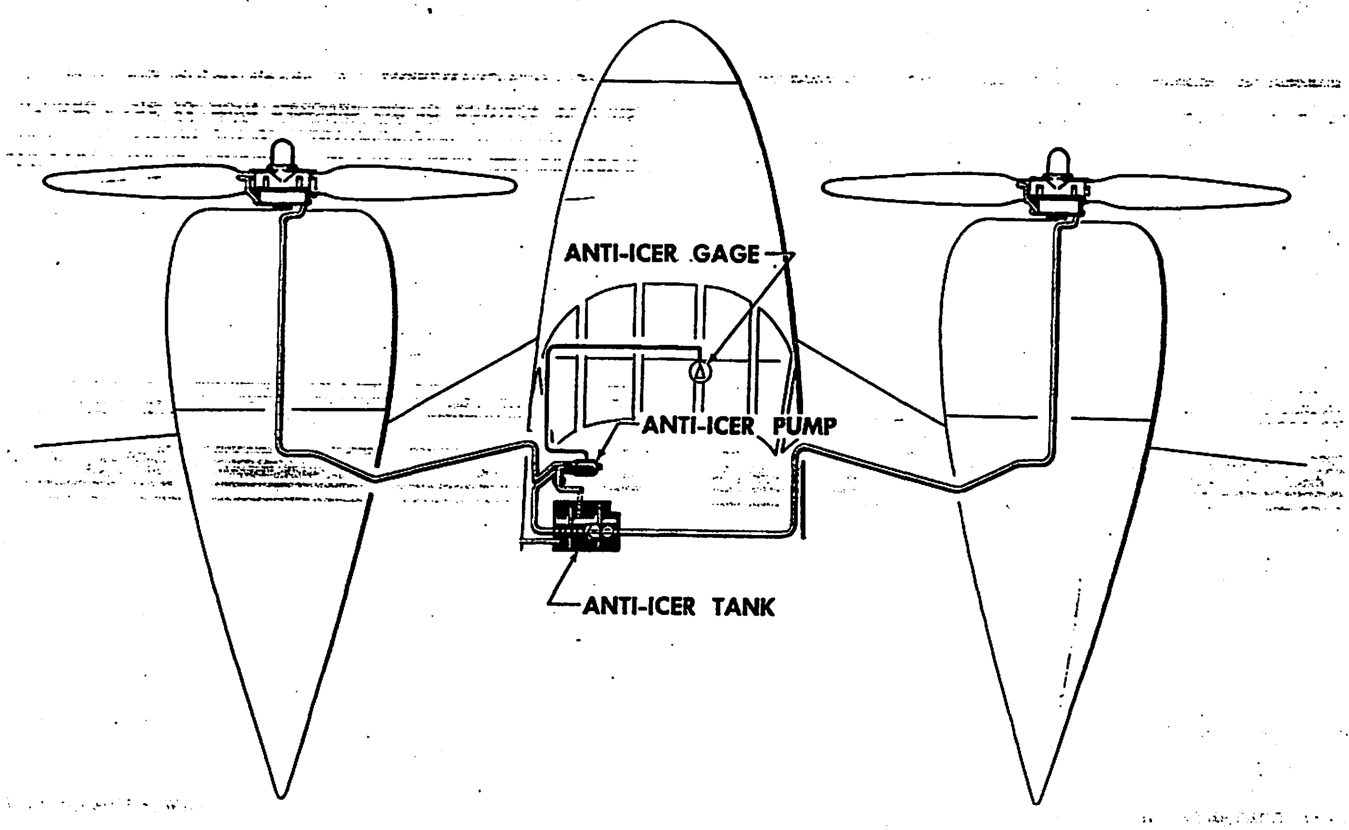


Figure 4-20. Anti-Icer System

4-109. INSTALLATION OF ANTI-ICER TANK.

a. Place tank in position under the pilot's seat and secure the tank straps. Make sure padding is in place around tank.

b. Connect vent lines at top of tank.

c. Install pilot's seat.

d. Working through belly access opening, connect supply line at the fitting below the tank.

e. Install drain plug and fill tank.

4-110. ANTI-ICER PUMP ASSEMBLY.

4-111. DESCRIPTION. The anti-icer pump assembly is located next to the tank underneath the pilots' seat (figure 4-23). It pumps fluid from the supply tank to each propeller hub slinger ring, which distributes the fluid as the propeller rotates. Speed of the pump motor is controlled by a switch rheostat located on the pilot's right subpanel (figure 4-21).

Figure 4-21. Anti-Icer Rheostat Switch

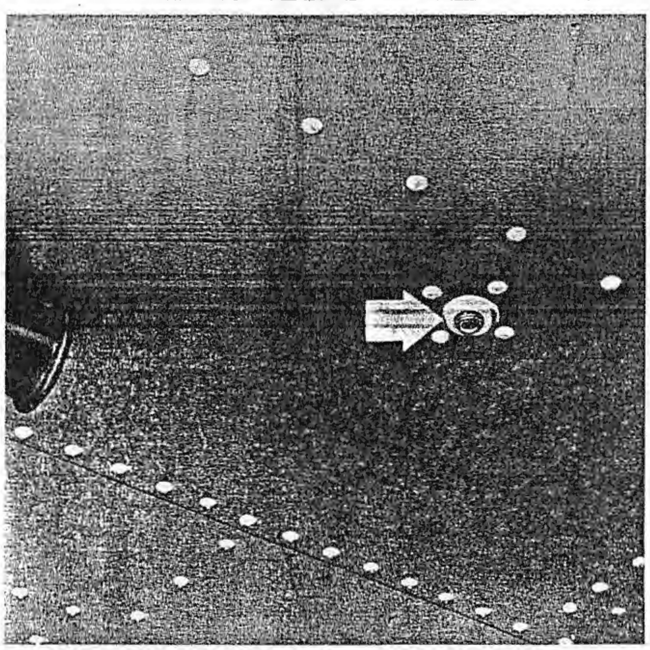


Figure 4-22. Anti-Icer Tank Drain

4-112. REMOVAL OF ANTI-ICER PUMP ASSEMBLY.

a. Disconnect electrical leads at the connector plug on the motor.

b. Drain tank.

c. Disconnect the two distributing lines at the pump fittings and the feed line at fitting aft of pump strainer.

d. Working through belly access opening, remove three bolts securing pump assembly to floorboard.

e. Remove pump assembly.

4-113. MINOR REPAIR AND PARTS REPLACEMENT. Brushes should be replaced on the motor at a minimum length of 5/16-inch. Due to the infrequent use of the equipment, this service usually is necessary only at long intervals.

4-114. INSTALLATION OF ANTI-ICER PUMP ASSEMBLY.

a. Place pump in position under pilot's chair.

b. Working through belly access opening, install three mounting bolts in pump and tighten.

c. Connect two distributing lines and feed line.

d. Connect electrical connector plug to motor.

e. Refill supply tank.

4-115. ANTI-ICER CHECK VALVE.

4-116. DESCRIPTION. A check valve for each engine is located in the inboard side of each nacelle. Fluid is allowed to pass through the check valve only when the anti-icer pump is operating, to prevent fluid from syphoning out the slinger ring during engine operation.

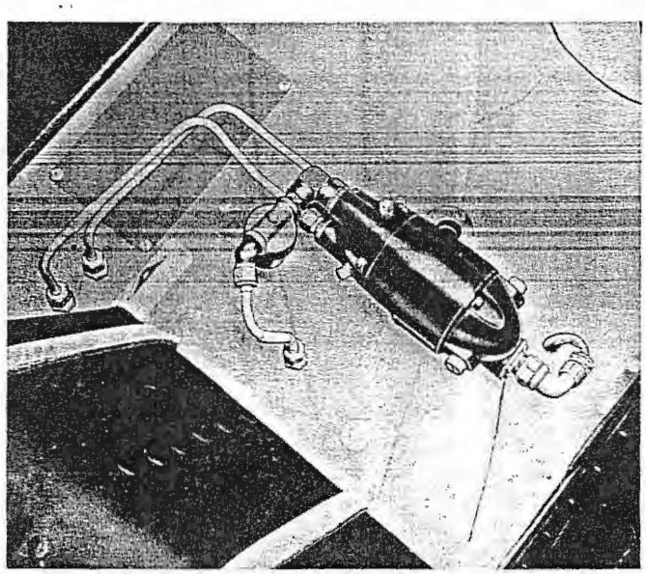


Figure 4-23. Anti-Icer Pump

4-117. REMOVAL OF ANTI-ICER CHECK VALVE.

a. Disconnect piping from valve.
b. Remove one mounting screw.

4-118. MINOR REPAIR AND PARTS REPLACEMENT. If valve is defective, remove and replace with a new valve. Send defective unit to a designated overhaul activity for repair.

4-119. INSTALLATION OF ANTI-ICER CHECK VALVE.

a. Install mounting screw in clip.
b. Connect piping to valve.

4-120. ADJUSTMENTS. With anti-icer pump running at 28.5 volts, adjust check valves to provide 3-1/2 to 3-3/4 quarts per propeller per hour.

TABLE XIII

TROUBLE SHOOTING (HEATING SYSTEM)

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Exhaust fumes in cabin and pilot's compartment.	a. Cracked or broken intensifier tube right hand or left hand.	a. Replace. Note: Make no welding repairs on intensifier tube.
	b. Exhaust deflector ring missing.	b. Install deflector ring.
2. Hot air control valve sticking.	a. Valve casting broken or bent.	a. Replace.
	b. Richland-type control bent or clamps too tight.	b. Loosen clamps and check control. Replace control if it is badly bent or kinked. Slight bends or kinks may be straightened by hand.
3. Hot air control valve inoperative.	a. Frozen due to exhaust corrosion.	a. Remove valve. Clean with solvent and polish parts with fine emery cloth.

Lubricate with powdered graphite only (Spec. MIL-G-6711).

TABLE XIV

TROUBLE SHOOTING (DEICING SYSTEM)

TROUBLE	PROBABLE CAUSE	CORRECTION
1. System inoperative.	a. Push-pull control loose or broken.	a. Check for broken or loose control, check for full throw of valve.
	b. Vacuum pumps inoperative.	b. Check deicer pressure and vacuum warning light. Replace pump if necessary.
	c. Open circuit in control valve motor.	c. Check circuit.
2. Partial or slight operation.	a. Lines may be clogged.	a. Check lines for stoppage and see that the lines are not kinked or bent.
	b. System pressure may be low.	b. Observe gauge and adjust relief valve if necessary.
	c. Loose or leaky connections.	c. Check connections and tighten if necessary.

TABLE XV

TROUBLE SHOOTING (WINDSHIELD WIPERS)

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Windshield wiper system inoperative.	a. Circuit breaker released.	a. Reset circuit breaker.
	b. Motor brushes worn.	b. Remove and replace brushes.
	c. Grounded circuit.	c. Check continuity between source of power to switch and switch to motor.
	d. Inoperative switch.	d. Check switch for proper operation; replace if necessary.
2. One wiper inoperative.	a. Broken flexible drive shaft.	a. Replace flexible drive shaft.
	b. Actuator shaft broken or stripped.	b. Determine broken part and replace unit.
	c. Converter arm broken.	c. Replace converter.

TABLE XVI

TROUBLE SHOOTING, ANTI-ICER SYSTEM

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Motor inoperative.	a. Circuit breaker out.	a. Check circuit breaker.
	b. Open circuit.	b. Test circuit continuity from circuit breaker through the rheostat to the pump motor.
	c. Poor ground.	c. Check the ground at the motor.
2. No fluid being delivered.	a. Circuit breaker out.	a. Check circuit breaker.
	b. Defective circuit.	b. Check continuity of circuit through motor.
	c. Lines clogged.	c. If pump is operating disconnect lines at pump and check for stoppage in lines. Clogged lines may be blown out with air hose.
	d. Check valve inoperative.	d. Replace check valve.

SECTION V

POWER PLANT

PART I

PREPARATION AND BUILD UP

TABLE OF CONTENTS

Paragraph		Page
Part I	Preparation and Build Up	131
1- 1.	Removal of Engine from Metal Shipping Container	132
1- 2.	Removal of Engine from Wooden Shipping Container	134
1- 3.	Engine Build Up	134
1- 4.	Installation of Engine	141
1- 5.	Propeller Installation	142
Part II	Depreservation and Run-In	143
2- 1.	Engine Depreservation	143
2- 2.	Depreservation of Engine	143
2- 3.	Pre-Oil	143
2- 4.	Engine Pre-Oil	143
2- 5.	Depreservation Run	143
2- 6.	Engine Pre-Start Check	144
2- 7.	Power Plant Operation	144
2- 8.	Engine Starting Procedure	144
2- 9.	Engine Warm-up Procedure	144
2- 11.	Cockpit Check	144
2- 22.	Shutdown Procedure	146
Part III	Power Plant Section	147
3- 1.	Engine	147
3- 3.	Engine Cowl and Mount	147
3- 4.	Ring Cowling	147
3- 6.	Cowling Adjustment	147
3- 8.	Wrapper Sheets	147
3- 11.	Engine Cowl Flaps	147
3- 14.	Engine Mount	147
3- 16.	Engine Controls	147
3- 21.	Cold Cylinder Check	149
3- 22.	Engine Cylinder Compression Check	151
3- 23.	Operation of MK-1 Compression Tester	151
3- 25.	Interpreting Results	152
3- 26.	Compression Check for Individual Cylinders	152
3- 28.	Establishing Crankshaft Position	152
3- 29.	Removal of Cylinder Assembly	153
3- 32.	Inspection of the Valve System	153
3- 36.	Corrective Action for Valve System Discrepancies	154
3- 37.	Adjusting Engine Valves	156
3- 38.	Fuel System	157
3- 39A.	Fuel System Maintenance Safety Precautions	157
3- 40.	Fuel Tanks	157
3- 47.	Fuel Booster Pump	158
3- 53.	Liquidometer Transmitter	158A
3- 59.	Fuel Level Gage	159
3- 68.	Selector Switch	160
3- 73.	Fuel Lines	160
3- 78.	Fuel Pump	160
3- 83.	Carburetors	161
3- 90.	Primer System	162
3- 98.	Lubrication	163
3-101.	Oil Tanks	163
3-106.	Oil Radiator and Radiator Air Ducts	165
3-119.	Oil Dilution System	166
3-124.	Oil System Desludging Procedures	167
3-129.	Cold Weather Maintenance of the Oil System	167

TABLE OF CONTENTS (CONT)

Paragraph		Page
3-136.	Oil By-Pass Valve	168
3-141.	Oil Drain "Y" Valve	169
3-145A.	Decontamination of Engine Oil System and Accessories	169
3-145C.	Decontamination After Internal Engine Failure	169
3-145D.	Oil Tank Decontamination	169
3-145E.	Oil Cooler Decontamination	169
3-145F.	Decontamination of Propeller Oil System	169
3-145G.	Decontamination of Oil System at Normal Engine Change	169
3-146.	Ignition System	170
3-149.	Induction Vibrator	170
3-155.	Magnetos and Ignition Switch	170
3-167.	Maintenance and Repair of High-Tension Ignition Harnesses	172
3-176.	Starting System	176
3-183.	Supercharging, Air Induction and Exhaust Systems	176
3-185.	Supercharger	176
3-191.	Air Induction System	177
3-199.	Exhaust Collector Ring	177
3-204.	Carburetor Alternate Air Valve	178
3-209.	Deleted.	178
3-220.	Propellers	184
3-227.	Propeller Governor	192
3-233.	Feathering Pump	195
Part IV	Reasons for Removal	205
4- 1.	Control of Engine Removal	205
4- 3.	Sudden Stoppage or Sudden Reduction in Speed	205
4- 7.	Emergency Procedure for Sudden Stoppage	206
4- 9.	Metal Particles in Oil	206
4- 21.	Engine Test for Metal Particles	208
4- 24.	In-Service Parts Failures	208
4- 26.	Low Cylinder Compression	208
4- 28.	Basic Mechanical Failures	208
4- 30.	Oil Consumption	208
4- 32.	Engine Overspeeding	208
4- 37.	Foreign Material in the Oil System	209
4- 40.	Spark Plug Copper Run-Out	209
Part V	Power Plant Removal, Stripping and Preservation Procedures	211
5- 1.	Preservation Run	211
5- 2.	Removal of Power Plant	211
5- 3.	Power Plant Stripping	212
5- 5.	Preservation of Interior Surfaces	213
5- 6.	Exhaust Valves	213
5- 7.	Rockerboxes	213
5- 8.	Thrust Bearing	213
5- 9.	Cylinder Treatment	213
5- 10.	Carburetor	213
5- 11.	Propeller Shaft	214
5- 12.	Accessory Drives	214
5- 13.	Magnetos	214
5- 14.	Spark Plugs	214
5- 15.	Installation into Metal Shipping Container	214
5- 16.	Installation into Wooden Shipping Container	214

1-1. REMOVAL OF ENGINE FROM METAL SHIPPING CONTAINER.

CAUTION

Metal engine shipping containers should not be open until engine is required for use. This will prevent corrosion from setting in. Release air from shipping container slowly, prior to opening, thus preventing damage to seals and gaskets.

a. Remove plug "A" and take out engine records found rolled up inside (see figure 5-1).

b. Remove plug "B" and release the air pressure from the container slowly.

c. Lift entire engine shipping container assembly clear of the floor with an overhead lift, using a self-centering sling. Allow sufficient time for assembly to center itself under lift, then lower to floor. Do not allow overhead lift to move from centered position while removing flange bolts and nuts.

d. Remove all flange bolts and nuts.

e. Lift the upper section of the engine shipping con-

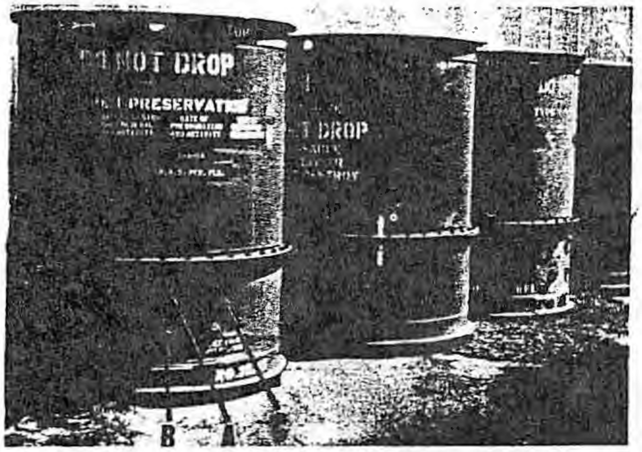


Figure 5-1. Metal Shipping Container

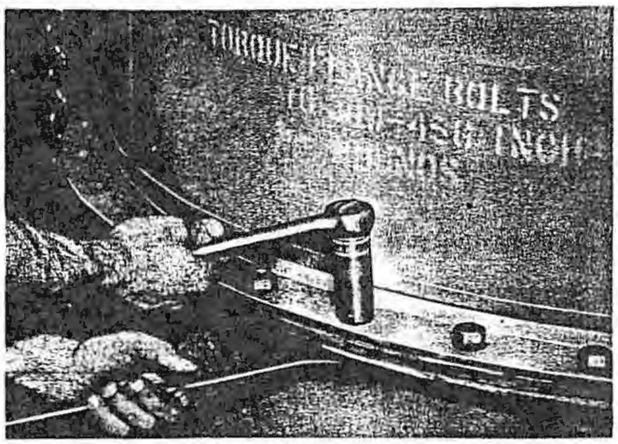


Figure 5-2. Engine Case Flange Bolts

tainer straight up carefully to prevent section from striking and damaging engine or sealing gasket. Remove cover to one side and lower to floor. Rest upper section on wood blocks to prevent damage to sealing surface.

CAUTION

Do not lift engine shipping container together with engine, using engine sling or engine hoist fitting.

f. Install lifting eye on propeller shaft. Remove mounting bracket bolts from engine mounting plate. For engines in horizontal engine shipping containers, install a self-centering sling adaptable to the R985 engine.

g. Raise the engine carefully from engine shipping container, exercising care to prevent engine from hitting mounting plate (see figure 5-5), with resultant damage to engine.

h. Remove ventilatory covers, plugs, non-ventilatory plugs, accessory mounting platforms, etc, and place in engine shipping container for use in reinstalling an engine in engine shipping container.

i. If engine shipping container is not to be reused immediately, top section will be replaced and secured using all bolts which will be tightened in accordance with established torque limit for bolts used. Flange bolts and nuts will be coated with Class 1, Specification MIL-C-11796 corrosion preventive compound.

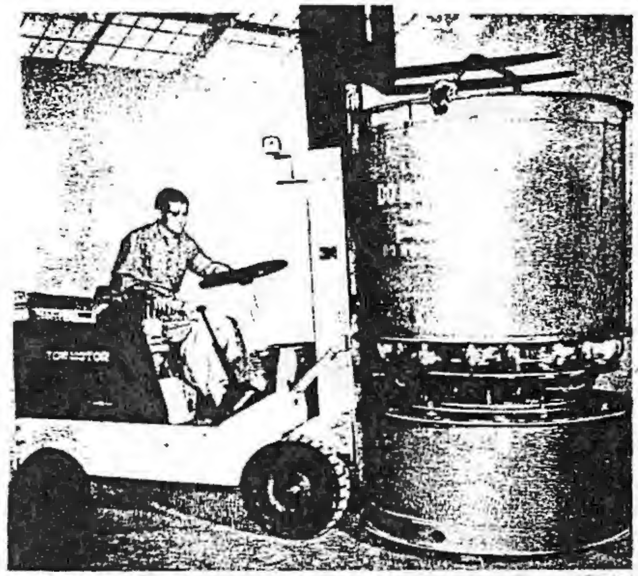


Figure 5-3. Lift Engine Container Cover

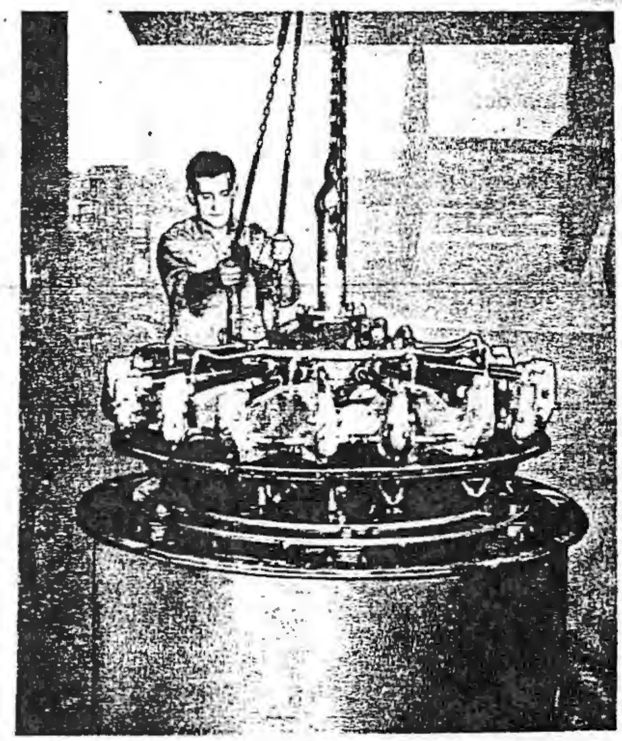


Figure 5-4. Lift Engine from Container

j. Metal shipping containers when received with engines containing rust and/or corrosion or otherwise damage, attributed to mechanical failure of the engine shipping container or its attachments will be made the subject of an Unsatisfactory Report. The Unsatisfactory Report will furnish information as to engine type, manufacturer's part number, and serial number. Engine shipping containers which are found

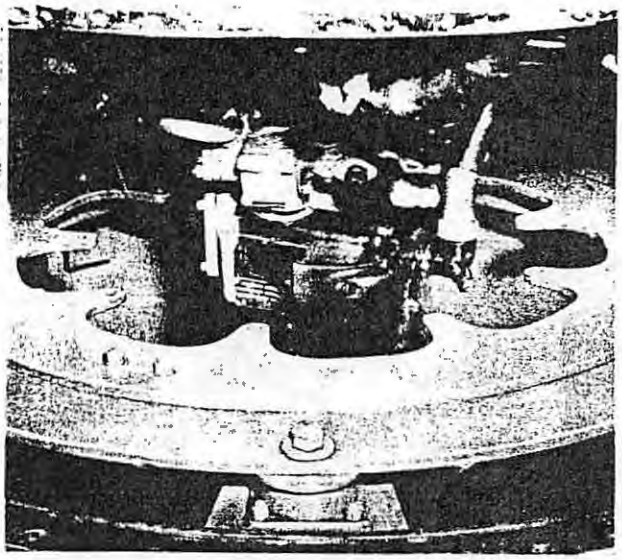


Figure 5-5. Avoid Striking Moving Plate Projections

to contain defective attachments and/or accessories, will also be made the subject of Unsatisfactory Report fully describing defects and/or damage specifying container type, manufacturer's part number, and serial number.

k. With the engine clear of the shipping container, either move the container lower section and move build up stand into position under the engine, or move the hoist to place the engine over a suitable stand.

l. Lower and attach the engine to the build up stand.

1-2. REMOVAL OF ENGINE FROM WOODEN SHIPPING CONTAINER.

a. Remove the metal straps from around shipping container (see figure 5-6).

b. Attach a sling to the two rings on each side of the cover, and lift the cover from the shipping container.

c. Cut the seal at top of engine envelope. Cut off as little envelope as possible so that it can be reused. Roll envelope down around the engine and remove creped barrier.

NOTE

Handle pliofilm envelopes at temperatures of 20°C (68°F) or higher. Lower temperatures tend to stiffen the envelope material, thereby creating difficulties in handling and making the envelopes more vulnerable to rupture.

d. Remove humidity indicator card and all bags of dehydrating agent from exterior of engine. Disposition of all spent dehydrating will be made in accordance with existing directives.

e. Remove engine mounting bolt nuts.

f. Remove engine from engine shipping container and envelope.

g. Clean engine protective envelope, fold carefully at seams, and roll on a tube or wood roll to preserve for subsequent reuse.

CAUTION

In no case should corrosion preventive mixture be drained from the engine, nor the propeller shaft turn, until within one week prior to ground run-up of engine after installation. If the propeller shaft is turned or corrosion preventive mixture drained from engine, corrosion may set in before engine ground run-up time.

h. Lower and attach engine to build up stand.

1-3. ENGINE BUILD UP. (See figure 5-7.)

a. Remove the inner cylinder baffles (1) between cylinder numbers 1 and 9, 1 and 2, and 4 and 5.

b. Remove inner cylinder baffle between cylinders 2 and 3 for 100 amp generator installation.

c. Remove all cylinder head baffles (4), replace attaching nuts on engine studs and clean head baffles as necessary. Place baffles in a suitable container until reinstallation.

NOTE

Inner cylinder baffles may be removed from the used engine and utilized as patterns in drilling the new inner cylinder baffles for primer lines, generator air cooling ducts, cold air inlet and intensifier cut-out.

d. Reinstall all inner cylinder baffles after drilling operation and safety.

e. Disconnect primer lines and remove primer cluster (75) from intake pipe. Check cluster for cracks and damaged threads.

f. Remove pipe plug from bottom of cluster and install AN822-4B elbow (76). Tighten elbow into position.

g. Reinstall primer cluster on intake pipe and reconnect primer lines to cluster.

h. Attach test apparatus to AN822-4B elbow in primer cluster.

i. Disconnect primer lines from cylinder priming elbows (3) and cap the end of the primer lines.

j. Apply pressure with test apparatus and check lines and cluster for air leaks. Remove caps from end of primer lines, apply pressure and check for free flow of air.

k. Reconnect primer lines to cylinder elbows.

l. Remove test apparatus from primer cluster and install No. 4 cap plug on primer elbow.

m. Remove all the protex plugs from the cylinders back row, install spark plugs and tighten all but No. 5 cylinder plug to 300-360 inch-pounds.

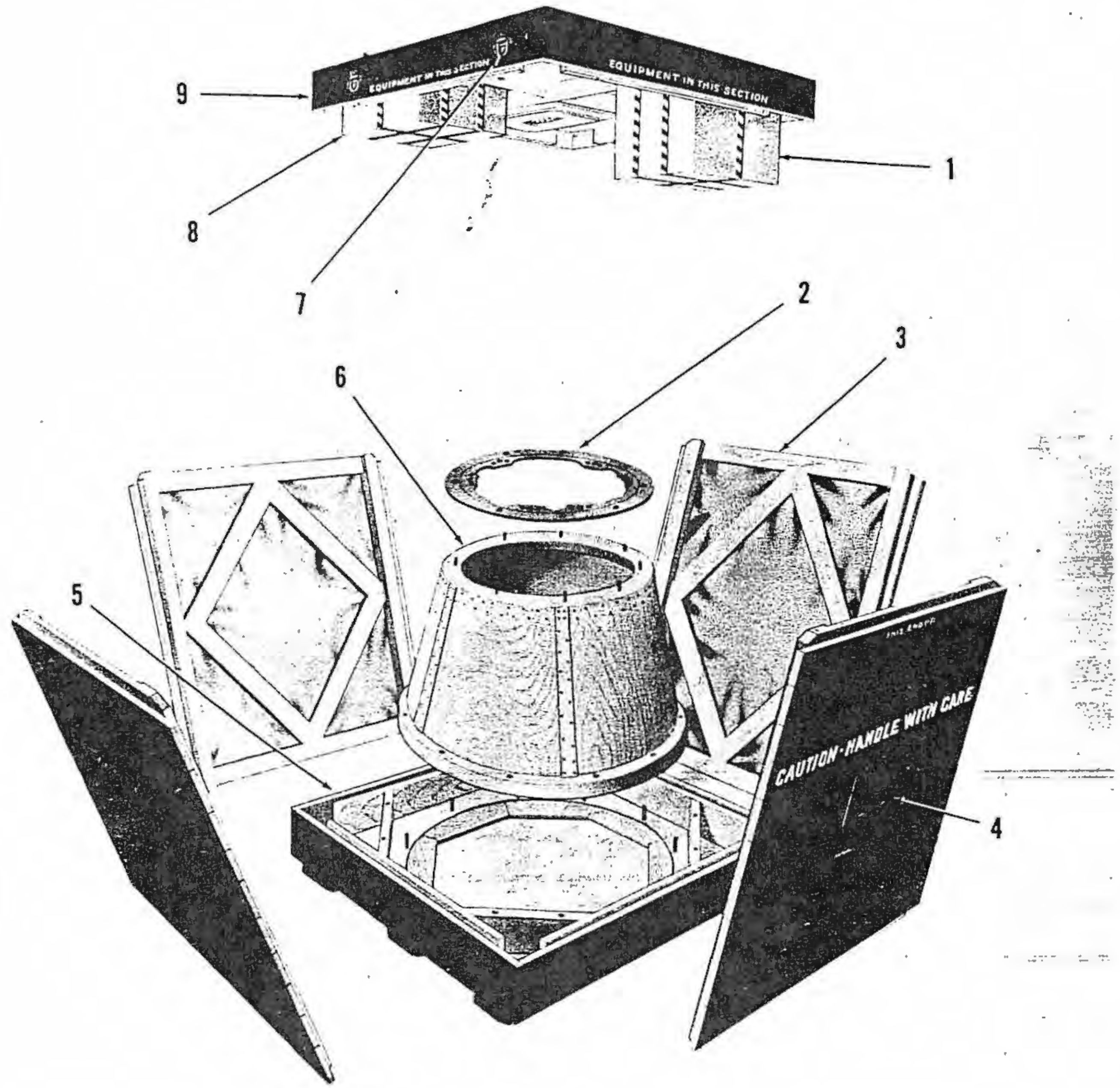
n. Connect ignition leads to spark plugs and tighten securely.

o. Install oil pressure fittings (36) and tighten securely.

p. Remove cover plate from oil inlet and install fitting (16), hose (17) and secure with clamp.

q. Remove the plug from oil outlet and install 90 degree elbow (21) and cap plug.

r. Remove spark plug and gasket from No. 5 cylinder (rear row), replace with thermocouple (59) and reinstall spark plug. Torque plug between 300-360 inch-pounds.



1. Carburetor Carton
2. Engine Mounting Plate
3. Side Panel
4. Inspection Port
5. Base
6. Support Cone
7. Cover Lifting Rings
8. Accessories Carton
9. Cover

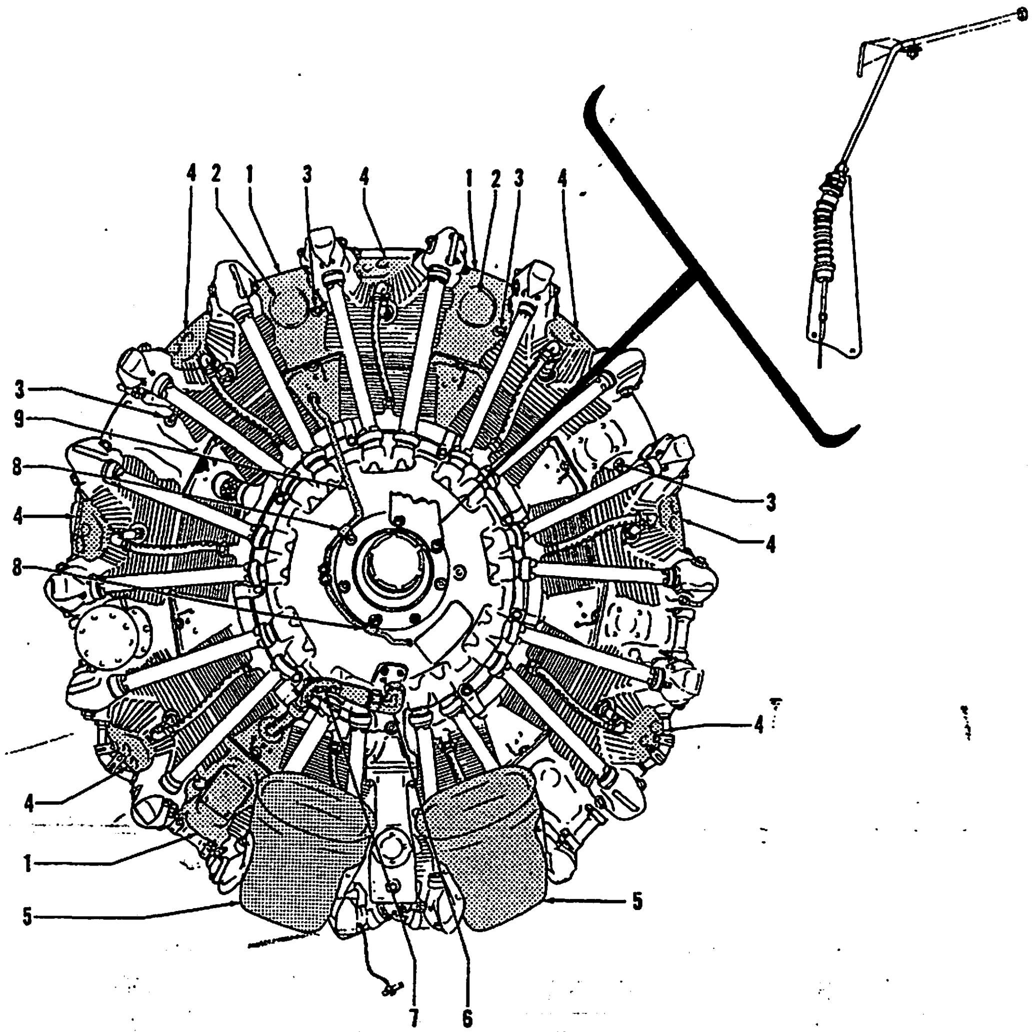
Figure 5-6. Exploded View of Wooden Shipping Container

s. Install exhaust manifold adapters (73) to all cylinders and tighten securely.

t. Install cowling support brackets (71) on the intake horn of each cylinder. Check rubber bumpers on the brackets for security.

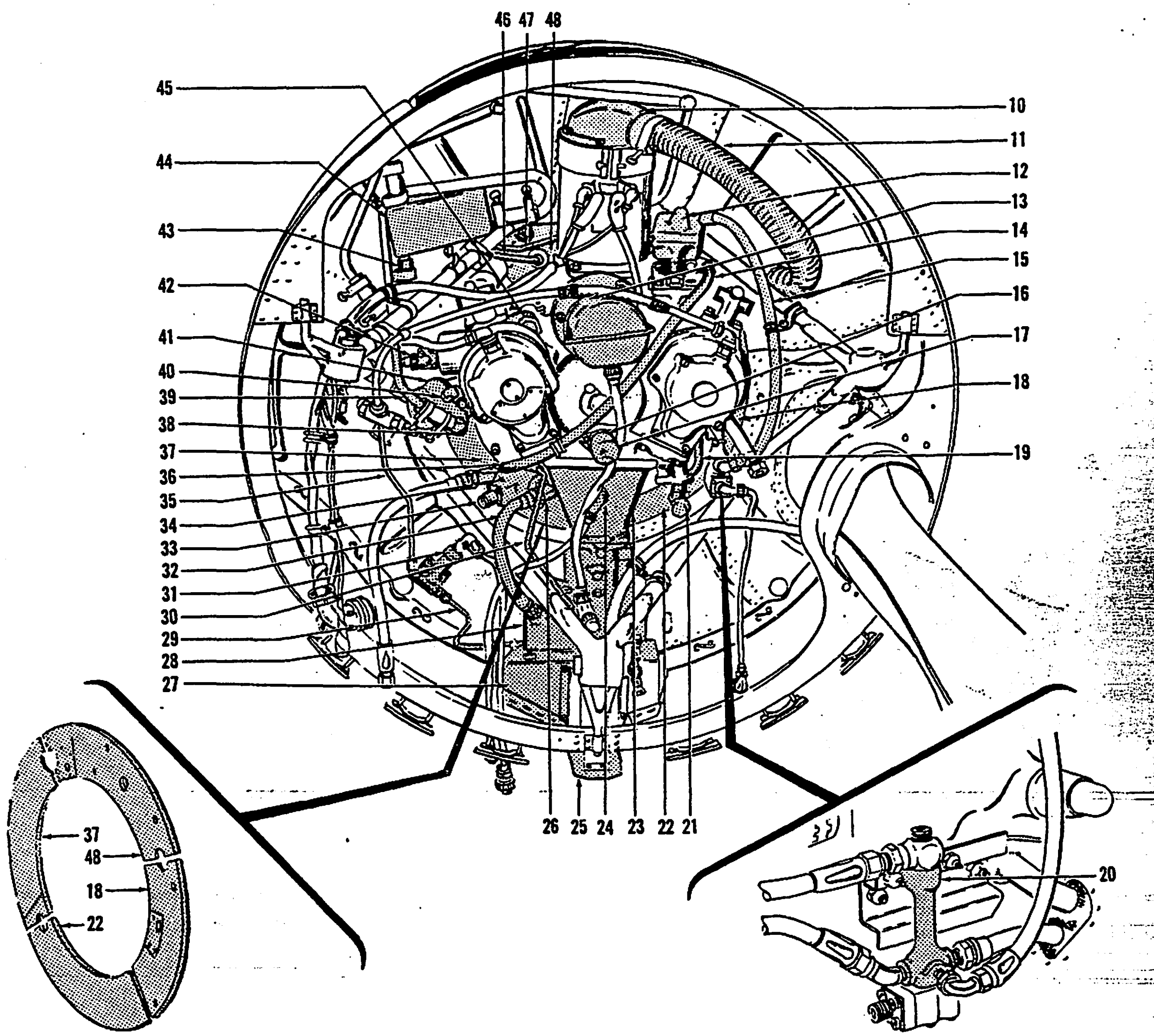
u. Inner cowling installation.

1. Clean paint from engine and inner cowl (72) at points of contact, also contact points between inner cowl and engine mount (67).
2. Inspect the inner cowling for cracks.
3. Install stud on engine mount pad between cylinders 4 and 5. Install guide pins in the remaining mounting holes.
4. Install the inner cowling on the mounting guide pins and stud.
5. Locate upper inner cowling segment (48) on top two guide pins with asbestos lining forward on all four segments.



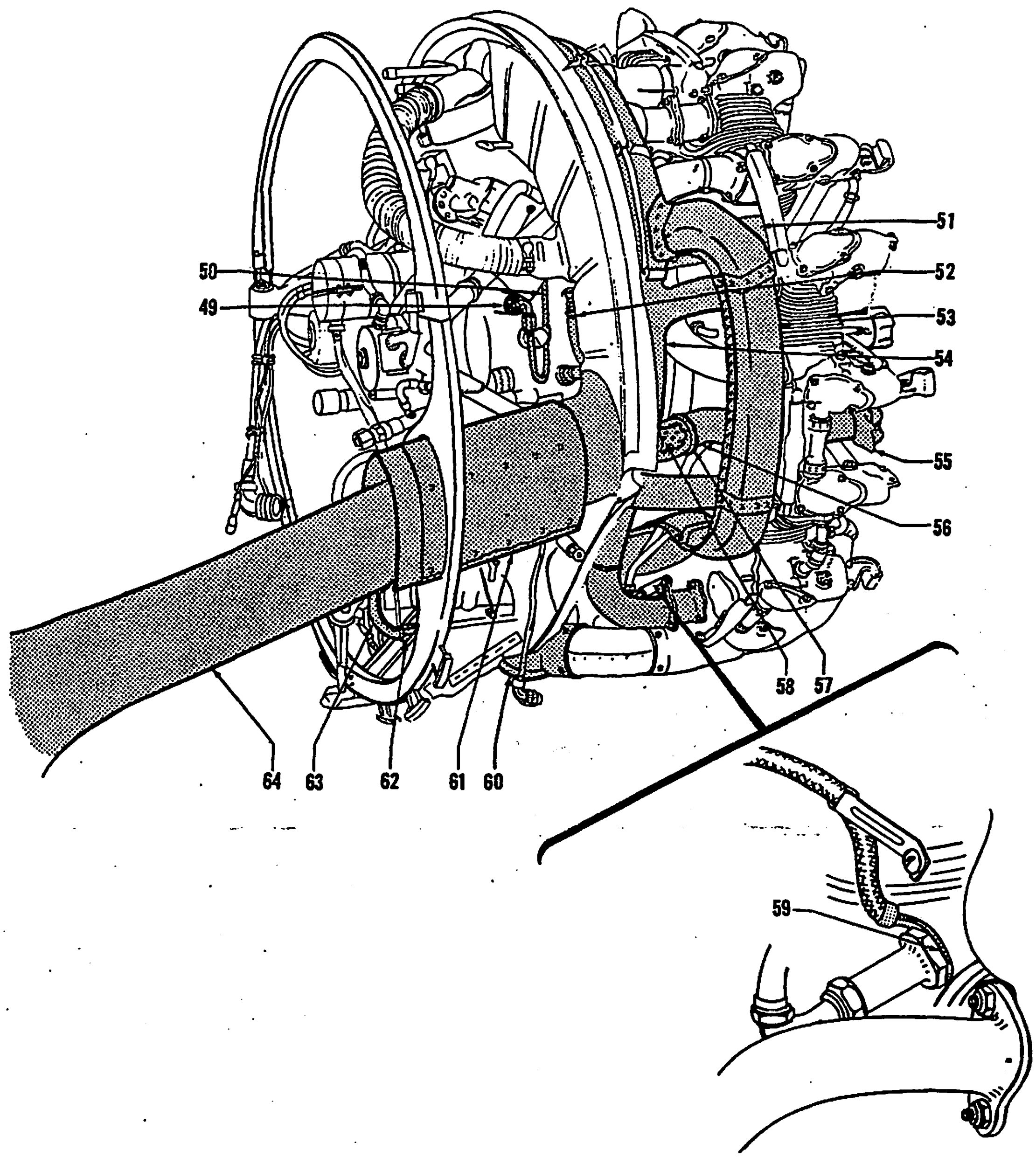
1. Inner Cylinder Baffles
2. Cold Air Inlets
3. Cylinder Priming Elbows
4. Cylinder Head Baffles
5. Carburetor Air Scoops
6. Propeller Oil Pressure Elbow
7. Oil Pressure Hose (Propeller Adapter to Oil Pressure Elbow)
8. Anti-Icer Line Clamps
9. Anti-Icer Line

Figure 5-7. Power Plant Build-Up - Front View (Sheet 1 of 4)



10. Generator
11. Flexible Blast Tube
12. Governor
13. Starter
14. Oil Hose (Governor to Rear Case Fitting)
15. Oil Pressure Hose (Propeller Adapter to Governor)
16. Oil Inlet Fitting
17. Oil Inlet Hose
18. Right Inner Cowling Segment
19. Oil Pressure Fitting (Propeller Adapter)
20. Propeller Adapter
21. Oil Outlet Elbow
22. Lower Inner Cowling Segment
23. Carburetor Adapter
24. Carburetor Air Temperature Bulb
25. Wrapper Sheet Bracket
26. Fuel Outlet Fitting
27. Carburetor Shield
28. Carburetor
29. Fuel Line (Carburetor to Primer Solenoid)
30. Fuel Pump Drain
31. Primer Solenoid
32. Fuel Line (Fuel Pump to Carburetor)
33. Fuel Pump
34. Fuel Inlet Fitting
35. Fuel Line (Primer Solenoid to Primer Cluster)
36. Oil Pressure Fitting (Rear Case)
37. Left Inner Cowling Segment
38. Elbow (Vacuum Pump Inlet)
39. Oil Line (Oil Separator to Vacuum Pump)
40. Elbow (Vacuum Pump Outlet)
41. Vacuum Pump
42. Tachometer Generator
43. Oil Line (Oil Separator to Swivel Drain)
44. Oil Separator
45. Swivel Drain
46. Manifold Pressure Fitting
47. Primer Line
48. Upper Inner Cowling Segment

Figure 5-7. Power Plant Build-Up - Rear View (Sheet 2 of 4)



49. Swivel Drain (Right)
50. Oil Line (Governor to Swivel Drain)
51. Air Intake Tube
52. Oil Pressure Hose (Propeller Adapter to Accessory Case)
53. Duct Assembly (Outboard)
54. Collector Ring (Outboard)
55. Intensifier Tube Air Intake
56. Intensifier Tube Elbow
57. Deflector Ring
58. Intensifier Tube
59. Thermocouple
60. Carburetor Air Intake Casting
61. Tail Pipe Shroud
62. Fitting (Fire Extinguisher)
63. Hose (Fire Extinguisher)
64. Tail Pipe

Figure 5-7. Power Plant Build-Up - Three-Quarter View (Right Rear) (Sheet 3 of 4)

65. Bolt
66. Former Ring
67. Engine Mount
68. Elbows
69. Carburetor Air Intake Ducts
70. Duct Assembly (Inboard)
71. Cowling Support Bracket
72. Inner Cowling
73. Exhaust Manifold Adapter
74. Collector Ring (Inboard)
75. Primer Cluster
76. Primer Cluster Elbow

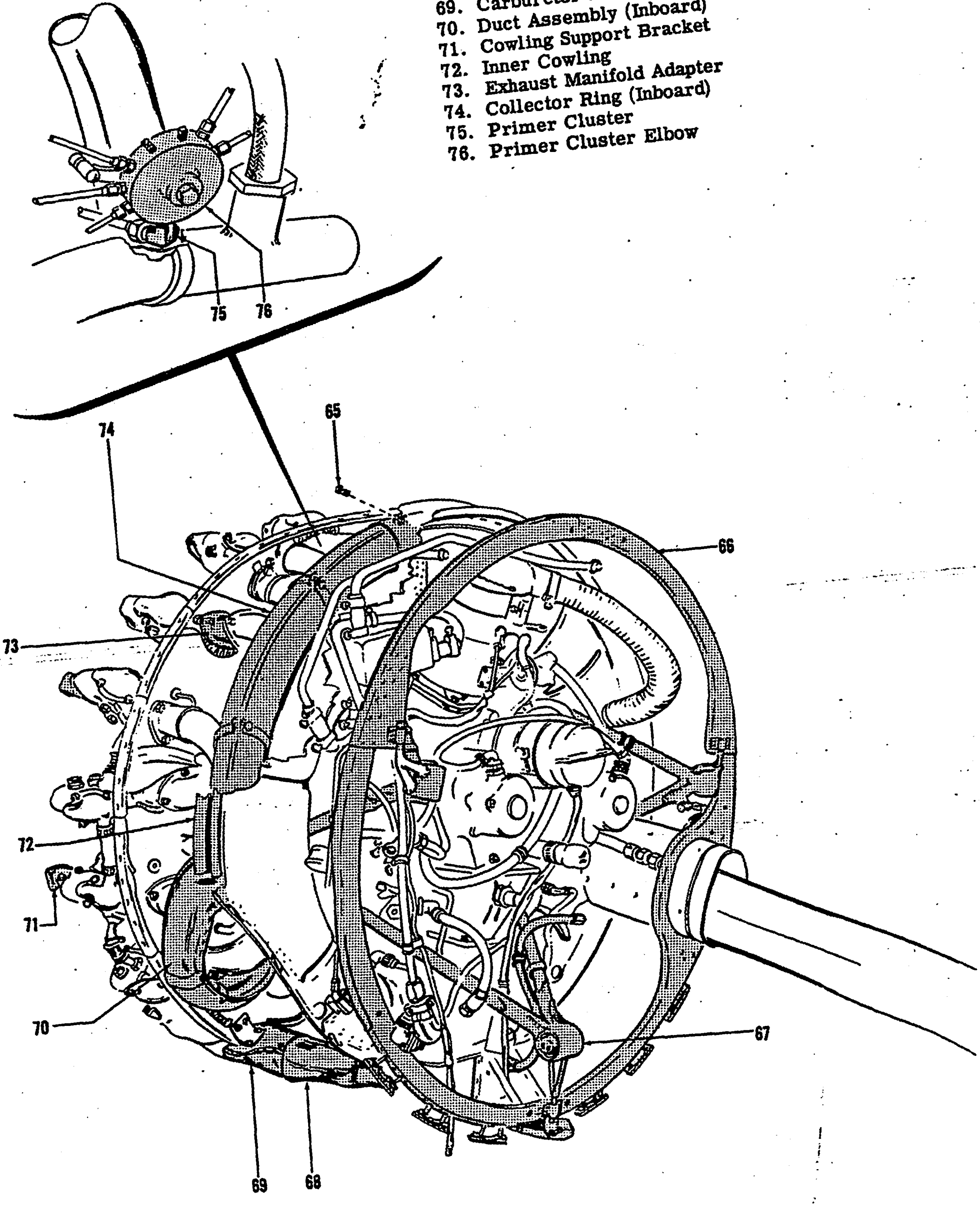


Figure 5-7. Power Plant Build-Up - Three Quarter View (Left Rear) (Sheet 4 of 4)

6. Locate left inner cowling segment (37) on center three guide pins.
7. Locate lower inner cowling segment (22) on the lower two guide pins.
8. Locate the right inner cowling segment (18) on center two guide pins.
9. Clean engine mount at points of contact with segments. Install engine mount on guide pins and stud.
10. Remove the guide pins and install AN7-47A (m) bolts from rear side. Install nuts and tighten to 450-500 inch-pounds and safety key.

v. Install manifold pressure fitting (46) through the top inner cowling segment and secure in supercharger housing.

w. Install primer line (47) through top cowling segment and connect line fitting to primer cluster.

x. Using a phenolic block, secure primer and manifold lines to engine mount truss on inboard side of engine.

y. Remove plug and install oil pressure fitting (19) and union on the right side of the accessory case.

z. Remove the cover plate and dehydrator bags and install carburetor adapter (23).

aa. Install gasket and carburetor shield (27) to carburetor studs then mount carburetor (28) to adapter. Adjust and attach shield to inner cowling.

ab. Attach primer solenoid (31) to inboard side of inner cowling.

ac. Connect the fuel line (29) between primer solenoid and carburetor, and fuel line (35) between primer solenoid and primer cluster.

ad. Installation of accessories.

1. Check fuel pump (33) for visual damage, record serial number and type.
2. Grease pump drive lightly with Lubriplate 130AA (manufactured by Fiske Bros. Co., Newark, N.J.).
3. Remove the cover plate from the accessory case and check the mounting gasket for a damage appearance.
4. Install gasket and pump on engine mount studs with fuel outlet fitting (26) located 90 degrees rearward and fuel inlet fitting (34) located 90 degrees down and to the rear. Tighten nuts evenly and securely.
5. Connect fuel line (32) between fuel pump and carburetor. Install fuel pump drain (30).
6. Check generator (10) for visual damage, remove base protector and record serial numbers.
7. Clean drive and base of generator and lubricate spline with a thin coat of Lubriplate 130AA (manufactured by Fiske Bros. Co., Newark, N.J.).
8. Remove cover plate from accessory case. Check gasket for damage and clean base.
9. Install generator mesh spline in place and locate generator wiring connection rear and inboard.
10. Reinstall washers and nuts - tighten and safety.
11. Install air intake tube (51) between inner cylinder baffle and inner cowling, (R.H. engines - between cylinders 2 and 3, L.H. engines - between cylinders 8 and 9), then install flexible blast tube (11) between generator head and inner cowl. Tighten clamps at both ends of tube.
12. Check starter (13) for visual damage and record serial number and type.
13. Extend starter jaw to end of travel and coat the lateral surface with Dow-Corning No. 7 Compound (manufactured by Dow-Corning Co., Midland, Mich.). Retract and extend jaw several times to distribute compound evenly over surface.
14. Remove cover plate from accessory case mounting pad and check mounting gasket for any damage. Clean engine and starter mounting surfaces.
15. Install starter on mounting pad studs, locating the starter terminal connection up.
16. Reinstall washers and palnuts and tighten evenly.
17. Install electrical lead to starter terminal connection.
18. Check vacuum pump (41), inspect for damage, remove base protector and record pump type and serial number.
19. Apply a thin coat of thread lubricant, Specification MIL-L-6032 to pump fittings.
20. Install AN842-10 elbow (40) in upper port of pump (outlet port). Locate elbow opening so that it aligns with tube from oil separator.
21. Install AN844-10 elbow (38) in lower (inlet) port of pump. Locate parallel and with opening opposite to outlet port elbow.
22. Lubricate drive lightly with Lubriplate 130AA (manufactured by Fiske Bros. Co.).
23. Remove cover plate from accessory case and install the pump on the base mounting pad.
24. Reinstall washers and nuts, tighten evenly and safety with palnuts.
25. Check tachometer generator (42) for visual damage, record serial number and type.
26. Remove cover plate from engine mounting pad. Check gasket and clean mounting base.
27. Clean base of tachometer generator and coat tachometer drive with Lubriplate 130AA (manufactured by Fiske Bros. Co., Newark, N.J.).
28. Install tachometer generator on engine mount pad with electrical connection facing aft.
29. Reinstall washers and nuts, tighten evenly and safety with palnuts.
30. Check governors (12) for visual damage, record serial number and type.
31. Remove cap from outboard governor pad, remove nut, washer and spacer from drive shaft.
32. Install screen over drive shaft bearing, drive gear on drive shaft, reinstall washer and nut, tighten and key.
33. Remove cover plate, clean mounting base, check gasket for deterioration. Install governor in position on outboard side of engine.
34. Reinstall washers and nuts, and tighten securely.
35. Position swivel drain (49) and connect oil line (50) between the governor and swivel drain. Tighten nut holding swivel drain in position and safety.
36. Connect oil line (14) between governor and rear case fitting (36).

ae. Install carburetor air temperature bulb (24) in carburetor adapter. Connect electrical lead to air temperature bulb.

af. Remove nuts and spacers from nose plate studs, top first outboard and lower first outboard (opposite for L.H. engines) and install anti-icer line clamps (8) in position on studs.

ag. Locate anti-icer line (9) through inner cowl and inner cylinder baffle (between cylinders 1 and 2).

ah. Position line around outboard engine nose plate and attach to brackets. Reinstall washers and nuts and tighten securely.
ai. Install bracket and propeller adapter (20) on the right side of rear accessory case.
aj. Connect oil pressure hose (7) between propeller adapter and oil pressure elbow (6).
ak. Connect oil pressure hose (15) between adapter and governor and oil hose (52) between adapter and engine accessory case. Tighten adapter head securely and install the electrical connection.
al. Install clamps in position on fuel, oil and vacuum lines, also wiring harnesses.
am. Install oil separator (44) on upper inboard engine mount truss. Locate separator 15 degrees below horizontal on drain.
an. Connect oil line (43) between oil separator and swivel drain (45) and oil line (39) between separator and vacuum pump.
ao. Installation of exhaust system and components.
1. Align the outboard side of collector ring (54) with the four exhaust adapters, install bolts and tighten nuts securely.
2. Position the inboard side of collector ring (74) so that it fits inside inboard portion of collector ring. Insert a 3/16 inch bolt (65) through the top of assembled collector ring and tighten securely.
3. Align the outboard side of collector ring to the five remaining exhaust adapters, install bolts and tighten nuts securely.
4. Reinstall all cylinder head baffles and secure.
5. Install the cold air inlets (2) through the inner cylinder baffling (between cylinders 1 and 2, 1 and 9) to the heater muff and secure.
6. Install the carburetor air intake casting (60), gaskets and screen to carburetor mounting studs. Install washers and nuts, tighten securely.
7. Attach elbows (68) to carburetor air intake ducts (69), insert screws and tighten securely.
8. Position and install the elbows and ducts to the carburetor air intake casting and secure.
9. Install front carburetor air scoops (5) to air intake ducts. Attach air scoops brackets to rocker box housing - tighten securely. Install air scoop bottom cover.
10. Install the inboard (70) and outboard (53) duct assemblies from heater muffs to carburetor air intake casting and secure.
11. Attach the former ring (66) to the engine mount. Install bolts and tighten securely.
12. Install intensifier tube air intake (55) through inner cylinder baffle (L.H. engine-between cylinders 7 and 8, R.H. engine-between cylinders 3 and 4) and secure tube to baffle.
13. Fit the intensifier tube elbow (56) to the air intake tube, install bolts and tighten securely.
14. Position and install tail pipe (64) to exhaust collector ring and connect intensifier tube (58) to intensifier tube elbow (56) with deflector ring (57) in place and secure.
15. Locate the tail pipe shroud (61) through former ring and install in position on the inner cowl. Insert bolts and tighten securely.
16. Attach the wrapper sheet bracket (25) to carburetor shield and former ring.
17. Install fire extinguisher fitting (62) and hose (63) into carburetor air scoop housing.

1-4. INSTALLATION OF ENGINE.

WARNING

A suitable hoist capable of supporting the entire engine assembly (approximately 1500 pounds capacity) must be attached to the hoisting eyes when installing engine assembly. Two men are needed to install the engine; one to install the bolts and guide the engine, the other to operate the hoist (figure 5-8).

a. Attach the hoist slings to lugs provided on the crankcase between cylinders 1 and 2 and cylinders 1 and 9 (figure 5-9).
b. Tighten chain hoist to support the engine.

CAUTION

Check hoisting sling to make certain the connections to the lugs are satisfactory and the separator bar on the sling prevents the cables from damaging the induction pipes.

c. Make a thorough inspection of the engine and firewall. Check to see that all caps are removed from the plumbing and plumbing is free of all foreign matter, that all accessories are on and properly in-

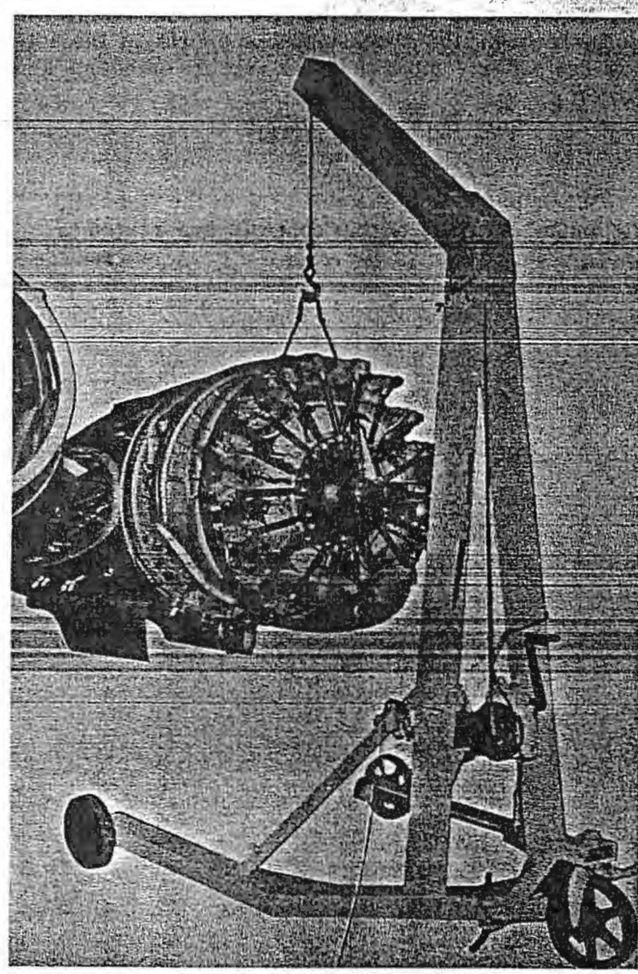


Figure 5-8. Hoisting Engine

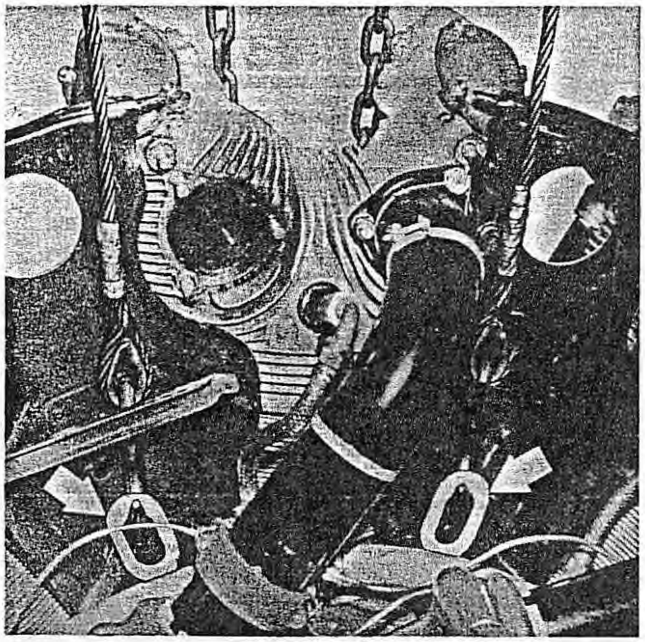


Figure 5-9. Engine Hoisting Lugs

stalled and that all bolts are properly keyed or safetied.

d. Move engine back to the firewall and install the bolts through the shock mount supports in the following order: upper inboard, upper outboard and lower.

CAUTION

When bringing the engine back to the firewall, make sure the engine controls are routed in their respective positions and the oil outlet hose is slipped into place on the firewall fitting.

e. Install the nuts and washers on the mounting bolts and torque each mount bolt to 165-185 inch-pounds and safety.
f. Connect all engine piping (fuel, oil and vacuum lines) at the firewall.
g. Connect all electrical wiring cannon plugs at the firewall and check all electrical connections to their respective units for tightness.
h. Connect engine control rods (throttle, carburetor air heat and mixture controls).
i. Reinstall propeller governor cable. Adjust the propeller governor (see paragraph 3-232).
j. Connect the cabin heater valve to the intensifier tube at the rear of the exhaust stack.
k. Connect fire extinguisher line at the firewall.
l. Connect automatic pilot oil line at firewall fitting. (This applies only to the right engine of aircraft equipped with automatic pilots.)
m. Installation of ring cowling.
1. Install upper section of the cowling and center it on the supporting lugs.
2. Place the wrapper sheets on the engine and secure Dzus fasteners.
3. Secure the strap fasteners connecting wrapper sheets to the upper section of the ring cowling.
4. Install the lower section of the cowling and secure the strap fasteners on each side.
5. Secure the Dzus fasteners on the front edges of the upper and lower ring cowling.
6. Connect the cowl flap control to actuating horn.

1-5. PROPELLER INSTALLATION. See paragraph 3-225.

PART II

DEPRESERVATION AND RUN-IN

2-1. ENGINE DEPRESERVATION. After the engine has been installed in the aircraft and before the initial ground run is attempted, there are several procedures that must be accomplished before the engine is started.

2-2. DEPRESERVATION OF ENGINE.

a. Check tail pipes and carburetor air scoops for dehydrator bags and remove any that are found.
b. Remove the silical jell plug from the timing hole, install plug and safety.
c. Fill the fuel tanks with proper grade of fuel. Observe safety precautions while filling fuel tanks as noted in Section I, paragraph 1-19.
d. Disconnect the main fuel line at the carburetor.
e. Using the boost pump, flush approximately two gallons of fuel through the line, then reconnect line to carburetor.
f. Place the throttle and mixture control forward, operate boost pump and flush carburetor.
g. Remove the drain plug from the oil sump and drain the preservation fluid from the engine.
h. Remove the oil strainer and clean by washing in a solvent such as kerosene or cleaning solvent, Federal Specification P-S-661. Remove all foreign material adhering to the strainer. To facilitate cleaning the strainer, rotate the strainer in the solvent. Immerse the strainer in clean engine oil prior to reinstallation into the engine.

CAUTION

Do not use an air jet or a hard pointed tool for Cleaning the strainer.

i. Place a drain pan directly beneath the engine to catch the preservative oil.
j. Remove the front protex plugs from all cylinders.
k. Rotate propeller several times by starter, allowing the preservation oil to flow from the spark plug holes into the drain pan.

2-3. PRE-OIL.

a. Fill the oil tank with oil conforming to Specification MIL-L-6082, Grade 1100.
b. Provide an external power source.
c. Place engine and fuel controls in the following positions:

1. Ignition switch. . . . . OFF
2. Throttle . . . . OPEN
3. Mixture Control. . . . . IDLE CUT-OFF
4. Fuel Selector Valve. . . . . OPEN

d. Provide a suitable container of approximately five gallons capacity to catch the oil that will drain from the sump during the pre-oiling operation.
e. On aircraft that have hydromatic propellers installed, remove the plug from the propeller dome and pour a sufficient amount of pre-oiling lubricant into the dome to bring the lubricant level to the plug hole. Reinstall and safety the plug in propeller dome.

2-4. ENGINE PRE-OIL.

a. Prime the oil pump by disconnecting the line at the oil pressure gage connection.
b. Rotate the crankshaft with the starter until all air is expelled from the line and a steady flow of oil is coming from the line.
c. Remove the drain plug from the sump.
d. Connect pre-oiler to oil pressure gage connection.
e. Rotate the engine with starter and commence pre-oiling with a pressure of 45-60 psi until oil is flowing freely from the sump plug holes and pressure is indicated on the oil pressure gage in the aircraft.
f. Replace the sump plug.
g. Remove both rocker box covers from No. 1 cylinder.
h. Rotate the engine with starter until oil is obtained from rocker arms.
i. Disconnect pre-oiler and reconnect the oil pressure gage line.

NOTE

Newly installed engines will be given initial start as soon as possible, but not later than four hours after pre-oiling has been accomplished. If any period of time in excess of four hours has elapsed since engine was pre-oiled, complete pre-oiling procedure will again be accomplished before attempting initial start of engine.

2-5. DEPRESERVATION RUN. The following instructions, if properly complied with will eliminate the necessity of removing intake pipes or draining intake pipes prior to installation of engine in the aircraft.

a. Install spark plugs in cylinders above the horizontal line (3-2-1-9-8) and tighten between 300-360 inch-pounds. Install spark plug leads.
b. Install a depreservation valve, Stock No. 9AMD-55A75017, in cylinders (4-5-6-7).
c. Wash the front of the engine down thoroughly with kerosene (Federal Specification VV-K-211) or cleaning solvent (Federal Specification P-S-661).
d. Determine that both ignition leads are disconnected on cylinders that have one spark plug removed and install plastic or metal shipping caps on the ignition terminals. The use of metal shipping caps is recommended since they will ground out the ignition, thereby eliminating excessive voltage build-up in the magneto and the possibility of flash-over at the terminal end of the ignition lead.
e. Start the engine and run at 800 to 1500 rpm for 30 seconds to one minute. Operation may be accomplished on either the primer or carburetor or both, to obtain the smoothest possible operation. Normally, smoothest engine operation will be obtained at the higher engine speeds and a higher air velocity through the intake pipes will result. In cases where extreme cold temperatures exist, the engine to be started should be pre-heated prior to starting and should be allowed to run longer than the one-minute period, provided excessive vibration is not encountered. Preservation oil, if present in the

intake pipes, will have adequate time to be heated and flow from the intake pipes into the combustion chamber and be expelled into the exhaust system or through the depreservation valves.

f. Stop the engine by closing the throttle and discontinuing the use of the primer or by moving mixture control to IDLE CUT-OFF position.

g. Remove depreservation valves, install spark plugs (torque 300-360 inch-pounds), ignition leads, engine cowling and proceed to start engine using the prescribed starting procedure.

2-6. ENGINE PRE-START CHECK.

a. With the ignition switch OFF, battery switch ON, mixture control in IDLE CUT-OFF and throttle CLOSED, observe the propeller while turning the engine through 8 blades with continuous starter action. This will insure proper pre-oiling. Any sign of hesitancy of propeller rotation indicates the possibility of liquid "LOCK".

NOTE

If liquid lock is noted, remove the plugs from the lower cylinders and check for presence of oil. Turn propeller through with plugs removed. Allow oil to drain and reinstall plugs.

b. Perform all ground operations with the propeller control lever in the full INCREASE low pitch-high rpm position.

c. Head the aircraft into the wind and set the parking brakes.

d. Place a fire extinguisher on the ground where it can be reached quickly, but will be clear of the propeller.

e. Place cowl flaps in the full open position.

f. Restrict engine speed to 1500 rpm after warm up, except for brief periods to check magneto drop-off and oil pressure.

g. Watch cylinder head and oil temperatures during ground operation, and do not continue operation when temperatures approach their maximum limits.

2-7. POWER PLANT OPERATION.

2-8. ENGINE STARTING PROCEDURE. Always make sure a fire guard is posted, the propeller clear, and wheel chocks in place before starting the engine. No start should be attempted until the CLEAR signal is received. Since the starting procedure is identical for both engines, the following procedure is written for right engine operation. Start the right engine as follows:

a. Connect external power supply if available.
b. Place right fuel selector handle on RIGHT FRONT.
c. Set right cowl flap handle - OPEN.
d. Recheck right throttle - 1/4-OPEN.
e. Place right mixture lever - FULL RICH.
f. Check right fuel booster switch - ON.
g. Turn master ignition switch - ON.
h. Turn selector switch - RIGHT.
i. Start right engine by engaging starter switch. Allow engine to turn over four or five revolutions then turn ignition switch to BOTH and ignition booster switch ON.
j. Use primer until engine fires and is operating smoothly.
k. Release starter switch.
l. Release ignition booster switch.

NOTE

If engine ceases to fire after starting, move the mixture lever to IDLE CUT-OFF until it again begins to fire. Then return the mixture lever to FULL RICH.

CAUTION

Overheating of the starter motor will occur with prolonged operation. Thirty seconds should be considered as the maximum period of continuous operation without a cooling period.

m. Adjust the engine speed to 1000 rpm.
n. Flip the fuel booster and engine selector switches OFF.
o. Check oil pressure immediately.

CAUTION

If oil pressure does not build up to 20 psi in 30 seconds, shut down engine and investigate. Do not exceed 1000 rpm until the oil temperature is over 40°C (104°F).

2-9. ENGINE WARM-UP PROCEDURE.

2-10. When oil pressure has stabilized within limits, engine speed should be increased to the smoothest operating speed between 1200 rpm and 1600 rpm for the remainder of the warm-up period. Warm up at this speed will assure best possible operation of the engine since adverse conditions such as improperly adjusted idle mixture, improperly adjusted engine valves, etc, will have the least effect at this speed. The cowl flaps will always be kept in the full open position. All gages and instruments will be observed to insure proper operation of the engine.

2-11. COCKPIT CHECK.

2-12. In order to assure proper power plant operation, the power plant will be given a power check, cruise mixture check, ignition switch check, magneto check, acceleration check, propeller check and generator system check. All engine checks will be made with the propeller in the low pitch, high rpm position and mixture lever in the full RICH position.

2-13. POWER CHECK.

a. Head aircraft into wind whenever possible. Advance throttle to rpm as specified in the applicable Pilot's Flight Handbook (T.O. 1C-45H-1, T.O. 1C-45G-1 or T.O. 1C-45(T)G-1).

b. With engine running at the designated rpm, manifold pressure should indicate the manifold pressure specified with a maximum variation of 1 inch Hg. A difference in indication of the engines, in excess of 1 inch Hg indicates one engine is not delivering proper power.

2-14. STABILITY CHECK.

a. Move mixture control into MANUAL LEANING RANGE until an approximate 100 rpm drop is noted; then return to RICH. During this operation the engine speed should increase approximately 25 rpm before decreasing. An immediate decrease indicates an engine or carburetor malfunction; a momentary increase in excess of 25 rpm indicates same.

NOTE

The carburetor will not be changed on the basis of this check.

2-15. IGNITION SWITCH CHECK.
a. Set engine speed to 700 rpm.
b. Momentarily move ignition switch to OFF and determine that engine completely ceases firing. Return switch to BOTH position as rapidly as possible to prevent severe backfire when switch is turned back to BOTH.
c. If engine does not cease firing, shut down engine.

WARNING

Make sure all personnel are clear of affected propeller until difficulty has been corrected.

2-16. MAGNETO CHECK.
a. With rpm as specified in the applicable Pilot's Flight Handbook (T.O. 1C-45H-1, T.O. 1C-45G-1 or T.O. 1C-45(T)G-1), switch ignition from BOTH to RIGHT and back to BOTH. Switch ignition from BOTH to LEFT and back to BOTH. Pause in each position until rpm stabilizes and is noted. Maximum drop-off in either position should not exceed 65 rpm. Maximum difference in drop-off between RIGHT and LEFT position should not exceed 40 rpm.

2-17. IDLE MIXTURE AND IDLE SPEED CHECK. Idle mixture and idle speed will be checked and adjusted, if necessary, as outlined in Part III, paragraph 3-88.

2-18. ACCELERATION CHECK.
a. With mixture control to RICH position.
b. Advance throttle smoothly and rapidly from idle rpm position to approximately power check rpm setting. Engine should accelerate rapidly and smoothly with no tendency to backfire.

(Deleted)

2-19. PROPELLER CHECK (RIGHT).
a. Adjust engine speed to 1600 rpm.
b. To feather the propeller, push the propeller feathering button in until a drop of approximately 200 rpm is noted. This drop indicates the propeller is beginning to feather.

NOTE

If the engine is operating at approximately 1600 rpm before feathering it will continue to run fully feathered at about 450 rpm. Under these conditions, once the propeller is feathered, it will tend to slowly and steadily come out of the feathered position. This should be considered abnormal since it is caused by the engine oil remaining under pressure.

c. As soon as rpm drop is noted, pull the propeller feathering button out. This will cause the propeller to begin unfeathering immediately.

NOTE

The propeller button should be pulled out as rapidly as possible since full feathering requires only 3 seconds.

2-20. INSTRUMENT CHECK. After the engine has been warmed up and operating temperatures are noted, the instruments should be checked for desired operating range.
a. Oil Temperature: normal 60°C to 75°C (140°F to 167°F), maximum 85°C (185°F).
b. Fuel Pressure: normal 3 to 4 psi, maximum 6 psi.
c. Cylinder Head Temperature: normal 150°C to 232°C (302°F to 450°F) maximum - during take-off 260°C (500°F).
d. Suction Gage: normal 3.75 to 4.25 inch Hg maximum 4.25 inch Hg.
e. Carburetor Mixture Temperature: normal 3°C to 20°C (20°F to 68°F) maximum 20°C (68°F) danger of detonation.

2-21. GENERATOR SYSTEM CHECK.
a. Disconnect external electrical power.
b. With both engines idling, voltmeter switch thrown to left generator, both generator switches ON, and battery master switches ON, slowly increase rpm of left engine and observe voltmeter. (The voltmeter reading should increase to a value at which it indicates the closing of the reverse current cutout. This closing shows up as a dip in voltage and should occur at approximately 26.5 volts. A current reading on the left generator ammeter also indicates that the cutout has closed.)
c. Continue increasing rpm on left engine and check to see that voltage increases to about 28.5 volts and remains at this value independent of any further increase in rpm.
d. Decrease the left engine rpm to idling and repeat steps b and c with voltmeter selector switch thrown to right generator.
e. Increase the rpm of both engines and turn additional electrical load on. Observe generator system

paralleling as indicated by ammeters. At full load the generators should parallel within 10 amperes. At light load, neither ammeter should read reverse current.

2-22. SHUTDOWN PROCEDURE.

a. Idle engines until cylinder head temperature stabilizes.

b. Leave propeller levers in the low pitch, high rpm position (full forward position).

c. Move mixture controls to IDLE CUT-OFF position (closed) at 600 to 800 rpm.

d. Turn OFF ignition and battery switches.

e. Leave cowl flaps full open until engine has cooled.

PART III

POWER PLANT SECTION

3-1. ENGINE.

3-2. C-45G and TC-45G airplanes are powered by two Pratt and Whitney Wasp Jr. R-985-AN-39 or R-985-AN-39A, 450 horsepower radial engines modified in accordance with TCTO 1C-45-518. C-45H airplanes use two R-985-AN-14B radial engines of the same horsepower. These engines are nine cylinder, air cooled and have a direct drive from the crankshaft to the propeller. Each cylinder has a bore of 5.1875 inches and a stroke of 5.1875 inches. Total piston displacement is 985 cubic inches, compression ratio is 6.1. The single-stage, single-speed supercharger impeller turns at a ratio of 10.1 to the crankshaft speed. The impeller operates continuously, there being no provisions for disengagement. Hamilton Standard Hydromatic two-bladed, full feathering propellers with constant speed governors are used on these aircraft. Propeller levers on the control console are linked to the propeller governors and feathering oil pressure is provided by separated, electrically driven pumps, one in each nacelle. Full dual ignitions systems, utilizing American Bosch SB9RU-3 magnetos, are used. The carburetors are Stromberg NAR9B-19. The engines are fitted with a ring cowling and pressure type baffles. Cooling air deflectors, baffles and adjustable gill type cowl flaps regulate air temperature in the forward part of the engine, whereas cooling air for the accessory compartment is taken in at the leading edge of the wings, directed through the oil radiator and then passed into the accessory compartment. The normal carburetor air intake is through air scoops at the front of cylinders 5 and 6. The air scoops are routed aft directly beneath the two cylinders and back to the carburetor. An alternate source of warm air, to control carburetor ice, is provided by muffs around the exhaust stacks. Valves operated by the manifold heat levers on the control pedestal may be positioned for either cold air, or heated air for the carburetor.

3-3. ENGINE COWL AND MOUNT.

3-4. RING COWLING.

3-5. DESCRIPTION. The engine ring cowlings are constructed in two sections, connected by adjustable, strap-type fasteners (figure 5-10). The upper section of the cowling extends to the firewall, covering the engine and engine accessory compartment. The lower section covers the engine section only and is fitted with adjustable flaps for temperature control.

3-6. COWLING ADJUSTMENT.

3-7. Turnbuckles inside the cowling may be adjusted to tighten or loosen the fasteners.

3-8. WRAPPER SHEETS.

3-9. DESCRIPTION. The engine wrapper sheets are in two sections fastened with Dzus and strap fasteners. They cover the lower section of the accessory compartment.

3-10. ADJUSTMENT OF WRAPPER SHEETS. Adjustment of the wrapper sheets may be made by changing length of the turnbuckles on the strap fasteners. Strap fasteners are located on the aft section of the upper ring cowling. Padded brackets on the former ring are also adjustable to give added support to the wrapper sheets.

3-11. ENGINE COWL FLAPS.

3-12. DESCRIPTION. Three separate, overlapping cowl flaps are fitted to the trailing edges of the lower section of the ring cowl on each side of the engine. They are hinged at the forward edge and interconnected so they operate as a unit. The pilot can close or open the cowl flaps to control the engine temperature by means of the cowl flap controls on the left side of the control pedestal.

3-13. COWL FLAP ADJUSTMENTS. Adjust the cowl flap control handle in the pilot's compartment to have 1/4-inch spring-back from the closed position. This will assure complete closing and eliminate excessive vibration of the cowl flaps in flight. When the control in the pilot's compartment is in the closed position the cowl flaps on each side of the engine should be closed. If adjustment is necessary, it may be made by changing the length of the main actuating rod attached to the center flap of each unit (figure 5-11). In addition to synchronizing the flaps on each side of the engine, the individual flaps in each unit must be synchronized with each other. The main control arm is attached to the center flap of each unit, which in turn is connected by rods to the other two flaps. The end flaps should be adjusted so they move freely without binding at the joints and yet form a smooth contour when closed.

3-14. ENGINE MOUNT.

3-15. DESCRIPTION. The engine mount (figure 5-12) is a welded assembly consisting of steel tubing, gussets and fittings for attachment to the engine and center section truss. It is attached to the engine and center section truss by AN. type (magnafluxed) bolts. The three mount fittings which attach to the center section truss contain Lord-type rubber shock mounts.

3-16. ENGINE CONTROLS.

3-17. DESCRIPTION. The throttle, mixture, pro-

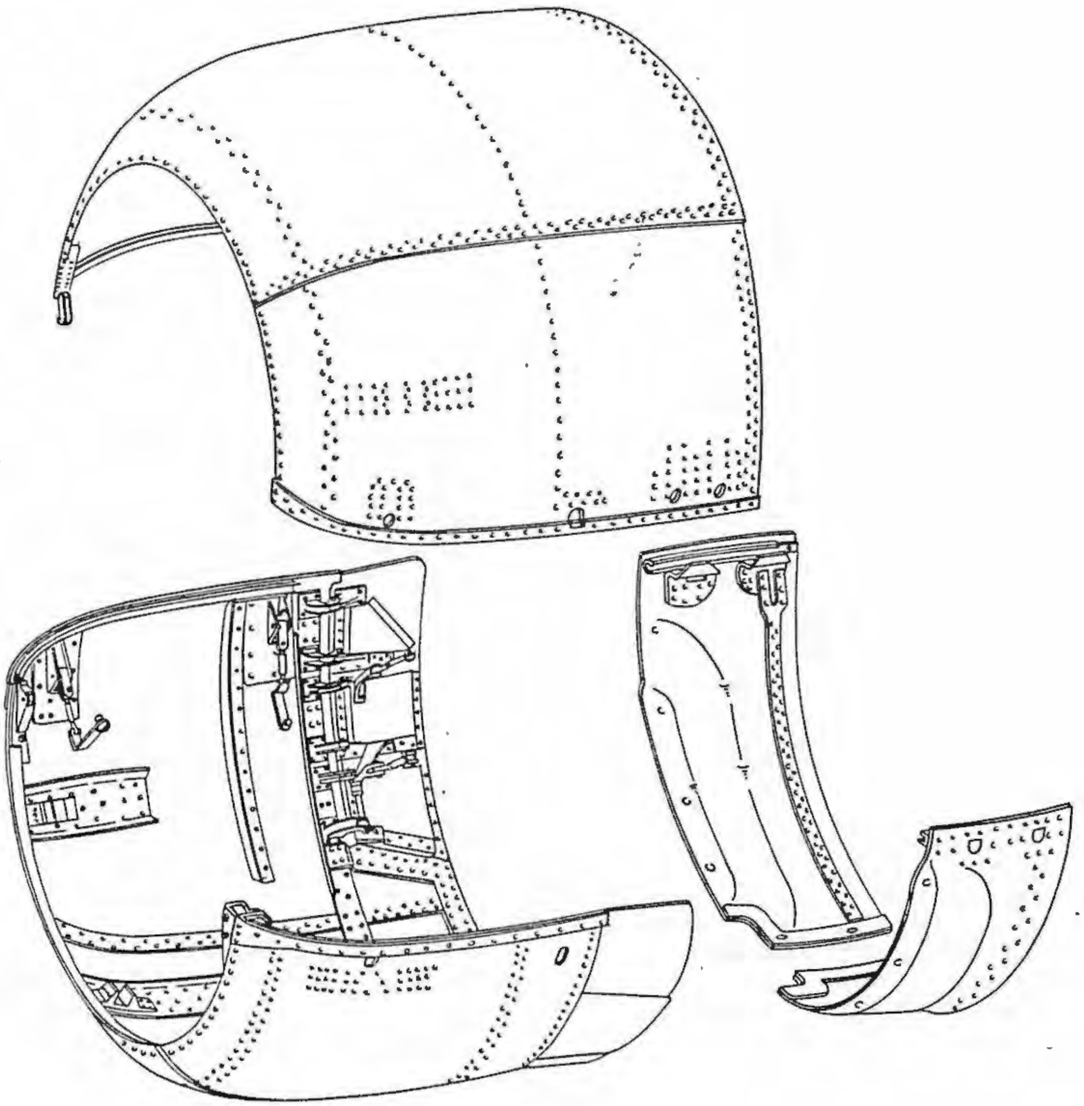


Figure 5-10. Engine Cowl

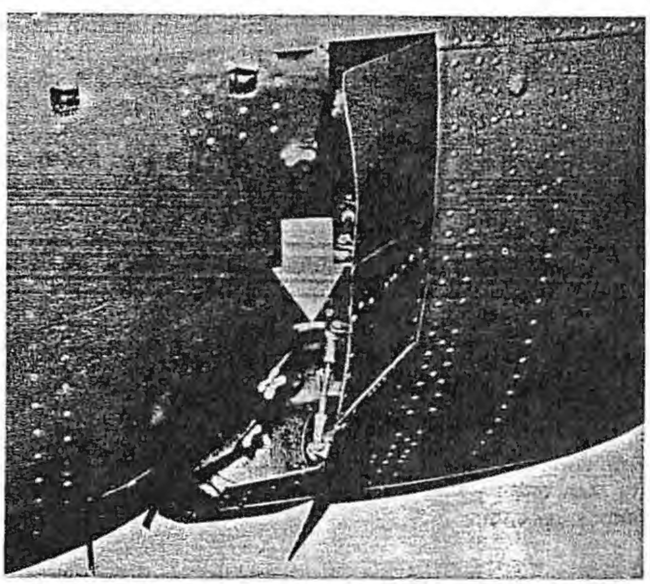


Figure 5-11. Cowl Flap Adjustment

peller, manifold heat, and oil temperature controls are grouped on top of control pedestal and so placed that left and right of each set may be operated individually or together, with one hand, by either pilot or copilot. Manually-adjusted friction brakes hold controls in any desired position.

3-18. Push-pull, self-locking controls for the oil temperature regulator by-pass valves are located side by side in the center of the control pedestal base. They may be reached by either pilot. Operating positions are "HOT" (full out) and "COLD" (full in).

3-19. Controls are of the flexible, push-pull type with mounting clamp to hold the ends rigid. They run from control levers down through the floor, then left and right through the noses of wing stubs to nacelles, where they turn forward through the firewalls and phenolic block assemblies (figure 5-13) to proper connection points. Exceptions are the oil by-pass valve control and oil temperature-regulator

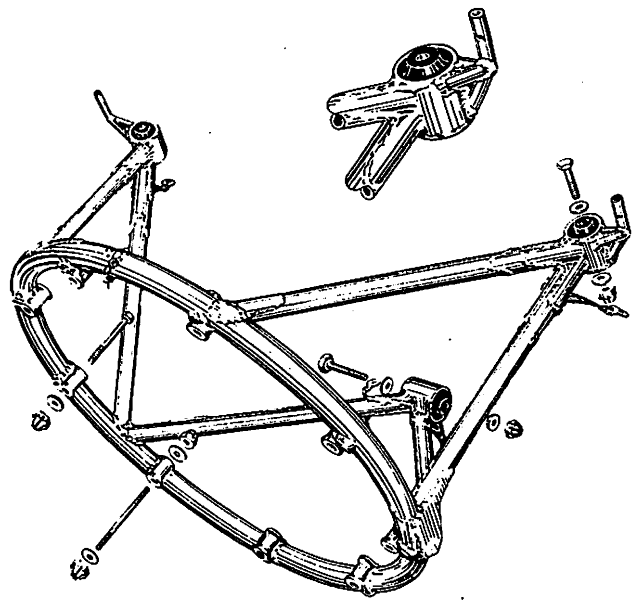
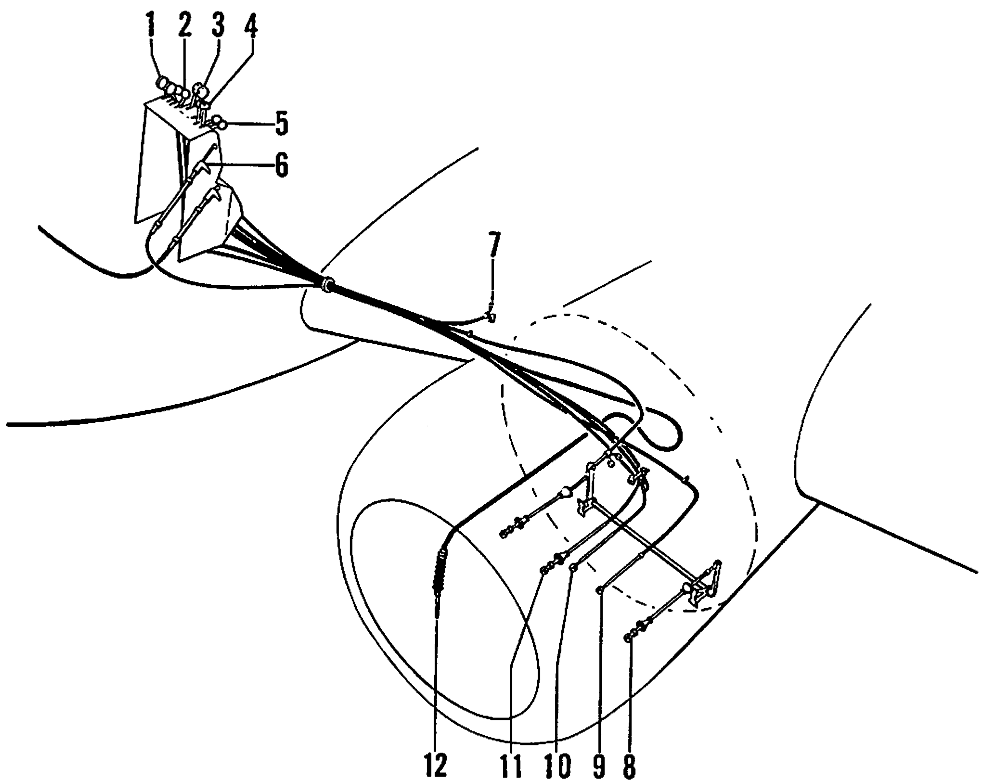


Figure 5-12. Engine Mount Assembly

shutter controls, which are connected aft of firewall and in the wing stub, respectively.

3-20. Two different types of controls are used in the C-45G airplane. The Teleflex-type control is used on the propeller, and American Chain and Cable controls are used on throttle, mixture, carburetor air heat, and oil temperature-regulator controls. The Teleflex-type control, comprised of a closely wound spring for compression and a flexible cable core for tension, operates inside a rigid conduit. This type control, as used on the propeller governor, may be disassembled by loosening jam nut on one end and pulling actuating cable through outer housing from the opposite end. The controls should be lubricated with grease, Specification MIL-L-7711. American Chain and Cable controls cannot be disassembled. If operation is faulty, check for binds caused by sharp bends, dented or broken housing, or overtightened clamping blocks. Controls may be removed by disconnecting at ends and loosening supporting blocks (figure 5-14).

3-21. COLD CYLINDER CHECK. The cold cylinder



1. Mixture Control Levers
2. Oil Shutter Control Levers
3. Throttle Control Levers
4. Propeller Control Levers
5. Manifold Heat Control Levers
6. Cowl Flap Control Levers
7. Oil Shutter Control
8. Cowl Flap Control
9. Mixture Control
10. Throttle Control
11. Manifold Heat Control
12. Propeller Control

Figure 5-13. Propeller and Engine Controls

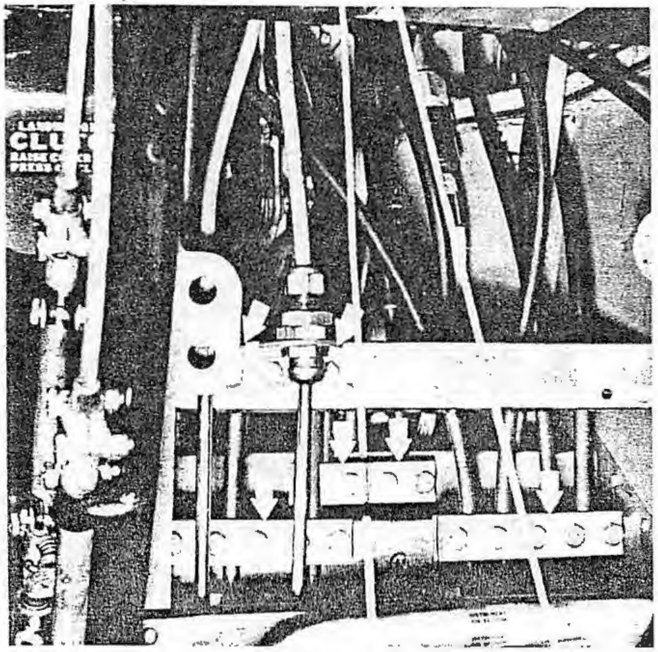


Figure 5-14. Engine Control Phenolic Block

check, as the name implies, is a check to determine the operating characteristics of each cylinder of the engine. Tendency for any cylinder or cylinders to be cold or to be only slightly warm indicates lack of, or incomplete, combustion within the cylinder. This must be corrected if optimum operation and power is to be obtained. Engine difficulties which normally may be detected by use of the cold cylinder indicator (Magic Wand), Stock No. 9AMD-47G11561, are rough engine operation, excessive rpm drop during the ignition system check, and high manifold pressure for a given engine rpm during the ground check for a speed when the propeller is in the full low pitch position. The check will be accomplished when any of the fore-going conditions occur.

a. Head the aircraft into the wind in order to minimize irregular cooling of individual cylinders, and to insure even propeller loading during operation of the engine.

b. Open cowl flaps. Do not close cowl flaps under any circumstances as the resultant excessive heat radiation will affect the readings obtained.

c. Start engine with the ignition switch on the BOTH position, and after engine is running, place ignition switch in position on which excessive rpm drop was obtained. In cases where excessive rpm drop is encountered on both RIGHT and LEFT switch positions, or where excessive manifold pressure is obtained at a given rpm, the engine will be run on either LEFT or RIGHT switch position, since it is necessary to make a test on each ignition switch position.

d. Operate engine at the roughest speed between 1200 and 1600 rpm or at any rpm up to the ignition check speed until a cylinder head temperature reading 150°C to 170°C (302°F to 338°F) is obtained, or until temperatures stabilize at a lower reading. In cases where engine roughness is encountered at more than one speed, or there is an indication that a cylinder ceases to operate at idle speeds, or at higher speeds, it will be desirable to run the engine at each of these speeds and perform a cold cylinder test to pick out all the dead or intermittent operating cylinders. In cases where low power output or engine vibration is encountered at speeds above 1600 rpm, when operating with ignition switch on BOTH, the engine should then run at the speed where the difficulty is encountered with the ignition switch on BOTH until the cylinder head temperatures have stabilized at a lower value.

e. Stop the engine by moving the mixture control to the IDLE CUT-OFF position when cylinder head temperatures have reached the values prescribed in paragraph 3-21, step d. When the engine ceases firing, turn off both individual and master ignition switches.

f. Record cylinder head temperature reading noted on cockpit gage.

g. As soon as propeller has ceased rotation, move maintenance stand to front of engine and connect the clip, attached to the cold cylinder indicator lead, to the engine or propeller to effect a ground of the instrument.

h. Check and record the relative temperature of each cylinder, starting with any cylinder and proceed in numerical order around the engine, by pressing the tip of the indicator pick-up rod against each cylinder. It is essential that a firm contact be made at the same relative location on each cylinder in order to obtain temperature values. This check must be performed in the shortest possible time after the engine ceases rotation.

i. Recheck any outstanding low values, and the two cylinders having the highest readings to determine the amount of cylinder cooling during the check.

j. Compare temperature readings obtained in order to determine which cylinders are dead or operating intermittently.

k. The magneto ground leads will be checked to determine that the RIGHT switch position fires front plugs and the LEFT switch position fires the rear plugs, prior to changing spark plugs, or making ignition harness test on cylinders which are not operating intermittently.

l. Spark plugs will be replaced in accordance with paragraphs 3-170 through 3-175 on cylinders which are dead or operating intermittently. In addition, the ignition leads will be checked as outlined in paragraph 3-164. In cases where the cylinder is completely dead on the "BOTH" position, the difficulty may be due to incorrect valve clearances, leaking intake pipes or lack of compression (blow-by).

m. Repeat the cold cylinder test for other magneto positions on the ignition switch, if necessary. Additional cold cylinder tests will be conducted at different speeds in the event any roughness is still encountered during the ignition system check. Cooling of the engine between tests is not necessary as the air flow created by the propeller and the cooling effect of the incoming fuel-air mixture into the cylinder will be sufficient to cool any cylinders which are functioning on one test and fail to function on the following test. For example, a set of readings obtained from a 9 cylinder engine is listed in figure 5-15. (The cylinder head temperature at the time the engine was shut down was 71°C (160°F) on both tests.)

n. Examination of the temperature readings obtained indicates that cylinders No. 6 and 8 are operating intermittently when operating on the front plugs (fired by the right magneto). In addition, cylinders No. 1 and 5 are dead when operating on the rear plugs (fired by the left magneto). This indicates that cylinder No. 5 is completely dead, which will result in a higher than normal manifold pressure at a given rpm below the propeller governor cut-in speed. However, the ignition system check would not disclose this dead cylinder since the cylinder is dead while on both RIGHT and LEFT positions. A dead cylinder may be caused by both plugs or leads or a combination thereof being inoperative.

CYLINDER NO.	RIGHT MAGNETO	LEFT MAGNETO
1	150	65
2	170	175
3	170	170
4	145	150
5	60	50
6	100	150
7	115	140
8	70	155
9	140	155

Figure 5-15. Reading Obtained on a Cold Cylinder Test

3-22. ENGINE CYLINDER COMPRESSION CHECK. Using Aircraft Engine Cylinder Compression Tester Assembly, Type S-1, Stock No. 7CAD-801818, and check cylinder compression as follows:

a. To obtain consistent readings, perform the compression check as soon as possible after the engine has been shut down in order that all piston rings, etc., will be uniformly lubricated.

NOTE

During engine build-up or on individually replaced cylinders it will not be necessary to operate the engine prior to accomplishing the compression checks. However, in such cases, a small quantity of lubricating oil must be sprayed in the cylinders and the engine turned over a few times to seal the piston rings prior to accomplishing the compression check.

b. Take standard precautions against accidental firing of the engine.

c. Remove the necessary cowling.

d. Remove the most accessible spark plug from each cylinder.

e. Install the spark plug bushing adapter and seal ring in the No. 1 cylinder spark plug bushing. Tighten spark plug bushing adapter sufficiently to insure a seal.

f. Connect compression tester assembly to the compressed air supply. With shut-off valve closed, adjust the main line pressure from the compressor to 80 psi on the regulated pressure gage.

g. Open shut-off valve and attach the air hose quick-connect fitting to the spark plug bushing adapter. This will establish a pressure of 15 to 20 psi in the cylinder when both intake and exhaust valves are closed, provided the cylinder will hold 15 to 20 psi air pressure.

h. Turn the crankshaft in the direction of rotation by hand until the piston in No. 1 cylinder is coming up on compression stroke against the 15 to 20 psi air pressure and continue turning slowly until piston reaches top center. Reaching top center is indicated by a flat spot or sudden decrease in force required to turn the crankshaft. If the crankshaft is rotated too far, back up at least one-half revolution and start over again to eliminate the effect of backlash in the valve operating mechanism and to keep piston rings seated on the lower ring lands.

i. Close shut-off valve. Check the regulated pressure and adjust, if necessary, to 80 psi.

CAUTION

Care must be exercised in closing the shut-off valve, because if the piston is not on top center there will be sufficient air pressure build-up in the cylinder to rotate the crankshaft approximately one-half turn.

j. With regulated pressure adjusted to 80 psi, if the cylinder pressure reading as indicated on the cylinder pressure gage is below the minimum requirement of 35 psi, proceed with the next cylinder. When all cylinders have been checked and readings recorded, return to the cylinder or cylinders having low compression readings. See special instructions in paragraph 3-27 for action to be taken. If the cylinder pressure readings do not meet the minimum requirement of 35 psi after accomplishing the action specified under special instructions, the cylinder will be replaced.

k. Repeat the procedure outlined for No. 1 cylinder on each cylinder of the engine.

3-23. OPERATION OF MK-1 COMPRESSION TESTER. When using the Type MK-1 compression tester the following safety precautions will be adhered to prior to performing the compression check.

a. The magneto switch will be in the "OFF" position or the magneto primary leads grounded.

b. The mixture control will be in the "IDLE CUT-

TEST EQUIPMENT REQUIRED

NAME	AN. TYPE DESIGNATION	USE AND APPLICATION
Aircraft Engine Cylinder Compression Tester Assembly, Type S-1 or MK-1	Stock Number 7CAD-801818 4910-287492	Obtain engine cylinder compression pressure readings.
Compression Tester Connector and Seal Ring Assembly		To connect compression tester to cylinder.

OFF" position and the engine fuel selector valve in the "OFF" position.

c. Personnel will be stationed to clear the propeller of personnel and work stands prior to and during propeller rotation.

d. The starter circuit breaker will be pulled when the propeller stops turning.

3-24. ENGINE PREPARATION FOR TESTING.

a. The compression check will be performed as soon as possible after engine shut-down to provide even and consistent readings.

b. Remove one spark plug from each cylinder to be checked.

c. Rotate the engine crankshaft a minimum of sixteen revolutions with the starter to expel any excess oil or loose carbon in the cylinder.

d. Install a compression tester in the spark plug opening of each cylinder. To install the tester, loosen the small sleeve 3 to 4 turns until hose assembly is free. Screw the large threaded body section into the spark plug opening until rubber gasket is firmly seated. Form flexible hose assembly until gage face is visible to the operator. As a final operation, tighten the small knurled sleeve to seal hose section inside of body section.

e. When testers have been installed in all cylinders, turn the engine crankshaft 16 revolutions with the starter.

f. Record the compression reading of each cylinder.

3-25. INTERPRETING RESULTS.

a. To evaluate and determine which cylinders have below minimum compression, the compression of all cylinders having readings above 20 psi will be totaled. All cylinders with a compression reading below 20 psi will be disregarded and automatically classed as a suspect.

b. Divide the total obtained by the number of cylinders with reading above 20 psi. This will establish the average cylinder compression pressures.

c. All individual cylinders with a reading 20 percent or more below the average cylinder compression will be checked in accordance with paragraph 3-27. If the compression remains 20 percent or more below the established average, it will be replaced.

NOTE

If a tester is suspected of being defective, replace with a tester that is indicating a normal reading and recheck the compression.

3-26. COMPRESSION CHECK FOR INDIVIDUAL CYLINDERS.

a. When it is necessary to perform a compression check on one or more cylinders, the compression of all cylinders will be checked, the compression readings totaled and the minimum compression established in the same manner as outlined in paragraph 3-25.

3-27. SPECIAL INSTRUCTIONS. The following procedures will be performed on engines having cylinders with compression values below 35 psi, and the compression rechecked prior to replacing the cylinders. The procedures are listed in the normal sequence that would be used; however, any sequence may be used, except the valves will not be checked for negative clearance or adjusted immediately after the engine has been operated.

a. Remove rocker box covers on the cylinders with low compression. Turn the crankshaft until piston is on top dead center of the compression stroke. Check the intake and exhaust valves for negative clearance. If the valves are being held open due to negative clearance, the trouble will be corrected by making necessary repairs or adjusting the valves in accordance with paragraph 3-37.

b. With the rocker box covers removed, rotate the crankshaft until each valve is closed and the piston is at least 2 inches from the top center position. Place a fiber drift on the rocker arm directly over the valve stem and tap the drift with a 1- or 2-pound hammer. Rotate the crankshaft by hand or starter a minimum of eight crankshaft revolutions to seat the valve in a normal manner.

c. Squirt a small quantity of oil in top cylinder spark plug holes. Rotate the crankshaft a minimum of eight revolutions by hand or starter.

d. Start the engine and operate at static rpm for a minimum period of three minutes. Shut down the engine and recheck the compression as soon as possible.

3-28. ESTABLISHING CRANKSHAFT POSITION.

a. Remove the front spark plug from No. 1 cylinder.

b. Referring to the handbook contained in the Time-Rite indicator box with each unit, install the correct contact arm and calibrated scale for the R-985 engine.

c. Turn crankshaft in normal direction of rotation until the No. 1 piston is coming up on the compression or exhaust stroke, whichever is required.

d. Screw housing of Time-Rite indicator, Stock No. 7CAD-438860, into spark plug hole, holding the face of the instrument stationary, so that the contact arm will not rotate as the housing is screwed into the spark plug hole.

e. Push slide pointer upward in the slot until it reaches the end of the slot or indicator arm.

f. Turn crankshaft in normal direction of rotation until indicating arm has moved slide pointer the maximum distance and indication arm starts to move back upward in the slot.

g. Move calibrated scale so that zero mark on scale aligns with the scribe mark on the slide pointer.

h. Move slide pointer back to top of slot, or until it contacts indicating arm.

i. Turn crankshaft opposite direction of rotation until indicating arm has returned to top of slot.

j. Recheck zero mark of calibrated scale against referenced mark on slide pointer.

k. Again move slide pointer to the top of the slot, or until it contacts indicating arm.

l. Turn crankshaft in normal direction of rotation. Movement of the slide pointer, by indicating arm, will indicate crankshaft position in relation to true top dead center on calibrated scale.

NOTE

The zero mark on the Time-Rite indicator is not top dead center crankshaft position, but may be used to locate top dead center piston position.

3-29. REMOVAL OF CYLINDER ASSEMBLY. Observe the following instructions before removing cylinders: Remove the master rod cylinder, No. 5, LAST if it is in a group of two or more cylinders to be removed. Upon removal of the master rod cylinder, the piston-pin end of the master rod should be centered in the crankcase opening by using PWA-2826 Holder. The holder allows rotation of the crankshaft without risk of damage to the cylinders and the crankcase section, should rotation of the crankshaft, after removal of the master rod cylinder, become necessary.

CAUTION

Do not allow the master rod to move sideways at any time, as damage to the piston rings and cylinder may result.

a. Turn the crankshaft until the piston of the cylinder to be removed is at the top of its compression stroke.
b. Remove the palnuts, then remove the cylinder flange nuts, using PWA-2006 or PWA-2399 Wrench and PWA-2398 or PWA-2411 Handle, leaving one nut on until just prior to the removal of the cylinder.

CAUTION

If a nut is found to be loose or there has been failure of a stud, replace that stud and the two adjacent studs. Proper fit of cylinder flange studs is indicated by a driving torque of 165 to 425 inch-pounds. If only two adjacent studs have failed or two adjacent nuts have been found loose, the cylinder may be reused provided the nuts adjacent to the failed studs or adjacent to the loose nuts are found to be at least to the minimum torque, 300 inch-pounds. If more than two adjacent studs have failed or if more than two adjacent nuts are known to have been loose during engine operation, the cylinder should be returned to overhaul and all the studs on the cylinder mounting pad replaced.

c. Remove the cylinder being careful that the piston pin does not fall out.
d. Remove the piston pin; if necessary use PWA-4911 Pusher and lift off the piston.
e. Place the cylinder in an appropriate carrier to prevent damage to the fins and the bottom edge of the barrel.
f. Secure the rod with PWA-2826 Holder as soon as the cylinder is removed. Cover all openings in the crankcase and the supercharger case to prevent the entrance of foreign matter.

3-30. CYLINDER REPAIR AND REPLACEMENT. Repairs other than straightening cooling fins, removing minor nicks and scratches will not be performed by personnel on the organizational flight line level. Repairable cylinders will be returned to an overhaul depot. If spare cylinders are not available, serviceable cylinders may be removed from repairable engine having the least operating time. Repairable cylinders will be installed on all repairable engines from which cylinders have been removed prior to shipment of the engine to depot.

TOTAL NO. OF CYLINDERS ON ENGINE	UP TO 1/2 ENGINE TIME	FROM 1/2 TO 3/4 ENGINE TIME	FROM 3/4 ENGINE LIFE UP TO MAXIMUM TIME
9	9	5	2

Figure 5-16. Cylinder Replacement

3-31. INSTALLATION OF CYLINDER ASSEMBLY:
a. If the master rod cylinder (No. 5) has been removed, it must be installed first. Coat the cylinder walls, piston pin, piston, and piston rings with oil.
b. Install the oil seal ring under the flange of the cylinder.
c. Rotate the crankshaft until the master rod or link rod of the cylinder is at the full outward position. Each piston, piston pin, and cylinder has a number denoting its proper position.
d. Install the piston and pin with their numbered sides toward the front of the engine. Stagger the ring gaps and apply a generous coating of oil to the rings; then compress the outer rings, using PWA-249 Clamp, and slide the cylinder over the rings.
e. Compress the scraper ring with the clamp; then slide the cylinder over the ring and into place against the mounting pad.
f. Center the cylinder with two locating nuts and install washers and nuts on the other studs.

CAUTION

Do not allow the master rod to move sideways at any time, as damage to the piston rings and cylinder may result.

g. Tighten the cylinder flange nuts between 300 and 350 inch-pounds. Any cylinder flange locknut, which becomes loose or is backed off for any reason after wrench pressure is applied must be removed and discarded.

CAUTION

Because of the necessarily special design of cylinder flange nut wrenches, particular care should be exercised in tightening nuts. See that the cylinder flange nut wrench, the extension and the torque indicating handle are so assembled that the handle is directly opposite the box end of the wrench, and apply torque by rotating assembly as a unit. Do not let the shaft of the wrench twist to one side.

3-32. INSPECTION OF THE VALVE SYSTEM. At time of valve adjustment, the valve operating mechanism (such as rocker arms, rocker arm bearing, and valve springs) will be checked for evidence of cracks, breaks, chipping and, on rocker arm bearing, indications of excessive clearance. In addition, the rocker arm will be checked for excessive dryness. In event the rocker box on the engine is excessively dry, it will be corrected as outlined in paragraph 3-36.

3-33. To determine whether an intake or exhaust valve inner spring is functioning properly, turn the crankshaft in normal direction of rotation until the valve spring assembly is compressed to full extent of rocker arm travel. If the inner valve spring is properly seated in its upper and lower washer recesses, the valve spring assembly may be even further compressed at least 1/8-inch to the solid height of the inner valve spring, using a depressor, Stock No. 9APW-PWA455.

CAUTION

Do not compress valve springs with the depressor, until they have been compressed as far as possible by normal cam action, as this might cause one of the push rod ball ends to drop out of its socket in a tappet or rocker arm.

However, if the inner valve spring is being compressed to its solid height by normal cam action so that it cannot be further compressed with the depressor, the spring is improperly seated on its washer. In some instances, an inner valve spring fouled in this manner may be properly seated by applying one end of a drift to the top washer in two or three evenly distributed places and tapping the other end of the drift with a mallet. If this attempt to seat the inner valve spring properly is unsuccessful, the valve spring assembly must be removed and properly reassembled. To remove the valve spring assembly, the push rod must first be removed. When removing and reassembling the valve spring assembly, hold the valve in place using a curved piece of stock wood or fiber inserted through the spark plug hole. (Place piston on top center.)

NOTE

Not more than six threads (1/4-inch) nor less than three threads (1/8-inch) of a valve adjusting screw should show above the locknut; and there should be a clearance of not less than 0.031 inch between the valve spring washer and the rocker arm with the valve closed. If clearance between the valve spring washer and the rocker arm is less than 0.031 inch, or if more than six threads on the adjusting screw show above the locknut, one or both of the push rod ball end spacers can be replaced with a thinner one. If less than three threads of the adjusting screw show above the locknut, a spacer must be used at one or both ends of the push rod. When replacing the ball end, extreme care must be taken to insure that the ball end is not cocked.

3-34. To eliminate oil leakage at the rocker box parting surface, all rocker box covers will be checked for flatness by using a surface plate or piece of plate glass and a 0.0015 inch feeler gage. Cast rocker box covers which are warped will be resurfaced by lapping the rocker box cover on fine emery paper (wet or dry), No. 280, placed on a surface plate or piece of plate glass until all indications of warpage are removed. Rocker box covers which are stampings, if warped, will be replaced. Rocker box cover warpage is caused by improper tightening of the rocker box cover nuts. Hence, warping can be prevented by torquing the rocker box cover nuts or screws to the proper torque values.

3-35. To eliminate excessive maintenance time and assure proper sealing of rocker box covers, the engine with cowling removed will be started and run for approximately five minutes at a speed not to exceed 1500 rpm, after which all rocker box covers will be checked for leaks. In cases where corrective action has been taken on a given cylinder for excessive dryness of the rocker box, the applicable rocker box cover will be removed after the engine run and a check made to establish that lubrication is reaching the valve mechanism.

3-36. CORRECTIVE ACTION FOR VALVE SYSTEM DISCREPANCIES.

a. Dry rocker boxes revealed during valve system inspection will require removal of the push rod housing and push rod, to determine the channel which is clogged or partially clogged. After a plugged condition of the valve mechanism has been detected and corrected, it will be further checked after the initial engine run following the valve inspection period, to determine that the corrective action taken has eliminated the trouble. This will be done by removing the rocker box cover and checking for presence of lubrication.

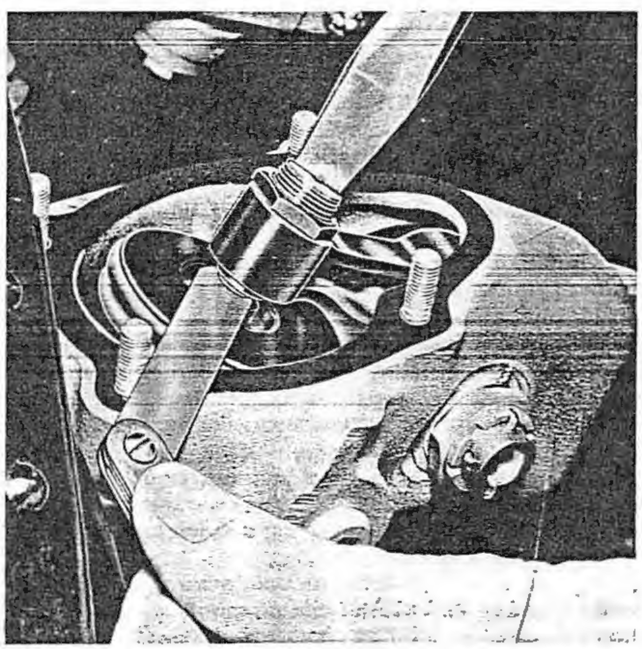


Figure 5-17. Valve Adjustment

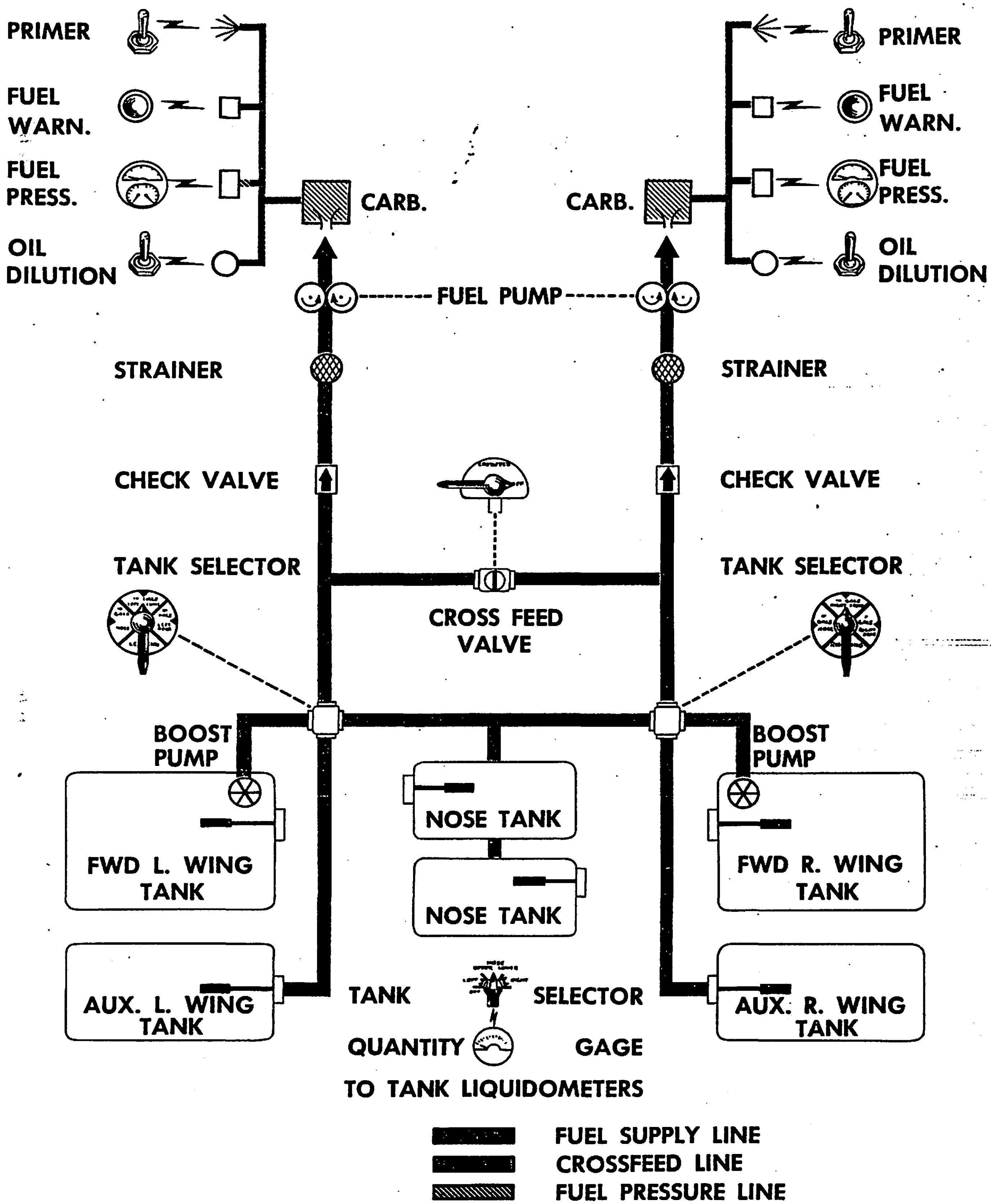


Figure 5-18. Fuel System Schematic

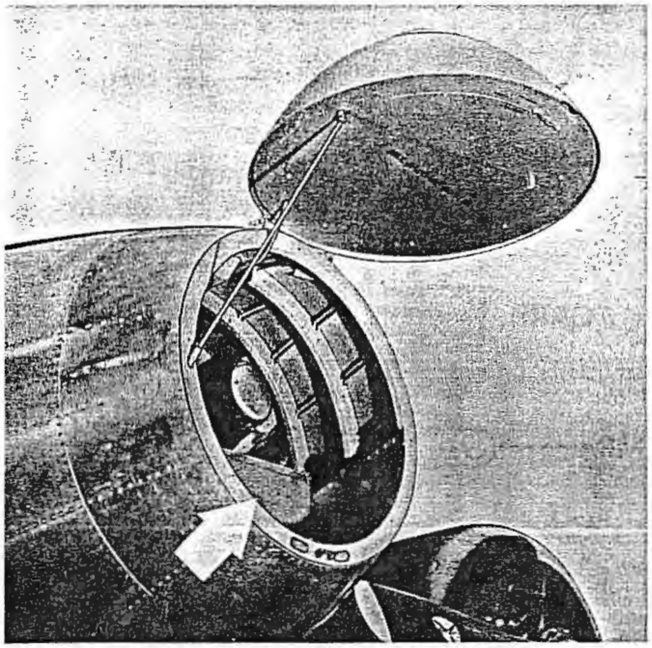


Figure 5-19. Nose Fuel Tank

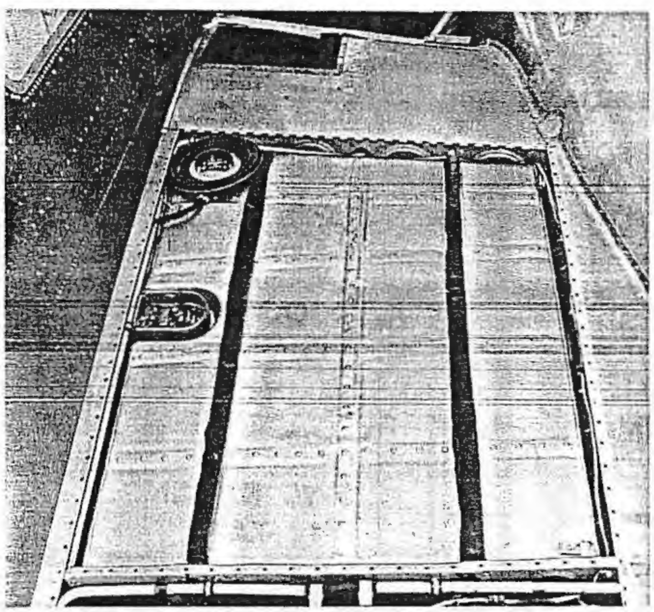


Figure 5-20. Main Fuel Tank

b. Broken or weak valve springs, cracked valve keepers, worn rocker arms, etc., will be replaced as specified in the applicable handbook for the engine.

c. Valve clearances found to be out of adjustment, either statically or dynamically, will be adjusted in accordance with paragraph 3-37.

3-37. ADJUSTING ENGINE VALVES.

NOTE

Set all valve clearances with the engine cold. INTAKE 0.010 ± 0.003, EXHAUST 0.010 ± 0.003.

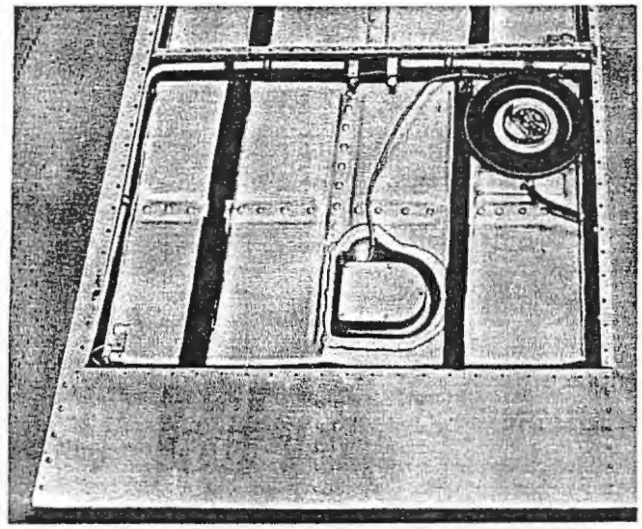


Figure 5-21. Auxiliary Fuel Tank

a. Remove ring cowling.

b. Remove all rocker box covers and forward spark plugs.

c. Place thumb over number one cylinder spark plug opening and rotate propeller to determine when piston has started the compression stroke.

d. Locate No. 1 piston at top center on the compression stroke (both valves closed) as specified in paragraph 3-28.

e. Loosen valve adjusting screw locknut and insert a 0.010 feeler gage between the valve stem and the adjusting screw insert. See figure 5-17.

f. Set adjusting screw until a slight drag is felt on the feeler gage, when it is moved between the adjusting screw insert and the valve stem.

NOTE

Valve clearance is adjusted by turning adjusting screw counterclockwise to obtain more clearance and clockwise to decrease clearance.

g. Hold adjusting screw securely to prevent adjustment being altered and tighten locknut to a torque of 300 to 350 inch-pounds. Check clearance, readjust if necessary.

h. Proceed by adjusting the other valve in number one cylinder, and remaining valves in the order of cylinder firing (1-3-5-7-9-2-4-6-8).

i. Be certain that each succeeding piston is at the exact top dead center position before making adjustment.

j. After all valve clearances have been adjusted, rotate engine several revolutions and recheck valve clearances to see that clearance has remained constant.

k. Any clearance that is not within specified limits will be readjusted and rechecked.

l. Install new gaskets on all rocker boxes.

m. Install rocker box covers and torque nuts from 60 to 75 inch-pounds.

n. Replace spark plugs and torque 300 to 360 inch-pounds.

o. Install ring cowling.

3-38. FUEL SYSTEM.

3-39. DESCRIPTION. Fuel is supplied to the engines from six supply tanks. Two main tanks, each of 78 US-gallon capacity are located in the center-section wing, one on each side of the fuselage aft of the center-section truss (see figure 5-20). Two auxiliary tanks, each of 25 US-gallon capacity, are also located in the center-section wing immediately aft of each main tank (see figure 5-21). In the nose compartment there is a 47 US-gallon tank, consisting of one 20 and one 27-gallon tank, mounted forward of Bulkhead 3 in lower part of the compartment. See figure 5-19.

3-40. FUEL TANKS. The fuel tanks are welded and riveted structures constructed of 52S-1/2H aluminum sheet with internal baffles. A fuel expansion tank is installed on the left side above the nose tank (figure 5-19).

3-41. REMOVAL OF MAIN AND AUXILIARY TANK.

WARNING

Before removing any part of the fuel system, make sure that all master battery and ignition switches are in "OFF" position. The airplane should be completely grounded.

a. Drain fuel from tanks.
b. Gaining access through battery well, disconnect fuel line from tank. Remove fitting in tank to prevent damaging bulkhead when tank is removed. Auxiliary tank fuel line connection is accessible through door in center section skin below tank.
c. Remove all screws in the tank cover.
d. Remove screws holding filler-neck scupper to tank-well cover.
e. Working from inside the nacelle, remove the hinge wire from the hinge on the front edge of the main tank cover. See figure 5-22.
f. Remove vent lines and fittings from the tanks.
g. Disconnect the bonding cable and the liquidometer wiring.
h. Remove the fuel booster pump wiring and fuel line before removing fuel tank. See paragraph 3-49.
i. Disconnect the tank retaining straps at the turnbuckles and lift the tank from the tank well.

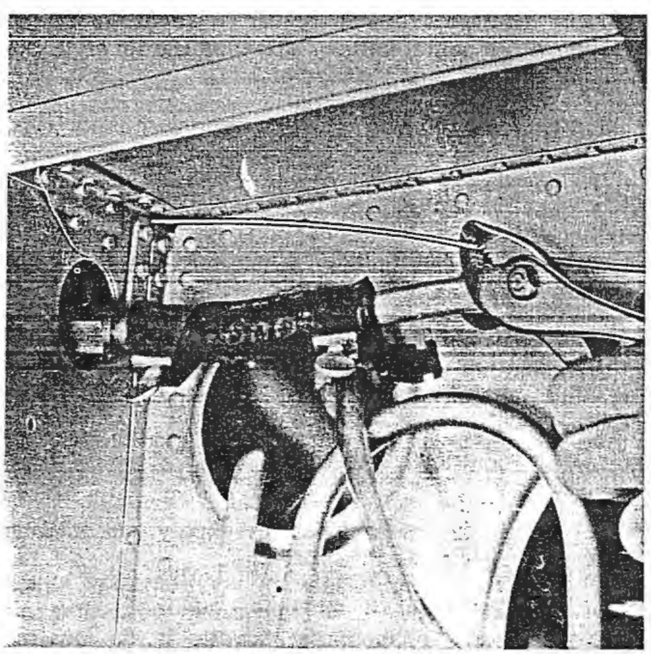


Figure 5-22. Main Fuel Tank Hinge Wire Removal

3-42. INSTALLATION OF MAIN AND AUXILIARY TANKS.
a. Inspect the wooden spacers and felt pads to be sure that they are in good condition and will protect the fuel tank from metal-to-metal contact.
b. Clean the tank well thoroughly.
c. Lower the tank into well carefully to avoid damage to the wooden spacers and felt pads.
d. Tighten the tank retaining straps securely, making sure the tank is properly seated and the protective felt strips are in place.
e. Connect the fuel booster pump wiring and fuel tank vent line, and fuel line to tank.
f. Connect the bonding cable to tank.
g. Connect the liquidometer wiring to the liquidometer unit in the fuel tank.

NOTE

The liquidometer unit must be checked for correct calibration. See paragraphs 3-65 through 3-67.

h. Install the fuel tank cover.
i. Dip screw threads in rubber cement (B.F. Goodrich Plasticon No. 169 Rubber Cement) before installing. Turn screws down tight. Back off screws next to fuselage one-quarter turn.

3-43. REMOVAL OF NOSE TANK.
a. Drain tank.
b. Remove covers over fuel tank.
c. Disconnect bonding cables. Loosen hose clamps on the filler neck.
d. Remove liquidometer covers. Cover on top tank is located on top of tank aft of the filler neck. On the lower tank, it is located in front.
e. Disconnect liquidometer wiring.
f. Disconnect vent lines.
g. Working through belly access door, disconnect fuel line from tank.
h. Remove hinged tank straps.
i. Remove panels above tank on Bulkhead 3.
j. Disconnect feed line between tanks located on the aft side of the tanks just forward from the pilot's rudder pedals.
k. Lift out upper half of the tank first, then remove lower half.

3-44. INSTALLATION OF NOSE FUEL TANK.
a. Make sure felt pads are in good condition and will protect the fuel tank from metal-to-metal contact.
b. Clean tank well thoroughly.
c. Place tank in position in nose compartment.

CAUTION

Use care to avoid damaging tanks or fittings. Be sure to install felt pad between tanks.

d. Connect feed lines between tanks located on the aft side of the tank.
e. Replace panels on the bulkhead above tank.
f. Install the hinged tank straps, tighten and safety. Make sure felt protective strips between straps and tank are in good condition.
g. Connect the vent lines.
h. Connect the liquidometer wiring.

NOTE

Liquidometer must be checked for calibration. See paragraphs 3-65 through 3-67.

i. Install all the liquidometer covers and safety.
j. Attach the filler neck hose and tighten the clamps.
k. Connect bonding cables to the tank.
l. Working through the belly access door, connect fuel line to tank.
m. Install drain plug.
n. Check the tanks for leaks at hose connections.
o. After tank has been checked, install tank covers.

3-45. MINOR REPAIR AND PARTS REPLACEMENT. Repairs shall be limited to the replacement of worn or damaged parts. Defective parts should be forwarded to a designated overhaul activity.

3-46. ADJUSTMENTS. The only adjustments on the fuel tank are the turnbuckles on the tank retaining straps and the liquidometer unit adjustment. See paragraphs 3-65 through 3-67.

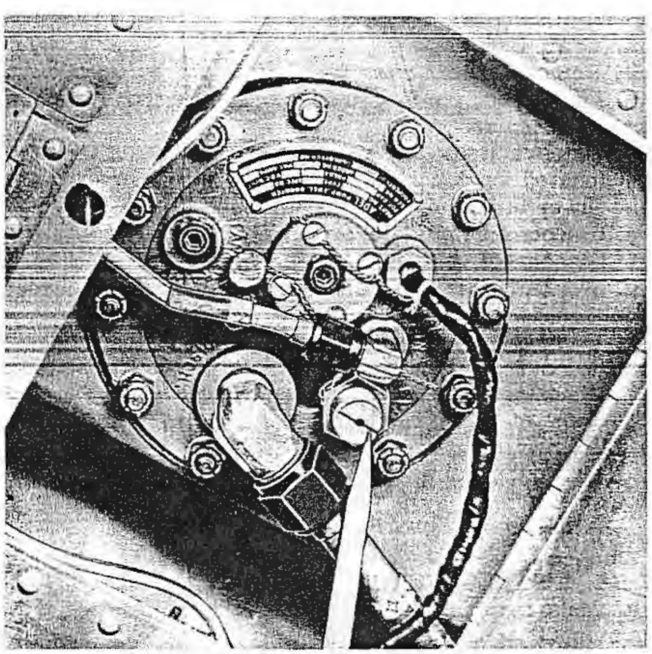


Figure 5-23. Fuel Booster Pump Adjustment

3-47. FUEL BOOSTER PUMP.

3-48. DESCRIPTION. Each main fuel tank is equipped with an Adel electric 24-volt d-c submerged booster pump. If a main fuel pump becomes inoperative, the respective fuel booster for that engine may be used to maintain fuel pressure.

3-49. REMOVAL OF FUEL BOOSTER PUMP.
a. Drain tank.
b. Disconnect fuel line connection.
c. Disconnect electrical connections.
d. Remove mounting nuts and remove pump.

3-50. MINOR REPAIR AND PARTS REPLACEMENT. Replacement is limited to the flange gasket. Send inoperative units to a designated overhaul activity.

3-51. INSTALLATION OF FUEL BOOSTER PUMP.
a. Install new gasket on pump flange.
b. Place pump on studs, install nuts and tighten. The fuel booster will fit the studs in only one position. Do not try to force the flange on the studs.
c. Install fuel line.
d. Install electrical connections. If the leads supplied with a new pump are too long, do not cut them off, but coil excess length and secure with tape.

3-52. ADJUSTMENTS. Fuel booster pumps should be adjusted at time of installation to 6 psi discharge pressure as indicated on fuel pressure gage with engine inoperative. Turn adjusting screw counterclockwise to decrease pressure or clockwise to increase pressure (figure 5-23).

3-53. LIQUIDOMETER TRANSMITTER.

3-54. DESCRIPTION. The transmitter consists of a housing mounted to the fuel tank to which is attached a float pivoting on an arm. Contained in the housing is a rheostat with provisions for adjustment and a movable contact arm connecting by leverage to the float arm. A metal bellows attaches the lever to the housing and prevents leakage of fuel.

3-55. REMOVAL OF LIQUIDOMETER TRANSMITTER.
a. Remove inspection plate.
b. Remove cover plate from tank unit and disconnect wiring.
c. Remove screws holding unit to tank and carefully lift unit from tank.

3-56. MINOR REPAIR AND PARTS REPLACEMENT. If liquidometer transmitter is defective, it should be replaced.

3-57. INSTALLATION OF LIQUIDOMETER TRANSMITTER.
a. Install gasket on tank flange. Apply tank sealing compound, Specification USAF 3596.
b. Place transmitter assembly in position, check clearance and freedom of movement of float arm.
c. Dip threads of mounting screws in the sealing compound, Specification USAF 3596, and install transmitter on tank. Tighten screws securely and safety.

d. Adjust calibration of transmitter (paragraphs 3-65 through 3-67).

e. Install liquidometer cover plate and wing inspection plate.

CAUTION

Make sure there are no metal particles of any kind in the liquidometer tank unit before installing cover. Such particles may cause a short circuit, resulting in false gage readings.

3-58. ADJUSTMENTS. Adjustments may be made with the airplane in a three-point position. Two men are required to make the fuel level indicator adjustments, one stationed in the pilot's compartment to check the gage readings and one at the tank unit to adjust the rheostat (see figure 5-24). Gage readings must be made from directly in front of the instrument to insure accurate calibration. In original liquidometer units, no stops were used, however, in liquidometer units being currently installed, stops (external) limit the float arm travel and protect the rheostat mechanism from possible damage caused by mishandling. The stops are adjusted to limit the float arm travel at 33 degrees down and 14 degrees up. Stops cannot be adjusted after installation of the unit. In the event it is necessary to install a new liquidometer unit, check the float arm travel prior to installation and adjust as necessary.

3-59. FUEL LEVEL GAGE.

3-60. DESCRIPTION. The fuel gage (figure 5-25) is an electrically-operated instrument which is connected to each fuel tank through a selector switch. It is located on the pilot's left subpanel.

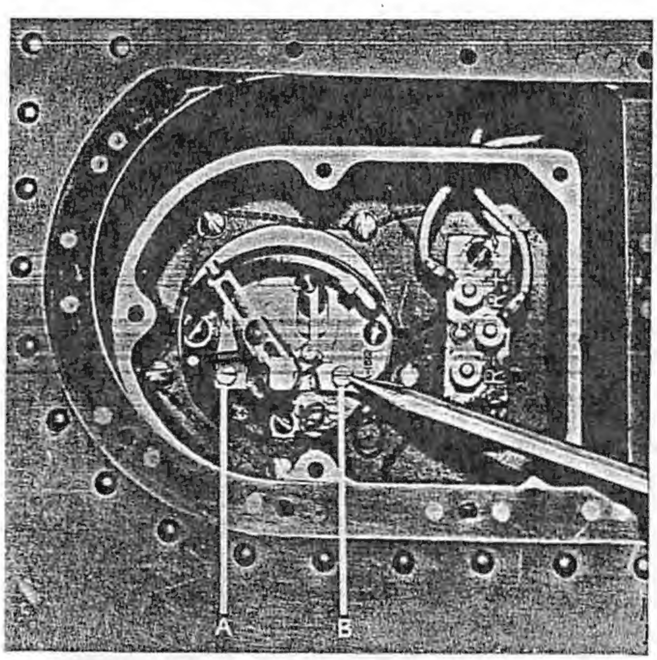


Figure 5-24. Liquidometer Adjustment

3-61. REMOVAL OF FUEL LEVEL GAGE.

a. Disconnect electrical wiring on the rear side of the instrument.

b. Remove four mounting screws.

3-62. MINOR REPAIR AND PARTS REPLACEMENT. Only repairs that do not require disassembly of the unit should be attempted. If unit is defective, replacement is necessary, and the defective unit must be sent to a designated overhaul activity for repair.

3-63. INSTALLATION OF FUEL LEVEL GAGE.

a. Place instrument in place in the panel and install mounting screws.

b. Attach electrical wiring on rear side of instrument.

c. Check calibration of instrument.

3-64. ADJUSTMENTS. Adjustments may be made with the airplane in a three-point position. Two men are required to make the fuel-level indicator adjustments: one stationed in the pilot's compartment to check the gage readings, and one at the tank transmitter to adjust the rheostat. Gage readings must be made from directly in front of the instrument to insure accurate calibration.

3-65. CALIBRATION OF TANK UNITS - "EMPTY" POSITION.

a. Turn selector switch to the desired tank.

b. Drain tank and let transmitter float rest on the bottom of the tank.

c. Remove wing inspection plate and liquidometer unit cover plate.

d. Turn empty adjustment, Screw A, on the fuel-level transmitter until the indicator in the cockpit reads "0." Refer to figure 5-24.

3-66. CALIBRATION OF THE MAIN AND NOSE TANK UNITS - "FULL" POSITION.

a. Raise the transmitter float until it rests lightly against the top of the tank.

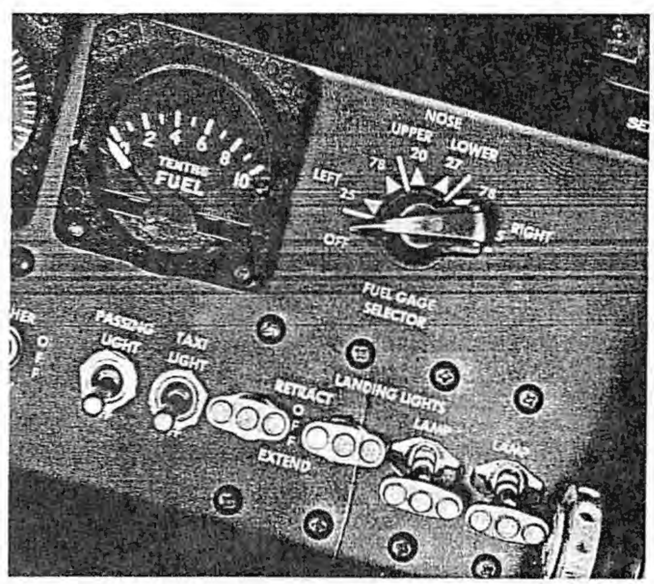


Figure 5-25. Fuel Gage and Tank Selector

b. Turn the full adjustment, Screw B, until the fuel gage pointer on the instrument panel rests above the "10" mark by a distance equal to the width of the mark. The pointer is not set directly on the "10" mark because of the difference encountered in raising the float by hand and the natural rise of the float in the tank.

3-67. CALIBRATION OF THE AUXILIARY TANK UNITS - "FULL" POSITION.
a. Raise the float until its center line is 1-1/2 inches from the top of the tank.
b. Turn the full adjustment, Screw B, until the gage pointer rests on the "10" mark.

CAUTION

Test the adjustments by placing the floats at the top and bottom positions for two or three times and checking with the gage reading by bending either the sliding contact arm or the arm of the float.

NOTE

In the event the correct reading cannot be made by changing the adjusting screws, the sliding contact arm can be rotated.

3-68. SELECTOR SWITCH.

3-69. DESCRIPTION. The selector switch is a six-position rotary switch mounted on the pilot's left subpanel. The switch barrel extends through the panel and is secured to the panel by a locknut. The switch pointer rotates over a placard which is marked to show the tank positions and their capacities.

3-70. REMOVAL OF SELECTOR SWITCH.
a. Disconnect wiring leads on the back of the switch.
b. Loosen setscrew securing handle to switch shaft and slip handle from shaft.
c. Remove locknut holding switch to left subpanel and pull switch clear.

3-71. MINOR REPAIR AND PARTS REPLACEMENT. Only repairs that do not require disassembly of the switch should be attempted. Repairs should be limited to replacement of broken leads, repair of loose connections, or replacement of the defective switch.

3-72. INSTALLATION OF SELECTOR SWITCH.
a. Connect wiring leads to the rear side of the switch.
b. Install switch in left subpanel and tighten locknut securely.
c. Install switch handle and tighten setscrew.

CAUTION

Make sure that handle pointer and position of switch agree.

3-73. FUEL LINES.

3-74. DESCRIPTION. Fuel lines are seamless aluminum tubing. The lines are preformed and are supported in phenolite blocks, clamps, and bulkhead fittings to protect the lines from vibration and chafing.

3-75. REMOVAL OF FUEL LINES. All fuel lines and fittings must be capped. To remove lines, remove the support clamps and disconnect lines at the fittings.

3-76. MINOR REPAIR AND PARTS REPLACEMENT. All fuel lines should be inspected for evidence of damage, especially at the points of contact with piping supports and clamps. If damaged, they must be replaced.

3-77. INSTALLATION OF FUEL LINES.
a. Remove the caps from the lines and fittings. Check for cracks and foreign material in the tubing and lines.
b. Install lines, check for proper positioning in phenolite support blocks, and tighten connections.
c. Check fuel systems for leaks as follows: (1) Plug fuel line connections at the firewall and the fuel-tank vent lines; (2) Using a special plug containing an air valve and an air pressure gage, plug the tank-filler neck openings; (3) Apply approximately 3-1/2 pounds of air pressure to each tank. A leak in the systems will be indicated by a drop in pressure on one or both of the gages attached to the tanks; (4) By use of a soap suds solution, leaks may be located. To protect the lines from vibration and chafing, effective with Serial 51-11605 and subsequent, the fuel lines in the right hand outboard wing and nacelle are slightly relocated to afford greater clearance from the landing gear cross shaft.

3-78. FUEL PUMP.

3-79. DESCRIPTION. Each engine is equipped with a Type G-6 fuel pump located on the left-hand side of

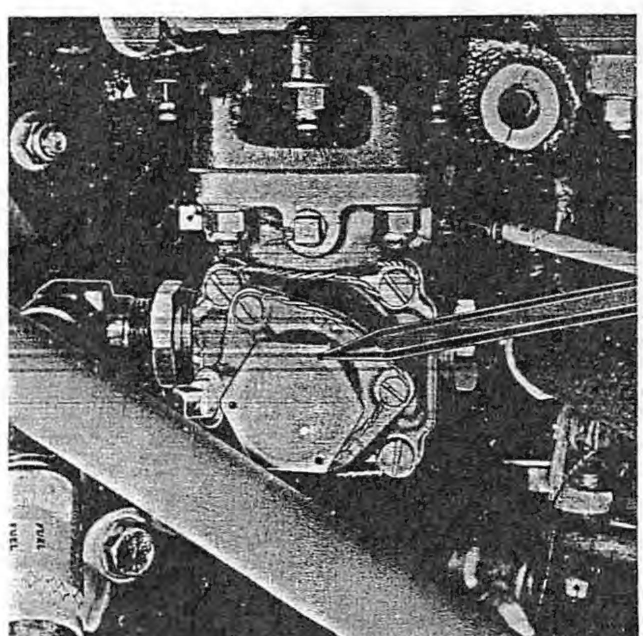


Figure 5-26. Fuel Pump Adjustment

the accessory case. The pumps are arranged to supply fuel to their respective engines only; should one pump fail, the other pump cannot supply fuel to both engines.

3-80. REMOVAL OF FUEL PUMP.
a. Place engine selector valve and tank selector valve in "OFF" position.
b. Drain fuel lines at strainer.
c. Disconnect fuel lines from pump.
d. Remove pump and adapter from engine.

3-81. INSTALLATION OF FUEL PUMP.

NOTE

Prior to installation of engine driven fuel pump, torque all 3/16-inch diameter bolts or fillister head screws to 20 - 30 inch-pounds and 1/4 inch diameter bolts or screws to 50 - 70 inch-pounds and resafety. This torquing will eliminate leakage between the pump body and relief valve housing due to shrinkage of gasket.

a. Install pump gasket on engine accessory pad.
b. Position pump on accessory pad so intake of pump is in position to be connected to the intake line.
c. Install mounting nuts, tighten evenly and safety.

CAUTION

Do not overtighten mounting nuts. Torque nuts to 25 inch-pounds.

d. Connect fuel lines to pump.
e. Check all lines and connections for leaks.

3-82. ADJUSTMENTS. The pressure relief valve on the fuel pump must be adjusted so the fuel pressure (with the engine turning 1800 rpm) will be 3-1/2 to 4 psi. To adjust the pressure relief valve, remove cap over adjusting screw, loosen locknut, and turn adjusting screw clockwise to increase pressure or counterclockwise to decrease pressure. See figure 5-26.

3-83. CARBURETORS.

3-84. DESCRIPTION. Bendix Stromberg NAR9B float type carburetors are used on the R-985-AN-39, R-985-AN-39A and R-985-AN-14B engines. These carburetors are conventional in design and operation, incorporating a throttle-operated accelerating pump and manual mixture control.

CAUTION

Do not vigorously open and close throttle when engines are not running and mixture control is in the "FULL RICH" position, as raw fuel will be pumped into the air scoop.

3-85. REMOVAL OF CARBURETOR.
a. Disconnect mixture control and throttle control at bell cranks.
b. Disconnect fuel lines from carburetor.
c. Remove four nuts from studs holding heater valve casting to carburetor. Heater valve drain plate must be removed for access to the two front nuts.
d. Remove carburetor by removing four bolts holding carburetor to carburetor adapter.

3-86. MINOR REPAIR AND PARTS REPLACEMENT. Only carburetor idle mixture and idle speed adjustments will be attempted in the field. All other replacements should be accomplished at a designated overhaul activity.

3-87. INSTALLATION OF CARBURETOR.
a. Install four bolts holding carburetor to adapter.
b. Install four nuts on studs holding heater valve casting to carburetor.
c. Install heater valve drain plate.
d. Connect fuel lines to carburetor.

NOTE

Prior to connecting carburetor fuel lines, coat pipe thread fittings with a light coat of anti-seize thread compound, Specification MIL-T-5544.

e. Connect mixture control and throttle control at bell cranks. Check for full travel and adjust as required.

3-88. CARBURETOR IDLE MIXTURE AND IDLE SPEED ADJUSTMENT.
a. Operate engine until cylinder head and oil temperatures are normal.
b. Perform a power and ignition system check as outlined in PART II, paragraphs 2-13 and 2-15, to determine that the engine is operating properly.
c. Move throttle controls to CLOSED position; engine should idle at 500 to 600 rpm.
d. Move the mixture control slowly and evenly toward IDLE CUT-OFF, observing rpm change. An increase of more than 10 rpm indicates a rich idle mixture, and an immediate decrease in rpm indicates a lean idle mixture.

NOTE

"Slowly" may be defined as the rate of movement which would require 12 to 15 seconds to move the mixture control from FULL RICH to the IDLE CUT-OFF position. This slow movement of the lever is necessary so that the engine can respond to the change in fuel-air mixture and that an accurate reading can be obtained as the best power mixture is reached.

e. After maximum rpm change has been noted move the mixture control back to RICH.
f. If an incorrect idle mixture was noted, move idle mixture adjustment one or two notches in the desired direction, either "R" (rich) or "L" (lean). (See figure 5-27.)
g. Run engine up to field barometric pressure to clear spark plugs.
h. Recheck idle mixture as outlined in steps d, e, and f.

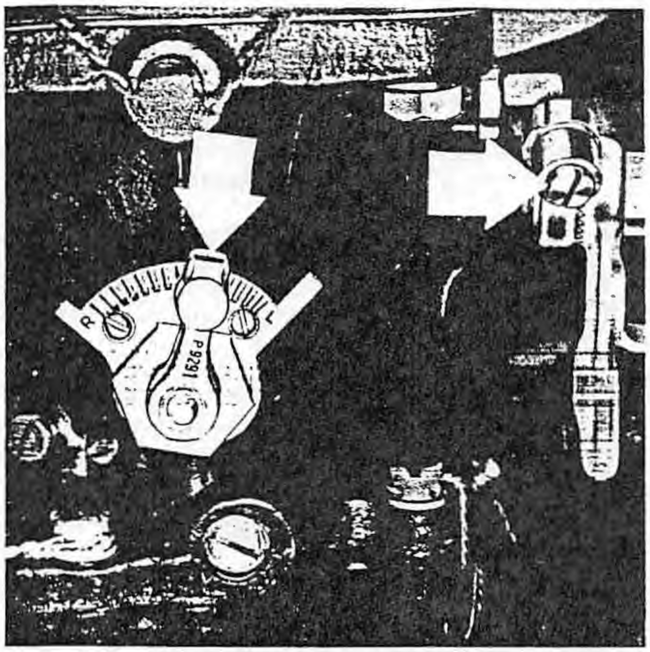


Figure 5-27. Carburetor Mixture and Idle Adjustment

3-89. CARBURETOR AND FUEL SYSTEM PRESSURE CHECK.

a. Build fuel pressure up to 6 psi.

b. Visually inspect carburetor gaskets, parting surfaces, plugs and connections for fuel leaks.

c. If carburetor shows signs of internal leaks, drain the carburetor.

d. Replace drain plug and repeat step a. This will usually free any foreign matter that becomes lodged under the float needle. If this does not eliminate the internal leak or flooding, replace the carburetor.

e. Gaskets, on parts which are required to be removed at time interval, should be replaced any time a leak is noted.

f. Leaking gaskets other than those specified in step e should be checked for looseness. If leak cannot be corrected with proper torque, the carburetor must be replaced.

g. Plugs that are leaking should be removed and inspected for damaged threads or cross threads. If plugs are serviceable, reinstall, torque and check for leakage.

NOTE

If gasket paste is used on the plugs, be certain that only a light amount is spread evenly on the threads and that none is on the thread end.

3-90. PRIMER SYSTEM.

3-91. DESCRIPTION. The primer system is actuated by an electrical solenoid. The solenoid is connected to the fuel pressure gage line and distributes fuel to the top cylinders of the engine being primed. The primer switch is located directly beneath the engine selector switch and on the right side of the starter switch (figure 5-28). Ignition booster, starter and primer switches are located under one safety cover. Priming system pressure is provided by the fuel booster pumps.

3-92. ENGINE TROUBLE SHOOTING. See Table XVII.

3-93. REMOVAL OF PRIMER SOLENOID.

a. Remove lower ring cowling.

b. Unsafety and remove electrical connection (figure 5-29).

c. Remove and cap fuel lines.

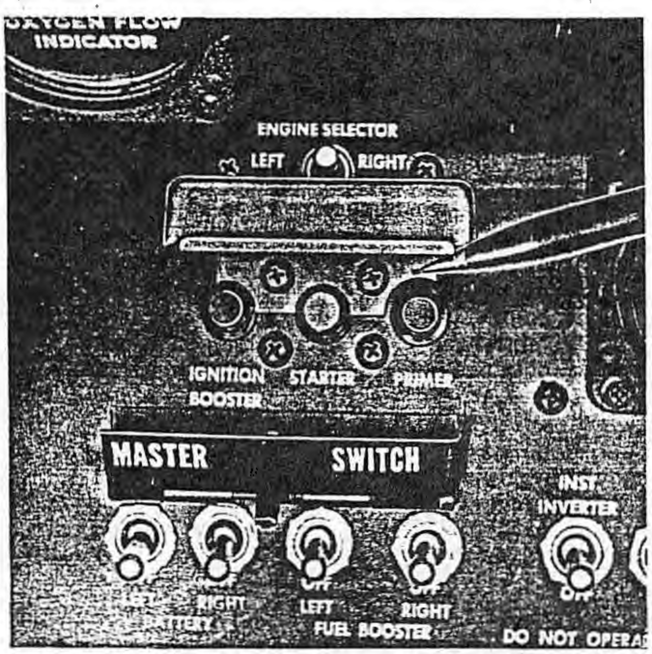


Figure 5-28. Primer Switch

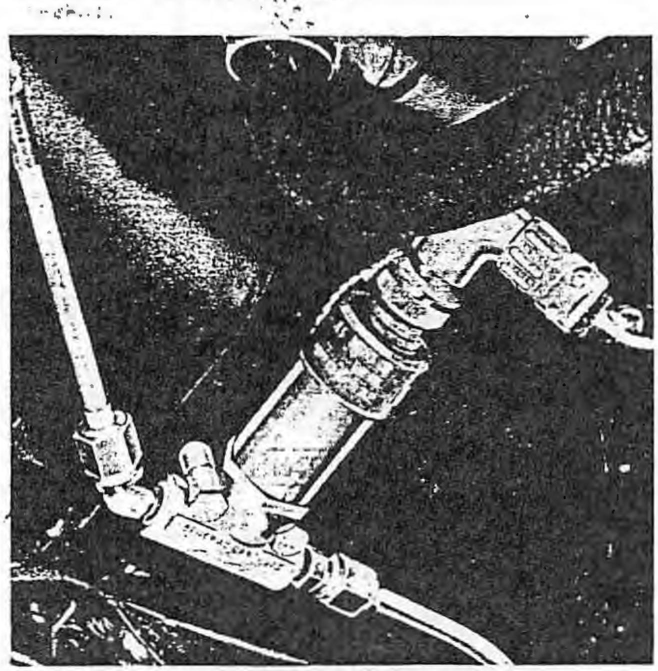


Figure 5-29. Primer Solenoid

the accessory case. The pumps are arranged to supply fuel to their respective engines only; should one pump fail, the other pump cannot supply fuel to both engines.

3-80. REMOVAL OF FUEL PUMP.
a. Place engine selector valve and tank selector valve in "OFF" position.
b. Drain fuel lines at strainer.
c. Disconnect fuel lines from pump.
d. Remove pump and adapter from engine.

3-81. INSTALLATION OF FUEL PUMP.

NOTE

Prior to installation of engine driven fuel pump, torque all 3/16-inch diameter bolts or fillister head screws to 20 - 30 inch-pounds and 1/4 inch diameter bolts or screws to 50 - 70 inch-pounds and resafety. This torquing will eliminate leakage between the pump body and relief valve housing due to shrinkage of gasket.

a. Install pump gasket on engine accessory pad.
b. Position pump on accessory pad so intake of pump is in position to be connected to the intake line.
c. Install mounting nuts, tighten evenly and safety.

CAUTION

Do not overtighten mounting nuts. Torque nuts to 25 inch-pounds.

d. Connect fuel lines to pump.
e. Check all lines and connections for leaks.

3-82. ADJUSTMENTS. The pressure relief valve on the fuel pump must be adjusted so the fuel pressure (with the engine turning 1800 rpm) will be 3-1/2 to 4 psi. To adjust the pressure relief valve, remove cap over adjusting screw, loosen locknut, and turn adjusting screw clockwise to increase pressure or counterclockwise to decrease pressure. See figure 5-26.

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CAUTION

Do not vigorously open and close throttle when engines are not running and mixture control is in the "FULL RICH" position, as raw fuel will be pumped into the air scoop.

3-85. REMOVAL OF CARBURETOR.
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b. Disconnect fuel lines from carburetor.
c. Remove four nuts from studs holding heater valve casting to carburetor. Heater valve drain plate must be removed for access to the two front nuts.
d. Remove carburetor by removing four bolts holding carburetor to carburetor adapter.

3-86. MINOR REPAIR AND PARTS REPLACEMENT. Only carburetor idle mixture and idle speed adjustments will be attempted in the field. All other replacements should be accomplished at a designated overhaul activity.

3-87. INSTALLATION OF CARBURETOR.
a. Install four bolts holding carburetor to adapter.
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d. Connect fuel lines to carburetor.

NOTE

Prior to connecting carburetor fuel lines, coat pipe thread fittings with a light coat of anti-seize thread compound, Specification MIL-T-5544.

e. Connect mixture control and throttle control at bell cranks. Check for full travel and adjust as required.

3-88. CARBURETOR IDLE MIXTURE AND IDLE SPEED ADJUSTMENT.
a. Operate engine until cylinder head and oil temperatures are normal.
b. Perform a power and ignition system check as outlined in PART II, paragraphs 2-13 and 2-15, to determine that the engine is operating properly.
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d. Move the mixture control slowly and evenly toward IDLE CUT-OFF, observing rpm change. An increase of more than 10 rpm indicates a rich idle mixture, and an immediate decrease in rpm indicates a lean idle mixture.

NOTE

"Slowly" may be defined as the rate of movement which would require 12 to 15 seconds to move the mixture control from FULL RICH to the IDLE CUT-OFF position. This slow movement of the lever is necessary so that the engine can respond to the change in fuel-air mixture and that an accurate reading can be obtained as the best power mixture is reached.

e. After maximum rpm change has been noted, move the mixture control back to RICH.
f. If an incorrect idle mixture was noted, move idle mixture adjustment one or two notches in the desired direction, either "R" (rich) or "L" (lean). (See figure 5-27.)
g. Run engine up to field barometric pressure to clear spark plugs.
h. Recheck idle mixture as outlined in steps d, e, and f.

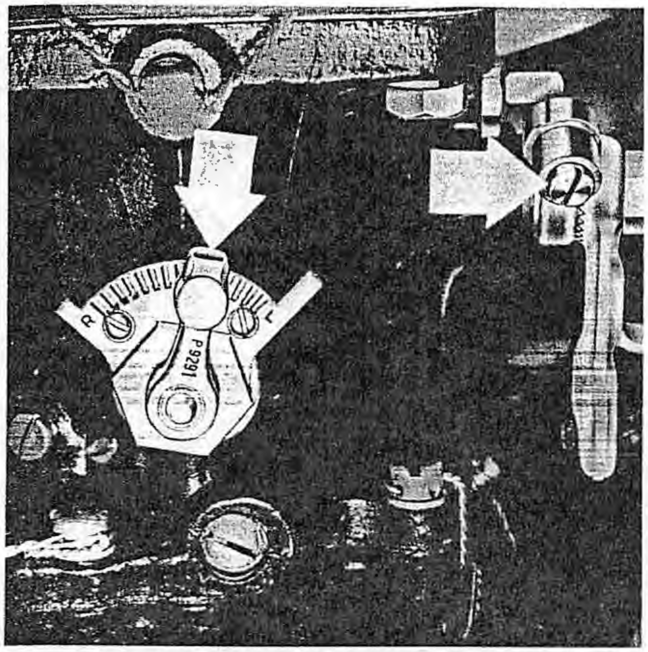

Figure 5-27. Carburetor Mixture and Idle Adjustment

3-89. CARBURETOR AND FUEL SYSTEM PRESSURE CHECK.

a. Build fuel pressure up to 6 psi.

b. Visually inspect carburetor gaskets, parting surfaces, plugs and connections for fuel leaks.

c. If carburetor shows signs of internal leaks, drain the carburetor.

d. Replace drain plug and repeat step a. This will usually free any foreign matter that becomes lodged under the float needle. If this does not eliminate the internal leak or flooding, replace the carburetor.

e. Gaskets, on parts which are required to be removed at time interval, should be replaced any time a leak is noted.

f. Leaking gaskets other than those specified in step e should be checked for looseness. If leak cannot be corrected with proper torque, the carburetor must be replaced.

g. Plugs that are leaking should be removed and inspected for damaged threads or cross threads. If plugs are serviceable, reinstall, torque and check for leakage.

NOTE

If gasket paste is used on the plugs, be certain that only a light amount is spread evenly on the threads and that none is on the thread end.

3-90. PRIMER SYSTEM.

3-91. DESCRIPTION. The primer system is actuated by an electrical solenoid. The solenoid is connected to the fuel pressure gage line and distributes fuel to the top cylinders of the engine being primed. The primer switch is located directly beneath the engine selector switch and on the right side of the starter switch (figure 5-28). Ignition booster, starter and primer switches are located under one safety cover. Priming system pressure is provided by the fuel booster pumps.

3-92. ENGINE TROUBLE SHOOTING. See Table XVII.

3-93. REMOVAL OF PRIMER SOLENOID.

a. Remove lower ring cowling.

b. Unsafety and remove electrical connection (figure 5-29).

c. Remove and cap fuel lines.

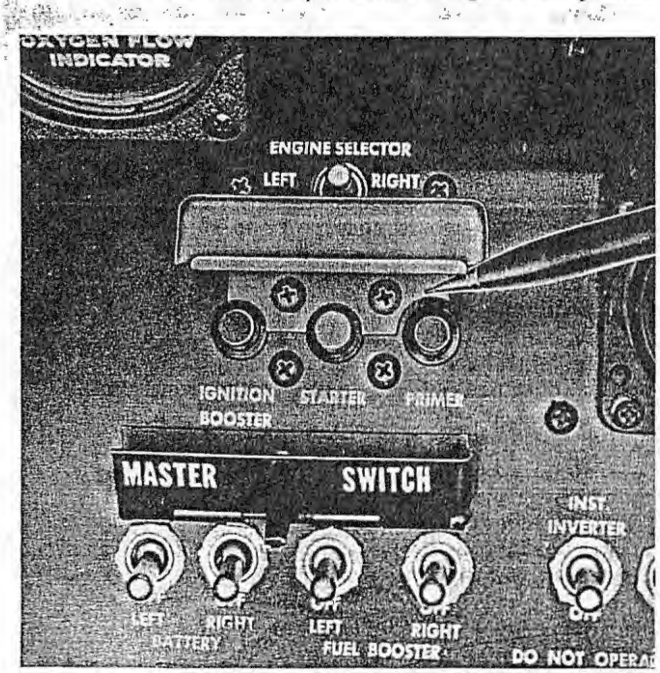

Figure 5-28. Primer Switch

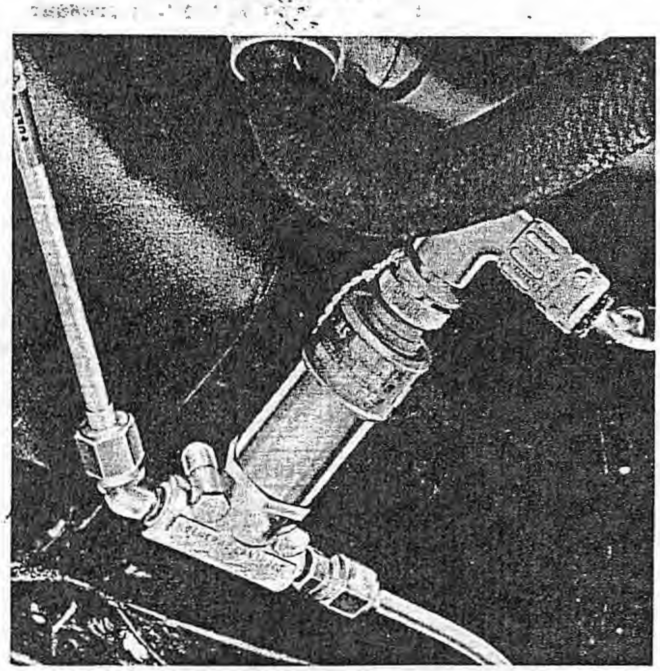

Figure 5-29. Primer Solenoid

3-94. INSTALLATION OF PRIMER SOLENOID.

a. Uncap fuel lines and check for cracks, breaks, etc.

b. Connect fuel lines to primer unit.

NOTE

Arrow on body of the solenoid valve indicates direction of fuel flow.

c. Connect and safety electrical connection.

d. Install lower ring cowling.

3-95. REMOVAL OF PRIMER SWITCH.

a. Remove four screws on pilot's subpanel underneath safety cover.

b. Disconnect electrical leads.

NOTE

The induction vibrator, starter and primer switches are all built in one mounting.

3-96. MINOR REPAIR AND PARTS REPLACEMENT. Repairs shall be limited to replacing or repairing broken leads, or replacement of either the switch or primer solenoid. If primer solenoid is defective replace and send old one to designated overhaul activity.

3-97. INSTALLATION OF PRIMER SWITCH.

a. Connect electrical leads to switch.

b. Install four screws and tighten.

3-98. LUBRICATION SYSTEM.

3-99. DESCRIPTION. An oil supply tank (figure 5-30) is located aft of the firewall in each engine nacelle. The oil flows from the supply tank to the engine oil pump on the accessory section and then through the engine under pressure. The return oil picked up from the sump by the scavenging section of the oil pump flows to the oil by-pass valve and the oil radiator and then to the supply tank. For quick warm-up purposes warm oil may be manually bypassed around the oil radiator by means of the bypass valve control in the pilot's compartment. Oil dilution is accomplished through an electrical solenoid-operated valve located on the upper rear portion of the firewall. When the oil dilution switch is closed the solenoid valve opens and allows the fuel to flow in the "Y" drain valve where it mixes with oil going into the engine. See figure 5-32.

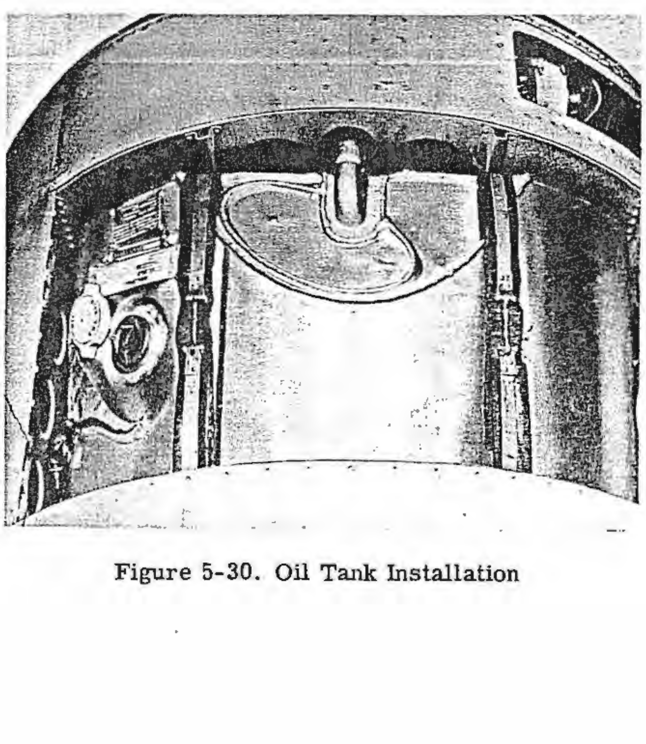

Figure 5-30. Oil Tank Installation

3-100. ENGINE TROUBLE SHOOTING. See Table XVII.

3-101. OIL TANKS.

3-102. DESCRIPTION. An oil tank for each engine is mounted in the top of each nacelle, just aft of the firewall; each is secured by two steel straps fitted with turnbuckles for adjustment and padded to protect the tank. The tanks are welded sheet aluminum and hold 8 US-gallons each. C-45H oil tanks are modified to provide reserve oil (1 gallon) for propeller feathering by installation of a standpipe for the engine oil lines. Feathering oil is drawn from separate fittings.

3-103. REMOVAL OF OIL TANK.

a. Remove tank access cover and drain tank.

b. Disconnect and plug piping and disconnect bonding links.

c. Disconnect retaining straps at turnbuckles and lift tank out.

3-104. MINOR REPAIR AND PARTS REPLACEMENT. If oil tank is damaged, replace it, sending damaged tank to a designated overhaul activity.

3-105. INSTALLATION OF OIL TANK.

a. Lower tank into well (figure 5-30).

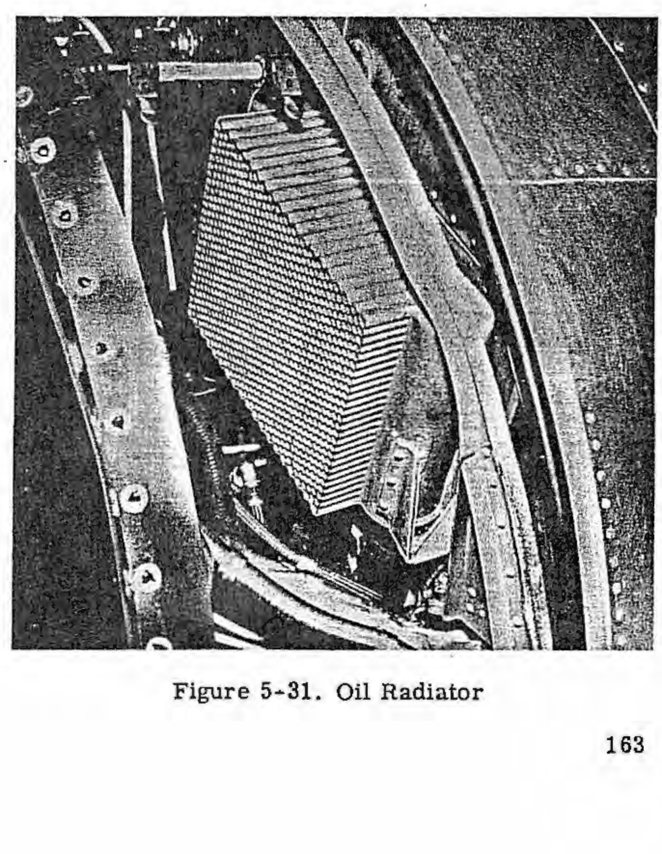

Figure 5-31. Oil Radiator

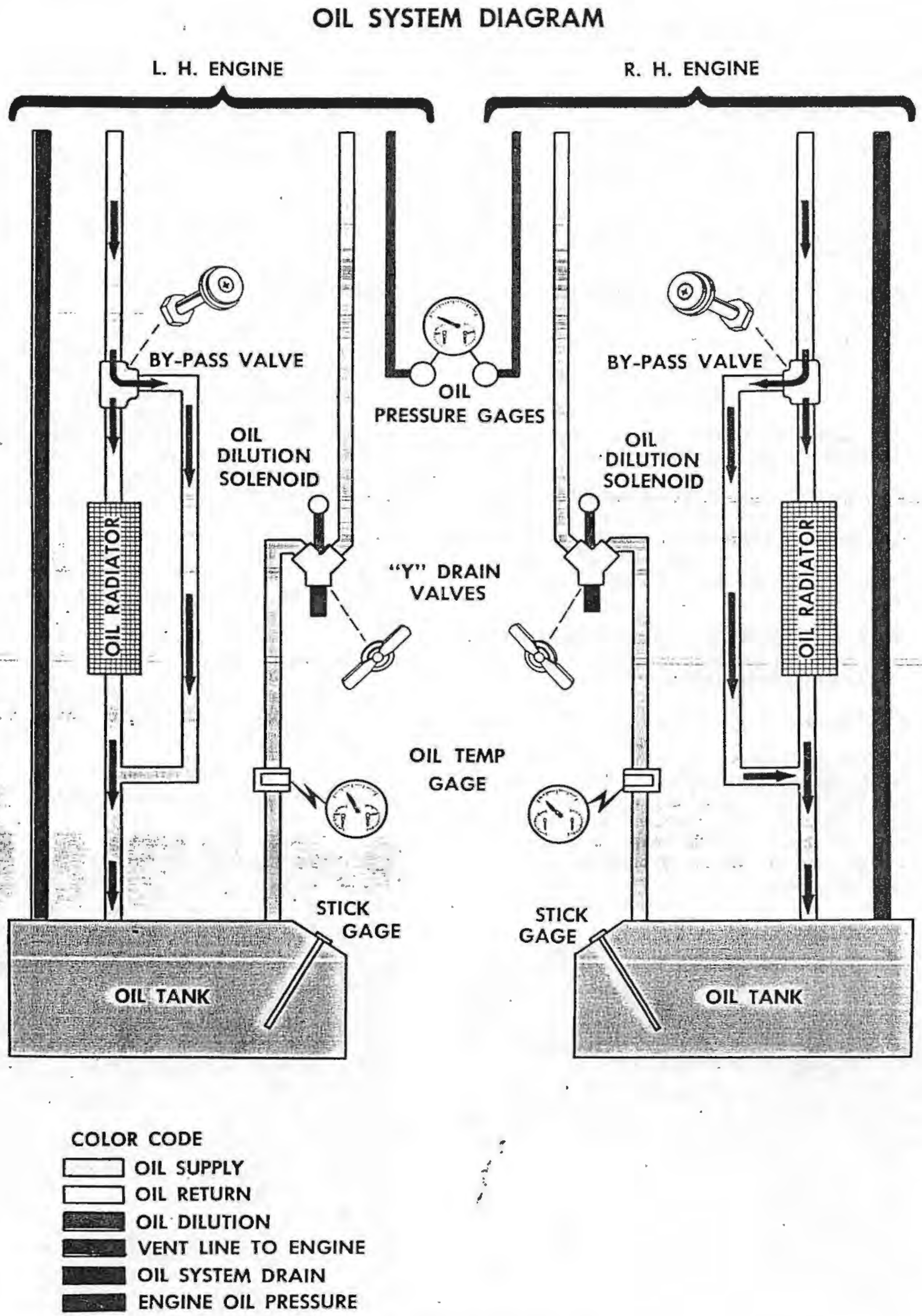

Figure 5-32. Oil System Schematic

b. Install retaining straps. Make sure padding is in place between tank and straps.
c. Attach bonding links and connect plumbing.

CAUTION

Make sure all plugs and foreign objects are removed from piping.

d. Fill tank and check for leaks.
e. Install recess cover.

3-106. OIL RADIATOR AND RADIATOR AIR DUCTS.

3-107. DESCRIPTION. The honeycomb-type oil radiator is located on the forward side of the firewall (figure 5-31). An air duct supplies a flow of air through the radiator for cooling the oil. Cooling air is routed from the intake located in the leading edge of the center wing between the nacelle and fuselage, through a duct to the oil radiator, at which point it is discharged through the oil radiator and into the engine accessory section. The amount of air flow may be regulated by a shutter incorporated in the oil radiator air ducts. Position of the shutter is adjusted by a control in the pilot's compartment.

3-108. REMOVAL OF OIL RADIATOR.
a. Remove engine ring cowling.
b. Loosen hose clamps on inlet and outlet lines.
c. Remove four mounting bolts securing radiator.
d. Lift radiator up and forward until clear of firewall.

3-109. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of replacing damaged oil radiator, shutter valves, and air ducts.

Figure 5-33. Removal of Oil Strainer

3-110. INSTALLATION OF OIL RADIATOR.
a. Make sure felt pad is cemented firmly into position.
b. Lower radiator into position, connecting piping as radiator is lowered.
c. Install mounting bolts, tighten and safety.
d. Tighten hose clamps on lines.
e. Install engine ring cowling.

3-111. REMOVAL OF OIL STRAINER. (See figure 5-33.)
a. Using PWA-228 Wrench, remove the oil strainer cover nut.
b. It may be necessary to tap cover lightly with a rawhide mallet to break the gasket seal.

CAUTION

Do not drive screwdriver or similar tool into parting surface to break cover loose, as damage to the machined surfaces will result.

c. Remove the cover, spring, oil strainer, and check valve assembly.

3-112. INSPECTION OF OIL STRAINER.
a. Examine the strainer for the presence of metal chips or foreign matter which may indicate a failure or some other unsatisfactory condition in the engine.
b. Inspect the oil strainer for distortion or splits at the soldered joints.
c. Check the fit of the strainer in its chamber in the rear case.
d. Inspect the oil check valve to see that it is free and seats properly.
e. Check the spring pressure and examine the cover for cracks and condition of paint.

3-113. CLEANING OIL STRAINER.
a. Immerse oil strainer in cleaning solvent, Federal Specification P-S-661, and wash it with a soft-bristle brush. Do not use a hard-edged or pointed tool to scrape or pick at the strainer.
b. Apply air blast from the inside of the oil strainer to remove solvent and loose foreign matter.
c. If heavy carbon deposits adhere to the oil strainer, immerse the oil strainer in stabilized degreasing fluid, trichlorethylene, Specification MIL-T-7003, at room temperature, and then blow the oil strainer dry with an air jet. Repeat this procedure if necessary.

WARNING

Air blast will be directed away from personnel in all cases to prevent injury.

d. Immediately after washing and prior to installation, immerse oil strainer in clean engine oil.

3-114. INSTALLATION OF OIL STRAINER.
a. Insert the check valve assembly, oil seal and oil strainer into the chamber in the rear case.
b. Position a new oil chamber gasket on the cover, using a small amount of grease (Specification MIL-L-3545) on both sides of the gasket.
c. Install the gasket and cover.

NOTE

The gasket is to be installed with smooth side toward the shoulder of the cover (the crimped or asbestos-exposed side toward the engine). This procedure keeps the gasket from turning and wearing a pattern into its sealing part while the cover is being tightened.

d. Tighten the cover with PWA-228 wrench. Lockwire the cover.

3-115. REMOVAL OF OIL PRESSURE RELIEF VALVE.

a. Remove the acorn shaped cap from the oil pressure relief valve.
b. Remove the oil pressure relief valve body, then withdraw the spring and plunger.
c. Remove the valve seat from the rear case, using a PWA-671 wrench.

3-116. INSPECTION OF OIL PRESSURE RELIEF VALVE.

a. Check the tension of the relief valve spring. Note the condition of the valve in the valve seat.
b. Lap these parts together with a very fine grade of lapping compound to form a perfect seat. The guide surfaces of the valve should have a free sliding fit in the seat.
c. Polish the guide surfaces with crocus cloth Specification P-C-458 and oil Specification VV-O-526.

3-117. INSTALLATION OF OIL PRESSURE RELIEF VALVE.

a. Install the valve seat in the rear case, using PWA-671 wrench.
b. Insert the plunger and spring into the oil pressure relief valve body.
c. Fit a new gasket under the flange on the valve body and screw the body into the rear case.
d. Install a gasket and screw the acorn shaped cap on the outer end of the valve body. Lockwire the cap to the adjacent squarehead plug.

3-118. OIL PRESSURE RELIEF VALVE ADJUSTMENT.

a. Remove wrapper sheets.
b. On right-hand side of engine accessory housing, remove the acorn cap from the oil pressure adjusting screw (figure 5-34).
c. Loosen locknut on adjusting screw.
d. With engine running and oil temperature in the normal operating range, turn adjusting screw clockwise to increase or counterclockwise to decrease until an oil pressure between 65 to 70 pounds is obtained at an engine rpm of 1800.
e. Tighten locknut, install cap and safety.
f. Install wrapper sheet.

3-119. OIL DILUTION SYSTEM.

3-120. DESCRIPTION. The oil dilution valve (figure 5-35) is located in the upper outboard section of each nacelle just aft of the firewall. The solenoid to each engine is controlled by a switch located on the pilot's left subpanel. When the switch is closed, the valve in the nacelle opens and allows fuel to mix with the oil before it enters the engine.

3-121. REMOVAL OF OIL DILUTION VALVE.

a. Disconnect electrical wiring.
b. Disconnect and cap fuel lines.
c. Remove four mounting screws and remove valve.

3-122. MINOR REPAIR AND PARTS REPLACEMENT. Repair should be limited to replacement of lines. Send inoperative valves to a designated overhaul activity.

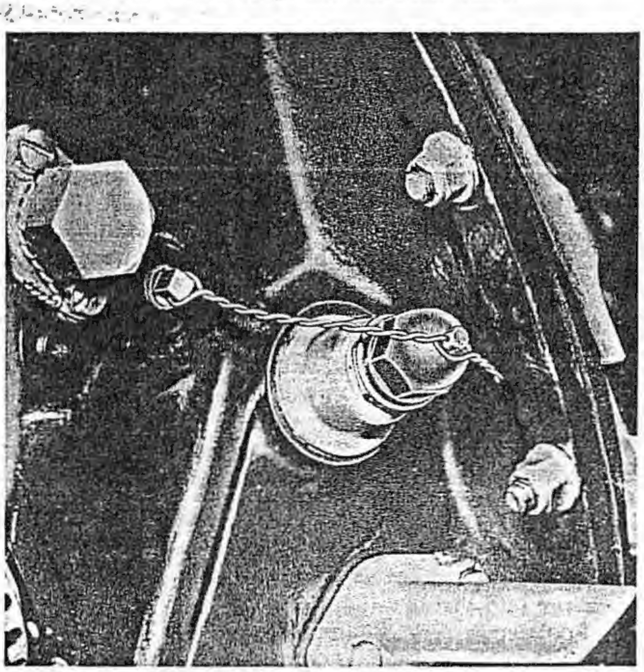

Figure 5-34. Oil Pressure Relief Valve Adjustment

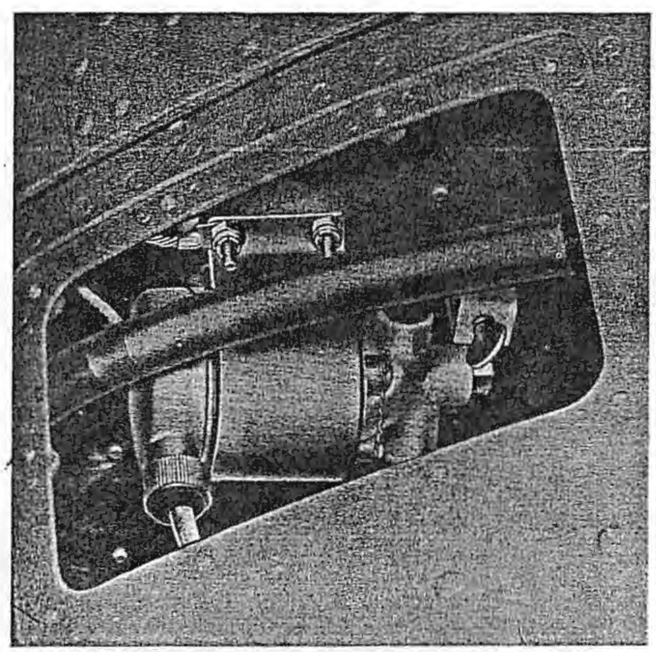

Figure 5-35. Oil Dilution Solenoid Valve

3-123. INSTALLATION OF OIL DILUTION VALVE.

a. Insert hold-down screws through holes in firewall, install valve on screws and tighten three nuts only.

b. Place bonding on remaining screw, install and tighten nut.

c. Check fuel lines for cracks or other defects and connect to solenoid valve.

d. Connect electrical wiring.

3-124. OIL SYSTEM DESLUDGING PROCEDURES.

3-125. A periodic oil dilution and desludging of the engine and oil system will be accomplished by Wing/Base and/or Flight-Line personnel. Each time periodic oil dilution is accomplished a suitable entry will be made on DD Form 781-2. At engine change, when periodic oil dilution is used, a notation will be entered on DD Form 829-1 indicating the period of dilution.

3-126. Oil dilution has always been considered as a "necessary evil" associated with cold weather starting. General experience accumulated over the years includes many epidemics of engine trouble associated directly with its misuse. These troubles have been mainly due to the violent desludging or purging action of diluted oil in normal carbon and sludge accumulations in the engine. The total accumulation of such deposits is a function of engine time and depends also on other variables such as operating temperatures, oil change frequency, and aircraft oil system design.

3-127. If an engine is operated for an extended period of time and is then diluted, these deposits may be flushed through the oil system. The larger particles and sludge masses can be trapped in the sumps and oil screens and can cause almost immediate clogging of oil strainer. If this occurs, the oil by-pass valve will open and the engine will be supplied with dirty unscreened oil. The contaminated oil includes a wide variety of deposits ranging from fine abrasive carbon particles to large slugs of sludge which can plug pressure or scavenge oil passages, such as reduction pinion gear oil holes, rocker box interconnect lines or tappet guide drains, and in turn can cause troubles which may vary from a maintenance or operational nuisance to an engine failure. Oil coolers and other oil system components can be plugged or restricted by these deposits and may tend to serve as storage reservoirs for these harmful residues.

3-128. Until all engines being operated by the using activity can be considered CLEAN, they will have two categories of engines in the activity.

a. Clean Engines. All engines with less than 130 hours of flying time will be considered as CLEAN engines.

b. Dirty Engines. Nondiluted engines with more than 130 hours of flying time will be considered as DIRTY engines. Diluted engines which have accumulated over 65 hours of operation since last dilution will also be considered DIRTY engines. Special desludging procedures are required on DIRTY engines before they can be considered as CLEAN engines. Use the following procedures for engine oil desludging.

1. Using the dilution procedures outlined in the applicable technical order (-1 Handbook), dilute the oil 10%. Where dilution is not expressed in terms of percentage, dilute the oil in the amount specified for an ambient temperature of -12.2°C (10°F) (approximately 10%).

CAUTION

DO NOT allow the engine oil pressure to fall below 15 psi during dilution.

2. Upon completion of the above and prior to take-off or high power operation, operate the engine a minimum of 10 minutes at an oil temperature above 50°C (122°F).

3. The following additional procedures will be adhered to on engines which are periodically diluted at intervals greater than 25 hours:

(a) Operate hydromatic propeller control through three cycles.

(b) During the above operation, the oil temperature should be maintained below 50°C (122°F) as long as possible. Before the entire operation is completed, the oil temperature may exceed 50°C (122°F).

(c) Operation should be for approximately 10 minutes, but may exceed this if necessary to accomplish the entire procedure.

(d) Upon completion of the preceding operations, remove, inspect, and clean, the following:

(1) Engine oil strainer.

(2) Front sump plug.

(3) Lower rocker box covers.

(e) If during the screen examination excessive deposits are noted, the engine should be run an additional 10 minutes and the inspection given under paragraph 3-128.3.

(f) After shutdown (preferably an hour or two), drain one gallon of oil from the "Y" drain, and oil cooler drain to eliminate sludge which may have accumulated at these points.

4. Engines which have over 130 hours of operation since new or newly overhauled and have over a 65-hour period of operation since last dilution (DIRTY engines), require the following procedures be accomplished in addition to those outlined in paragraphs 3-128.1 through 3-128.3.

(a) In place of the oil draining required by paragraph 3-128.3.f, drain and replace all oil from the engine oil tank.

(b) Remove, inspect, clean and reinstall (safety as required), the propeller dome and propeller governor oil screen.

(c) Carefully inspect the main oil screen and sump plugs at 10-hour operation intervals (or as close thereto as possible), for 100 hours after this desludging dilution.

3-129. COLD WEATHER MAINTENANCE OF THE OIL SYSTEM.

3-130. Difficulties in cold engine starts fall into three categories: slow and difficult cranking, improper viscosity of the lubricant, (use grade 1065 below 40°F, grade 1100 above 40°F) and fuel vaporization. Proper oil dilution will eliminate the first two of these difficulties. Dilution reduces the viscosity of the oil in the aircraft, thereby decreasing the amount of electrical power necessary to turn over the engine and accelerate it to starting speeds. In addition, dilution adjusts the viscosity of the cold oil so that it is able to provide proper lubrication. By employing proper oil dilution procedures the preheat time required to start an engine is considerably reduced.

3-131. Operate the engine at 1000 to 1200 rpm.

3-132. Maintain the oil temperature and pressure as outlined in the applicable technical orders. If the oil temperature becomes too high, shut down the engine, service if necessary, and allow it to cool and restart for dilution. Keep in mind that some aircraft are serviced with less oil when dilution is employed. Oil temperature in excess of 50°C (122°F) results in improper dilution as the gasoline will boil off.

3-133. Hold the oil dilution switches on for the period specified in the aircraft handbook for the anticipated starting temperature.

NOTE

Operation of the oil dilution system is indicated by a substantial fuel pressure drop. If this pressure drop is not obtained, investigate the dilution system for such troubles as sticking dilution solenoids, plugged dilution lines and reversed restrictor fittings.

3-134. Operate the propeller pitch control through full range and the feathering switch through a 600 rpm change three times during the last 2 minutes of the dilution period. This procedure will insure diluted oil in the propeller control system for the next engine start.

3-135. Advance the throttle to 1500 rpm, shut down the engine and release the dilution switches as the propellers stop rotating. This procedure insures that fuel rather than oil will be in the line from the oil dilution solenoid valve to the Y-drain. In this way, difficulties may be avoided if it becomes necessary to dilute again.

3-136. OIL BY-PASS VALVE.

3-137. DESCRIPTION. The by-pass valve (figure 5-36) is installed in the oil return line to provide a means of returning oil to the supply tank without passing through the radiator. It may be manually operated from the pilot's compartment. The valve is spring-loaded to open automatically at pressures not to exceed 25 to 45 psi, to assure oil circulation if the radiator becomes clogged.

3-138. REMOVAL OF OIL BY-PASS VALVE.
a. Disconnect the oil by-pass control from the control arm on the valve.
b. Disconnect the oil lines at the valve.
c. Remove the bolts securing the valve to the retaining clamps and remove the valve.

3-139. MINOR REPAIR AND PARTS REPLACEMENT. Inspect actuating arm and lever for excessive wear; replace if necessary. If valve leaks, replace packing.

3-140. INSTALLATION OF OIL BY-PASS VALVE.
a. Place valve in position and install mounting bolts.
b. Connect oil lines to the valve.
c. Connect control to control arm.

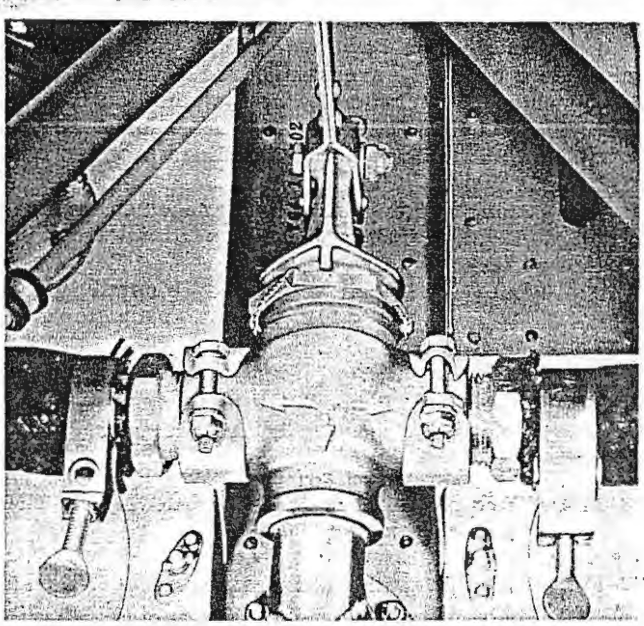

Figure 5-36. Oil By-Pass Valve

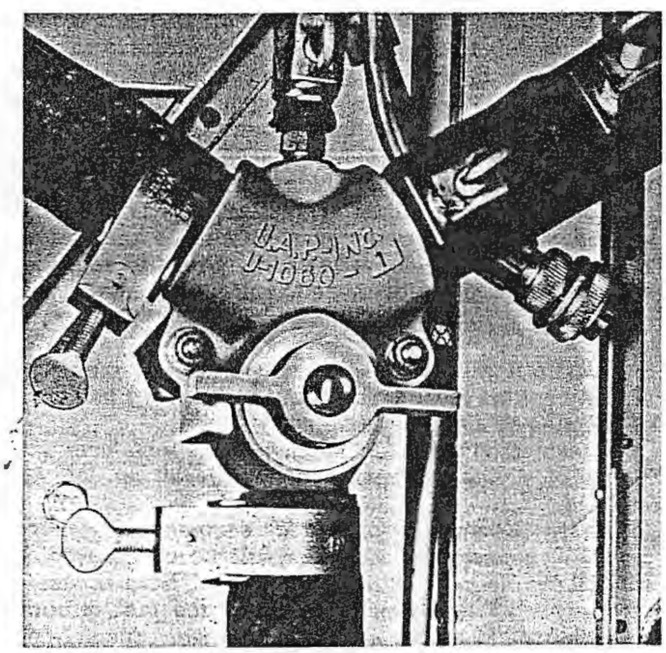

Figure 5-37. Oil Drain "Y" Valve

3-141. OIL DRAIN "Y" VALVE.

3-142. DESCRIPTION. An oil drain "Y" valve (figure 5-37) is installed in the oil supply line to facilitate draining the oil system. The oil dilution line attaches to a fitting in the top of the oil drain "Y" valve. In aircraft which use the hydromatic propeller a drain outlet plug is provided in bottom of oil tank, adjacent to feathering pump to drain the system of feathering reserve oil only. It is recommended to use this outlet in combination with the oil tank "Y" drain valve, located behind the firewall in the wheel well, if system is to be flushed and drained thoroughly. Otherwise the drain plug is left in the safetied closed position to retain the feathering reserve oil.

3-143. REMOVAL OF OIL DRAIN "Y" VALVE.
a. Disconnect all lines.
b. Remove attaching bolts and valve.

3-144. MINOR REPAIR AND PARTS REPLACEMENT. Leaks sometimes occur in the oil drain "Y" valve due to a collection of foreign particles on the neoprene seal which prevents the valve from seating properly. Thorough cleaning of the seal and seat may correct the condition. If not, the seal must be replaced.

3-145. INSTALLATION OF OIL DRAIN "Y" VALVE.
a. Attach valve in place with mounting bolts and safety.
b. Connect all lines.

3-145A. DECONTAMINATION OF ENGINE OIL SYSTEM AND ACCESSORIES.

3-145B. The engine oil system will be decontaminated at the time of internal engine failure and at the time of normal engine change in order to prevent future engine failures and lengthen engine service time. Oil systems will be decontaminated by removing dirt, metal particles and other foreign materials from the system and accessories in accordance with the following instructions:

3-145C. DECONTAMINATION AFTER INTERNAL ENGINE FAILURE. In all cases of internal engine failure, decontamination of the oil system will be accomplished as follows:
a. The oil system will be drained. When all excess oil has been removed, the complete oil system will be cleaned thoroughly with an oil system flushing solution consisting of eight parts kerosene, Federal Specification VV-K-211, one part dry cleaning solvent, Federal Specification P-S-661 (or equal) and one part corrosion preventive compound, Specification MIL-C-6529. For best results in cold weather, the solution should be kept warm (but not to exceed 80° F (+27° C) by flash proof, thermostatically controlled, electrical heating elements.

b. Oil lines will be cleaned, while installed, by circulating the flushing solution through them under pressure, provided facilities are available and adequate for this procedure. A disassembly and inspection of a duplicate installation, that has been cleaned in the same manner with the same equipment, will establish the effectiveness of the flushing facilities.

c. Oil lines that cannot be cleaned while installed will be removed and cleaned. Vacuum pump pressure line and the oil separator will be removed, inspected for trapped debris, and thoroughly cleaned before being reinstalled on the aircraft.

3-145D. OIL TANK DECONTAMINATION. The oil tank will be cleaned and inspected while installed in the aircraft in accordance with the following instructions:
a. Remove the filler cap, the sump fitting and the sump plate.
b. Flush all corners and/or recesses in the tank with flushing solution, using whichever item of the following equipment that is available; DeVilbiss spray gun cleaner, Specification Number 50062-B, stock number 7900-101050 (or equal), or an adequate flushing device of local origin (this does not imply fabrication authorization).

NOTE

All lines between the engine and the tank should be disconnected when flushing the oil system, if engine is installed.

c. Dry out the tank thoroughly with compressed air.

3-145E. OIL COOLER DECONTAMINATION. Oil coolers must be removed after engine failure and tagged with AF Form 50D, marked "Removed after internal engine failure - Decontaminate at specialized depot", and forward to the specialized depot. In addition, a locally fabricated thin metal tag, made from SO aluminum material under 0.040 gage (size 3/4 x 1/2 inches, with a hole drilled to accommodate installation of a retaining bolt, 3/8 inch from end of tag) will be firmly attached to the cooler, with the words METAL CONT die stamped on the tag in 3/16 inch high letters. Metal tag will be bent to conform to configuration of the cooler to prevent tag from being torn off during packaging or handling.

3-145F. DECONTAMINATION OF PROPELLER OIL SYSTEM. Decontaminate the propeller and accessories in accordance with the following instructions:
a. The propeller governor will be disassembled, cleaned and tested in accordance with the applicable technical order.
b. All propellers and components, which have been subjected to contamination as a result of internal engine failures, shall be disassembled, in accordance with applicable overhaul handbooks, and thoroughly cleaned with an approved cleaning solvent, inspected, reassembled and adequately tested. This disassembly and reassembly shall be accomplished only by authorized personnel.
c. In the event the propeller feathering pump was used at the time of engine failure, the assembly will be returned for overhaul.

3-145G. DECONTAMINATION OF OIL SYSTEM AT NORMAL ENGINE CHANGE.

3-145H. Cleaning at the normal engine change shall be accomplished by draining the oil from the system and then thoroughly flushing and cleaning the system by pumping flushing solution through the system. Removal of oil coolers, oil tanks, propellers and other accessories in the oil system will not be necessary. Every effort shall be made to assure a clean oil system.

CAUTION

When using flushing solution, which contains kerosene and/or dry cleaning compounds, in cleaning operation, adequate precautions against fire hazards shall be observed at all times.

3-146. IGNITION SYSTEM.

3-147. DESCRIPTION. The ignition system in C-45G, TC-45G and C-45H airplanes consists of an induction vibrator and two SB9RU-3 magnetos on each engine. Each of these systems will be discussed in the following paragraphs.

3-148. ENGINE TROUBLE SHOOTING. See Table XVII.

3-149. INDUCTION VIBRATOR.

3-150. DESCRIPTION. When starting, the engines do not turn over fast enough to produce a hot spark in the magnetos. For this reason an induction vibrator (figure 5-38) is included in the starting ignition circuit to furnish high voltage current directly to the magneto distributor to assist in the starting operation. The induction vibrator is controlled by the "BOOSTER" switch located under the safety cover on the pilot's left subpanel.

3-151. REMOVAL OF INDUCTION VIBRATOR.
a. Disconnect wiring plugs from vibrator.
b. Remove the mounting screws and remove vibrator.

3-152. MINOR REPAIR AND PARTS REPLACEMENT. Repair should be limited to securing terminal clips and checking continuity of wiring. If unit is defective, it must be replaced. Send old unit to a designated overhaul activity for repair.

3-153. INSTALLATION OF INDUCTION VIBRATOR.
a. Attach vibrator to firewall.
b. Connect wires to proper terminals.

3-154. ADJUSTMENTS. No adjustments are to be made while the unit is on the airplane. Return the removed unit to a designated overhaul activity for adjustment and repair.

3-155. MAGNETOS AND IGNITION SWITCH.

3-156. DESCRIPTION. Two American Bosch SB9RU-3 magnetos are used on each engine. The induction vibrator energizes the primary coil of the inboard magnetos to furnish a strong spark for starting. The magnetos are connected to the magneto drive with rubber couplings. The ignition switches are located on the pilot's left subpanel (figure 5-39). A ground-return system is used in wiring the switch unit to the magnetos. The ignition system is shielded to prevent radio interference.

3-157. REMOVAL OF MAGNETO.
a. Remove ring cowling.
b. Remove electrical ground connection from rear of magneto.
c. Remove screws from radio shield and remove shield.
d. Remove four screws from distributor block dust cover.

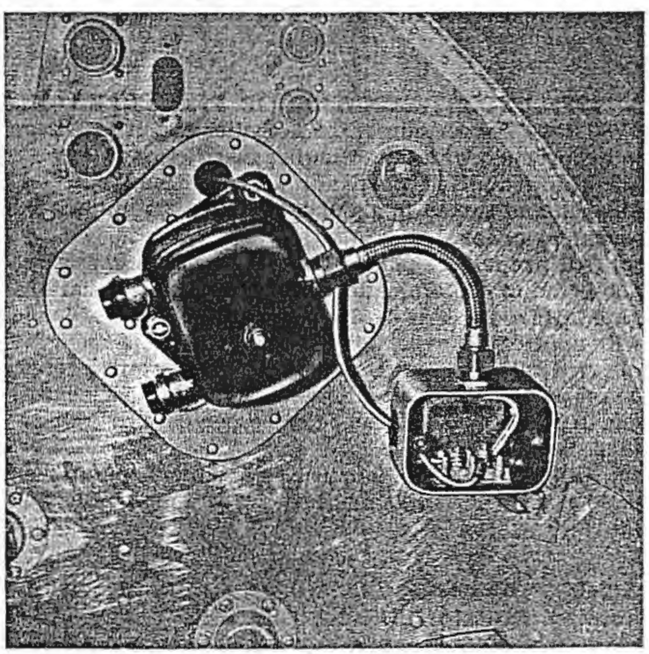

Figure 5-38. Induction Vibrator

Figure 5-39. Ignition Switches

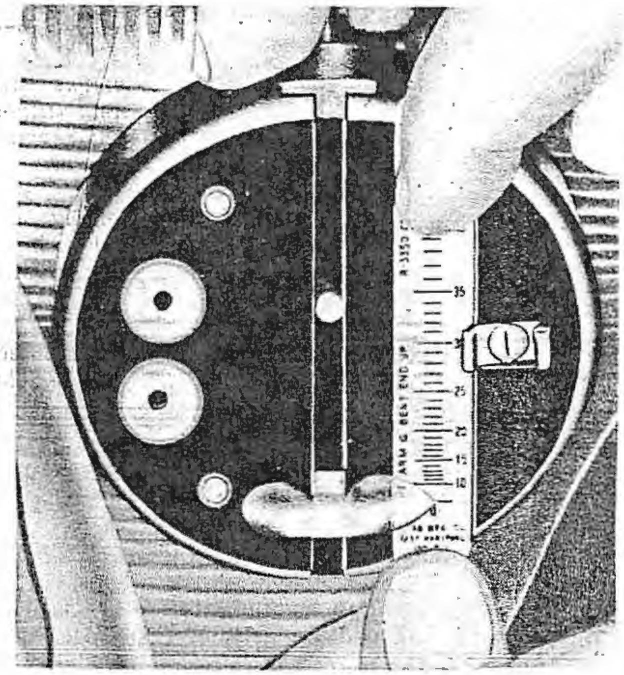

Figure 5-41. Zeroing the Time-Rite Indicator

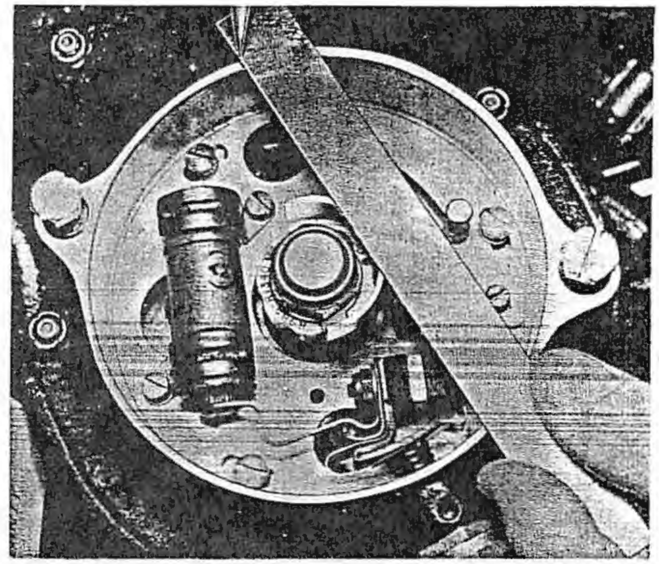

Figure 5-42. Magneto Timing Marks

472650, by attaching a red lead to the breaker connector and the black lead to the magneto housing.
d. Rotate magneto drive until timing light comes on for the No. 1 lobe of the cam.
e. Holding magneto exactly in this position, place a straightedge on the cam step.
f. If the straightedge aligns with the stationary timing mark (± 1/64-inch) internal timing of the magneto is correct. (See figure 5-42.)
g. Magnetos found to have incorrect internal timing will be sent to base shops for adjustment.

3-161. INSTALLATION OF MAGNETO.
a. Place magneto on mounting.

NOTE

It will be necessary to time the magneto to the engine. See paragraph 3-162 for timing of magnetos to engine.

b. Place distributor block and dust cover in magneto.
c. Install four screws in distributor block dust cover.
d. Engage rubber coupling (figure 5-43) and fit magneto over dowel pins in mounting pad. Fasten magneto to engine with cap screws and safety.
e. Install radio shield.

3-162. CHECKING MAGNETO-TO ENGINE TIMING.
a. Locate correct crankshaft timing position (25° before top center compression stroke) of No. 1 cylinder.
b. Connect respective red leads of the timing light to the magneto breaker point connectors and the black lead to the magneto housing. Turn timing light switch ON.
c. Turn master ignition switch ON.
d. Rotate engine crankshaft opposite normal direction of rotation one-fourth turn.
e. Move pointer on Time-Rite indicator to top of scale.
f. Rotate crankshaft slowly in direction of rotation, holding approximately 40 inch-pounds torque on cam retaining screw head opposite direction of cam rotation, until timing light comes on for the No. 1 lobe.

NOTE

The timing light must come on for each breaker point opening within 1/2° of the specified magneto-to-engine timing position.

g. If the magnetos are correctly timed to the engine the following will be noted:
1. Time-Rite pointer will indicate proper crankshaft position.
2. Step on the cam will align with the stationary timing mark (± 1/64-inch) when the straightedge is placed on the cam step.
h. Magnetos found to be incorrectly timed to the engine will be retimed prior to further engine operation.

NOTE

The breaker points or the breaker plate will not be moved to accomplish magneto-to-engine timing.

3-163. RETIMING MAGNETOS TO THE ENGINE.
a. Locate correct crankshaft timing position 25° before top center compression stroke of No. 1 cylinder as outlined in paragraph 3-159.
b. Connect timing light to magneto and turn the timing light switch ON.
c. Turn master ignition switch ON.
d. Rotate crankshaft opposite normal direction of rotation one-fourth turn.

e. Move pointer on Time-Rite indicator to top of scale.
f. Rotate crankshaft slowly in direction of normal rotation, holding approximately 40 inch-pounds of torque on the cam retaining screw opposite direction of cam rotation, until the timing light comes on for the No. 1 lobe.
g. Note direction the magneto is out of time (advance or retard) on the Time-Rite indicator.
h. Reset crankshaft to proper timing position.
i. Remove magneto mounting bolts and remove magneto from engine.
j. Rotate vernier coupling one tooth in required direction and reinstall magneto.
k. Check timing as outlined in paragraph 3-162.
l. If magneto is still incorrectly timed rotate vernier coupling one tooth at a time until correct timing is obtained.

3-164. IGNITION HARNESS CHECK. Proper operation of the ignition system is dependent upon proper installation of all leads and proper condition of the insulation as provided by the dielectric parts in the magneto. The part of the ignition system contained in the magneto can generally be checked by electrical means. However, the part of the ignition lead at the spark plug elbow, due to variations in position between the installed position and electrical test position, cannot always be checked by electrical means. Hence, a visual inspection at this point is required in addition to the electrical check.

NOTE

In the event that a number of spark plugs are replaced in the same cylinder due to improper operation, a high-tension harness check will be made. All defective leads and/or magneto covers will be replaced.

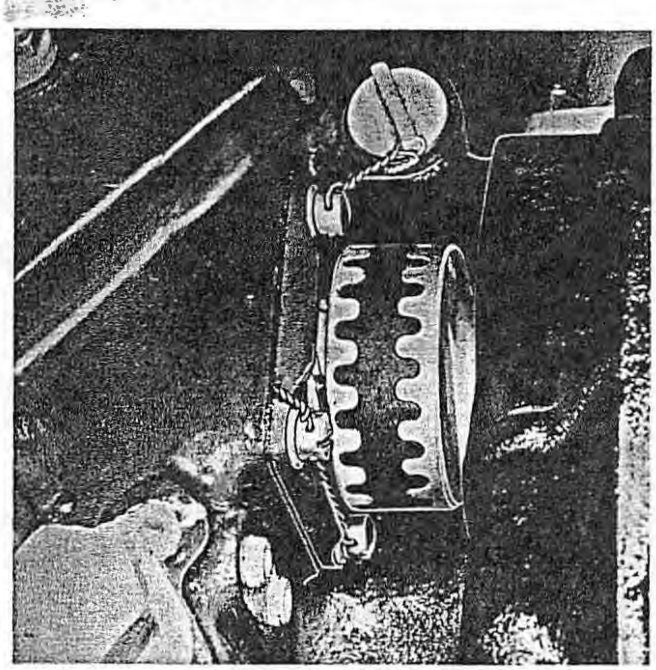

Figure 5-43. Magneto Drive Coupling

3-165. EQUIPMENT REQUIRED. The high-tension harness test may be accomplished with any of the approved harness testers.
a. Delco, Stock No. 7CAC-801815.
b. Hoke, Model 61A, Stock No. 7CAC-801815-8.
c. Electronic Brazing Company, Model 178, Stock No. 7CAC-801815-8.
d. Tensor Electrical Development Company, Model 1111, Stock No. 7CAC-801815-8.

3-166. TEST PROCEDURE FOR IGNITION HARNESS. When conducting the ignition lead test, possibility of leakage will exist between leads and the shielding, and from one electrode in the magneto cover to another electrode in the magneto cover. Hence, the test procedure used must be such that any of the foregoing conditions will be indicated when making the test. The test will be accomplished as follows:
a. Disconnect all leads from the plugs and ground each lead to the engine.
b. Connect ground wire of the ignition tester to either the engine or airframe.
c. Connect lead wire from the tester to one lead at a time of the harness, regrounding each lead after the lead has been tested. If leakage is indicated, the propeller should be rotated to determine if leakage is eliminated with a different crankshaft position. If the indicator leakage stops with a different crankshaft position, it indicates that the leakage was through the distributor finger to the magneto, then through the secondary coil to ground, and does not constitute a lead breakdown.
d. If, during the high-tension electrical test, two or more leads show leakage, repeat the test on one of the leads showing leakage, with the other lead or having leakage insulated from the engine. If insulating other lead or leads eliminates the indication of leakage on the lead being tested, then the leakage is between corresponding electrodes in the magneto cover. Hence, all defective leads will be removed from the cover and retested. Replace defective leads and/or magneto covers as necessary.

3-167. MAINTENANCE AND REPAIR OF HIGH-TENSION IGNITION HARNESSES.

3-168. IGNITION CABLE FOR REWIRABLE HARNESS. To insure maximum ignition system performance on rewirable harness, use 5 mm cables together with the proper terminal assemblies. The entire length of neoprene ignition cables will be thoroughly coated with insulating and sealing compound, Specification MIL-I-8660, prior to installation in the harness to reduce chafing. Use only 7 mm cable grommets. This replacement will be accomplished at all spark plug elbow and manifold outlet connections.

3-169. REPLACEMENT OF IGNITION LEADS. When defective ignition leads are found as a result of the ignition harness test, the test should be continued as outlined in paragraph 3-166 to determine whether the leads or distributor block are defective. If the difficulty is localized to individual ignition leads, a further check should be made to determine if the electrical leaks occur at the spark plug elbow. This can be accomplished by removing the spark plug elbow from the ignition harness, pulling the ignition lead out of the manifold a slight amount, and repeating the harness test on the defective lead. If this corrects the difficulty, sufficient wire should be pulled out of the manifold to permit reinstallation of the elbow assembly, integral seal, and cigarette. In the event it is necessary to replace one or more leads in the ignition harness or rewirable harness, the leads will be replaced as follows:

a. Disassemble magneto or distributor so that distributor block is accessible.
b. Loosen piercing screw in the distributor block for applicable lead to be replaced.
c. Remove lead end from distributor block.
d. Remove approximately 1 inch of insulation from the distributor block end of applicable lead.
e. Remove approximately 1 inch of insulation from end of replacement cable and twist end of replacement cable to end of lead to be replaced and solder.
f. Liberally coat exterior of replacement cable with Dow-Corning Compound, No. 4.
g. Remove elbow adapter from spark plug end of lead and pull the lead through the harness.

NOTE

When pulling the lead through, personnel should also push replacement lead into ignition manifold at distributor block end, to eliminate necessity of excessive force during installation of the new leads.

h. When replacement lead has been pulled completely through the manifold, the ignition lead should be forced up into the manifold from the distributor block end to provide for future shortening of the lead as a result of chafing at the spark plug elbow.
i. Remove approximately 3/8-inch insulation from the distributor block end and prepare end of cable for installation into the distributor block well.
j. Remove approximately 1/4-inch insulation from the spark plug end of the terminal, assemble integral seal, and cigarette.
k. Install marker on the cable to indicate applicable cylinder. In the event new markers are not available, the marker removed from the defective cable should be installed.
l. Install proper ferrule and seal on cable and install in distributor block and secure.
m. Install spark plug terminal sleeve and cigarette. All micalex (grey color) type cigarettes will be replaced with ceramic (white color) type.
n. When a distributor block or one or more cables is replaced, check for continuity and correct location in the distributor.

3-170. SPARK PLUG REMOVAL.

a. When withdrawing the ignition cable lead connection from the plug, care must be taken to pull the lead straight out and in line with the center line of the plug barrel; otherwise, a side load will be applied, which frequently results in damage to the barrel insulator and connector. If the lead cannot be removed easily in this manner, the resisting contact between the neoprene collar and the barrel insulator will be broken by a rotary twisting of the collar. Avoid undue distortion of the collar and possible side loading of the barrel insulator. (See figure 5-44.)
b. In the course of engine operation, carbon and other combustion products will be deposited on the end of the spark plug and will penetrate the lower threads to some degree. As a result, greater torque frequently is required for removing a plug than for its installation. Accordingly, the torque limitations given do not apply to plug removal, and sufficient torque must be used to unscrew the plug. The higher torque in removal is not as detrimental as in installation, since it cannot stretch the threaded section. It does, however, impose a shearing load on this section and may, if sufficiently severe, produce a failure at this location.

NOTE

Torque indicating handle should not be used for spark plug removal because of the greater torque requirement.

c. If the plug is sheared in attempted removal, the cylinder assembly will be replaced, as efforts to unscrew the threaded end are seldom successful under these circumstances, and usually lead to damaged bushing threads which are unsuitable for the installation of a replacement plug. Because of the higher torque involved in plug removal, precautions against

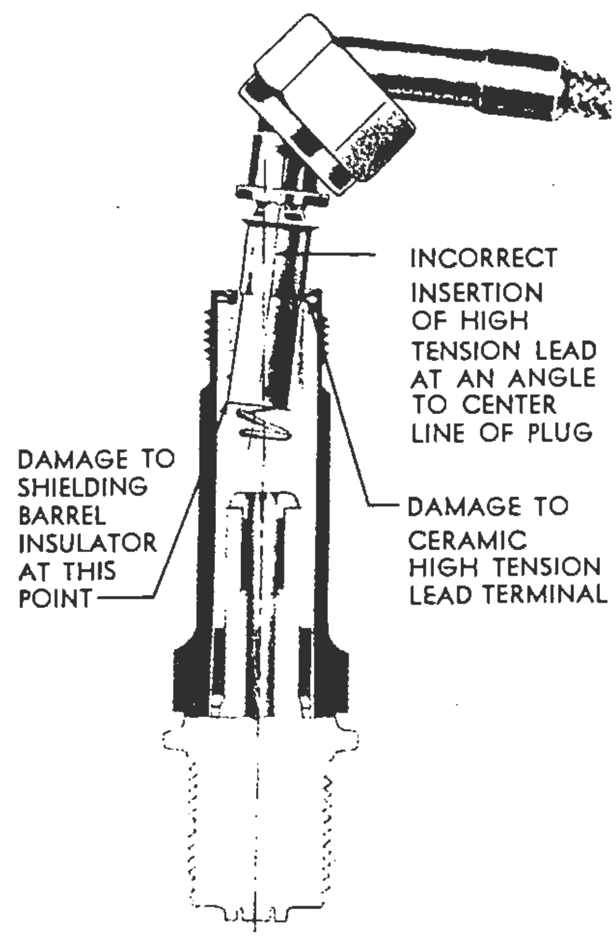

Figure 5-44. Removing Spark Plug Lead

tilting and slipping of the wrench are of increased importance.

d. As spark plugs are removed from the engine, they will be placed in a tray that will identify their position in the engine before removal in order that they may be inspected to determine condition of the cylinders and/or engine.

e. Removal of seized spark plugs in the cylinder may be accomplished by application of liquid carbon dioxide. Conical metal funnel adapter is fabricated which has a hole at the apex just large enough to accommodate the funnel of a CO_2 bottle. (See figure 5-45.) When a seized spark plug cannot be removed by normal means, the funnel adapter is placed over and around the spark plug. Place the funnel of the CO_2 bottle inside the funnel adapter and release the carbon dioxide to chill and contract the spark plug. Break the spark plug loose with a wrench. A warm cylinder head at the time the carbon dioxide is applied will aid in the removal of an excessively seized spark plug.

3-171. INSPECTION OF REMOVED SPARK PLUGS.

a. Inspect the removed spark plugs to determine the cylinder condition and if further maintenance is required.

b. Check for the following conditions:

1. Excessive carbon on firing end of spark plug.
2. Oil in the spark plug firing end.
3. Damaged electrodes or ceramic.
4. Spark plug fouling.
5. Spark plug is authorized for that specific engine.
6. Copper runout of the center electrode.

NOTE

If copper runout is noted, the cylinder that the spark plug was removed from will be replaced, as this indicates that the temperature in the cylinder has exceeded 1981.4°F. The engine will be inspected to locate the reason for the excessive temperature, and the oil screen and magnetic sump plugs will be checked for metal particles. Engines found to have spark plug copper runout on more than 25 percent of the cylinders will be removed from service, as the engine has been subjected to excessive heat that may cause engine failure. Carbon deposits must not be confused with copper runout.

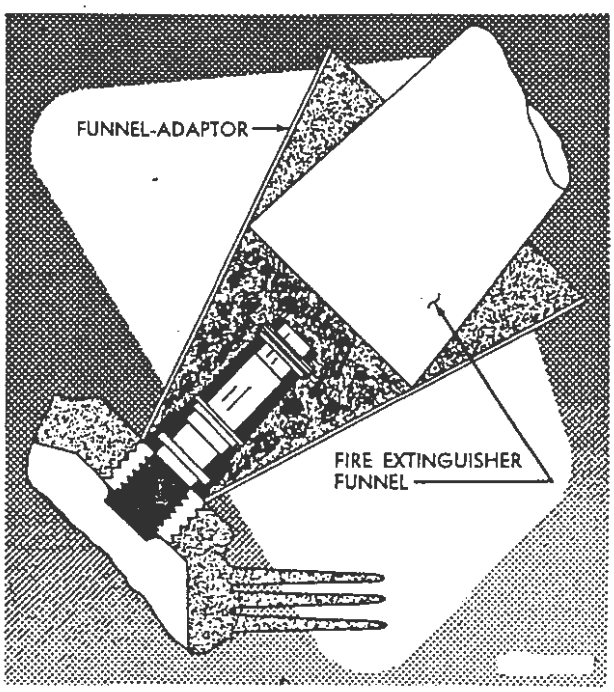

Figure 5-45. Removing Spark Plug Frozen to Bushing

c. When it is noted that a spark plug has not been firing, the cause will be located and corrected prior to any further engine operation.

3-172. PREPARATION OF THE ENGINE FOR SPARK PLUG INSTALLATIONS.

a. Prior to installation of spark plugs in cylinders, action will be taken to clean spark plug bushings in order to insure insertion of plug by using fingers only.

b. The spark plug bushing threads will be cleaned with a tap, stock No. 9DMD-44A6955. Fill between the flutes of the tap with clean grease, Specification MIL-L-3545, or equal. This will prevent dropping of hard carbon or other material into the combustion chamber. Align tap with bushing by sight where possible and start by hand into bushing until certain there is no possibility of tap cross-threading in the bushing. On some installations it may be necessary to use a short length of hose slipped over the square end of the tap to facilitate starting the tap into the bushing. Screw the tap into the bushing to a depth sufficient to insure that full tap cutting thread diameter reached the bottom bushing thread. The tap will remove carbon and combustion deposits from the bushing threads but should not remove bushing material unless the pitch diameter of the threads has contracted due to shrinkage or some other unusual condition. If the bushing is loose in the cylinder, or threads are cross-threaded or otherwise seriously damaged, the cylinder will be replaced.

NOTE

Piston will be moved from top center position before inserting tap into bushing.

c. To eliminate possible spark plug gap fouling at time of spark plug installation, the spark plug gasket seating surfaces will be thoroughly cleaned, using a clean cloth and naphtha.

3-173. INSPECTION OF SPARK PLUGS PRIOR TO INSTALLATION. To insure optimum operation of the spark plugs, the following action and inspection will be accomplished:

a. Ascertain that spark plug type is an approved type plug. (Refer to T.O. 8E2-6-1-37.)

b. Check for evidence of rust-preventive compound on spark plug exterior, core, and interior of barrel end of plug. If rust-preventive compound is evident, it will be removed by cleaning the plug with cleaning solvent, Federal Specification P-S-661, applied by a brush, after which the plug will be dried with air supplied by a tank containing dehydrated air.

c. Check for nicked or damaged threads and indication of cracks in the insulator.

d. Inspect barrel end of plug for rust at center electrode contact, and for foreign material which would result in poor contact. Foreign material may be removed with air blasts.

e. Check copper gaskets. Gaskets which have been excessively flattened, scored, dented, or distorted by previous use will not be used. When thermocouple gasket is used, no additional gasket will be used.

f. Spark plugs which are found defective for any of the foregoing reasons will be disposed of in accordance with T.O. 8E2-6-1-37.

3-174. SPARK PLUG INSTALLATION.

NOTE

Important points to be understood and remembered regarding the proper installation of spark plugs are insertion and torque. Insertion refers to screwing the plug into the bushing with the fingers until it contacts the gasket. If the spark plug can be inserted into the head by using fingers only, this indicates good threads. Torque refers to the action of compressing the gasket. Results of various torque are shown in figure 5-46.

a. Apply a very light coat of anti-seize compound, Specification MIL-T-5544, to the first three threads from the electrode end of each spark plug to be installed.

NOTE

Anti-seize compound will be used on spark plugs to be installed in engines with bronze spark plug bushings to prevent seizure upon removal.

b. Insert the spark plug in the bushing, screwing it all the way in with the fingers.

c. Apply 300 to 360 inch-pounds torque on 18 mm spark plugs. (Refer to figure 5-46 for effects of improper torque.)

3-175. INSTALLATION OF SPARK PLUG TERMINALS.

a. Clean high-tension lead terminal sleeve contact and integral seal with a cloth moistened with methyl-ethyl-ketone, Federal Specification TT-M-261, stock No. 8500-605600, to remove any trace of dirt and grease that may be present. Replace cracked terminal sleeves, deteriorated integral seals, corroded contact springs, etc.

b. Apply a light coat of Dow-Corning Compound No. 200, Federal Stock No. 9150-286-8088, to the lower surface of the integral seal. Application of the compound will be accomplished with a small, clean, dry brush to insure cleanliness.

c. Insert the high-tension terminal sleeve contact in the spark plug barrel, taking precautions not to break the sleeve or crack the barrel insulator.

d. Screw terminal nut all the way on with the fingers.

e. Tighten terminal nut with the proper lead wrench.

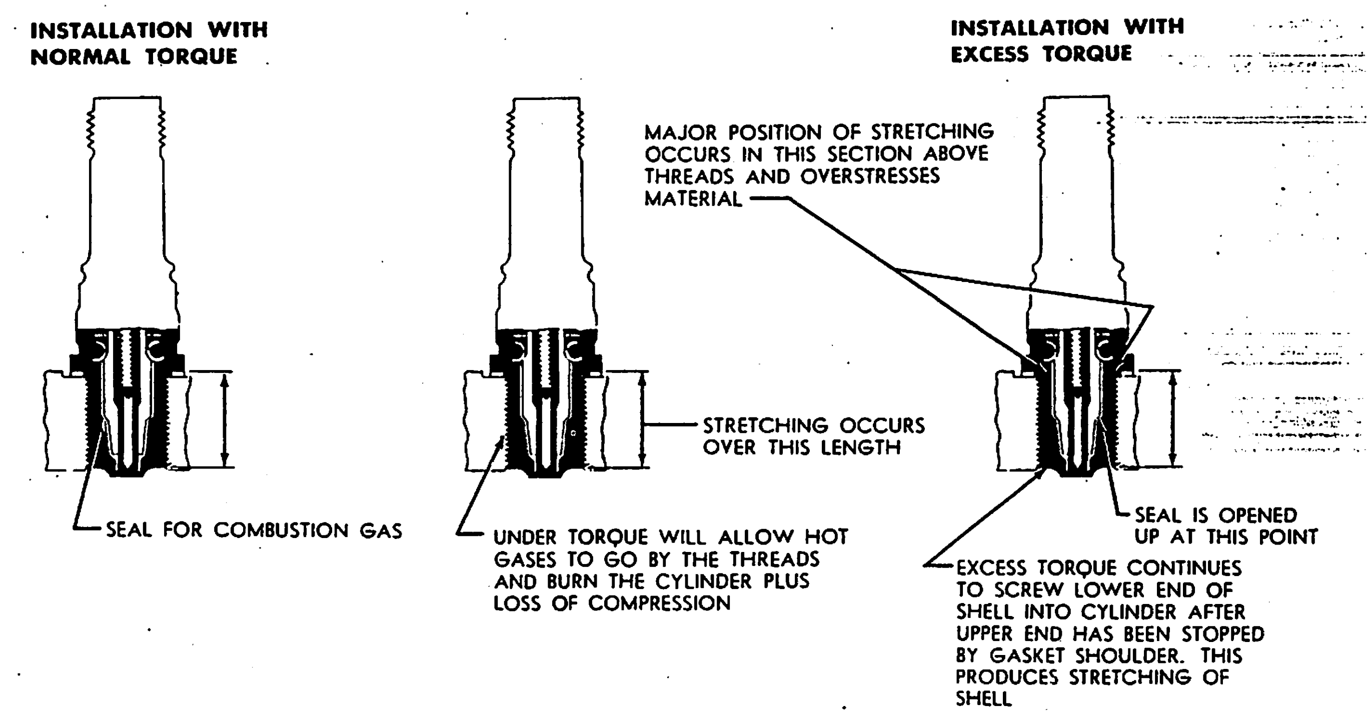

Figure 5-46. Effect of Torque Applied to Spark Plugs

NOTE

If proper lead wrench is not available the terminal nut may be tightened with the proper size open end wrench. Turn nut 15° to 60° past the noticeable point of drag.

3-176. STARTING SYSTEM.

3-177. DESCRIPTION. The starting system consists of an Eclipse Type J-1, 24-volt d-c electric starter on each engine, starter switch located on the pilot's left subpanel (figure 5-47), between the booster switch and primer switch, and an engine selector switch which connects the starter, booster and primer circuits to the engine being started. The starter switch actuates a solenoid switch which is located in the nacelle which in turn connects the starter directly to the battery.

3-178. REMOVAL OF STARTER.
a. Remove junction cap from aft end of starter and disconnect lead from starter terminal.
b. Remove six nuts from studs holding starter to case.
c. Pull starter aft and lift from engine.

3-179. ENGINE TROUBLE SHOOTING. See Table XVII.

3-180. MINOR REPAIR AND PARTS REPLACEMENT. Field repair of starters shall be limited to exterior cleaning, replacement of brushes and springs, or cleaning of commutator.
a. Starter Brushes. Worn brushes should be replaced before their maximum wear limit is reached. The maximum permissible wear of brushes is 5/32-inch from a new length of 1/2-inch. When replacing a worn brush, the new brush should be properly seated by inserting a strip of No. 000 sandpaper between brush and commutator with sanded side next to the brush and pulling in direction of rotation. Repeat until brush is fully seated.

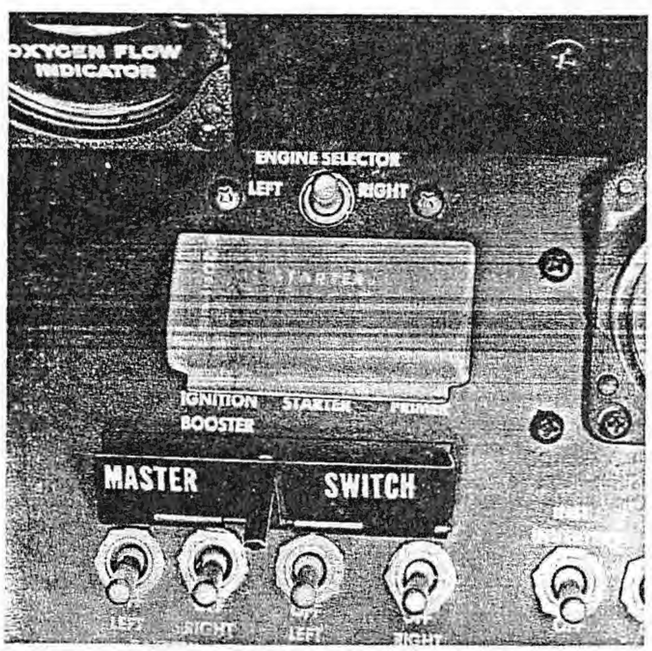

Figure 5-47. Starter Switch

b. Starter Brush Springs. Starter brush springs should be replaced if tension is less than 24 ounces or more than 28 ounces, measured when spring leaves top of new brush.
c. Commutator. If commutator is rough or dirty, smooth with No. 000 sandpaper. If it is badly scored, remove and send to a designated overhaul activity for repair.

3-181. INSTALLATION OF STARTER.
a. Install starter gasket.
b. Place starter in position on mounting studs.
c. Install six screws on mounting studs.
d. Connect lead to starter terminal and install junction cap on rear of starter.

3-182. ADJUSTMENTS. No adjustments other than those listed in the preceding paragraph will be made in the field. If starter is faulty, remove and replace with a new or overhauled starter. Send defective starter to a designated overhaul activity for repair.

3-183. SUPERCHARGING, AIR INDUCTION AND EXHAUST SYSTEMS.

3-184. DESCRIPTION. The supercharging, air induction and exhaust systems are closely interrelated. Each of these systems will be explained separately in the following paragraphs.

3-185. SUPERCHARGER.

3-186. DESCRIPTION. The supercharging system in the R-985-AN-39, R-985-AN-39A and R-985-AN-14B engines consists of a single-stage, single-speed impeller, an impeller gear train, diffuser, diffuser vane, and collector. The supercharger is an integral part of the engine and no repair of superchargers will be accomplished in the field; however, the brief description following should help the mechanic in his understanding of the supercharging system.

3-187. A supercharger is essentially an air compressor. It compresses a greater mass of air into the volume of the cylinders than could be obtained in the normally-aspirated engine. After leaving the carburetor, the fuel-air mixture passes through the supercharger throat to the impeller. The impeller is driven at 10 times crankshaft speed, and because of this speed imparts a large velocity energy to the mixture.

3-188. As the fuel-air charge leaves the supercharger impeller, it passes into the diffuser. The diffuser vanes ensure a smooth flow while allowing the charge to slow down as it moves outward, with the result that the velocity pressure acquired from the impeller is transformed into static pressure. After leaving the diffuser, the charge is stored momentarily and equalized in the collector, then fed to the cylinders through the intake pipes. The manifold pressure is taken at the collector rim.

3-189. Since indicated horsepower is proportional to mass airflow, the engine will respond to this increase in airflow by producing a net gain in available brake horsepower.

3-190. Some of the secondary effects of supercharging are: more even distribution of the fuel-air charge to the cylinders, and more complete vaporization of the fuel. The fuel is injected into the air stream at the carburetor. Vaporization is assisted by the whirling action of the impeller as well as by the heat of compression.

3-191. AIR INDUCTION SYSTEM.

3-192. DESCRIPTION. Provisions for both hot and cold air induction are included in the carburetor air induction system. Cold air enters the ducts at the front of the engine. The carburetor cold air ducts are mounted directly in front of Cylinder 5 and Cylinder 6 (figure 5-48). The heater muff installed around the exhaust collector ring provides heated alternate air to the carburetor. An alternate air valve just below the carburetor, controlled from the pilot's compartment, regulates the flow of hot or cold air through the carburetor.

3-193. ENGINE TROUBLE SHOOTING. See Table XVII.

3-194. REMOVAL OF COLD AIR DUCTS.
a. Remove four bolts from mounting on cylinder head.
b. Remove four bolts from rear baffle mounting.
c. Remove three fillister head screws securing air duct to alternate air valve.

3-195. MINOR REPAIR AND PARTS REPLACEMENT. Replacement of the entire cold air duct will constitute minor repairs.

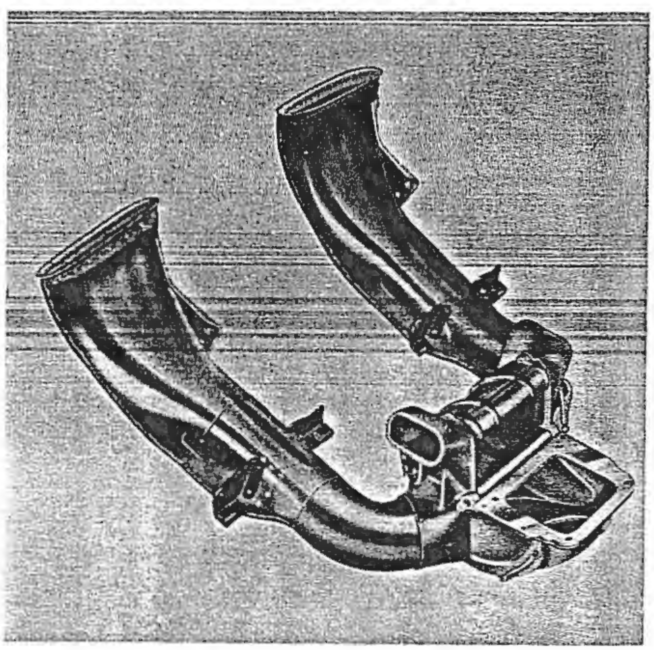

Figure 5-48. Carburetor Cold Air Ducts

3-196. INSTALLATION OF COLD AIR DUCTS.
a. Place duct in alternate air valve and install three fillister head screws.
b. Install and safety four bolts in rear baffle mounting.
c. Install and safety four bolts in cylinder-head mounting.

3-197. MINOR REPAIR AND PARTS REPLACEMENT. Repair shall be limited to the replacement of any or all sections of the heater muff.

3-198. INSTALLATION OF HEATER MUFFS.
a. Place heater muff in position on collector ring.
b. Install and safety eight bolts to heater-muff connections.

3-199. EXHAUST COLLECTOR RING.

3-200. DESCRIPTION. The exhaust collector ring (figure 5-49) on each engine is composed of five segments of corrosion-resistant welded steel tubing. On the outboard side of each ring is a "Y" section through which exhaust gases pass into the tail pipe. The collector ring is connected to the cylinder exhaust ports by short adapters.

3-201. REMOVAL OF EXHAUST COLLECTOR RING.
a. Remove engine wrapper sheets and cowlings.
b. Remove tail pipe fairing.
c. Remove cabin heat valve.
d. Remove bolt between collector ring "Y" and tail pipe.
e. Remove bolt attaching tail pipe to bracket on center section truss.
f. Pull tail pipe and intensifier tube aft until they are clear of "Y" section.

NOTE

The deflector ring installed at the forward end of the intensifier tube between the fresh air inlet and the "Y" section will fall free when tail pipe and intensifier tube are pulled aft.

g. Remove "Y" section.
h. Remove fresh air inlets located on engine baffles

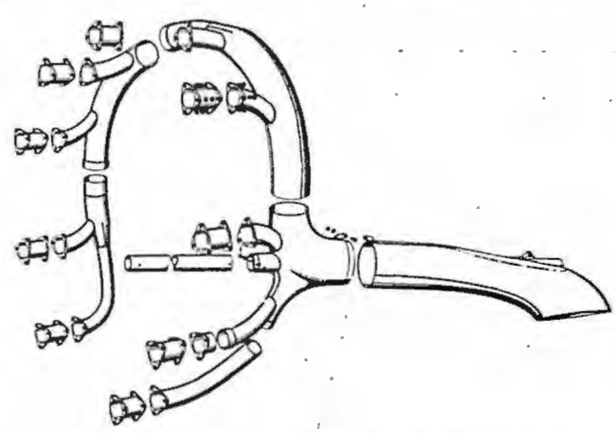

Figure 5-49. Exhaust Collector Ring

between Cylinders 1 and 2 and Cylinders 1 and 9. Remove air ducts to carburetor.

i. Remove bolts holding inboard section of collector ring to adapters.

j. Slip inboard section of collector ring away from engine.

k. Repeat the procedure for the outboard section.

l. Adapters may be removed after the collector-ring sections have been removed.

CAUTION

Special bolts hold the collector ring to the adapters. Do not replace them with standard AN. bolts.

3-202. MINOR REPAIR AND PARTS REPLACEMENT. Repairs shall be limited to the replacement of exhaust adapters or replacement of a section of collector ring.

3-203. INSTALLATION OF EXHAUST COLLECTOR RING.

a. Assemble outboard section of collector ring.
b. Install heater muffs on outboard section.
c. Install outboard section on engine.
d. Assemble inboard section of collector ring and heater muff.
e. Install inboard section on engine.
f. Install "Y" section of collector ring.
g. Install heater muff air inlets.
h. Install tail pipe and intensifier tube.
i. Install cabin heat valve.
j. Install intensifier tube air intake and deflector ring.
k. Install tail pipe fairing.
l. Install engine cowling and wrapper sheets.

3-204. CARBURETOR ALTERNATE AIR VALVE.

3-205. DESCRIPTION. The valve consists of a casting and an internal flapper the purpose of which is to regulate the flow of either hot or cold air through the carburetor. The valve is controlled by the MANIFOLD HEAT controls in the pilot's compartment.

3-206. REMOVAL OF CARBURETOR ALTERNATE AIR VALVE.

a. Remove screws holding the air ducts to the valve.
b. Remove the cover on the bottom of the valve.
c. Remove the nuts attaching the valve to the carburetor.
d. Disconnect control linkage.
e. Pull the valve free of the engine.

3-207. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of replacing the valve casting, the flapper, the shaft bearings which support the flapper and adjustment of the control.

3-208. INSTALLATION OF CARBURETOR ALTERNATE AIR VALVE.

a. Raise valve into position and guide the air ducts into their respective ports.
b. Install attaching nuts. Safety.
c. Install cover plate on the bottom of the adapter.
d. Install the air duct attaching screws.
e. Connect control linkage.

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Pages 179, 180, 181, 182, figures 5-50, 5-51, 5-52, 5-53, 5-54, 5-55, deleted.

2. Remove accumulator retaining bolts with 7/16-inch wrench.
3. Pull straight out on the accumulator, removing it from the hub.

c. Disconnect the propeller control linkage.
d. Remove the locking pin which locks the shaft nut to the propeller shaft.
e. Attach hoist slings to the two blades of the propeller.
f. Using a four-foot bar in the shaft nut wrench (No. 6500246), loosen the shaft nut by turning counterclockwise. Turn it until it is free of the threads, using the hoist to gradually relieve shaft of propeller weight.
g. Carefully manipulate the hoist to prevent the weight of the propeller from damaging the shaft or hub. Care should also be exercised to prevent nicking the rear cone seat of the hub. Pull the propeller slowly off the shaft and place it on a dolly in such a manner that the regulator is not supporting any weight.
h. Remove the rear cone.

3-213. MINOR BLADE REPAIR (AEROPRODUCTS - TC-45G and C-45G).

a. Blade Repair.

1. Make a thorough inspection of the blades, and remove from service any blade showing evidence of any of the following: dents or dimples in the camber sheet 0.015 inch or deeper; bent blades; deep cuts; scratches or damage likely to induce a crack; and nicks which require the removal of an excessive amount of material.
2. In deciding on the repair of nicks or scratches, make note of location and seriousness of the damage. Consideration must be given to any previous repair which has been made on any blade, as additional repairs in the same area might impair the safety of the blade. The blade record should indicate the amount of metal which has been removed in previous repairs, and will enable one to decide upon the extent of further repairs. Enter on AF Form 61 the amount and location of any metal removed in making blade repair.
3. When removing metal, a fine stone should be used and as little metal as possible should be removed. Sharp edges concentrate stresses and may eventually lead to cracks. After dressing with a stone, the surface should be smoothed with crocus cloth. Raised edges or nicks, scratches, and cuts may be removed as shown in figure 5-50. The maximum allowable amount of metal which may be removed is shown in figures 5-51 and 5-52.

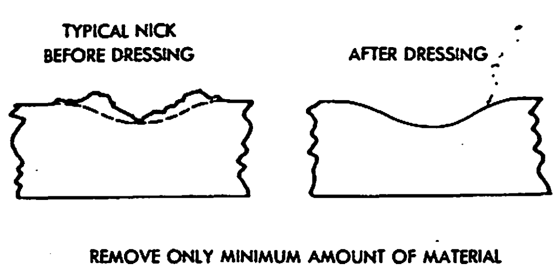

Figure 5-50. Blade Repair

NOTE

Small pin holes or longitudinal voids along the leading and trailing edges often occur from brazing the camber sheet to the thrust member. These voids in no way affect the serviceability of the blade. To improve its appearance, these areas were filled with silver solder at the factory. However, this silver solder is frequently eroded by action of sand and water spray, exposing the voids.

4. Exterior circular pin-hole voids in any location which do not exceed 3/64-inch in diameter are acceptable.
5. Longitudinal voids in the copper braze joint are acceptable providing that copper or silver solder is visible at the bottom of the void. The sharp edges of the voids may be dressed-off level with the copper braze, using a suitable stone and then polishing smooth with crocus cloth Specification P-C-458.

b. Cleaning the Filter. At postflight nearest 25 hours, clean the filter as follows:

1. Cut the safety wire which secures the filter cap. Remove the cap by turning counterclockwise with a socket wrench.
2. Remove the cartridge filter assembly.
3. Remove the O-ring packing from the end of the filter cartridge.
4. Remove the O-ring packing from the filter cap.
5. Thoroughly clean all parts with cleaning solvent, Federal Specification P-S-661. Dry with compressed air.
6. Assemble the filter, installing new O-ring packings.
7. Install and safety the filter cap.

3-214. INSTALLATION OF PROPELLERS AEROPRODUCTS TC-45G and C-45G).

a. Preparation of new propeller for installation.

NOTE

The regulator is shipped 3/4 full of hydraulic fluid.

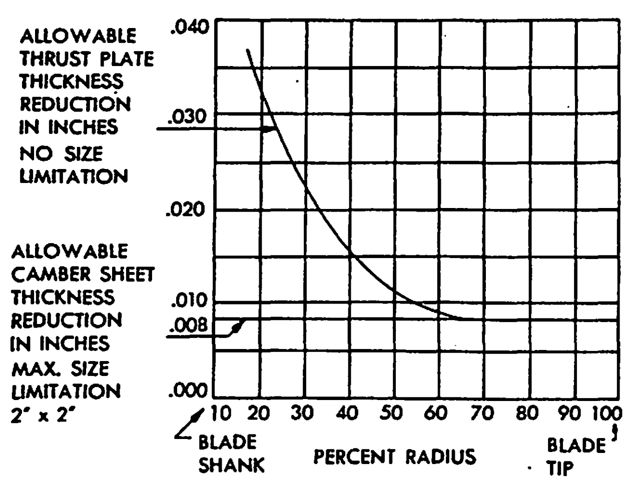

Figure 5-51. Material Removal Chart

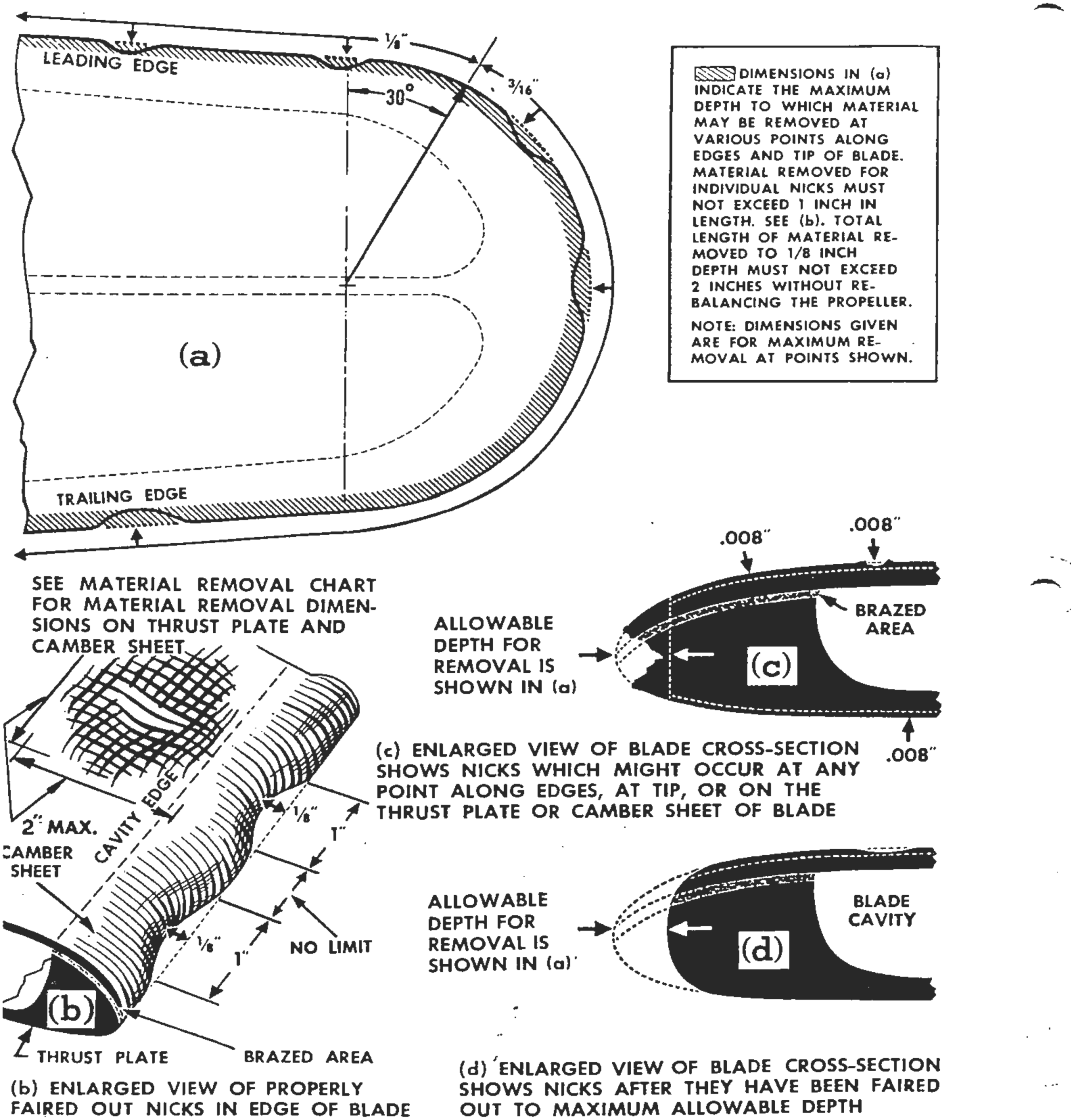

Figure 5-52. Blade Repair Limits

1. Remove the retaining board and the hub case plug from the regulator.
2. Remove the rear cone.
3. Remove the accumulator from the crate.
4. Lift the propeller assembly from the crate.
5. Remove the anti-corrosion compound from the rear cone, the hub bore, and the exterior of the propeller, using clean rags and cleaning solvent, Federal Specification P-S-661.

CAUTION

On new propellers, the hub must be greased before propeller is placed in service. Care should be exercised on this operation as air must be bled from the hub. Insert hub socket air bleeder (No. 6500075) between blade retaining nut and blade shank, being careful not to damage retaining nut grease seals. Apply grease with gun until it appears at the bleeder tool. Remove bleeder tool and relieve excess grease pressure by removing one grease fitting. Reinstall the grease fitting.

b. Propeller Installation Procedure. To prevent corrosion of the engine propeller shaft due to exposure, the propeller shaft will be treated with corrosion preventive compound, Specification MIL-C-16173, prior to installation of the propeller.

1. Remove the nuts and spacers from the engine nose thrust plate at the six o'clock position. Install the adapter stop assembly. Replace the nuts and tighten properly. See figure 5-53.
2. Remove the protective material from the propeller shaft.
3. Note the location of the master spline on the shaft and turn the shaft as required for proper alignment with the hub.
4. Clean the propeller shaft and thrust nut with cleaning solvent, Specification P-S-661, and inspect the clean area for corrosion. Check the shaft for scratches or burrs on the threads or spline.
5. If corrosion is present, remove the thrust nut and repeat cleaning process, being careful not to permit any of the solvent to enter the engine.
6. Remove any burrs, nicks and scratches with a suitable stone and crocus cloth. Remove corrosion by polishing the affected area with crocus cloth or with a small hand buffing wheel, using jewelers rouge or suitable substitute. Do not use any abrasive coarser than specified.
7. If the propeller shaft is severely pitted or galled, replace engine.
8. Clean the shaft to remove traces of corrosion and polishing agents.
9. Install thrust nut and tighten to proper torque (250 foot-pounds, then turn through 25 to 30 additional degrees).
10. Fill the cavity between the thrust nut and the propeller shaft with corrosion preventive compound, Specification MIL-C-16173.
11. Apply a thin coat of corrosion preventive compound, Specification MIL-C-16173, to the propeller shaft.
12. Install a piece of 1/8 inch rubber sheet, Class 2, Specification MIL-R-6855, in the slot of the rear cone. Using a razor blade or sharp knife, trim the rubber to the contour of the rear cone cross section, being careful not to permit any rubber to protrude beyond the surfaces of the cone.
13. Coat the shaft area of the rear cone seat liberally with corrosion preventive compound, Specification MIL-C-16173.
14. Install the rear cone on the propeller shaft (figure 5-54). Push the rear cone against the corrosion preventive compound, rotating the cone about the shaft and against the thrust nut to displace as much of the compound as possible from the rear mating surfaces, completely filling the spaces between the rear cone and the thrust nut.

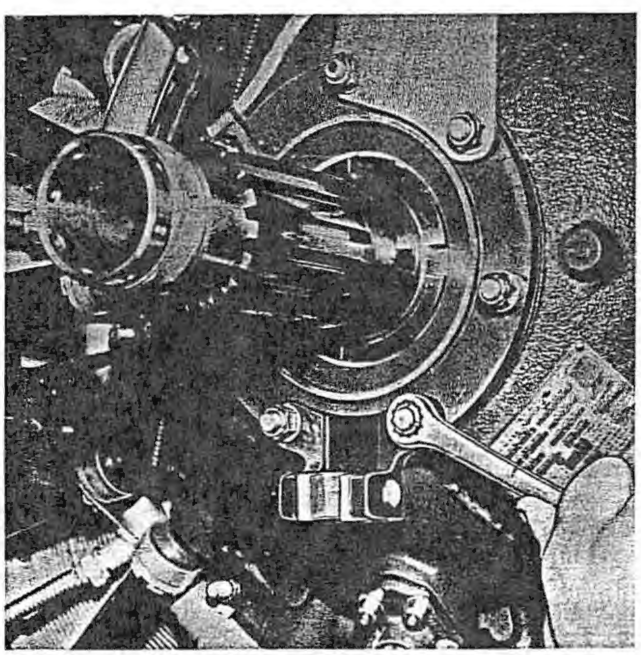

Figure 5-53. Installation of Adapter Stop Assembly

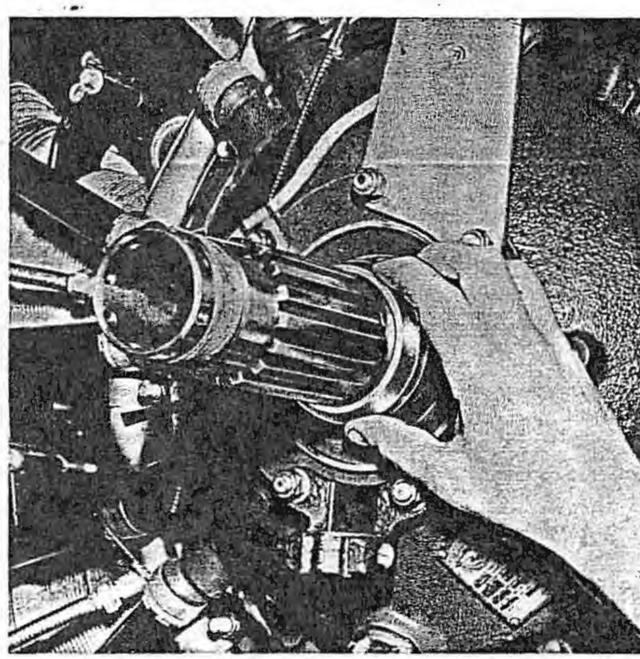

Figure 5-54. Installing Rear Cone

15. With rear cone in position, wipe off the excess corrosion preventive compound on the cone and exposed portion of the thrust nut, leaving a thin film of corrosion preventive compound on the mating surfaces of the cone.

16. Apply a thin coat of anti-seize compound, Specification JAN-A-669, to the shaft threads.

17. Using hoist, align the propeller and guide it over the shaft, being careful not to damage the cone seat, threads, or splines.

CAUTION

Carefully observe that the adapter stop lug aligns with and slides freely into the adapter stop assembly on the engine nose section.

18. Start the nut by hand, turning two or three complete turns.

19. Remove the hoist slings from the propeller.

20. Using propeller shaft nut wrench (No. 6500246) and a four-foot bar in the shaft nut wrench, apply approximately 750 foot-pounds torque (figure 5-55).

21. Install the shaft nut locking pin in one of the holes drilled through the propeller shaft by inserting the pin from the inside diameter of the propeller shaft outward through the hole in the shaft which mates with a castellation of the shaft nut.

CAUTION

If the holes drilled through the propeller shaft will not mate with castellations on the shaft nut tighten the shaft nut slightly. Do not loosen the shaft nut to obtain alignments for the lock pin. If continued difficulty is encountered, remove propeller and replace rear cone.

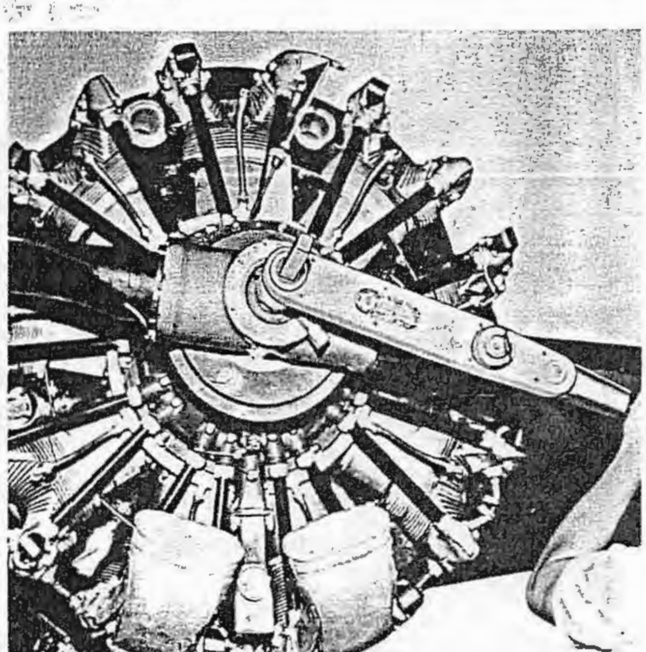

Figure 5-55. Tightening Propeller Shaft Nut

22. Install a washer on the locking pin. Install a cotter pin through the shaft nut locking pin for security.

23. Connect the propeller control linkage. Make certain that the maximum rpm position of the control lever arm is attained and that at least 1/16-inch (maximum 1/8-inch) spring-back is obtained at the control quadrant with the control in the maximum rpm position to assure full travel of the propeller control lever.

24. Warm up engine and operate for approximately 15 minutes.

25. Recheck propeller retaining nut for proper torque (750 foot-pounds).

3-215. INSTALLATION OF ACCUMULATOR (AEROPRODUCTS - TC-45G and C-45G).

a. To prevent possible damage to the regulator as a result of nitrogen leakage the accumulator shall be tested as follows:

1. Charge the accumulator with nitrogen to a pressure of 400 psi.

2. Immerse the accumulator in oil, Specification MIL-O-5606, and inspect for nitrogen leaks from the accumulator disconnect, which indicates leakage past the piston O-ring seal. Inspect for leaks past the O-ring seal on the accumulator head, the air valve body and the air valve.

3. If leakage is in evidence the accumulator shall be returned to overhaul.

4. If no leakage is apparent install the accumulator as outlined below, steps b through d.

b. Install new O-ring gasket, part No. AN6230B18 over the installation end of the accumulator shell and pull up against the attaching flange to prevent entry of water and foreign matter.

c. Install the accumulator.

d. Install the retaining bolts. Tighten to 50 to 70 inch-pounds and safety. Do not use thread lubricant when installing the accumulator retaining bolts.

3-216. CHARGING ACCUMULATOR AND CHECKING NITROGEN CHARGE (AEROPRODUCTS - TC-45G and C-45G).

NOTE

Discharge oil from the accumulator before checking nitrogen charge. To discharge the oil from the accumulator with the engine stopped, move the propeller control lever from feathering to unfeathering position repeatedly, until no further blade angle change is noted. Do not leave the control lever in the feathered position or the blades will not return to the unfeathered position without external aid.

a. Obtain an Aeroproducts propeller accumulator nitrogen recharge truck assembly, Stock No. 8200-954565.

b. Attach the hose valve connection of the recharger to the accumulator air valve.

c. To open valve, turn the knurled wheel of the valve connection clockwise as far as possible.

d. Turn the pressure regulator valve on the nitrogen

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3-220. PROPELLERS.

3-221. DESCRIPTION. The propellers used on all models are full-feathering Hamilton Standard Hydromatic Propeller Model 22D30-313 or 317. The blade design number is 6531A-15. The propeller diameter is 99 inches and the angle at the 42-inch station is from 13 degrees in the low pitch position to 86 degrees in the full-feathered position. This propeller employs the inverted cam whereby the centrifugal twisting moment of the blade and engine oil pressure directed to the inboard side of the propeller piston decreases the blade angle. Oil under governor pump pressure directed to the outboard side of the piston increases the blade angle. Feathering pumps located in each engine nacelle provide oil, under pressure, for feathering and unfeathering. The propeller feathering and unfeathering switches, which were originally located directly in front of the pilot, on the windshield cowl have been moved to the center of the instrument panel (figure 6-3). The switches are located on the small panel in the cutout for the automatic pilot. The switches are positioned with the left propeller feathering switch to the left of the panel center line and the right propeller feathering switch to the right of the panel center line. A distributor valve mounted inside the propeller shaft and extending into the dome assembly permits passage of governor or auxiliary oil to the inboard side of the propeller piston and engine oil to the outboard side during constant speed and feathering operations. However, during the unfeathering operation, the valve shifts under auxiliary pressure and reverses these passages so that oil from the auxiliary pump flows to the outboard side of the propeller piston and oil on the inboard side flows back to the engine. The governor setting is controlled by the pilot to maintain the desired rpm.

3-222. REMOVAL OF PROPELLER.

a. General Procedure.

1. In general, the procedure for removing the propeller is the reverse of the installation procedure. In removal of the dome assembly, care must be taken not to damage the dome retaining nut oil seal. Turn the blades into full high pitch and remove the dome. The dome is usually filled with engine oil and provision should be made to take care of this oil which is to be discarded when the dome is removed from the propeller. Lift the dome assembly off on a line parallel with the shaft so as not to damage the distributor valve. Do not remove dome retaining nut lockwires.

CAUTION

Unless the propeller retaining nut lockwire is removed before the distributor valve is turned, the locking splines on the valve will be damaged.

2. Remove the distributor valve. If difficulty is experienced in removing the valve, back off the propeller retaining nut two or three turns to relieve any compressive effect on the engine shaft.

3. The following steps will complete removal of the propeller from the shaft.

(a) Install the hoisting sling.

(b) Back off the propeller retaining nut and attached front cone. When the retaining nut is backed off the propeller shaft, the outboard ledge of the front cone will contact the hub snap ring and jack the propeller off the rear cone.

(c) Cover the propeller shaft threads with a thread protector, or wrap with tape, if protector is not available.

(d) Remove the spider-shaft oil seal ring, seal, and washer. The seal can be removed in good condition if the propeller is first moved back on the shaft, and the seal carefully guided over the propeller shaft threads.

(e) Remove the propeller from the propeller shaft.

(f) If another propeller is not to be installed immediately, clean, oil, and then cover the propeller shaft.

(g) If the propeller is to be left in storage for any length of time, protect all metal surfaces by applying a coating of corrosion preventive after first cleaning with either Varsol or methyl alcohol (Federal Specification O-M-232). The recommended corrosion preventives are MIL-C-16173 and MIL-C-6529.

b. Removal of Deicing Device.

1. If necessary, disconnect the feed bracket from the engine nose section and then break hose coupling between slinger ring and bracket and tube assembly, leaving the coupling secured to either the slinger ring or the bracket and nozzle assembly. Remove bracket and nozzle assembly from locations at barrel bolts nearest leading edge of each blade. Remove slinger ring.

3-223. MINOR REPAIR AND PARTS REPLACEMENT. Small nicks or scratches may be removed from the propeller blades. A curved "riffle" file is recommended for removing the sharp base of the nick or scratch. Fine emery cloth should be used for polishing and the surface should be etched and examined with a magnifying glass after the defect is removed.

CAUTION

Only small nicks or scratches should be reworked by line maintenance personnel. Other repairs must be made at a designated overhaul activity.

Oil leakage is ordinarily the result of bad seals or improperly torqued sections. Repair of these difficulties will require partial disassembly of the propeller and should be attempted only by authorized personnel.

3-224. MINOR BLADE REPAIR

a. Minor Blade Repair.

1. Aluminum alloy blades which are bent or otherwise damaged beyond the minor repair limits outlined in the following paragraphs shall be forwarded to an approved overhaul base for repair. The types of damage outlined below can be repaired locally by any activity having the facilities and personnel familiar with the work. Typical nicks and methods of removal are shown in figure 5-56.

b. Local Etching.

1. Caustic soda solution for the local etching process to discover cracks, is made by adding one pound of commercial technical-grade caustic soda to a gallon of water maintained at approximately 150 - 170 degrees F. The quantity of solution will depend upon the amount of etching to be done. With No. 00 sandpaper or crocus cloth, clean and smooth off the area containing the apparent crack. Apply a small quantity of the caustic soda solution to the suspected area with a swab or brush. After the area is well darkened, thoroughly wipe it off with a clean damp cloth. Too much water may entirely remove the solution from the crack and spoil the test. If a crack extending into the metal exists, it will appear as a dark line or mark, and by using a magnifying glass, small bubbles may be seen forming in the damage. Immediately upon completion of the checks, all traces of the caustic-soda solution shall be removed with a solution of one part of concentrated technical-grade nitric acid to five parts of water. Wash the blade with clean water. Dry the blade and coat it with clean engine oil.

2. Raised edges of cuts, scars, scratches, and nicks, etc., shall be removed; however, if their re-

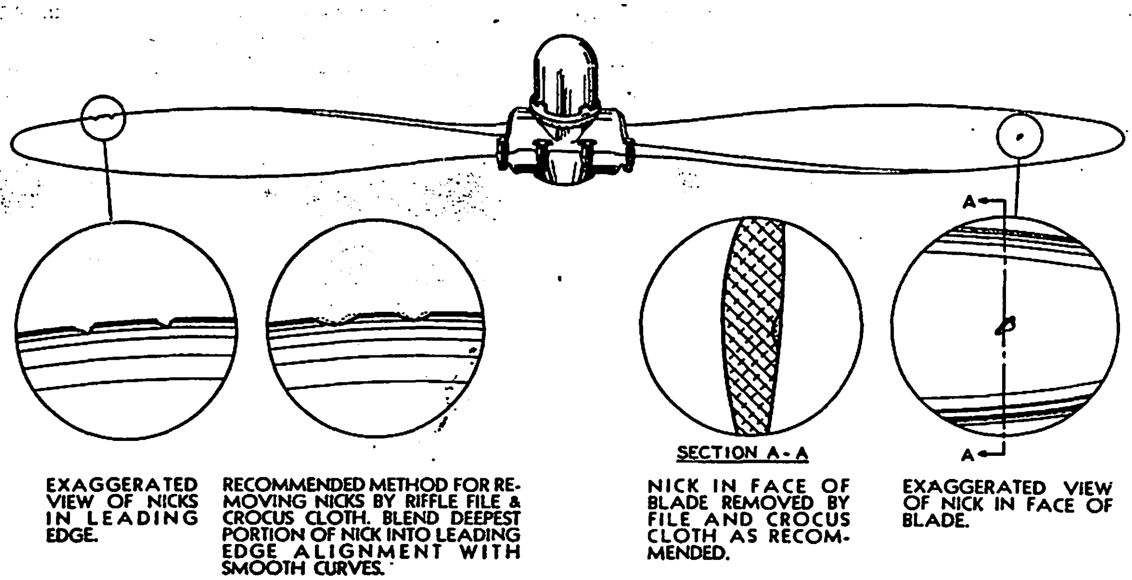


Figure 5-56. Typical Nicks and Methods of Removal

moval or treatment takes the blade below field repair limits, the blade shall be sent to the overhaul base for disposition.

3. Metal around longitudinal surface cracks, narrow cuts and shallow scratches shall be removed in such a way that shallow saucer-shaped depressions are formed. Blades requiring the removal of metal which would form a finished depression more than 0.125 inch in depth at the deepest point 0.375 in width, and one (1) inch in length shall be rebalanced. Blades from which less material than this has been removed, generally do not require rebalancing. Blades that require the removal of metal to a depth of more than 0.125 inch and a length of 0.750 inch shall also be sent to an overhaul base.

CAUTION

The only acceptable methods of repairing cuts, nicks, cracks, etc., in blades are those by which metal containing and adjacent to the damage is removed from the blade to leave a smooth well-faired surface. Methods which attempt to relocate metal by cold working to cover or conceal the damage rather than remove the same are not acceptable.

4. A reasonable number of repairs in a given blade area is not limited provided that their locations with respect to one another do not form a continuous line of repairs which would materially weaken the blade structure.

5. With the exception of cracks, it is not necessary to completely remove or "saucer out" all of a comparatively deep nick unless it has a sharp bottom. Since it is essential that no metal be removed unnecessarily, properly rounding off the edges and smoothing out the surface within the edges is usually sufficient.

6. Blades that have the leading edges pitted from normal wear may be reworked by removing sufficient material to eliminate the irregularities. The metal shall be removed by starting at approximately the thickest section, and working forward over the leading edge camber so that the contour of the reworked portion shall remain substantially the same. In all cases, avoid abrupt changes in the section, or blunt edges. (See figure 5-57).

7. A suggested tool for measuring the depth of depressions is a dial indicator (HSP-1827) having a knife edge base 2.5 inches in length, and a spindle with a phonograph needle at the point. (See figure 5-58.) Determine the deepest point of the damage by visual inspection and careful trial and error method by checking the bottom of the damage with the depth gage and note the indicator reading.

NOTE

Before using the depth gage, check for misalignment of the point with respect to the knife edge by rocking the gage on a hard flat surface. Misalignment will be evident by movement of the indicator pointer. When measuring the depth of the damage, the gage straight edge should be parallel with the blade centerline. When damage in a previously reworked area is being measured the straight edge should be across the area and parallel with the blade centerline, taking zero reference adjacent to this previously reworked area.

8. The only acceptable method of removing the damage is that by which metal of and adjacent to the damage is removed from the blade with die-makers riffler files and emery cloth. All traces of the damage should be reworked from the blade and the resulting depression should be smoothly faired into the blade surface. The equipment necessary for blade damage rework includes one each die-makers, No. 8, 10 and 17, "0" cut, dry emery cloth numbers 120 and 240, a 3-power magnifying glass, and local etching equipment.

c. Rework. The following procedure is recommended for rework of blade damage:

1. Using a pencil or another soft marking device which will not penetrate the blade surface, mark light perpendicular lines on the blade surface so that they intersect at the deepest point of the damaged area and extend them sufficiently to permit location

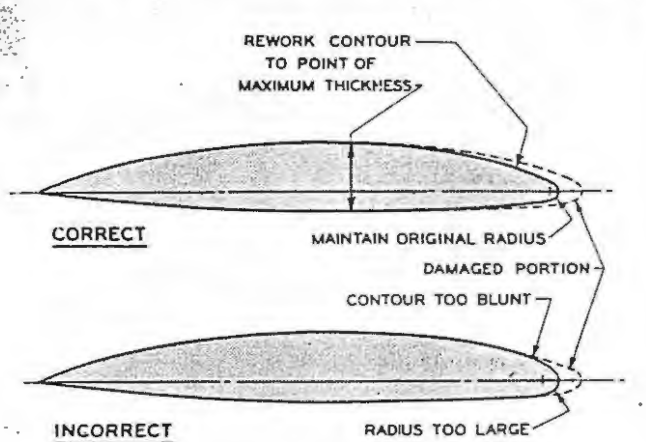


Figure 5-57. Rework the Leading Edge

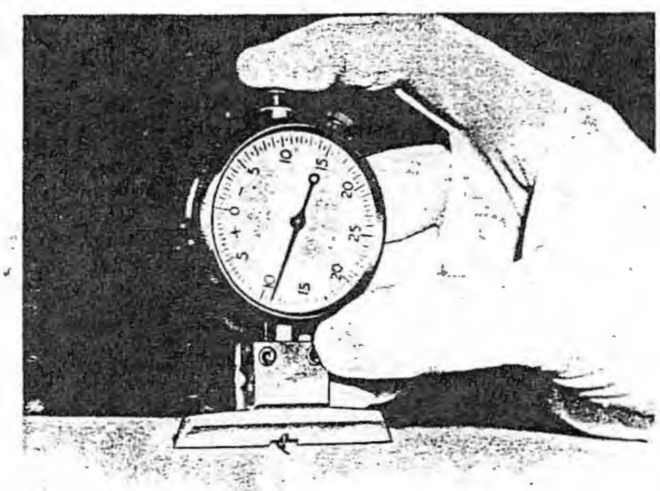


Figure 5-58. Measuring Depth

of the deepest point of the damage following rework. (See figure 5-59.)

2. Work out the abrasion using the file with the cut most convenient. File in a direction parallel to the scratches. (See figure 5-60.) Blend in the reworked area with the original blade surface by filing to form a saucer-shaped depression being careful to remove all traces of the damage. The depression must not exceed the dimensions stated in previous paragraphs. Remove all traces of the file marks with No. 120 emery cloth followed by No. 240 emery cloth, leaving a polished surface. The applications of the emery cloth can be facilitated with the use of a riffler as shown in figure 5-61.

3. With a depth micrometer set at zero reference, measure the amount of blade stock removal. If the final depth exceeds permissible stock removal depth, the blades shall be removed from service.

d. Inspection of Reworked Area. If local etching is performed on reworked areas to inspect for possible cracks resulting from abrasion, the following procedure is recommended:

1. Swab the reworked area with the solution recommended in paragraph 3-224.b.1.

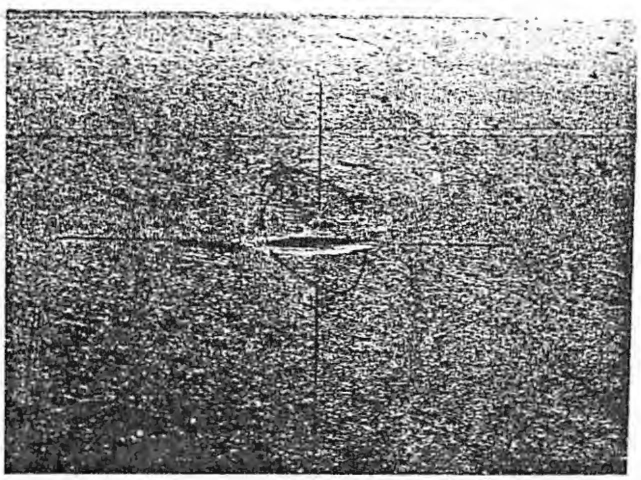


Figure 5-59. Abrasion Before Rework

CAUTION

Do not allow the caustic soda or nitric acid to contact rubber or enter the cavity between the blade and hub.

2. After the area has been etched for approximately three (3) minutes, clean by swabbing with the nitric acid solution recommended, afterward swabbing off the area with clean, warm water.

3. Any cracks in the reworked area will appear as dark lines. Evidence of a crack is cause for removing the blade from service.

4. If no cracks are evident, polish the treated area to remove all traces of the etch as shown in figure 5-62.

3-225. INSTALLATION OF PROPELLERS

a. Description of Propeller Parts. (See figure 5-63.)

1. The 22D30 propellers prepared for installation on the engine-propeller shaft consists of the barrel and blade assemblies, the dome assembly and the distributor valve assembly. (The deicing device assembly if used, is secured to the hub.) Certain attaching parts are included in the barrel assembly and are: the rear cone, the front cone, the spider shaft oil seal group, the spider barrel seal, the retaining nut, the hub snap ring, and the retaining nut lockwire. The attaching parts for the dome assembly consist of dome seal, retaining nut, and lockwires.

2. To insure proper balance and dome-barrel gear preload, the assemblies of each propeller should be kept together as a propeller unit.

3. On certain airplanes the deicing device is not used. However, in the event the deicing device is called for, it is recommended that these parts be installed on the propeller assembly previous to installation. Install the feeder tube assembly on the engine using a 0.312 spacer. See figure 5-64. Connect the deicing fluid supply tubing to the feeder tube. Make certain all connections are tight.

4. It is not necessary to wash down the propeller prior to installation in order to remove the corrosion

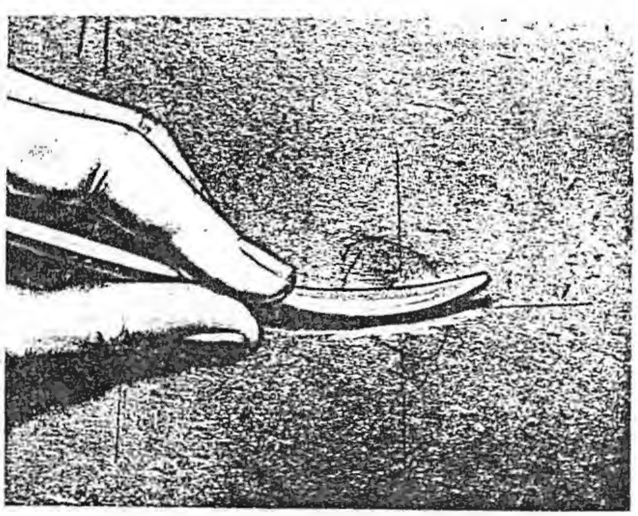


Figure 5-60. Filing Tool Application

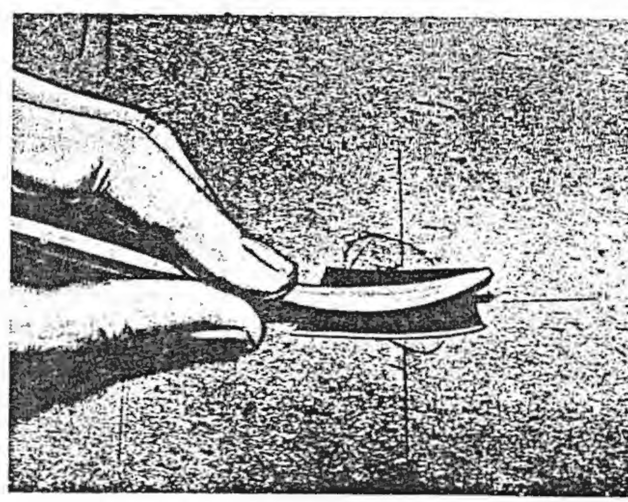


Figure 5-61. Emery Cloth Application

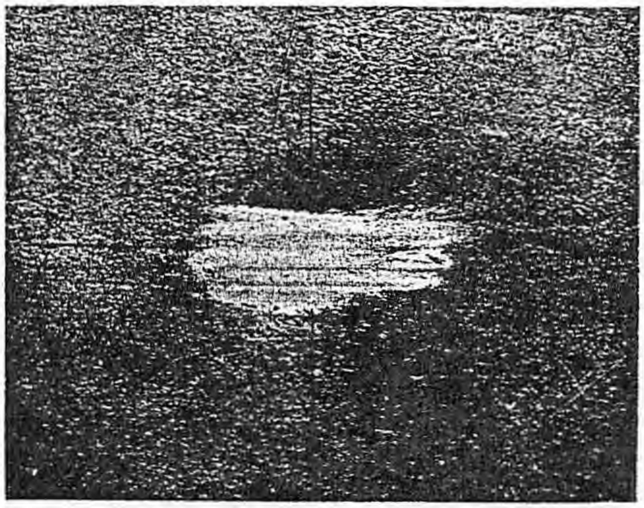


Figure 5-62. Abrasion Area After Rework

preventive compound. Since the compound is soluble in engine oil, it has no ill effects on either the engine oil or any parts concerned. However, it may be desirable to remove the material from external surfaces to facilitate handling.

5. If the propeller assembly has been standing idle for a considerable length of time, either in storage or on an airplane, the blades' packings may stick to the blade shank. This condition causes high blade torque which is especially noticeable during feathering and unfeathering checks. These sticking packings can be loosened up by working a small quantity of engine oil between the blade packing and the blade shank. To facilitate this operation, hold back the blade packing from the blade with about a 0.010 inch feeler gage, or use some other piece of thin shim stock which will not damage the blade or packing and then work in the oil.

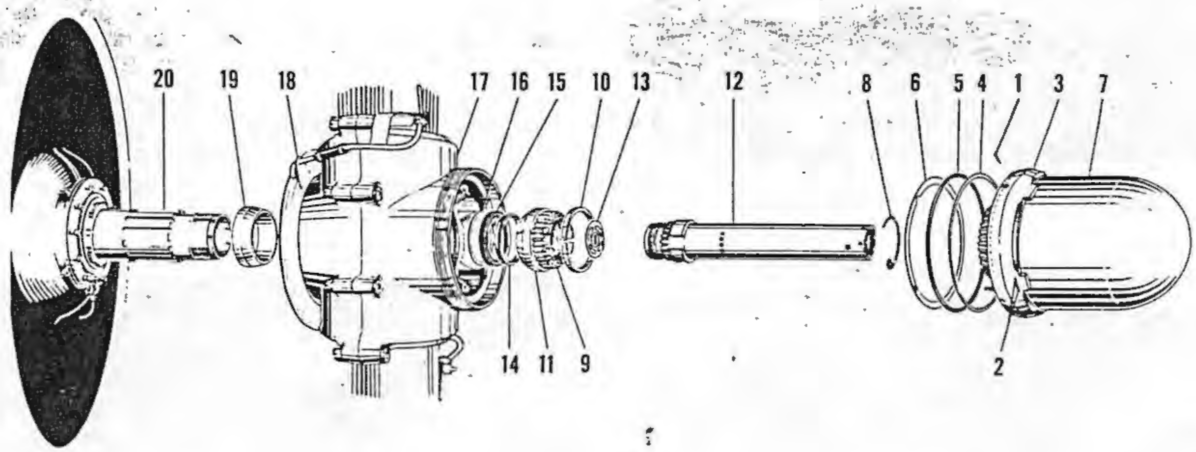
NOTE

On those propellers having restrained blade packings and special washers, the minimum clearance between the blade shank and washer ID is 0.010 inch. If the clearance is less, the washer should be replaced with a like washer which will permit this clearance.

b. Preinstallation Checks.

1. Before installing a propeller, all parts which are accessible without disassembling should be visually examined for damage and checked for fit and freedom of movement. All traces of corrosion and all raised edges of nicks, burrs, cuts, galling and scoring on joining surfaces of attaching parts shall be carefully stoned down. All small metal particles following any stoning or dressing of propeller parts should be removed. If carbon tetrachloride or any other recommended cleanser is used, make certain all traces are finally removed and the parts thoroughly dried. In order to protect the synthetic rubber seals and packings, use either carbon tetrachloride or straight-run gasoline. Do not use aromatic fuels for cleaning a propeller.

2. Inspect the propeller shaft splines and threads for nicks, burrs or similar damage. Dress down any



1. Cotter Pin
2. Lockwires
3. Dome Retaining Nut
4. Shim
5. O-Ring Seal
6. Preload Shim
7. Dome Assembly
8. Propeller Retaining Nut Lockwire
9. Propeller Retaining Nut
10. Snap Ring
11. Front Cone
12. Distributor Valve
13. Gasket
14. Spider and Shaft Seal Ring
15. Spider and Shaft Seal
16. Spider and Shaft Seal Washer
17. Barrel Assembly
18. Deicing Device Assembly
19. Rear Cone
20. Propeller Shaft

Figure 5-63. Propeller Assembly Extended Off Propeller Shaft

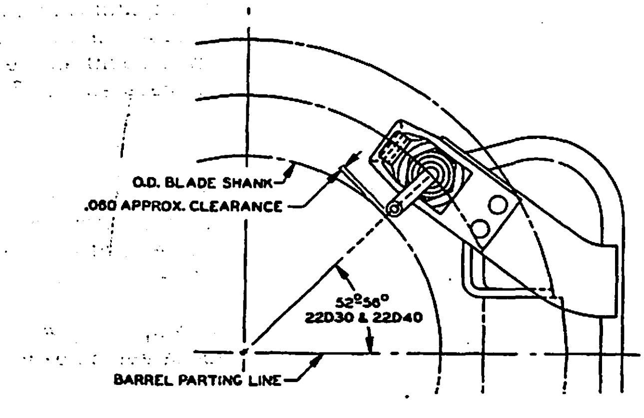


Figure 5-64. Deicing Device Nozzle Installation

such imperfections with a fine stone and polish with crocus cloth. Wash the shaft with a recommended cleanser and allow to dry thoroughly afterward applying a light film of clean engine oil (Specification MIL-L-6082) to both outside and inside of the propeller shaft.

c. Propeller Installation Procedure.

1. Install a sheet of 1/8-inch rubber Class 2, Specification MIL-R-6855, in the slot of the rear cone. Using a razor blade or a sharp knife, trim the rubber to the contour of the rear cross section, being careful to permit no rubber to protrude beyond the surfaces of the cone. Install the rear cone with its slot in line with the centerline of the wide spline on the propeller shaft and move it back until it contacts the propeller shaft thrust bearing nut. The cone and shaft may be lightly oiled or left dry. To prevent possible seizure of the propeller retaining nut, apply a thin film of thread lubricant or clean engine oil to the shaft internal and external threads.

2. Cover the propeller shaft threads with a thread protector or wrap with tape if a protector is not available. Lift the propeller assembly by means of the hoist and sling making certain the propeller is held so that the blank spline in the spider is in line with the wide spline on the engine-propeller shaft, and that proper blade clearance is provided for the work stand. Install the propeller on the shaft.

NOTE

On most new engines, oil and corrosion preventives are flushed from the cylinders prior to installation of the engine on the airplane. In the event this has not been done and the engine has been standing idle for an appreciable time after propeller installation and before engine run-up, the portion of the cylinder interiors wiped clean of the protective coating due to propeller rotation during installation, may corrode. In such a case, it may be well to install the propeller on the shaft while it is still in the dead center position with the wide spline aligned with number one cylinder as is customary. This will eliminate turning the shaft.

3. Remove the thread protector (or tape) from the shaft. The spider-shaft seal group consists of the spider-shaft oil seal washer, spider-shaft oil seal, and the spider-shaft oil seal ring. Install these parts over the shaft in that order to fit outboard of the propeller splines. The open end (or lips) of the seal faces forward or away from the engine. Use a blunt soft instrument while installing the seal to aid in seating it without damage.

4. Apply a thin film of thread lubricant or clean engine oil to the inner diameter of the propeller retaining nut.

5. Install the front cone on the propeller retaining nut. These parts are made so that the groove incorporated inside of the front cone matches with the flange at the base of the retaining nut. Turn the blades to low pitch to move the toothed portion of the blade gear segments down into the hub, thereby providing the necessary clearance which will allow installation of the propeller retaining nut and front cone halves. The ends of the blade gear segments will contact the phenolic spider ring; therefore, do not swing blades hard, but turn slowly and only far enough to provide clearance. Start the propeller retaining nut and attaching front cone on the propeller shaft threads by hand. Install the front cone so that the parting surfaces of the two halves which are adjacent to the cone part number are in line with the wide spline centerline. Equidistance between the front cone halves should be maintained when applying torque to the propeller retaining nut.

CAUTION

The propeller retaining nut should advance on the threads without binding or catching. If it does not, recheck both the retaining nut and the propeller shaft threads for burrs, nicks, the cross-threading, etc.

6. Tighten the propeller retaining nut on the shaft using the installation wrench HSP-1483 in conjunction with a bar. The required torque for this operation is 750 - 1100 foot-pounds.

7. In order to fully tighten the nut on the shaft, strike the bar close to the wrench with a hammer weighing about 2.5 pounds while the tightening torque is being applied. Determine if one of the locking slots in the retaining nut is in alignment with one of the holes in the propeller shaft. If not, continue tightening until one slot and hole are in alignment. Spacing of the slots in the propeller retaining nut with respect to the holes in the propeller shaft is such that alignment of a slot and hole will occur at each five degrees of rotation.

8. Compress the propeller hub snap ring and install it in the spider snap ring groove.

CAUTION

Removal of the propeller may be extremely difficult if the hub snap ring is not in place.

d. Distributor Valve Installation.

CAUTION

Do not tamper with or attempt to turn the engine crankshaft standpipe in a counterclockwise direction. This turning will cause disengagement of the standpipe components, thus rendering the engine unserviceable. Should movement of the standpipe be detected, turn the standpipe in a clockwise direction until snugly fitted. Installation of distributor valve will retain the standpipe in a locked position.

1. Install the correct gasket inside the propeller shaft. Make certain that the engine shipping plug is removed from the shaft. Apply a thin film of thread lubricant or clean engine oil to the threads on the base of the distributor valve. Screw the valve into the propeller shaft by hand.

CAUTION

The valve should advance into the propeller shaft smoothly and easily. If binding is noticed, remove the valve and check the threads of the shaft and valve for burrs, damaged threads, cross-threading, etc. If binding persists, back off the propeller retaining nut two or three turns and then screw the valve into the shaft. Backing off the nut relieves the compressive effect. Tightening the propeller nut will occasionally reduce the internal dimensions of the shaft sufficiently enough to cause binding between the valve housing and the propeller shaft threads.

2. Tighten the distributor valve into the propeller shaft using wrench HSP-1482 and a bar one foot long using a torque of 100 foot-pounds. While this torque is being applied, strike the bar lightly near the wrench with a hammer weighing 2.5 pounds. Repeat this tightening operation until one of the locking slots on the valve housing is in alignment with the same locking hole in the shaft as determined by the retaining nut.

CAUTION

Under no conditions should the valve housing be backed off even slightly in order to obtain slot and hole alignment. If this alignment cannot be obtained without exceeding the specified torque, remove the distributor valve and reinstall it using a new gasket.

3. Insert the propeller retaining nut lockwire in the lockwire groove of the retaining nut and make certain that the extended portion of the wire fits through the propeller retaining nut and the propeller shaft and locks into a slot in the valve housing.
4. Install the proper preload shims.

NOTE

The thickness of shims required is etched on the dome barrel shelf.

5. Set propeller blades to the full feather position (86 degrees).

e. Installation of Dome Stop Rings.

1. Prior to dome installation, the high and low pitch stop rings must be checked for correct positioning in the dome. The cam track length determines the maximum possible angular travel of the cam bevel gear and consequently the blade range. The stop rings determine the actual angular settings (operating limits) always shorter than the maximum possible range. The relationship of the blade gear segments to the rotating cam gear determines where the blade angular range is positioned. The gear ratio between the cam bevel gear and the blade segment is 4.3 and determines the actual angular travel of the blade for a given angular travel of the cam. In other words, a four degree movement of the rotating cam produces a three degree movement of the blades.
2. The angle between adjacent teeth determines the major steps of indexing the blade to the cam. Without changing the position of the rollers on the cam track, the blade range can be shifted the amount of tooth angle (in this case 7.5 degrees) by reindexing the gear segment to the cam bevel gear. This permits selection of various blade angle ranges for the same cam range. The indexing is automatically accomplished by use of stop rings properly selected for the range desired.
3. The stop rings serrated on their ID to match with serrations on the OD of the rotating cam are used to set the low pitch blade angle and full feathering blade angle. The stop rings are stamped with four numbers as shown with five serrations representing five degrees between numbers. Both rings are identical in construction and marking and are functionally interchangeable.
4. The following example will serve to illustrate the procedure used in setting the stop rings in the dome assembly to obtain the required blade angles: Assuming (as is required) a basic low blade angle of 13 degrees and a feathering angle of 86 degrees is required. The index angle number on the low pitch stop ring must be equal to or lower than the required low angle. Since the markings on the rotating cam are increments of five degrees, we therefore select number 10 degree marking on the low pitch stop ring and install it on the rotating cam to mesh with its degree marking of 13. See figure 5-65. The high pitch stop ring will also use the number 10 as its indexing angle meshing it with the 86 degree marking of the rotating cam four teeth clockwise of the 82 degree mark on the cam. See figure 5-66. The blade segmental gears will be installed with the serrations at the 10 degree marking on the gear mating with the arrow-indicated serrations on the blade bushings. As the operating range is 83 degrees and the basic range is 73 degrees, ten degrees of cam track will not be in the operating range.
5. In order to prevent the stop rings from falling out of the dome, it is permissible to spring the stop rings slightly out of round so as to provide sufficient friction to hold them against their own weight. The low pitch stop is installed first and the high pitch stop ring last.

3-226. INSTALLATION OF DOME. Domes may be encountered on 22D30 propellers with either a Toroid O-ring type seal or a chevron type seal. The installation procedure with either seal is the same. It is necessary to follow the procedure below at the time the entire propeller is removed and installed or when the dome only is removed and installed to insure the dome is bottoming against the barrel shelf so that the seal will not wrinkle and subject the dome to leakage and possible failure. After the high and low pitch stop rings have been installed, install the dome in the following manner:

a. Install the required number of preload shims over the fixed cam locating dowels in the dome assembly.

NOTE

The thickness of shims required is etched on the dome barrel shelf.

b. Set the dome assembly in the high pitch position.

c. Place the propeller blades in the same high pitch position by lining up the correct angle stamped on the blade butt with the index line on the inner periphery of the dome barrel shelf. Be certain that all blades are at the same angle as the dome.

CAUTION

When installing the dome assembly on the hub assembly, it is absolutely essential that the cam gear in the dome meshes properly with the blade gear segments. When the dome assembly and the blade assemblies are set at the same high pitch angle, the mating teeth will mesh properly. Make certain that the high pitch angle set in both the dome and the hub assemblies is identical.

NOTE

The initial installation is made without the dome barrel seal in place to determine the proper position of the retaining nut when fully tightened.

d. Lift the dome assembly into position and install it so the fixed cam locating dowels fit into their respective holes in the hub assembly. Make certain that the arrow etched on the base of the fixed cam coincides at installation with the arrow stamped on the dome barrel shelf of the outboard barrel half.

CAUTION

Make certain the dome slides over the distributor valve evenly without damage to the valve or to the piston sleeve.

e. Turn the dome in a counterclockwise direction until the fixed cam locating dowels enter the dowel holes in the dome barrel shelf of the outboard barrel half.

f. Start the dome retaining nut into the hub assembly by hand, turning the dome retaining nut, then attach the proper wrench and wrench bar. Tighten the dome retaining nut, using a torque sufficient to seat the dome on the barrel shelf (usually about 250 foot-pounds). Do not exceed 750 foot-pounds.

g. Mark the position of the dome retaining nut with respect to the barrel. Then remove the dome.

NOTE

With the dome assembly properly seated in the barrel, the front face of the dome retaining nut will be approximately flush with the front edge of the outboard barrel half. Tightening of the dome retaining nut, in addition to fastening the dome unit to the hub, serves to apply the preloading force to the gears and to compress the dome barrel seal. Failure to tighten the dome unit securely in the hub will result in elongation or failure of the dome shell retaining screws and oil leakage around the dome retaining nut.

h. Install the proper dome barrel oil seal seat.

i. Reinstall the dome assembly and apply sufficient torque to the dome retaining nut to bring it at least to the position previously marked and to obtain alignment of the dome retaining nut cotter pin hole with one of the slots in the outboard barrel half dome re-

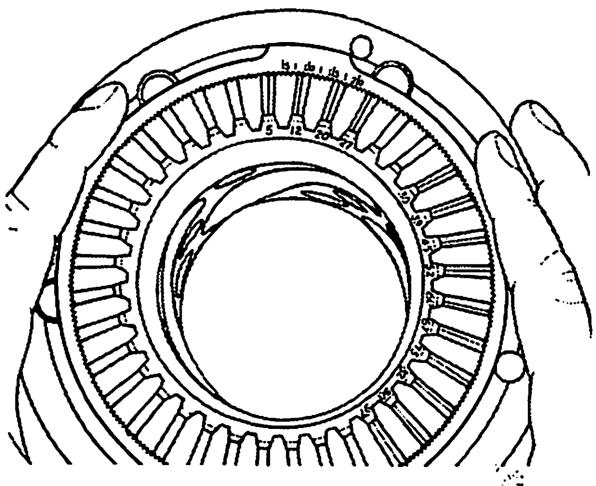


Figure 5-65. Inspecting Setting of Low Pitch Stop Ring

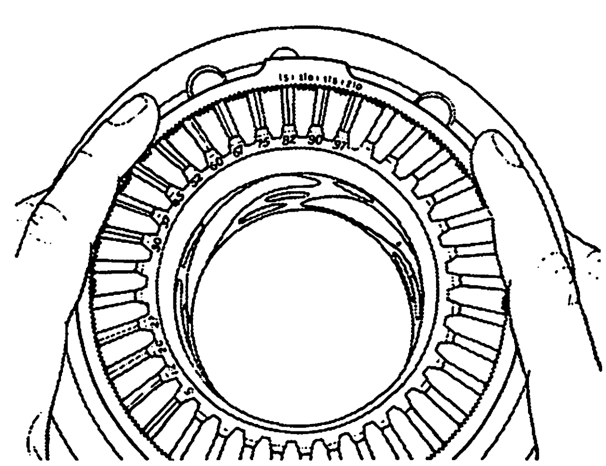


Figure 5-66. Inspecting Setting of High Pitch Stop Ring

taining nut threads. Once the dome retaining nut has been started into the hub, do not back it out; the dome barrel seal may catch between the threads when the retaining nut is retightened after it has been partially backed out.

j. Install the two dome retaining nut lockwires and cotter pin.

k. Check the high pitch blade angle either by the index line on the blades and the graduations on the barrel blade bore (if the propeller has this feature) or by a bubble protractor at the reference station and then, using suitable blade turning levers, shift the propeller blades into the full low pitch position and check the low blade angle. These angles should be the same as the high and low pitch settings of the stop rings and this check will insure that the correct relationship between the blade gear segments and the cam gear has been obtained.

l. If, after installing the dome according to the procedures outlined above, leaks are encountered around the dome, proceed as follows:

1. Remove the dome.
2. Install a shim or shims as required to the outboard side of the seal to stop leakage (a maximum of 6 each shims is permitted).
3. Reinstall the dome and check for leakage.

3-227. PROPELLER GOVERNOR.

a. The 4B2-1 (formerly known as 4B2P8) Hydromatic Constant Speed Control is a self-contained single action, single capacity control which automatically brings about adjustments in the propeller blade angle necessary to maintain constant engine speed under varying flight conditions. This control or governor consists of: a gear pump which takes oil from the engine lubricating system and boosts it in pressure to that required to operate the propeller blade angle changing mechanism; a pilot valve actuated by spring-balanced flyweights which controls the flow of oil to and from the propeller; a pressure operated transfer valve which on feathering installations allows high pressure oil from an auxiliary pump to shut out the governor when the propeller is being feathered and unfeathered; and a relief valve system which limits the output pressure of the gear pump yet allows it to provide sufficient operating pressures to control the propeller.

3-228. REMOVAL OF PROPELLER GOVERNOR. Disconnect cockpit control from unit. Following one of the two removal procedures outlined below will aid in reestablishing the same relationship between the cockpit control and constant speed control high rpm setting, thereby reducing to a minimum the amount of rpm adjustment necessary when the unit is reinstalled on the engine.

a. If the pulley is to be taken off with the control, the cable should be marked where it attaches to the cable clamp on the pulley. At governor reinstallation, insert the marked section of the cable under the governor pulley clamp, tighten the retaining nut and then secure with a cotter pin.

b. If convenient, leave the pulley attached to the control cable at the time of governor removal. This eliminates handling. The cockpit control should be moved to an intermediate position approximating cruising rpm before the pulley is taken off the control shaft, note the pulley position number (marked on the outer pulley face) with respect to the index mark on the end of the control shaft. With the cockpit control at this intermediate setting, an approximate balance between the speeder and balance springs is established. Therefore, when the pulley is removed from the constant speed control, the control shaft should remain approximately the same as it was when the cockpit control was still connected. As a result, adjustment of the high rpm setting at reinstallation will be greatly facilitated.

c. Disconnect the feathering line from the high pressure swivel fitting. The angular position of this fitting should be marked with respect to the adapter.

d. Disconnect the pressure cut-out switch line. The position of the switch should be noted.

e. Disconnect the propeller line leading from the adapter to the engine nose section.

f. Disconnect the control drain line leading from the control base to the oil tank vent connection.

g. Disconnect the engine pressure lines leading from the control engine pressure port to the adapter and engine pressure outlet.

h. Disconnect the control propeller line leading from the control to the adapter.

i. Remove the four control unit mounting stud nuts and remove the control.

NOTE

If the governor is to be removed for any length of time and another unit not substituted immediately, it is advisable to replace the governor mounting pad cover on the engine.

3-229. MINOR REPAIR AND PARTS REPLACEMENT. Faulty propeller governors should be forwarded to a designated overhaul activity for repair.

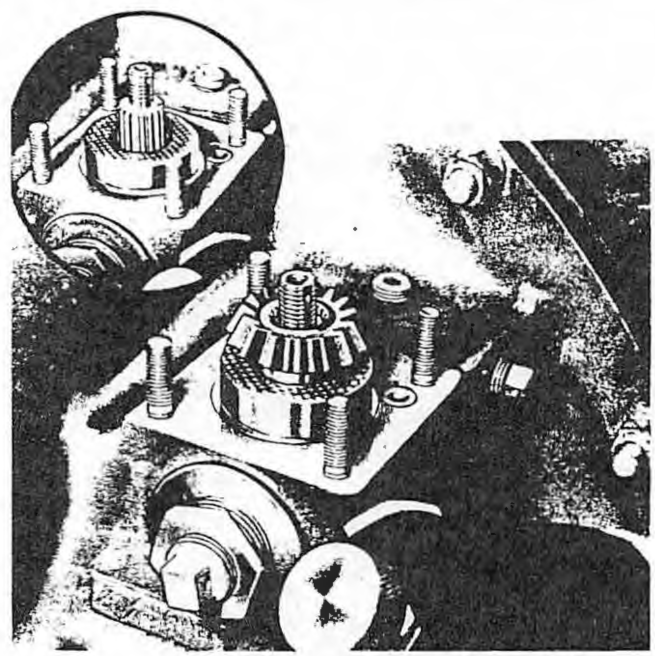


Figure 5-67. Assembly Liner and Drive Installed

3-230. GOVERNOR PRE-INSTALLATION CHECKS.

a. To install the governor, remove the mounting cover from the mounting pad on which the unit is to be installed. Make certain that the engine shipping gasket included between this cover and the mounting boss is removed, since its use for installation of the control would result in malfunctioning of the unit. The mounting pad must be free from irregularities. The assembly liner should be put into position over the gun synchronizer drive ball bearing. See figure 5-67. Then the bevel gear should be installed.

b. Determine freedom of movement of the control by turning the drive gear shaft or by removing the head and turning the flyweight cup since the head should be removed during installation. See figure 5-68. Abnormal binding or dragging due to improper fit or foreign particles in the mechanism will usually be revealed by this preliminary test. In cold weather, the increased viscosity of the oil surrounding the parts may cause increased resistance to rotation. In a new control, a similar condition due to corrosion preventive compound may exist. It is not necessary to remove the corrosion preventive from the governor as it does not interfere with proper operation and should cause no trouble when absorbed into the engine lubricating system.

c. Oil Control Plugging. See figure 5-69. Check the governor for proper rotation by noting the location of oil control plugs in the base and the body, since the control incorporates a gear type pump, it is necessary that the oil inlet and outlet passages be on the correct sides of the pump according to the direction of pump gear rotation.

d. Since the control uses a 35 degree angular base (Model 2) the direction of the governor drive is determined by viewing the angular face of the base rather than the engine mounting pad. If the direction of rotation of the gear in the base is clockwise, (holes "B" are plugged) and if the direction of rotation is counterclockwise, the holes "A" are plugged. This procedure is necessary because the direction of the control drive is reversed by the auxiliary drive in the base. The "B" holes are plugged in the constant speed controls used in these propeller installations as the gun synchronizer drive is counterclockwise.

3-231. INSTALLATION OF PROPELLER GOVERNOR.

a. Install the gasket and governor in position on the engine accessory mounting studs aligning the bevel gears with each other. Install stainless steel self-locking nuts, stock number 6500-513295-327, part number 46A1135-428 and tighten nuts evenly and securely.

NOTE

Two special stud nuts, part number 51738, and two spacer washers, part number 56109, are required with the Model 2 base governor. These stud nuts shall be safetied in pairs. Stainless steel self-locking nuts shall be used on the remaining studs. Retighten the mounting nuts securely after first 15 minutes of engine operation as compression of seal may permit the nuts to loosen.

CAUTION

Since this governor is used on a rear auxiliary drive pad it has a one piece drive shaft and an additional check for binding should be made. Remove the governor head assembly if this has not already been done. Check the governor for freedom of movement by turning the flyweight cup during the tightening procedure. As an additional precaution, check the governor for freedom with the engine shaft turned to different positions. When satisfied and

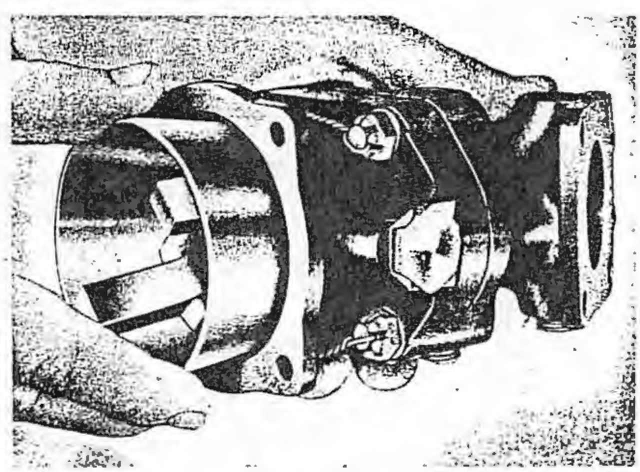


Figure 5-68. Check Freedom of Movement with Flyweight Cup

CLOCKWISE PLUG B-B

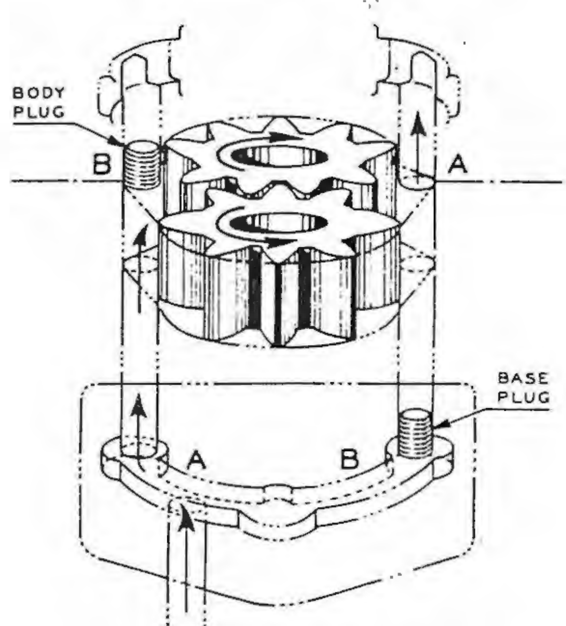


Figure 5-69. Diagram of Body and Base Oil Control Plugging

when the base is secure, reinstall the governor head assembly.

b. If the pulley (if used) is not already on the governor and if required, it should be installed in its correct angular position on the hex section of the governor control shaft with a hex washer inboard of the pulley, and a circular washer on the outboard side. Tighten the castellated retaining nut with a torque of 60 inch-pounds, and lock with a cotter pin.

CAUTION

To prevent the hard steel control shaft from broaching the comparatively soft aluminum pulley, make certain that the hex washer is included on the inboard side of the pulley.

c. If the governor speed range has previously been set on a test rig, the pulley should be in its corrected numbered position with respect to the index line on the end of the control shaft. The correct relationship allows the governor to operate through a satisfactory speed range; namely, from the low rpm setting established by the low rpm adjusting screw in the rack assembly to the high rpm setting established by contact of the pulley stop pin with the high rpm adjusting screw on the governor head. If the pulley stop pin is moved to an adjacent hole in the pulley, the high rpm setting of the control will be changed approximately 250 rpm. Turning the external high rpm adjusting screw one complete turn changes the high rpm setting approximately 25 rpm. The relationship between the governor pulley travel in degrees and the governor speed setting is shown in figure 5-70.

NOTE

The pulley should be installed with the cable always tangent to this pulley on both sides of the cable clamp.

d. To use these diagrams, first multiply the maximum engine rpm by the governor drive ratio. As an example: If maximum engine rpm is 2300 and the governor-engine drive is 1.144:1, maximum governor rpm would be approximately 2630, then read opposite 2630 to obtain a maximum pulley travel of 106 ± 5 degrees. Also multiply minimum engine rpm by 1.144 and take the difference between this and high governor rpm to obtain pulley travel. Allow a tolerance of ± 5 degrees on all control shaft rotation calculations obtained from these charts which are primarily for 1200 rpm minimum settings only. When the rack contacts the governor head casting, establishing the low setting, the scribe line on the control chart will be in line with the zero position on the chart. Therefore, to obtain the required pulley travel on installation where the minimum setting is above 1200 rpm, note the pulley degrees marked on the charts opposite the desired low rpm setting and subtract this value from the pulley degrees marked opposite the high rpm setting. The scribe line is also used to indicate one of the six numbered pulley positions stamped opposite the pulley hex center hole. If the governor is being reinstalled on the same aircraft, the correct angular position of the pulley should have been noted when the unit was removed.

e. Secure the pulley control cable to the pulley by tightening the cable clamp and then safety the castellated nut with a cotter pin. Make certain the pulley is installed in such a way that full angular travel is possible without pinching the control cable and that the cable clamp is positioned in such a way that it will not pull the cable out of tangency with the pulley.

f. When a governor is removed from the engine, it is often more convenient to remove the pulley from the governor rather than removing the control cable from the pulley. In this event, the numbered position of the pulley with respect to the index line on the control shaft should be noted and possibly marked on the pulley at the time of removal. See figure 5-71. At reinstallation, the pulley with the control cable attached is then reinstalled in the same position. This procedure minimizes the amount of adjustment required to obtain the correct relationship between the pulley range, control cable location, etc. The control cable should never be ex-

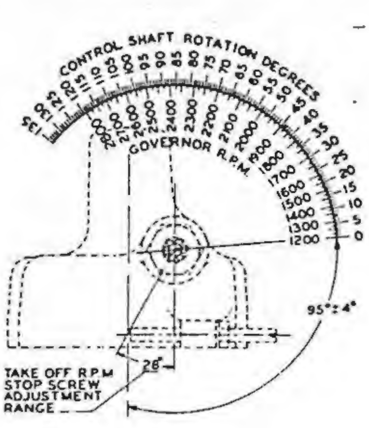


Figure 5-70. Pulley Travel Chart

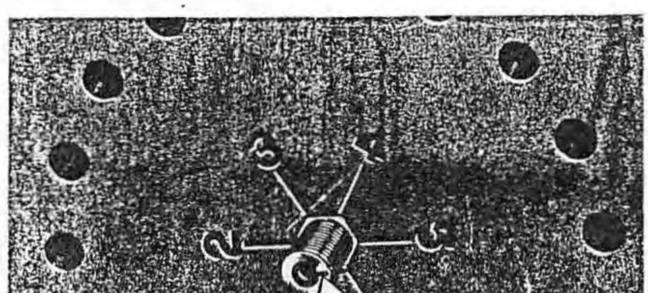


Figure 5-71. Control Shaft Scribe Mark and Pulley Index Numbers

cessively tightened since this results in undue wear on the control shaft and the shaft bushing. Satisfactory operation is obtained if the cable is under a tensile load of approximately 20 pounds. In adjusting the control cable tension it is necessary that allowance be made for movement of the engine on its flexible mounts. Many operators have found it convenient to compensate for this engine movement by installing a constant loading device at some convenient point in the control cable line. With the control pulley at the high rpm position and the cockpit control 1/8 inch from its full forward position, secure the control cable to the pulley with the cable clamp.

g. Five external oil lines are required: one leading from the engine supply (engine pressure line) and calls for the installation of a plug having a 0.250 internal pipe thread. A line leads from this plug and connects to a tee. Two lines from the tee lead to the supply side of the control and to the engine pressure side of the differential cutout switch. Another line in the system leads from the drain port of the control to the engine oil tank vent connection. A third section of tubing leads from the control discharge port to the governor port of the transfer valve and cutout switch adapter. The fourth line leads from the transfer valve to the governor engine valve plug on the engine nose section. The fifth line leads from the feathering pump to the adapter. Generally, 3/8 tubing is used throughout the installation with the exception of the 1/2 inch stainless steel tubing leading from the propeller port of the transfer valve to the governor engine valve port. To insure satisfactory feathering and unfeathering operation, the line from the feathering pump to the transfer valve which is also 0.500 inch tubing, should be primed before it is secured to the transfer valve. The engine manufacturer's instructions should be consulted in making the installation.

3-232. ADJUSTMENT OF PROPELLER GOVERNOR.

a. General. When the governor unit is installed, it is important that the system used be so installed as to permit the pilot to adjust the rpm accurately and conveniently, and when once adjusted, to have the governor remain set on the desired rpm. If a cable arrangement is used, it is important that the correct size be installed in order that cable loading and resulting stretch will be as small as possible. If the cable size is too small, it may stretch with the result that lost motion and poor adjustment of the rpm setting will be introduced into the control system. A four inch diameter pulley is used in this control system, measured across the smaller (groove) diameter of the pulley. The recommended cable size is from 0.062 to 0.094 inch diameter depending upon the length of the cable.

b. The total angular pulley travel required is that which will give minimum rpm at one extreme, and take-off rpm at the other. The total travel of the cockpit control should be so regulated as to give the total angular range required at the constant speed control unit plus about 1/8 inch PINCH at the end of each cockpit control quadrant travel. The installation should be adjusted so that when the cockpit control lever is in its extreme forward position the constant speed control unit is set to govern at take-off rpm. Under these conditions, the pulley stop pin will be against the high rpm adjustment screw.

NOTE

The airplane must be flight tested to see if constant speed is maintained on both engines at 2300 rpm. If the engine speed is too high, turn the adjusting screw on the propeller governor clockwise to decrease the rpm. Each complete turn will change the speed approximately 25 rpm. Adjust the governor stop screw until a constant speed of 2300 rpm is maintained.

3-233. FEATHERING PUMP. An electric feathering pump is provided in each nacelle to furnish oil under booster pressure for propeller feathering. Oil is furnished directly from the tank to the feathering pump and is pumped through the feathering adapter to the outboard side of the propeller piston for feathering and to the inboard side of the piston for unfeathering. When the propellers reach the full-feathered position, a feathering pump cutout switch is opened, releasing the feathering button, stopping the feathering pump.

3-234. REMOVAL OF FEATHERING PUMP.

a. Drain engine oil tank and emergency feathering pump.

b. Disconnect oil inlet and outlet lines from the pump.

c. Disconnect electrical connections and remove pump.

3-235. MINOR REPAIR AND PARTS REPLACEMENT. Faulty and malfunctioning feathering pumps must be removed and forwarded to a designated overhaul activity.

3-236. INSTALLATION OF FEATHERING PUMP.

a. Install feathering pump on brackets.

b. Connect oil inlet and outlet lines to pump.

c. Connect electrical leads to pump.

d. Fill the engine oil tank to the full mark on the oil dip stick.

TABLE XVII

ENGINE TROUBLE SHOOTING

The following tables list some of the more common engine and propeller troubles usually found in maintaining C-45 aircraft in the field. Prior to the use of these charts, the engine should be operated and a complete cockpit check performed.

TROUBLE	POSSIBLE CAUSE	METHOD OF DETECTING CAUSE	CORRECTIVE ACTION
1. Engine fails to start.	a. Incorrect ignition timing.	a. Check ignition timing as outlined in Part III, paragraph 3-162.	a. Repair or adjust as necessary.
	b. Dirty or glazed contact points.	b. Inspect as outlined in Part III, paragraph 3-158.	b. Clean points or replace magneto.
	c. Primer defective.	c. Check as outlined in Part III or remove primer line and check for proper operation.	c. Repair or replace as necessary.
	d. Inoperative starting vibrator.	d. Check for buzzing sound from vibrator when it is engaged. Check for proper voltage to the vibrator.	d. Repair or replace as necessary.
2. Engine backfires.	a. Improper magneto to engine timing.	a. Check as outlined in Part III.	a. Adjust as outlined in Part III, paragraph 3-163.
	b. Air leaking into induction system.	b. See lean mixture of this Chart.	
	c. Insufficient fuel pressure.	c. Check for correct fuel pressure on the engine involved.	c. Adjust fuel pressure as necessary.
	d. Defective spark plugs.	d. Check as outlined in Part III, paragraph 3-171.	d. Replace defective spark plugs.
	e. Defective ignition harness or high tension leads.	e. Perform cold cylinder, harness check.	e. Repair or replace as necessary.
	f. Improper starting procedure.	f. Refer to -1 handbook for proper starting procedures.	
	g. Improper valve clearance.	g. Check for rough engine operation, low rpm, excessive slow rpm drop at ignition check and incorrect manifold pressure at power check rpm.	g. Adjust valves as specified in Section V, Part III, paragraph 3-37, and adjust valves shown to be out of adjustment.
	h. Sticking valves or broken valve springs.	h. Inspect valves as outlined in Part III, paragraph 3-32.	h. Replace defective cylinder.
	i. Corrosion or moisture in the magneto.	i. Inspect magneto.	i. Clean or replace magneto as necessary.
3. Low oil pressure.	a. Excessive oil dilution.	a. Check oil for excessive diluent.	a. Replace defective valve or correct oil dilution procedure.
	b. Clogged oil strainer.	b. Remove oil strainer and check for carbon and sludge.	b. Install clean oil screen.
	c. Aerated oil supply.	c. Check oil in tank for foaming.	c. Bleed oil system of all air and replenish oil supply.
	d. Malfunctioning oil pump.	d. Take direct reading of oil pressure at the pump for proper output pressure.	d. If defective, replace pump, or adjust as required.
	e. Engine oil supply line clogged.	e. Disconnect engine oil supply line and check for foreign material or air lock.	e. Remove foreign material or bleed air from line.
	f. Improper setting of oil pressure relief valve.	f. Check adjustment of oil pressure relief valve.	f. Readjust relief valve.
	g. High oil temperature.	g. Check engine instrument for indication of high oil temperature.	g. Repair malfunctioning part of oil system such as oil cooler door or oil cooler regulator.

TABLE XVII (CONT)

ENGINE TROUBLE SHOOTING

TROUBLE	POSSIBLE CAUSE	METHOD OF DETECTING CAUSE	CORRECTIVE ACTION
3. Low oil pressure (Cont)	h. Inadequate oil supply.	h. Check oil quantity in the engine oil tank or crankcase.	h. Replenish oil supply.
	i. Defective oil pressure gage.	i. Check instrument for proper operation.	i. Replace defective gage.
	j. Broken or loose connections on oil lines.	j. Check lines for leaks.	j. Repair or replace as necessary.
4. High oil pressure.	a. Improper adjustment of the oil pressure relief valve.	a. Check adjustment of oil pressure relief valve.	a. Adjust relief valve.
	b. Defective oil pressure transmitter or gage.	b. Have transmitter and gage checked for proper operation.	b. Repair or replace as necessary.
5. Rough engine operation.	a. Sticking valves or broken valve springs.	a. Inspect valves as outlined in Part III, paragraph 3-32.	a. Repair as necessary.
	b. Defective ignition system.	b. Check ignition system as outlined in Part III, paragraph 3-162.	b. Repair or adjust as necessary.
	c. Improper valve clearance.	c. Inspect clearance as outlined in Part III, paragraph 3-37.	c. Adjust as necessary.
	d. Incorrect fuel air ratio.	d. Perform stability check.	d. Refer to rich or lean mixtures of this section.
	e. Loose engine mount.	e. Inspect mounts (vibration isolators).	e. Replace defective mounts.
	f. Loose propeller shaft nut.	f. Check nut for proper torque.	f. Retorque nut.
	g. Propeller out of balance or track.	g. Check propeller for proper track and balance.	g. Repair or replace as necessary.
	h. Defective spark plugs.	h. Check as outlined in Part III, paragraph 3-171.	h. Replace defective spark plugs.
6. Engine smoking excessively.	a. Clogged rocker box interconnector.	a. Check interconnector of smoking cylinder.	a. Remove sludge from interconnector.
	b. Clogged tappet drain.	b. Inspect rocker box for excessive oil.	b. Clean tappet drain with compressed air.
	c. Defective piston and/or piston rings.	c. Perform compression check as outlined in Part III, paragraph 3-22.	c. Replace cylinder assembly.
	d. Impeller oil seal leaking.	d. Check induction system for excessive oil.	d. Replace the engine.

NOTE

There must be enough oil in the induction system to consistently foul the spark plugs.

TROUBLE	POSSIBLE CAUSE	METHOD OF DETECTING CAUSE	CORRECTIVE ACTION
	e. Excessively worn valve guides.	e. Remove exhaust stack and check for oil seepage around valve stem.	e. Replace cylinder.
	f. Defective oil scavenger pump.	f. Inspect sump for excessive oil. Check for oil seeping from breather.	f. Replace pump.
	g. Defective primer.	g. See rich mixture chart.	
	h. Defective spark plugs.	h. Perform cold cylinder check as outlined in Part III, paragraph 3-21.	h. Replace defective spark plugs.
7. Excessive rpm drop on side during ignition system check.	a. Magneto incorrectly timed to the engine.	a. Slow rpm drop noted during ignition system check, and excessive manifold pressure during power check.	a. Time magneto as outlined in Part III, paragraph 3-162.
	b. Defective ignition harness.	b. Perform cold cylinder check as outlined in Part III, paragraph 3-21.	b. Repair or replace as necessary.
	c. Moisture in the magneto.	c. Excessive rpm drop with possible backfiring.	c. Clean or replace magneto as necessary.

TABLE XVII (CONT)

ENGINE TROUBLE SHOOTING

TROUBLE	POSSIBLE CAUSE	METHOD OF DETECTING CAUSE	CORRECTIVE ACTION
7. Excessive rpm drop on one side during ignition system check. (Cont)	d. Defective primary condenser.	d. Inspect breaker points for pitting or burning.	d. Replace magneto.
	e. Dirty or burned breaker points.	e. Inspect breaker points for pitting or burning.	e. Replace magneto.
	f. Defective ignition switch.	f. Perform continuity check with switch in ON and OFF position.	f. Replace defective switch.
	g. Faulty starting coil or vibrator.	g. Check for operation during start by watching analyzer scope for indication of coil or vibrator operation.	g. Replace coil or vibrator if defective.
8. Excessive rpm drop on both sides during ignition system check.	All items listed in the preceding trouble will also apply to the present trouble.		
	a. Incorrect valve clearance.	a. Note excessive slow rpm drop when making ignition check.	a. Readjust valves as outlined in Part III, paragraph 3-37.
	b. Incorrect fuel air ratio.	b. Perform stability check.	b. Repair as necessary.
9. No rpm drop during ignition system check.	a. Advance magneto to engine timing.	a. Check magneto timing as outlined in Part III, paragraph 3-162.	a. Retime as necessary.
	b. Open "P" lead.	b. Perform magneto grounding check.	b. Repair as necessary.
	c. Defective tachometer.	c. Tap rim of tachometer during ignition check.	c. Replace tachometer.
10. Oil spewing from breather.	a. Defective piston or piston rings.	a. Perform compression check as outlined in Part III, paragraph 3-22.	a. Replace defective cylinder assembly.
	b. Improper grade of oil in tank.	b. Check oil in tank for proper grade.	b. Reservice oil tank with proper grade oil.
	c. Excessive oil dilution.	c. Check oil for excessive diluent.	c. Reservice oil tank.
	d. Malfunctioning scavenger pump.	d. Check for excessive oil in sump. Oil quantity will reduce rapidly.	d. Replace scavenger pump.
	e. High oil temperature.	e. Check oil in tank for foaming.	e. Repair malfunctioning part of oil cooler system.
11. Low power.	a. Air leak in the induction system.	a. Check induction system for leaks. Perform stability check.	a. Repair as necessary.
	b. Defective spark plugs.	b. Perform cold cylinder check as outlined in Part III, paragraph 3-21.	b. Replace defective spark plugs.
	c. Low compression.	c. Perform compression check as outlined in Part III, paragraph 3-22.	c. Replace defective cylinder or cylinders.
	d. Incorrect ignition timing.	d. Slow rpm drop will be noted during ignition system check.	d. Retime magneto.
	e. Improper grade of fuel (low).	e. Check fuel for proper grade.	e. Reservice fuel system.
	f. Improper valve clearance.	f. Excessive slow rpm drop may be noted on ignition system check.	f. Readjust valves found to be improperly set.
	g. Defective cylinders.	g. Perform compression check as outlined in Part III, paragraph 3-22.	g. Replace defective cylinder assemblies.
	h. Defective instruments.	h. Have instruments checked.	h. Replace as necessary.
	i. Defective ignition system.	i. Perform ignition system check.	i. Repair as necessary.
	j. Incorrect fuel air ratio.	j. Refer to rich or lean mixtures of this chart after performing cruise mixture check.	
12. Overheating.	a. Improper valve clearance.	a. Excessive rpm drop noted during ignition system check. Check as outlined in Part II, paragraph 2-16.	a. Adjust valve clearance.
	b. Burned valves.	b. Check as prescribed in Part III, paragraph 3-32.	b. Replace defective cylinder.

TABLE XVII (CONT)

ENGINE TROUBLE SHOOTING

TROUBLE	POSSIBLE CAUSE	METHOD OF DETECTING CAUSE	CORRECTIVE ACTION
12. Overheating (Cont)	c. Advanced ignition timing.	c. Low manifold pressure at power check rpm.	c. Retime magneto.
	d. High carburetor air temperature.	d. Check carburetor air inlet system.	d. Repair or replace malfunctioning parts.
	e. Defective ignition system.	e. Perform ignition system check.	e. Repair or adjust as necessary.
	f. Clogged oil cooler.	f. Inspect oil cooler and regulator.	f. Repair or replace as necessary.
	g. Malfunctioning oil temperature regulator unit.	g. Inspect regulator unit.	g. Repair or replace as necessary.
	h. Insufficient oil supply.	h. Check oil level in tank or crankcase.	h. Reservice oil system.
	i. Improper grade of oil.	i. Check for proper grade oil.	i. Reservice with proper grade oil.
	j. Air leak into induction system.	j. Refer to lean mixtures of this table.	j. Correct leaks.
	k. Excessive oil dilution.	k. Check oil for excessive diluent. Inspect oil dilution system.	k. Repair as necessary any malfunctioning part of oil dilution system.
	l. Clogged oil strainer.	l. Check for low oil pressure.	l. Clean or replace strainer.
	m. Improperly adjusted cowl flaps.	m. Check rigging of cowl flaps.	m. Adjust as necessary.
	n. Thermocouple lead defective or leads crossed.	n. Check leads.	n. Repair as necessary.
	o. Lean mixture.	o. Refer to lean mixtures of this Table.	o. Correct as necessary.
	p. Engine mount bonding loose.	p. Check bonding terminal for cleanliness and security.	p. Correct as necessary.
13. Surging rpm.	a. Defective propeller governor.	a. Propeller will cause surge in rpm at take-off.	a. Repair or replace as necessary.
	b. Fluid level or nitrogen charge in propeller regulator unit low.	b. Check fluid level and/or nitrogen charge.	b. Reservice as necessary.
	c. Defective tachometer generator or instrument.	c. Check instrument and generator for proper operation.	c. Repair or replace as necessary.
14. Mixture too lean.	a. Induction leak.	a. Check for fuel stains.	a. Repair as necessary.
	b. Air leak between carburetor and mounting case.	b. Engine rough at low rpm.	b. Replace gasket or resurface mounting case.
	c. Improper idle mixture adjustment.	c. Check idle mixture as outlined in Part III, paragraph 3-88.	c. Adjust as necessary.
	d. Improper valve clearance.	d. Excessive slow rpm drop during ignition check.	d. Adjust valves having incorrect clearance.
15. Mixture too rich.	a. Leaking primer.	a. Refer to pressure check in Part III, paragraph 3-89.	a. Repair or replace primer.
	b. Idle mixture too rich.	b. Refer to idle mixture adjustment in Part III, paragraph 3-88.	b. Adjust idle mixture.
	c. Excessive fuel pressure.	c. Check for proper pressure.	c. Adjust pressure.

TABLE XVII (CONT)

ENGINE TROUBLE SHOOTING

TROUBLE	POSSIBLE CAUSE	METHOD OF DETECTING CAUSE	CORRECTIVE ACTION
16. Improper acceleration.	a. Incorrect idle mixture adjustment.	a. Check idle mixture.	a. Adjust idle mixture.
	b. Defective spark plugs.	b. Excessive rpm drop at ignition system check.	b. Replace defective spark plugs.
	c. Defective ignition system.	c. Excessive rpm drop at ignition system check.	c. Repair or adjust as necessary.
	d. Malfunctioning valve or valves.	d. Perform compression check.	d. Repair or adjust as necessary.
	e. Incorrect throttle or mixture linkage.	e. Inspect linkage.	e. Repair or adjust as necessary.
	f. Defective primer.	f. Refer to pressure check in Part III, paragraph 3-89.	f. Repair or replace as necessary.
	g. Low compression.	g. Check compression as outlined in Part III, paragraph 3-22.	g. Replace defective cylinder or cylinders.
	h. Air leak in the induction system.	h. Check induction system for leaks.	h. Correct leaks.
	i. Blower drain valve stuck open.	i. Inspect valve.	i. Replace defective valve.
17. Engine will not idle properly.	a. Incorrect idle adjustment.	a. Check idle mixture as outlined in Part III, paragraph 3-88.	a. Adjust idle mixture.
	b. Air leak in induction system.	b. Check induction system for leaks.	b. Correct leaks.
	c. Malfunctioning valves.	c. Excessive slow rpm drop during ignition system check.	c. Repair or adjust as necessary.
	d. Defective spark plugs.	d. Excessive rpm drop at ignition system check.	d. Replace defective spark plugs.
	e. Magneto to engine timing incorrect.	e. Check as outlined in Part III, paragraph 3-162.	e. Retime magneto.
18. Engine.	a. Malfunctioning valves.	a. Excessive slow rpm drop at ignition system check.	a. Replace or adjust as necessary.
	b. Magneto to engine timing incorrect.	b. Check as outlined in Part III, paragraph 3-162.	b. Retime magneto.
	c. Rich mixture.	c. Perform idle mixture and cruise mixture check.	c. Repair or adjust as necessary.
	d. Defective ignition system.	d. Perform cold cylinder check.	d. Repair or adjust as necessary.
19. Engine fails to stop.	a. Mixture control rigging improper.	a. Inspect rigging.	a. Adjust as necessary.
	b. Linkage does not permit full travel of "IDLE CUT-OFF".	b. Inspect rigging.	b. Readjust linkage for full travel.
	c. Fuel leakage at primer	c. Check primer.	c. Replace primer.
	d. Faulty ignition switch.	d. Check ground wires.	
	e. Leaking "IDLE CUT-OFF".	e. Check carburetor and switch.	e. Repair or replace as necessary.

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TABLE XVIII

PROPELLER TROUBLE SHOOTING (AEROPRODUCTS, TC-45G AND C-45G)

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Maximum governing rpm too low.	a. Insufficient engine power during engine ground check.	a. Refer to engine handbook.
	b. Regulator fluid supply at improper level.	b. First empty accumulator of oil. Rotate the propeller until the regulator filler plug is 15° above horizontal. Fill until oil runs from the filler plug hole.
	c. Insufficient control lever travel.	c. Disconnect and check the control lever and linkage for full travel.
	d. Tachometer reading incorrectly.	d. Repair or replace the tachometer.
	e. Propeller governor improperly adjusted.	e. Readjust governor.
2. Maximum governing rpm too high.	a. Regulator fluid supply at improper level.	a. First empty accumulator of oil. Check fluid level with the filler plug hole 15° above horizontal. Fill until oil runs from filler plug hole.
	b. Tachometer reading incorrectly.	b. Repair or replace the tachometer.
	c. Propeller governor improperly adjusted.	c. Readjust governor.
3. Sluggish propeller response, hunting condition, over speed or under speeding.	a. Low fluid level.	a. Fill regulator to proper level.
	b. Clogged screen.	b. Remove external filter and check for clogged screen and metal particles. Clean screen. If metal particles are found, remove regulator for overhaul.
	c. Contaminated fluid or incorrect fluid.	c. Check regulator for contaminated or incorrect fluid. If contaminated, empty accumulator of oil and drain oil from regulator. Refill the regulator with recommended oil to 15° above the horizontal position. Run the engine and change the pitch on the propeller several times. Stop the engine, empty the accumulator of oil and drain oil from the regulator. Repeat this procedure two or three times until incorrect or contaminated oil has been completely flushed from the system. Refill the regulator to proper level with recommended fluid.
	d. Ruptured seal in regulator hydraulic system.	d. Remove regulator for overhaul.
	e. Governor not functioning properly.	e. Remove regulator for overhaul.
4. Binding propeller control linkage.	a. Control jammed or binding.	a. Check for freedom of movement. Correct trouble.
	b. Regulator control lever binding.	b. Remove regulator for overhaul.
5. Hydraulic fluid on blades.	a. Loose regulator cover bolts.	a. Torque bolts to 90/95 inch-pounds.
	b. Damaged or improperly installed cord seal.	b. Remove regulator for overhaul.
	c. Defective transfer seals.	c. Replace transfer seals between hub and regulator.
	d. Excessive clearance between hub and regulator.	d. Remove regulator and replace transfer seals in hub. Replace regulator, making certain clearance is less than 0.002 inch between hub and regulator.
	e. Leakage at filler plug.	e. Check and replace seals if necessary.

TABLE XVIII (CONT)

PROPELLER TROUBLE SHOOTING (AEROPRODUCTS, TC-45G AND C-45G)

TROUBLE	PROBABLE CAUSE	CORRECTION
6. Hydraulic fluid or oil on regulator cover, around adapter plate, on engine, or cowling.	a. Engine oil leak.	a. Repair engine oil leak.
	b. Regulator fluid level too high.	b. Check regulator fluid level.
	c. Regulator housing or cover seals damaged.	c. Remove regulator for overhaul.
7. Leakage when propeller is stationary, but not in flight.	a. Regulator seals holding off or cut.	a. Remove regulator for overhaul.
	b. Adapter relief valve assemblies leaking.	b. Remove regulator for overhaul.
8. Rough operation or excessive vibration.	a. Engine operation unsatisfactory or loose engine mount bolts.	a. Check engine mount bolts.
	b. Propeller unbalanced.	b. Remove propeller for overhaul.
	c. Loose shaft nut.	c. Tighten shaft nut.
	d. Blade angles not same all blades.	d. Check blades for uniformity of angle.
9. Grease or regulator fluid appears at hub relief fitting.	a. Defective torque unit seals.	a. Remove propeller for overhaul.
	b. Leak at fixed spline gasket caused by loose fixed spline bolt, or damaged spline gasket.	b. Remove propeller for overhaul.
10. Failure to change blade angle.	a. Lack of fluid in regulator.	a. First empty accumulator of fluid. Check fluid level. Regulator must be filled 15° above horizontal.
	b. Insufficient hydraulic pressure.	b. Remove regulator for overhaul.
	c. Governor not functioning.	c. Remove regulator for overhaul.
11. Propeller will not feather following engine run up. Engine stopped.	a. Accumulator not correctly charged.	a. Charge accumulator with nitrogen gas, while operating propeller control handle in and out of feathering position to empty accumulator of excess oil. Run engines, recheck feathering. See Table XIX for charging pressure.
	b. Incorrect control travel.	b. Re-rig control.
	c. Feathering valve inoperative.	c. Remove regulator for overhaul.
12. Propeller will not unfeather following feathering.	a. Accumulator not charged with nitrogen gas.	a. Charge accumulator with nitrogen gas, while operating propeller control handle in and out of feathering position to empty accumulator of excess oil. Run engines, recheck feathering. See Table XIX for charging pressure.
	b. Feathering valve inoperative.	b. Remove regulator for overhaul.
13. Propeller feathering slowly in flight and rotation does not stop completely.	a. Too low or too high accumulator nitrogen pressure.	a. Upon landing check accumulator nitrogen pressure. See paragraph 3-216.
	b. Control rigged improperly.	b. Rig control properly.
	c. Erroneous operation of feathering valve.	c. Move propeller control in and out of feathering position. Upon landing remove propeller regulator for overhaul.
14. Propeller will not unfeather in flight.	a. Too low or too high accumulator nitrogen pressure.	a. With control in cruising position, crank engine with starter until wind-milling starts. Upon landing check accumulator nitrogen pressure. See paragraph 3-216.
15. Hydraulic fluid leak at accumulator attaching flange.	a. Leaking accumulator body disconnect O-ring packings.	a. Replace packings.

TABLE XIX (Deleted)

TABLE XX

PROPELLER TROUBLE SHOOTING

The following information in its condensed table form lists the trouble, probable cause, and corrections for the difficulties most frequently encountered in propeller field servicing work. Some of these troubles might also be the result of malfunctioning of the governor, the engine, or other accessories in the aircraft. This information, supplemented by a thorough understanding of the principle of operation of the propeller, should make trouble shooting relatively simple. Careful and accurate determination of the troubles, their related cause and corrections will reduce to a minimum the time required for servicing and will aid in extending the life of the equipment. Many of the following corrections must be performed by partial disassembly of the propeller. In general, this shall be accomplished in the overhaul shop and shall not be attempted during line maintenance.

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Leakage at dome retaining nut.	a. Damaged seal.	a. Replace seal.
	b. Loose nut.	b. Retorque nut.
	c. Too many preload shims.	c. Recheck preload.
	d. Too few dome-barrel seal shims.	d. Add shims. (A maximum of 6 each shims permitted.)
2. Leakage at barrel blade bore.	a. Damaged blade packing.	a. Replace packing.
	b. Incorrect blade packing.	b. Replace packing.
	c. Foreign materials on packing or blade shank.	c. Clean packing and blade shank.
3. Overspeeding on take-off.	a. Wrong setting of constant speed control.	a. Reset control.
	b. Insufficient exercise of propeller mechanism prior to take-off.	b. Move control several times through constant speed range.
	c. Too rapid opening of throttle.	c. Advance throttle slowly and evenly.
	d. Damaged gasket between distributor valve and propeller shaft.	d. Install new gasket.
	e. Sticky pilot valve or relief valve.	e. Disassemble and clean.
	f. Erroneous reading tachometers or manifold pressure gages.	f. Replace or calibrate.
	g. High engine transfer leakage.	g. Consult engine manual.

TABLE XX (CONT)

PROPELLER TROUBLE SHOOTING

TROUBLE	PROBABLE CAUSE	CORRECTION
4. Failure to feather.	a. Batteries low.	a. Replace or charge batteries.
	b. Faulty electrical system.	b. Check control and power circuits of feathering system.
	c. Restricted oil supply to auxiliary pump.	c. Check pump inlet for foreign material.
	d. Malfunctioning auxiliary pump or motor.	d. Examine pump and test same.
	e. Failure of push button to remain engaged.	e. Check battery and low pressure setting of cutout switch. Check hold-down circuit.
	f. Defective feathering pump.	f. Replace pump.
	g. Windmilling of propeller.	g. Check high blade angles, if incorrect, reset high pitch stop ring.
5. Due to leakage.	a. Improper distributor valve installation.	a. Re-install distributor valve.
	b. Damaged or wrong gasket installed between governor base and interior of propeller shaft.	b. Replace gasket.
	c. Engine transfer rings not functioning propeller.	c. Consult engine handbook.
	d. High blade torque resulting from packing sticking to blade shank.	d. Loosen up the packing with a 0.010 inch feeler gage and work in engine oil and graphite powder between packing and blade shank.
6. Failure to unfeather.	a. Batteries low.	a. Change or recharge.
	b. Faulty electrical system.	b. Check control and power circuits.
	c. Defective pump.	c. Replace pump.
	d. Restricted oil supply to feathering pump.	d. Check pump inlet lines for foreign material and bleed.
7. Due to leakage.	a. Engine transfer rings.	a. Consult engine handbook.
	b. Improper distributor valve installation.	b. Reinstall distributor valve.
	c. Damaged or wrong distributor valve gasket.	c. Replace gasket.

PART IV

REASONS FOR REMOVAL

4-1. CONTROL OF ENGINE REMOVAL.

4-2. Except in cases of obvious failure, such as complete internal failure, or when the time between overhauls, as specified in T.O. 00-25-4, has been reached, engines will not be removed until a complete investigation of the engine has been made by a competent engine conditioning team.

4-3. SUDDEN STOPPAGE OR SUDDEN REDUCTION IN SPEED.

4-4. SUDDEN STOPPAGE OF ENGINES. Sudden stoppage is defined as "a very rapid stoppage of the engine by one or more of the propeller blades hitting an object in such a manner that the engine rpm goes to zero and is not regained." When sudden stoppage occurs, internal damage such as cracked gear teeth, crankshaft misalignment, damaged bearings, etc., may result. Engines reported to have encountered sudden stoppage will be changed.

4-5. SUDDEN REDUCTION IN SPEED (PROPELLER STRIKING A SMALL MOVABLE OBJECT). Sudden reduction in speed is defined as "a rapid reduction in engine rpm when one or more of the propeller blades strikes a small movable object such as a tool box, and the engine continues to run and recovers its former rpm." Engines reported to have encountered reduction in speed will be thoroughly inspected as follows:

a. Remove and inspect engine oil strainer for presence of metal particles. The engine sump plug will be removed and the oil drained into a clean container and strained through a clean cloth to check for metal particles. If heavy metal particles are found, indicating a definite engine failure, the engine will be removed. However, if metal particles in the nature of filings are found, continued inspection of the engine to determine its serviceability will be accomplished.

b. Check the propeller shaft for misalignment. (See figure 5-73.) A reversible, dial-type test indicator, graduated in 1/1000-inch, can be mounted on the thrust bearing cover stud with the dial plunger resting on the propeller shaft and the propeller shaft checked for run-out at both the front and rear propeller cone seat locations. Propeller shafts will be checked for run-out by turning the crankshaft with a suitable turning bar. Prior to making the run-out check, the front or rear spark plugs will be removed from all cylinders. If the run-out of the propeller shaft at the front cone seat location (see figure 5-73) is more than 0.015 full indicator reading, the engine will be removed. If the run-out of the propeller shaft at the front cone seat is less than 0.015 full indicator reading, a check will be made at the rear seat location. If any run-out is found at this location which is not in the same plane as the run-out at the front cone seat location, the engine will be removed. If the propeller shaft run-out does not exceed the foregoing specified limits, a serviceable propeller will be installed and an additional check will be made by tracking the propeller at the tip in the same plane, perpendicular to the axis of rotation, to assure that blade track tolerance is within limits of 0.441-inch.

c. The engine will be operated and checked for smoothness of operation and power output. If the engine operates properly during the ground check, it will be shut down and procedures outlined in paragraph 4-5, step a, will be repeated. If there is no

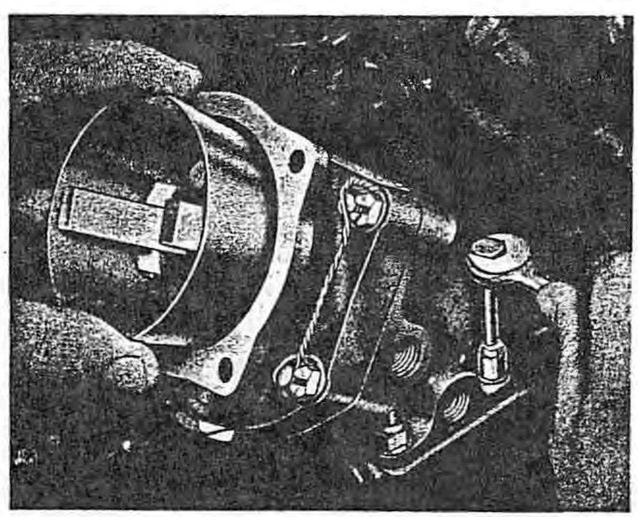

Figure 5-72. Checking Backlash with Flyweight Cup

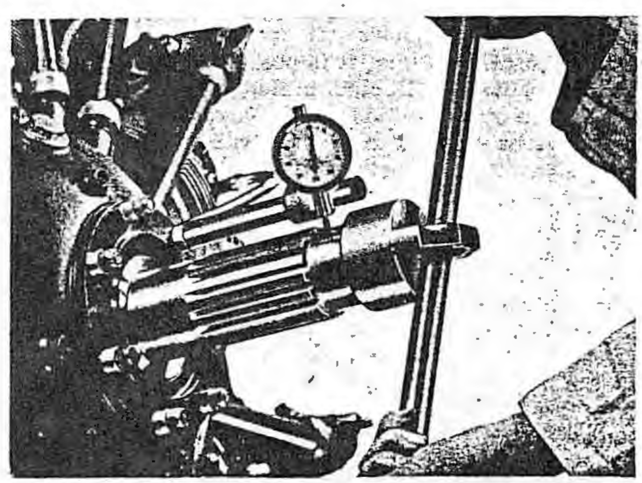

Figure 5-73. Checking Propeller Shaft Runout

indication of heavy metal particles in the engine, it will be given a two-hour flight test. If the engine operates properly during the flight test, it will be checked again for metal in the oil system. If no further indication of metal is found after the flight test, the engine will be considered serviceable. However, the oil screens and magnetic sump plugs will be rechecked for presence of metal after ten hours of operation and after 20 hours of operation. If no indication of internal failure is found after 20 hours of operation, the engine will require no further special inspections.

4-6. SUDDEN REDUCTION IN SPEED (PROPELLER STRIKING AN IMMOVABLE OBJECT). When an engine is operating and the propeller rpm is suddenly reduced by propeller striking an immovable object such as the ground, ramp, a building, or runway, the engine shall be replaced.

4-7. EMERGENCY PROCEDURE FOR SUDDEN STOPPAGE.

4-8. If the accident which caused the sudden slowing or stoppage occurs at an outlying field where a replacement or necessary checking equipment is not available, the aircraft will be grounded until proper action in accordance with paragraph 4-3 can be taken.

4-9. METAL PARTICLES IN OIL.

4-10. The following guide to the analysis of engine indications and the evaluation of engine serviceability is based on past indications, the findings on engines at time of overhaul, and operating experience. This guide has been established on a conservative basis; therefore, it is consistent with the policy of not operating engines of doubtful serviceability. Sound decisions will require a careful analysis of the indications of failure of parts as found, and careful inspection and analysis of each engine involved.

4-11. Generally, metal particles found on the engine oil strainer is an indication of partial internal failure of the engine. However, due to the construction of aircraft oil systems, it is possible that metal particles may have collected in sludge in the oil system at the time of a previous engine failure; consequently this must be taken into account when metal particles are found in the engine oil strainer. Frequently, carbon tends to break loose from the interior of the engine in large pieces which have the outward appearance of metal. However, carbon can be distinguished from metal by placing the foreign material on a flat metal object and hitting it with a hammer. If the material is carbon, it will disintegrate when struck with a hammer, whereas metal will either remain intact or change shape, depending on the malleability of the metal. Before removing an engine for suspected internal failure as indicated by foreign material on the oil strainer collect all obtainable metal particles for analysis and samples. In order to save fine metal particles, it may be necessary to strain the oil through a cloth. The cloth and metal particles can be placed in a clean metal container and sent with the engine to overhaul.

CAUTION

An oil soaked rag can very easily cause spontaneous combustion unless placed in a tightly closed container, such as a quart or pint can with a press-fit lid.

4-12. IDENTIFICATION OF METAL PARTICLES. Metal particles found in an engine may be any of five kinds: steel, tin, aluminum, silver, and copper (or bronze). A visual inspection as to color and hardness will occasionally be sufficient to determine the kind of metal present. When visual inspection does not positively identify the metal, the kind of metal present may be determined by a few simple tests performed with a permanent magnet, electric soldering iron, and approximately two ounces each of concentrated hydrochloric (muriatic) acid (Specification O-A-86) and concentrated nitric acid (Specification O-A-88), as follows:

WARNING

Exercise care in handling the acids.

a. Steel particles can be isolated by means of a permanent magnet.

b. Tin particles can be identified by their low melting point. The soldering iron should be cleaned, heated to about 260°C (500°F), and tinned with 50-50 solder (50% lead - 50% tin). Wipe off the excess solder. A tin particle dropped on the heated iron will melt and fuse with the solder. Care will be exercised to avoid excessive over-heating of the iron during this test.

c. Aluminum particles may be identified by their reaction with hydrochloric acid. When a particle of aluminum is dropped into hydrochloric (muriatic) acid, it will "fuzz" with a rapid emission of bubbles. The particle will gradually disintegrate and form a black residue (aluminum chloride).

d. Silver and copper (or bronze) may be identified by their respective reactions in nitric acid. When a silver particle is dropped into the nitric acid, it will react rather slowly, producing a "whitish" fog in the acid. When a particle of copper (or bronze) is dropped into the nitric acid, it will react rapidly, producing a bright green cloud in the acid. There is no need in this instance to separate the copper from the bronze.

4-13. SIGNIFICANCE OF METAL PARTICLES. Generally, when metal particles are found and the kind of metal present is determined, the serviceability of the engine will depend upon the quantity and the form of the metal. Granular metal particles, in any amount greater than a trace, require a very careful inspection of the engine, as the presence of these particles is usually an indication of an impending part failure. Each kind of metal, however, will be judged individually. Paragraphs 4-14 through 4-22 are intended as a guide in judging the serviceability of the engine after the kind of metal has been determined.

4-14. STEEL When steel particles are found in splinter or in granular form, engine removal is required. Thin steel flakes, when found in quantities not greater than 20 flakes, may not require engine removal. A small quantity of steel flakes will not cause engine bearing failure. When thin steel flakes accompanied by aluminum flakes are found, these flakes are probably the result of a warped piston ring land or hole burned in a piston. Replacement of defective piston and cylinder assembly will correct the difficulty. When not accompanied by aluminum flakes, it is possible that the steel flakes are from foreign material introduced into the engine through the oil tank.

4-15. Test the engine in accordance with paragraphs 4-21 through 4-23. If more than five additional flakes are found during the oil strainer inspection after run-up, engine removal is required. If five or less flakes are found, the engine may be released for service as stated in paragraphs 4-21 through 4-23. When not more than 20 thin steel flakes are found, and they are accompanied by thin aluminum flakes, the following will be accomplished:

a. Carefully inspect cylinders by visual examination of the cylinder bore and by compression check in an effort to locate the faulty piston. A bright streak along the cylinder barrel or any evidence of scuffing would be an indication of a warped piston ring land. Warped lands are predominant in winter operations and occur most frequently on lower cylinders.

b. When not more than two faulty cylinders are found, the faulty piston and cylinder assemblies will be replaced before continuing with the procedure. When more than two faulty cylinders are found by inspection, the engine will be removed.

c. After faulty cylinders have been changed or when no faulty cylinders are found, test the engine in accordance with instructions contained in paragraphs 4-21 through 4-23.

d. If more than two additional steel flakes or 15 aluminum flakes are found during the oil strainer inspection after engine run-up, removal is required. If less than these quantities are found, the engine may be released for service as stated in paragraphs 4-21 through 4-23.

NOTE

Ring fuzz may be on the oil sump magnetic plug of any normal engine. These very fine hairlike particles are the result of normal seating of the piston rings and cylinders, and are not cause for any concern regarding the serviceability of the engine.

4-16. TIN. Tin in any quantity may be disregarded. Since tin is used only in plating engine parts and in thickness not greater than 0.0005 inch, granular tin will not be found.

4-17. ALUMINUM. The presence of aluminum particles in granular form may be an indication of piston failure. When granular aluminum particles are found, the following procedures will be accomplished:

a. Inspect cylinders by visual examination of cylinder bores and a compression check in an effort to locate a faulty piston.

b. When not more than two faulty pistons are found, the faulty piston and cylinder assemblies will be changed before continuing with the procedure. When more than two faulty pistons are found by inspection, the engine will be removed. After faulty pistons and cylinder assemblies have been changed, or when no faulty pistons are found, continue with the procedure.

c. Drain and flush the oil system, and clean the oil strainer.

d. Test the engine as prescribed in paragraphs 4-21 through 4-23.

e. If not more than two additional granular particles are found during the screen and sump inspection after run-up, the engine may be released for service as stated in paragraphs 4-21 through 4-23. If more than five particles are found, the engine will be removed.

4-18. Aluminum flakes may not necessarily require engine removal. In winter operations, when warped piston ring lands are frequent, considerable quantities of aluminum from the pistons may be discharged into the engine oil system. It will be necessary to exercise judgement before continuing with the following procedure; for instance, if the oil sump or screen is found choked with a mass of aluminum flakes or particles, regardless of size, it will probably be necessary to remove the engine even though the faulty piston can be located. When aluminum flakes are found, the following procedures will be accomplished:

a. Make a careful inspection of the cylinders by examination of the cylinder bores and a compression check in an effort to locate the faulty piston.

b. When not more than two faulty pistons are found, the faulty piston and cylinder assemblies will be changed before continuing with the procedure. When more than two faulty pistons are found by inspection, the engine will be removed. If two or less faulty pistons are found, continue with the procedure.

c. Drain and flush the oil system and clean the oil strainer.

d. Test the engine in accordance with instructions in paragraphs 4-21 through 4-23.

e. If more than five additional aluminum flakes are found during the strainer and sump inspection after run-up, engine removal is required. If less than this quantity is found, the engine may be released for service as stated in paragraphs 4-21 through 4-23.

4-19. SILVER. Silver particles in granular form indicate a master rod bearing failure in advanced stages. When these particles are found in any quantity, engine removal is required. Silver is used in plating numerous other parts, and silver flakes, not exceeding ten in number, do not necessarily indicate a part failure. Since silver is quite soft, some small flakes will occasionally be released by the normal working of these parts. Some silver flakes may be formed by a slight scaling-off of the back of the master rod bearings. A very small quantity of silver from the master rod bearings will make a large number of tiny flakes as it passes through roller bearings or gears within the engine. Large quantities of silver flakes indicate an excessive loss of bearing or plating material and the engine will be removed as a precautionary measure.

4-20. COPPER OR BRONZE. Copper or bronze particles in granular form, and in quantities greater than a few particles, indicate disintegration of a bushing or valve guide and are cause for engine removal. Copper or bronze flakes, in quantities not exceeding ten flakes, do not necessarily indicate a part failure. Bronze flakes may be formed in small quantities through normal seating of bushings or valve guides. Larger quantities of copper or bronze flakes, however, may indicate excessive loss of bushing material and the engine will be removed as a precautionary measure.

4-21. ENGINE TEST FOR METAL PARTICLES.

4-22. The external oil system will be drained and flushed and the tank refilled. When it is required that the engine be subjected to further examination for metal particles, the test procedure given in paragraph 4-23 will be followed. This will insure that an engine released for service after examination for metal particles will continue to operate satisfactorily.

4-23. ENGINE TEST. This test is made for the purpose of subjecting the engine to sufficient operations to cause any additional metal in the oil system to collect on the oil screen and in the main sump, and also to reveal any incipient trouble. This additional metal will determine whether the engine needs to be removed or allowed to continue in service.

a. Run the engine for 10 minutes at 2000 rpm to bring it to proper operating temperatures and make a minimum of three power checks, as outlined in Part II, paragraph 2-13. (Allow engine to cool between checks.) Take care not to exceed the allowable limits for ground operation for the particular engine.

b. Again remove the oil strainer and examine for metal accumulation. Remove the sump plug and drain the sump. Examine the plug and strainer for metal accumulations. If engine is released for service, it will be watched closely for the next 25 hours for any indications of malfunction or internal failure.

4-24. IN-SERVICE PARTS FAILURES.

4-25. If all pieces of a steel part which has failed, such as a piston ring, valve, valve spring, washer, rocker arm, rocker arm bearing, etc., cannot be located and removed, the engine will be replaced. Otherwise, particles from the part will induce failure in other parts within the engine and may result in serious damage.

4-26. LOW CYLINDER COMPRESSION.

4-27. The engine may be removed for low cylinder compression if more cylinders are affected than specified in figure 5-16. In cases where it is more economical to remove the engine from the aircraft than to replace the cylinders with the engine installed, the engine may be removed and returned to base shops for cylinder changes and reinstallation in another aircraft.

4-28. BASIC MECHANICAL FAILURES.

4-29. An engine may be removed when an internal or external portion of the engine, such as an impeller, boss, casting, threads, studs, etc., become cracked, nicked, broken, or damaged to the extent that repair cannot be made in the field and depot assistance is not available. Failures of this type are limited to portions of the engine such as impeller, crankcase, supercharger housing, and reduction gear housing. External failures on engines, cylinders, and accessories can be corrected by replacing the damaged assembly and the engine continued in service. However, due to improved techniques many of these engines can be repaired. Most studs, accessory sections, and nose sections, can be replaced or repaired at base shops level with the aid of depot personnel, time on the engine being a deciding factor.

4-30. OIL CONSUMPTION.

4-31. Oil consumption varies with engine power settings used. An oil consumption limit which is satisfactory for maximum cruising power would be too high for low cruising power, or vice versa. In addition, one or more cylinders having high oil consumption could cause engine malfunctioning and still not be regarded as high engine oil consumption. Therefore the quantity of oil versus the length of the proposed mission will determine the maximum allowable oil consumption.

4-32. ENGINE OVERSPEEDING.

4-33. When engine speeds exceed the limits the maintenance officer will immediately direct an inspection or removal depending upon the amount of overspeed reported, using figure 5-74 to determine whether the engine will be removed or will be inspected as follows:

NOTE

Enter on DD Form 829-1 and 829-2 the information that was written on DD Form 781 each time an overspeed condition occurs.

	Overspeed rpm	
Engine	For Inspection	For Removal
R-985-AN-1, -3 R-985-AN-39, -39A	from 2700 to 3000	above 3000
R-985-AN-14B	from 2900 to 3000	above 3000

Figure 5-74. Overspeed Tolerances

4-34. ENGINE INSPECTION. Inspect for cracked or broken cylinder heads and barrels. In the event a cylinder head is cracked or broken or a peened piston head is found on the engine and no particles of pistons or rings have entered the power section of the engine, the cylinders and piston assembly for the cylinders with the cracked heads will be removed and the articulating and master rods inspected for misalignment. If the rods are satisfactory, the piston and cylinder assemblies will be replaced with serviceable units and the engine continued in service as specified in paragraph 4-36. In any case of misalignment of the link or master rods, the engine will be replaced. In the event cylinder heads or coolant jackets are cracked on in-line engines, engine change is mandatory.

4-35. OIL SYSTEM INSPECTION.

a. The removable oil strainer will be removed and thoroughly inspected for metal particles.

b. The oil sump will be drained, using a clean cloth to catch any particles that may be present in order that they may be inspected.

c. Care will be exercised to insure that particles inspected are metal and not carbon particles. (See paragraph 4-11.) Should the inspection of the oil screens or filters disclose an abnormal amount of metal particles, the engine will be removed immediately and forwarded to the designated AMA for overhaul. When no metal particles are found, the engine will be operated as specified in the following paragraph.

4-36. OPERATION SUBSEQUENT TO INSPECTION. When inspection of the engine discloses no visible damage as a result of overspeeding or overboost, the aircraft will be restricted to local flights and flown on a red diagonal status for a period of ten hours. An inspection of the oil strainer and sump plug will be accomplished at the end of the tenth hour, as prescribed in this section. Should the inspections of the oil strainer or sump plug disclose an abnormal amount of metal particles, the engine will be removed. However, if the final inspection proves negative, the aircraft will be unconditionally released for normal flight operations. Should subsequent inspections of the oil strainer and sump plug, performed at normal inspection periods (specified in technical order for the engine), disclose an abnormal amount of metal particles, the engine will be removed. In addition to the usual description of the failure of the engine, specific reference will be made to all known instances of overspeed and over-power operations with all pertinent information outlined in this section.

NOTE

Enter on DD Form 829-1 and 829-2 the information that was written on DD Form 781 each time an overspeed condition occurs.

4-37. FOREIGN MATERIAL IN THE OIL SYSTEM.

4-38. The following is a guide to the analysis of engine indications and the evaluation of engine serviceability, the findings on engines at time of overhaul, and operating experience. This guide has been established on a conservative basis; therefore, it is consistent with the policy of not operating any engine of doubtful air-worthiness. Sound decisions will require a careful analysis of the foreign material found, and careful inspection and analysis of each engine involved.

4-39. Generally, rubber-like particles found on the oil strainer are an indication of faulty oil line. On C-45 aircraft engines, the oil system has an oil screen by-pass valve. This valve opens for a short time, each time the engine is started and at any time the oil strainer is clogged enough to restrict the oil flow, thereby allowing unscreened oil to flow through all oil passages of the engine. The following procedures will be accomplished when the oil strainer or the oil is found to have foreign material:

a. Check aircraft DD Form 781 for any write-ups of high oil temperature that could not be lowered by normal methods.

b. If the oil temperature had been high and the oil strainer was found to have foreign material, the engine will be removed. The oil radiator will be thoroughly inspected for foreign material, and flushed as outlined in the applicable technical order. Source of the material will be detected and corrected.

c. If no indication of high oil temperatures is found, the oil system will be drained and refilled. Operate the engine for 15 minutes at field barometric pressure and observe oil temperature for any indication of high temperature.

d. After the engine is shut down, remove the oil strainer and check for any foreign material. If the oil strainer or the oil is not contaminated, the engine will be considered serviceable.

4-40. SPARK PLUG COPPER RUN-OUT.

4-41. If copper run-out is noted, the cylinder from which the spark plug was removed will be replaced as this indicates that temperature in the cylinder has exceeded 1083°C (1981.4°F). The engine will be inspected to locate the reason for excessive temperature and the oil screen and magnetic sump plugs will be checked for metal particles. Engines found to have spark plug copper run-out on more than 25 percent of the cylinders will be removed from service as the engine has been subjected to excessive heat that may cause engine failure.

CAUTION

Carbon deposits must not be confused with copper run-out.

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PART V

POWER PLANT REMOVAL, STRIPPING AND PRESERVATION PROCEDURES

5-1. PRESERVATION RUN. Immediately prior to removal of engine from the aircraft, the engine shall be given a preservation run in accordance with the following procedural steps:

NOTE

The corrosion preventive mixture referred to in the following instructions in Part V, is composed of three parts of lubricating oil, Specification MIL-L-6082, and one part of corrosion preventive compound, Specification MIL-C-6529. Heating the corrosion preventive mixture to a temperature of 220°F to 250°F (104°C to 121°C) is desirable to eliminate moisture from the mixture and to facilitate operation.

a. Drain the oil from the engine sump and oil tank while the engine is still warm.
b. Reinstall the oil drain plugs and fill the oil tank with enough corrosion preventive mixture to insure adequate lubrication during the preservation run plus the quantity to preserve the induction system.
c. Join together two separate 10 foot lengths of number 6 hydraulic hose by means of a suitable two-way valve.
d. Remove the oil strainer cover drain plug and install TAM-30659 adapter in the drain plug hole.
e. Install a 45° elbow (125-27 N.P.T.) in the manifold pressure gage connection.
f. Connect the hydraulic hose between the two fittings. If desired, the control valve may be located in the cockpit and may be manipulated by the operator or his assistant. (This method affords the use of the same preservative mixture contained in the engine oil system during the preservation run and thus eliminates the need of a supplementary tank for preserving the induction system.)
g. Make sure that the control valve on the hydraulic hose is in the closed position.
h. Block off or by-pass the oil cooler to produce a minimum oil inlet temperature of 95°C (203°F) during the preservation run.
i. Start the engine and then continue to run (on normal service fuel) at idling speed for at least 15 minutes, using the corrosion preventive mixture as a lubricant.
j. At the end of the run, open the throttle to attain a speed of 1500 rpm. All safety precautions pertaining to ground running (see Part II) should be carefully observed. Cylinder head and oil temperatures should not be allowed to exceed their prescribed limits, and every effort should be made to keep the length of the run to a minimum.
k. With the throttle advanced as described, and with the oil temperature at no less than 95°C (203°F) open the control valve to allow the engine preservation mixture to be introduced into the induction system.
l. When the exhaust stacks are smoking profusely, move the mixture control to IDLE CUT-OFF position and simultaneously cut the ignition switch to shut down the engine.
m. After the engine has stopped, close the control valve within 3 seconds.
n. Remove the hydraulic hose from the manifold pressure gage fitting and oil strainer drain adapter.
o. Remove the elbow from the manifold pressure gage connection and reconnect the line.
p. Remove adapter and oil strainer from oil drain plug hole.
q. After the engine has drained, reinstall the oil strainer and all drain plugs.

5-2. REMOVAL OF POWER PLANT.
a. Turn the fuel selector valve to the OFF position. This will make it unnecessary to drain the complete fuel system. Have a suitable container on hand to catch fuel remaining in the lines when the engine is being disconnected.
b. Check ignition and master switches, both in the OFF position.
c. Disconnect and remove the battery from the aircraft.
d. Remove the detachable cowling and wrapper sheets.
1. Disconnect cowl flap controls at the actuating horn.
2. Release strap fastener on each side of the cowling.
3. Release Dzus fasteners connecting the front edges of the upper and lower ring cowlings.
4. Drop lower section of cowling until it clears engine.
5. Release the strap fasteners connecting wrapper sheets to the upper section of the ring cowling.
6. Release Dzus fasteners at the lower ends of both sections of the wrapper sheets.
7. Release the winged Dzus fasteners on the forward edges of the wrapper sheets and remove wrapper sheets.
8. Lift upper section of cowling clear of engine.

CAUTION

Lift upper section carefully to prevent damage to the propeller blades.

e. Drain oil system by removing cotter pin from "Y" valve drain located on the aft side of firewall and turning valve 90 degrees.
f. Remove propeller (see paragraphs 3-212 Aero Products or 3-222 Hydromatic) and cap the engine crankshaft.
g. Disconnect and plug all engine piping at the firewall.

NOTE

Disconnecting flexible hose union, such as the fire extinguisher line, requires the use of a second wrench to prevent the flexible hose from being twisted as the swivel nut is loosened.

h. Disconnect engine electrical wiring by disconnecting cannon plugs on the forward side of the firewall.
i. Disconnect throttle mixture and carburetor air-heat control rods by removing the bolts at engine end of push-pull rods.
j. Drain and disconnect at the filter, the hoses to the autopilot hydraulic pump.

NOTE

Paragraph "j" above applies to the right-hand engine only on airplanes equipped with A-3A autopilot.

k. Remove rod end and unscrew nut from bottom of propeller control linkage conduit and remove conduit section. Unscrew small spring lock on control cable. Disconnect conduit connection forward of firewall and pull control cable aft through conduit. Coil and tape control cable to prevent damage.

NOTE

Paragraph "k" above pertains to aircraft equipped with Aero Products propellers.

l. Remove exhaust tail pipe shroud, disconnect tail pipe and intensifier tube and remove tail pipe fairing.
m. Disconnect fire extinguisher lines at forward end of flexible hose.

CAUTION

In disconnecting fire extinguisher line, hold solidly the fitting on forward end of flexible hose and screw off fitting on CO_2 diffuser tube assembly, to prevent damage to hose.

n. Disconnect any remaining lines, hoses or electrical connections leading from engine accessories to units mounted on the firewall, and that they are properly secured so as not to interfere with removal of engine from the aircraft.
o. Attach hoist slings to lugs on engine crankcase just aft of and between cylinders 1 and 2 and 1 and 9.

WARNING

A suitable hoist capable of supporting the entire engine section must be applied to hoisting lugs before removing engine assembly. Two men are required to remove assembly; one to remove bolts, the other to operate hoist.

p. Take up cable slack to support the weight of engine.

WARNING

Check hoisting sling to make certain connection to hoisting lugs is satisfactory and that hoisting sling separator bar prevents cables from damaging induction pipes.

q. Remove nuts from three bolts attaching engine mount to center section truss.

WARNING

Do not remove bolts.

r. Make a final check to see that the engine is properly supported by the hoist.
s. Remove bolts in the following order: (1) lower; (2) outboard upper; (3) inboard upper.
t. Swing the engine clear of the aircraft, and move a disassembly stand into position under the engine.

5-3. POWER PLANT STRIPPING. The removal of the engine accessories may be accomplished while the engine is suspended from a hoist or supported on a suitable stand.
a. Remove the mounting plate from the former ring and remove bolts through upper mounting brackets. Slip former ring forward until free of brackets.
b. Remove the forward wrapper sheet former by removing four screws and two bolts.
c. Remove carburetor air scoop elbows.
d. Remove carburetor hot air ducts.
e. Remove carburetor box and heater valve casting by removing four nuts from studs on lower side of carburetor. The heater drain plate must be removed for access to the two front nuts.
f. Disconnect main fuel pressure and primer lines from carburetor.
g. Remove carburetor from carburetor adapter.
h. Remove clamps holding flexible conduits to engine mounts.
i. Disconnect and remove the electrical wiring from the generator, starter and tachometer generator.
j. Remove fuel, oil and vacuum lines from engine accessories.
k. Detach and remove the starter, generator, tachometer generator, governor, fuel pump and oil separator. Do not remove magnetos or ignition harness.
l. Remove flexible duct from generator head.
m. Remove clamp from propeller deicing line.
n. Remove phenolic clamp holding primer and manifold pressure gage lines to engine mount.
o. Disconnect and remove right-hand section of fire extinguisher loop.
p. Remove exhaust collector ring.
q. Remove cotter pins and nuts from nine bolts holding engine mount ring to blower section of engine crankcase. Pull engine mount aft from engine.
r. Remove inner cowl from engine mount.
s. On vacant mounting pads install the original gaskets and covers which can be obtained from the replacement engine.
t. Install plastic caps over the magneto "P" leads connections at the rear of the magnetos.
u. Detach all ignition conduit elbows from lower spark plugs, and screw protectors into the elbow coupling nuts.

v. Remove all front and rear spark plugs, and install fresh dehydrator plugs in their places. Torque dehydrator plugs to 25 inch-pounds. Snap the cable protectors over the dehydrator plugs.
w. Install pipe plugs in the vacant holes to prevent any oil leakage that might occur.

5-4. PRESERVATION PROCEDURE. As soon as practicable after the preservation run (and under no circumstances more than four (4) hours afterward) the engine should be removed from the aircraft and the following procedures accomplished, using a mixture of corrosion preventive compound, Specification MIL-C-6529, and lubricating oil, Specification MIL-L-6082. Mount the engine on a rotary overhaul stand and recheck all engine openings for suitable oil and moisture resistant caps.

5-5. PRESERVATION OF INTERIOR SURFACES.

5-6. EXHAUST VALVES. Thoroughly spray each exhaust valve with corrosion preventive mixture through the spark plug holes or the exhaust ports. Be sure each exhaust valve is fully open when it is being sprayed. Use only dry air to operate the spray gun. Rotate the propeller shaft at least four revolutions in the normal direction of rotation to work the mixture into the valve guides. Install exhaust port covers.

5-7. ROCKERBOXES. It will not be necessary to remove the rockerbox covers and spray the rockers if the engine was preserved at specified oil temperatures. Engines preserved under low temperature or if the alternate method of treating cylinder boxes is used, must have the rockerbox covers removed and the rockers, valve springs, washers, and valves sprayed with corrosion preventive mixture.

5-8. THRUST BEARING. Take out the 1/8-inch plug in the recess at the top of the cover. Insert the nozzle of the spray gun in the hole where the plug was removed and spray enough corrosion preventive mixture to cover the thrust bearing thoroughly. Reinstall the plug.

5-9. CYLINDER TREATMENT. With the piston at the bottom of its intake stroke, spray hot, 210°F to 220°F (99°C to 104°C), corrosion preventive mixture into the front spark plug hole of each cylinder and in the same sequence as the firing order. This spray should be deposited on the inlet valves and the cylinder walls. Rotate the propeller shaft at least six revolutions to insure piston ring coverage for each cylinder. Respray each cylinder without turning the propeller shaft to cover the cylinder walls.

CAUTION

Do not turn the propeller shaft after this spraying of the cylinders. If the shaft is turned the spraying procedure must be repeated.

NOTE

Do not apply excessive amounts of corrosion preventive mixture. All that is necessary is a uniform thin coating of all surfaces. Excessive amounts of mixture do not contribute to the preservation; they cause difficulty at the time of depreservation and increase the chances of hydraulic lock.

It is of the utmost importance that personnel entrusted with the cylinder spray operation be properly trained in the techniques required. The recommended procedure to be used by the operator is as follows:
a. Place the preservation mixture in the reservoir, heat to the correct operating temperature, and mix thoroughly. Premixing and preheating the compound prior to placing it in the reservoir will be a timesaver.
b. Close the vessel and connect the gun and all lines.
c. Discharge the gun into a clean container until a fine uniform spray is produced at the nozzle. The mixture discharge during this operation should be retained for the final operation.
d. Insert the discharge tube of the gun into the cylinder and determine the position of the piston. Use the free hand to mark the distance to come to a point just short of the piston. Withdraw the gun tube until the nozzle is at the spark plug opening.
e. Start spraying. As soon as the trigger is pressed move the gun so that the nozzle will travel slowly from the spark plug opening to the piston, but without touching the piston head, then back to the spark plug opening where the trigger should be released immediately.
f. Proceed at once to spray each of the remaining cylinders in the same manner. If the spray gun will be idle more than one minute, repeat step c to insure that a slug of cold preservation mixture is not injected and to insure that a fine even spray is obtained.

5-10. CARBURETOR. When a carburetor is to be out of service, prepare it for storage in accordance with the following instructions. Use cleaning solvent, Federal Specification P-S-661 for cleaning. Use only oil Grade 1065, Specification MIL-O-6081, for preservation purposes.
a. Remove the carburetor from the engine; then remove the drain plug in the bottom of the float bowl, and drain all fuel from the carburetor through this opening and the carburetor fuel inlet. A few strokes of the throttle lever will pump out any gasoline that may have collected in the accelerating pump system.
b. After the carburetor has been drained thoroughly, place the carburetor on its top flange. Install a fitting in the carburetor drain and attach an oil line. Pump in slushing oil, Grade 1065, Specification MIL-O-6081, until the oil flows from the discharge nozzle. The slushing oil pressure applied to the carburetor should not exceed 3 to 4 psi. If a pump is not available, the oil may be poured in providing precautions are taken to insure complete slushing.
c. When the oil flows from the discharge nozzle, disconnect the oil line and replace the drain plug. Set the carburetor in an upright position and operate the throttle lever until oil is discharged from the accelerating pump discharge nozzle.

NOTE

While the flushing oil prescribed for the flushing operation may be reused, this oil is continually picking up gasoline in the flushing process. A supply of oil should be discarded when its gasoline content reaches 2 percent by volume.

d. Place the throttle valve in the closed position and adjust the throttle stop to obtain the maximum throttle opening; then lockwire the throttle valve in this position against the stop.

e. If the carburetor is to be shipped over or stored near salt water, spray the outside of the carburetor with the approved flushing oil.

f. The carburetor should be packed in a dustproof container and given such protection against moisture as climatic conditions at the point of storage require. In ordinary cases this will consist of storing the carburetor in as dry a location as possible. If the carburetor is to be shipped over, or stored near salt water, usual practice calls for wrapping the dustproof sealed container in waterproof paper and then placing the carburetor so wrapped in a strong wooden box.

NOTE

It is recommended that a cloth bag containing 1/2 pound of silica gel crystals be placed in the dustproof container in such a way that the cloth bag does not come in actual contact with the carburetor.

5-11. PROPELLER SHAFT.

a. Coat the exposed surface of the propeller shaft with compound, Specification MIL-C-11796.

b. Spray the interior of the propeller shaft with the corrosion-preventative mixture and wrap the shaft with barrier conforming to MIL-B-121, grade A.

5-12. ACCESSORY DRIVES. Remove all accessory drive cover plates. Cover the drive ends with corrosion preventive mixture, then reinstall the cover plates.

5-13. MAGNETOS.

a. Seal all the external openings, conforming with Specification JAN-P-127.

b. Check the cam, springs and all other steel parts of the breaker mechanism for a light coating of oil. In the event oil is to be applied, use grade 1100, Specification MIL-L-6082, and be careful when applying, that oil does not come in contact with breaker points.

5-14. SPARK PLUGS. Refer to T.O. 8E2-6-1-37.

5-15. INSTALLATION INTO METAL SHIPPING CONTAINER. Before installing the engine into the container, be sure all necessary repairs have been made and that all the containers original parts are in place and thoroughly cleaned. To mount the engine and prepare it for storage or shipment, proceed in the following manner.

a. Equip the propeller shaft with a lifting eye and, using a chain hoist or other lifting device of one ton capacity, lower the engine into the shipping container (see figure 5-4). Be careful to guide the engine so that it will not be damaged on the projecting lugs of the mounting plate inside the container.

b. Secure the engine to the mounting plate with bolts, nuts and lock washers and install a protector on the propeller shaft threads.

c. Attach a new humidity indicator so that it will be completely visible through the inspection port in the shipping container, plug "C," (figure 5-1).

d. Attach bags of dehydrating agent (Specification MIL-D-3464) to the cylinders at the minimum rate of two pounds per cylinder. Coat the propeller shaft with soft film corrosion preventive compound, Specification MIL-C-11796, then wrap the splines with barrier conforming to MIL-B-121, grade A.

e. Attach an improvised lifting sling to the two lifting eyes in the top of the engine container and, using a chain hoist or other lifting device, raise the cover high enough to clear the propeller shaft. Move the cover over the engine; then lower it carefully into place, guiding it so that it does not strike the engine (see figure 5-3).

f. Align the indexing marks on the upper and lower sections of the container and drop a few bolts through both flanges and the rubber seal to align all the bolt holes (see figure 5-2). This work will be made easier if the full weight of the cover is supported by the hoist until all bolts, nuts and washers are in place and are ready to be tightened.

g. Tighten the flange bolts to 300-450 inch-pounds torque; then spray them with a preservative conforming to Specification MIL-C-16173, Grade 1.

h. Install dehydrator plug, Stock No. 6750-652855, in the receptacle provided and torque to 25 inch-pounds.

i. Pressurize the container to 5 psi (gage) through the valve under plug "B" (figure 5-1) using dehydrated air only, and install the receptacle cover.

j. Place AF Form 60B in plug "A" provided in the lower section of the container and install the cap.

k. Stencil engine type, serial number, and date or preservation, on the engine container.

l. The air pressure within the container will be checked 1 hour after pressurizing. If no drop in pressure is observed, the container will be considered satisfactory. If a rapid drop in pressure is observed, the container will be checked for leaks. Leaks will occur frequently at the base of the relief valve, filler valve, or dehydrator plug. Soap suds may be used for testing. No attempt will be made to stop leaks at the bolting flange by torquing bolts in excess of the established torquing limits for the bolts used. If leakage occurs at the bolting flange, the air pressure will be released and the cover removed; the gasket and upper and lower flanges will be inspected and any discrepancies corrected. The cover will be reinstalled and the container repressurized to 5 psi (gage).

5-16. INSTALLATION INTO WOODEN SHIPPING CONTAINER. A new or properly reconditioned wooden container may be used. Responsible personnel will inspect the container prior to installation of the engine, for damage or defective sills, cone, bracing, mounts and side, top and bottom boards. Check all exterior markings for proper identification and legibility. Accomplish the installation as outlined in the following steps:

a. Unfasten and remove the engine from the stand, using PWA-520 lifting eye, and hoist with a minimum capacity of two tons.

b. Place the support cone on the shipping container base, fitting the holes in the cone over the studs in the base. Fasten the cone to the base with washers and nuts. Place the shipping container mounting plate in position but do not secure it.

c. Place the engine case base with the support cone attached and the mounting plate in position, under the engine. Carefully spread the protective enevelope inside the support cone, locating the large reinforcing washers over the holes in the mounting plate.

d. Carefully lower the engine onto the mounting plate, secure nuts to two opposite bolts, raise the engine and mounting plate and fasten the remaining bolts to the mounting plate.

e. Cover with tape any protruding nuts, studs, or lockwire which might damage the protective envelope.

f. Fasten two 1 pound bags of dehydrating agent, Specification MIL-D-3464, to each cylinder. Wrap crepe paper around the power section; then attach the humidity indicator to the crepe paper.

g. Lower the engine onto the cone and fasten the mounting plate to the cone. Clean the exposed surface of the propeller shaft with a film of corrosion preventive compound, Specification MIL-C-11796.

h. Wrap the propeller shaft with barrier conforming to MIL-B-121, grade A. Bring the protective envelope up around the engine. Install the spacer, place the envelope reinforced opening on the propeller shaft and screw the spanner tight against the envelope. Install the protector cap and seal the protective envelope, withdrawing as much air as possible without shrinking the envelope against the engine. Fasten the excess envelope material around the propeller shaft.

i. Install the four side panels in the base, attach the carburetor to the shipping container cover, and lower it in position. Pass two steel straps over the top and under the bottom of the case, tighten and secure with crimping tool. Pass the third strap around the case horizontally, tighten and secure with crimping tool. Place the engine log data sheets behind the inspection port cover and wire the cover.

j. The engine should be regularly inspected by means of the humidity indicator, which is a color chart showing the safe and unsafe color ranges of the dehydrating agent. The frequency with which engines in storage should be inspected will depend largely upon storage conditions. This agent is a deep blue when dry, ranging to a lighter and into pink as it becomes moist. When the relative humidity exceeds 20 percent, the dehydrating agent assumes an unsafe color as shown on the color chart. If the humidity indicator registers unsafe, replace all old dehydrating agent and install a new humidity indicator.

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SECTION VI

INSTRUMENTS AND RELATED SYSTEMS

TABLE OF CONTENTS

Paragraph		Page
6- 1.	Instruments	217
6- 3.	Engine Instruments	217
6- 9.	Flight Instruments	217
6-16.	Navigation Instruments	219
6-23.	Navigation Training Instruments (TC-45G)	220
6-34.	Miscellaneous Instruments	221
6-40.	Instrument Vacuum System	228
6-59.	Pilot's Floating Instrument Panel	229
6-64.	Pitot and Static Pressure System	230
6-67.	Automatic Pilot	230
6-77.	Servo Units	232
6-86.	Flushing Automatic Pilot System	234
6-87.	Bleeding the Automatic Pilot System	234

6-1. INSTRUMENTS.

6-2. GENERAL DESCRIPTION. Since instruments are delicate and require highly trained personnel to perform detailed repair on them, this section deals only with generalized system maintenance and repairs which can be performed in the field. The instrument trouble shooting tables list some of the most common instrument troubles. A dual set of flight and navigation instruments and a single set of engine instruments are mounted on the floating panel, which has rubber vibration absorbers to help keep the instruments from being damaged (figure 6-1). The floating panel is provided with a cutout to accommodate the automatic pilot control units. Mounted on the subpanels are miscellaneous instruments, switches and warning lights. The instruments are divided into four classifications: engine, flight, navigation, and miscellaneous.

6-3. ENGINE INSTRUMENTS.

6-4. DESCRIPTION. The engine instruments on the C-45G and the TC-45G airplanes are properly grouped and located in the center of the floating instrument panel to enable either pilot or copilot to tell at a glance if the engines are functioning correctly. Each instrument is individually lighted for night operation. Engine instruments are as follows:

a. Cylinder head temperature indicator (dual).
b. Tachometer (dual).
c. Manifold pressure indicator (dual).
d. Carburetor mixture temperature indicator (dual).
e. Engine gage units (two) (oil temperature and pressure, fuel pressure).

6-5. TROUBLE SHOOTING. See Table XXI.

6-6. REMOVAL OF ENGINE INSTRUMENTS.

a. Remove screws holding floating panel in vertical position and tilt panel down.
b. Disconnect electrical wiring or plumbing on instrument to be removed.
c. Remove mounting screws holding instrument to panel and remove instrument.

6-7. MINOR REPAIR AND PARTS REPLACEMENT. If instrument is defective, replace. Defective instruments will be sent to a designated overhaul activity.

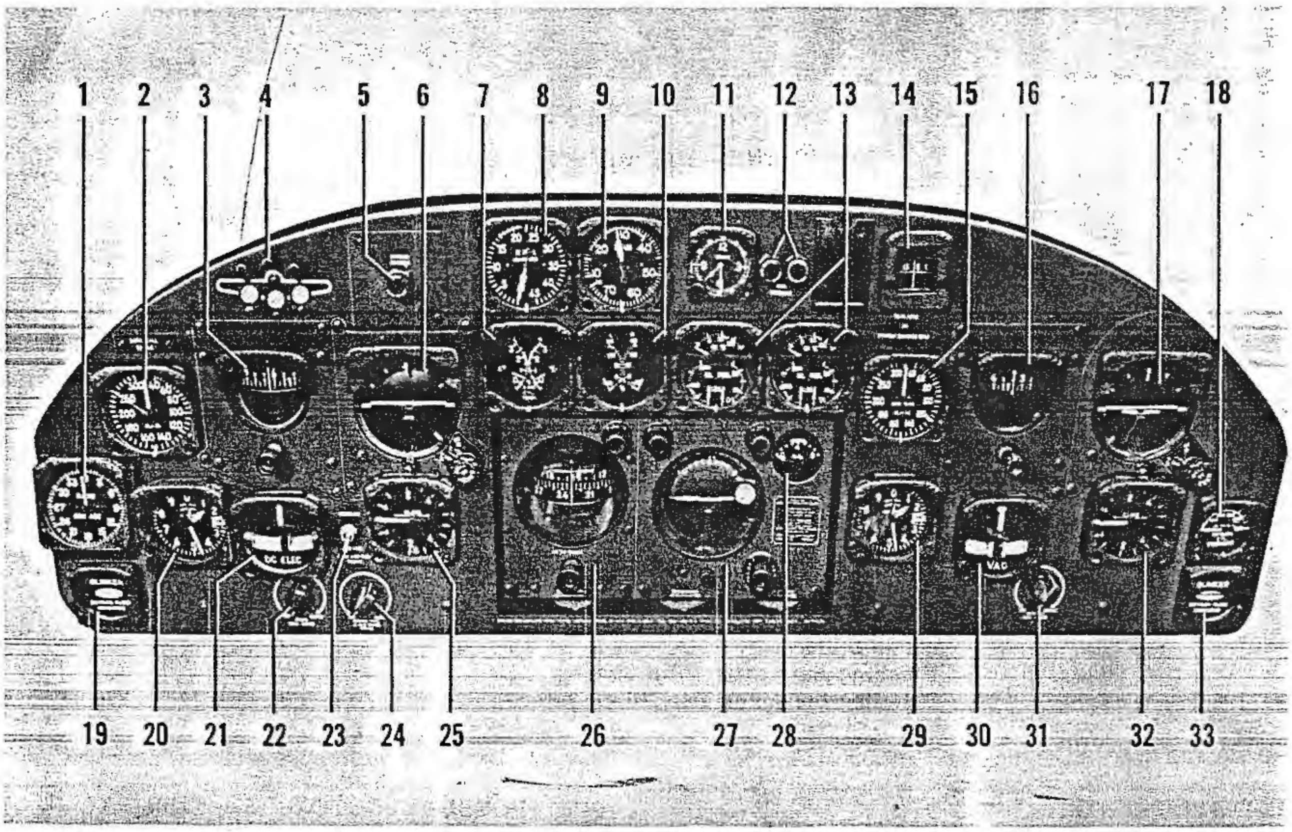
6-8. INSTALLATION OF ENGINE INSTRUMENTS.

a. Position instrument in instrument panel and install mounting screws.
b. Make correct electrical or plumbing connections.
c. Raise panel to vertical position and install screws.

6-9. FLIGHT INSTRUMENTS.

6-10. DESCRIPTION. Flight instruments are composed of a group of instruments needed by the pilot or copilot to keep the airplane in a safe flying attitude at all times. The gyroscopic flight instruments are divided into two categories: electrically driven and vacuum driven. This allows the alternate instruments to be used in case of failure of either power source. The flight instruments are face-mounted on the floating panel and consist of the following:

a. Pilot's airspeed indicator.
b. Pilot's gyro horizon.
c. Copilot's airspeed indicator.
d. Copilot's gyro horizon.
e. Pilot's altimeter.



1. Radio Compass Indicator
2. Pilot's Airspeed Indicator
3. Pilot's Directional Gyro
4. Landing Gear Position Indicator
5. Marker Beacon Light
6. Pilot's Gyro Horizon
7. Dual Cylinder Head Temperature Indicator
8. Dual Tachometer
9. Dual Manifold Pressure Indicator
10. Dual Carburetor Mixture Temperature Indicator
11. Clock
12. Fuel Warning Lights
13. Engine Gage Units
    (Oil Temperature and Pressure, Fuel Pressure)
14. Magnetic Compass
15. Copilot's Airspeed Indicator
16. Copilot's Directional Gyro
17. Copilot's Gyro Horizon
18. Oxygen Cylinder Pressure Gage
19. Pilot's Oxygen Flow Indicator
20. Pilot's Altimeter
21. Pilot's Turn and Bank Indicator
22. Pilot's Instrument Light Rheostat
23. Turn and Bank Alternate Power Selector Switch
24. Engine Instrument and Subpanel Light Rheostat
25. Pilot's Rate of Climb Indicator
26. Automatic Pilot Directional Control Unit
27. Automatic Pilot Bank and Climb Control Unit
28. Automatic Pilot Suction Gage
29. Copilot's Altimeter
30. Copilot's Turn and Bank Indicator
31. Copilot's Instrument Light Rheostat
32. Copilot's Rate of Climb Indicator
33. Copilot's Oxygen Flow Indicator

Figure 6-1. Floating Instrument Panel

f. Pilot's turn-and-bank indicator.
g. Pilot's rate-of-climb indicator.
h. Copilot's altimeter.
i. Copilot's turn-and-bank indicator.
j. Copilot's rate-of-climb indicator.

6-11. TROUBLE SHOOTING. See Table XXII.

6-12. REMOVAL OF FLIGHT INSTRUMENTS.
a. Remove screws holding instrument panel in vertical position and tilt panel down (figure 6-2).

NOTE

Take care not to break the instrument faces by dropping the panel on the control knobs.

b. Disconnect plumbing or electrical wiring on instrument to be removed.
c. Remove instrument mounting screws and remove instrument.

6-13. MINOR REPAIR AND PARTS REPLACEMENT.

6-14. Defective instruments must be replaced and sent to a designated overhaul activity.

6-15. INSTALLATION OF FLIGHT INSTRUMENTS.
a. Position instrument in floating panel and install mounting screws.
b. Make correct electrical or plumbing connections.
c. Raise floating panel to vertical position and install retaining screws.

6-16. NAVIGATION INSTRUMENTS.

6-17. DESCRIPTION. The navigation instruments consist of the pilot's and copilot's directional gyros, mounted directly in front of the pilot and copilot; a radio compass indicator mounted on the lower left side of the instrument panel; and a clock and magnetic standby compass mounted on the upper right side of the instrument panel. Provision has been made for the installation of a gyrosyn compass indicator which will be mounted on the right upper aft portion of Bulkhead 5 facing the pilot. Effective with Serial 52-10750 and after, a gyrosyn compass, to provide improved flight equipment for navigation, is installed in lieu of a directional gyro. The bracket used to support the gyrosyn compass flux valve is strengthened and made more durable, effective with Serials 52-10539 and after.

6-18. TROUBLE SHOOTING. See Table XXIII.

NOTE

Upon removal and/or installation of compass, and as prescribed in the applicable -6 Handbook of Inspection Requirements, compensation and precision compass swing will be accomplished in accordance with Technical Order 05-15-3.

6-19. REMOVAL OF NAVIGATION INSTRUMENTS.
a. Remove screws holding instrument panel in vertical position and tilt panel down.
b. Disconnect plumbing or electrical wiring on instrument to be removed.
c. Remove instrument mounting screws and remove instrument.

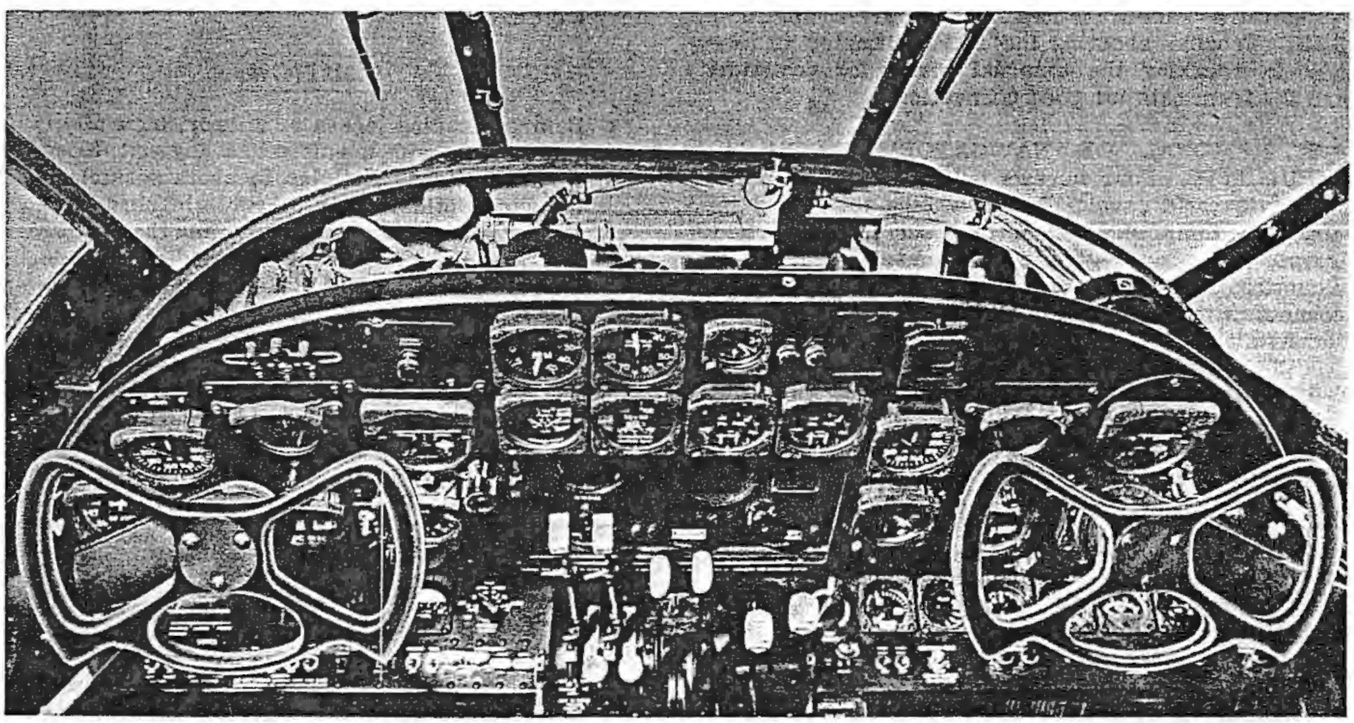


Figure 6-2. Instrument Removal Access

6-20. MINOR REPAIR AND PARTS REPLACEMENT.

6-21. Defective instruments must be replaced and sent to a designated overhaul activity.

6-22. INSTALLATION OF NAVIGATION INSTRUMENTS.

a. Position instrument in panel and install mounting screws.
b. Make correct electrical or plumbing connections.
c. Raise instrument panel to vertical position and install retaining screws.

6-23. NAVIGATION TRAINING INSTRUMENTS (TC-45G).

6-24. DESCRIPTION. Cabin instrumentation in the TC-45G consists of a clock, altimeter and airspeed indicator mounted on the first navigator's panel located on the forward left side of the cabin; a radio compass indicator mounted on the second navigator's panel directly above the second navigator's table; a B-3 driftmeter and navigator's top reading compass mounted on a shelf to the right of the second navigator; a B-5 driftmeter mounted on the right cabin wall adjacent to the third navigator's table; and an outside air temperature gage mounted in the left forward cabin window. Provision has also been made for the installation of a gyrosyn compass repeater indicator in the first navigator's instrument panel.

NOTE

The B-3 driftmeter cannot be operated without first placing the AN/ARN-7 radio compass in operation.

6-25. TROUBLE SHOOTING. Trouble shooting the navigator's panel instruments is given in Table XXII. Trouble shooting the B-3 driftmeter is limited to checking the external wiring for continuity and the terminals for good connections.

6-26. REMOVAL OF NAVIGATOR'S PANEL INSTRUMENTS. Four screws hold each instrument to the navigator's panel. Pull down the top of the instrument lamp shield and fold out the instrument lamps. This will give easy access to the upper mounting screws. Remove mounting screws. Disconnect wiring and plumbing and pull instrument forward.

6-27. INSTALLATION OF NAVIGATOR'S PANEL INSTRUMENTS.

a. Position instrument on panel.
b. Connect wiring and plumbing.
c. Install instrument lamp assembly on face of instrument.
d. Install mounting screws and secure lamp shield.

6-28. REMOVAL OF B-3 DRIFTMETER.

NOTE

Make certain that driftmeter is properly caged before removing from airplane.

a. Disconnect electrical wiring.
b. Remove screws holding driftmeter to the shock mountings.
c. Lift driftmeter out.

6-29. MINOR REPAIR AND PARTS REPLACEMENT. Maintenance of the driftmeter will consist of cleaning the lenses, tightening lens mounting screws and adjusting or replacing the 3-volt lamp assembly. If the instrument is defective it must be replaced and sent to a designated overhaul activity.

NOTE

It is imperative to set the driftmeter at 180° on the drift scale before landing and take-off to prevent breakage of the driftmeter by stones thrown up from the runway.

6-30. INSTALLATION OF B-3 DRIFTMETER.

a. Place driftmeter in correct position.
b. Insert screws holding the driftmeter to the shock mountings.
c. Connect electrical wiring.

6-31. REMOVAL OF B-5 DRIFTMETER. Lift guide pins out of detents in channel rails and slide instrument out.

6-32. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will be limited to cleaning the eyepiece, reticle and outside mirror surfaces, tightening screws and replacing pencil in pencil tube. Wipe lenses and mirror gently with a soft clean cloth dampened with clean water. See that the pencil has a good point. The pantograph arm reticle bearing and connecting arm may be oiled as needed with a drop of instrument oil, Specification MIL-L-6085. Wipe off excess oil.

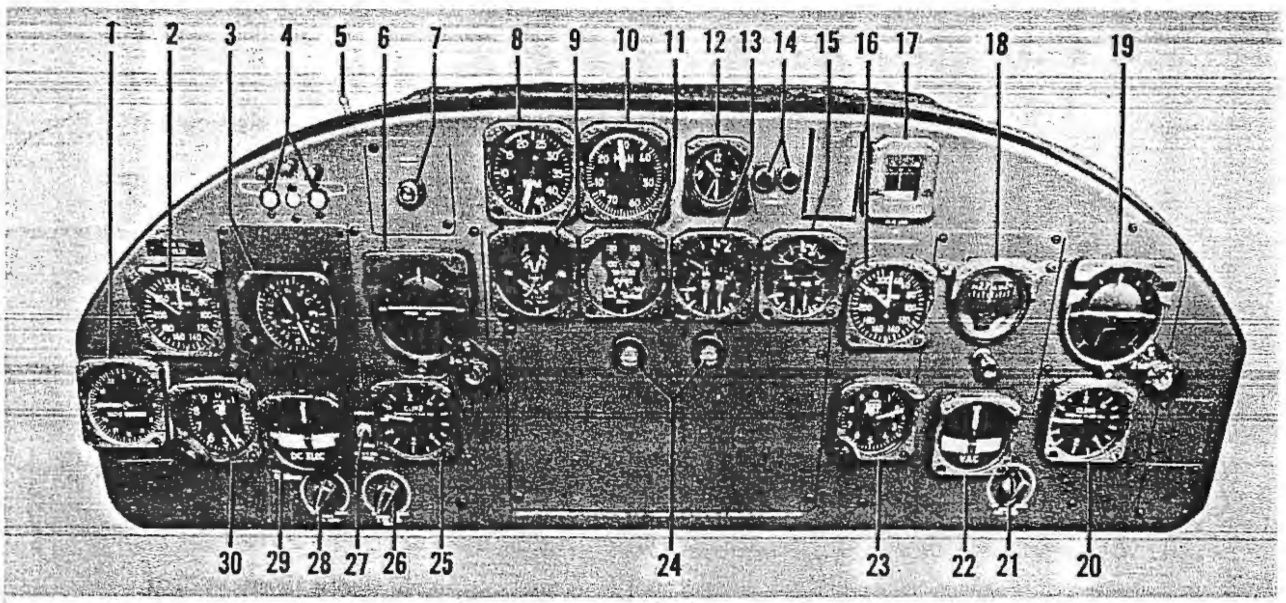
CAUTION

Before cleaning lenses or mirror, blow off or brush away with a soft brush any grit, filing or other hard particles to avoid scratching the soft optical glass. Avoid cleaners containing alcohol, which may soften the shellac in which the lens mounts are set. The inside mirror is a single-surface mirror and probably will be destroyed by attempts to clean it.

6-33. INSTALLATION OF B-5 DRIFTMETER. Depress with the fingers the tension spring in the end of each channel rail and slide the instrument on the rails in the aircraft structure. The guide pin in the center of each rail will drop into a detent when the instrument is correctly positioned. On reinstallation, check alignment of driftmeter as follows: with the aircraft in a level flight attitude, place a straightedge or stretch a cord on the ground parallel to the longitudinal center line of the airplane and positioned beneath the outside mirror of the driftmeter so it appears near the center of the reticle. Move the driftmeter indicator knob left or right until the drift lines on the reticle appear parallel to the straightedge. The pointer on the indicator dial should read zero. If it does not, loosen the screws on each end of the scale and set zero on the scale opposite the pointer. Retighten screws.

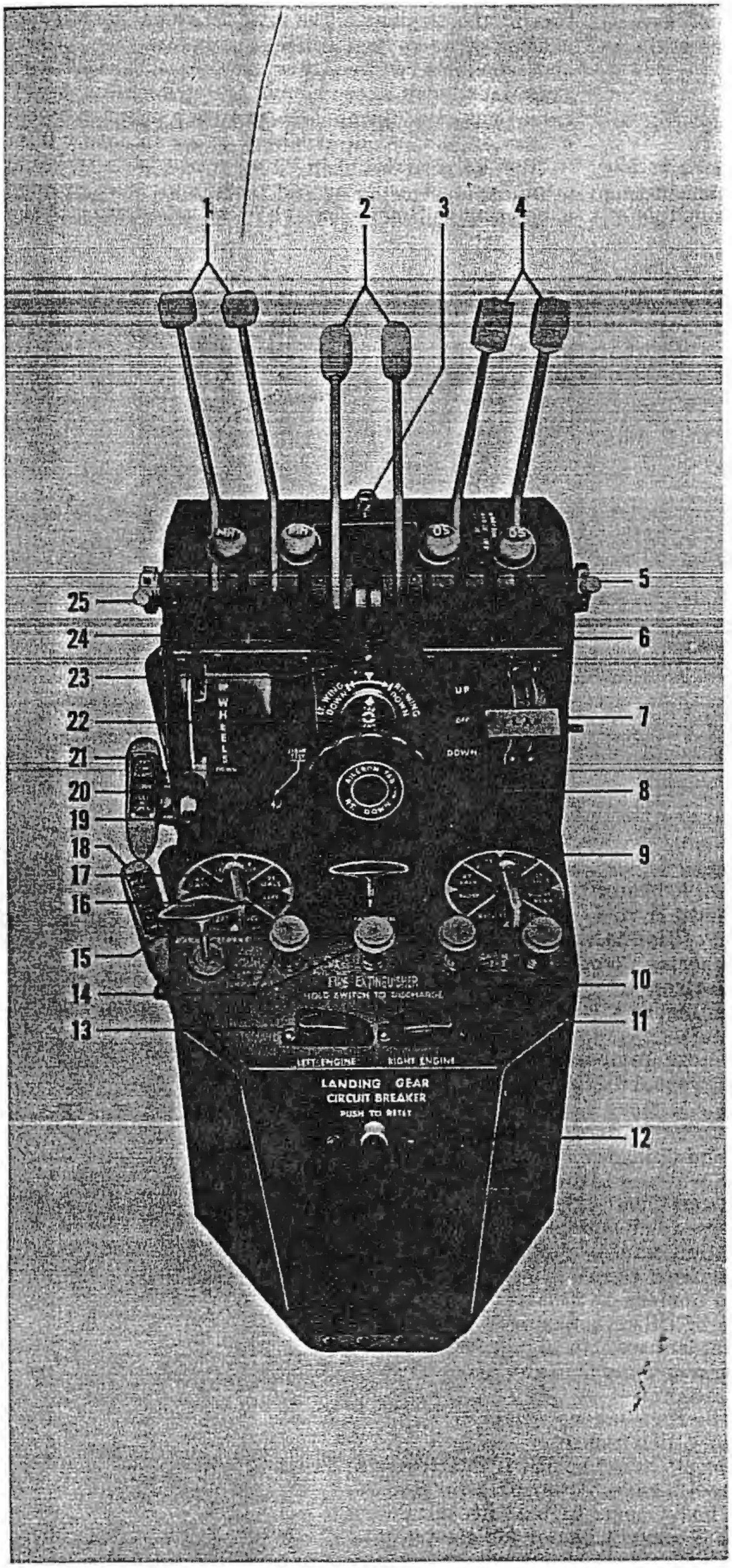
6-34. MISCELLANEOUS INSTRUMENTS.

6-35. DESCRIPTION. Miscellaneous instruments are those not contained in the preceding instrument groups, but which are necessary to the safe operation of the airplane. The miscellaneous instruments consist of an oxygen cylinder pressure gage, pilot's and copilot's oxygen flow indicators, and landing gear indicators mounted on the instrument panel; cabin oxygen cylinder pressure gage mounted on the upper left portion of Bulkhead 5; an automatic pilot suction gage mounted in the automatic pilot bank and climb control unit; and an outside air temperature gage mounted on the pilot's overhead adjacent to the



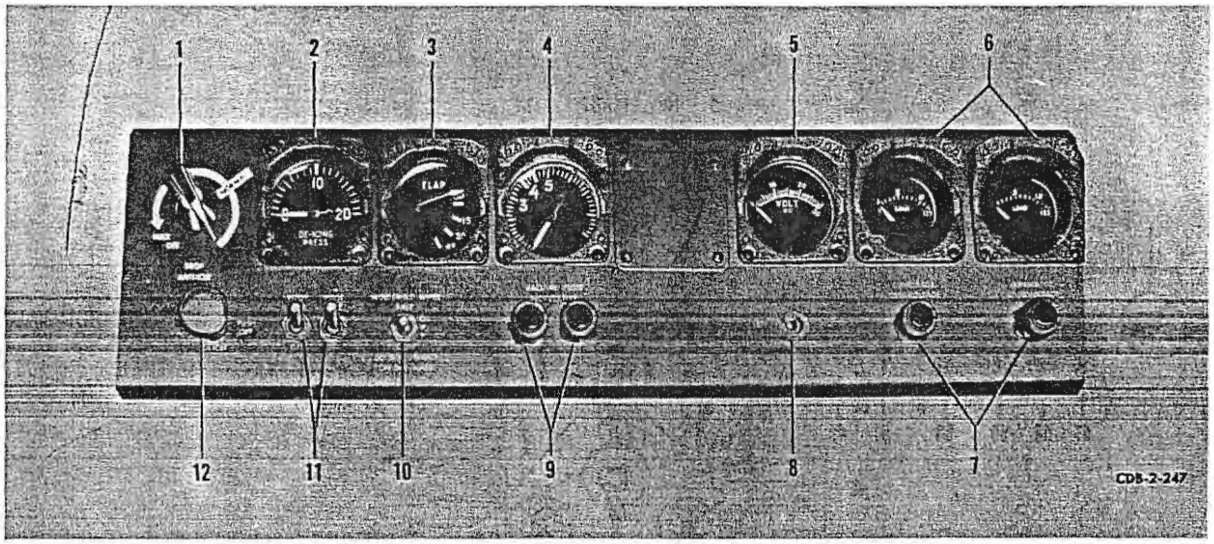
1. Radio Compass
2. Pilot's Airspeed Indicator
3. Pilot's Directional Gyro
4. Landing Gear Position Indicator
5. Propeller Feathering Circuit Breaker
6. Pilot's Gyro Horizon
7. Marker Beacon Light
8. Dual Tachometer
9. Dual Cylinder Head Temperature Gage
10. Dual Manifold Pressure Gage
11. Dual Carburetor Mixture Temperature Gage
12. Clock
13. Left Engine Gage Unit
14. Fuel Pressure Warning Lights
15. Right Engine Gage Unit
16. Copilot's Airspeed Indicator
17. Standby Magnetic Compass
18. Copilot's Directional Gyro
19. Copilot's Gyro Horizon
20. Copilot's Rate-of-Climb Indicator
21. Copilot's Flight Instruments Lights Rheostat Switch
22. Copilot's Turn-and-Bank Indicator
23. Copilot's Altimeter
24. Propeller Feathering Buttons
25. Pilot's Rate-of-Climb Indicator
26. Engine Instruments and Subpanel Lights Rheostat Switch
27. Turn-and-Bank Alternate Power Selector Switch
28. Pilot's Flight Instruments Lights Rheostat Switch
29. Pilot's Turn-and-Bank Indicator (dc electric)
30. Pilot's Altimeter

Figure 6-3. Floating Instrument Panel (C-45H)



1. Propeller Levers
2. Throttles
3. Warning Horn Silencer
4. Mixture Levers
5. Mixture and Oil Shutter Levers Lock
6. Oil Shutter Levers
7. Flap Lever
8. Aileron Trim Tab Wheel
9. Right Engine Fuel Selector Handle
10. Cabin Heat Buttons
11. Right Engine Fire Extinguisher Switch
12. Landing Gear Motor Circuit Breaker
13. Left Engine Fire Extinguisher Switch
14. Oil By-Pass Buttons
15. Parking Brake Handle
16. Tail Wheel Lock Handle
17. Left Engine Fuel Selector Handle
18. Right Engine Cowl Flap Handle
19. Landing Gear Malfunction Light Test Switch
20. Landing Gear Position Switch and Malfunction Light
21. Left Engine Cowl Flap Handle
22. Aileron Trim Tab Position Indicator
23. Throttle Lock
24. Manifold Heat Levers
25. Propeller and Manifold Heat Lever Lock

Figure 6-4. Control Pedestal (C-45H)



RIGHT:

1. Propeller Anti-Icer Pump Valve
2. Wing and Tail Deicer Pressure Gage
3. Flap Position Indicator
4. Copilot's Suction (Vacuum) Gage
5. Voltmeter
6. Generator Loadmeters
7. Generator Overvoltage Lights
8. Voltmeter Switch
9. Vacuum Pump Warning Lights
10. Windshield Wiper Switch
11. Pitot Heater Switches
12. Wing and Tail Deicer Button

LEFT:

1. Left Engine Ignition Switch
2. Master Engine Ignition Switch
3. Right Engine Ignition Switch
4. Ignition Booster, Starter and Primer Switches Cover
5. Engine Selector (Starting System)
6. Elevator Tab Position Indicator
7. Pilot's Suction (Vacuum) Gage
8. Fuel Gage
9. Fuel Gage Tank Selector Switch
10. Landing Light Lamp Switches
11. Landing Light Extend-Retract Switches
12. Taxi Light Switch
13. Passing Light Switch
14. Navigation Lights Switch
15. Navigation Lights Dimmer Switch
16. Cabin Dome Lights Switch (White Lights)
17. Engine Oil Dilution Switches
18. Instrument Inverter Switch
19. Fuel Booster Pump Switches
20. Master Switch
21. Battery Switches

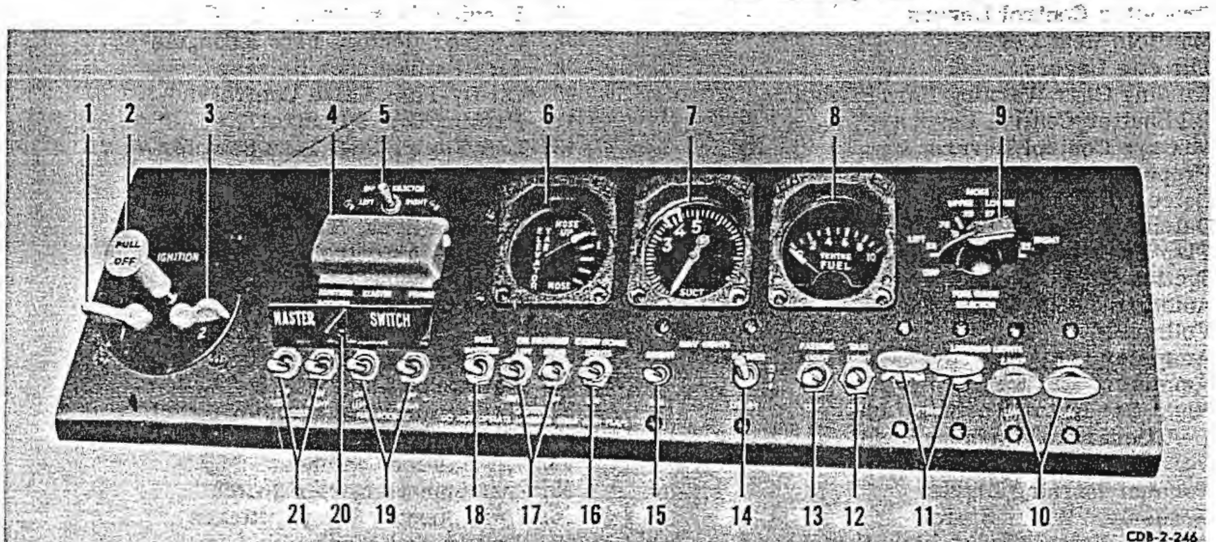
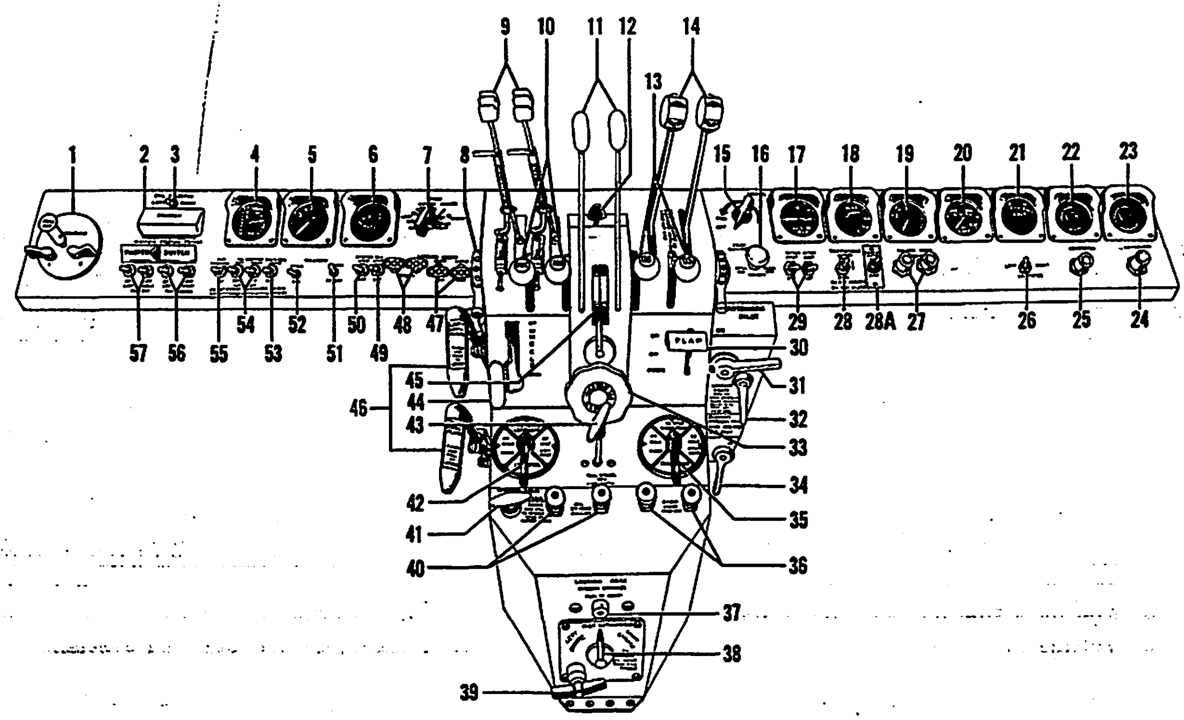


Figure 6-5. Subpanels (C-45H)



1. Ignition Switches
2. Booster, Starter, Primer Switch Panel
3. Engine Selector Switch
4. Elevator Tab Indicator
5. Suction Gage
6. Fuel Level Indicator
7. Fuel Level Indicator Selector Switch
8. Friction Lock, Propeller, Manifold Heat Levers
9. Propeller Control Levers
10. Manifold Heat Levers
11. Throttle Levers
12. Landing Gear Warning Horn Silencer
13. Oil Shutter Control Levers
14. Mixture Control Levers
15. Propeller Anti-Icer Rheostat
16. Deicer Control
17. Deicing Pressure Gage
18. Flap Position Indicator
19. Suction Gage
20. Automatic Pilot Hydraulic Pressure Gage
21. Voltmeter
22. Ammeter
23. Ammeter
24. Right Generator Warning Light
25. Left Generator Warning Light
26. Voltmeter Selector Switch
27. Vacuum Warning Lights
28. Windshield Wiper Switch

28A. Anti-Collision Beacon Light Switch

29. Pitot Heat Switches
30. Flap Position Switch
31. Automatic Pilot "ON-OFF" Valve
32. Automatic Pilot Emergency Vacuum Valve
33. Aileron Tab Control
34. Automatic Pilot Emergency Hydraulic Valve
35. Right Engine Fuel Tank Selector Valve
36. Cabin Heat Controls
37. Landing Gear Circuit Breaker
38. Engine Selector, Fire Extinguisher
39. Fire Extinguisher Release
40. Oil By-Pass Valve Controls
41. Parking Brake Control
42. Left Engine Fuel Tank Selector Valve
43. Tail Wheel Lock Control
44. Landing Gear Position Switch
45. Friction Lock, Throttle Levers
46. Cowl Flap Controls
47. Landing Light Lamp Switches
48. Landing Light Extension Switches
49. Taxi Light Switch
50. Passing Light Switch
51. Navigation Light Flasher Switch
52. Navigation Light Dimmer Switch
53. Cabin Dome Light Switch
54. Oil Dilution Switches
55. Instrument Inverter Switch
56. Fuel Booster Pump Switches
57. Battery Switches

Figure 6-6. Control Pedestal and Subpanels

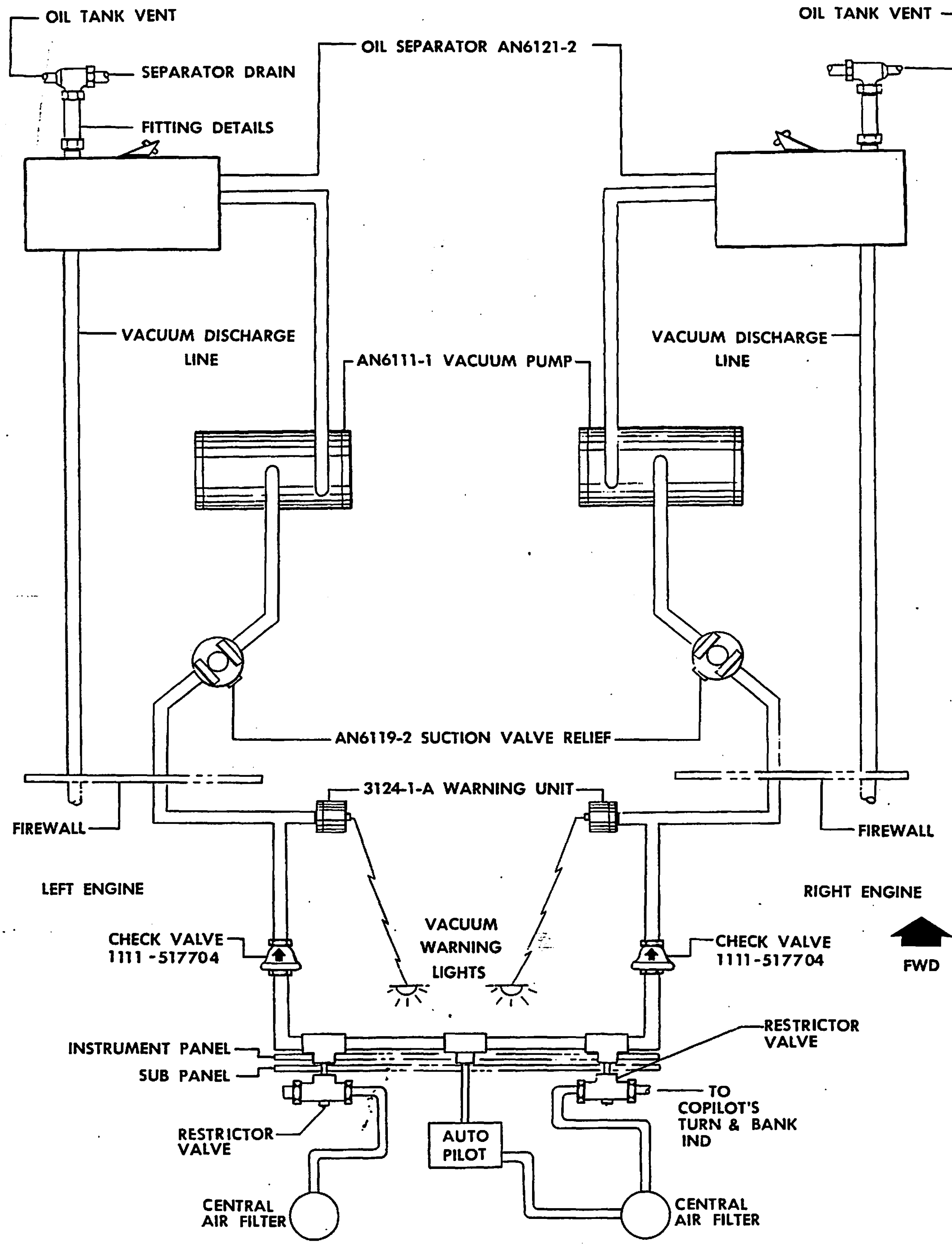


Figure 6-7. Instrument Vacuum System (TC-45G)

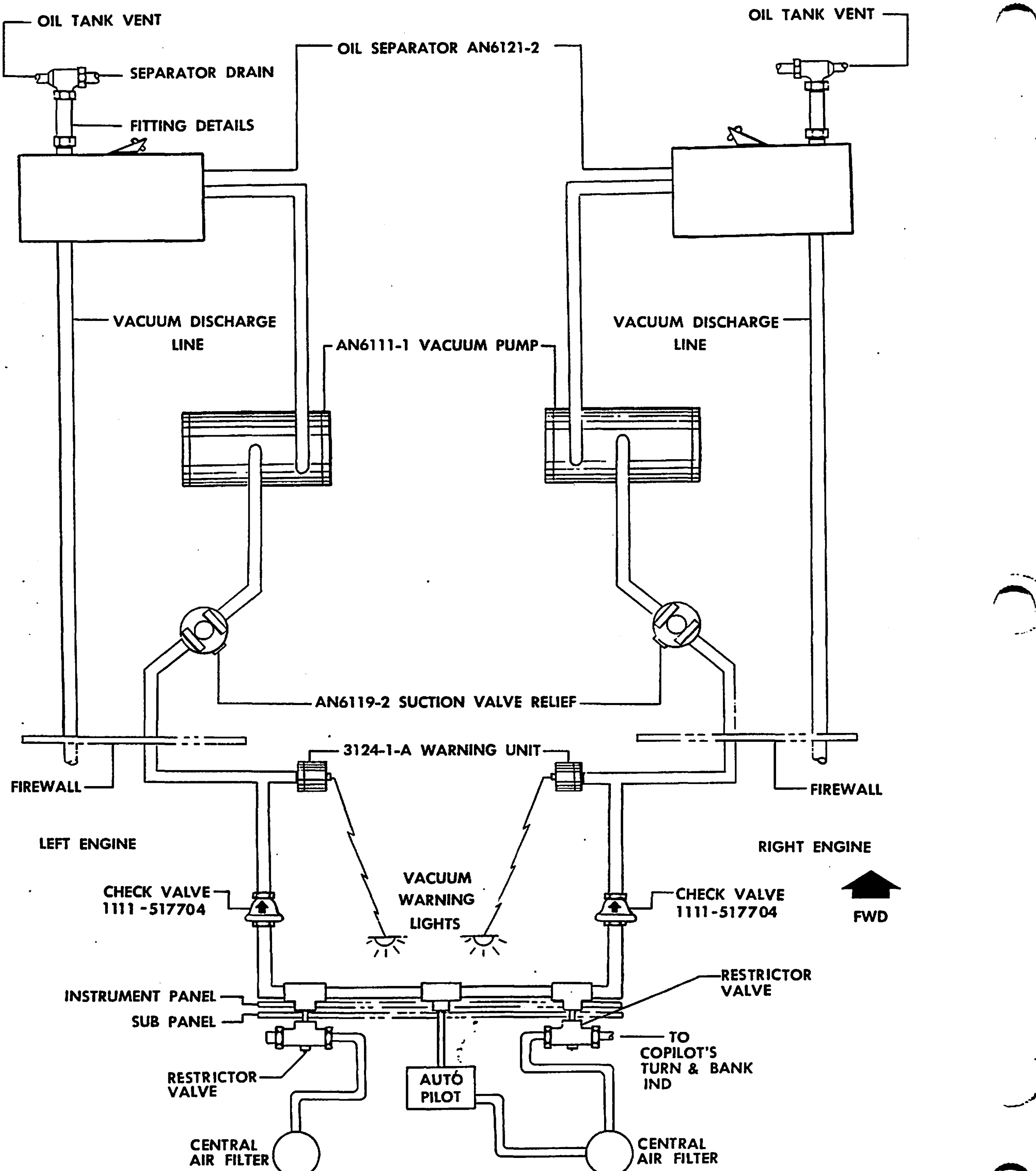


Figure 6-8. Instrument Vacuum System (C-45G)

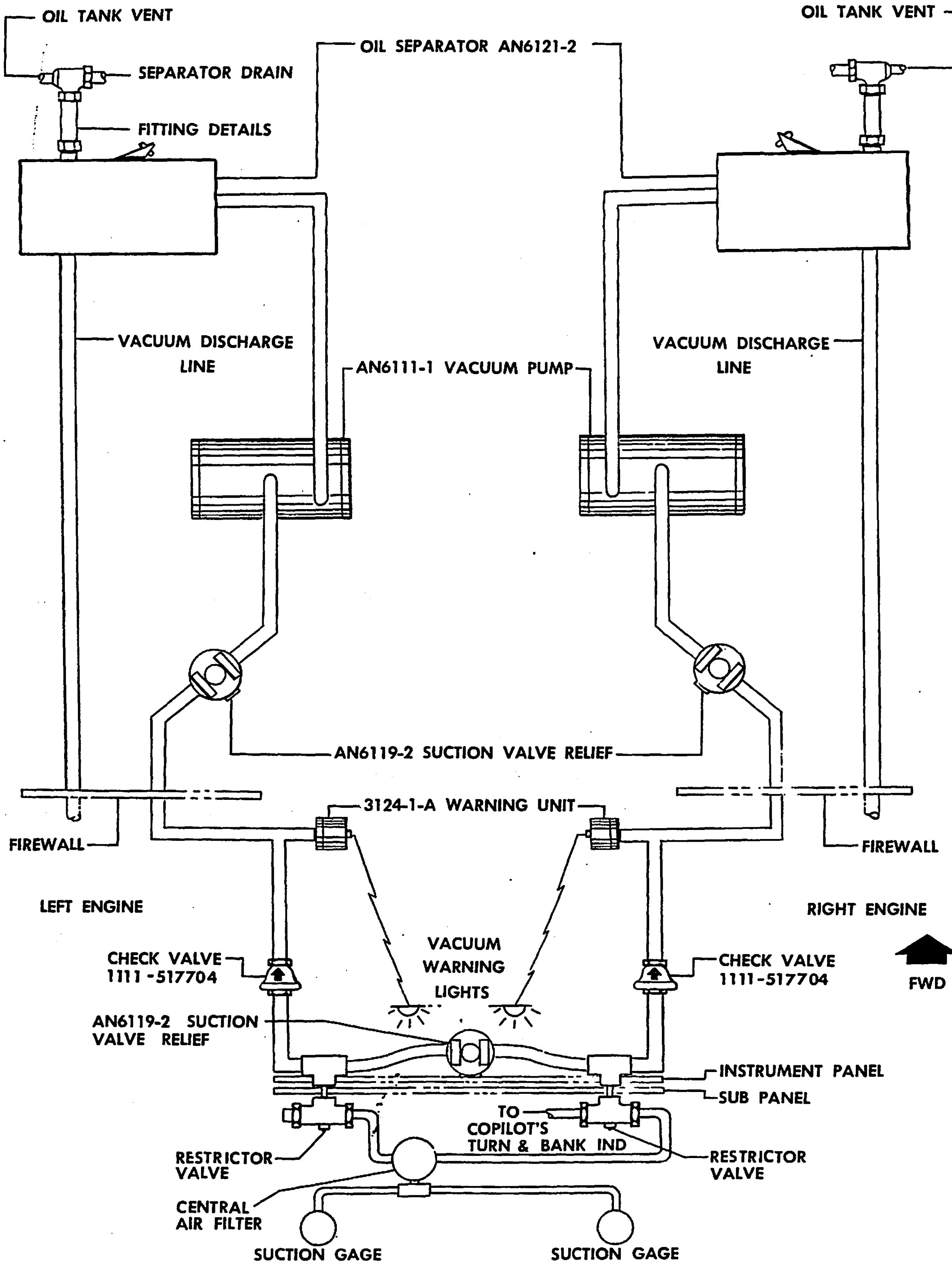


Figure 6-9. Instrument Vacuum System (C-45H)

windshield wiper. The remainder of the miscellaneous instruments are all mounted on the pilot's and copilot's subpanels (figure 6-6). The instruments are face-mounted and consist of the following:

a. Elevator tab indicator.
b. Suction gage (pilot's subpanel and copilot's subpanel).
c. Fuel quantity indicator.
d. Deicing pressure gage.
e. Flap position indicator.
f. Automatic pilot hydraulic pressure gage.
g. Voltmeter.
h. Ammeter (2).

6-36. TROUBLE SHOOTING. See Table XXIV.

6-37. REMOVAL OF MISCELLANEOUS INSTRUMENT (SUBPANEL).

a. Working through the nose compartment, disconnect electrical or plumbing connections on instrument to be removed.
b. Remove instrument mounting screws and remove instrument.

6-38. MINOR REPAIR AND PARTS REPLACEMENT. If instrument is defective or malfunctioning, it must be replaced and sent to a designated overhaul activity.

6-39. INSTALLATION OF MISCELLANEOUS INSTRUMENT (SUBPANEL).

a. Position instrument in subpanel and install mounting screws.
b. Make correct electrical or plumbing connections, working through the nose compartment.

6-40. INSTRUMENT VACUUM SYSTEM.

6-41. DESCRIPTION. Engine-driven vacuum pumps (one on each engine) furnish vacuum to the directional, bank, and turn control of the automatic pilot and all gyroscopic flight instruments, except the pilot's turn and bank indicator which is electrically operated. Each nacelle houses a suction relief valve and an air-oil separator. A vacuum warning switch is located in each battery well. An adjustable restrictor valve and a check valve is located on each side of the nose compartment just forward of the instrument panel, with a turn and bank indicator throttling valve behind the right side of the instrument panel. Both subpanels incorporate a suction gage, with both warning lights on the right subpanel. On Serial 52-10539 and after, a third relief valve is installed forward of the instrument panel (figure 6-9). Aircraft Serial 51-11816 and after, the turn and bank indicator throttling valve is relocated to a position under the right subpanel.

6-42. TROUBLE SHOOTING. See Table XXV.

6-43. REMOVAL OF VACUUM PUMP.

a. Remove engine cowling.
b. Disconnect suction and discharge lines.
c. Remove safety wire and nuts from mounting studs.
d. Pull pump out and off engine mounting pad.

6-44. MINOR REPAIR AND PARTS REPLACEMENT. If the pump is inoperative or malfunctioning, replace and send to a designated overhaul activity.

6-45. INSTALLATION OF VACUUM PUMP.

a. Slide pump into position on the engine mounting pad with the suction and discharge ports facing aft.
b. Install nuts on the mounting studs and safety.
c. Connect suction and discharge lines to the correct ports.
d. Reinstall engine cowling.

NOTE

When installing pump, be sure lubrication holes in pump flange are not covered by flange gasket.

6-46. REMOVAL OF SUCTION RELIEF VALVE. Disconnect lines at inlet and outlet elbows. The unit will fall free.

6-47. MINOR REPAIR AND PARTS REPLACEMENT. Clean the relief valve screen in solvent, Specification P-S-661 or equivalent, and dry with compressed air.

6-48. INSTALLATION OF SUCTION RELIEF VALVE. Hold relief valve in position. Connect lines to inlet and outlet elbows.

6-49. ADJUSTMENT OF SUCTION RELIEF VALVES. To adjust the suction relief valves proceed as follows:

a. Turn the automatic pilot control and the automatic pilot emergency vacuum valve to the "OFF" position.
b. Start one engine and set throttle to 1500 rpm.
c. Check suction gages. If the gages do not read 4-inches Hg proceed as follows:

1. Adjust the suction relief valve to obtain a gage reading of 4-inches Hg by loosening the locknut and turning the adjusting screw (figure 6-10) counterclockwise to increase suction or clockwise to decrease suction.

NOTE

If a setting of 4-inches Hg has been obtained

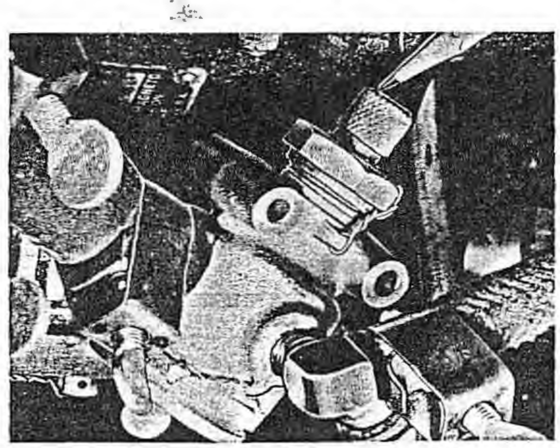


Figure 6-10. Suction Relief Valve Adjustment

on one instrument and the other does not agree, check the lines of this instrument for foreign material.

d. Stop engine and repeat step b and c with the opposite engine running.
e. After both suction relief valves have been individually adjusted to obtain 4 inches Hg suction, start both engines, turn automatic pilot emergency vacuum valve to "ON" position, and resafety. Set throttles to obtain 1500 rpm and check for proper suction settings.
f. Check all suction gages for a consistent reading or 4 inches Hg. If this reading is not obtained, readjust the individual suction relief valves as described in steps b and c until the proper reading is obtained.

6-50. ADJUSTMENT OF RESTRICTOR VALVE.
a. Run one engine up to 1500 rpm. Gage should read in the green arc (on C-45G and TC-45G the autopilot "OFF".) Adjust valve as necessary.
b. Repeat step a with opposite engine.
c. Run up both engines and check suction gages (C-45G and TC-45G turn autopilot "ON".) Each gage should read the same.

6-51. ADJUSTMENT OF VACUUM WARNING LIGHT SWITCHES. On Serial 51-11444 through 51-11716, an Eclipse-Pioneer vacuum warning light switch in the outboard, forward section of each battery well, connected to the vacuum line between the pump and the check valve, warns the pilot of a drop in vacuum in either the right or left hand portion of the system by lighting warning lights on the right subpanel. An adjusting screw moves the contact points closer together, so they close with a smaller drop in vacuum, or farther apart so a greater drop is required to close them. When the adjusting screw is turned out too far, no warning will be given by the vacuum warning light until too large a drop in vacuum has occurred, or the system has failed completely. With the screw turned in too far and the contact points too close, vibration set up in flight will cause the warning lights to blink intermittently, or to flicker, tending to give a false indication of failure. For satisfactory operation of the warning lights, adjust the switches as follows:
a. Remove battery access door and remove the warning light switch cover.
b. Turn battery switches on and turn warning light switch adjusting screw out (counterclockwise) until the warning light in the pilot's compartment goes out. Turn adjusting screw in (clockwise) approximately 1/2 to 3/4 turn. (The warning light should light.)
c. Lock the adjusting screw and replace the switch cover. Install battery access door.
d. Repeat the procedure for the opposite switch.
e. Flight test the airplane and check the warning lights for correct operation as follows:
1. Reduce power on one engine and note when the vacuum warning light comes on. Note reading on suction gage. The light should come on when the gage shows approximately 1-inch Hg. Continue flight testing and ground adjustments until the warning lights will come on between 1 and 1-1/2-inch Hg.
2. Note the operation of the warning lights for intermittent blinking or flickering. Adjust until the lights no longer flicker.

6-52. On Serials 51-11717 and after, the Eclipse-Pioneer warning light switch is replaced with a Cook Electric switch. This switch is a sealed unit and no adjustments are to be attempted.

6-53. REMOVAL OF OIL SEPARATOR.
a. Disconnect inlet, outlet and oil return lines.
b. Remove nuts from the two mounting bolts.
c. Lift unit off inner cowl.

6-54. MINOR REPAIR AND PARTS REPLACEMENT. Disassemble and clean in solvent, Specification P-S-661 or equivalent. Dry thoroughly with compressed air and reassemble.

6-55. INSTALLATION OF OIL SEPARATOR.
a. Place separator in position on inner cowl.
b. Install nuts on the two mounting bolts.
c. Connect inlet, outlet and oil return lines. Use a thread lubricant on fittings and tighten fully.

6-56. REMOVAL OF CENTRALIZED AIR FILTER.
a. Disconnect instrument lines at manifold.
b. Remove nuts from the two mounting bolts.
c. Lift unit off mounting bracket.

6-57. MINOR REPAIR AND PARTS REPLACEMENT. Minor repairs will consist of removing the filter bowl and cleaning the air filter inlet screen or cleaning and replacing the filter element. Use solvent, Specification P-S-661 or equivalent. Dry thoroughly with compressed air.

NOTE

To clean element, blow air through element in the direction opposite to normal flow. Care should be taken not to blow air into element at right angles, as this will tend to clog dust in the element. Tilt air hose at approximately 45 degrees. When operating in abnormally dusty areas, clean element more frequently than at normal intervals.

6-58. INSTALLATION OF CENTRALIZED AIR FILTER.
a. Place filter in position on mounting bracket with intake port facing down.
b. Install nuts on the mounting bolts.
c. Connect instrument lines at manifold.

6-59. PILOT'S FLOATING INSTRUMENT PANEL.

6-60. DESCRIPTION. The pilot's floating instrument panel is hinged at the bottom to four shock mount assemblies. These are fastened to a ridged cross member which is firmly mounted to the fuselage. The panel is held at the top by a single shock mount which attaches to the panel by one screw. For access to the back of the panel, remove the top screw and the screws from the four bottom shock mounts and swing the panel down (figure 6-2).

6-61. REMOVAL OF INSTRUMENT PANEL.

a. Remove the one top and four bottom screws holding the panel to the shock mounts.

b. Lower panel (taking care not to break the glass fronts of instruments) and disconnect all wiring and plumbing attached to instruments and panel.

c. Remove the two hinge pins connecting panel to the lower shock mounts and remove panel.

6-62. MINOR REPAIR AND PARTS REPLACEMENT. Repairs to the panel will consist of replacement of Lord bushings in the shock absorber units.

6-63. INSTALLATION OF INSTRUMENT PANEL.

a. Align hinges on bottom of panel with matching parts on four lower shock mounts and install the two hinge pins as follows:

1. Insert one pin through two lower left-hand shock mounts, through inboard mount first, then through outboard mount.

2. Insert the other pin through the two lower right-hand shock mounts, starting the pin through inboard mount first.

b. Mark all electrical and plumbing connections.

c. Raise panel to vertical position and attach the panel to the five shock mounts with screws.

6-64. PITOT AND STATIC PRESSURE SYSTEM.

6-65. DESCRIPTION. The pitot and static pressure system is designed primarily to furnish pitot (impact) pressure for the airspeed indicators and static pressure for the airspeed indicators, altimeters and rate of climb indicators. The pitot pressure comes from two pitot masts, which are mounted side by side under the nose section of the airplane at Bulkhead 3. The right-hand mast provides pitot pressure for the copilot's airspeed indicator. The left-hand mast provides pitot pressure for the pilot's airspeed indicator. A heating element is built into each mast head as a precaution against moisture freezing and obstructing the air passages. Each element is operated by an individual switch, mounted directly in front of the copilot on the right subpanel. Static pressure for the pilot's and copilot's altimeters, airspeed indicators and rate of climb indicators is provided by two static buttons (ports) which are riveted flush with the fuselage skin, one on each side of the fuselage between Bulkheads 12 and 13. By connecting these ports, a common line provides static pressure from either or both ports. A drain is located aft of the lower portion of Bulkhead 10.

6-66. TROUBLE SHOOTING. See Table XXVI.

6-67. AUTOMATIC PILOT.

6-68. DESCRIPTION. On the C-45G and TC-45G airplanes, an A-3A Jack and Heintz automatic pilot will maintain a heading and attitude fixed by the human pilot; C-45H airplanes, Serials 52-10539 and after, have no automatic pilot. Gyroscopic flight instruments form an integral part of the automatic pilot and give visual reference for either manual or automatic flight. The mount assembly, Jack and Heintz Model JH4000-1, is shock mounted to brackets behind the instrument panel at four points. To this mount are attached air relays, balanced oil valves and follow-up mechanisms. The mount also supports the control units which slide on tracks into the mount. All mechanical and air connections on the rear of the control units are established when the control units are bolted into place. The follow-up pulleys, to which the follow-up cables are attached, are provided with clutch discs which carry their motion to the control unit. Inside the follow-up pulley drum is a spring which keeps the cables taut. Other component parts of the system are as follows:

a. Overpower Valve. The overpower valve pressure of 97-1/2 psi must be set on a test bench before the unit is installed. If adjustment is needed in the field, the unit must be removed from the airplane and adjusted on a test bench by authorized personnel.

b. Hydraulic Pressure Relief Valve. The hydraulic pressure relief valve is located in the right wheel well. Hydraulic pressure should be 80 psi plus or minus 10 psi. To adjust, loosen the locknut and then turn adjusting screw counterclockwise to increase or clockwise to decrease the pressure.

c. Oil and Air Filters. To clean the hydraulic oil filter, remove the nut on the bottom of filter, which will allow the bowl and filter to fall free. Wash the filter, soak covering and bowl with a suitable solvent, Specification P-S-661 or equivalent, and dry the filter thoroughly with compressed air before reinstallation. Remove the vacuum filters, located in the nose compartment, clean with dry air blast, and reinstall.

6-69. TROUBLE SHOOTING. See Table XXVII.

6-70. REMOVAL OF BANK AND CLIMB CONTROL UNIT.

a. Turn caging knob to lock gyro and prevent it from being damaged during handling.

b. Remove two bolts at lower corners of control unit.

c. Pull bank and climb gyro out and away from instrument panel.

6-71. MINOR REPAIR AND PARTS REPLACEMENT. Replace the air relay grommets to insure a tight seal. Repairs other than replacement of the entire control unit and air relay grommets should be done at a designated overhaul activity.

6-72. INSTALLATION OF BANK AND CLIMB CONTROL UNIT.

a. Insert unit into proper track and gently press into place, making sure air connection fittings have seated properly in the rubber grommets.

b. Install the two attaching bolts and tighten securely.

6-73. REMOVAL OF DIRECTIONAL CONTROL UNIT.

a. Push caging knob in to prevent damage to the gyro during handling.

b. Remove the two attaching bolts at the lower corners of the control unit.

c. Pull instrument out and away from the control unit.

6-74. MINOR REPAIR AND PARTS REPLACEMENT. Replace air relay grommets to insure a tight seal.

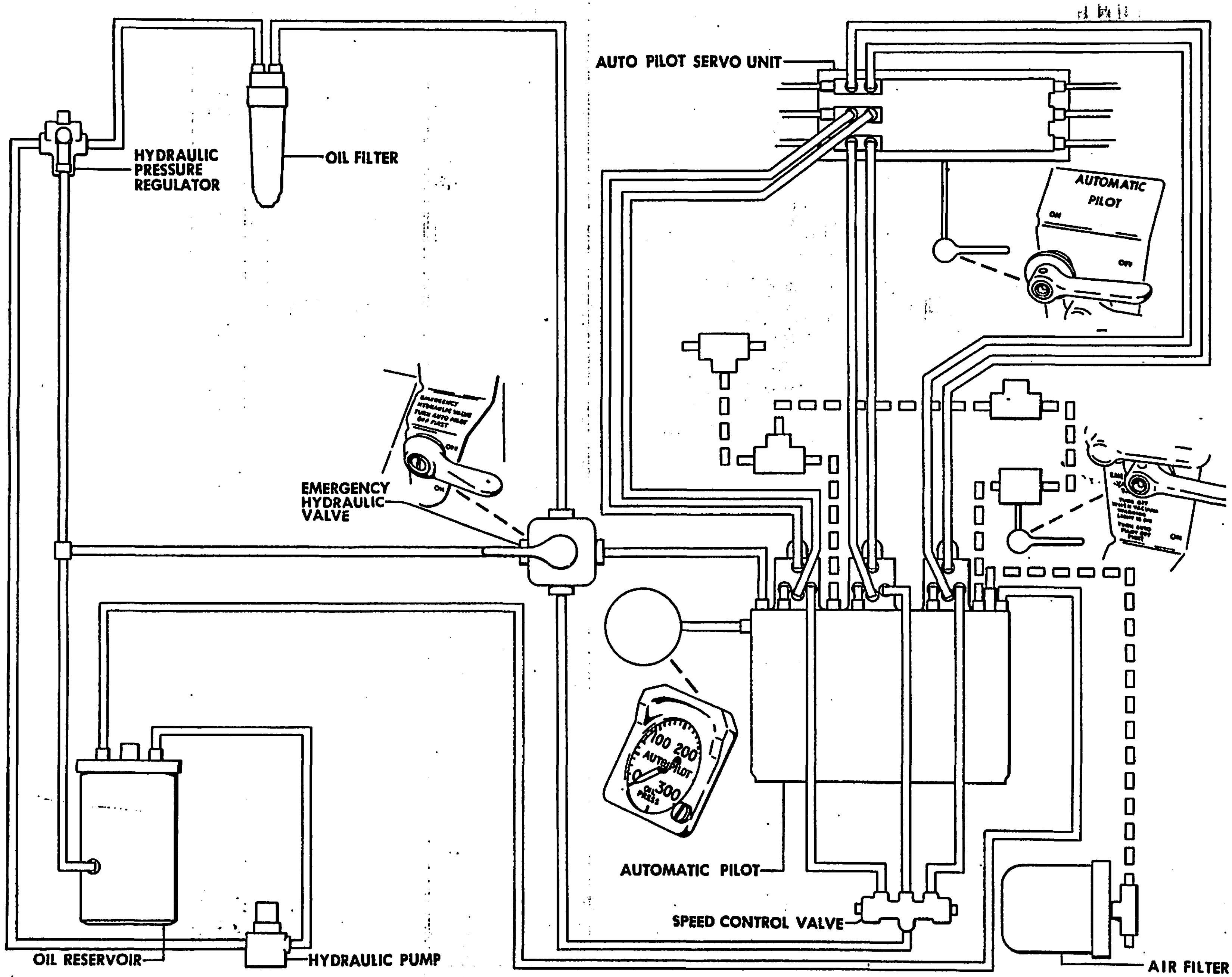


Figure 6-11. Automatic Pilot System (C-45G and TC-45G)

Repairs other than the replacement of the entire control unit and air relay grommets should be done at a designated overhaul activity.

6-75. INSTALLATION OF DIRECTIONAL CONTROL UNIT.

a. Insert unit into proper track and gently press into place, making sure air-connection fittings have seated properly in the rubber grommets.
b. Install the two attaching bolts and tighten securely.

6-76. ADJUSTMENT OF DIRECTIONAL AND BANK AND CLIMB CONTROL UNITS. Adjustments to air relays and balance valves individually should be done only by authorized personnel at a designated overhaul activity. Lubrication will be necessary only at overhaul.

6-77. SERVO UNITS.

6-78. DESCRIPTION. The servo units consist of three cylinders cast in one unit with piston rods extending from the cylinders at each end of the unit. Each piston operates one of the control systems. A manually-operated by-pass valve engages the automatic pilot. The servo piston rods are connected directly through cables to the main control cables of the airplane.

6-79. REMOVAL OF SERVO UNITS. Access to the servo units is made through the nose section of the airplane. Remove access cover on Bulkhead 3, then proceed as follows:

a. Place a flat pan under the servo units to catch hydraulic fluid.
b. Disconnect all hydraulic lines leading to the unit and mark each line to insure proper reinstallation.
c. Disconnect control cables and follow-up cables from the servo piston rods.
d. Disconnect the "ON-OFF" valve handle.
e. Remove four mounting bolts and lower the unit away from the mounting support.

6-80. MINOR REPAIR AND PARTS REPLACEMENT. Replacement and repairs other than tightening of the cylinder-gland nut should be attempted only by authorized personnel at a designated overhaul activity.

6-81. INSTALLATION OF SERVO UNITS.

a. Place servo units in position. Insert four mounting bolts. Do not tighten fully.
b. Connect servo cables, follow-up cables, quick-release brackets, and control-cable turnbuckles. Make sure turnbuckles guide pins are in guide slots.

NOTE

It will be necessary to properly rig all servo and follow-up cables. See paragraphs 6-82 through 6-85.

c. Tighten servo mounting bolts.
d. Attach "ON-OFF" handle to valve.
e. Reinstall all hydraulic lines correctly to the servo unit.
f. Fill hydraulic reservoir and operate the system until all air is discharged from the automatic pilot system.

6-82. RIGGING AILERON SERVO CABLE. The aileron servo is the forward cylinder of the gang servo unit. The servo control cable attaches to the left end of the servo piston and is routed over pulleys to connect to an attaching lug on the pilot's control balance cable. A cable also attaches to the right end of the servo piston, similarly running to the copilot's control column balance cable. These servo cables should have tension of 35 pounds, plus or minus 5 pounds. When rigging the aileron servo cables, the servo piston and piston rod extends an equal distance on each side of the cylinder when it is in the neutral position.

6-83. RIGGING ELEVATOR SERVO CABLE. The elevator servo is the center cylinder of the gang servo unit. The servo control cable attaches to the left end of the servo piston and is routed over a series of pulleys to the lower part of the elevator control cable bull wheel in the belly of the airplane. A cable routed from the upper part of the bull wheel follows a series of pulleys to the right end of the elevator-servo piston. The tension on the elevator servo cables should be 45 pounds plus or minus 5 pounds. When rigging the elevator servo cables, the elevator should be set in the full down position. Rig the cables so there will be a clearance of approximately 3/8-inch between the nut on the end of the piston rod and the large packing nut on the right end of the servo cylinder. After rigging the cables, move the elevator to the up position and check to see if the piston rod has approximately the same amount of clearance on the left end of the cylinder. If the rod does not have clearance and the piston is striking the end of the cylinder, further adjustment is necessary.

CAUTION

Adjust carefully. Serious damage to the piston packing will result if the piston is allowed to strike against the end of the cylinder. Also, control surface travel will be restricted.

6-84. RIGGING RUDDER SERVO CABLE. The rudder servo is the rear cylinder of the gang servo unit. The left end of the rudder servo piston is attached to a cable, which is routed over a series of pulleys to the pilot's left rudder pedal. Similarly, the right end of the servo piston is attached to a cable routed to the copilot's right rudder pedal. The tension on the rudder servo cables should be 35 pounds plus or minus 5 pounds. When rigging the rudder servo cables, the servo piston and the rudder surfaces must be in neutral position. If the piston rod extends an equal distance on each side of the cylinder, the servo piston is in neutral position.

6-85. RIGGING OF FOLLOW-UP CABLES. Proper tension is maintained by a return coil spring encased in the follow-up pulley and by a definite cable length. Looking at the follow-up cable pulleys from the nose aft, rotate the pulleys clockwise all the way against the spring stops. Then wrap the cables around the pulleys and attach the swaged end to the

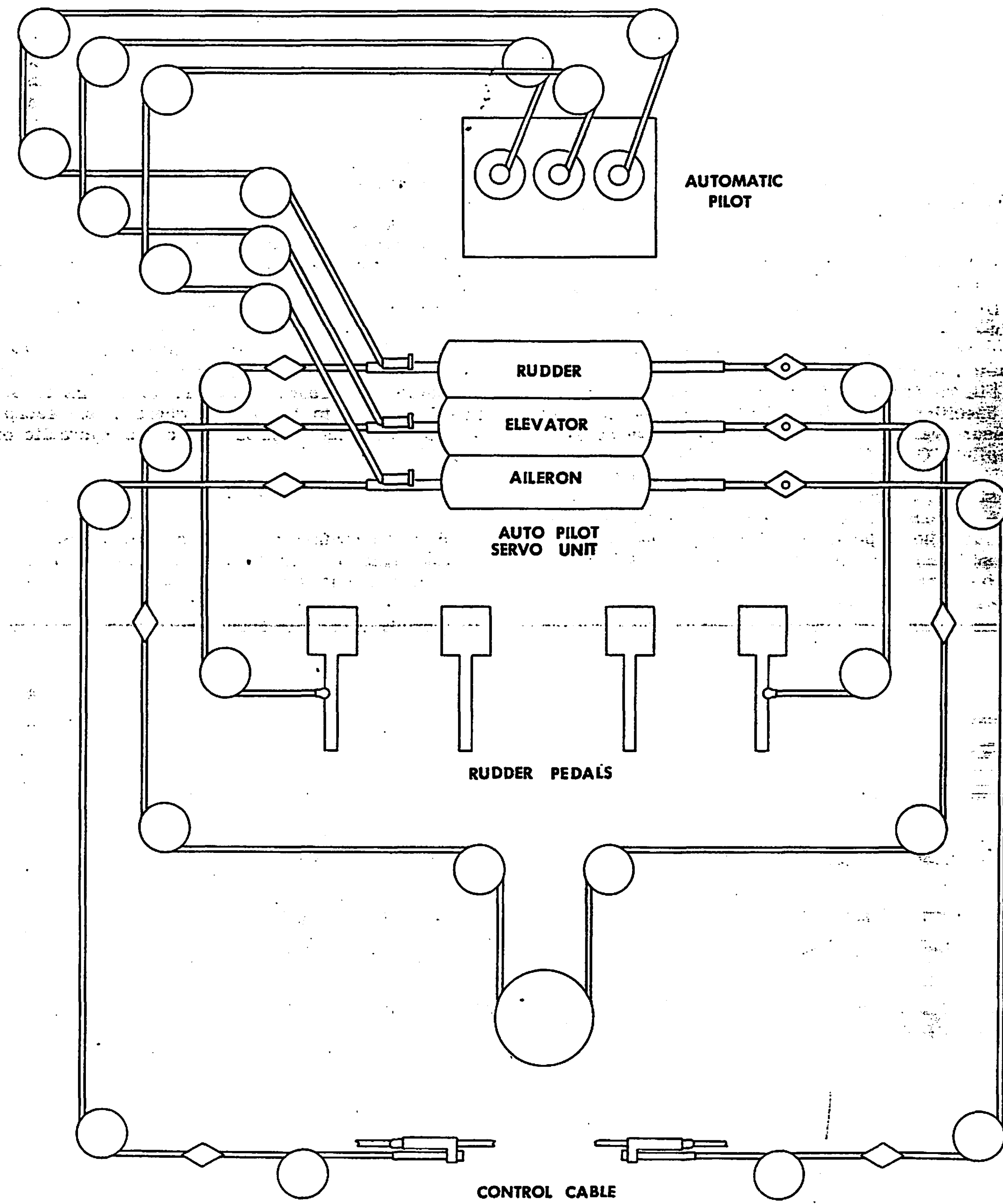


Figure 6-12. Automatic Pilot Control and Follow-Up Cables

pulleys. When released, the pulleys should spring back about one-third of a turn. When installing a new aileron, rudder, or elevator cable, the length of the cable should be the same as the one removed. Cable lengths are as follows:

Aileron	48-3/8 inches
Rudder	50-3/8 inches
Elevator	46-3/8 inches

As an added check for proper installation, move all controls so the servo piston (the side to which the follow-up cables are attached) is all the way inside the cylinder. The follow-up pulleys (figure 6-12) should have at least one-third of a turn of cable remaining on them.

6-86. FLUSHING AUTOMATIC PILOT SYSTEM. To flush the automatic pilot system proceed as follows:

a. Drain main reservoir of oil, disconnect the main engine-driven hydraulic pump and the vacuum pump from the system, and connect auxiliary hydraulic pump and vacuum pump.

b. Fill the reservoir three-fourths full with hydraulic oil Specification (MIL-O-5606). Turn the main oil pressure valve to the "ON" position and the automatic pilot "ON-OFF" valve to the "OFF" position.

c. Start the auxiliary oil pump and vacuum pump, adjust the pressure regulator and vacuum relief valve (external) to obtain the proper operating pressure for the airplane as indicated by the hydraulic pressure gage and the suction gage on the bank and climb control unit.

d. With control units in position in the mount assembly center the controls manually and align the automatic pilot indices by means of the hand control knobs. Move the controls to extreme travel and hold for three minutes. Move the controls to the opposite extreme and again hold for three minutes. Repeat the procedure six times to completely flush the system.

e. Disconnect the auxiliary pumps, drain sump, clean the filter, reconnect the vacuum and hydraulic lines and refill the system.

6-87. BLEEDING THE AUTOMATIC PILOT SYSTEM. To remove air from the automatic pilot hydraulic system:

a. Run engines to approximately 1700 to 1900 rpm to obtain operating pressure.

b. Turn automatic pilot oil pressure valve "ON" and the automatic pilot master control lever "OFF."

c. Center the flight controls and align the follow-up indices.

d. Operate the flight control under full extreme travel in both directions, first each control separately, and then all controls together. Hold each control in its extreme position 20 to 30 seconds.

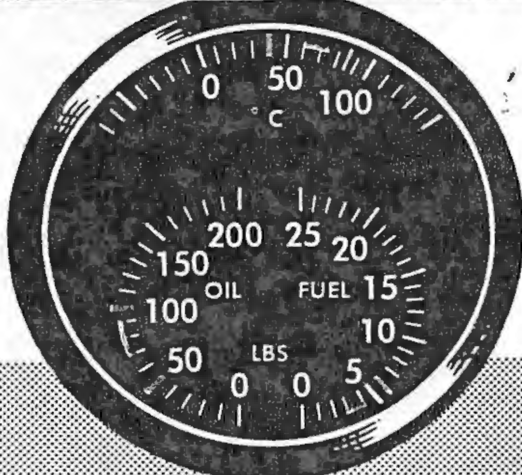
e. Repeat the above procedure three times. Air will be forced to the sump, where it can escape.

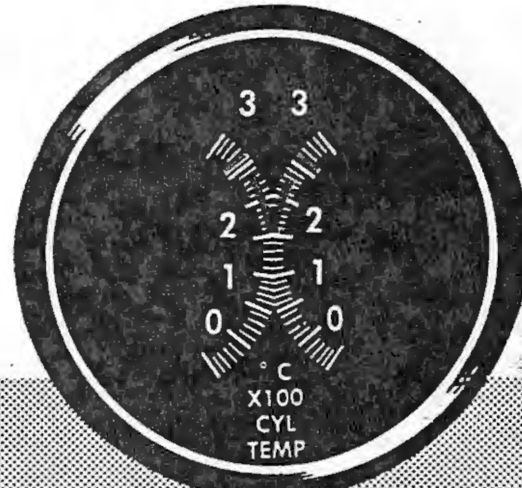
f. Shut down the engines and check hydraulic oil level.

NOTE

With the engines shut down and the automatic pilot master control lever "ON," the controls should feel locked. Any spongy feeling of the controls indicates air in the system and the bleeding procedure should be repeated.

INSTRUMENT MARKINGS





ENGINE GAGE UNIT

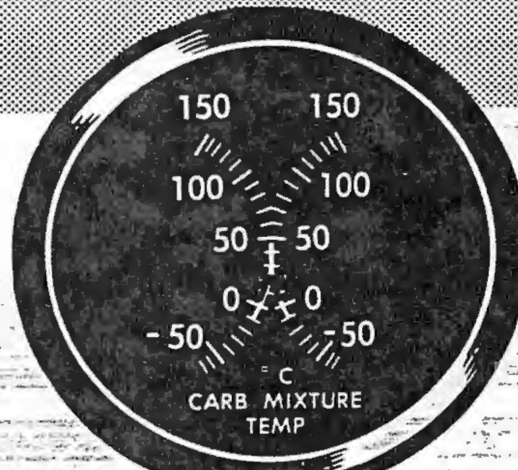
OIL TEMP	OIL PRESS	
40°C	50 PSI	MINIMUM
60° TO 75°C	70 TO 90 PSI	NORMAL
85°C	100 PSI	MAXIMUM

FUEL PRESS

- 3 PSI MON FOR FLIGHT
- 3 TO 4 PSI NORMAL
- 6 PSI MAXIMUM

CYLINDER HEAD TEMP

- 150° TO 232° C NORMAL
- 260° C MAXIMUM DURING TAKE-OFF



AIRSPEED INDICATOR
MPH

- 117 MAXIMUM FOR FLAPS (LANDING GEAR 125)
- 253 MAXIMUM ALLOWABLE (STILL AIR)

CARB MIXTURE TEMP

- -10° TO +3° C ICING ZONE
- 3° TO 20° C NORMAL
- 20° C DANGER OF DETONATION

Figure 6-13. Instrument Limitations Markings (Sheet 1 of 2 Sheets)

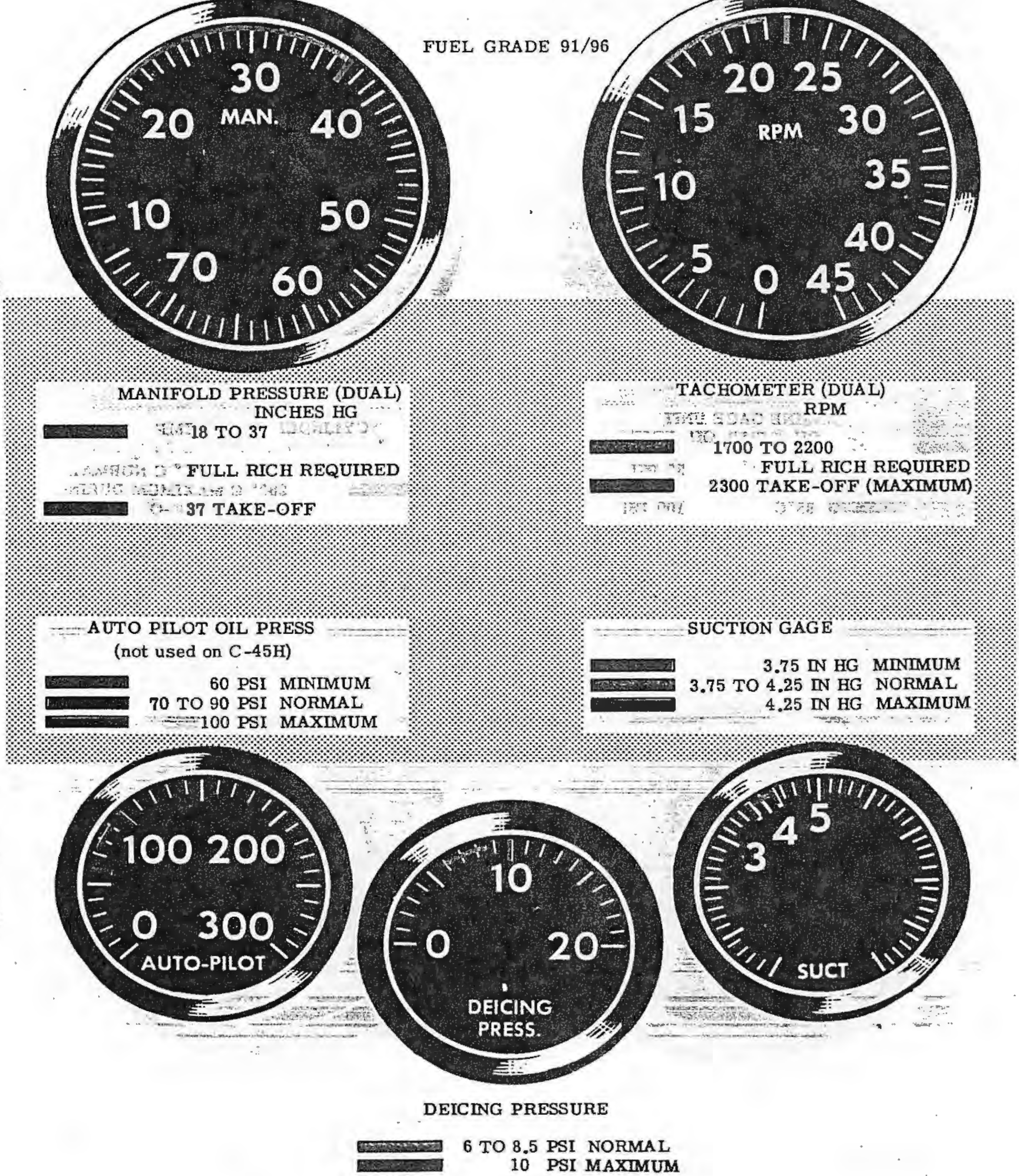


Figure 6-13. Instrument Limitations Markings (Sheet 2 of 2 Sheets)

TABLE XXI

TROUBLE SHOOTING, ENGINE INSTRUMENTS

TROUBLE	PROBABLE CAUSE	CORRECTION
CYLINDER HEAD TEMPERATURE GAGE (DUAL)		
1. Instrument fails to indicate or indicates incorrectly.	a. Defective instrument.	a. Remove and replace.
	b. Loose connection, grounded or broken circuit.	b. Check for continuity, ground in circuit. Repair or replace.
	c. Defective thermocouple.	c. Remove and replace.
TACHOMETER (DUAL)		
1. No reading on one indicator.	a. Tachometer generator defective.	a. Check for generator output. If defective, replace.
	b. Defective indicator.	b. Replace.
	c. Open circuit.	c. Check circuit continuity, repair.
	d. Defective tachometer drive mechanism.	d. Remove tachometer generator and check drive mechanism on engine. Repair or replace.
2. No reading on either indicator.	a. Loose connection.	a. Repair.
	b. Defective indicator.	b. Replace indicator.
MANIFOLD PRESSURE GAGE (DUAL)		
1. Instrument fails to indicate or give correct indication,	a. Defective instrument.	a. Replace.
	b. Loose or broken line of fitting.	b. Repair and replace.
CARBURETOR MIXTURE TEMPERATURE INDICATOR (DUAL)		
1. Full scale reading on high scale. No reading.	a. Open circuit in the resistance bulb.	a. Replace bulb.
	b. Broken power lead or poor connection in receptacle.	b. Check continuity of wiring and receptacle connections. Repair or replace.
OIL TEMPERATURE INDICATOR (ENGINE GAGE UNITS)		
1. Full scale reading on high scale. No reading.	a. Open circuit in the resistance bulb.	a. Replace bulb.
	b. Broken power lead or poor connection in receptacle.	b. Check continuity of wiring and receptacle connections. Repair or replace.
OIL PRESSURE GAGE (ENGINE GAGE UNIT)		
1. Instrument fails to indicate or indicates incorrectly.	a. Defective line or Bourdon tube in instrument.	a. Repair or replace line, replace instrument.
	b. Defective indicator.	b. Check oil pressure, replace instrument if required.
FUEL PRESSURE GAGE (ENGINE GAGE UNIT)		
1. Gage does not show indication.	a. Defective line or internal pressure housing and diaphragm.	a. Repair or replace line, replace instrument.
	b. Malfunction of pressure gage.	b. Check fuel pressure, replace instrument if required.

TABLE XXII

TROUBLE SHOOTING, FLIGHT INSTRUMENTS

TROUBLE	PROBABLE CAUSE	CORRECTION
	AIRSPEED INDICATOR	
1. Instrument inoperative.	a. Pressure line not properly connected.	a. Tighten or repair connection.
	b. Pitot line clogged.	b. Disconnect lines and blow clear.
	c. Defective instrument.	c. Replace instrument.
2. Incorrect indication.	a. Leak in lines.	a. Locate and repair.
	b. Leak in instrument.	b. Replace instrument.
	c. Restricted pitot or static line.	c. Disconnect and blow clear.
	d. Defective instrument.	d. Replace instrument.
	RATE OF CLIMB INDICATOR	
1. Does not indicate zero with constant altitude.	a. Ageing aneroid.	a. Return pointer to zero with pointer reset. Tap lightly while resetting.
2. Instrument inoperative.	a. Clogged static line.	a. Disconnect lines and blow clear.
	b. Plugged aneroid equalizing port.	b. Replace instrument.
	c. Defective instrument linkage.	c. Replace instrument.
3. Incorrect indication.	a. Leak in static lines.	a. Repair.
	b. Restricted static lines.	b. Remove restriction.
	c. Leak in instrument case.	c. Replace instrument.
	d. Ruptured aneroid.	d. Replace instrument.
	GYRO HORIZON INDICATOR, TURN AND BANK INDICATOR	
1. Instrument inaccurate or fluctuating.	a. Leak in line or instrument.	a. Repair line leak. Replace instrument if leaking.
	b. Damaged gyro.	b. Replace instrument.
	c. Vacuum supply fluctuating or not properly set.	c. Check for constant and correct vacuum.
	ALTIMETER	
1. Instrument fails to operate.	a. Static pressure lines are clogged.	a. Disconnect all instruments operating on static pressure. Blow lines clear.
2. Pointer oscillates.	a. Irregular static pressures received in instrument case.	a. Check static lines for restriction.
	b. Leak in instrument case.	b. Replace instrument.

TABLE XXIII

TROUBLE SHOOTING, NAVIGATION INSTRUMENTS

TROUBLE	PROBABLE CAUSE	CORRECTION
	DIRECTIONAL GYRO	
1. Instrument inaccurate or fluctuating.	a. Leak in line or instrument.	a. Repair leak. Replace instrument if leaking.
	b. Damaged gyro.	b. Replace instrument.
	c. Vacuum supply fluctuating or not properly set.	c. Check for constant and correct vacuum.

TABLE XXIII (CONT)

TROUBLE	PROBABLE CAUSE	CORRECTION
	PILOT'S STANDBY COMPASS	
1. Excessive card error.	a. Compass not properly compensated.	a. Compensate instrument.
	b. External magnetic interference.	b. Locate magnetic interference and eliminate if possible.
2. Excessive card oscillation.	a. Insufficient liquid.	a. Add liquid, Specification MIL-L-5020.
	b. Excessive vibration of instrument mounting panel.	b. Correct vibration.
	c. Friction between jewel port and jewel port support bearing.	c. Replace compass.
3. Card element not level.	a. Leaking float chamber.	a. Replace compass.
	b. Card magnets detached from card.	b. Replace compass.
4. Card sluggish.	a. Weak card magnets.	a. Replace compass.
	b. Excessive pivot friction or broken jewel.	b. Replace compass.
	c. Instrument heavily compensated.	c. Recompensate.
5. Leakage of fluid.	a. Loose screws.	a. Tighten screws.
	b. Broken glass or case.	b. Replace compass.
	c. Defective gaskets.	c. Replace compass.
6. Discolored liquid or card markings.	a. Age.	a. Replace compass.

TABLE XXIV

TROUBLE SHOOTING, MISCELLANEOUS INSTRUMENTS

TROUBLE	PROBABLE CAUSE	CORRECTION
	FUEL QUANTITY INDICATOR	
1. Low indication or no indication.	a. Damaged pivots in indicator.	a. Replace instrument.
	b. Defective transmitter.	b. Replace transmitter.
	c. Open circuit or poor connection in electrical circuit.	c. Locate and repair.
	d. Less than operating voltage available.	d. Supply adequate voltage.
	e. Tank unit out of adjustment.	e. Readjust unit.
	f. Float arm stuck to bottom of tank.	f. Free float arm.
2. Instrument pointer slams one peg or the other.	a. Short circuit.	a. Check and repair.
	b. Open circuit.	b. Check and repair.
	VOLTMETER	
1. Fails to indicate.	a. Defective switch.	a. Remove and replace.
	b. Shorted or open circuit.	b. Check continuity.
	c. Loose terminal connection or defective instrument.	c. Check and repair. Remove and replace instrument.

TABLE XXIV (CONT)

TROUBLE	PROBABLE CAUSE	CORRECTION
	AMMETERS	
1. Fails to indicate.	a. Shorted or open circuit. b. Loose terminal connection. c. Defective instrument.	a. Check for continuity. b. Check and repair. c. Remove and replace.
	OXYGEN PRESSURE	
1. Fails to operate.	a. Ruptured line or loose fitting. b. Defective instrument:	a. Repair or replace. b. Remove and replace.
	OXYGEN FLOW INDICATOR	
1. Indicator fails to operate.	a. Broken lines or loose fittings. b. Defective instrument.	a. Repair or replace. b. Replace.

TABLE XXV

TROUBLE SHOOTING, VACUUM SYSTEM

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Low suction gage reading.	a. Suction relief valve not properly adjusted. b. Pump failure. c. Insufficient lubrication of vacuum pump. d. Leak or break in suction line. e. Defective gage.	a. Adjust suction relief valve. b. Replace pump. c. Provide proper lubrication. d. Locate and repair. e. Replace.
2. Excessive suction gage reading.	a. Air filter clogged. b. Suction relief valve not properly adjusted. c. Suction relief valve failure. d. Defective gage.	a. Clean filter element. b. Adjust valve. c. Repair or replace. d. Replace gage.
3. Suction gage inoperative.	a. Clogged lines. b. Shaft on vacuum pump broken.	a. Clean lines. b. Replace pump.
4. Vacuum operated instruments inoperative.	a. Clogged lines. b. Oil separator defective. c. Shaft on vacuum pump broken.	a. Clean lines. b. Replace separator. c. Replace pump.

TABLE XXVI

TROUBLE SHOOTING, PITOT AND STATIC PRESSURE SYSTEM

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Heating element inoperative.	a. Bad switch. b. Grounded or open circuit.	a. Replace switch. b. Check circuit for continuity. Repair or replace as necessary.
2. Circuit breaker trips.	a. Grounded wire.	a. Replace or repair wire.
3. Instruments do not read the same.	a. Line clogged or connections loose.	a. Check all fittings for tightness. Disconnect lines from instruments and blow lines clear.

TABLE XXVII

TROUBLE SHOOTING, AUTOMATIC PILOT

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Insufficient vacuum (under 3-inches Hg).	a. Suction relief valve not properly adjusted.	a. Adjust relief valve.
	b. Pump failure.	b. Repair or replace pump.
	c. Insufficient lubrication of vacuum pump.	c. Provide proper lubrication.
	d. Leak or break in vacuum line.	d. Locate and repair. Check for collapsed inner wall of flexible hose.
	e. Incorrect gage reading.	e. Check gage for calibration, repair or replace.
2. Excessive vacuum (over 5-inches Hg).	a. Suction relief valve not properly adjusted.	a. Adjust suction relief valve.
	b. Air intake filter clogged.	b. Clean filter element.
	c. Suction relief failure.	c. Repair or replace valve.
	d. Incorrect gage reading.	d. Check gage for calibration, repair or replace.
3. Insufficient oil pressure.	a. Oil supply low.	a. Refill hydraulic reservoir.
	b. Leak or break in oil line.	b. Locate and repair.
	c. Pressure relief valve not properly adjusted.	c. Adjust with speed control valves closed. Remove top of relief valve and loosen lock nut. Screw in to raise pressure, out to lower pressure.
	d. Hydraulic pressure relief valve dirty.	d. Clean or repair and readjust.
4. Excessive oil pressure.	a. Hydraulic pressure relief valve not properly adjusted.	a. Adjust with speed control valves closed. Remove cap nut of relief valve and loosen lock nut. Screw out to lower pressure.
	b. Hydraulic pressure relief valve stuck in closed position.	b. Free, clean and adjust.
	c. Incorrect gage reading.	c. Check gage for calibration. Replace if defective.
5. Foaming of oil.	a. Air leak in line from sump or oil reservoir to hydraulic pump inlet, or leak in pump.	a. Locate and repair.
6. No control.	a. "ON-OFF" valve in "OFF" position.	a. Turn valve to "ON" position.
	b. Insufficient vacuum.	b. See causes and correction under insufficient vacuum.
	c. Insufficient oil pressure.	c. See causes and correction under insufficient oil pressure.
	d. Broken connection between valve and "ON-OFF" control.	d. Locate and repair.
	e. Speed control valves closed.	e. Open speed control valves.
	f. Adjustable bleeds closed.	f. Reset adjustable bleeds.
7. Failure of one of the controls.	a. Corresponding speed control valve closed.	a. Open valve.
	b. Corresponding balanced oil valve stuck.	b. Remove rear cap and work valve back and forth and turn until free, then hold in both extreme positions for about two minutes. This should be done with oil pressure on and "ON-OFF" valve in "OFF" position. If defective, replace.

TABLE XXVII (CONT)

TROUBLE	PROBABLE CAUSE	CORRECTION
8. Controls oscillating.	a. Air relay stuck.	a. Clean or replace.
	b. Air in oil system.	b. Bleed system.
	c. Lag in follow-up.	c. Examine follow-up pulleys and cable. Installation inspection.
	d. Balanced oil valve sticking.	d. Remove rear cap and work valve back and forth and turn until free, then hold in both extreme positions for about two minutes. This should be done with oil pressure on and the "ON-OFF" valve in "OFF" position. If defective, replace.
9. Controls jerky.	a. Follow-up pulleys sticking.	a. Remove control units and lubricate pulley springs and bearings.
	b. Control unit air signal unbalanced.	b. Check with control unit known to be in good condition. Replace if defective.
10. Control lagging (one direction only.)	a. Corresponding follow-up pulley spring not wound sufficiently.	a. Rewind so that when control is fully over in one position to wind spring, the spring will be within 1/4 turn of being wound tight.
	b. Corresponding balanced oil valve sticking.	b. Remove rear cap and work valve back and forth and turn until free, then hold in both extreme positions for about two minutes. This should be done with oil pressure on and "ON-OFF" valve in "OFF" position.
	c. Control unit air signal too low.	c. Check with unit known to be in good condition. If defective, replace.
11. Control lagging in both directions.	a. Oil filter dirty; pressure falls to low reading each time automatic pilot operates.	a. Clean filter thoroughly.
	b. Speed control valve setting too low.	b. Increase valve setting.
	c. Oil pressure too low.	c. Hydraulic pressure relief valve not properly adjusted. Adjust to proper setting.
	d. Oil supply restricted.	d. Examine interior of flex hose. Check oil supply line and clean if necessary.
12. Leakage at servo fittings.	a. Loose fitting.	a. Tighten.
	b. Damaged flare.	b. Replace tube.
13. Overpower valve set too high or too low.	a. Incorrect setting.	a. Relief valve.

OPERATING CONDITIONS (F)

A EQUIPMENT	B PART DESIGNATION	C NUMBER OF UNITS	D AMPERES PER UNIT	E OPERATING TIME-MIN	F-1 LOADING & ANCHOR AMP	F-1 AVERAGE AMP 0.5 MIN	F-1 AVERAGE AMP 2.0 MIN	F-1 AVERAGE AMP 15.0 MIN	F-1 AVERAGE AMP MIN	F-2 START & WARM-UP AMP	F-2 AVERAGE AMP 0.5 MIN	F-2 AVERAGE AMP 2.0 MIN	F-2 AVERAGE AMP 15.0 MIN	F-2 AVERAGE AMP MIN	F-3 TAXI AMP	F-3 AVERAGE AMP 0.5 MIN	F-3 AVERAGE AMP 2.0 MIN	F-3 AVERAGE AMP 15.0 MIN	F-3 AVERAGE AMP MIN
C - Control Surface																			
Motor, Wing Flap		1	11.80	0.16															
E - Engine Instruments																			
Indicator, Carb Mixture Temp		2	0.07	60.0															
Indicator, Fuel Quantity		1	0.18	60.0	0.358					0.4	0.4	0.4	0.4		0.4	0.4	0.4	0.4	
Indicator, Oil Temperature		2	0.02	60.0															
F - Flight Instruments																			
Pitot Heater		2	3.30	60.0						6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	
Indicator, Vac Pres Warning	AN3157-2	2	0.17	Neg															
G - Landing Gear																			
Indicator Lights, Ldg Gr Pos.	AN3157-2	2	0.17	5.0						0.2	0.2	0.2	Neg		0.2	0.2	0.2	Neg	
Motor, Landing Gear		1	70.00	0.16															
Signal, Ldg Gear Warning		1	1.00	Neg															
Solenoid, Ldg Gear Latch		1	1.00	0.16															
H - Heating, Ventilating & Deicing																			
Motor, Propeller Anti-Icer		1	1.00	60.0						1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	
Motor, Wing Deicer Valve		1	1.00	60.0						1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	
J - Ignition																			
Vibrator, Induction		2																	
K - Engine Control																			
Motor, Engine Start		2	75.0	2.0						75.0	75.0	75.0	10.0						
Relay, Engine Start		2	0.80	2.0						0.8	0.8	0.8	0.1						
L - Lighting																			
Baggage Lights-Nose & Rear	AN3124-5B307	2	0.80	2.0						1.6	1.6	1.6	0.2		0.8	0.8	0.8	0.1	
Compass Light	AN3136-323	1	0.19	60.0						0.2	0.2	0.2	0.2		0.2	0.2	0.2	0.2	
Dome Lights, Clear	AN3124-307	3	0.80	2.0						2.4	2.4	2.4	0.3		2.4	2.4	2.4	0.3	
Dome Lights, Red	AN3133-R311	3	1.50	2.0						4.5	4.5	4.5	0.6		4.5	4.5	4.5	0.6	
Extension Light, B-7	AN3137-304	1	0.30	2.0						0.3	0.3	0.3	Neg		0.3	0.3	0.3	Neg	
Subtotals										94.0	94.0	94.0	20.4		17.4	17.4	17.4	10.3	

A EQUIPMENT	F-4 TAKE-OFF & CLIMB AMP	F-4 AVERAGE AMP 0.5 MIN	F-4 AVERAGE AMP 2.0 MIN	F-4 AVERAGE AMP 15.0 MIN	F-4 AVERAGE AMP MIN	F-5 CRUISE AMP	F-5 AVERAGE AMP 0.5 MIN	F-5 AVERAGE AMP 2.0 MIN	F-5 AVERAGE AMP 30.0 MIN	F-5 AVERAGE AMP 60.0 MIN	F-6 CRUISE - COMBAT AMP	F-6 AVERAGE AMP 0.5 MIN	F-6 AVERAGE AMP 2.0 MIN	F-6 AVERAGE AMP 30.0 MIN	F-6 AVERAGE AMP 60.0 MIN	F-7 LANDING AMP	F-7 AVERAGE AMP 0.5 MIN	F-7 AVERAGE AMP 2.0 MIN	F-7 AVERAGE AMP 5.0 MIN	F-7 AVERAGE AMP 15.0 MIN
C - Control Surface																				
Motor, Wing Flap	11.8	3.8	Neg	Neg		11.8	3.8	Neg												
E - Engine Instruments																				
Indicator, Carb Mixture Temp																				
Indicator, Fuel Quantity	0.4	0.4	0.4	0.4		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4		0.4
Indicator, Oil Temperature																				
F - Flight Instruments																				
Pitot Heater	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6		6.6
Indicator, Vac Pres Warning																				
G - Landing Gear																				
Indicator Lights, Ldg Gr Pos.																0.2	0.2	0.2		Neg
Motor, Landing Gear	70.0	22.4	5.6	0.7												70.0	22.4	5.6		0.7
Signal, Ldg Gear Warning																				
Solenoid, Ldg Gear Latch	1.0	0.3	Neg	Neg												1.0	0.3	Neg		Neg
H - Heating, Ventilating & Deicing																				
Motor, Propeller Anti-Icer	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0
Motor, Wing Deicer Valve	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0
J - Ignition																				
Vibrator, Induction																				
K - Engine Control																				
Motor, Engine Start																				
Relay, Engine Start																				
L - Lighting																				
Baggage Lights-Nose & Rear	0.8	0.8	0.8	0.1		0.8	0.8	0.8	Neg	Neg	0.8	0.8	0.8	Neg	Neg	0.8	0.8	0.8		0.1
Compass Light	0.2	0.2	0.2	0.2		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2		0.2
Dome Lights, Clear	2.4	2.4	2.4	0.3		2.4	2.4	2.4	0.2	Neg	2.4	2.4	2.4	0.2	Neg	2.4	2.4	2.4		0.3
Dome Lights, Red	4.5	4.5	4.5	0.6		4.5	4.5	4.5	0.3	0.1	4.5	4.5	4.5	0.3	0.1	4.5	4.5	4.5		0.6
Extension Light, B-7	0.3	0.3	0.3	Neg		0.3	0.3	0.3	Neg	Neg	0.3	0.3	0.3	Neg	Neg	0.3	0.3	0.3		Neg
Subtotals	100.0	43.7	23.8	10.9		17.2	17.2	17.2	9.7	9.3	17.2	17.2	17.2	9.7	9.3	100.2	23.9	23.0		10.9

Chart 1. Power Loading, C-45G (Sheet 1 of 2 Sheets)

A Equipment	B Part Designation	C Number of Units	D Amperes per Unit	E Operating Time-Min	F-1 Loading & Anchor: AMP	F-1 Average Amp 0.5 Min	F-1 2.0 Min	F-1 15.0 Min	F-1 Min	F-2 Start & Warm-Up: AMP	F-2 Average Amp 0.5 Min	F-2 2.0 Min	F-2 15.0 Min	F-2 1 Min	F-3 Taxi: AMP	F-3 Average Amp 0.5 Min	F-3 2.0 Min	F-3 15.0 Min	F-3 Min
L - Lighting (Continued)																			
Flasher, C-2		1	0.90	60.0						0.9	0.9	0.9	0.9		0.9	0.9	0.9	0.9	
Instrument Light Shield, Red	AN3140-327	66	0.046	60.0						3.1	3.1	3.1	3.1		3.1	3.1	3.1	3.1	
Landing Lights	AN3130-4560	2	21.4	1.5															
Map Light	AN3131-303	2	0.30	2.0						0.6	0.6	0.6	Neg		0.6	0.6	0.6	Neg	
Passing Light	AN3133-311	1	1.50	60.0						3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	
Radio Panel Light	AN3124-307	1	0.80	60.0						0.8	0.8	0.8	0.8		0.8	0.8	0.8	0.8	
Relay, Landing Light	AN3350-2	2	0.35	1.5															
Spotlight, C-4 Red	AN3121-313	6	0.17	2.0						1.0	1.0	1.0	0.1		1.0	1.0	1.0	0.1	
Tail Lights	AN3124-307	2	0.80	60.0						1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	
Taxi Lights	GE4570	2	5.36	5.0											10.7	10.7	10.7	3.5	
Wing Position Lights	AN3122-1524	2	0.75	60.0						1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5	
M - Miscellaneous																			
Motor - Windshield Wiper		1	7.63	60.0						7.6	7.6	7.6	7.6		7.6	7.6	7.6	7.6	
P - D. C. Power																			
Battery Charging				60.0															
Battery Relay	B-4A	2	0.80	60.0						1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	
Indicator, Gen Overvoltage	AN3157-2	2	0.17	Neg															
Inverter, AN/ARN-7 Radio	MG149-F	1	15.0	60.0						15.0	15.0	15.0	15.0		15.0	15.0	15.0	15.0	
Inverter, Instrument	AN3499-1	1	6.0	60.0						6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	
Q - Fuel & Oil																			
Motor, Booster Pump		2	2.00	15.0						4.0	4.0	4.0	4.0						
Primer Solenoid		2	0.33	Neg															
Indicator, Low Fuel Pressure	AN3157-2	2	0.17	Neg															
R - Radio																			
Interphone	RC-36	1	2.20	60.0						2.2	2.2	2.2	2.2		2.2	2.2	2.2	2.2	
Marker Beacon Receiver	RC-193A	1	0.65	60.0						0.6	0.6	0.6	0.6		0.6	0.6	0.6	0.6	
Radio Compass Receiver	AN/ARN-7	1	1.95	60.0						1.9	1.9	1.9	1.9		1.9	1.9	1.9	1.9	
Range Receiver	BC-453-B	1	1.60	60.0						1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	
VHF Radio Receiver	AN/ARC-3	1	5.50	60.0						5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	
VHF Radio Transmitter	AN/ARC-3	1	7.50	0.5						7.5	7.5	1.9	0.2		7.5	7.5	1.9	0.2	
Totals										161	161	155	78		90	90	85	67	

A Equipment	F-4 Take-Off & Climb: AMP	F-4 Average Amp 0.5 Min	F-4 2.0 Min	F-4 15.0 Min	F-4 Min	F-5 Cruise: AMP	F-5 Average Amp 0.5 Min	F-5 2.0 Min	F-5 30.0 Min	F-5 60.0 Min	F-6 Cruise - Combat: AMP	F-6 Average Amp 0.5 Min	F-6 2.0 Min	F-6 30.0 Min	F-6 60.0 Min	F-7 Landing: AMP	F-7 Average Amp 0.5 Min	F-7 2.0 Min	F-7 5.0 Min	F-7 15.0 Min
L - Lighting (Continued)																				
Flasher, C-2	0.9	0.9	0.9	0.9		0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9		0.9
Instrument Light Shield, Red	3.1	3.1	3.1	3.1		3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1		3.1
Landing Lights																42.8	42.8	32.1		4.3
Map Light	0.6	0.6	0.6	Neg		0.6	0.6	0.6	Neg	Neg	0.6	0.6	0.6	Neg	Neg	0.6	0.6	0.6		Neg
Passing Light	3.0	3.0	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0
Radio Panel Light	0.8	0.8	0.8	0.8		0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8		0.8
Relay, Landing Light																0.3	0.3	0.2		Neg
Spotlight, C-4 Red	1.0	1.0	1.0	0.1		1.0	1.0	1.0	Neg	Neg	1.0	1.0	1.0	Neg	Neg	1.0	1.0	1.0		0.1
Tail Lights	1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6		1.6
Taxi Lights																10.7	10.7	10.7		3.5
Wing Position Lights	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5		1.5
M - Miscellaneous																				
Motor - Windshield Wiper	7.6	7.6	7.6	7.6		7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6		7.6
P - D. C. Power																				
Battery Charging	81.6	81.6	51.0	30.6		61.2	61.2	38.1	16.5	11.4	40.8	40.8	25.5	11.0	7.6	20.4	20.4	12.7		7.6
Battery Relay	1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6		1.6
Indicator, Gen Overvoltage																				
Inverter, AN/ARN-7 Radio	15.0	15.0	15.0	15.0		15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0		15.0
Inverter, Instrument	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Q - Fuel & Oil																				
Motor, Booster Pump	4.0	4.0	4.0	4.0												4.0	4.0	4.0		4.0
Primer Solenoid																				
Indicator, Low Fuel Pressure																				
R - Radio																				
Interphone	2.2	2.2	2.2	2.2		2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2		2.2
Marker Beacon Receiver	0.6	0.6	0.6	0.6		0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6		0.6
Radio Compass Receiver	1.9	1.9	1.9	1.9		1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9		1.9
Range Receiver	1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6		1.6
VHF Radio Receiver	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5		5.5
VHF Radio Transmitter	7.5	7.5	1.9	0.2		7.5	7.5	1.9	0.1	Neg	7.5	7.5	1.9	0.1	Neg	7.5	7.5	1.9		0.2
Totals	248	192	135	99		141	141	112	60	74	121	121	100	74	70	241	185	140		84

Chart 1. Power Loading, C-45G (Sheet 2 of 2 Sheets)

A EQUIPMENT	B PART DESIGNATION	C NUMBER OF UNITS	D AMPERES PER UNIT	E OPERATING TIME - MIN	F-1 LOADING & ANCHOR AMP	F-1 AVERAGE AMP 0.5 MIN	F-1 AVERAGE AMP 2.0 MIN	F-1 AVERAGE AMP 15.0 MIN	F-1 AVERAGE AMP MIN	F-2 START & WARM-UP AMP	F-2 AVERAGE AMP 0.5 MIN	F-2 AVERAGE AMP 2.0 MIN	F-2 AVERAGE AMP 15.0 MIN	F-2 AVERAGE AMP MIN
C - Control Surface														
Motor, Wing Flap		1	11.60	0.16										
E - Engine Instruments														
Indicator, Carb Mixture Temp		2	0.07	60.0										
Indicator, Fuel Quantity		1	0.18	60.0	0.358					0.4	0.4	0.4	0.4	
Indicator, Oil Temperature		2	0.02	60.0										
F - Flight Instruments														
Pitot Heat		2	3.30	60.0						6.6	6.6	6.6	6.6	
Indicator, Vac Press Warning	AN3157-2	2	0.17	Neg										
G - Landing Gear														
Indicator Lights, Ldg Gr Pos	AN3157-2	2	0.17	5.0						0.3	0.3	0.3	Neg	
Motor, Landing Gear		1	70.00	0.16										
Signal, Ldg Gear Warning		1	1.00	Neg										
Solenoid, Ldg Gear Latch		1	1.00	0.16										
H - Heating, Ventilating & Deicing														
Motor, Prop Anti-Icer		1	1.00	60.0						1.0	1.0	1.0	1.0	
Motor, Wing Deicer Valve		1	1.00	60.0						1.0	1.0	1.0	1.0	
J - Ignition														
Vibrator, Induction		2												
K - Engine Control														
Motor, Engine Start		2	75.0	2.0						75.0	75.0	75.0	10.0	
Relay, Engine Start	AN3371-1	2	4.5	2.0						4.5	4.5	4.5	.6	
L - Lighting														
Baggage Light	AN3124-5B307	1	0.80	2.0						0.8	0.8	0.8	0.1	
Compass Light	AN3136-323	1	0.19	60.0						0.2	0.2	0.2	0.2	
Dome Lights, Clear	AN3124-307	2	0.80	2.0						1.6	1.6	1.6	0.2	
Dome Lights, Red	AN3133-R311	2	1.50	2.0						3.0	3.0	3.0	0.4	
Extension Light, B-7	AN3137-304	1	0.30	2.0						0.3	0.3	0.3	Neg	
Flasher		1	0.90	60.0						0.9	0.9	0.9	0.9	
Subtotals										95.7	95.7	95.7	21.4	

A EQUIPMENT	F-3 TAXI AMP	F-3 AVERAGE AMP 0.5 MIN	F-3 AVERAGE AMP 2.0 MIN	F-3 AVERAGE AMP 15.0 MIN	F-3 AVERAGE AMP MIN	F-4 TAKE-OFF & CLIMB AMP	F-4 AVERAGE AMP 0.5 MIN	F-4 AVERAGE AMP 2.0 MIN	F-4 AVERAGE AMP 15.0 MIN	F-4 AVERAGE AMP MIN
C - Control Surface										
Motor, Wing Flap						11.8	3.8	0.9	Neg	
E - Engine Instruments										
Indicator, Carb Mixture Temp										
Indicator, Fuel Quantity	0.4	0.4	0.4	0.4		0.4	0.4	0.4	0.4	
Indicator, Oil Temperature										
F - Flight Instruments										
Pitot Heat	6.6	6.6	6.6	6.6		6.6	6.6	6.6	6.6	
Indicator, Vac Press Warning										
G - Landing Gear										
Indicator Lights, Ldg Gr Pos	0.3	0.3	0.3	Neg						
Motor, Landing Gear						70.0	22.4	5.6	0.7	
Signal, Ldg Gear Warning										
Solenoid, Ldg Gear Latch						1.0	0.3	Neg	Neg	
H - Heating, Ventilating & Deicing										
Motor, Prop Anti-Icer	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	
Motor, Wing Deicer Valve	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	
J - Ignition										
Vibrator, Induction										
K - Engine Control										
Motor, Engine Start										
Relay, Engine Start										
L - Lighting										
Baggage Light	0.8	0.8	0.8	0.1		0.8	0.8	0.8	0.1	
Compass Light	0.2	0.2	0.2	0.2		0.2	0.2	0.2	0.2	
Dome Lights, Clear	1.6	1.6	1.6	0.2		1.6	1.6	1.6	0.2	
Dome Lights, Red	3.0	3.0	3.0	0.4		3.0	3.0	3.0	0.4	
Extension Light, B-7	0.3	0.3	0.3	Neg		0.3	0.3	0.3	Neg	
Flasher	0.9	0.9	0.9	0.9		0.9	0.9	0.9	0.9	
Subtotals	16.1	16.1	16.1	10.8		88.6	42.3	22.3	11.5	

A EQUIPMENT	F-5 CRUISE AMP	F-5 AVERAGE AMP 0.5 MIN	F-5 AVERAGE AMP 2.0 MIN	F-5 AVERAGE AMP 30.0 MIN	F-5 AVERAGE AMP 60.0 MIN	F-6 CRUISE - COMBAT AMP	F-6 AVERAGE AMP 0.5 MIN	F-6 AVERAGE AMP 2.0 MIN	F-6 AVERAGE AMP 30.0 MIN	F-6 AVERAGE AMP 60.0 MIN	F-7 LANDING AMP	F-7 AVERAGE AMP 0.5 MIN	F-7 AVERAGE AMP 2.0 MIN	F-7 AVERAGE AMP 5.0 MIN	F-7 AVERAGE AMP 15.0 MIN
C - Control Surface															
Motor, Wing Flap															
E - Engine Instruments															
Indicator, Carb Mixture Temp															
Indicator, Fuel Quantity	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4		0.4
Indicator, Oil Temperature															
F - Flight Instruments															
Pitot Heat	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6		6.6
Indicator, Vac Press Warning															
G - Landing Gear															
Indicator Lights, Ldg Gr Pos											0.3	0.3	0.3		Neg
Motor, Landing Gear											70.0	22.4	5.6		0.7
Signal, Ldg Gear Warning															
Solenoid, Ldg Gear Latch											1.0	0.3	Neg		Neg
H - Heating, Ventilating & Deicing															
Motor, Prop Anti-Icer	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0
Motor, Wing Deicer Valve	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0
J - Ignition															
Vibrator, Induction															
K - Engine Control															
Motor, Engine Start															
Relay, Engine Start															
L - Lighting															
Baggage Light	0.8	0.8	0.8	Neg	Neg	0.8	0.8	0.8	Neg	Neg	0.8	0.8	0.8		0.1
Compass Light	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2		0.2
Dome Lights, Clear	1.6	1.6	1.6	0.1	Neg	1.6	1.6	1.6	0.1	Neg	1.6	1.6	1.6		0.2
Dome Lights, Red	3.0	3.0	3.0	0.2	0.1	3.0	3.0	3.0	0.3	0.1	3.0	3.0	3.0		0.4
Extension Light, B-7	0.3	0.3	0.3	Neg	Neg	0.3	0.3	0.3	Neg	Neg	0.3	0.3	0.3		Neg
Flasher	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9		0.9
Subtotals	15.3	15.8	15.8	10.4	10.2	15.8	15.8	15.8	10.4	10.2	87.1	38.8	21.7		11.5

Chart 2. Power Loading, TC-45G (Sheet 1 of 2 Sheets)

A EQUIPMENT	B PART DESIGNATION	C NUMBER OF UNITS	D AMPERES PER UNIT	E OPERATING TIME-MIN	F-1 LOADING & ANCHOR AMP	F-1 AVERAGE AMP 0.5 MIN	F-1 AVERAGE AMP 2.0 MIN	F-1 AVERAGE AMP 15.0 MIN	F-1 AVERAGE AMP MIN	F-2 START & WARM-UP AMP	F-2 AVERAGE AMP 0.5 MIN	F-2 AVERAGE AMP 2.0 MIN	F-2 AVERAGE AMP 15.0 MIN	F-2 AVERAGE AMP 1 MIN
L - Lighting (Continued)														
Instrument Light Shield, Red	AN3140-327	75	0.048	60.0						3.6	3.6	3.6	3.6	
Landing Lights	AN3130-4560	2	21.4	1.5										
Map Light	AN3131-303	2	0.30	2.0						0.6	0.6	0.6	Neg	
Table Light	AN3132-308	3	0.80	60.0						2.4	2.4	2.4	2.4	
Passing Light	AN3133-311	1	1.50	60.0						1.5	1.5	1.5	1.5	
Radio Panel Light	AN3124-307	1	0.80	60.0						0.8	0.8	0.8	0.8	
Relay, Landing Light	AN3350-2	2	0.35	1.5										
Spotlight, C-4 Red	AN3121-313	4	0.17	2.0						0.7	0.7	0.7	0.1	
Tail Lights	AN3124-307	2	0.80	60.0						1.6	1.6	1.6	1.6	
Taxi Lights	GE4570	2	5.36	5.0										
Wing Position Lights	AN3122-1524	2	0.75	60.0						1.5	1.5	1.5	1.5	
M - Miscellaneous														
Motor, Windshield Wiper		1	7.63	60.0						7.6	7.6	7.6	7.6	
P - D. C. Power														
Battery Charging				60.0										
Battery Relay	AN3370-1	2	0.6	60.0						1.2	1.2	1.2	1.2	
Indicator, Gen Overvoltage	AN3157-2	2	0.17	Neg										
Inverter, AN/ARN-7 Radio	MG149F	1	15.4	60.0						15.0	15.0	15.0	15.0	
Inverter, Instrument	AN3499-1	1	6.0	60.0						6.0	6.0	6.0	6.0	
Q - Fuel & Oil														
Motor, Booster Pump		2	2.00	15.0						4.0	4.0	4.0	4.0	
Primer Solenoid		2	0.33	Neg										
Indicator, Low Fuel Pressure	AN3157-2	2	0.17	Neg										
R - Radio														
Interphone	RC-36	1	2.20	60.0						2.2	2.2	2.2	2.2	
Marker Beacon Receiver	RC-193A	1	0.65	60.0						0.6	0.6	0.6	0.6	
Radio Compass Receiver	AN/ARN-7	1	1.95	60.0						1.9	1.9	1.9	1.9	
Range Receiver	BC-453-B	1	1.60	60.0						1.6	1.6	1.6	1.6	
VFH Radio Receiver	AN/ARC-3	1	5.50	60.0						5.5	5.5	5.5	5.5	
VFH Radio Transmitter	AN/ARC-3	1	7.50	0.5						7.5	7.5	1.9	0.2	
Totals										161.5	161.5	145.9	78.7	

EQUIPMENT	F-3 TAXI AMP	F-3 AVERAGE AMP 0.5 MIN	F-3 AVERAGE AMP 2.0 MIN	F-3 AVERAGE AMP 15.0 MIN	F-3 AVERAGE AMP MIN	F-4 TAKE-OFF & CLIMB AMP	F-4 AVERAGE AMP 0.5 MIN	F-4 AVERAGE AMP 2.0 MIN	F-4 AVERAGE AMP 15.0 MIN	F-4 AVERAGE AMP MIN
L - Lighting (Continued)										
Instrument Light Shield, Red	3.6	3.6	3.6	3.6		3.6	3.6	3.6	3.6	
Landing Lights										
Map Light	0.6	0.6	0.6	Neg		0.6	0.6	0.6	Neg	
Table Light	2.4	2.4	2.4	2.4		2.4	2.4	2.4	2.4	
Passing Light	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5	
Radio Panel Light	0.8	0.8	0.8	0.8		0.8	0.8	0.8	0.8	
Relay, Landing Light										
Spotlight, C-4 Red	0.7	0.7	0.7	0.1		0.7	0.7	0.7	0.1	
Tail Lights	1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	
Taxi Lights	10.7	10.7	10.7	3.5						
Wing Position Lights	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5	
M - Miscellaneous										
Motor, Windshield Wiper	7.6	7.6	7.6	7.6		7.6	7.6	7.6	7.6	
P - D. C. Power										
Battery Charging						81.6	81.6	51.0	30.6	
Battery Relay	1.2	1.2	1.2	1.2		1.2	1.2	1.2	1.2	
Indicator, Gen Overvoltage										
Inverter, AN/ARN-7 Radio	15.0	15.0	15.0	15.0		15.0	15.0	15.0	15.0	
Inverter, Instrument	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	
Q - Fuel & Oil										
Motor, Booster Pump						4.0	4.0	4.0	4.0	
Primer Solenoid										
Indicator, Low Fuel Pressure										
R - Radio										
Interphone	2.2	2.2	2.2	2.2		2.2	2.2	2.2	2.2	
Marker Beacon Receiver	0.6	0.6	0.6	0.6		0.6	0.6	0.6	0.6	
Radio Compass Receiver	1.9	1.9	1.9	1.9		1.9	1.9	1.9	1.9	
Range Receiver	1.6	1.6	1.6	1.6		1.6	1.6	1.6	1.6	
VFH Radio Receiver	5.5	5.5	5.5	5.5		5.5	5.5	5.5	5.5	
VFH Radio Transmitter	7.5	7.5	1.9	0.2		7.5	7.5	1.9	0.2	
Totals	88.6	88.6	83.0	67.6		246.0	189.7	133.5	99.4	

EQUIPMENT	F-5 CRUISE AMP	F-5 AVERAGE AMP 0.5 MIN	F-5 AVERAGE AMP 2.0 MIN	F-5 AVERAGE AMP 30.0 MIN	F-5 AVERAGE AMP 60.0 MIN	F-6 CRUISE - COMBAT AMP	F-6 AVERAGE AMP 0.5 MIN	F-6 AVERAGE AMP 2.0 MIN	F-6 AVERAGE AMP 30.0 MIN	F-6 AVERAGE AMP 60.0 MIN	F-7 LANDING AMP	F-7 AVERAGE AMP 0.5 MIN	F-7 AVERAGE AMP 2.0 MIN	F-7 AVERAGE AMP 5.0 MIN	F-7 AVERAGE AMP 15.0 MIN
L - Lighting (Continued)															
Instrument Light Shield, Red	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6		3.6
Landing Lights											42.8	42.8	32.1		4.3
Map Light	0.6	0.6	0.6	Neg	Neg	0.6	0.6	0.6	Neg	Neg	0.6	0.6	0.6		Neg
Table Light	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4		2.4
Passing Light	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5		1.5
Radio Panel Light	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8		0.8
Relay, Landing Light											0.7	0.7	0.5		0.1
Spotlight, C-4 Red	0.7	0.7	0.7	Neg	Neg	0.7	0.7	0.7	Neg	Neg	0.7	0.7	0.7		0.1
Tail Lights	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6		1.6
Taxi Lights															
Wing Position Lights	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5		1.5
M - Miscellaneous															
Motor, Windshield Wiper	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.6		7.6
P - D. C. Power															
Battery Charging	61.2	61.2	38.1	16.5	11.4	40.8	40.8	25.5	11.0	7.6	20.4	20.4	12.7		7.6
Battery Relay	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2		1.2
Indicator, Gen Overvoltage															
Inverter, AN/ARN-7 Radio	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0		15.0
Inverter, Instrument	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0		6.0
Q - Fuel & Oil															
Motor, Booster Pump											4.0	4.0	4.0		4.0
Primer Solenoid															
Indicator, Low Fuel Pressure															
R - Radio															
Interphone	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2		2.2
Marker Beacon Receiver	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6		0.6
Radio Compass Receiver	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9		1.9
Range Receiver	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6		1.6
VFH Radio Receiver	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5		5.5
VFH Radio Transmitter	7.5	7.5	1.9	0.1	Neg	7.5	7.5	1.9	0.1	Neg	7.5	7.5	1.9		0.2
Totals	138.8	138.8	110.1	80.0	74.6	118.4	118.4	97.5	74.5	70.8	217.4	168.5	127.2		80.8

Chart 2. Power Loading, TC-45G (Sheet 2 of 2 Sheets)

SECTION VII

ELECTRICAL SYSTEM

TABLE OF CONTENTS

Paragraph		Page
7- 1.	General Description	244
7- 3.	Battery System	244
7- 4.	Description	244
7- 5.	Trouble Shooting	244
7- 6.	Removal of Battery	244
7- 7.	Installation of Battery	244
7- 8.	Specific Gravity Tests	244
7- 9.	Generator System	245
7-10.	Description	245
7-11.	Control Box Cooling	245
7-13.	Trouble Shooting	245
7-14.	Removal of Generator	245
7-15.	Removal of 100-Amp Generator	245
7-16.	Minor Repair and Parts Replacement	245
7-17.	Installation of Generator	246
7-18.	Installation of 100-Amp Generator	246
7-19.	Generator Field Flashing Procedure	246
7-20.	Regulation and Adjustment of Generator Control Equipment	246
7-21.	Voltage Regulator	246
7-22.	Testing and Voltage Regulator Adjustment	246
7-23.	Paralleling Generators	247
7-24.	Reverse-Current Relay	247
7-25.	Overvoltage Relay	247
7-28.	Testing Procedure for Overvoltage Protection System	248
7-29.	Field Control Relay	248
7-31.	Interior Lighting	248
7-32.	Description	248
7-45.	Trouble Shooting	249
7-46.	Replacement of Fixture	249
7-47.	Replacement of Lamp	249
7-48.	Exterior Lighting System	249
7-49.	Description	249
7-50.	Position Lights	249
7-51.	Position Light Flasher Control	249
7-52.	Trouble Shooting	249
7-53.	Replacement of Flasher Control	249
7-54.	Landing Lights	249
7-55.	Trouble Shooting	249
7-56.	Removal	249
7-57.	Minor Repair and Parts Replacement	249
7-57A.	Landing Light Protective Seal	250
7-58.	Installation	250
7-59.	Adjustment	250
7-60.	Taxi Lights	250
7-61.	Replacement of Taxi Light Lamp	250
7-62.	Replacement of Taxi Light Fixture	250A
7-63.	Clearance Lights	250A
7-64.	Passing Light	250A
7-65.	Anti-Collision Light	250A
7-66.	Removal	250A
7-67.	Minor Repair and Parts Replacement	250A
7-68.	Installation	250A
7-69.	Circuit Protection	250A
7-70.	Electrical Power Loading	250A

7-1. GENERAL DESCRIPTION.

7-2. This aircraft is equipped with a 24-volt, dc electrical system. The primary sources of current are two engine-driven generators. Current to operate electrical equipment when generators are inoperative is furnished by two 24-volt batteries. The batteries are connected in parallel to the bus system through two relays. Battery charge is maintained by the engine-driven generators. All primary circuits are supplied through circuit breakers from the bus system. The structure of the aircraft is utilized as a common ground for all circuits. Electrically-operated systems and accessories include: engine starters, landing gear, wing flaps, instruments, lights, warning systems, windshield wipers, anti-icer equipment, deicer equipment, oil dilution valves, pitot heaters, primer solenoids, ignition booster coils, radio equipment, and fuel booster pumps.

NOTE

ALL AN. connectors will be safetied in accordance with the applicable technical order on safety wiring unless otherwise specified herein.

7-3. BATTERY SYSTEM.

7-4. DESCRIPTION. The battery system consists of two AN3151-2, 24-volt, 24-ampere-hour batteries. The battery is located in each wing stub leading edge between the fuselage and the nacelles. They are connected in parallel to the bus system through two AN3370-1 relays. These relays connect the positive battery leads to the main belly distribution post located under the pilot's floorboard. The individual battery switches, on the lower left subpanel, control the relays. The negative battery leads connect to a structural ground. Each battery is vented and equipped with an overflow jar containing bicarbonate of soda, which will neutralize any excess electrolyte spilled or boiled from the batteries (figure 7-1).

NOTE

When servicing the battery, check the overflow jar for condition of the neutralizing agent. If overflow jar is contaminated, remove jar and clean with warm water. Wash the felt pad in a solution of 3 parts water and 1 part sodium bicarbonate. Allow excessive solution to drain from pad. Place the two felt pads in the overflow jar and reinstall.

7-5. TROUBLE SHOOTING. See Table XXVIII.

7-6. REMOVAL OF BATTERY.

a. Place both of the battery switches in "OFF" position.

b. Remove clamp holding battery on stand. Disconnect vent hoses and remove cover from battery.

c. Remove quick disconnect. Lift battery up and out.

7-7. INSTALLATION OF BATTERY. Reverse the removal steps given in paragraph 7-6. Turn the applicable battery switch "ON." Test the polarity at the subpanel bus bar by grounding the negative lead of a dc voltmeter while the positive lead is held on the bus bar. A positive voltage indicates correct installation.

7-8. SPECIFIC GRAVITY TESTS.

a. Use a temperature-corrected hydrometer and take a reading from each cell. The reading should be between 1.260 and 1.310 in the fully charged state.

CAUTION

Always return electrolyte to the cell from

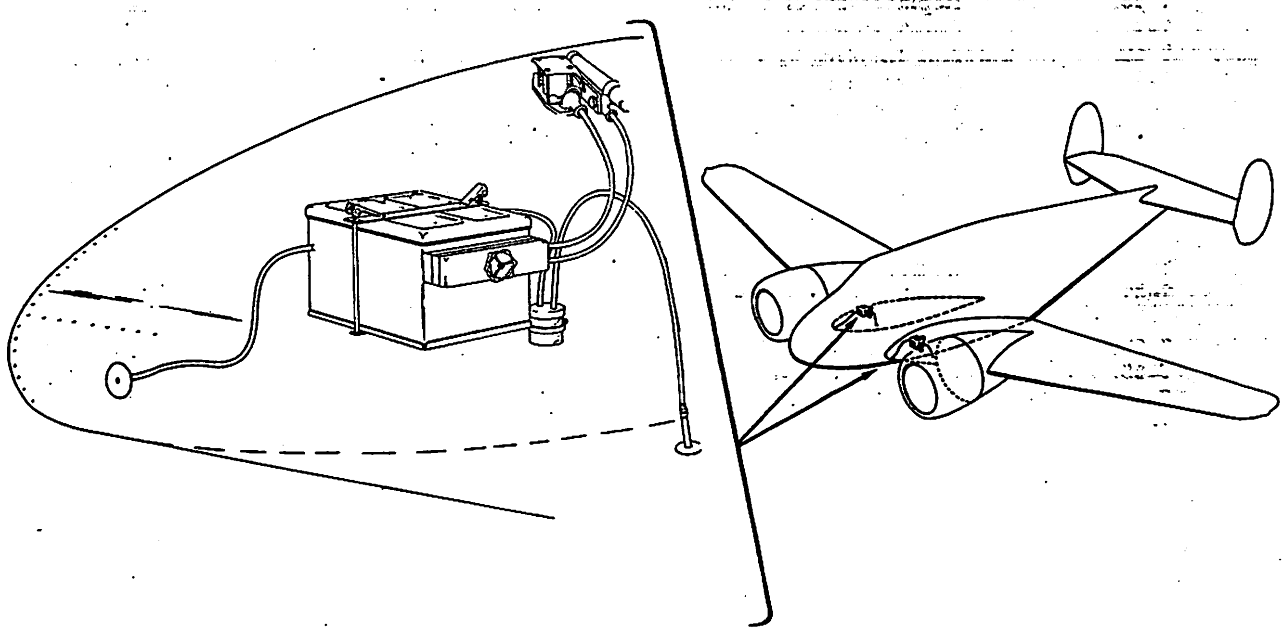


Figure 7-1. Battery Vent System

which it came to insure accurate readings. Electrolyte will vary from cell to cell. If continued charging results in specific gravity readings above 1.310 or below 1.260 when battery is fully charged adjustment of the specific gravity should be made.

b. The electrolyte level should be checked daily. If the electrolyte is too low to take a specific gravity reading, fill with distilled water to 3/8-inch above protector over separators.

7-9. GENERATOR SYSTEM.

7-10. DESCRIPTION. The generator system consists of two, type 30E16-1-A Eclipse-Pioneer 100-ampere generators, one driven by each engine. Each generator is designed for use as an engine-driven source of D-C power and is nominally rated at 30 volts, 100 amperes with continuous duty over a speed range of 2500 to 4500 rpm. This generator is recommended for use in 28-volt D-C electrical systems. The generator has a square mounting flange which is built in accordance with USAF drawing number 52B6588. The 6-tooth spline drive rotates in a counterclockwise direction when viewed from the mounting flange end. Interpole and compensating windings are provided in a negative circuit to prevent field distortion and to provide favorable commutation conditions. The generator incorporates a filter condenser to minimize radio interference. Flexible conduits carry the leads from each generator to plugs on the engine firewall. The generator "A" lead goes through the field control relay to the voltage regulator, the "B" lead goes to the reverse-current relay, the "D" lead is grounded to the nacelle structure through an equalizing resistor. On the C-45G the control box for each generator is mounted respectively, either left or right, on the aft side of Bulkhead 5 on either side of the pilot's compartment doorway. The TC-45G has both generator control boxes mounted on the left side of the cabin aft of Bulkhead 5. For equipment housed in each control box, see paragraph 7-12.

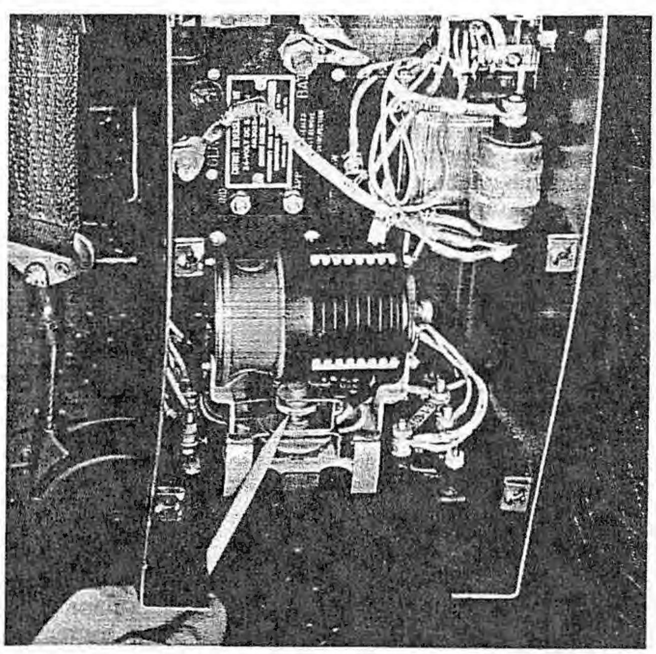


Figure 7-2. Voltage Regulator Adjustment

7-11. CONTROL BOX COOLING. On C-45H airplanes, Serials 52-10539 and after, each voltage regulator is cooled by drawing hot air from the control box through a flexible hose routed from the forward side of the box through the floorboards to an opening in the belly. Negative air pressure behind the scupper over this opening draws the hot air from the box; cool air enters through vents on the aft side of the box.

7-12. Equipment housed by each control box is as follows:

PART	TYPE	SPEC
Voltage Regulator	DC Carbon Pile	1042-17A
Voltage Regulator Base		49C7573
Reverse Current Relay		AN3025-1
Generator Field Control Relay	M-2	32603
Generator Overvoltage Relay	E-2	32591
Generator "ON-OFF" Switch		AN3227-5
Generator Paralleling Resistor	2-ohm, 25 watt Dividohm	036B
Ammeter Shunt	250 volt, 0-100 Amperes	694-180573
2-Capacitors	0.55 Microfarad	26F55G3
Ammeter Circuit Breakers		49B6768-5

7-13. TROUBLE SHOOTING. See Table XXIX.

7-14. REMOVAL OF GENERATOR.

a. Remove cowling.
b. Remove electrical connector plug at generator.
c. Remove nuts on studs at mounting flange.
d. Lift generator up and out.

7-15. REMOVAL OF 100-AMP GENERATOR.

a. Remove engine cowling.
b. Disconnect the four electrical leads from the generator terminal strip.

NOTE

On the left engine only, loosen governor bolts to permit governor to be moved to obtain space for removal of generator.

c. Remove blast tube from generator.
d. Remove generator nuts from studs at mounting flange.
e. Lift generator up and out.

7-16. MINOR REPAIR AND PARTS REPLACEMENT. Field repair of generators must be limited to external cleaning, replacement of brushes and cleaning the commutator. Minimum brush length is 1/2-inch. Brushes should be replaced before minimum length is reached. When replacing a worn brush, it should be properly seated against the generator commutator by inserting a strip of No. 000 sandpaper and sanding in direction of generator rotation, being careful that sandpaper is kept in same contour as surface of commutator. Repeat sanding operation until brush is completely seated. Sticking brushes should be wiped clean with a cloth moistened with unleaded gasoline. If commutator is rough or dirty, smooth with No. 000 sandpaper. If roughness, scoring or pitting is extreme, generator should be sent to depot for repair.

CAUTION

Do not use emery cloth or coarse sandpaper to seat brushes or clean commutator. Remove metal particles with dry compressed air. Do not use carbon tetrachloride to clean generator parts.

7-17. INSTALLATION OF GENERATOR. Reverse removal procedure in paragraph 7-14.

7-18. INSTALLATION OF 100-AMP GENERATOR.
a. Position generator on mounting flange and tighten nuts.
b. On left hand engine retighten governor nuts and safety.
c. Install blast tube to generator.
d. Install the four electrical leads to the generator strip, as shown in figure 10-17.

7-19. GENERATOR FIELD FLASHING PROCEDURE. If generator fails to build up voltage because of reversed polarity, loss of residual magnetism, or excessively filmed commutator, the generator field may be flashed as follows:
a. Turn generator switch to "OFF" position, battery switch to "ON" position and voltmeter switch to the generator to be flashed.

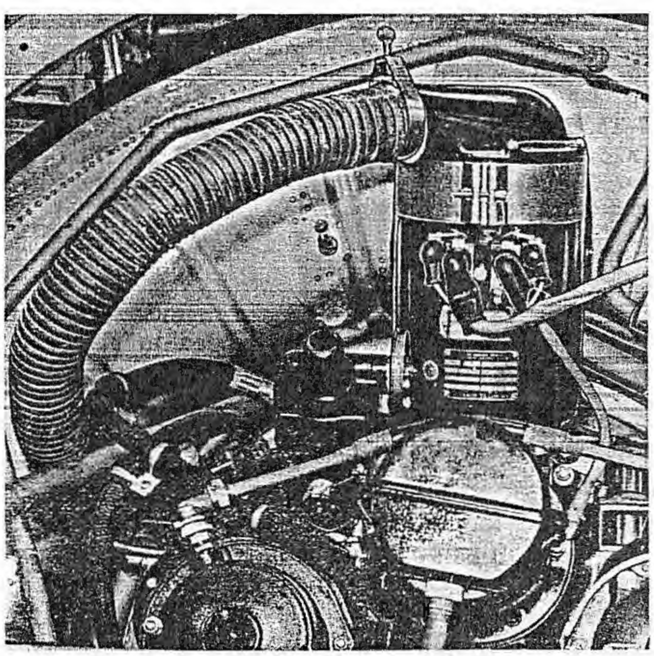


Figure 7-3. Installation of 100-Amp Generator

b. Remove voltage regulator from the circuit to be flashed.
c. Disconnect wire from terminal marked "S.W." on the reverse-current relay.
d. Connect one end of suitable length of cable, 18-gauge or better, to terminal "A" on the voltage regulator base.
e. With engine operating at normal cruising rpm (approximately 1800) touch the other end of the cable to terminal marked "BAT" on the reverse-current relay and hold for one second. Note if voltage is shown by the aircraft system voltmeter or by a test voltmeter connected to the system.
f. If voltage is not obtained, the generator is faulty and must be replaced. If voltage is obtained, reinstall voltage regulator and lead to reverse-current relay. Turn generator switch to "ON" and check to see if voltage is maintained. If voltage is not maintained, replace voltage regulator.

NOTE

If generator repeatedly fails to put out voltage on run-up, check generator to see if commutator is dirty, or excessively coated with oil, etc. Clean commutator sufficiently to obtain continued operation. The commutator need not be cleaned to a bright surface. A slight lubrication film, identifiable as a bronze discoloration, is desirable for high generator loading and high altitude operation.

7-20. REGULATION AND ADJUSTMENT OF GENERATOR CONTROL EQUIPMENT.

7-21. VOLTAGE REGULATOR. One voltage regulator is mounted in each generator control box. The voltage regulator consists of a base assembly, regulator assembly and rheostat-adjusting assembly. The regulator assembly is made up of a stack of carbon discs compressed by spring loading. The spring loading is opposed by an electromagnet, the field of which varies with generator output. Generator output, which flows through the carbon pile, thus can be held at a preset specific voltage since any increase will cause the electromagnet to lessen the spring compression, which increases resistance to flow through the carbon. Conversely a decrease in output voltage lessens the effect of the electromagnet permitting increased spring compression with its accompanying decrease in resistance within the carbon.

7-22. TESTING AND VOLTAGE REGULATOR ADJUSTMENT. A precision, portable voltmeter must be used for test purposes.

NOTE

The voltmeter on the panel should not be used as a test instrument.

a. With the negative lead of the voltmeter connected to a structural ground, the positive lead should be connected to the generator post on the reverse-current relay.
b. With the generator and battery master switches

"ON," run-up engine until generator is operating at or above the minimum rated speed, with small load, such as lamps or radio, for a period of 15 to 30 minutes, allowing the regulator to reach normal operating temperatures.

NOTE

Perform all regulator checks at or above 1700 engine rpm. Make all regulator adjustments with the generator operating at minimum speed at which voltage output remains constant (2500 generator rpm).

CAUTION

Observe applicable instructions carefully to prevent overheating when operating engine on ground. As soon as the checking procedure is completed, the engine should be throttled back.

c. Turn generator switch to "OFF" position. The no load or minimum load voltage limits should be between 26.9 and 28.5 volts. If either limit is exceeded, the regulator must be removed for repair.
d. If voltmeter does not indicate between 27.7 and 28.0 volts, turn rheostat (figure 7-2) one notch at a time (clockwise to increase and counterclockwise to decrease voltage) until proper voltage is obtained.
e. Check bus bar voltage. If voltage is greater than 28.5, regulator must be readjusted.

NOTE

Factory setting (Eclipse-Pioneer) is 27.7 volts for regulator.

CAUTION

Do not adjust core or pile adjusting screw at any time or voltage setting as well as regulating characteristics of regulator will be altered. The type 1042-17A regulators are designed to operate within a tolerance of plus or minus 0.8 volts over the full range of the generator speed and load, at normal operating temperature. Voltage should never exceed 28.5.

f. During first flight following ground adjustment, ammeters or load indicators should be checked for unequal generator load division. Repeat adjustment procedure if necessary.

7-23. PARALLELING GENERATORS. To simplify paralleling adjustment, it is very important that each voltage regulator be adjusted to exactly the same no load voltage.
a. Run engines at or above 1700 rpm for approximately 30 minutes to insure normal operating temperature of all units.

NOTE

It is important that ammeters used for checking load current during adjustment for parallel operation be accurate. To check for satisfactory ammeters, switch on one generator at a time while a constant load (approximately equivalent to the full load rating of one generator) is also maintained. Compare ammeter readings of each generator. If individual readings are equal, the ammeters are satisfactory for test.

b. Check generator ammeters. Each generator should support half of the total load within plus or minus 10 percent of its rated output. If such is not the case, proceed as follows:
1. From readings of the individual ammeters, determine which generator has the greater load division error.
2. Adjust the generator paralleling resistor (mounted in the generator control box) to increase or decrease the load carried by the generator, as required.
3. Continue paralleling adjustments until an equal load of distribution is obtained on each generator. Always select the generator with the greater error in load distribution for adjustment.

7-24. REVERSE-CURRENT RELAY. This unit (AN3025-1) is designed to close the generator circuit when the output voltage is from 20 to 24 volts, provided this voltage exceeds the bus voltage by 0.35 to 0.65 volts and the generator switch is in the "ON" position. The relay automatically disconnects the generator from the bus system when a 16 to 25-ampere current is flowing from the battery to the generator. This relay is not adjustable in the airplane, but may be checked for proper operation as follows:
a. Using a precision voltmeter, ground the negative lead and attach the positive lead to the terminal marked "BAT" on the reverse-current relay.
b. Start engine and run at idling speed, noting the indication on the test voltmeter.
c. Increase engine speed slowly until the test voltmeter shows a sudden increase in voltage, indicating the voltage at which the relay closes. If this indication is not between 20 and 24 volts, replace the relay.

NOTE

The reverse-current relay is entirely self-contained and fully automatic, requiring no adjustment. Since this is a delicate device, the cover should not be removed for any reason except overhaul by qualified personnel with bench test equipment.

7-25. OVERVOLTAGE RELAY.

7-26. DESCRIPTION. The overvoltage relay, in each generator control circuit, consists of normally open contacts which are closed by solenoid action. The solenoid action is opposed by spring tension and is preset to operate with 31 volts minimum and 33 volts maximum on the coil. A time delay feature is incorporated in the relay which is inversely proportional to the amount of voltage overload. This time varies from 0.015 to 0.5 second. The relay is a sealed unit and no adjustment can be made.

7-27. FUNCTION. The purpose of the overvoltage relay is to actuate the field control relay by completing the circuit to the TRIP coil.

7-28. TESTING PROCEDURE FOR OVERVOLTAGE PROTECTION SYSTEM. The following is the approved procedure for testing the overvoltage relay for proper operation without removing it from the airplane.

a. Check to assure that all switches are "OFF."
b. Install a temporary jumper from the "A" to "B" terminals on the voltage regulator in the circuit being checked. Connect a test voltmeter, with a 50-volt or more capacity, between the "B" terminal and ground.
c. Place the generator control switch for the generator circuit being checked and the battery switch in the "ON" position.
d. Start the airplane engine.
e. Increase the engine rpm gradually until the field control relay and overvoltage relay disconnect the generator from the main electrical distribution bus. If the overvoltage and field control relays function properly, the overvoltage warning light will come on at an indicated voltage of between 31 and 33 volts. When the overvoltage system disconnects the generator from the main distribution bus, the voltage should drop to approximately 2 volts. In no case will the voltage be allowed to go higher than 35 volts and in the event the overvoltage relay and field control relay do not disconnect the generator from the main electrical distribution bus after the maximum of 35 volts is reached, the engine will be shut off IMMEDIATELY. If the overvoltage and field control relays and the balance of the system have functioned properly, the affected generator will be disconnected from the airplane electrical system at an indicated voltage of 31 to 33 volts. If the system operates at a voltage in excess of the 33-volt limit or completely fails to operate, the necessary repair and replacement will be accomplished.
f. Remove the jumper from the voltage regulator and disconnect and remove the voltmeter.
g. Momentarily place the generator control switch in a "RESET" position and then return the switch to an "ON" position. Check the generator system for specified voltage (28 volts) and proper operation.

7-29. FIELD CONTROL RELAY.

7-30. DESCRIPTION. The generator field control relay is a multi-circuit relay with two solenoids, one to trip the relay and the other for resetting. When tripped by the overvoltage relay, the field control relay opens the field supply circuit, the voltage equalizing circuit and the generator switch circuit and lights the overvoltage warning light. To reset the relays, push the reset button in the generator control box or momentarily place the generator control switch in the "RESET" position.

7-31. INTERIOR LIGHTING.

7-32. DESCRIPTION. Except the lavatory compartment, with white light only, both red and white lights are installed throughout the interior. On Serials 51-11494, 51-11496, 51-11497, 51-11499, 51-11501, 51-11502, 51-11503, 51-11518 and after, the dome light bracket only is installed in the nose and the wire taped and stowed.

7-33. All instruments on the panel have individual red lights which are controlled by three rheostat switches: one, located on the lower left-hand side of the floating panel, controls the pilot's flight instrument lights; another, located beside the pilot's instrument light rheostat, controls lights for the engine instruments and the subpanels; the third, located on the lower right-hand side of the floating panel, controls the copilot's flight instrument lights.

7-34. Immediately above and at the extreme left and right sides of the windshield are two map reading lights, fitted with clear white lamps. Their respective switches are integral parts of the assemblies.

7-35. Two utility lights are provided on the forward side of Bulkhead 5. They are mounted at the top of the bulkhead inboard of the pilot's seats on either side. These lights, fitted with clear lamps, have removable red filters and a clear lens. They are ball-joint mounted for focusing on any part of the cockpit, or may be removed from their mounting brackets and used as extension lights. Rheostat switches are mounted in the lamp assemblies.

7-36. A reel-type extension light with a six-foot cord and rotating cover to dim the light is mounted on the bulkhead behind the copilot's seat. Its switch is mounted on the reel housing. C-45G airplanes, Serials 51-11823 through 51-11911 and C-45H airplanes, Serials 52-10539 and after, do not have this light.

7-37. A red spotlight on the bulkhead beneath the threshold lights the overhead radio panel; a rheostat switch is mounted beside the light. Effective with Serial 51-11600 the light dimming rheostat used originally for integrally lighted radio control panels is replaced with an improved new type having increased resistance, thus resulting in improved dimming characteristics of the radio panel lights.

7-38. Except for C-45H airplanes, on which they were omitted, the cabin is lighted by a reading light at each seat and by three overhead dome lights. On Serial 52-10539 only, the wiring for the cabin reading lights is taped at the ends, secured in place and left in the airplane. The reading lights are the same as the cockpit utility lights described in paragraph 7-35. The dome lights have both red and white lamps in the same fixture; individual switches on the cabin control the red lamps while a switch on the pilot's subpanel controls the white lamps. The two forward dome light switches are mounted on the right side next to the reading lights; the aft switch is on Bulkhead 9.

7-39. A dome light, with its switch in the housing, is mounted overhead in the lavatory compartment.

7-40. Due to its different primary mission, the TC-45G has the following differences in interior lighting:

7-41. The navigator's instrument panel is lighted by individual instrument lights in the same manner as the cockpit panel. The control rheostat is located on the inboard side of the panel assembly.

7-42. The forward cabin dome light is not installed, nor are the left-hand reading lights.

7-43. Three adjustable work table light assemblies are mounted on the right side of the airplane. These assemblies incorporate four ball-socket joints, and are mounted on the cabin wall, one above each table. They are fitted with white lamps in bell-type reflectors. Individual rheostats adjacent to the assembly bases control these lights.

7-44. Reading lamps of the same type as are installed on the C-45G, are mounted above the forward and aft work tables.

7-45. TROUBLE SHOOTING. See Table XXX.

7-46. REPLACEMENT OF FIXTURE. To replace interior lighting fixture:
a. Remove fixture mounting screws, lift assembly from mount, and disconnect electrical leads.
b. Connect electrical leads to new fixture, place fixture in position, install and tighten mounting screws.

7-47. REPLACEMENT OF LAMP. To remove lamp:
a. Remove light cover assembly and remove lamp by pushing it in and turning to the left, then pulling it out. Install new lamp and reinstall cover assembly.
b. To remove individual instrument lamp (figure 7-4), first fold down upper half of light shield. Swing base of lamp holder away from ground contact and pull holder plug from socket. Using fingernail or knife blade, lift lamp from holder. Press new lamp into holder, install holder plug in its socket and swing base into position against ground contact. Raise cover and snap back into place.

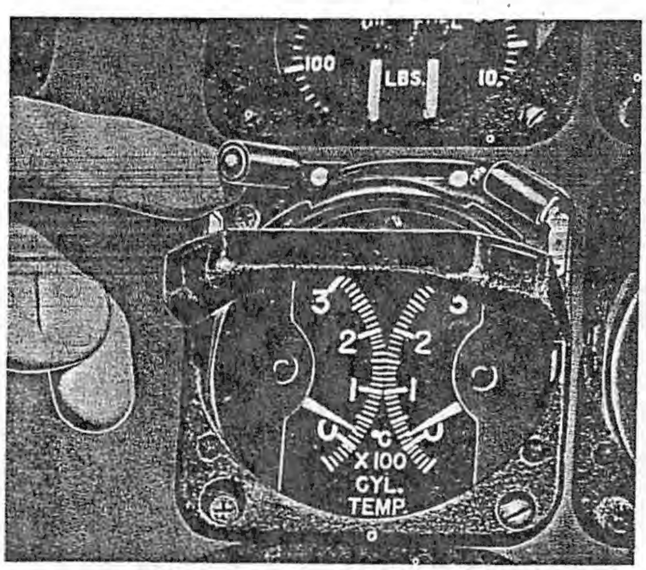


Figure 7-4. Instrument Lamp Replacement

7-48. EXTERIOR LIGHTING SYSTEM.

7-49. DESCRIPTION. The exterior lighting system consists of position lights, clearance lights, position light flasher, landing lights, taxi lights, passing lights, and anti-collision light.

7-50. POSITION LIGHTS. Conventional position lights are controlled by a three-position toggle switch, marked "STEADY," "OFF," and "FLASHER." When the switch is in the "STEADY" position, the wing tip lights and the white tail light burn continuously. When the switch is in the "FLASHER" position the wing tip lights and the white tail light flash alternately with the amber tail light. A dimmer switch having "DIM" and "BRIGHT" positions controls the brilliance of the position and clearance lights. Plastic telltales are installed on the wing position lights, allowing the pilot to check the function of these lights in flight.

7-51. POSITION LIGHT FLASHER CONTROL. The flasher control unit is mounted on the cockpit floorboard in front of the engine control pedestal. It is incorporated into the position light circuit.

7-52. TROUBLE SHOOTING. See Table XXXI.

7-53. REPLACEMENT OF FLASHER CONTROL. To replace the flasher control:
a. Remove the flasher unit by disconnecting the electrical wiring plug, then remove the four screws holding the flasher to the floorboards.
b. Set the new flasher in place, insert and tighten the retaining screws, and connect the electrical plug. Test for proper functioning by throwing control switch to "FLASHER" position.

7-54. LANDING LIGHTS. A retractable, flush-mounted landing light is installed approximately in the center of the lower surface of each outer wing panel. They are individually controlled by toggle switches located on the inboard end of the pilot's subpanel. There are two switches for each light, one to extend and retract the light, and one to turn the light on and off.

7-55. TROUBLE SHOOTING. See Table XXXII.

7-56. REMOVAL. Remove landing light as follows:
a. Remove screws attaching outer ring of light housing to lower surface of wing.
b. Lower light assembly and disconnect wires.

7-57. MINOR REPAIR AND PARTS REPLACEMENT. To replace landing light lamp, extend light, remove lamp retaining ring, remove old lamp and install new one; reinstall lamp retaining ring and retract light.

NOTE

Contact points must be kept clean to insure proper operation. Do not attempt repair other than cleaning contact points, replacing lamp, or adjusting extended and retracted positions. Other repairs or overhaul must be performed by a designated overhaul activity.

7-57A. LANDING LIGHT PROTECTIVE SEAL. To reduce the possibility of an explosion resulting from arcing contacts in the presence of explosive vapors, all retractable landing light assemblies mounted in areas adjacent to fuel and anti-icing alcohol tanks, or their respective lines, will be vapor proofed prior to installation and each time the sealed surface is disturbed or broken. Vapor proof as follows:

a. Mask the parts of the light assembly not to be sprayed or brushed including the electrical connector.
b. Apply the synthetic rubber sealer, stock number 7300-828075, MIL-S-7124, into all holes, openings, and crevices around the noise filter, the motor, and the gear housing. Also apply the synthetic rubber sealer where the gear housing and canopy join.
c. Brush or spray the entire motor, the gear housing and the area where the gear housing and the canopy join with two coats of Sealant, Buna "N" type, stock number 7300-825156, MIL-S-4833.

WARNING

Sealant should be applied in well ventilated rooms or spray booths. Respiratory protection is necessary when ventilation is inadequate. Care should be taken to keep the compound away from flame as it is highly inflammable in a liquid state.

d. Allow the sealant to dry thoroughly (approximately 4 hours) before removing the masking. When removing the masking use a dull knife to cut the sealant along the edges to prevent the sealant being peeled off with the masking.

7-58. INSTALLATION. To install landing light:
a. Hold landing light assembly below well and connect electrical leads.
b. Place assembly in position and install mounting screws.
c. Operate light to test for proper installation, adjustment, and electrical connections.

7-59. ADJUSTMENT. To regulate extended position of landing light, extend light and measure distance from lower aft edge of lens rim to aft edge of light housing (figure 7-5). This measurement should be 11-1/2 inches. If it is not, remove landing light assembly from wing, remove switch contact housing cover and adjust movable contact point (figure 7-6). Using suitable ground connection, extend and retract light several times and check extended measurement again. Readjust movable contact point as required. Reinstall landing light in wing. To regulate retracted position of light, stationary contact point arm may be bent slightly.

7-60. TAXI LIGHT. Two lights with sealed beam lamps are installed in the nose of the airplane for use while taxiing. Both are controlled by one toggle switch located on the inboard end of the pilot's subpanel.

7-61. REPLACEMENT OF TAXI LIGHT LAMP. To remove a taxi light lamp, remove the screws in the retaining ring and lift lamp forward and out. Install new lamp, reinstall hold-down ring and install and securely tighten retaining screws.

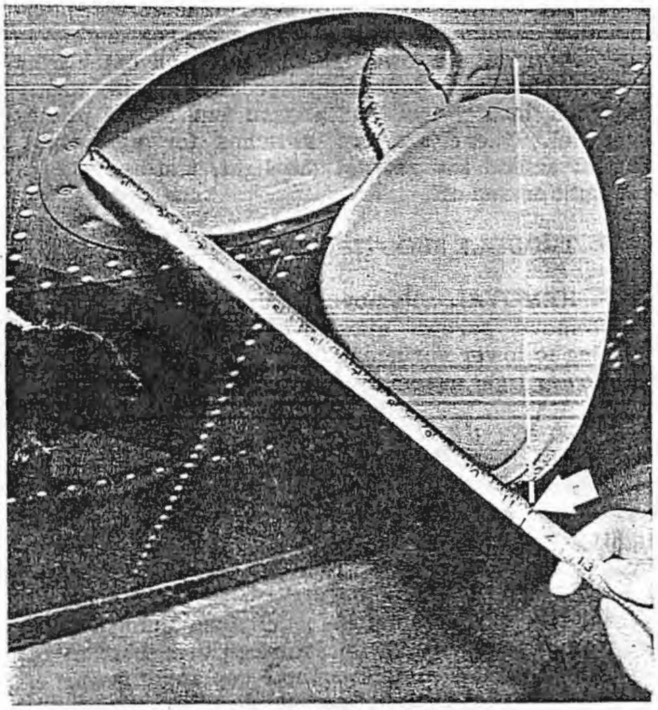


Figure 7-5. Landing Light Extension Measurement

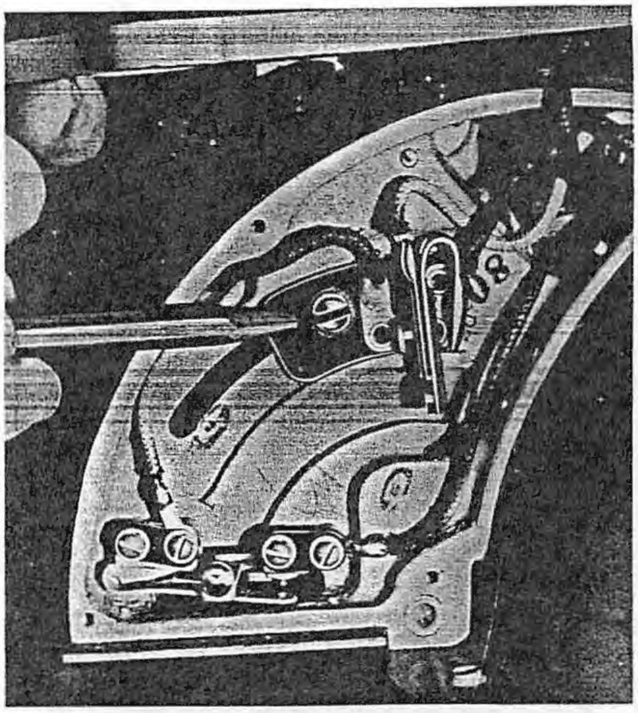


Figure 7-6. Landing Light Adjustable Contact

7-62. REPLACEMENT OF TAXI LIGHT FIXTURE. To remove a taxi light fixture, open nose baggage compartment door, remove inside door cover, remove fixture retaining screws, disconnect electrical wiring and remove fixture. Place new fixture in position, install retaining screws, connect electrical wiring and replace baggage door inside cover.

7-63. CLEARANCE LIGHTS. Two white lights, one on the top and one on the belly of the fuselage, are wired in with the navigation lights and controlled by the navigation light switch. They are not, however, connected into the flasher circuit, and will burn continuously regardless of the position of the navigation light switch.

7-64. PASSING LIGHT. A red passing light is installed in the left outer wing leading edge and controlled by a toggle switch on the pilot's subpanel.

7-65. ANTI-COLLISION LIGHT. The anti-collision light is mounted on top of the fuselage between stations 285 and 313. The light is intended to provide, by means of a flashing red light, a warning to other airplanes flying at the same altitude, thereby minimizing the possibility of a collision. The light assembly consists of two reflector lamps enclosed in a red glass lens. The two lamps are motor driven to rotate at 45 plus or minus 5 revolutions per minute resulting in 80 to 100 flashes per minute. A 10 ampere circuit breaker protects the circuit. An anti-collision light ON-OFF switch is provided on the right hand instrument subpanel.

7-66. REMOVAL.

a. Open anti-collision light circuit breaker.

b. Remove three screws that secure light to base assembly.

c. Disconnect electrical connection and lift light assembly out.

7-67. MINOR REPAIR AND PARTS REPLACEMENT. To replace light lamps, remove lens retainer band, remove lens, remove old lamp and install new one. Reinstall lens and lens retainer band. The retainer band screw should be in the aft position.

7-68. INSTALLATION.

a. Place light assembly into position so that securing screw holes align. Install screws.

b. Connect electrical connection to light.

c. Close circuit breaker and place light switch "ON". Check that light glows and that motor is turning at 45 plus or minus 5 rpm or light flashes 80 to 100 times per minute.

7-69. CIRCUIT PROTECTION. The circuits are protected by circuit breakers. All circuit breakers (except the landing gear motor circuit breaker, which is located in the lower center of the control pedestal and the ammeter circuit breakers which are located on the generator control boxes) are on the circuit breaker panel, located above and behind the copilot. The generators are protected by over-voltage relays in the generator control boxes, with a reset switch on top of each box.

7-70. ELECTRICAL POWER LOADING. See Charts 1 and 2.

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TABLE XXVIII

TROUBLE SHOOTING, BATTERY SYSTEM

TROUBLE	PROBABLE CAUSE	CORRECTION
1. No power indicated with battery switches "ON."	a. Batteries dead.	a. Check batteries; replace if discharged.
	b. Open circuit between battery and battery switches.	b. Check all terminals and connections for tightness. Check solenoid primary circuit; replace solenoid if defective.
	c. Battery not grounded.	c. Check continuity from battery negative terminal to airplane. Repair ground if necessary.
	d. Relay contacts not closing.	d. Inspect solenoid switch contacts. Clean if possible, or replace relay if necessary.

CAUTION

Disconnect battery before exposing relay contacts.

TROUBLE	PROBABLE CAUSE	CORRECTION
2. Power on with battery switches "OFF."	a. Ground between battery switches and solenoid.	a. Inspect wire for grounding between battery switches and solenoid.
	b. Relay contacts stuck.	b. Check operation of solenoid switch. If contacts do not move when battery switches are "ON," clean and repair contacts.

TABLE XXIX

TROUBLE SHOOTING, GENERATOR

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Zero or low voltage indicated.	a. Loose connector or open circuit.	a. Check connections at generator. firewall, control box, voltmeter, and voltmeter selector switch. Check continuity of circuits.
	b. Open or shorted field circuit in generator; defective armature.	b. Test resistance of field. Resistance should be 3 ohms. Check field circuit connections. Replace generator if defective.
	c. Brushes binding in holders; weak brush springs.	c. Clean brushes and holders with a clean lint-free dry cloth. Replace weak springs.
	d. Brushes worn out.	d. Replace brushes if worn to a length of 1/2-inch or less.
	e. Dirty commutator.	e. With generator running, polish commutator with No. 000 sandpaper.
	f. Defective voltmeter.	f. Replace voltmeter..
	g. Loss of residual magnetism.	g. Flash generator field.
	h. Defective regulator.	h. Replace regulator.
	i. Generator not turning.	i. Check generator shaft. Replace generator if necessary.
2. No generator output.	a. Engine speed too low.	a. Increase engine rpm until voltage reaches 28 volts. Turn on lights or some other electrical load. Ammeter should show current flow.
	b. Loose connection or open circuit.	b. Check all terminals in system for tightness. Check continuity of circuits.

TABLE XXIX (CONTINUED)

TROUBLE	PROBABLE CAUSE	CORRECTION
	c. Defective generator control switch or reverse-current relay.	c. Test switches; replace if necessary. Replace reverse-current relay.
	d. Brushes not contacting commutator.	d. Check for worn or sticking brushes, rough or damaged commutator. Service or replace brushes and springs. Seat brushes by wrapping commutator with No. 000 sandpaper with the abrasive toward brushes and rotate until contacting surfaces are same contour as commutator.
	e. Defective regulator.	e. Replace regulator.
3. Low generator output.	a. Voltage regulator out of adjustment.	a. Set generator voltage at 28-volts.
	b. High resistance connection.	b. Tighten generator system connections.
	c. Worn or sticking brushes.	c. Check brush length; minimum length is 1/2-inch. Make sure brushes are free in holders.
	d. Dirty commutator.	d. Polish commutator with No. 000 sandpaper; use air jet to remove grit.
	e. Defective generator.	e. Replace generator if defective.
	f. Generator voltages not equal.	f. Adjust regulators to give equal voltage.

TABLE XXX

TROUBLE SHOOTING, INTERIOR LIGHTING

TROUBLE	PROBABLE CAUSE	CORRECTION
1. No lights go on.	a. Batteries dead.	a. Replace batteries.
	b. Loose connection.	b. Check and tighten electrical connections.
2. One circuit does not light.	a. Circuit breaker tripped.	a. Check for short circuit; reset circuit breaker.
	b. Loose connection.	b. Check connections and continuity of circuit.
3. One bulb does not light.	a. Bulb burned out.	a. Replace bulb.
	b. Fixture not grounded.	b. Check for good bonding between fixture and structure. Tighten mounting screws.
	c. Loose connection.	c. Check all connections in circuit.
	d. Defective fixture or switch.	d. Replace fixture or switch.

TABLE XXXI

TROUBLE SHOOTING, POSITION LIGHTS

TROUBLE	PROBABLE CAUSE	CORRECTION
1. No lights go on.	a. Master circuit not energized.	a. Check "MASTER SWITCHES," batteries and connections.
2. One circuit does not light.	a. Circuit breaker tripped.	a. Check for short circuit. Reset circuit breaker.

TABLE XXXI (CONTINUED)

TROUBLE	PROBABLE CAUSE	CORRECTION
	b. Loose connection or defective wire.	b. Tighten connections; test wire for continuity and replace or repair as necessary.
3. One bulb does not light.	a. Bulb burned out.	a. Replace bulb.
	b. Loose connection or defective ground.	b. Tighten connections and check for continuity and replace or repair as necessary.
	c. Defective switch or fixture.	c. Replace defective part. Repair or replace wire as necessary.
4. Position lights steady with switch in flasher position.	a. Defective flasher control.	a. Replace flasher control.

TABLE XXXII

TROUBLE SHOOTING, LANDING LIGHTS

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Light fails to extend or retract.	a. Circuit breaker tripped.	a. Check for short circuit. Reset circuit breaker.
	b. Loose connection or defective wire.	b. Tighten connections and check continuity; replace or repair wire if necessary.
	c. Defective ground.	c. Check ground connections.
	d. Defective switch or extension-retraction motor.	d. Check continuity of circuits. Replace any defective part.
	e. Dirty, burned or pitted contact point.	e. Clean contact points.
2. Lamp fails to light.	a. Circuit breaker tripped.	a. Check for short circuit. Reset circuit breaker.
	b. Lamp burned out.	b. Replace.
	c. Loose connection or defective wire.	c. Tighten connections; check circuit continuity. Repair or replace wire if necessary.
	d. Landing light lamp relay inoperative.	d. Check operation of relay. Replace if defective.
	e. Landing lamp switch defective.	e. Check continuity through switch; replace if necessary.
3. Light does not extend to proper angle.	a. Contact points not properly adjusted.	a. Adjust movable contact point so that when fully extended, bottom rim of lamp is 11-1/2 inches from aft edge of lamp housing.
4. Light does not retract flush with wing.	a. Stationary contact switch not properly aligned.	a. Bend stationary contact switch arm as necessary to stop lamp flush with lower side of wing.

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SECTION VIII

RADIO SYSTEMS

TABLE OF CONTENTS

Paragraph		Page
8- 1.	General Description	259
8- 3.	AN/ARC-3 VHF Radio Equipment	259
8-17.	AN/ARN-7 Radio Compass	261
8-29.	R-122/ARN-12 Marker Beacon Receiver	262
8-36.	BC-453-B Range Receiver	263
8-45.	Interphone System	264
8-60.	Antenna Installation	265

8-1. GENERAL DESCRIPTION.

8-2. Electronic equipment installed in C-45G and TC-45G aircraft is similar and consists of an eight channel VHF transmitting and receiving set for communications; a radio compass receiver, marker beacon receiver, and low frequency range receiver for radio navigation. An interphone system facilitates communication between crew members and allows the crew to monitor audio from the receivers. A mixer panel incorporating individual audio switches allows the pilot and copilot to monitor audio independently of each other. All circuits are protected by circuit breakers installed in a box behind the copilot's seat.

NOTE

ALL AN. connectors will be safetied in accordance with the applicable technical order on safety wiring unless otherwise specified herein.

WARNING

Operation of the electronic equipment involves the use of high voltages. Injury or death may result from tampering or repair by unauthorized personnel.

8-3. AN/ARC-3 VHF RADIO EQUIPMENT.

8-4. DESCRIPTION. The AN/ARC-3 command set is a VHF multi-channel receiver and transmitter, designed to provide airplane to ground and airplane to airplane communication on eight preset frequencies. The equipment operates over a "line of sight" distance within the 100 to 156 megacycle frequency range. Eight crystal controlled channels are available for both transmission and reception. The transmitter T-67/ARC-3, receiver R-77A/ARC-3, power junction box J-68/ARC-3, dynamotor DY-21/ARC-3, and dynamotor DY-22/ARC-3 are located in the aft section of the fuselage. The set is remotely controlled by the C-404A/A control panel mounted in the pilot's overhead radio control panel.

8-5. TROUBLE SHOOTING. See Table XXXIII.

8-6. REMOVAL OF VHF RECEIVER.
a. Disconnect antenna coaxial cable.
b. Disconnect channel selector plug.
c. Remove safety wire and release snap slides.
d. Raise unit up and out.

8-7. REMOVAL OF VHF TRANSMITTER.
a. Disconnect the two antenna coaxial cables.
b. Disconnect channel selector cable plug.
c. Remove safety wire and release snap slides.
d. Raise unit up and out.

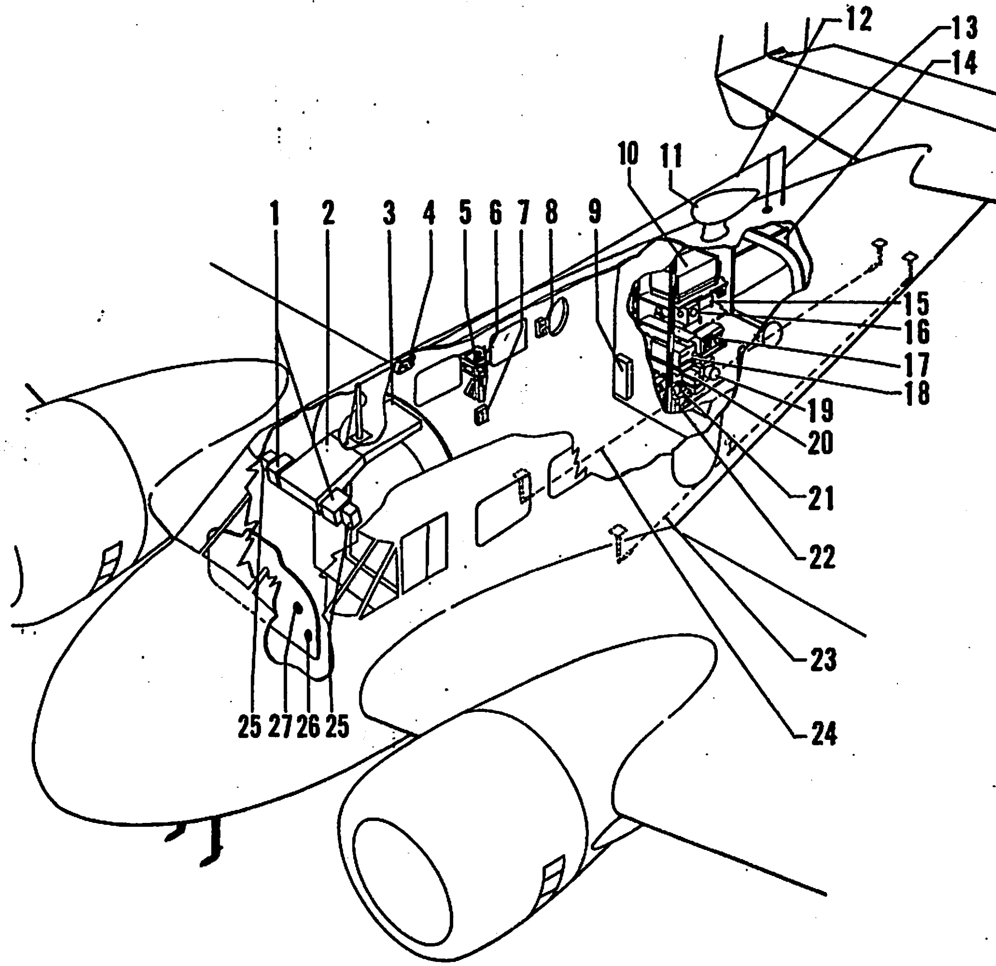
8-8. REMOVAL OF VHF POWER JUNCTION BOX AND DYNAMOTORS.
a. Disconnect four plugs.
b. Remove safety wire and release snap slides.
c. Lift junction box up and out.
d. Dynamotors may be removed individually by releasing snap slides and pulling straight up on unit.

8-9. REMOVAL OF VHF CONTROL PANEL.
a. Removal of this unit is restricted to authorized personnel. To field check wiring continuity, release the four mounting fasteners and pull complete control panel out of the overhead radio control panel.

8-10. MINOR REPAIR AND PARTS REPLACEMENT. Do not attempt repairs beyond replacing low and audio frequency tubes and dynamotors. Other repairs will be accomplished at a designated overhaul activity where trained personnel and proper equipment are available.

8-11. INSTALLATION OF VHF RECEIVER.
a. Set receiver in mounting base.
b. Engage snap slides and safety.
c. Connect channel selector cable plug.
d. Connect antenna coaxial cable.

8-12. INSTALLATION OF VHF TRANSMITTER.
a. Set transmitter in mounting base.
b. Engage snap slides and safety.



1. BC-1366M Jack Box (Pilot and Copilot)
2. Overhead Radio Control Panel
3. Forward Radio Junction Panel
4. BC-1366M Jack Box (Cabin)
*5. C-4/ARN-7 Radio Compass Control Box
*6. I-82-A Radio Compass Indicator
*7. BC-1366M Jack Box (2nd Navigators)
*8. BC-1366M Jack Box (3rd Navigators)
*9. BK-22-K Relay
10. R-5/ARN-7 Radio Compass Receiver
11. LP-21-LM Loop Antenna
12. Radio Compass Sense Antenna
13. Vhf Antenna
14. Rear Radio Junction Box
15. R-122/ARN-12 Marker Beacon Receiver
16. BC-453-B Range Receiver
17. T-67/ARC-3 Vhf Transmitter
18. R-77A/ARC-3 Vhf Receiver
19. MG-149-F Inverter
20. PE-86 Dynamotor
21. J-68/ARC-3 Power Junction Box
22. BC-347 Interphone Amplifier
23. Range Antenna
24. Marker Antenna
25. FL-30 Radio Filter
26. I-81-A Radio Compass Indicator
27. Marker Beacon Indicator Light

*Apply to TC-45G only.

Figure 8-1. Radio Location Diagram

c. Connect channel selector cable plug.
d. Connect the two antenna coaxial cables.

8-13. INSTALLATION OF VHF POWER JUNCTION BOX AND DYNAMOTORS.

a. Push dynamotor down into position on junction box, engage snap slides and safety.
b. Place junction box in position on mounting. Engage snap slides and safety.
c. Connect four plugs.

8-14. INSTALLATION OF VHF CONTROL PANEL.

a. Check to see that cables on control panel are attached to terminal strip.
b. Slide control panel into overhead radio control panel and secure the four mounting fasteners.

8-15. TESTING AND PREFLIGHT CHECK.

a. Insert headset plug into "PHONE" jack on pilot's jack box.
b. Insert microphone plug into "MIC" jack on pilot's jack box.
c. Start equipment by placing switch on C-404A/A control panel in "ON" position and selecting desired channel.
d. Allow 30 to 45 seconds for the tubes in the equipment to reach operating temperature. During the latter portion of this warm-up period, an audio tone will be heard in the headset. When this tone stops the transmitter and receiver have been tuned to the selected channel.
e. Depress microphone button and speak into microphone. Speech (sidetone) should be audible in headset. If not, check to see that crystal is installed for that channel in the transmitter. Release the microphone button to restore receiver operation.
f. Adjust "SQUELCH" control on receiver for the desired background noise level.
g. Establish two-way communication with control tower as a final check on operation of equipment.

NOTE

Operation should be checked on all channels. Test may be conducted from any of the crew locations equipped with a jack box.

h. The transmitter and receiver tune to the selected channel simultaneously, requiring about two seconds. Audio tone will be noticed in headset while equipment is tuning.

8-16. TUNING AND ADJUSTING. The tuning and adjusting of the VHF transmitter or receiver will be attempted only by authorized personnel. If a unit is out of adjustment it should be replaced and sent to a designated overhaul activity.

8-17. AN/ARN-7 RADIO COMPASS.

8-18. DESCRIPTION. The AN/ARN-7 radio compass is used as an aircraft navigational aid. Characteristics of the radio compass make it possible to obtain automatic visual bearing indication of the source of radio signals received and simultaneous aural reception of the same signals; aural reception of modulated rf signals with the non-directional antenna; and aural and directional indication with the loop antenna. Components of the system include an

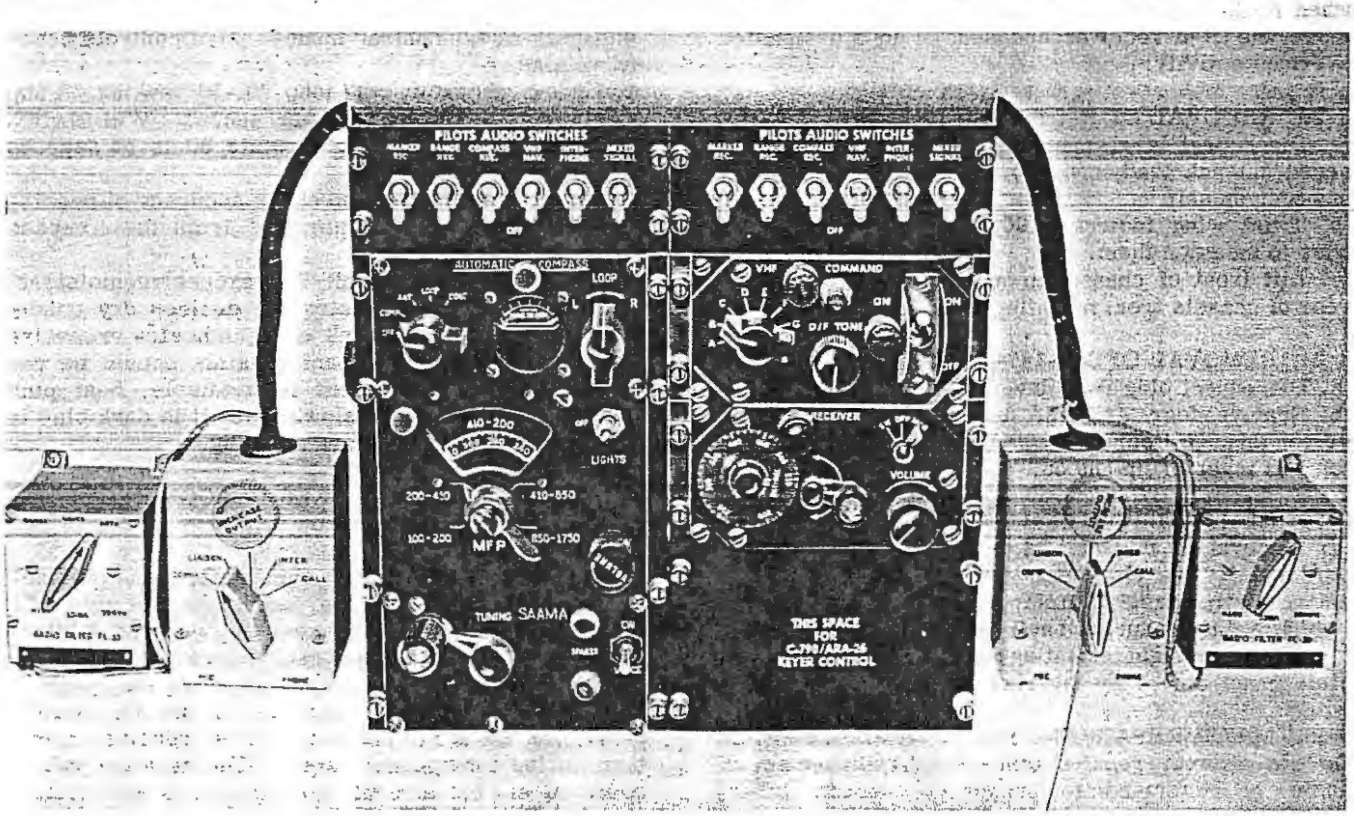


Figure 8-2. Overhead Radio Panel

R-5 or R-5A superheterodyne receiver, MG-149-F inverter, loop antenna dehydrator unit, and BK-22-K relay box in the aft fuselage section; an I-81-A indicator on the pilot's floating instrument panel; a sense antenna located atop the fuselage between Bulkheads 4 and 11; a LP-21-LM loop antenna located atop the aft fuselage section; a C-411/A control panel located in the pilot's overhead radio control panel, and the necessary interconnecting tuning shafts and wiring. The radio compass installation in the TC-45G is similar, with the exception of a C-4/ARN-7 control box and an I-82-A indicator which are located above the second navigator's table.

8-19. TROUBLE SHOOTING. A satisfactory trouble shooting operation cannot be performed in the aircraft. However, if the equipment is found to be inoperative, make the following checks before removing the equipment from the aircraft:

a. Check the fuse in the BK-22-K relay to make certain it is functioning properly. See that terminals 60 and 61 are properly connected for the system voltage of the airplane.

b. See that the AC supply voltage and battery voltage are normal. Between terminal 61 and ground should be 24 to 28 volts DC.

c. See that relays BK-22-K and Re-8, on the rear of the BK-22-K connector panel, are operating satisfactorily. The Re-8 relay should operate when the switch is operated on the C-411/A control panel.

d. See that Loop LP-21-LM is installed and properly connected.

e. Make sure the non-directional antenna and lead-in are not grounded or open.

f. If, after running these checks and correcting when necessary, the set still does not operate, remove the R-5 receiver and send it to a designated overhaul activity.

8-20. REMOVAL OF R-5 RECEIVER.

a. Disconnect large cannon plug, loop cannon plug, sense antenna lead, and grounding braids from front of receiver unit.

b. Twist wing fasteners 90 degrees counterclockwise to unfasten them.

c. Lift front of chassis up and forward to disengage rear of chassis from mounting rack.

8-21. REMOVAL OF MG-149-F INVERTER.

a. Disconnect plug from inverter.

b. Remove four AN3-12A bolts from base of inverter through floorboard.

c. Lift inverter up and out.

8-22. REMOVAL OF C-411/A CONTROL PANEL.

a. Removal of this unit is restricted to authorized personnel. To field check wiring continuity remove entire control panel as follows:

1. Disconnect tuning shaft at adapter below panel.
2. Release eight mounting fasteners and pull complete panel out of the overhead radio control panel.

8-23. MINOR REPAIR AND PARTS REPLACEMENT. Do not attempt repairs other than replacement of audio or intermediate frequency vacuum tubes, tightening loose connections, or replacing entire components. More extensive repairs must be made at a designated overhaul activity where trained personnel and proper equipment are available.

8-24. INSTALLATION OF R-5 RECEIVER.

a. Place receiver in proper position on mounting rack, making sure the flange at the rear of the receiver is secured in the rear of the rack.

b. Secure fasteners at front of receiver. Make sure receiver is in place properly and securely fastened to the rack.

c. Connect all plugs and ground braids.

8-25. INSTALLATION OF MG-149-F INVERTER.

a. Position inverter correctly on floorboard.

b. Install four AN3-12A bolts through base of inverter and floorboard.

c. Connect plug to inverter.

8-26. INSTALLATION OF C-411/A CONTROL BOX.

a. Slide control panel into overhead radio control panel and secure the eight mounting fasteners.

b. Connect tuning shaft at the MC-136 adapter.

8-27. TUNING AND ADJUSTING. Tuning and adjusting of the receiver and loop will be attempted only by authorized personnel. If units are out of adjustment remove and send to a designated overhaul activity.

8-28. TESTING RADIO COMPASS.

a. Check "ANT" and "LOOP" operation on all four bands. Check compass operation and indicator response.

b. Turn control switch to "COMP" and note whether or not magnetic compass is affected.

c. Turn control to "LOOP" and tune several stations in to check sensitivity.

d. Check audio control to see that it controls headset volume.

e. Check operation of loop "L-R" switch. Loop should rotate 10 degrees per second. With switch pushed in, the loop should rotate 30 to 55 degrees per second.

f. Switch to "COMP" and check accuracy of bearing to transmitters while operating from the compass rose.

g. Check dehydrator unit for excessive moisture. A dark blue color indicates the desired dry condition. A light blue or pink color indicates excessive moisture and the desiccant crystals should be replaced. If no replacement is available, heat pink desiccant in a flap pan slowly until it is dark blue in color. Allow to cool before refilling.

8-29. R-122/ARN-12 MARKER BEACON RECEIVER.

8-30. DESCRIPTION. The superheterodyne type receiver is fixed-tuned to a carrier frequency of 75 megacycles, and is designed to receive signals transmitted by a ground beacon transmitter. The receiver furnishes a visual indication of the received signal through the indicator on the pilot's floating panel, and an aural indication of the received signal through the interphone system. The receiver, which operates on the aircraft electrical system voltage, is located on the radio equipment rack in the aft fuselage section. The set does not have a separate control switch, and is operating at all times that the electrical system is energized.

8-31. TROUBLE SHOOTING. See Table XXXIV.

8-32. REMOVAL OF MARKER BEACON RECEIVER.
a. Disconnect antenna and power plugs.
b. Remove safety wire and loosen thumb screw.
c. Pull out on receiver releasing rear flange then lift up and out.

8-33. MINOR REPAIR AND PARTS REPLACEMENT. Do not attempt repairs other than replacing known defective tubes, tightening loose connections or replacing entire unit. More extensive repairs must be accomplished at a designated overhaul activity where trained personnel and proper equipment are available.

8-34. INSTALLATION OF MARKER BEACON RECEIVER.
a. Place receiver in position on mounting being sure to engage rear flange.
b. Tighten thumb screw and safety.
c. Connect antenna and power plugs.

8-35. TESTING. After a receiver has been installed in the aircraft, it should be checked before being placed in service. Proceed as follows:
a. Connect a suitable external power source to the airplane.
b. After receiver has energized, allow to warm up a period of one minute.
c. Adjust voltage to 28 volts as measured at the aircraft bus. THIS ADJUSTMENT MUST BE MADE ON EXTERNAL POWER SOURCE.
d. Place Test Oscillator BC-376 on the ground about 15 feet from aircraft marker antenna. Oscillator antenna should be extended full length and placed parallel to fore and aft axis of the aircraft.
e. Turn test oscillator switch "ON" and adjust in accordance with instructions on the inside of oscillator cover plate. Set modulation switch on "1300."
f. While the test oscillator is radiating a signal modulated at 1300 cycles and the marker beacon receiver is energized, the indicator lamp should be observed to insure that it is functioning properly. Connect headset plug to "PHONE" jack on pilot's jack box and set interphone control for reception of marker signals. Note whether audio system is functioning properly.

NOTE

Marker beacon receivers BC-1033 or BC-1333, will be installed as substitute equipment, when the R-122/ARN-12 marker beacon receiver is not available.

8-36. BC-453-B RANGE RECEIVER.

8-37. DESCRIPTION. The BC-453-B receiver is used as a radio navigational aid, and is designed to receive signals transmitted by the various range stations in the 190-550 kilocycle frequency range. The receiver and dynamotor DM-32-A, which is a component of the receiver, are installed on the radio rack in the aft fuselage section. The receiver is remotely controlled by the C-570A/A control panel located in the pilot's overhead radio control panel.

8-38. TROUBLE SHOOTING, BC-453-B RECEIVER. If the receiver fails to perform in a normal manner proceed as follows to check for faulty parts of the equipment:
a. See that switch on the C-570A/A control panel is in "CW" or "MCW" position.
b. Check all the plugs and connections for proper attachment.
c. See that battery voltage is satisfactory.
d. Check for proper operation of the dynamotor.
e. Check antenna, making sure it is in good condition and properly connected.
f. Check ground connections.

8-39. REMOVAL OF THE BC-453-B RECEIVER.
a. Disconnect antenna lead.
b. Disconnect tuning shaft.
c. Remove safety wire and release snap slides.
d. Raise unit up and out.
e. Dynamotor can be removed from receiver by releasing snap slides and lifting unit up and off.

8-40. REMOVAL OF C-570A/A CONTROL PANEL. Removal of this unit is restricted to authorized personnel. To field check wiring continuity remove the entire control panel from the pilot's overhead radio control panel as follows:
a. Release four mounting fasteners.
b. Pull unit out of overhead radio control panel and disconnect tuning shaft.

8-41. MINOR REPAIR AND PARTS REPLACEMENT. Do not attempt repairs beyond replacement of known defective tubes, tightening loose connections, or replacing receiver and dynamotor. More extensive repair work is to be carried out by authorized personnel only, or at a designated overhaul activity where trained personnel and proper equipment are available.

8-42. INSTALLATION OF BC-453-B RECEIVER.
a. Place unit in proper position in rack.
b. Engage snap slides and safety.
c. Connect antenna lead and tuning shaft.

8-43. INSTALLATION OF THE C-570A/A CONTROL PANEL.
a. Slide unit into overhead radio control panel as required until tuning shaft can be connected, then slide on into position.
b. Secure the four mounting fasteners.

8-44. TESTING AND PREFLIGHT CHECK. The equipment must be tested or given a preflight inspection in accordance with the following instructions:
a. See that the receiver installed is correct for operation on the scheduled frequencies.
b. Check receiver control operation and make sure the receiver is operating. An aural check on the receiver should be made by listening to signals on CW at maximum gain while tuning through the entire band.
c. Check the input alignment of the receiver by re-adjusting the "ALIGN INPUT" knob for maximum re-

ceiver output while listening to a weak signal.
d. Advance the "INCREASE OUTPUT" control to maximum and listen for electrical noise produced by the receiver dynamotor. The noise should be negligible.

8-45. INTERPHONE SYSTEM.

8-46. DESCRIPTION. The interphone system installed in the C-45G and TC-45G airplanes is designed to facilitate communication between the crew members, and allow the crew members to monitor audio from the various equipment. The installation consists of standard RC-36 interphone equipment modified to include the addition of pilot's and copilot's mixer panels and two mixer amplifiers. The mixer panels and mixer amplifiers are wired into the interphone system. With this type installation it is possible for the pilot and copilot to monitor audio output of the various equipment independently of each other, since audio in their respective jack boxes will be determined by the switches which are closed on the mixer panel. Components of the system include a BC-347 interphone amplifier, two AM-142/AIC mixer amplifiers, and a PE-86 dynamotor located in the aft fuselage section; pilot's and copilot's jack boxes (BC-1366M), two FL-30 range filters, and pilot's and copilot's mixer panels located adjacent to the overhead radio control panel; one cabin jack box (BC-1366M) located near Bulkhead 6 in the C-45G; or three cabin jack boxes (BC-1366M) located adjacent to the navigator's tables in the TC-45G, and the necessary interconnecting wiring. The interphone amplifier is powered by the dynamotor, which in turn is energized by the aircraft electrical system voltage. The mixer amplifiers are powered by electrical system voltage. Connection is made in such a manner that the mixer amplifiers and 28 volt dynamotor input are all protected by a common circuit breaker. A separate interphone control is not provided and the interphone system will be in operation at all times the aircraft electrical system is energized.

8-47. TROUBLE SHOOTING. See Table XXXV.

8-48. REMOVAL OF INTERPHONE AMPLIFIER.
a. Remove two screws holding cover assembly.
b. Pull cover straight out, this will disconnect internal plug.
c. Remove wires from terminal strip of plug remaining on the base. (Identify wires for the correct replacement.)
d. Remove screws attaching base to bulkhead, base will fall free.

8-49. REMOVAL OF DYNAMOTOR.
a. Remove safety wire and release snap slides.
b. Lift unit up and off.

8-50. REMOVAL OF MIXER AMPLIFIER.
a. Remove two screws from cover and remove cover from chassis.
b. Remove electrical plug.
c. Remove the safety wire and release snap slides on chassis.
d. Remove chassis from mounting base.

8-51. REMOVAL OF MIXER PANEL. Removal of this unit is restricted to authorized personnel. To check wiring continuity and switches remove the entire unit from the overhead radio control panel as follows:
a. Release four mounting fasteners.
b. Pull entire mixer panel out of overhead radio control panel, as necessary to perform required checks.

8-52. REMOVAL OF JACK BOX.
a. Remove two cover screws.
b. Pull cover assembly straight out, this will disconnect internal plug.
c. Remove wires from terminals on plug remaining on the base (identify wires for correct replacement).
d. Remove screws attaching base to mounting structure, base will fall free.

8-53. MINOR REPAIR AND PARTS REPLACEMENT. Repairs will be limited to replacement of defective amplifier tubes, tightening loose connections, replacing dynamotor brushes, or replacement of entire defective units. The jack box circuit is grounded to the base of the selector switch. Connections are easily checked and resoldered. If jack box has been extensively damaged, it should be replaced. A serviceable jack box in another portion of the airplane can be used as a guide in making correct wiring con-

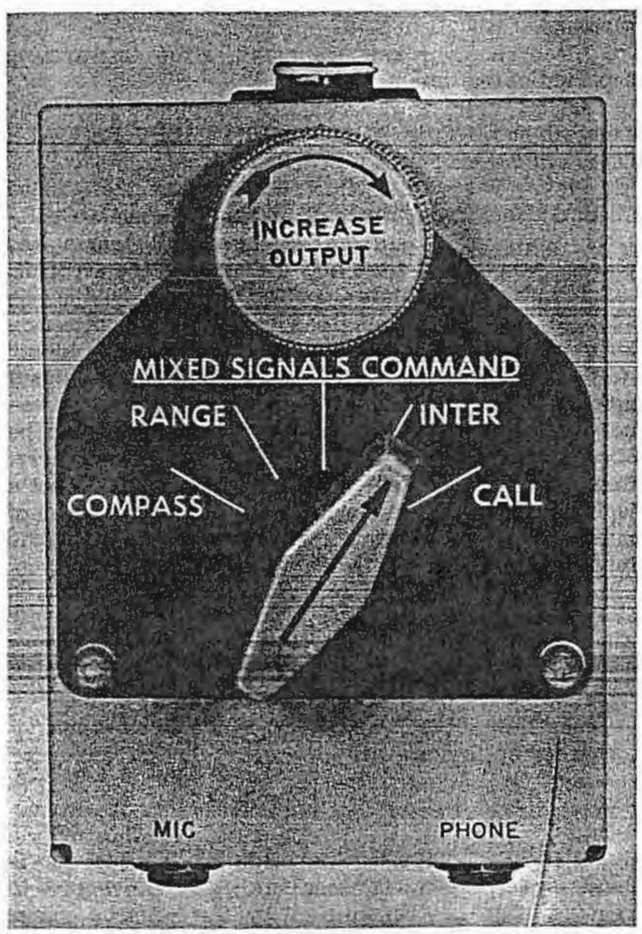


Figure 8-3. Cabin Jack Box, Serials 52-10539 and Subsequent

nections. More extensive repairs will be accomplished at a designated overhaul activity.

8-54. INSTALLATION OF INTERPHONE AMPLIFIER.

a. Place base in position on the bulkhead and install mounting screws.
b. Correctly attach wiring to terminal strip of plug in the base.
c. Place the cover in position being sure that plug is properly engaged.
d. Install two cover screws.

8-55. INSTALLATION OF DYNAMOTOR.

a. Place dynamotor in position on mounting, be sure that the electrical connection between dynamotor and mounting is correctly lined up.
b. Engage snap slides and safety.

8-56. INSTALLATION OF MIXER AMPLIFIER.

a. Place chassis in position on mounting.
b. Engage snap slides and safety.
c. Install electrical plug.
d. Install the cover over chassis and secure with two cover screws.

8-57. INSTALLATION OF MIXER PANEL.

a. Slide entire mixer panel into position in the overhead radio control panel.
b. Secure the four mounting fasteners.

8-58. INSTALLATION OF JACK BOX.

a. Place base in position on mounting structure and install mounting screws.
b. Correctly attach wiring to terminals of plug in the base (use a serviceable jack box as a guide).
c. Place cover in position being sure that plug is properly engaged.
d. Install two cover screws.

8-59. TESTING. Perform operational test on the interphone system as follows:

a. Connect suitable external power source.
b. Connect headset plug to "PHONE" jack, and microphone plug to "MIC" jack on the jack box being tested.
c. Place other radio equipment in operation.
d. Check reception of audio from various radio equipment when interphone (jack box) control is in specified position. Check for excessive noise, distorted background, and low output.
e. Continue checking until audio reception has been checked on all equipment at each jack box location.
f. Disconnect external power source.

8-60. ANTENNA INSTALLATION.

8-61. DESCRIPTION. Five antennas are installed on the exterior of the fuselage on C-45G and TC-45G airplanes. The installation consists of a vhf antenna, AN104-B, which is a vertical mast located on top the fuselage at Bulkhead 11; a radio compass loop antenna, LP-21-LM, located on top the fuselage at Bulkhead 10; a range antenna, 694-180671-4, located between masts on the under left side of the fuselage at Bulkheads 7 and 11; a marker beacon antenna, 694-180671-6, located between masts on the under right side of the fuselage at Bulkheads 7 and 11; and a radio compass sense antenna, 694-180671-2, located on top the fuselage between a mast at Bulkhead 5 and the vhf vertical mast.

8-62. TROUBLE SHOOTING. Trouble shooting the five antennas will consist of checking for wire continuity from the equipment to and including the antenna. If this does not eliminate the apparent trouble inspect the masts and attaching devices for grounding; check couplings, adapters and lead-in for cracks or grounding; and for slackness in the antenna. Replace any defective parts. In the case of the LP-21-LM loop antenna, complete the above inspection. If the trouble is not located make the following additional checks:

a. See that the fuse in relay BK-22-K is not burned out and that Terminals 60 and 61 are properly connected for the system voltage of the airplane.
b. See that the a-c supply voltage and the battery voltage are normal.
c. See that the relay BK-22-K and the on-off relay Re-8 are operating satisfactorily.
d. See that all cables are connected.
e. See that loop assembly, and loop housing are installed properly.

8-63. REMOVAL OF VHF ANTENNA.

a. Disconnect the coaxial cable from the mast.
b. Detach the mounting block.
c. Loosen the ground strap screws.
d. Remove hardwood mast (AN104-B) from fuselage.

8-64. REMOVAL OF RADIO COMPASS LOOP ANTENNA.

a. Disconnect dehydrator hose.
b. Disconnect electrical plugs.
c. Remove the seven mounting screws.
d. Lift housing and loop assembly up and out.

8-65. REMOVAL OF RANGE ANTENNA.

a. Remove two screws from lead-in coupling.
b. Lift coupling and detach lead-in wire from screw.
c. Remove attaching screw at mast on Bulkhead 11 and mast at Bulkhead 7, antenna will fall free.

8-66. REMOVAL OF MARKER BEACON ANTENNA.

a. Disconnect lead-in at TM-201 terminal.
b. Remove terminal connection from lead-in wire.
c. Remove screw from mast at Bulkhead 11 and mast at Bulkhead 7, antenna will fall free.

8-67. REMOVAL OF RADIO COMPASS SENSE ANTENNA.

a. Remove two screws from top of lead-in coupling.
b. Lift coupling and detach lead-in wire from screw.
c. Remove screw from vhf mast on Bulkhead 11 and mast at Bulkhead 5, antenna will fall free.

8-68. MINOR REPAIR AND PARTS REPLACEMENT. Damaged antenna parts will be replaced. The radio compass loop antenna must be replaced if damaged. Antenna insulators that are cracked, and antennas with broken strands will be replaced. Wire connecting points will be cleaned and sealed to prevent foreign matter from collecting.

8-69. INSTALLATION OF VHF ANTENNA.
a. Place mast in position just aft of Bulkhead 11, on top of fuselage.
b. Attach the mounting block.
c. Connect coaxial cable to base of mast.

8-70. INSTALLATION OF RADIO COMPASS LOOP ANTENNA.
a. Place gasket in position and install antenna in place atop the fuselage.
b. Secure the seven mounting screws.
c. Connect the electrical plugs.
d. Connect dehydrator hose.
e. Recompensate if necessary. (Recompensation of loop will be performed by authorized personnel only.)

8-71. INSTALLATION OF RANGE ANTENNA.
a. Holding antenna in correct position, install screws at mast on Bulkhead 11 and mast at Bulkhead 7.
b. Run lead-in wire through coupling and connect wire to screw.
c. Place coupling in position and install screws.

8-72. INSTALLATION OF MARKER BEACON ANTENNA.
a. Holding antenna in correct position, install screws at mast on Bulkhead 11 and mast at Bulkhead 7.
b. Install terminal connection on lead-in wire.
c. Connect the lead-in at TM-201 terminal.

8-73. INSTALLATION OF RADIO COMPASS SENSE ANTENNA.
a. Holding antenna in correct position, install screws at vhf mast on Bulkhead 11 and mast at Bulkhead 5.
b. Run lead-in wire through coupling and connect wire to screw.
c. Place coupling in position and install screws.

8-74. TESTING OF RADIO COMPASS LOOP ANTENNA.
a. Place function switch on C-411/A control panel on "LOOP."
b. Operate loop "L-R" switch and observe indicator for directional indication. Check rotation of indicator needle at both high and low speeds. Observe smoothness of rotation, taking into consideration the fact that the indicator needle varies its speed during a 360° rotation of the loop. Nulls may be observed by the variation of volume of the audible signal and a decrease in tuning meter deflection.
c. Tune to station and switch to "COMP." Observe indicator reading. Switch to "LOOP." Operate loop "L-R" switch until the indicator pointer is 175° clockwise from station bearing position. Switch back to "COMP" and observe the time it takes the needle to return to station bearing. It should take approximately six seconds on a moderately strong signal. Repeat this check rotating indicator pointer to a position 175° counterclockwise from the station bearing.
d. Repeat this check using each band whose station is known. The indicator should show the correct position of the stations with respect to the fore and aft line of the airplane.
e. Turn function switch on C-411/A control panel "OFF."

TABLE XXXIII

TROUBLE SHOOTING, AN/ARC-3 VHF RADIO SET

TROUBLE	PROBABLE CAUSE	CORRECTION
	TRANSMITTER	
1. Transmission but no sidetone, tuning system stops at proper channel.	a. Defective relay K406 in power junction box.	a. Clean relay contacts or replace.
2. No modulation or sidetone, tuning system stops at proper frequency.	a. Defective tubes.	a. Replace tube V106 or V109.
3. No transmission or sidetone, tuning system stops at proper frequency.	a. Defective crystal. b. Defective tubes. c. Defective crystal relay.	a. Replace crystal. b. Replace tube V101, V102, V103, V104, V107, or V108. c. Clean contacts of crystal relay for inoperative channel.
	RECEIVER	
1. No reception, tuning system stops at proper frequency.	a. Defective relay K406 in power junction box. b. Defective tubes.	a. Clean relay contacts or replace. b. Replace tube V211, V212, V213, V214, V215, or V216.

TABLE XXXIII (CONT)

TROUBLE SHOOTING, AN/ARC-3 VHF RADIO SET

TROUBLE	PROBABLE CAUSE	CORRECTION
	RECEIVER (CONT)	
2. No reception, tuning system stops at high frequency end of band.	a. Defective tubes.	a. Replace tube V201, V202, V203, V204, V205, V206, V208 or V209.
	b. Defective crystal relay.	b. Clean contacts of crystal relay for inoperative channel.
	c. Defective crystal.	c. Replace crystal.
3. No reception, tuning system stops at wrong frequency.	a. Defective crystal relay.	a. Clean contacts of crystal relay for inoperative channel.
	b. Improper thumbwheel setting.	b. Check thumbwheel setting for inoperative channel.
4. No reception, motor will not stop.	a. Defective fuse.	a. Replace receiver fuse on power junction box.
	b. Defective tubes.	b. Replace tube V207 or V210.
	c. Defective relay K404 or K405 in power junction box.	c. Clean relay contacts or replace.
	d. Defective dynamotor operation.	d. Replace dynamotor brushes.

TABLE XXXIV

TROUBLE SHOOTING, R-122/ARN-12 MARKER BEACON RECEIVER

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Weak signal.	a. One or more of the tubes V101 through V109 weak.	a. Replace suspected tubes one at a time until fault is corrected.
2. No signal detected aurally or visually.	a. Switch off or circuit breaker open.	a. Turn battery switch "ON." Reset circuit breaker.
	b. Tube V101, V102, V103, V104, V105, V106, or V109 defective.	b. Replace all defective tubes.
	c. Antenna input cable not securely fastened.	c. Tighten cable in its receptacle.
	d. Power plug not securely fastened.	d. Tighten power plug in receptacle.
3. Visual signals appear but aural signals are not detected.	a. V107 defective.	a. Replace.
	b. Jack box defective.	b. Replace.
4. Aural signals detected but indicator lamp does not light.	a. V106 or V108 defective.	a. Replace tubes.
	b. Indicator lamp defective.	b. Replace indicator lamp on floating instrument panel.
	c. Aircraft cabling from receiver to indicator lamps defective.	c. Repair or replace.

TABLE XXXV

TROUBLE SHOOTING, INTERPHONE SYSTEM

TROUBLE	PROBABLE CAUSE	CORRECTION
1. Jack box inoperative.	a. Jack box not grounded properly.	a. Remove jack box cover and check ground below switch. Repair if necessary.
	b. Open circuit.	b. Check continuity between jack boxes or from forward junction box to jack box. Repair as needed.
	c. Open circuit inside jack box.	c. Check all connections inside box. Repair or replace jack box.
2. All jack boxes inoperative.	a. Open circuit at interphone amplifier.	a. Check terminal connections at interphone amplifier.
	b. Open or shorted windings on input or output transformers.	b. Check continuity and leads to ground. Replace interphone amplifier if necessary.
	c. Defective tube in interphone amplifier.	c. Replace tube.
3. Distorted background.	a. Open capacitor in interphone amplifier.	a. Check leads on capacitor, replace capacitor if necessary.
4. Low output.	a. Open or shorted turns of transformer windings.	a. See 2(b) above.
	b. Defective tube.	b. Replace tube.
5. Noisy.	a. Defective capacitor.	a. Check leads on capacitor, replace capacitor if necessary.
	b. Defective tube.	b. Replace tube.

INDEX NUMBER	PART NUMBER	NAME OF PART
122	189630-2	Transmitter - Right front fuel tank
123	189726-2	Transmitter - Right rear fuel tank
124	189630-1	Transmitter - Left front fuel tank
125	189726-1	Transmitter - Left rear fuel tank
126	EA-102-10	Fuel gage
127	AN3106B-14S-2S	Plug - Fuel gage
128	734-183826	Switch - Fuel gage tank selector
129	AN3021-2	Switch - Pitot heat
130	782-02	Pitot tube
131*	0147	Rheostat - Cabin table lamp
132	D15834	Motor - Windshield wiper
133	AN3106B-18S-5S	Plug - Windshield wiper motor
134	CA275	Capacitor - Radio noise suppressor, 4MFD-50 volt dc
135	DT-2R-A7	Switch - Throttle warning horn and red indicator light
136	Deleted	
137	Deleted	
138	Deleted	
139	Deleted	
140*	AN3132-308	Lamp - S-8 Bulb, cabin table lamp
141	Deleted	
142	Deleted	
143	AN5775-2	Warning Horn - Landing gear
144	DT-2R-A7	Switch - Landing gear up limit, position indicator and malfunction light
145	DT-2R-A7	Switch - Landing gear down limit, position indicator, malfunction light and warning horn
146	YZ-RQ-41	Switch - Latching solenoid safety (LH)
147	AN3210-1	Switch - Landing gear up position indicator and malfunction light
148	AN3210-1	Switch - Landing gear down position indicator, malfunction light and warning horn
149	YZ-RQ-41	Switch - Latching solenoid safety (RH)
150	6046-H39A	Relay - Landing gear dynamic brake
151	84-188900	Motor Assembly - Landing gear
152	AN3234-1	Switch - Flap up position control
153	AN3234-1	Switch - Flap down position control
154	WZ-R31	Switch - Flap upper limit
155	WZ-R31	Switch - Flap lower limit
156	20023	Relay - Flap dynamic brake
157	814-180592	Box Assembly - Flap dynamic brake relay
158	804-182626	Motor - Flap
159	AN3435-6A-5	Strip Assembly - Flap terminal
160	AN3155-50-30	Rheostat - Anti-icer control
161	J25-24D-4 1/8	Motor - Anti-icer pump
162	AN3108B-12S-4S	Plug - Anti-icer pump motor
163	94-189682	Deicer - Motor switch valve
164	150 ohm, 10 watt	Resistor - Flap and elevator tab position indicator
165	734-183802	Indicator - Flap position
166	G-106337	Rheostat - Flap position
167	404-186117	Rheostat - Elevator tab position
168	894-183797	Indicator - Elevator tab position
169	3124-1-A-1	Switch - Vacuum pressure
170	AN3106A-12S-3S	Plug - Vacuum pressure switch
171	AN3157-6	Light Assembly - Vacuum pressure indicator
172	94-32215	Switch - Fuel pressure warning (Type C-3A)
173	AN3106A-12S-3S	Plug - Fuel pressure warning switch
174	AN3157-6	Light Assembly - Fuel pressure warning indicator
175	AN3022-4B	Switch - Landing light lamp
176	AN3022-15B	Switch - Landing light motor control
177	AN3350-2	Relay - Landing light lamp
178	AN3095-9	Lamp Assembly - Electric retractable landing
179	AN3106B-18-5S	Plug - Landing light
180	GK-C8-21C-5/8B	Plug - Outboard wing junction

INDEX NUMBER	PART NUMBER	NAME OF PART
59	Deleted	
60	Deleted	
61	Deleted	
62	0360B	Resistor - Generator paralleling (2 ohm, 25 watt)
63	694-180570	Box Assembly - Electric generator control (LH)
64	694-180570-1	Box Assembly - Electric generator control (RH)
65	Deleted	
66	Deleted	
67	Deleted	
68	138143E	Switch - Starter
69	AN3226-1	Switch - Engine selector
70	138143	Switch - Induction vibrator
71	138143	Switch - Fuel boosters and primer solenoid valves
72	AN3027-3	Switch - Fuel boosters
73	MIL-A-5125	Ammeter - Direct current, 50 millivolt
74	694-189641	Motor - Submerged booster pump
75	AV-1B1100	Valve - Primer solenoid
76	AN3108B-10S-2S	Plug - Primer solenoid valve
77	AN3106A-14S-7S	Plug - Primer solenoid valve, firewall
78	AN3100A-14S-7P	Receptacle - Primer solenoid valve, firewall
79	694-180556	Box Assembly - Radio noise suppression (LH)
80	694-180556-1	Box Assembly - Radio noise suppression (RH)
81	JAN-C-25	Capacitor, Radio noise suppression
82	VJR-24B-5X	Induction Vibrator
83	A-24976	Connector - Magneto "Y" conduit
84	SB9RU-3	Magneto - Engine
85	Deleted	
86	Deleted	
87	Deleted	
88	Deleted	
89	Deleted	
90	814-180537	Post Assembly - Terminal distribution
91	AN3213-1A	Switch - Ignition
92	AN5795-T6	Indicator - Dual carburetor mixture temperature
93	AN3106A-14S-5S	Plug - Dual carburetor mixture temperature indicator
94	AN5525-1	Bulb - Electric resistance type (oil and carburetor mix. temp)
95	AN3108B-12S-3S	Plug - Carburetor mixture temperature bulb
96	AN3108B-12S-3P	Plug - Carburetor mixture temperature bulb firewall
97	AN3100A-12S-3S	Receptacle - Carburetor mixture temperature bulb firewall
98	AN3106A-12S-3S	Plug - Oil temperature bulb
99	AN5773T1A	Indicator - Oil temperature (engine gage unit)
100	A-57	Disconnect splice
101	B-57	Disconnect splice
102	694-189050	Controls Installation - Pedestal
103	A-50	Tip - Disconnect splice
104	B-50	Tip - Disconnect splice
105	7	Coupler - Disconnect splice
106	Deleted	
107	BB	Connector - Two way
108	1071	Antenna Connector - Male and female
109	AN3106B-14S-2S	Plug - Oil temperature indicator
110	AN5540-2	Thermocouple - Aircraft engine gasket type
111	8T113	Block Assembly - Firewall thermocouple
112	Deleted	
113	AN5536T2A	Indicator - Dual cylinder head temperature
114	AN5531-2	Generator - Tachometer
115	AN3108B-14S-1S	Plug - Tachometer generator
116	AN3108B-14S-1S	Plug - Tachometer generator firewall
117	AN3100A-14S-1P	Receptacle - Tachometer generator - Firewall
118	AN5530-T2A-12	Indicator - Dual tachometer
119	AN3108B-14S-1S	Plug - Dual tachometer indicator
120	18R9714	Transmitter - Upper nose baggage compartment tank
121	18R9715	Transmitter - Lower nose baggage compartment tank

ELECTRICAL EQUIPMENT LIST

INDEX NUMBER	PART NUMBER	NAME OF PART
1	AN3151-2	Battery - 24 Volt 24 amp hr shielded storage
2	49B6768-5	Circuit Breaker - Primer, solenoid valves
3	49B6768-5	Circuit Breaker - Right booster pump motor
4	49B6768-5	Circuit Breaker - Left booster pump motor
5	49B6768-5	Circuit Breaker - Vacuum, fuel and generator warning lights
6	49B6768-5	Circuit Breaker - Type J-1, slaved gyro, magnetic compass
7	49B6768-10	Circuit Breaker - Flight instrument inverter
8	49B6768-10	Circuit Breaker - Landing gear control switch
9	49B6768-10	Circuit Breaker - Induction vibrator
10	49B6768-20	Circuit Breaker - Flap control switch and motor
11	49B6768-20	Circuit Breaker - Pitot heat tube
12	49B6768-25	Circuit Breaker - Right landing light
13	49B6768-10	Circuit Breaker - Pilot's instruments
14	49B6768-25	Circuit Breaker - Left landing light
15	49B6768-10	Circuit Breaker - Navigation and passing lights
16	49B6768-10	Circuit Breaker - Anti-icer and deicer
17	49B6768-15	Circuit Breaker - Oil dilution and taxi light
18	49B6768-10	Circuit Breaker - Landing gear warning horn
19	49B6768-10	Circuit Breaker - Elevator tab and flap position indicators
20	49B6768-10	Circuit Breaker - Instrument and radio panel lights
21	49B6768-10	Circuit Breaker - Dome cabin, map and red lights
22	49B6768-20	Circuit Breaker - Windshield wiper motor
23	PLM-50	Circuit Breaker - Landing gear motor
24	Deleted	
25	Deleted	
26	Deleted	
27	Deleted	
28	Deleted	
29	Deleted	
30	Deleted	
31	Deleted	
32	AN3130-4560	Lamp - Par-64 bulb landing
33	AN3124-307	Lamp - S-8 bulb (radio panel clear dome and tail lights)
34	AN3122-1524	Lamp - GG-10 bulb (wing position lights)
35	AN3133-R311	Lamp - S-11 bulb (red dome lights)
36	AN3131-303	Lamp - G-6 bulb (map lights)
37	AN3121-313	Lamp - T-3 1/4 bulb (utility, reading and indicator lights)
38	AN3136-323	Lamp - T-1 1/4 bulb (compass light)
39	AN3137-304	Lamp - G-6 bulb (extension light)
40	4570	Lamp - Par-46 bulb (taxi lights)
41	AN3133-311	Lamp - S-11 bulb (passing light)
42	AN3370-1	Relay - 200 Amperes, 24-volt direct current single pole (battery master)
43	AN3021-2	Switch - Battery
44	734-183855	Bus Bar
45	AN2552A3	Receptacle, External power source
46	180961	Box Assembly - External power source
47	32424	Relay - 250 Amperes, 24-volt direct current single pole (starter)
48	AN4116L1	Starter, Electric direct cranking
49	AN3108B-18-6P	Plug - Starter - Firewall
50	AN3100A-18-6S	Receptacle - Starter, firewall
51	49C7573	Base Assembly - Voltage Regulator
52	1042-17A	Voltage Regulator - Direct current carbon pile
53	AN3227-5	Switch - Generator control
54	32591	Relay - Overvoltage generator, 28-volt direct current
55	32603	Relay - Field control, generator
56	AN3106B-24-7S	Plug - Generator field control relay
57	AN3025-1	Relay - Reverse current
58	26F558G3	Capacitor - Radio noise suppression (.55MFD, 250-volt, 0-100A)

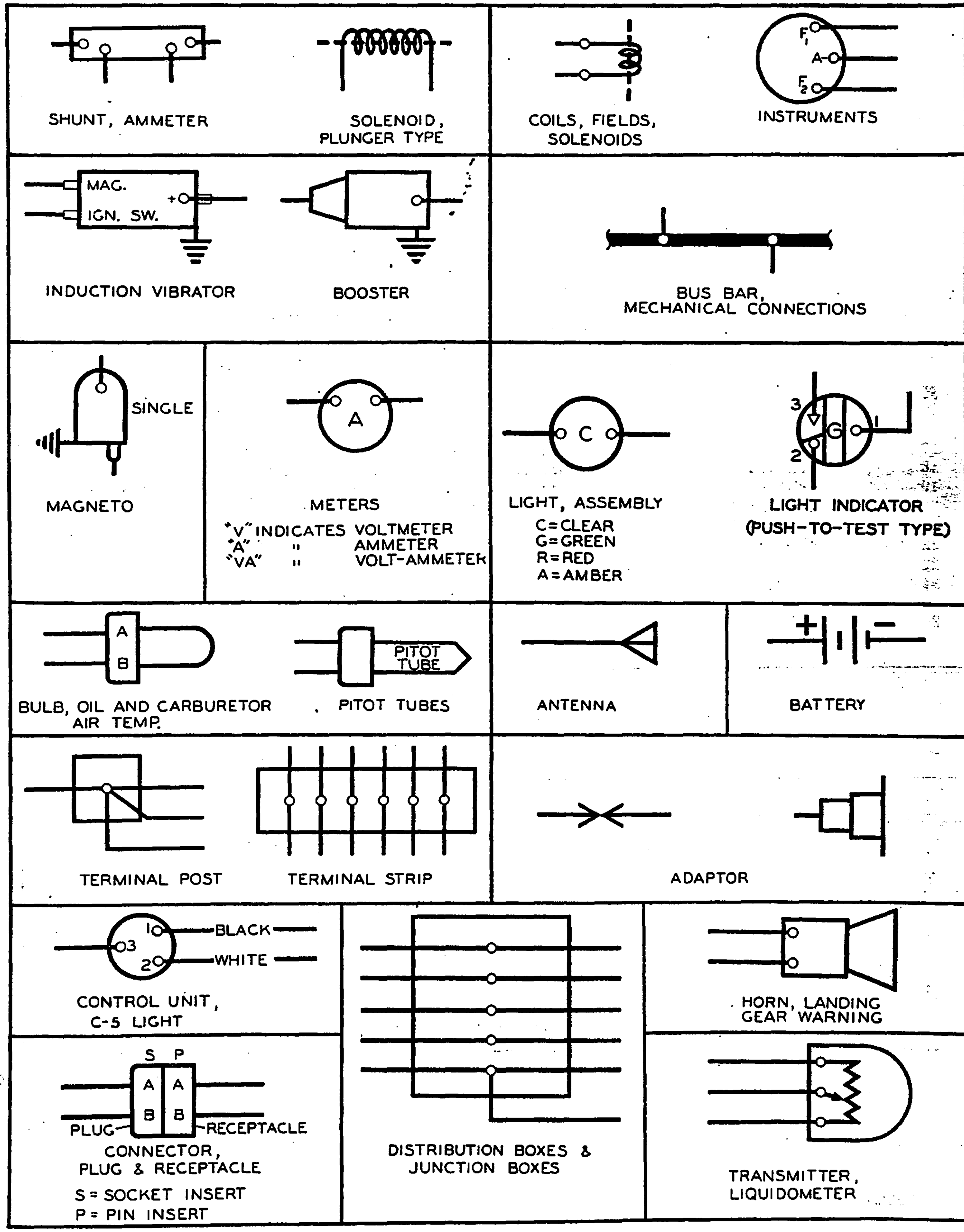


Figure 10-1. Electrical Symbols (Sheet 2 of 2 Sheets)

SECTION IX

PHOTOGRAPHIC

NOT APPLICABLE

SECTION X

WIRING DATA

10-1. INTRODUCTION.

10-2. In this section are wiring diagrams of electrical and radio circuits in C-45G, TC-45G and C-45H airplanes. Included is a chart showing all graphic symbols used on diagrams, an alphabetical index of the diagrams, an electrical and radio equipment list, and a general electrical system schematic drawing.

10-3. Each piece of equipment has been assigned an index number and this index number is used on all diagrams on which the corresponding component appears. Quick identification of a component can be made by noting the index number that appears adjacent to the component on the wiring diagram, and then refer to the corresponding number on the equipment list for proper nomenclature. Similar numbers will be found in both the electrical and radio equipment lists, therefore, the list which is applicable to the diagram (electrical or radio) being examined must be consulted to obtain the correct parts identification. To simplify use of the equipment lists all electrical and radio wiring diagrams will be grouped separately, and the diagrams will be arranged in the same order that components represented on them were discussed in the previous sections of the handbook.

10-4. Each equipment list will give name and applicable AN. or military part number where possible. When a piece of equipment used has no military nomenclature, identifying part number of the manufacturer is given.

10-5. An alphabetical index of wiring diagrams is listed on page 279.

10-6. The wiring diagram for each circuit is shown on a separate page, except where the simplicity and brevity of the circuit does not merit a full page presentation. Wire numbers are those found in airplane.

10-7. The schematic wiring diagrams are arranged with the components of the circuit as near to their true position, relative to each other, as possible. Each figure includes an oblique view of the airplane showing routing of the wiring and location of equipment used in the schematic diagrams. Length and size of wires are given only when they are critical to the operation of the circuit.

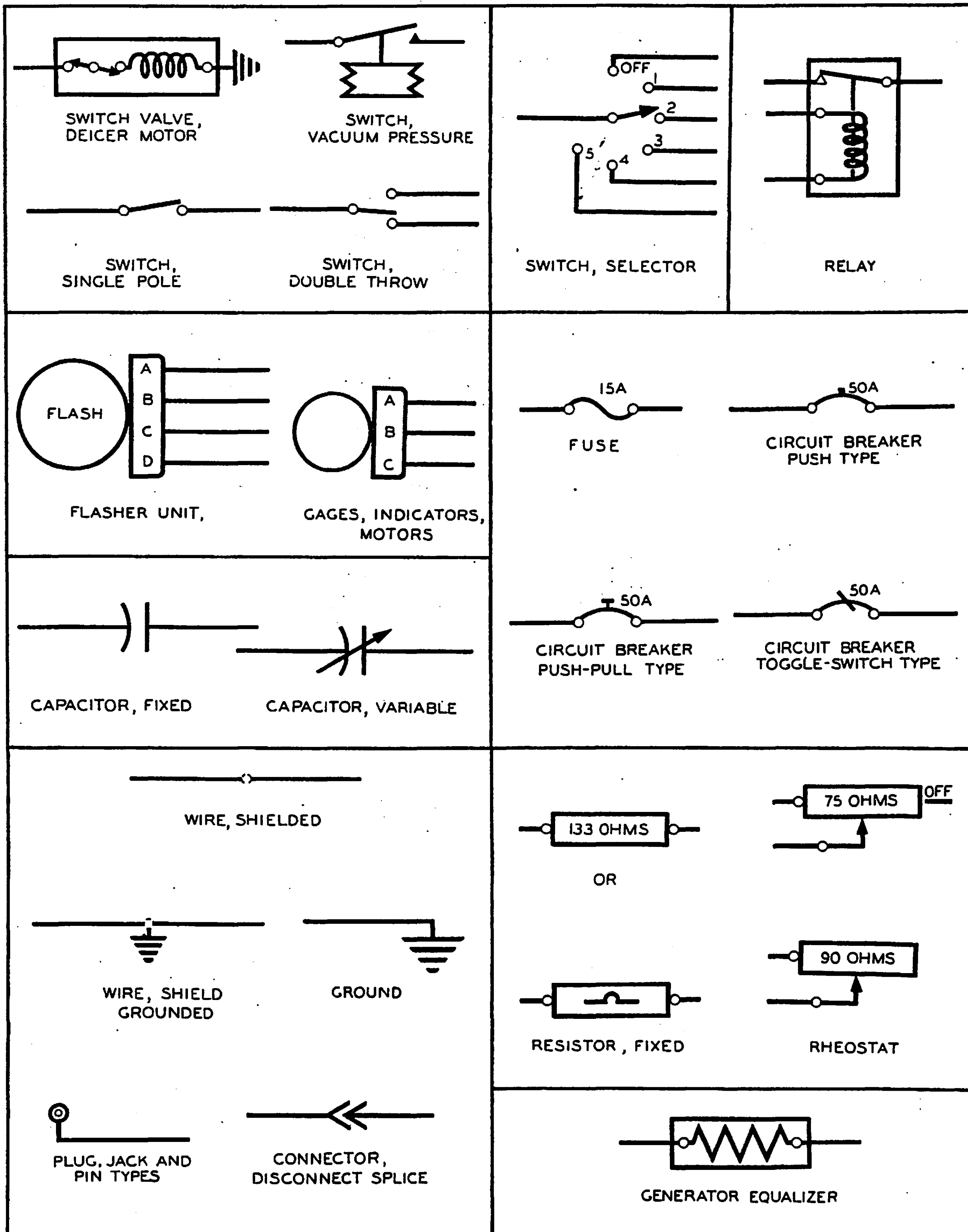


Figure 10-1. Electrical Symbols (Sheet 1 of 2 Sheets)

INDEX NUMBER	PART NUMBER	NAME OF PART
181	GK-C8-32SL	Receptacle - Outboard wing
182	AN3124-SB307	Lamp - S-8 Bulb (nose and rear baggage compartment dome)
183	AN3037-2	Light Assembly - Nose baggage compartment dome
184	894-180805-1	Light Assembly - Pilot's map reading
185	AN3037-2	Light Assembly - Rear baggage compartment dome
186	SC2611	Socket - Radio panel light
187	AN3158-1	Light Assembly - Tail position (white)
188	AN3158-2	Light Assembly - Tail position (amber)
189	AN3400-2	Light Assembly - Red and clear illumination, dome
190	AN3033-3	Light Assembly - Wing position, wing tip (LH red)
191	AN3033-4	Light Assembly - Wing position, wing tip (RH green)
192	94-32294	Lamp Assembly - Cockpit, Type C-4A (cockpit utility)
193	94-32294	Lamp Assembly - Cockpit, Type C-4A (cabin reading)
194	AN3021-2	Switch - Red dome light
195	AN3436-2-4	Strip Assembly - Tail position lights and rudder tab terminal
196	694-180795	Plate Assembly - Radio terminal box
197	Deleted	
198	Deleted	
199	AN3108B-18-22S	Plug - Magneto, firewall
200	AN3100A-18-22P	Receptacle - Magneto, firewall
201	27634	Indicator - Slaved gyro magnetic compass, Type V-1
202	AN3106A-14S-6S	Plug - Type V-1 indicator (junction box cable)
203	AN3106A-14S-5P	Plug - Type V-1 indicator (transmitter cable)
204	21174	Indicator - Slaved gyro magnetic compass Type V-3
205	AN3106A-14S-5S	Plug - Type V-3 indicator (junction box cable)
206	Deleted	
207	Deleted	
208	Deleted	
209	694-180779	Box Assembly - Electric power fuse junction
210	694-180719	Box Assembly - Slaved gyro magnetic compass junction
211	JAN-C-25	Capacitor - Type CP54B1EE504V
212	AN3499-1	Inverter - Instrument, class A 100 Volt - Ampere 3 Phase
213	AN3106A-14S-7S	Plug - Inverter
214	AN749-310	Jumper - Bonding
215	27635	Transmitter - Remote compass Type C-2
216	AN3106A-16S-1S	Plug - Outboard wing junction (junction box cable)
217	AN3100A-16S-1P	Receptacle - Outboard wing junction (transmitter cable)
218	AN3021-2	Switch - Nose and rear baggage compartment dome
219	94-32228	Lamp Assembly - Cockpit B-7A (aircraft extension)
220	32660	Flasher - Position light, periodic, aircraft Type C-2
221	AN3106B-16S-8S	Plug - Type C-2 flasher
222	94-32118	Light Assembly - Passing, type B-3
223	AN3140-327	Lamp - T-1 3/4 bulb midget flange base
224	AN5766T2	Compass - Pilot's stand-by (Specification AN-C-146)
225	84-180857	Plug - Magnetic compass light
226	37A5222-12	Resistor - Compass light (135 ohms)
227	AN3155-25-25	Rheostat - Copilot's flight instrument light fixtures
228	AN3155-25-15	Rheostat - Engine and subpanel instrument light fixtures
229	AN3155-25-25	Rheostat - Pilot's flight instrument light fixtures
230	404-180520	Box Assembly - Nacelle junction (LH)
231	404-180520	Box Assembly - Nacelle junction (RH)
232	AN3436-2-7	Strip Assembly - Nacelle junction box terminal
233	103038-0082	Jumper - Bonding (left landing light)
234	103038-0102	Jumper - Bonding (right landing light)
235	RW36F5RO	Resistor - Fuselage clearance lights, dimming (Spec JAN-R-26)
236	RW34F100	Resistor - Position light dimming (Spec JAN-R-26)
237	RW33F250	Resistor - Tail light dimming, (Spec JAN-R-26)
238	AN3226-2	Switch - Navigation lights dimming
239	AN3227-1	Switch - Navigation lights
240	AN3021-2	Switch - Taxi lights
241	AN3027-2	Switch - Inverter and J-1 compass direct current power
242	AN3021-8	Switch - Oil dilution
243	AN3021-2	Switch - Passing light

INDEX NUMBER	PART NUMBER	NAME OF PART
244	AN3021-2	Switch - White cabin dome light
245	AN3097-13	Light Assembly - Upward recognition (Upper)
246	AN3097-2	Light Assembly - Upward recognition (Lower)
247	AN3120-1047	Lamp - RP-11 bulb (fuselage clearance lights)
248	37D6210	Valve - Oil dilution solenoid
249	AN3155-25-75	Rheostat - Radio controls light
250	Deleted	
251	Deleted	
252	AN5819T4	Indicator - Electric turn and bank
253	AN3106A-10SL-3S	Plug - Electric turn and bank indicator
254	49B6768-5	Circuit Breaker - Electric turn and bank indicator
255	AN3021-3	Switch - Electric turn and bank indicator power
256	AN5766T2	Compass - Pilot's stand-by (Specification MIL-C-5604)
257	AN3021-1	Switch - Windshield wiper motor control
258	694-183821	Bus - Terminal
259	AN5839-1	Indicator - Landing gear position
260	AN3106A-10SL-3S	Plug - Landing gear position indicator
261	49B6768-5	Circuit Breaker - Landing gear position indicator
262	694-180615	Bus Bar - Circuit breaker box lower
263	694-180614	Bus Bar - Circuit breaker box upper
264	694-180616	Lid Assembly - Electrical circuit
265	49B6768-15	Circuit Breaker - Taxi lights
266	AN3210-1	Switch - Tail gear down position indicator, malfunction light and warning horn
267	AN3210-1	Switch - Tail gear up position indicator and malfunction light
268	A-4899-24	Light Fixture - Instrument
269	333	Lamp
270	49B6768-5	Circuit Breaker - Ammeter lead
271	10-SW-75	Switch - Map reading lamp
272	AN3436-2	Terminal Block Assembly
273*	94-32372	Light Assembly - Cabin table
274	694-180805-2	Lamp Assembly - Pilot's map reading
275*	AN3155-25-50	Rheostat - Navigator's panel fixture
276	Deleted	
277	AN5763-27	Driftmeter
278	E-1002-13-20	Plug - Breeze
279**	AN3022-8	Switch - Left hand fire extinguisher
280**	AN3023-8	Switch - Right hand fire extinguisher
281**	2CD-6440	Sphere - CB
282**	2CD-6362	Directional valve
283**	404-189080	Circuit Breaker - Fire extinguisher
284**	54267	Switch - Propeller feathering
285**	67191-1	Relay - Propeller feathering motor
286**	AN3100-12S-4P	Receptacle - Propeller feathering switch
287**	AN3108B-12S-4S	Plug - Propeller feathering switch
288**	55526	Switch - Propeller feathering, pressure
289**	AN3160-5	Circuit Breaker - Propeller controls
290**	404-189080	Motor - Propeller feathering
291**	AN3140-328	Lamp - Landing gear switch
292**	894-180760	Knob Assembly - Landing gear switch
293**	10 watt, 150 ohm Code: DIVAA	Resistor - Dividohm
294**	894-180732	Solenoid - Landing gear switch latch
295**	1PB6	Switch - Test, landing gear indicator light
296**	AN3234-1	Switch - Landing gear down position
297**	AN3234-1	Switch - Landing gear up position
298**	894-180737	Switch Assembly - Landing gear position
299**	6-140	Strip - Terminal
300**	AN753A1	Splice - Disconnect
301	30E16-1-A	Generator - 100 Ampere
302	AN3108-28-5P-12	Plug - Generator firewall

*Apply to TC-45G only
**Apply to C-45H only

INDEX NUMBER	PART NUMBER	NAME OF PART
303	AN3100-28-55-12	Receptacle - Generator Firewall
304	54C109	Shunt - 100 Ampere
305	AN3106A-10SL-3S	Receptacle - Anti-Collision Light
306	AND10066-10SL-3P	Plug-Anti-Collision Light
307	AN3022-2	Switch - Anti-Collision Light Switch Installation
308	G7740-1-24	Rotating Light
309	AN3161-P10	Circuit Breaker - Anti-Collision Light Installation

RADIO EQUIPMENT LIST

INDEX NUMBER	PART NUMBER	NAME OF PART
1	C-570A/A	Control Panel
2	BC-453-B	Receiver
3	694-180790	Mixer Panel (Pilots)
4	AM-142/AIC	Amplifier
5	BC-1366-M	Jack Box
6	FL-30	Filter
7	694-180795	Junction Panel
8	PE-86	Dynamotor
9	BC-347	Amplifier
10	694-180678	Circuit Breaker Box
11	T-67/ARC-3	Transmitter
12	R-77A/ARC-3	Receiver
13	C-404A/A	Control Panel
14	J-68/ARC-3	Junction Box
15	BC-1333	Receiver
16	AN3157-4	Light Assembly
17	R-252/ARN-14	Receiver
18	ID-251/ARN	Indicator Control
19	DY-66/ARN-14	Dynamotor
20	694-180690	Junction Box
21	AN3106A-14S-5S	Plug
22	ID-249/ARN or ID-249A/ARN or ID-249B/ARN	Indicator
23	Type C-1	Amplifier
24	C-512/ARN-14 or C-512A/ARN-14 or C-760/ARN-14 or C-760A/ARN-14	Control Panel
25	694-180719	Junction Box
26	ID-250/ARN	Indicator
27	C-411A/A	Control Panel
28	AN3155-25-75	Rheostat
29	AN3106A-14S-2S	Plug
30	U-16/U	Plug
31	U-15/U	Plug
32	PL-153-A	Plug
33	PL-148-A	Plug
34	PL-259-A	Plug
35	M-359	Adapter
36	AN-104-B	Antenna
37	PL-151-A	Plug
38	AN3106M-22-14S	Plug
39	Deleted	
40	AN3057-16	Adapter
41	MC-277	Coupling
42		Marker Antenna
43	PL-219	Plug
44	PL-108	Plug

INDEX NUMBER	PART NUMBER	NAME OF PART
45	AN3108B-12S-3P	Plug
46	AN3057-4	Adapter
47	Deleted	
48		Range Antenna
49	CU-165/ARN-6	Coupling Uniter
50	RC31AE105M	Resistor, (Spec JAN-R-11)
51	PL-152-A	Plug
52	MG-149F	Inverter
53	LP-21-LM LP-31-A or AM	Loop
54	PL-112	Plug
55	R-5/ARN-7	Compass Unit
56	PL-122	Plug
57		Sense Antenna
58	49A6549-1-3	Fuse (3 Amp)
59	SW-172	Relay
60	Deleted	
61	Deleted	
62	RC21BE511K	Resistor, (Spec JAN-R-11)
63	RC21BE102K	Resistor, (Spec JAN-R-11)
64	CS3554	Relay
65	694-180791	Mixer Panel
66	Deleted	
67	AN3057-6	Adapter
68	Deleted	
69	AN3057-16	Adapter
70	Deleted	
71	AT-172/ARN-14	Antenna
72	UG-21C/U	Plug, (Spec MIL-C-71)
73	AN3106M-20-29S	Plug
74	AN3106M-28-12S	Plug
75	AN3106B-20-27S	Plug
76	I-81-A	Indicator
77	PL-118	Plug
78	AN3101M-22-14P	Receptacle
79	UG-27B/U	Angle Adapter (Spec MIL-C-71)
80	AN3108B-22-4S	Plug
81	PL-259A	Co-Axial Plug
82	694-180743	Box Assembly
83	694-180718	Cable Assembly
84	694-180752	Cable Assembly
85	694-180760	Cable Assembly
86	Deleted	
87	Deleted	
88	Deleted	
89	AN3106B-24-28SW	Plug
90*	Deleted	
91	BK-22-K	Relay
92*	R-122/ARN-12	Radio Receiver
93	FT-224-A	Mounting
94	AN3108B-18-9S	Plug
95*	C-4/ARN-7	Control Box
96	AN3059-10	Adapter
97*	I-82-A	Indicator
98	PL-258	Adapter
99*	AN3102-24-28P	Receptacle
100	AN3100A-18-9P	Receptacle
101*	AN3106-24-28S	Plug
102	Deleted	
103*	BC-1366-M	Jack Box Second Navigator's
104*	BC-1366-M	Jack Box Third Navigator's

*Apply to TC-45G only

ALPHABETICAL INDEX OF WIRING DIAGRAMS

ELECTRICAL WIRING DIAGRAMS

Title	Figure No.	Page	Code
Anti-Collision Light Circuit	10-23A	302	A
Anti-Icer and Deicer Circuits	10-6	284	A
B-3 Driftmeter Circuit	10-16	294	B
Electric Turn-and-Bank Indicator Circuit	10-15	293	A
Elevator Tab Indicator Circuit	10-2	280	A
Engine Fire Extinguisher Circuit	10-5	283	C
Flap Indicator Circuit	10-2	280	A
Flap Motor Circuit	10-2	280	A
Fuel Pressure Warning and Vacuum Warning Light Circuit	10-12	290	A
Fuel Quantity Indicator Circuit	10-7	285	A
General Electric Schematic Diagram	10-34	313	D
General Electric Schematic Diagram	10-35	320	C
Generator Circuit	10-17	295	A
Gyrosyn Compass Circuit	10-14	292	A
Instrument Lighting Circuit	10-20	298	A
Interior Lighting Circuit	10-18	296	A
Interior Lighting Circuit	10-19	297	C
Landing Gear Circuits	10-3	281	C
Landing Gear Circuits	10-4	282	D
Landing Lights Circuit	10-23	301	A
Navigation, Taxi and Passing Light Circuit	10-22	300	A
Navigators Instrument Lighting and Table Light Circuit	10-21	299	B
Oil Dilution and Pitot Heat Circuit	10-13	291	A
Propeller Feathering Circuit	10-10	288	C
Starter, Primer, Booster, Ignition and Battery Circuit	10-8	286	A
Tachometer Circuit	10-9	287	A
Cylinder Head Temperature Indicator Circuit	10-11	289	A
Windshield Wiper Circuit	10-6	284	A

RADIO WIRING DIAGRAMS

Title	Figure No.	Page	Code
AN/ARC-27 Wiring Diagram	10-27	305	A
ARN-14 Radio Circuit	10-31	310	C
Interphone Circuit	10-28	306	B
Interphone Circuit	10-32	311	E
Interphone Circuit	10-30	309	C
Low Frequency Range Receiver Circuit	10-26	304	A
Marker Beacon Receiver Circuit	10-24	302A	A
Radio Compass Circuit	10-29	307	F
Radio Compass Circuit	10-33	312	B
VHF Receiver and Transmitter Circuit	10-25	303	A

WIRING DIAGRAM CODE

A	All Models
B	TC-45G Only, Serials 51-11504 through 51-11599
C	C-45H Only, Serials 52-10539 and After
D	C-45G, TC-45G, Serials 51-11544 through 51-11599
E	C-45G, Serials 51-11544 through 51-11503, 51-11600 through 51-11911
F	C-45G Only, Serials 51-11544 through 51-11503, 51-11600 through 51-11911

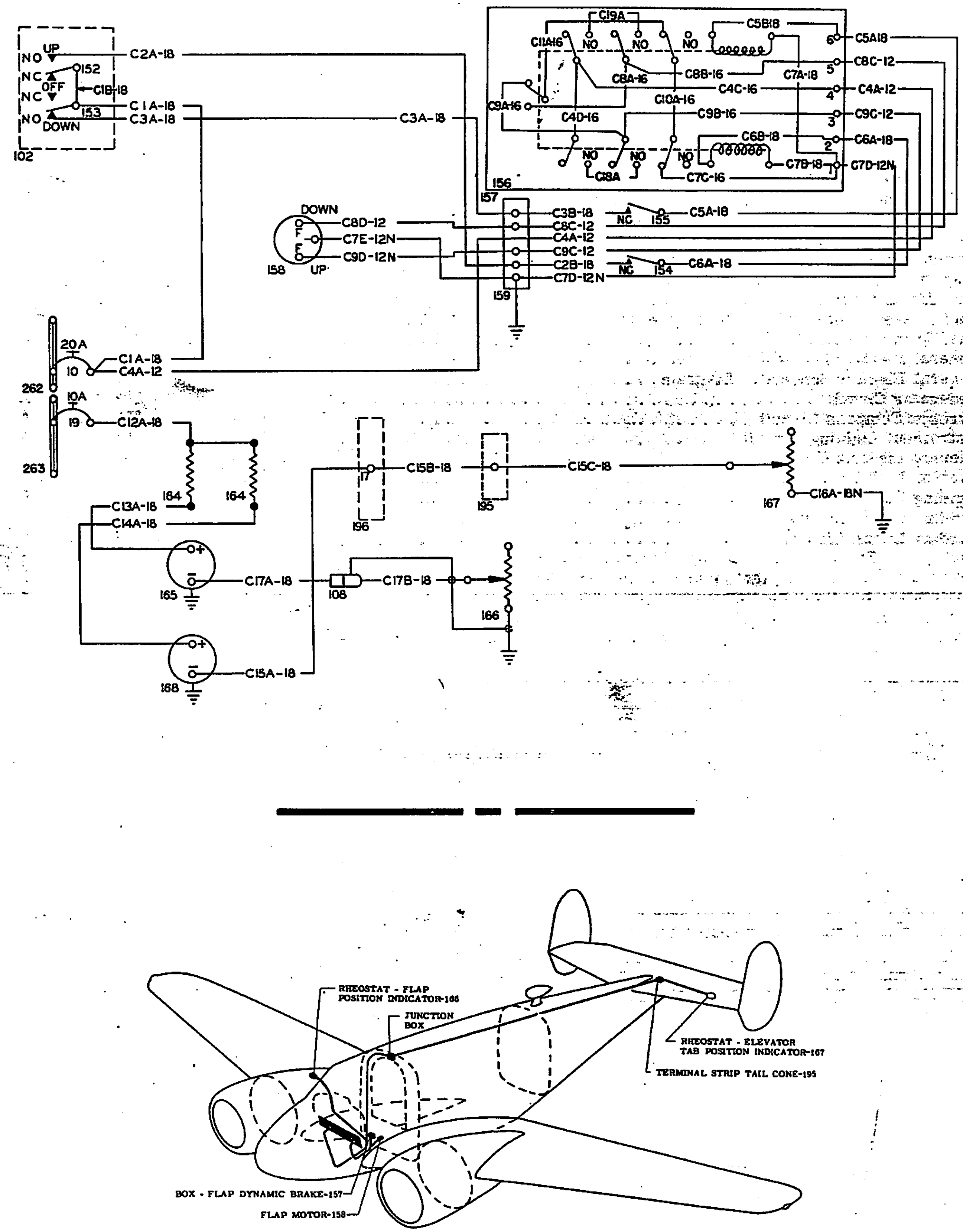
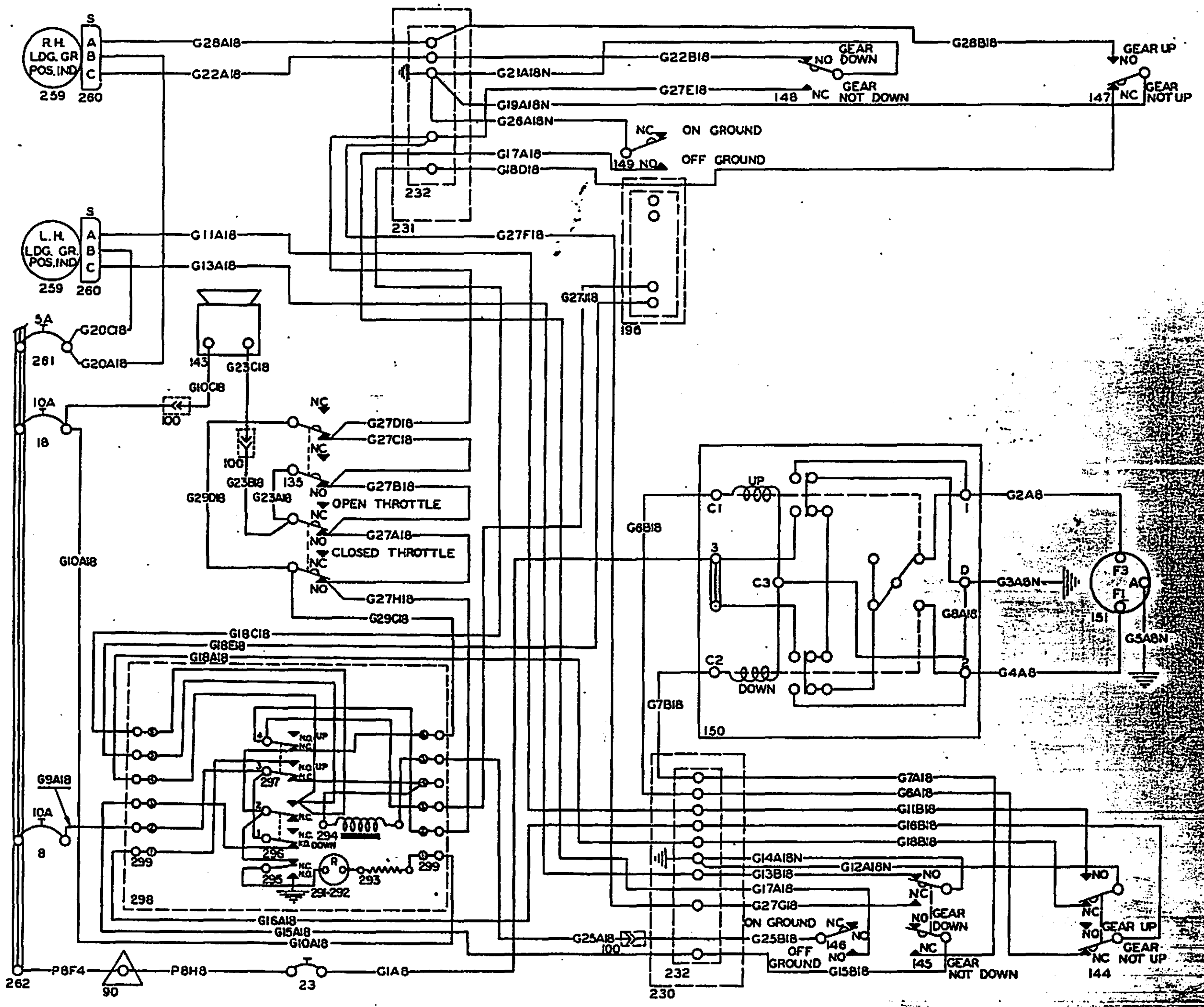


Figure 10-2. Flap Motor, Flap Indicator, and Elevator Tab Indicator Circuits



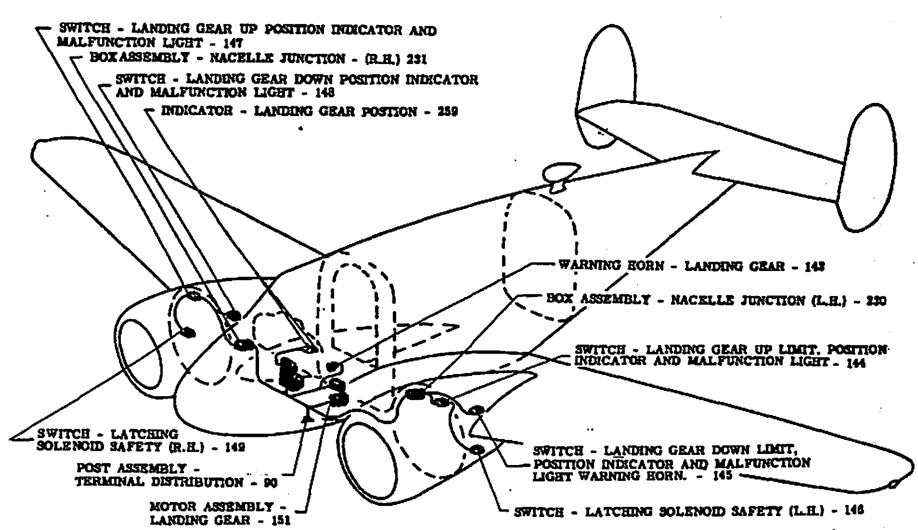


Figure 10-3. Landing Gear Circuits

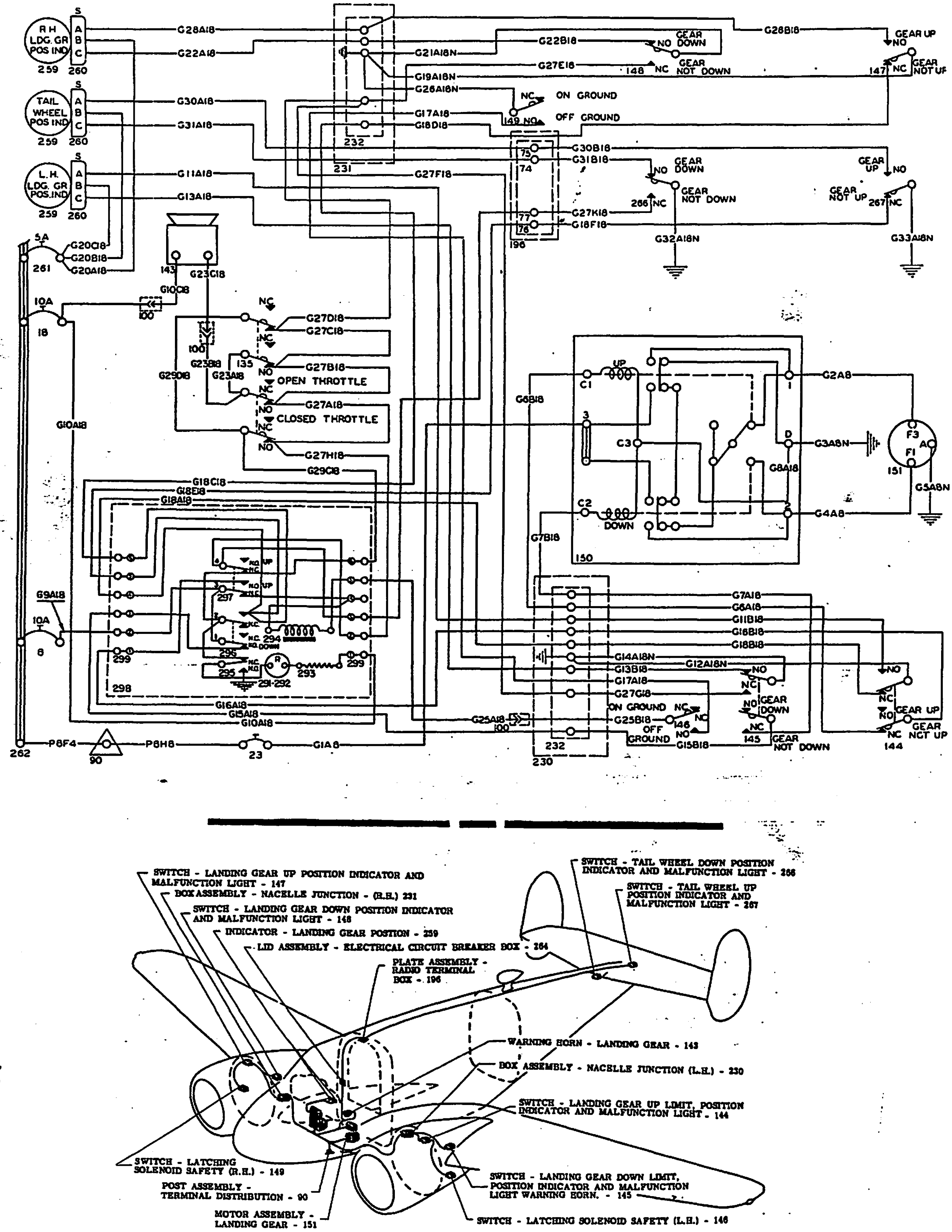
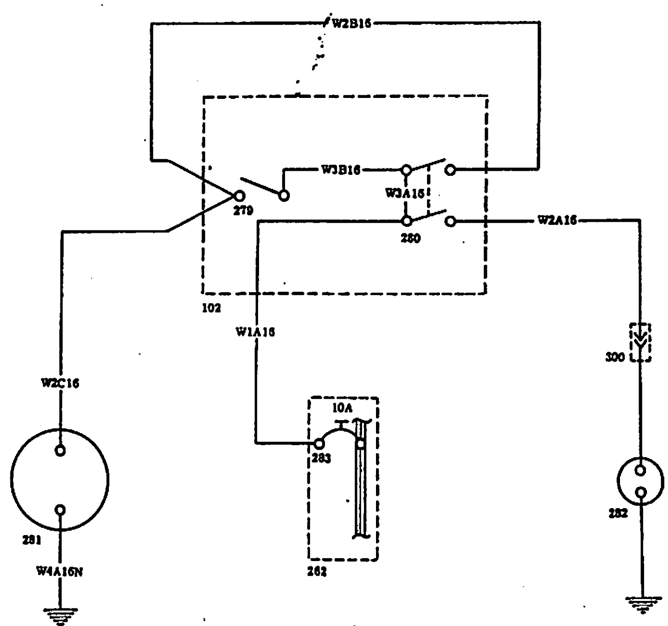


Figure 10-4. Landing Gear Circuits



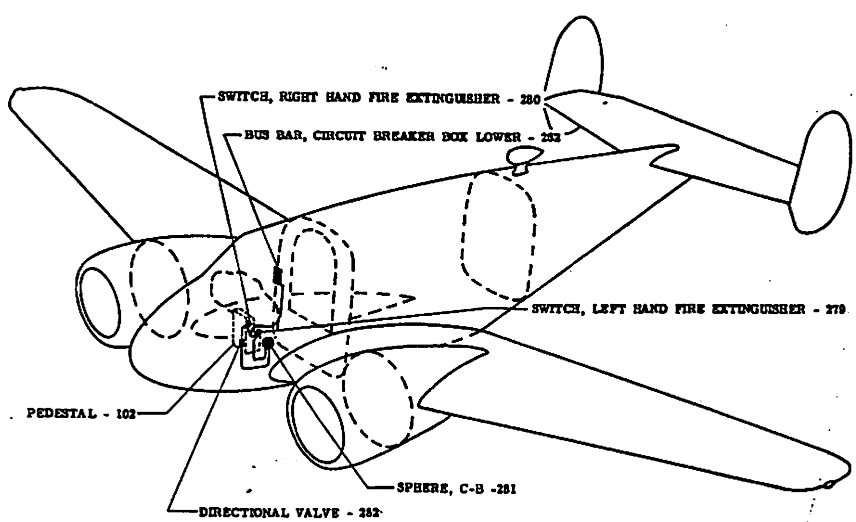


Figure 10-5. Engine Fire Extinguisher Circuits

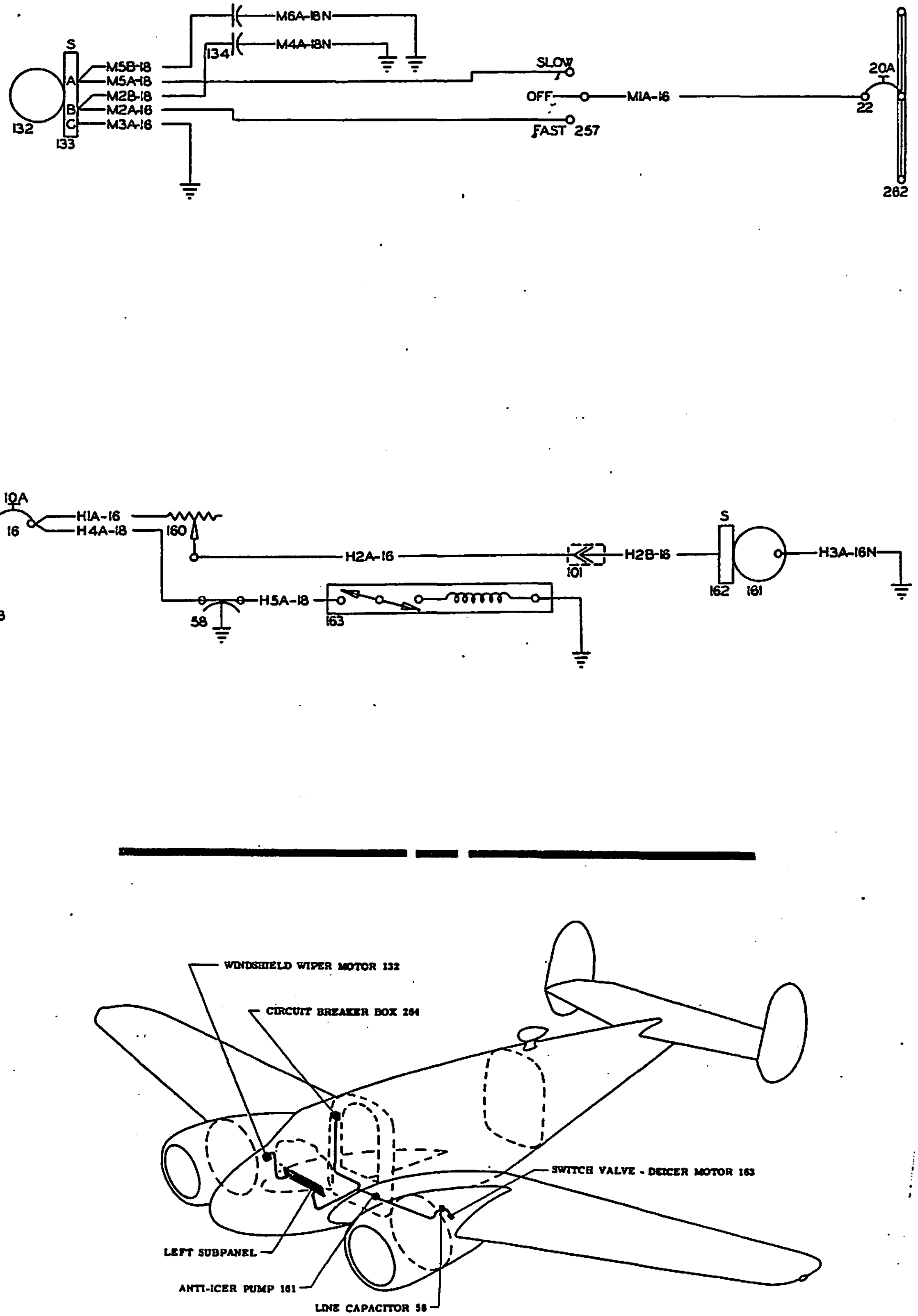


Figure 10-6. Windshield Wiper, Anti-Icer and De-Icer Circuits

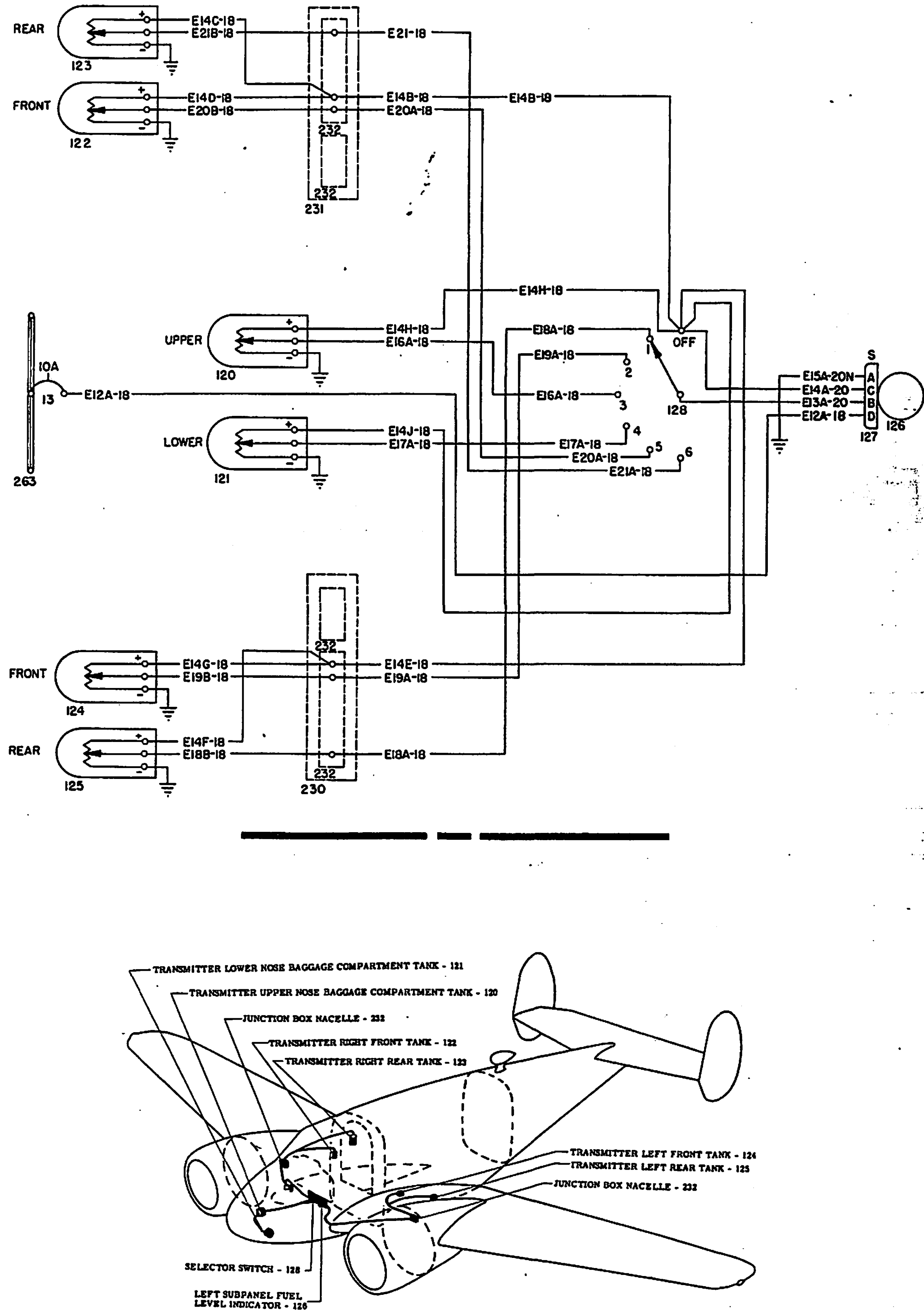
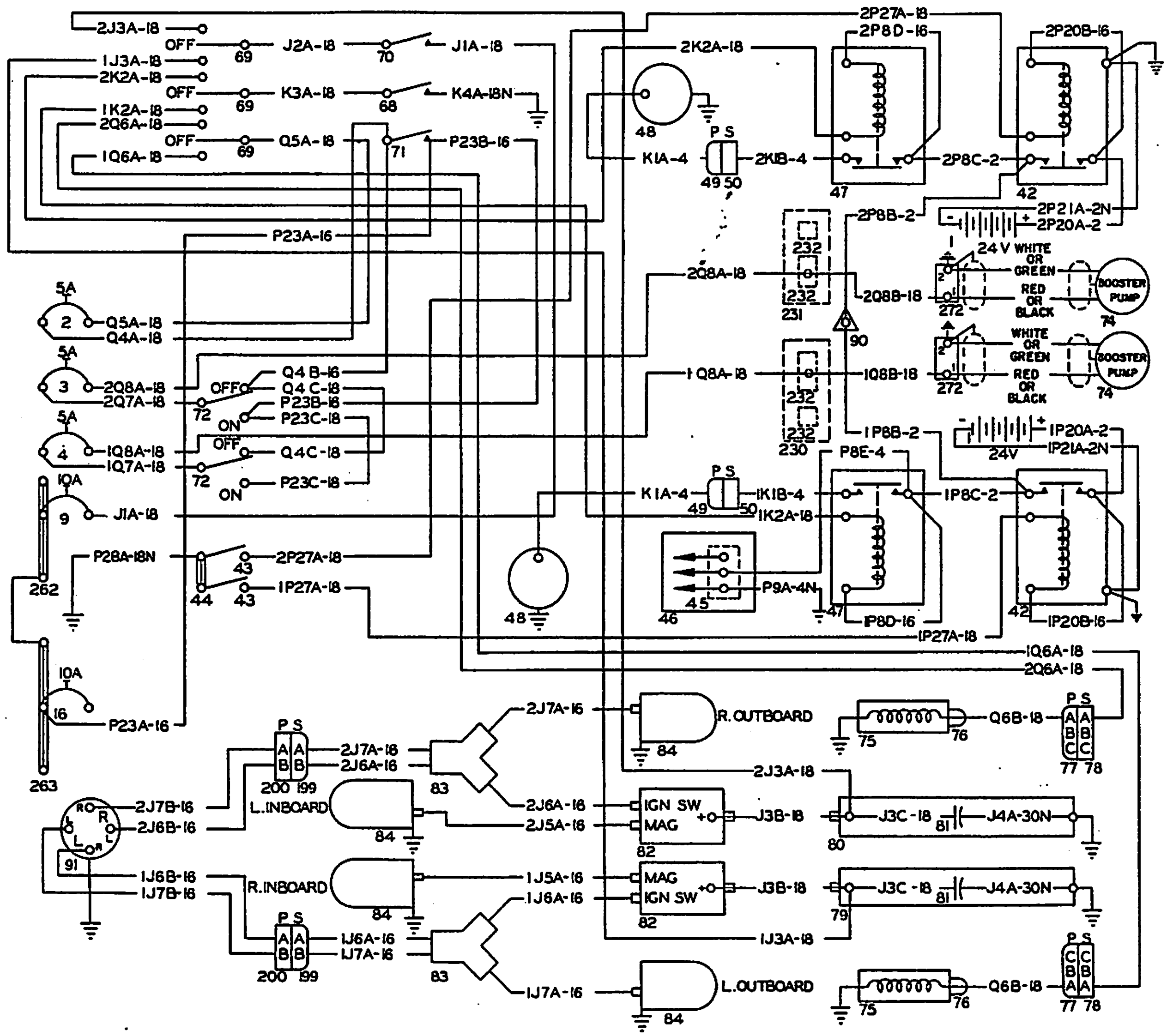


Figure 10-7. Fuel Quantity Indicator Circuits



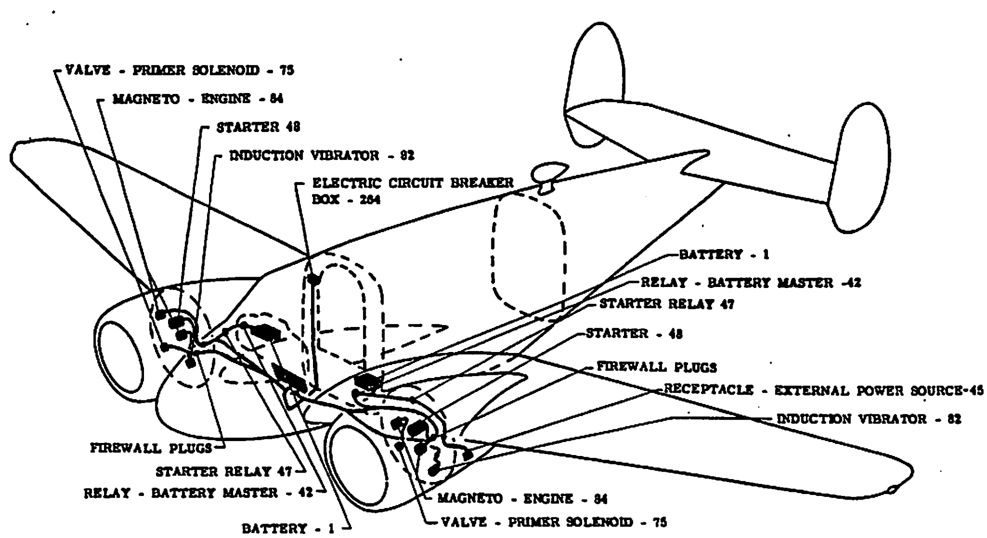
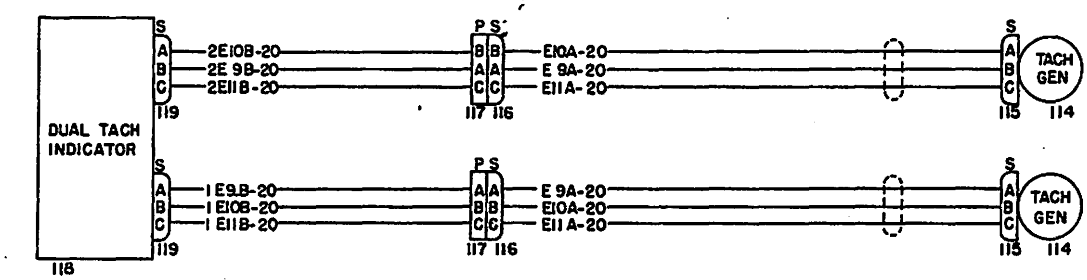


Figure 10-8. Starter, Primer, Booster, Ignition and Battery Circuits



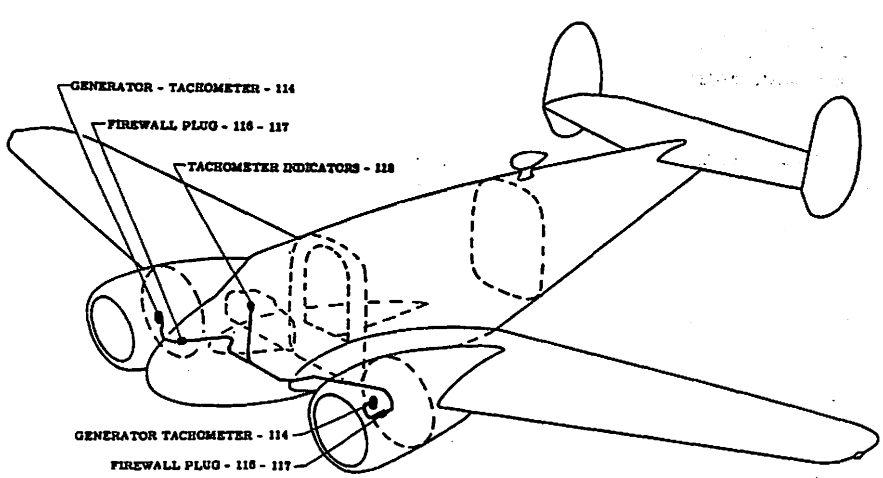


Figure 10-9. Tachometer Circuit

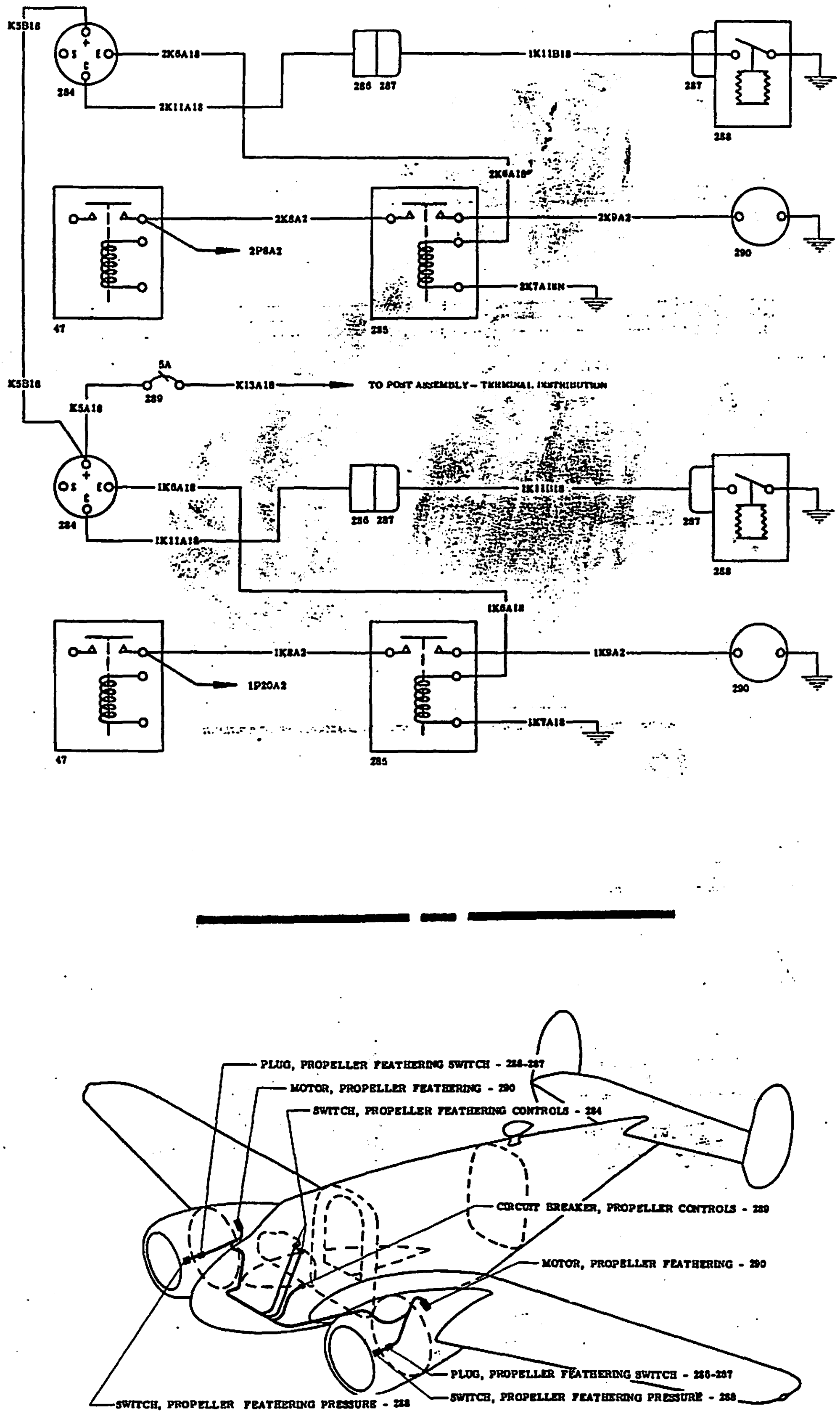
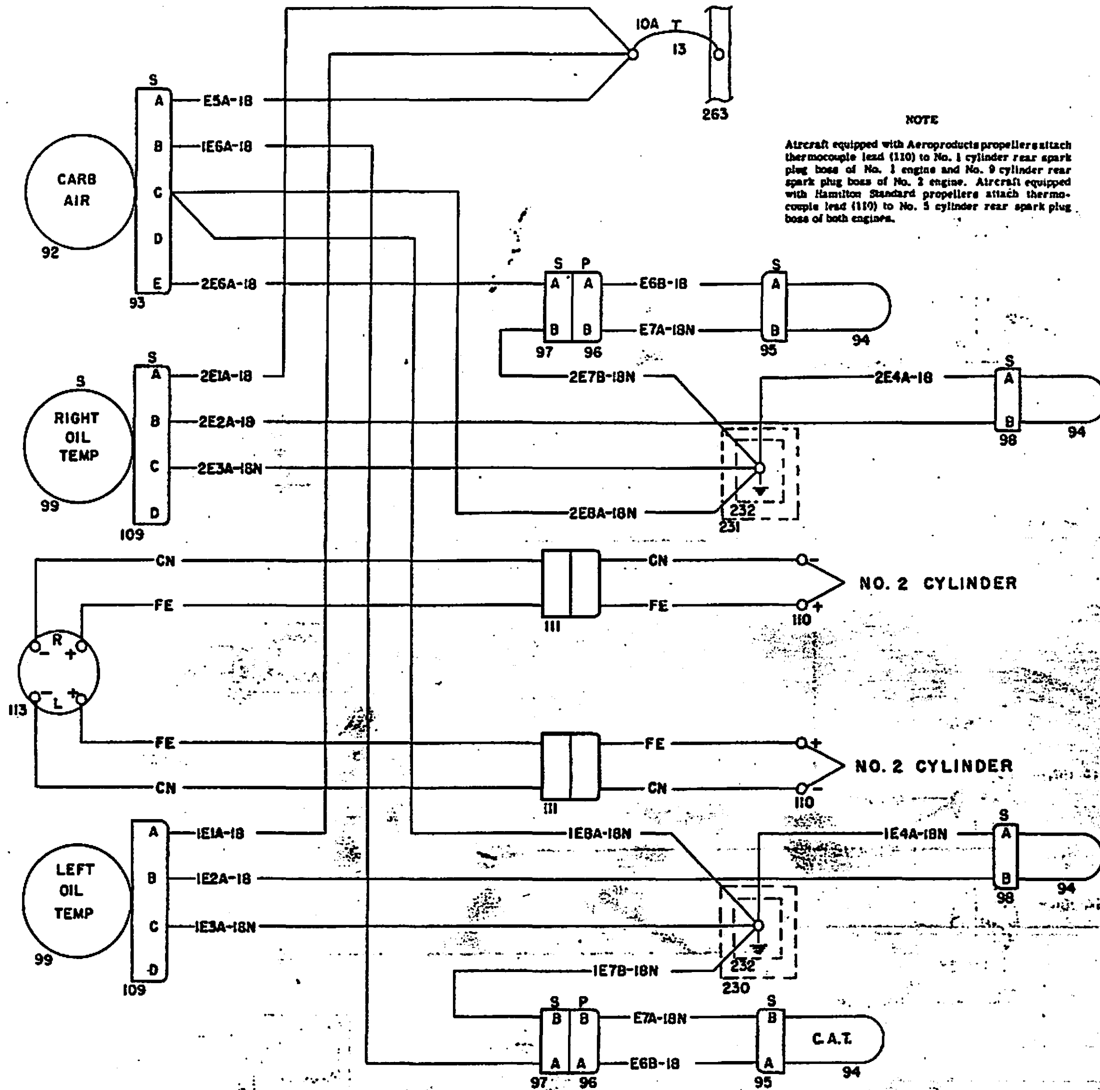


Figure 10-10. Propeller Feathering Circuit



NOTE

Aircraft equipped with Aeroproducts propellers attach thermocouple lead (110) to No. 1 cylinder rear spark plug boss of No. 1 engine and No. 9 cylinder rear spark plug boss of No. 2 engine. Aircraft equipped with Hamilton Standard propellers attach thermocouple lead (110) to No. 5 cylinder rear spark plug boss of both engines.

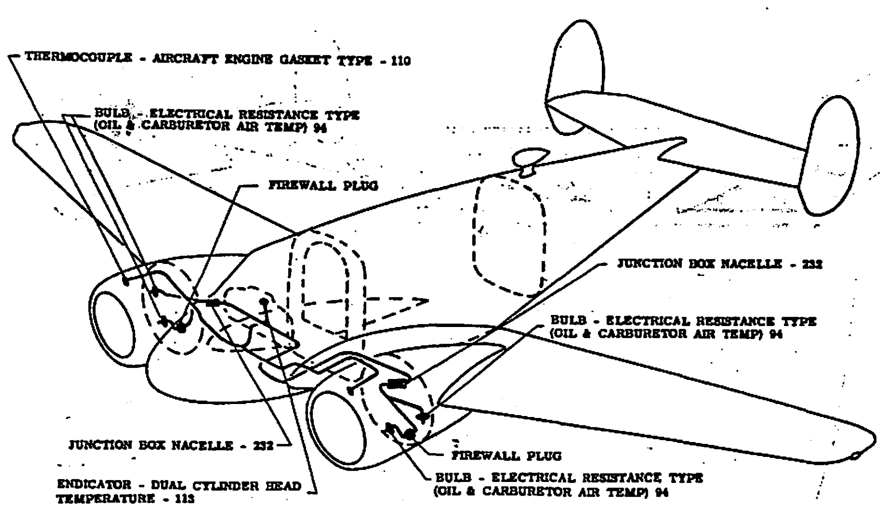


Figure 10-11. Temperature Indicator Circuits

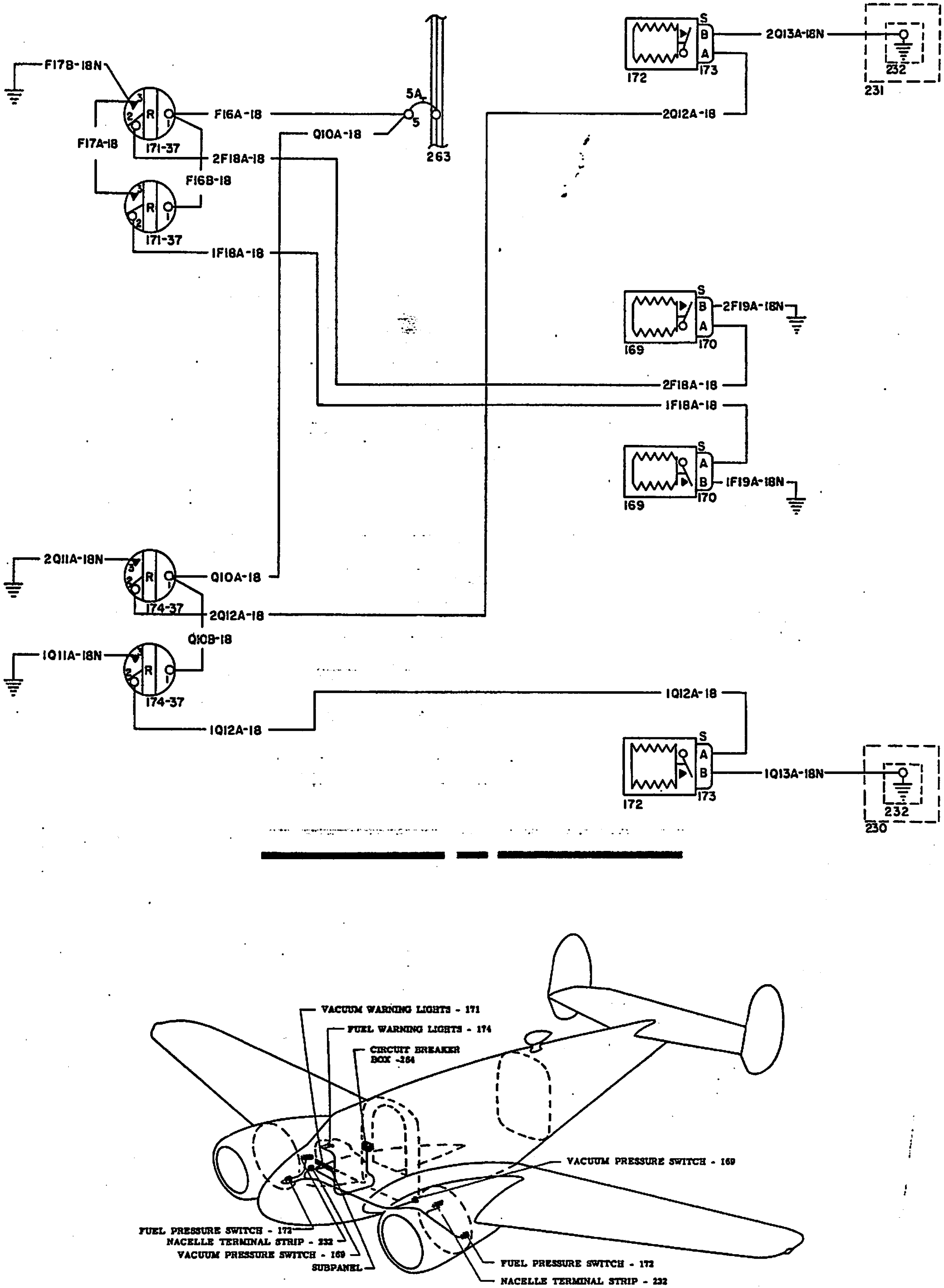
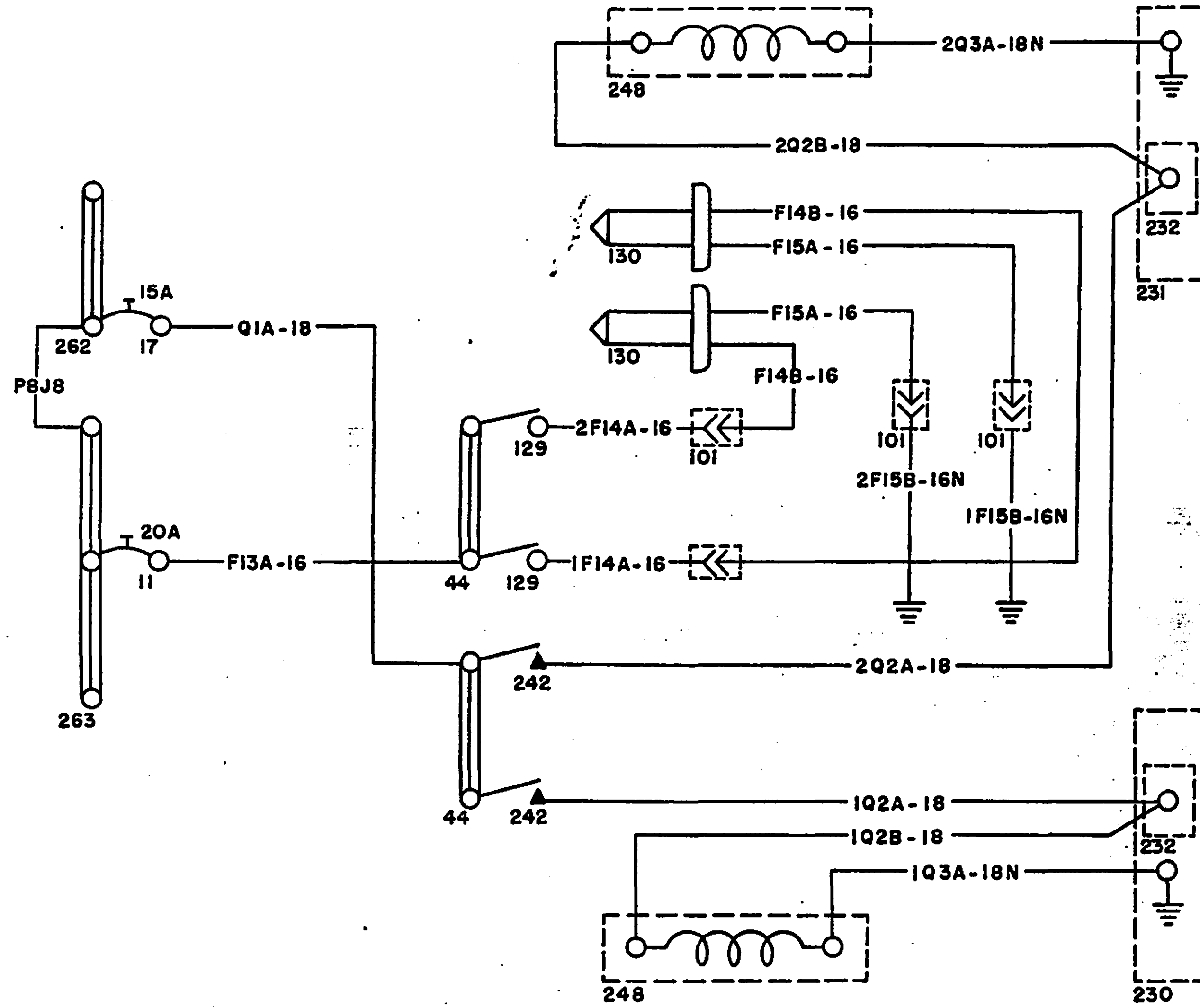


Figure 10-12. Fuel Pressure Warning and Vacuum Warning Light Circuits



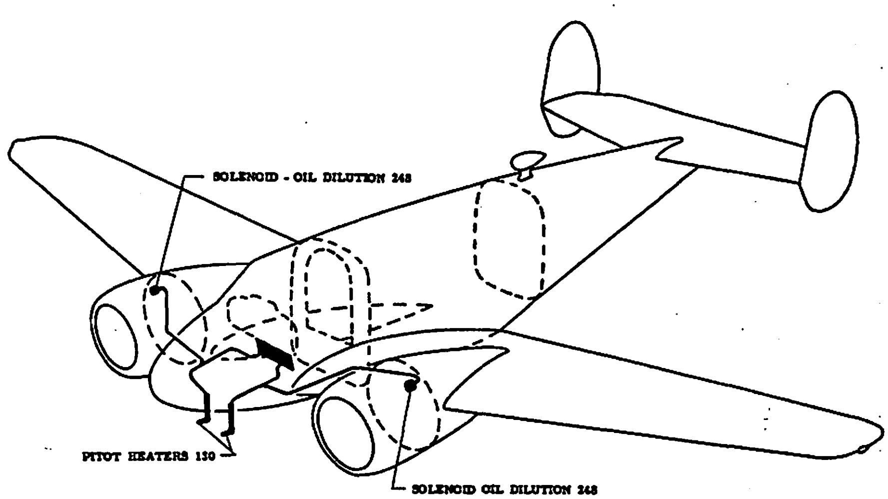
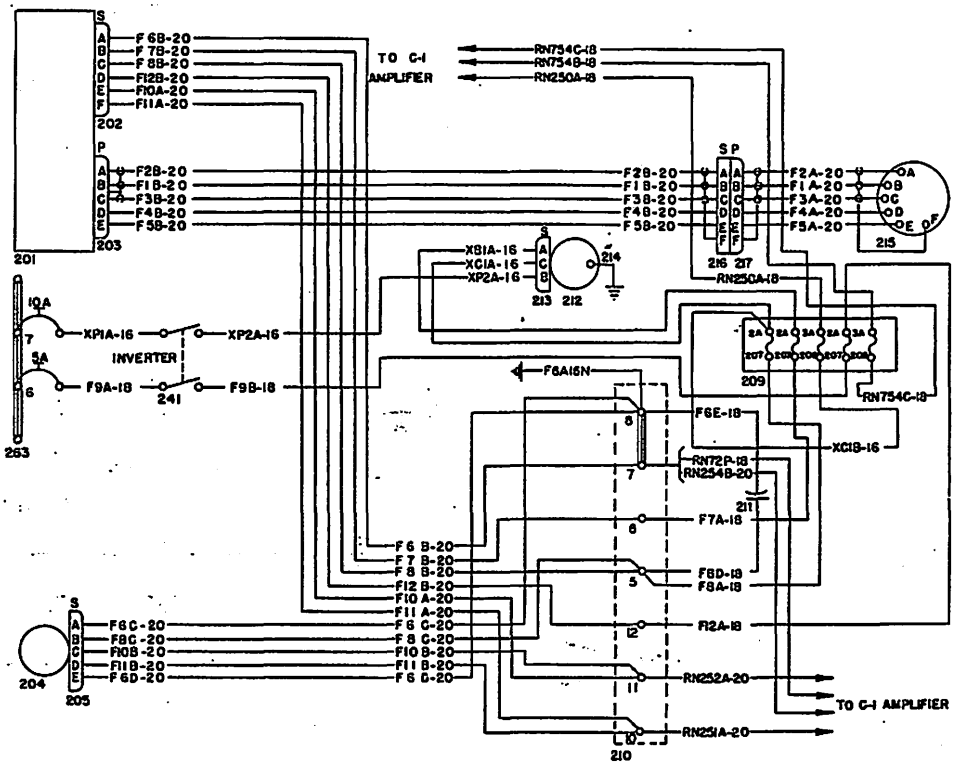


Figure 10-13. Oil Dilution and Pitot Heat Circuits

1D250 - 26



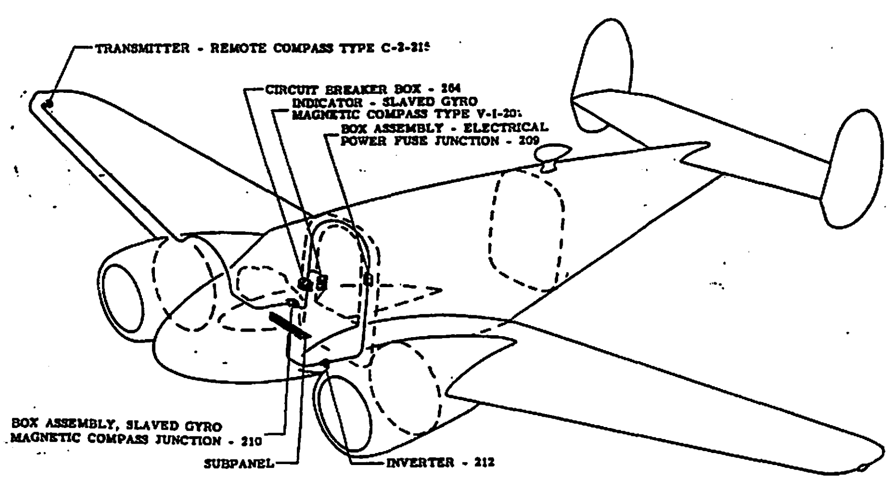


Figure 10-14. Gyrosyn Compass Circuit

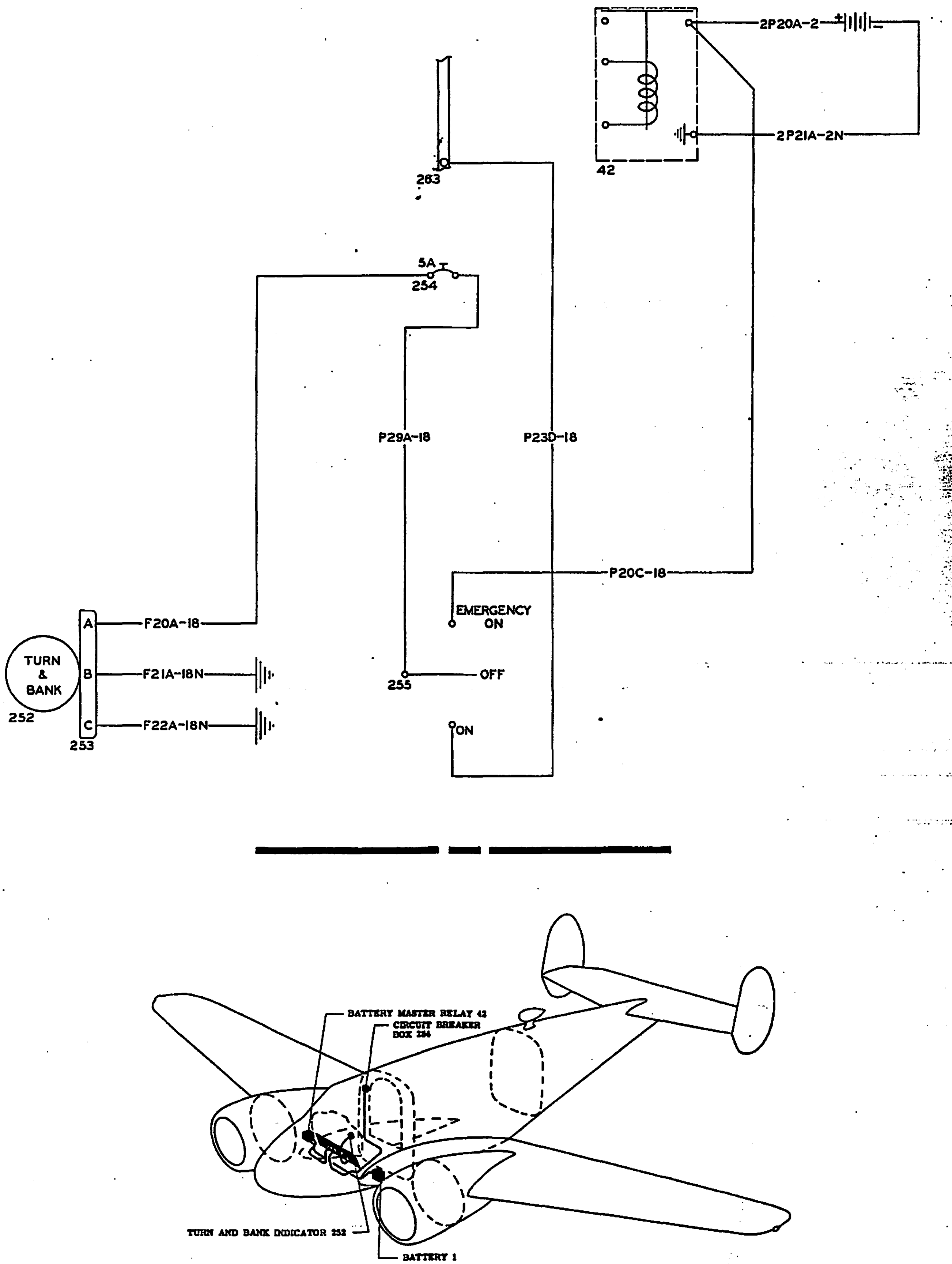


Figure 10-15. Electric Turn-and-Bank Indicator Circuit

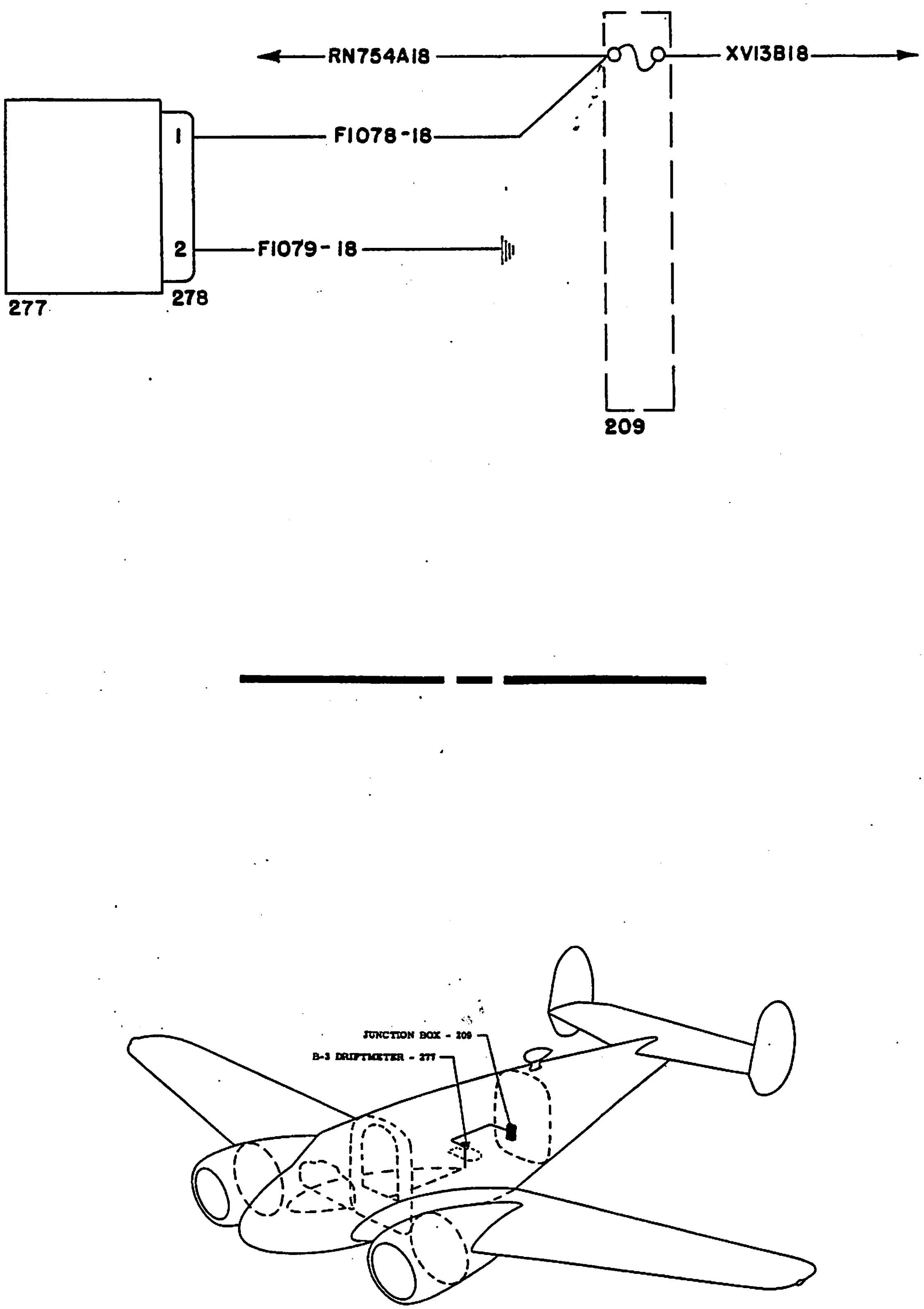
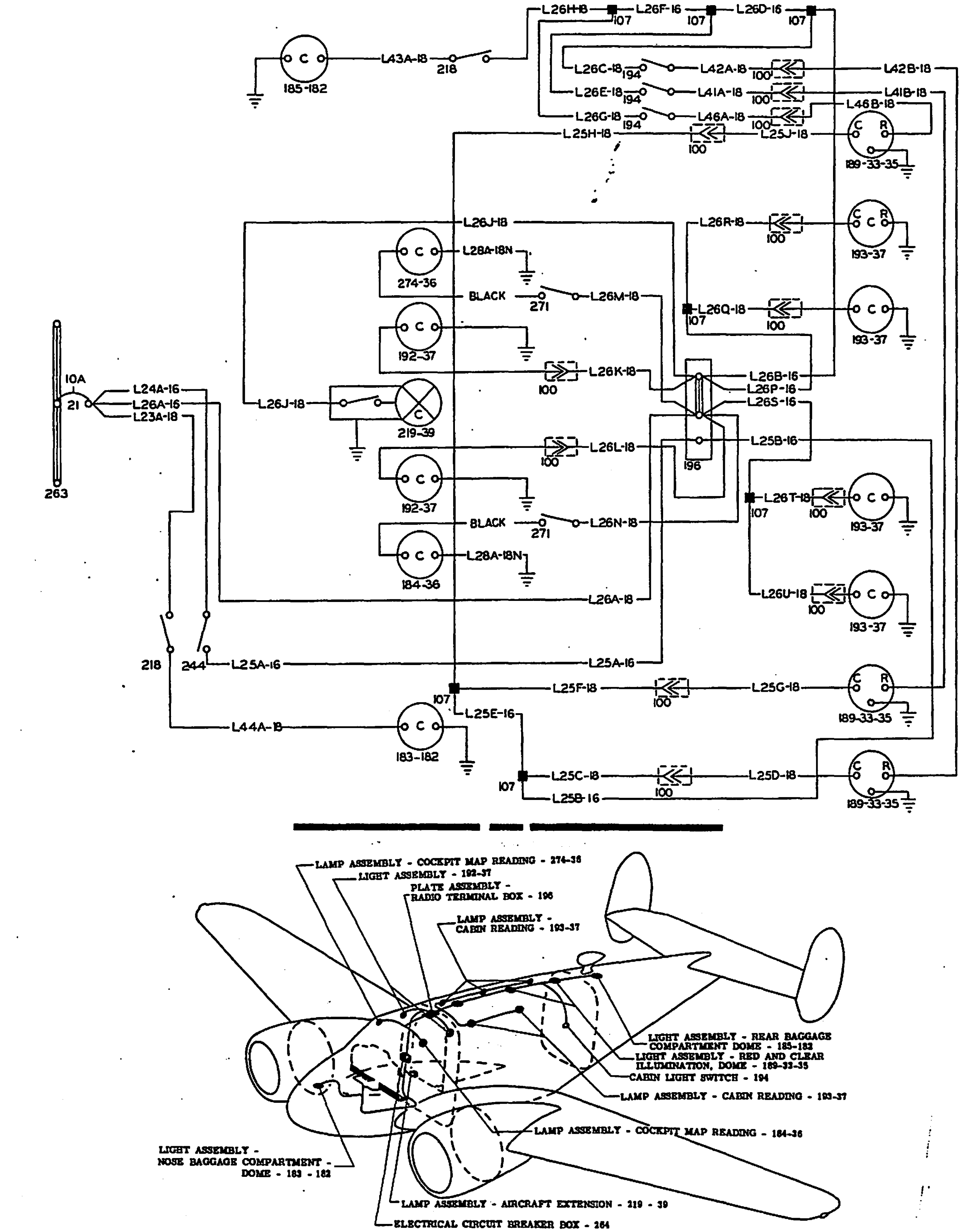


Figure 10-16. B-3 Driftmeter Circuit



NOTE: Items 182, 183, 218 and wires L23A-18, L44A-18 removed on airplane serials 51-11494, 51-11496, 51-11497, 51-11499, 51-11501, 51-11503, 51-11518 and after.

Figure 10-18. Interior Lighting Circuit

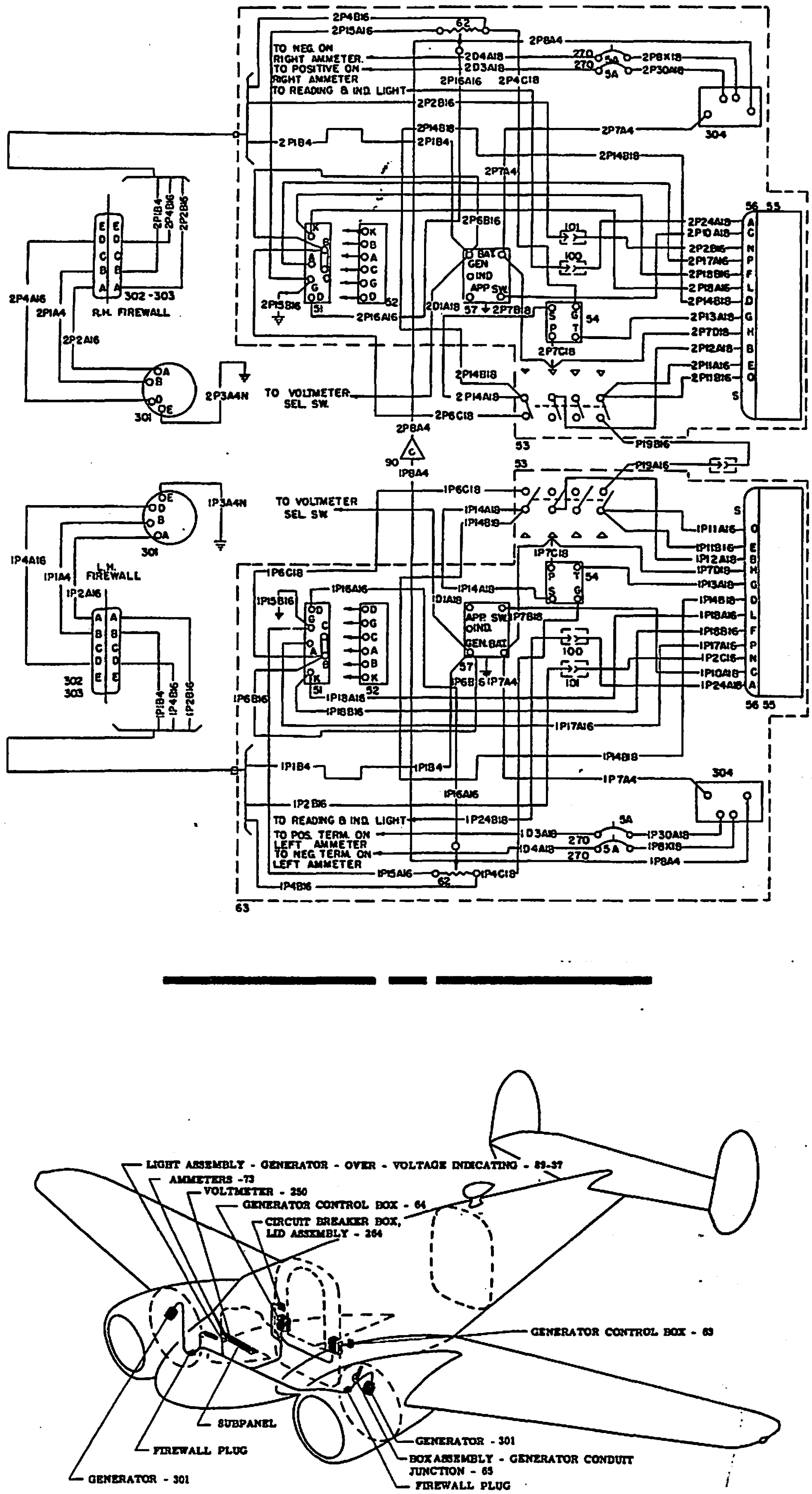


Figure 10-17. Generator Circuit (100 Amp)

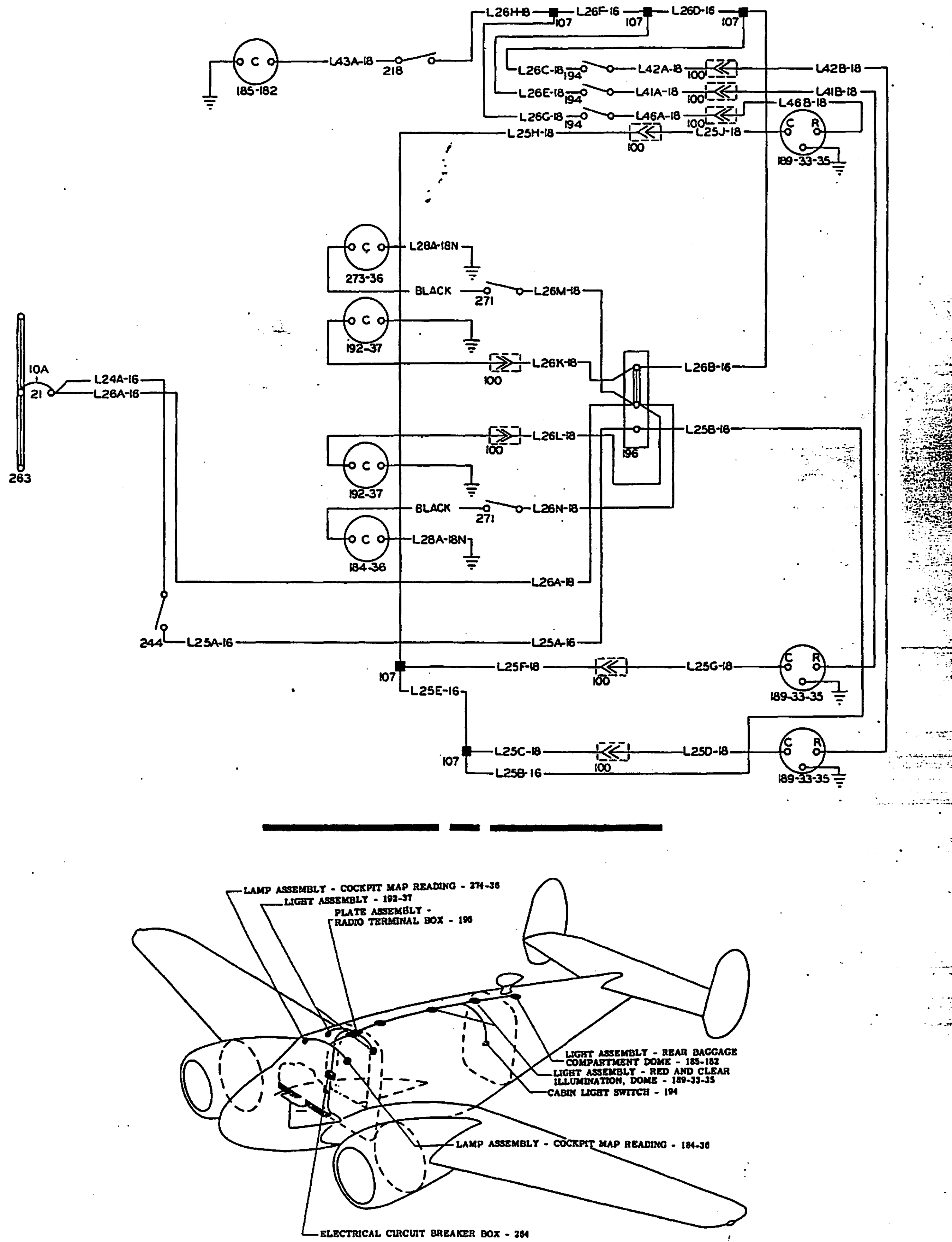
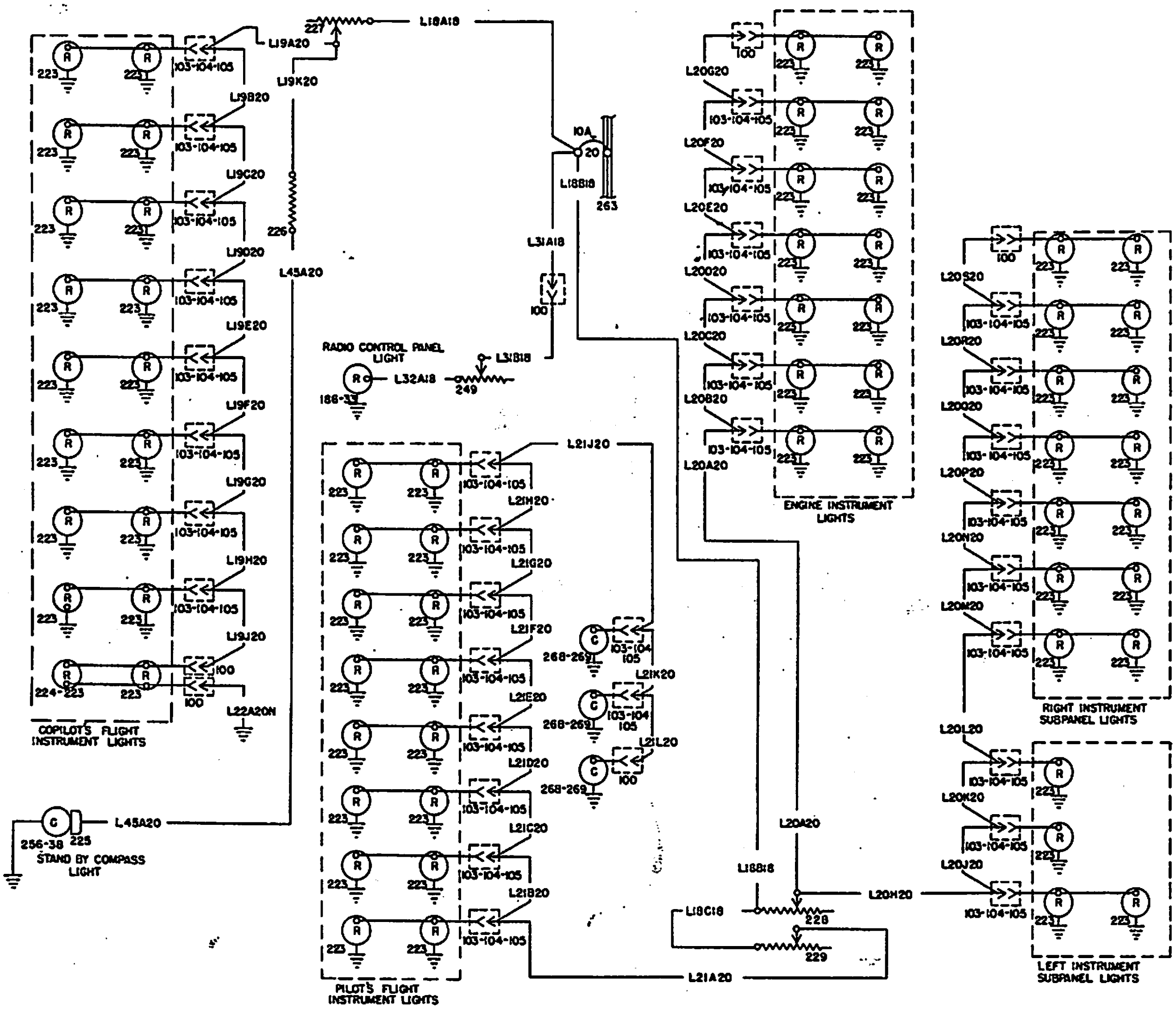


Figure 10-19. Interior Lighting Circuit



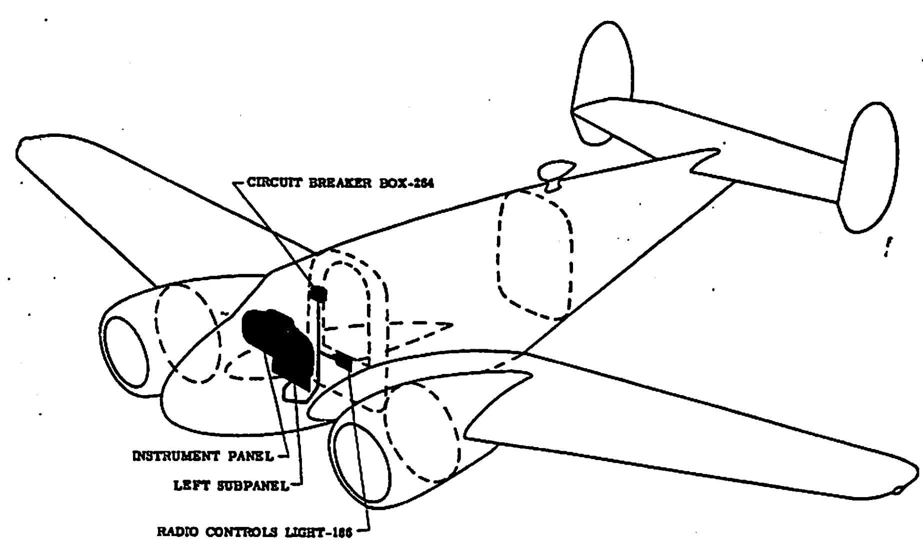
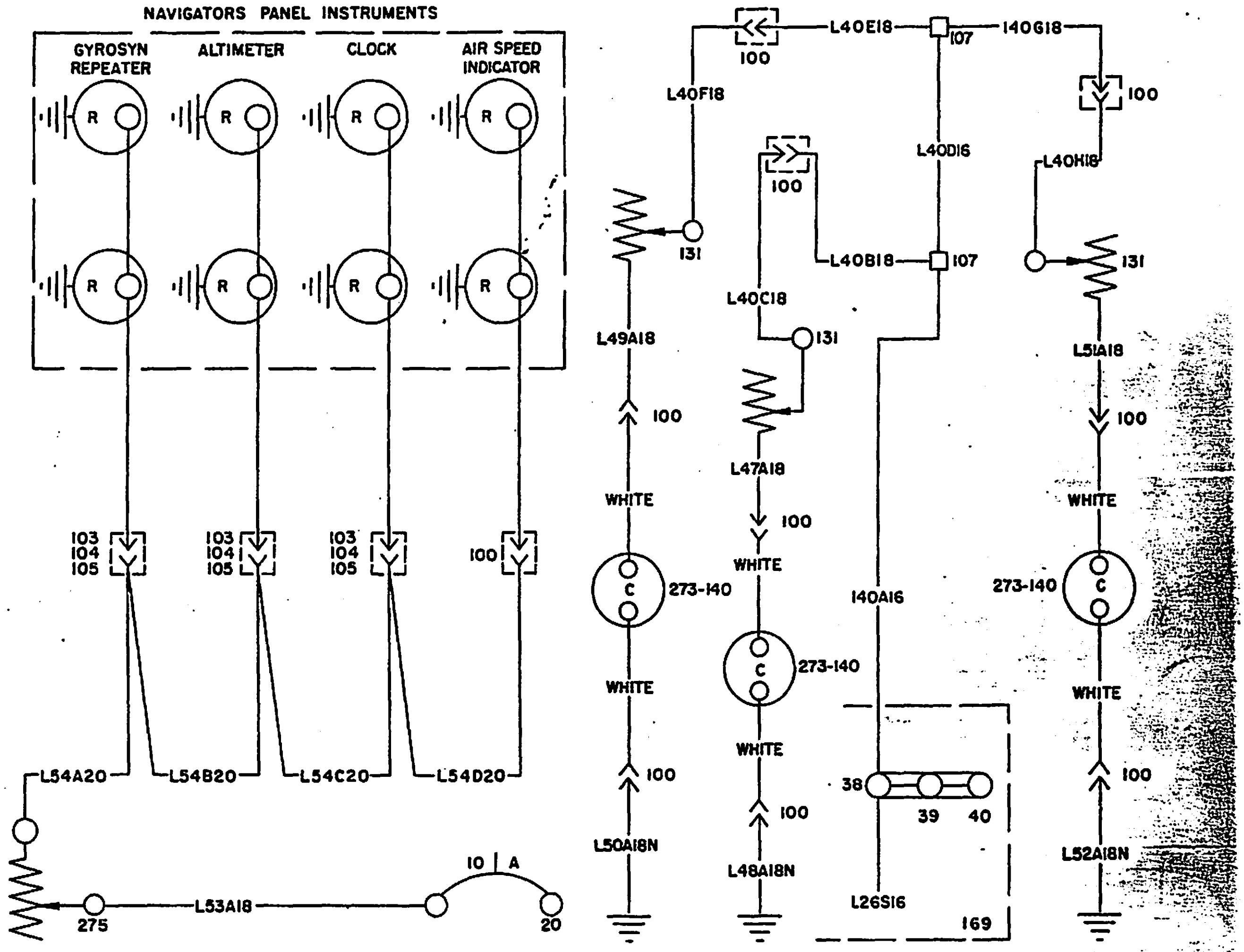


Figure 10-20. Instrument Lighting Circuit



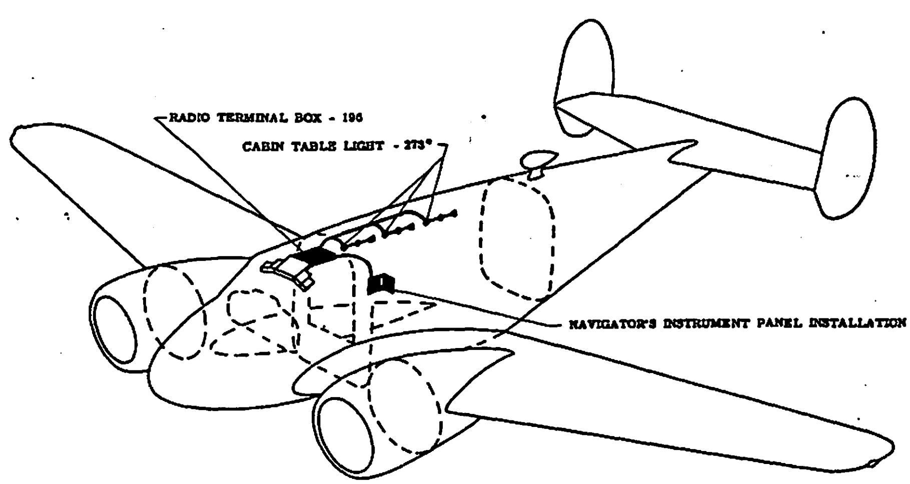
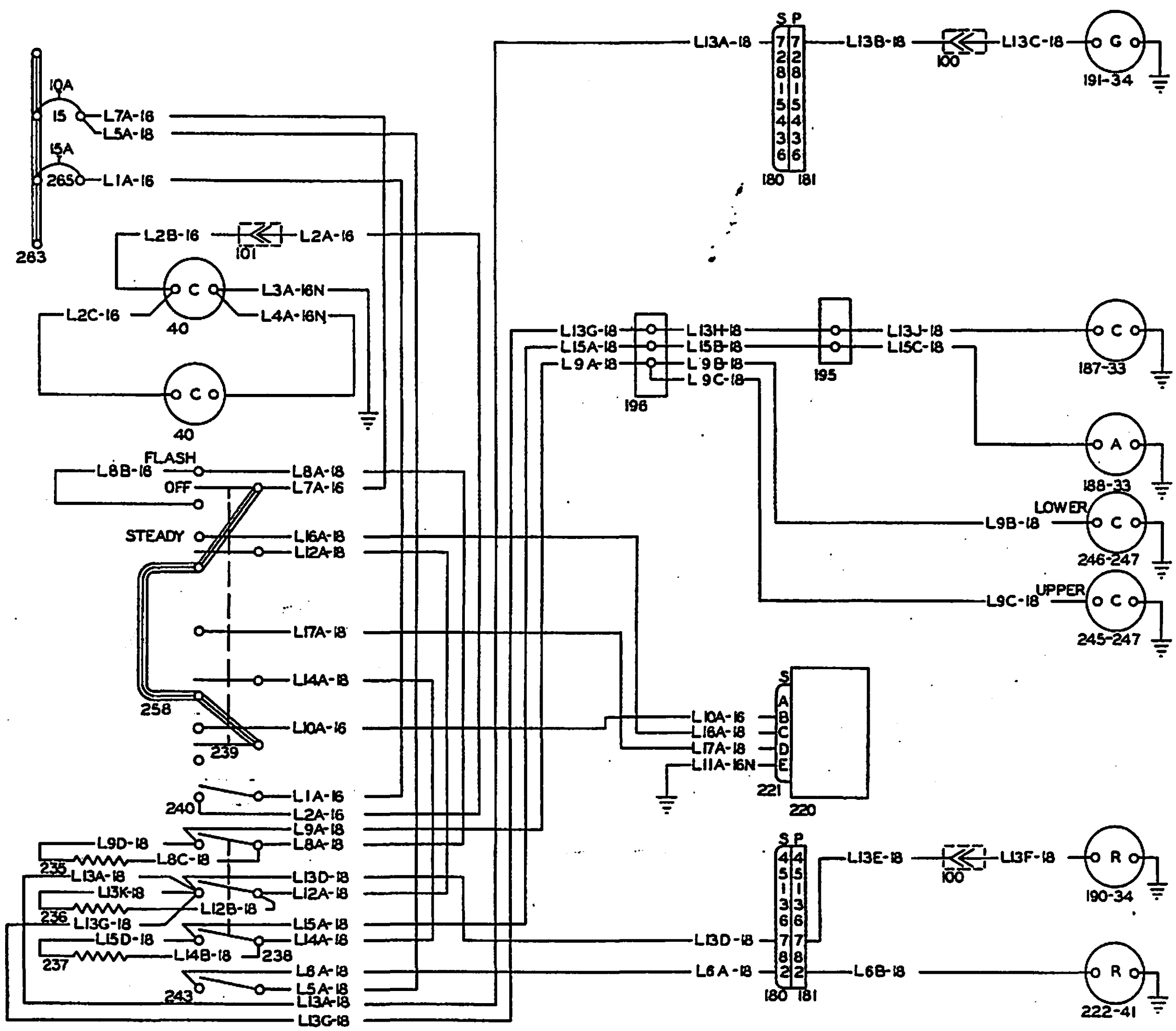


Figure 10-21. Navigator's Instrument Lighting and Table Light Circuit



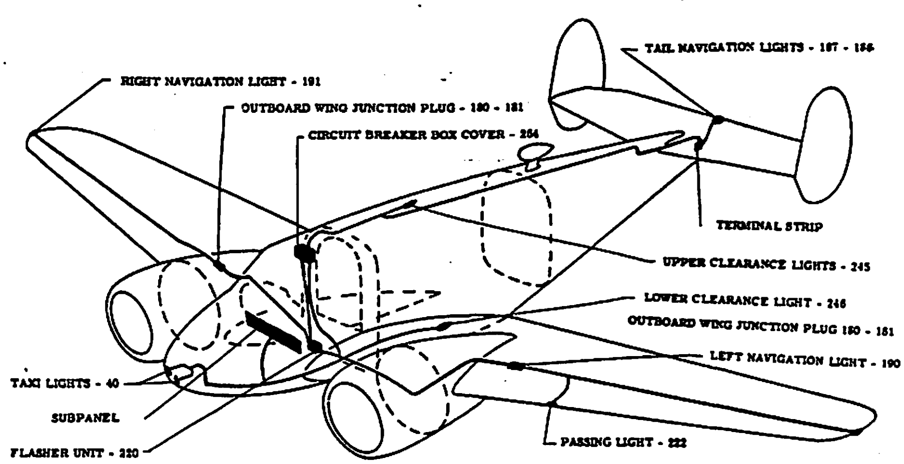


Figure 10-22. Navigation, Taxi and Passing Light Circuits

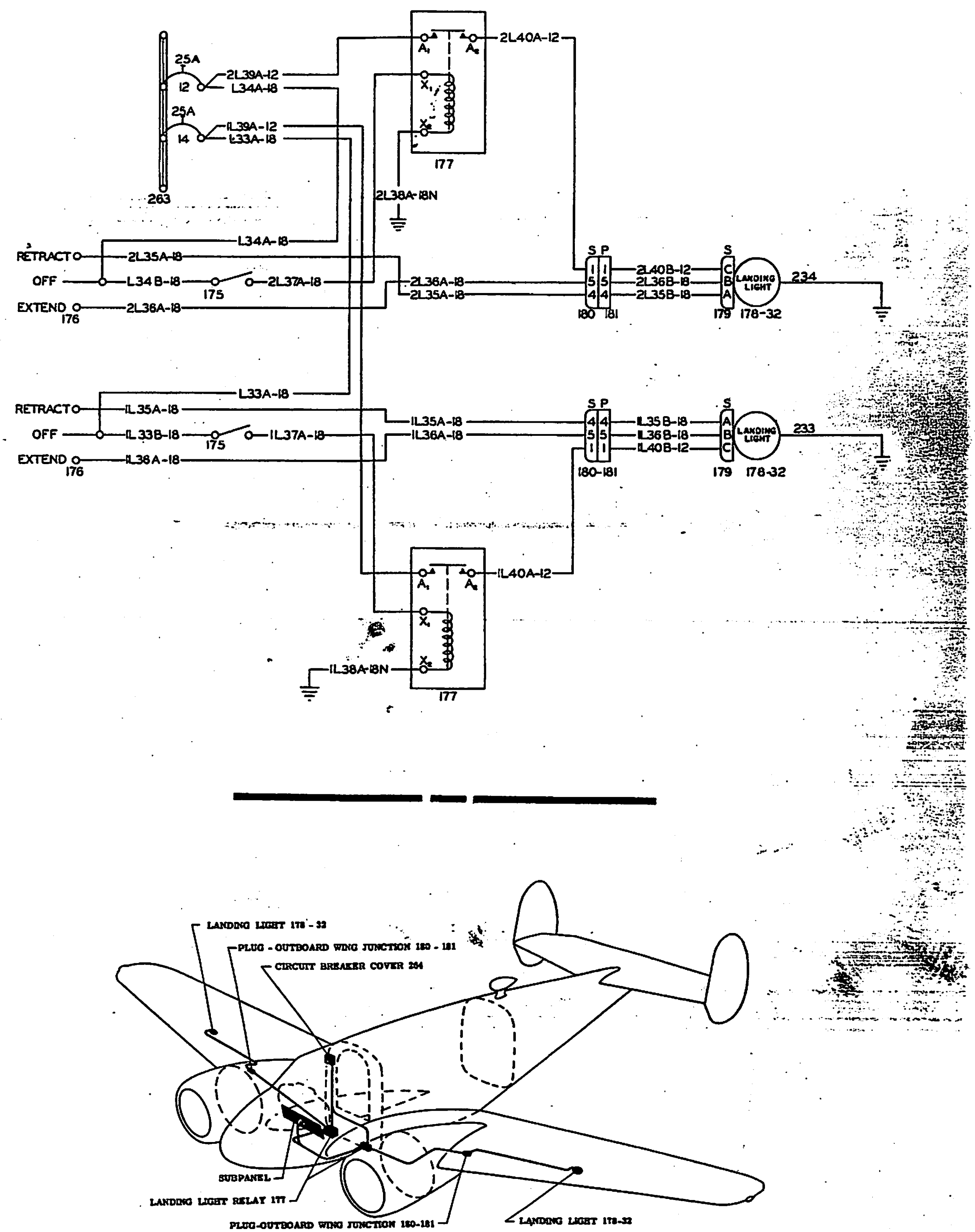


Figure 10-23. Landing Lights Circuit

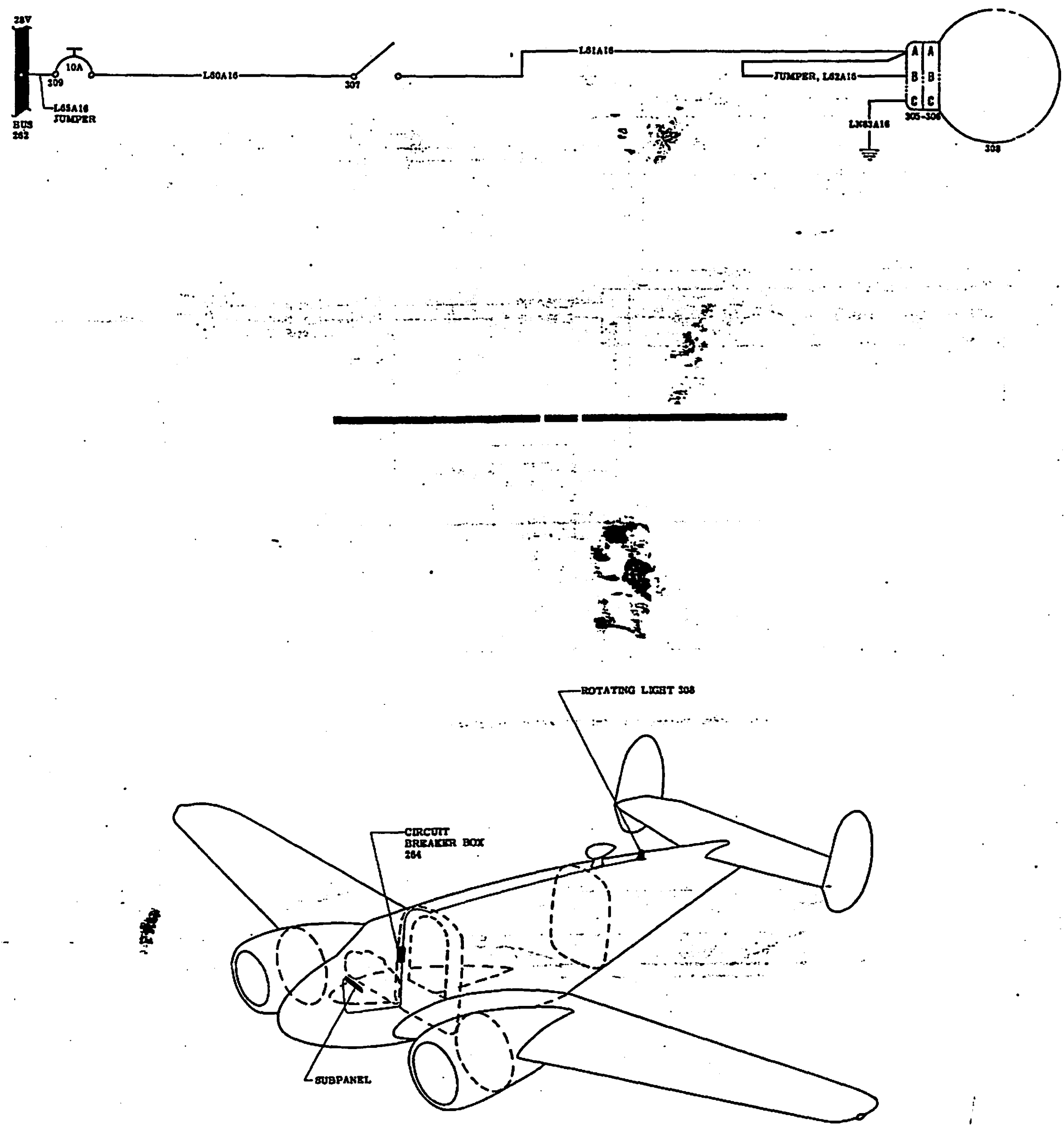


Figure 10-23A. Anti-Collision Light Circuit

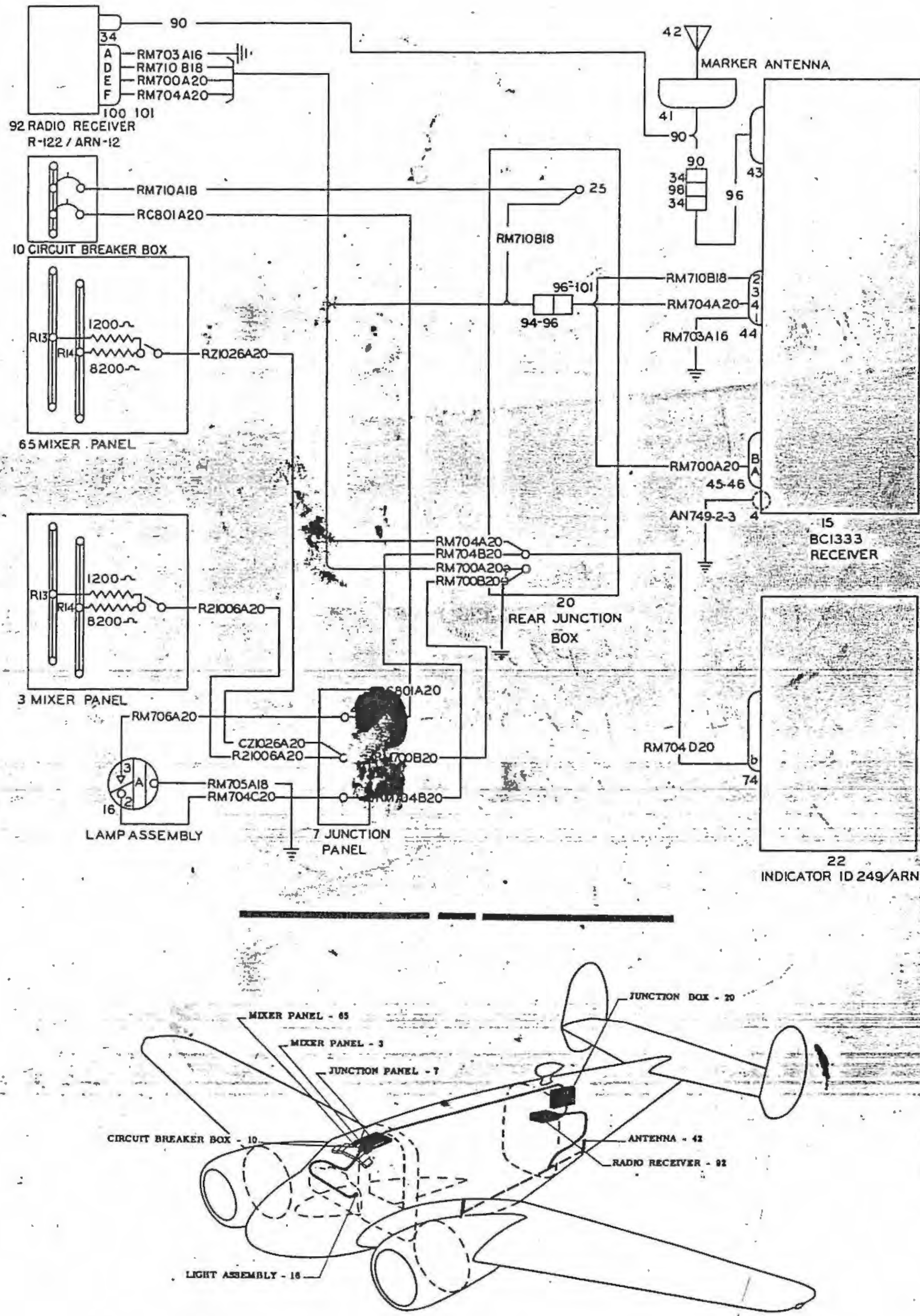


Figure 10-24. Marker Beacon Receiver Circuit

CABLES AVAIL:
~~79?~~
~~793~~
~~RN 79?~~
~~RN 795~~

RN 93
94
RN 95
RN 96

BLANK PAGE

POWER:

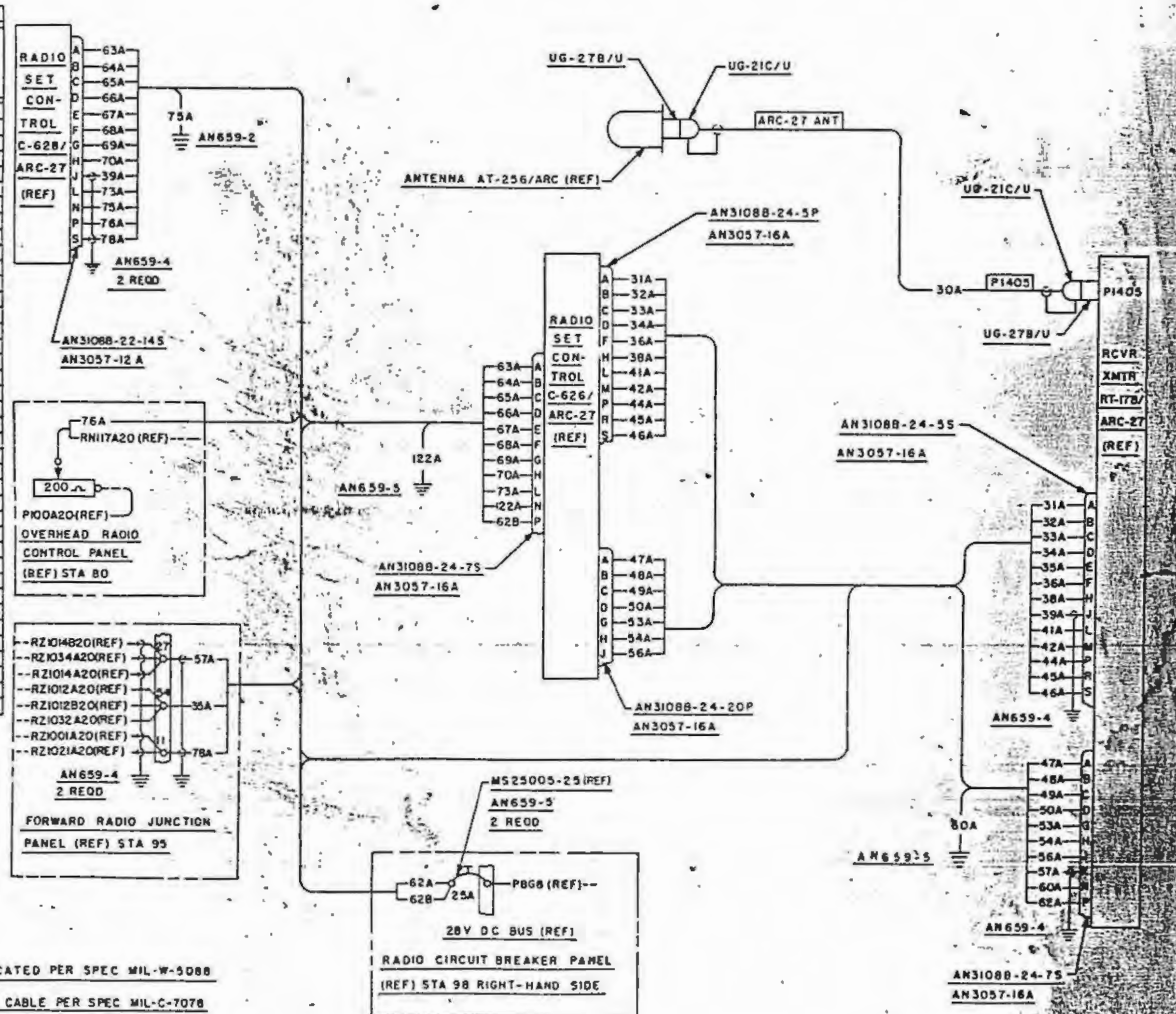
ARN14 - 10 AMP - RN105A - BLUE - TERM

MARKER - RN 910

25

ARC
① - RN72 570 (B)
2 - 73 G
3 - 74 B
4 - 75 B 5 - 76
80
81
82 B

WIRE TABLE		
EXAMPLE OF SECOND WIRE NO. SHOWN IN TABLE BELOW (RU31A20)		
WIRE NO	SIZE	LENGTH
30A	RG-8A/U	10'- 0"
31A	20	5'- 1"
32A		5'- 1"
33A		5'- 1"
34A		5'- 1"
35A		23'-4"
36A		5'- 1"
38A		5'- 1"
39A	+	24'-10"
41A		5'- 1"
42A		5'- 1"
44A		5'- 1"
45A		5'- 1"
46A		5'- 1"
47A		4'- 5"
48A		4'- 5"
49A		4'- 5"
50A		4'- 5"
53A		4'- 5"
54A		4'- 5"
55A		4'- 5"
57A	20 +	22'- 8"
60A	12	1'- 7"
62A	12	20'- 0"
62B	12	22'- 9"
63A	20	21'- 5"
64A		21'- 5"
65A		21'- 5"
66A		21'- 5"
67A		21'- 5"
68A		21'- 5"
69A		21'- 5"
70A		21'- 5"
73A		21'- 5"
75A		0'- 9"
76A		2'- 5"
78A	20	4'-10"
122A	12 +	1'- 6"

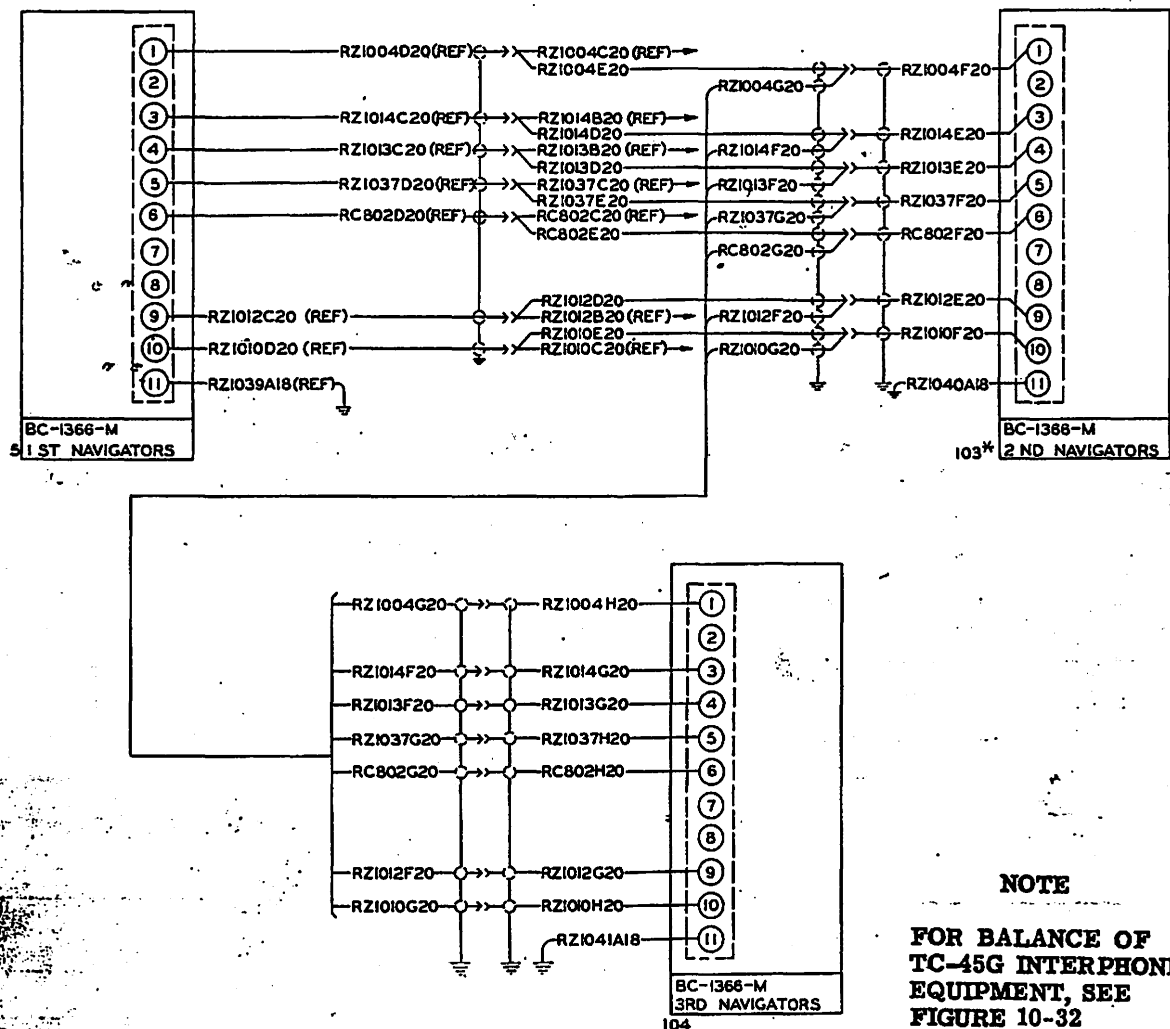


CABLES TO BE FABRICATED PER SPEC MIL-W-5088

+DENOTES SHIELDED CABLE PER SPEC MIL-C-7078

WIRE IS AIRCRAFT CABLE PER SPEC MIL-W-5086

Figure 10-27. AN/ARC-27 Wiring Diagram



NOTE

FOR BALANCE OF TC-45G INTERPHONE EQUIPMENT, SEE FIGURE 10-32

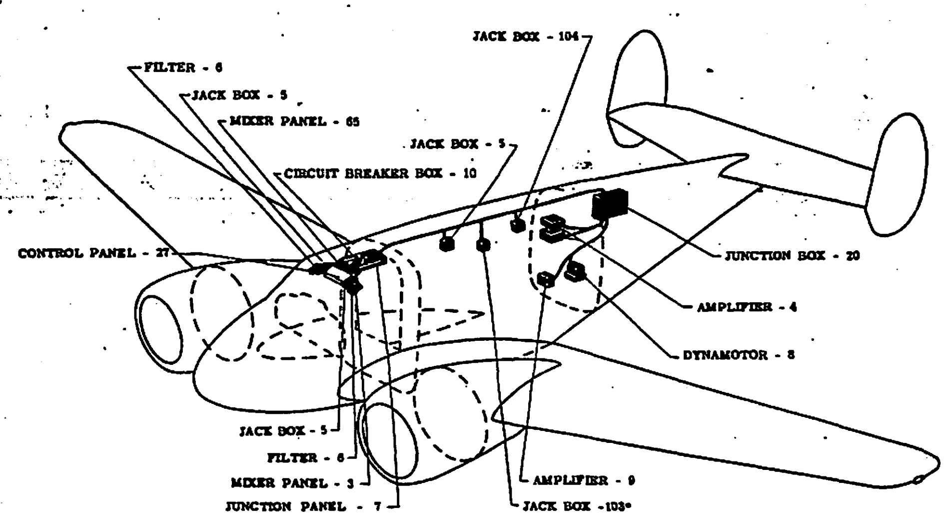
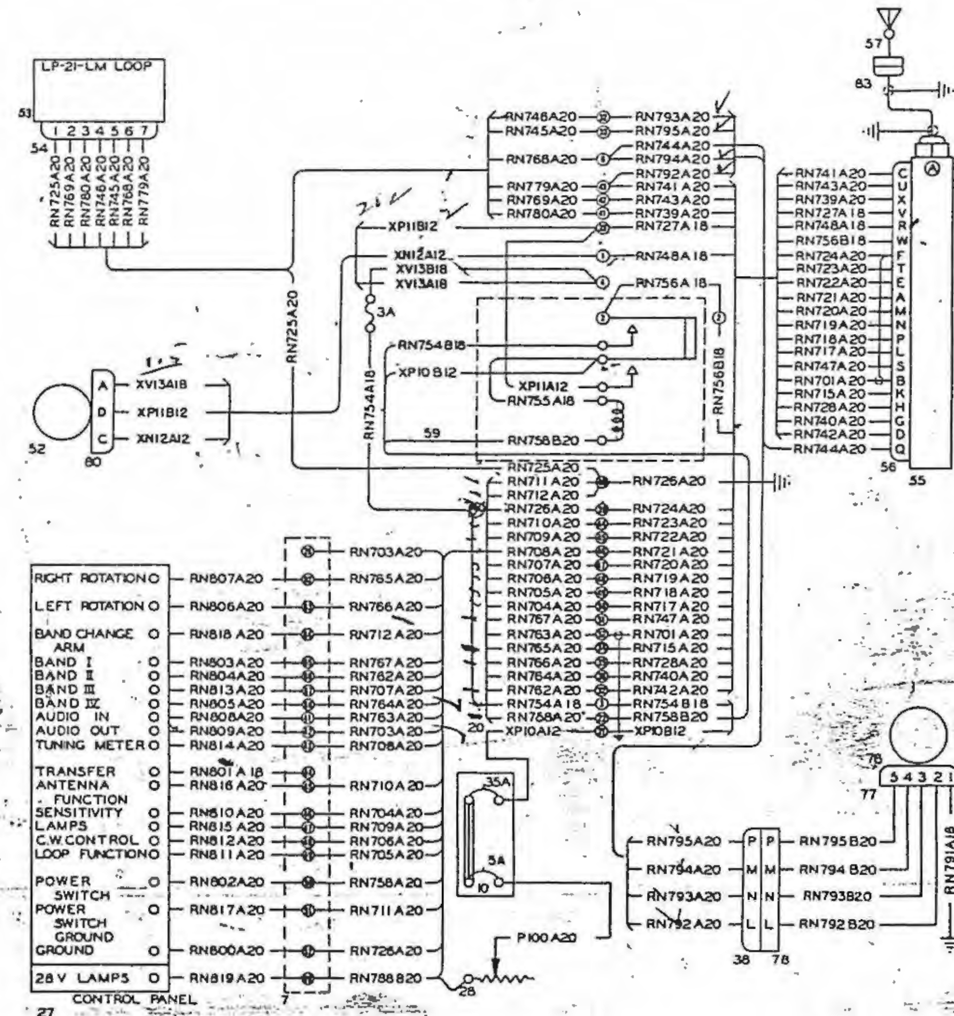
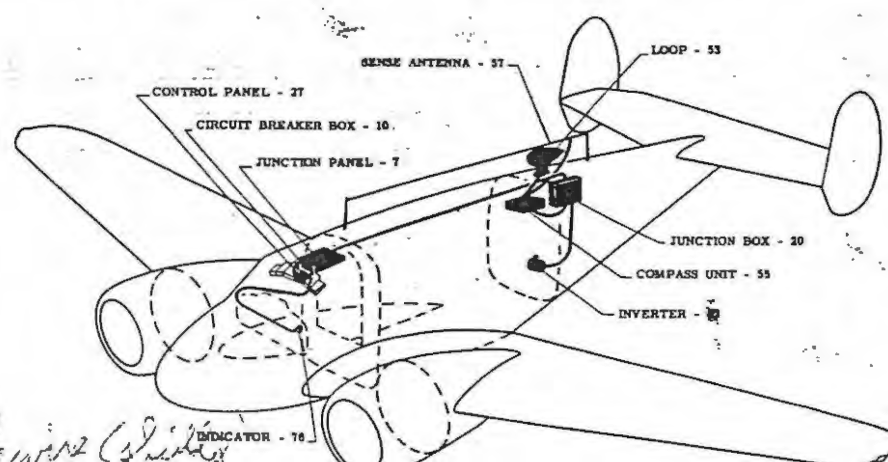


Figure 10-28. Interphone Circuit



O.H.

762-37 742
(SOLDER JOINT)



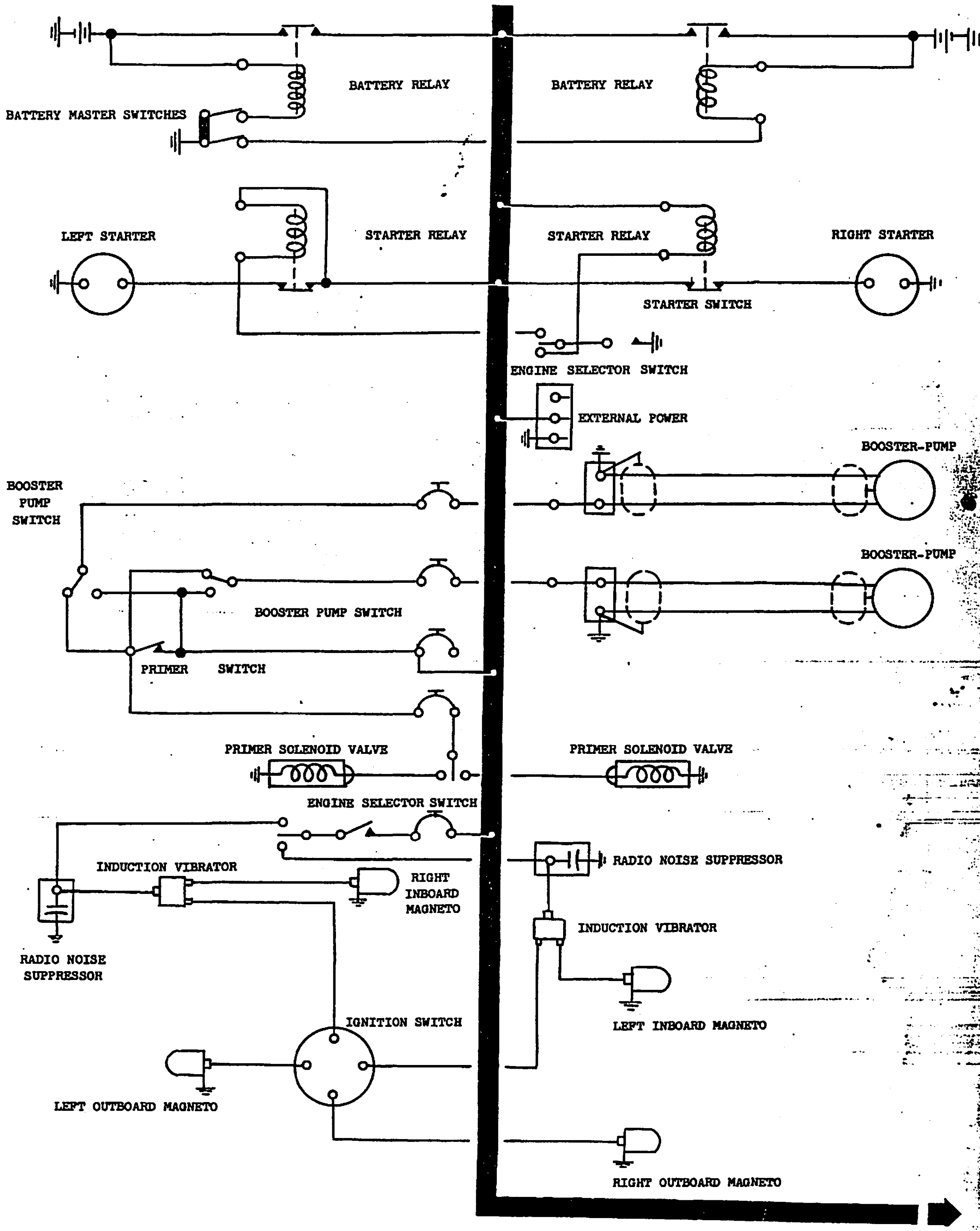
763 wire

Figure 10-29. Radio Compass Circuit

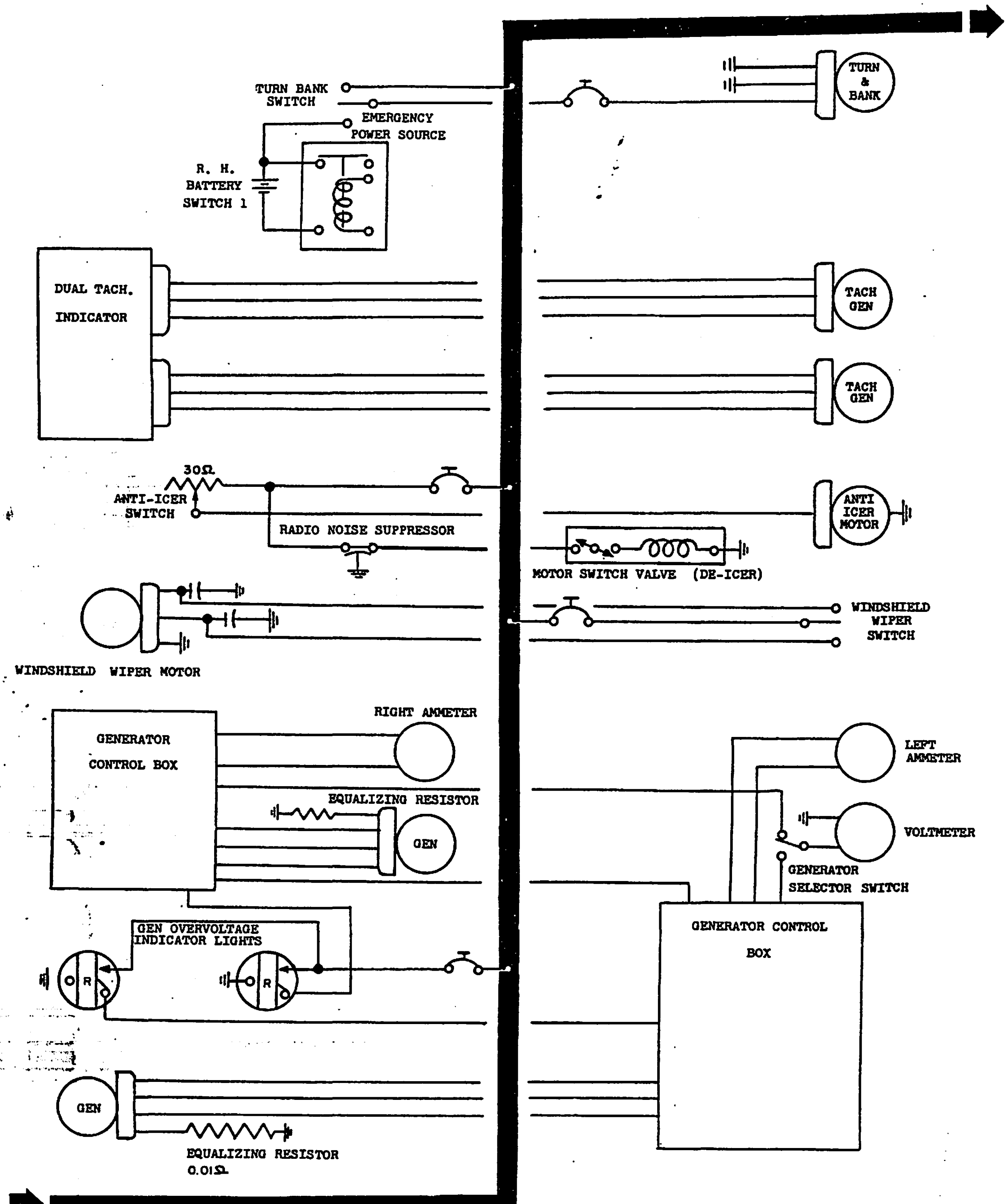
BLANK PAGE

ARN7 BOOK	(TECH MAN.)
(1)	40
(2)	42
(H)	35
(K)	34

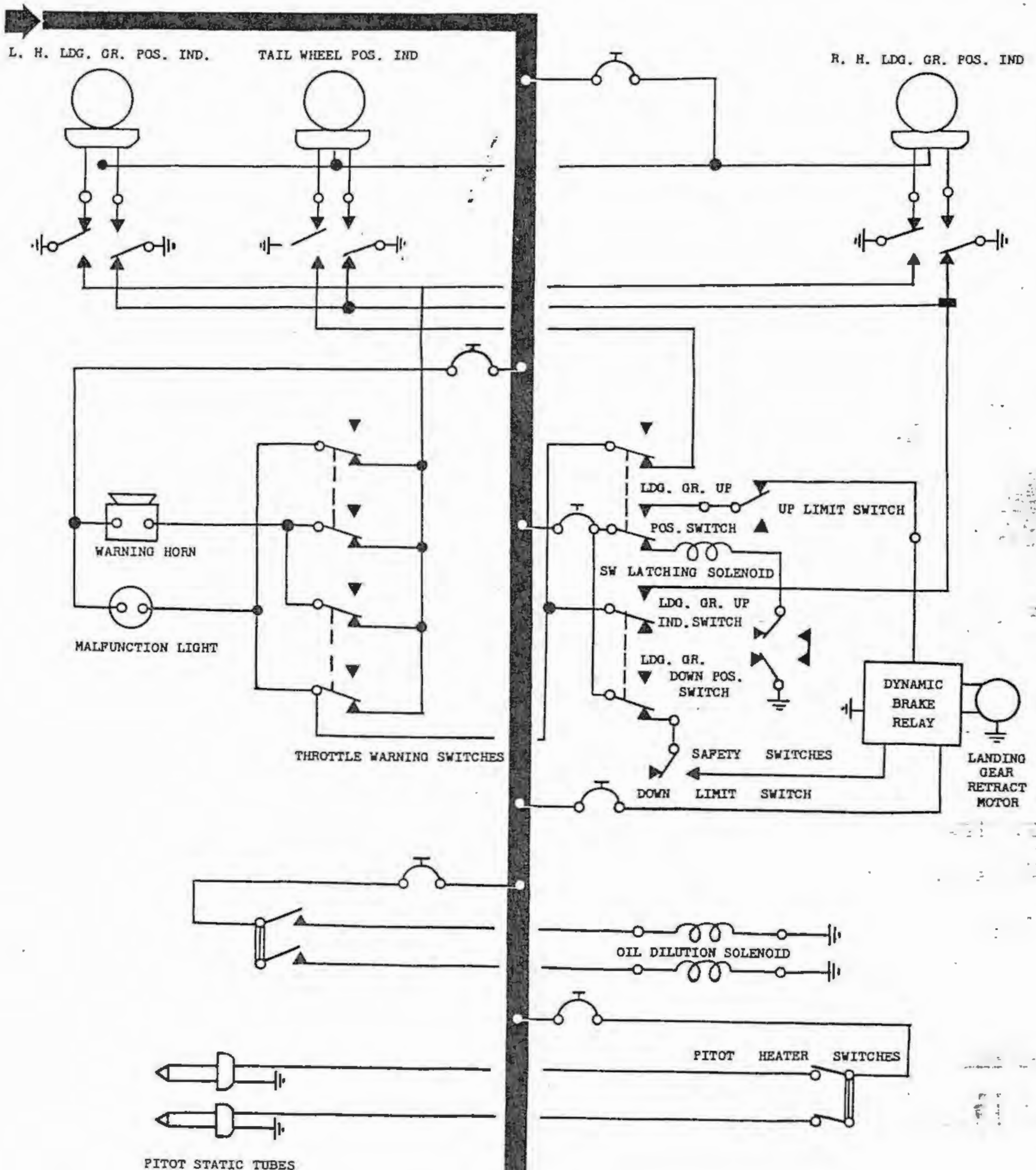
REVERSED DUE TO SENS. ANT. MOUNTED BOTTOM.



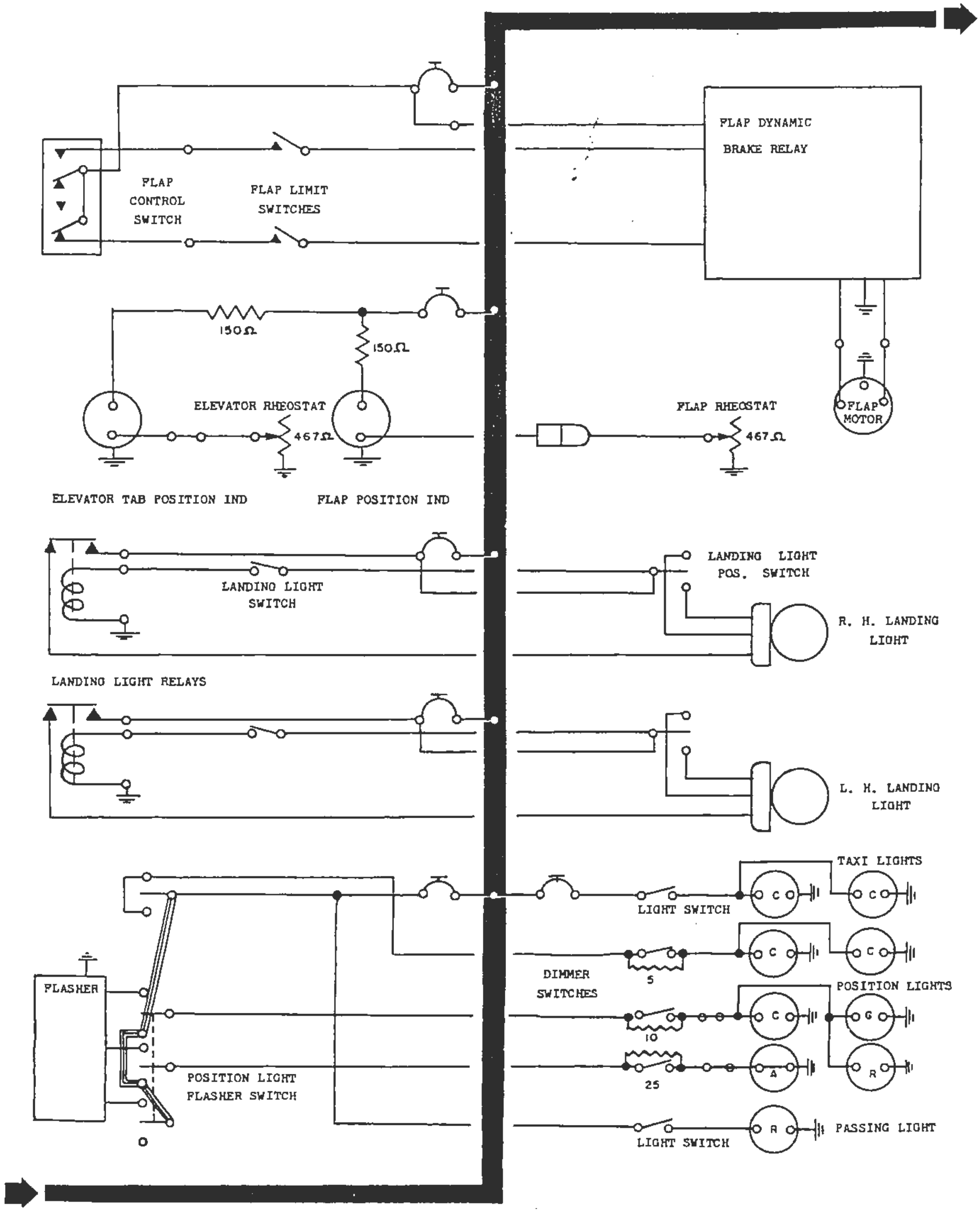
(C-45G and TC-45G)
Figure 10-34. General Electrical Schematic Diagram (Sheet 1 of 7 Sheets)



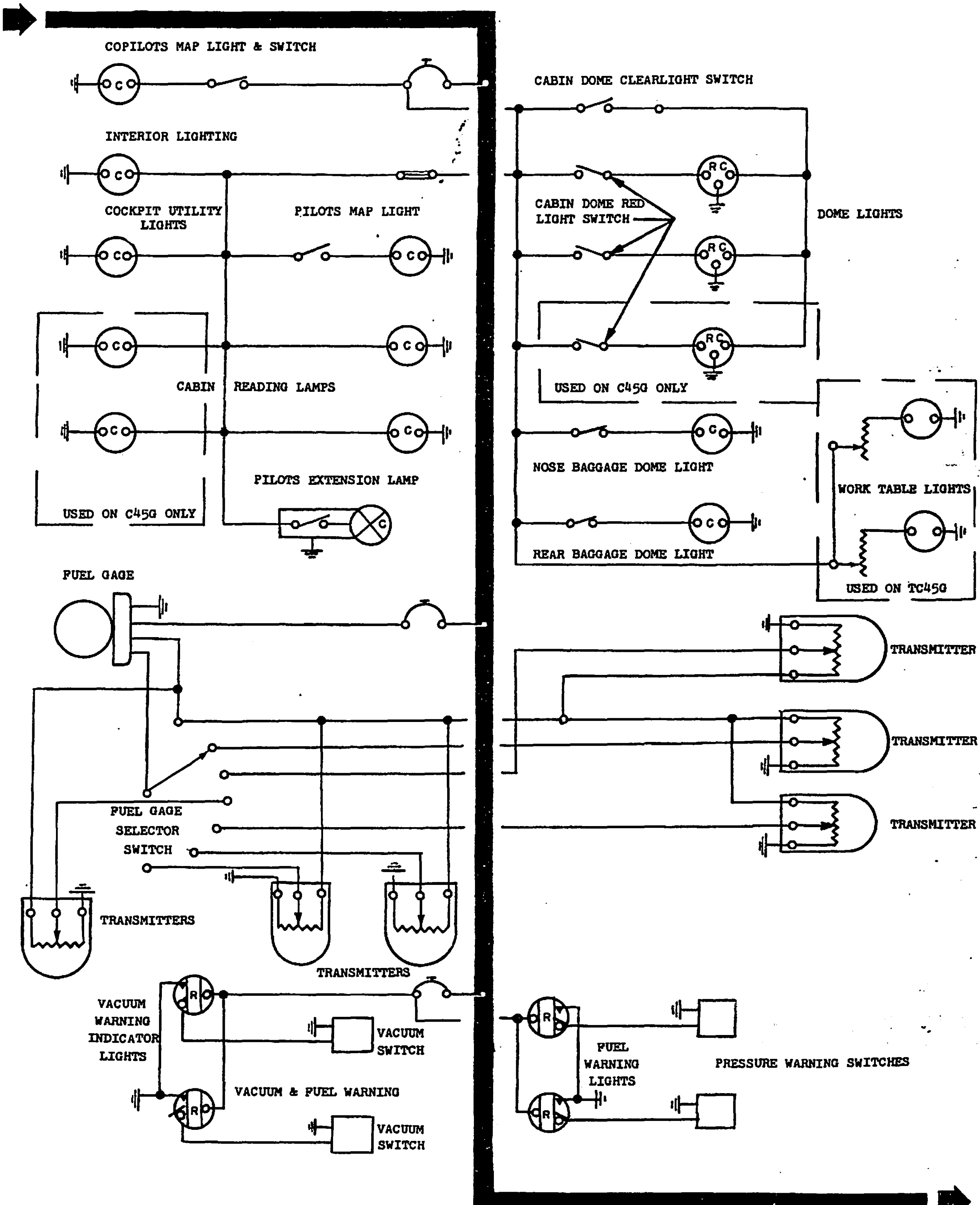
(C-45G and TC-45G)
Figure 10-34. General Electrical Schematic Diagram (Sheet 2 of 7 Sheets)



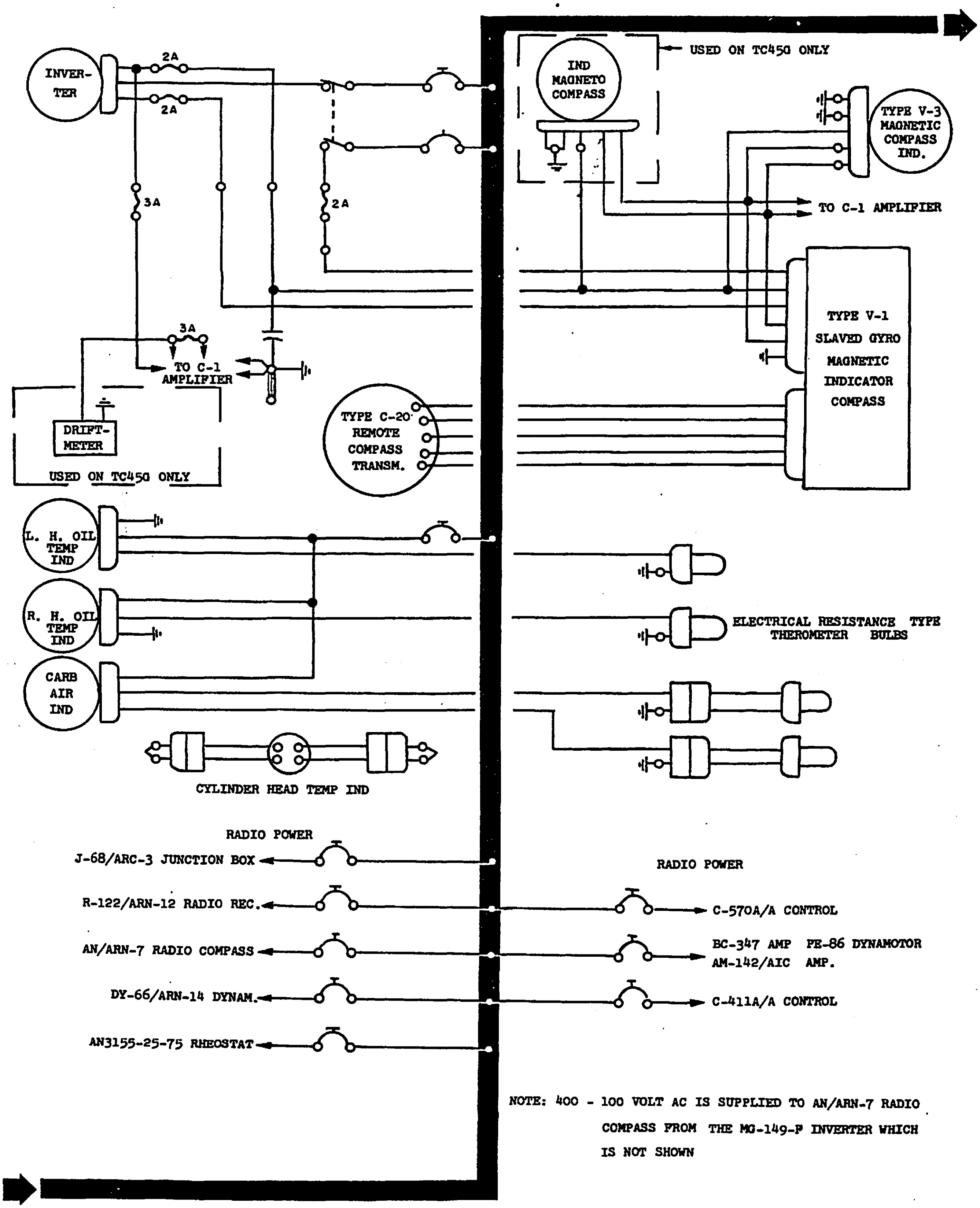
(C-45G and TC-45G)
Figure 10-34. General Electrical Schematic Diagram (Sheet 3 of 7 Sheets)



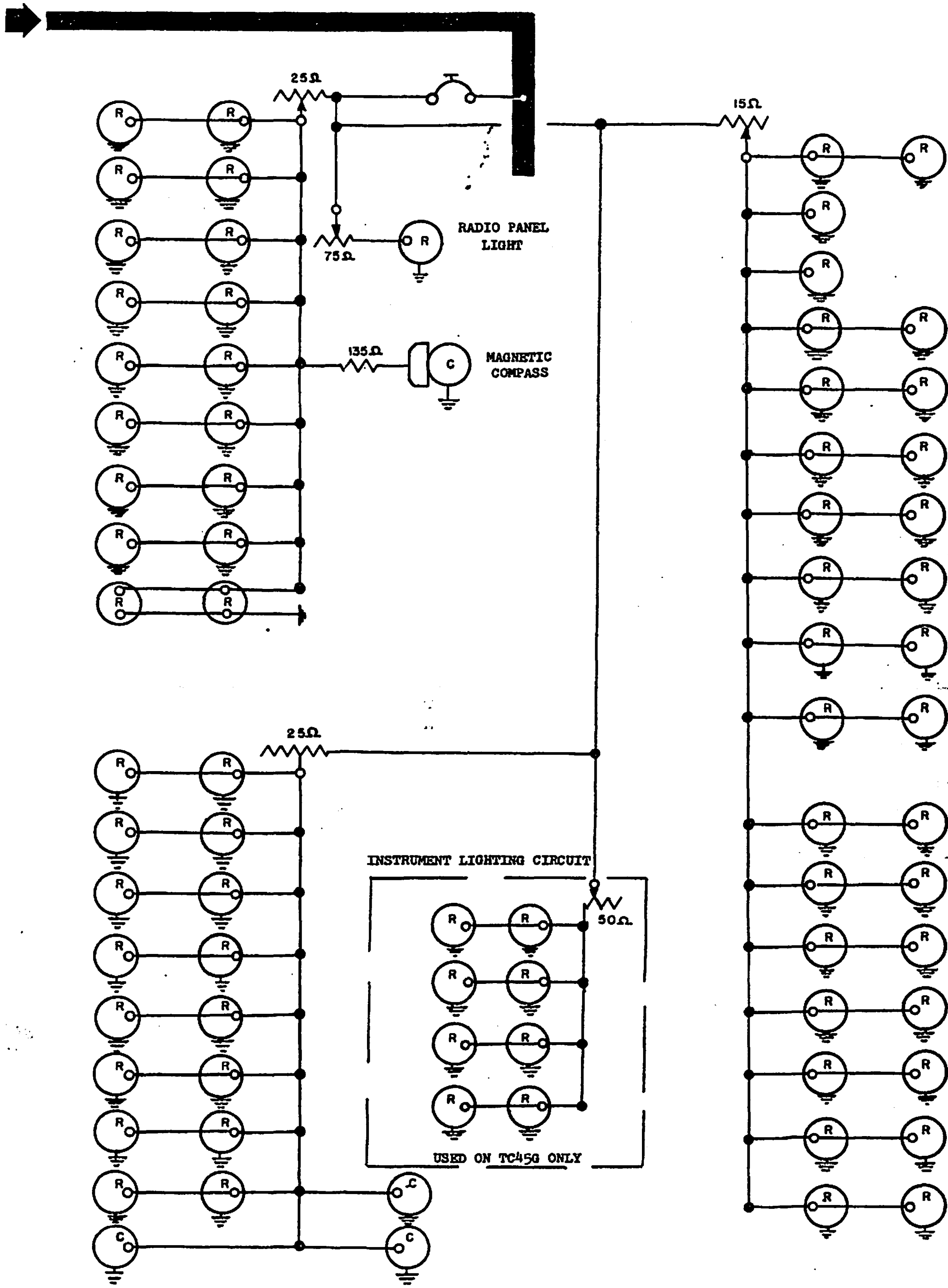
(C-45G and TC-45G)
Figure 10-34. General Electrical Schematic Diagram (Sheet 4 of 7 Sheets)



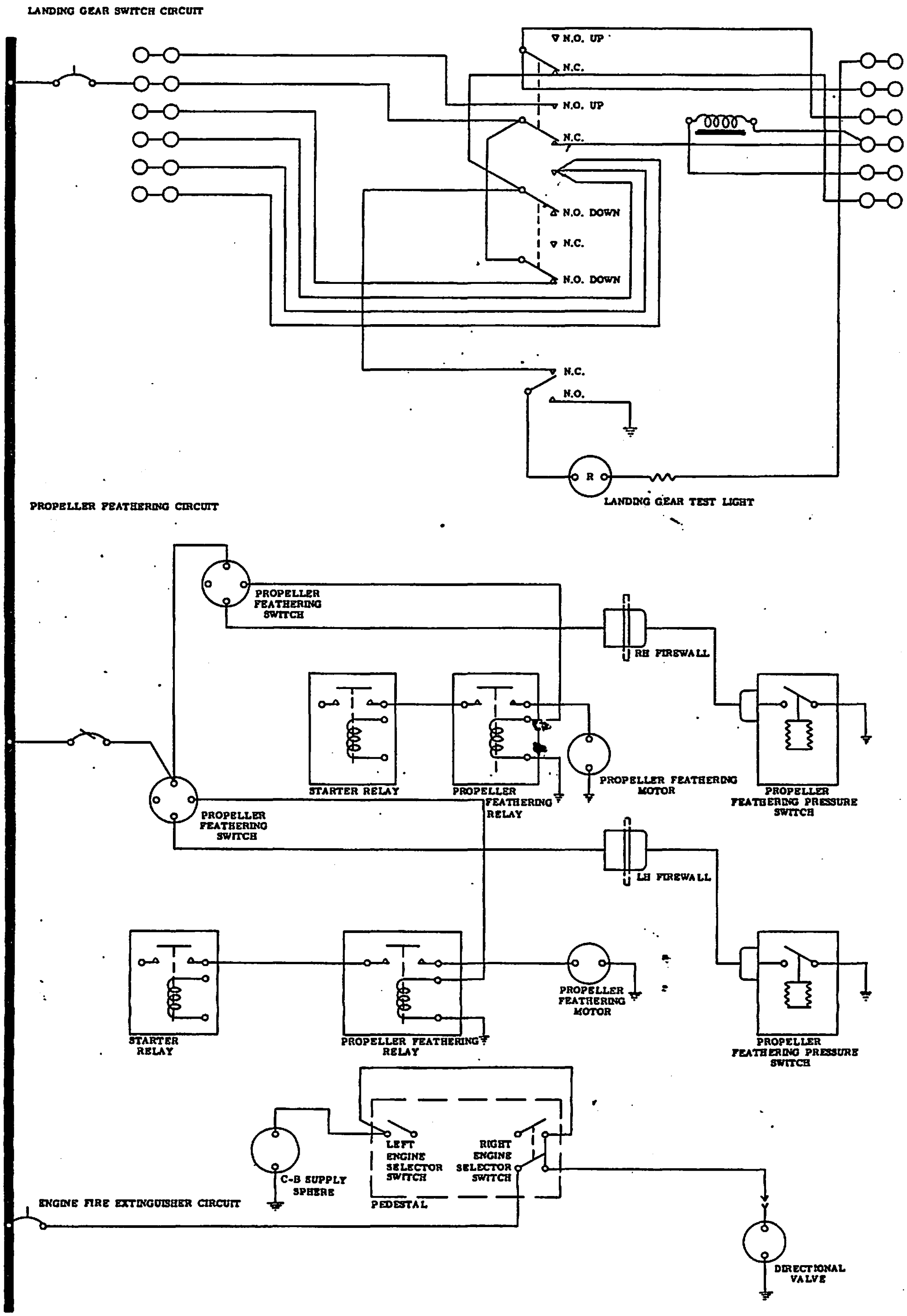
(C-45G and TC-45G)
Figure 10-34. General Electrical Schematic Diagram (Sheet 5 of 7 Sheets)



(C-45G and TC-45G)
Figure 10-34. General Electrical Schematic Diagram (Sheet 6 of 7 Sheets)



(C-45G and TC-45G)
Figure 10-34. General Electrical Schematic Diagram (Sheet 7 of 7 Sheets)



(C-45H)
Figure 10-35. General Electrical Schematic Diagram

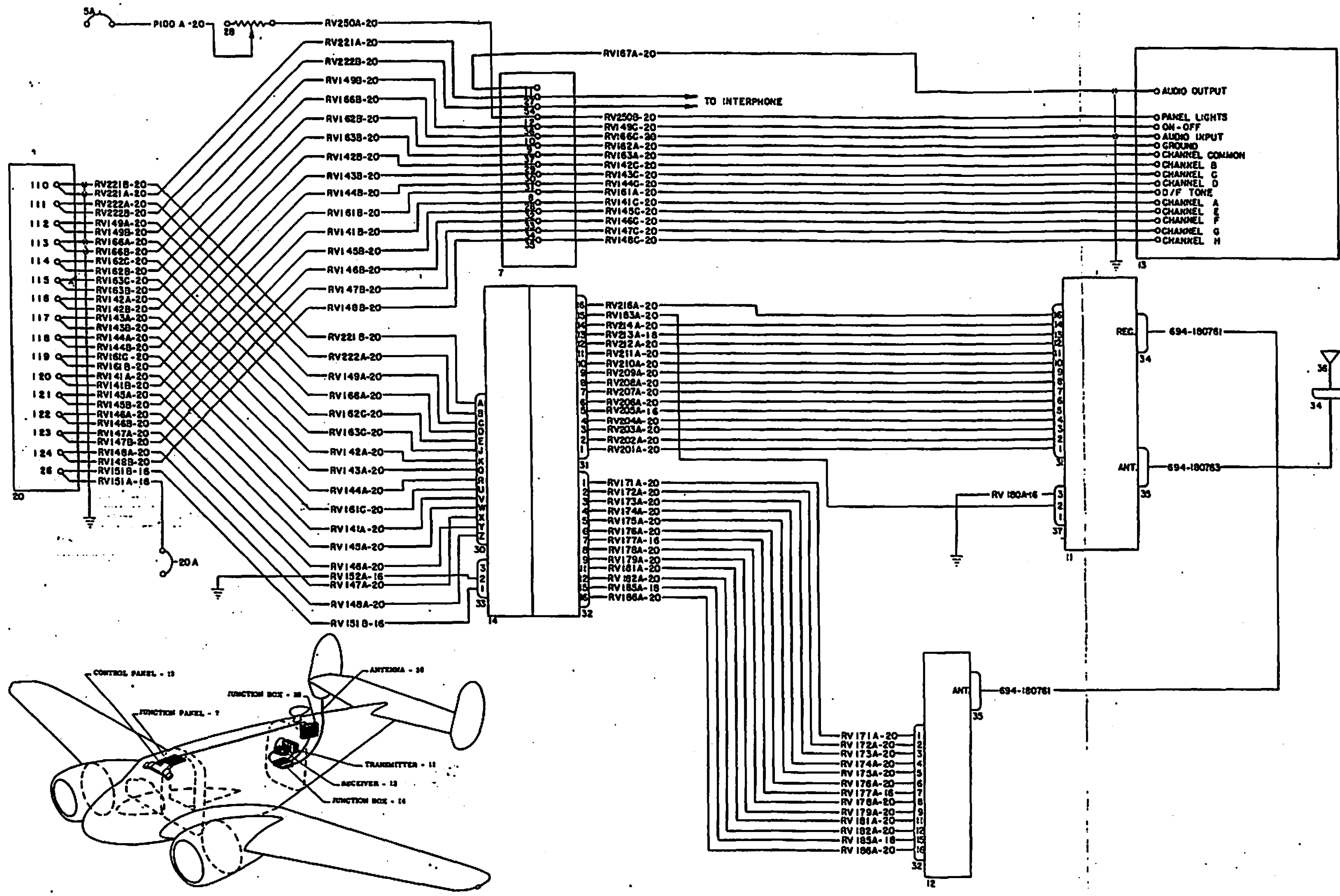
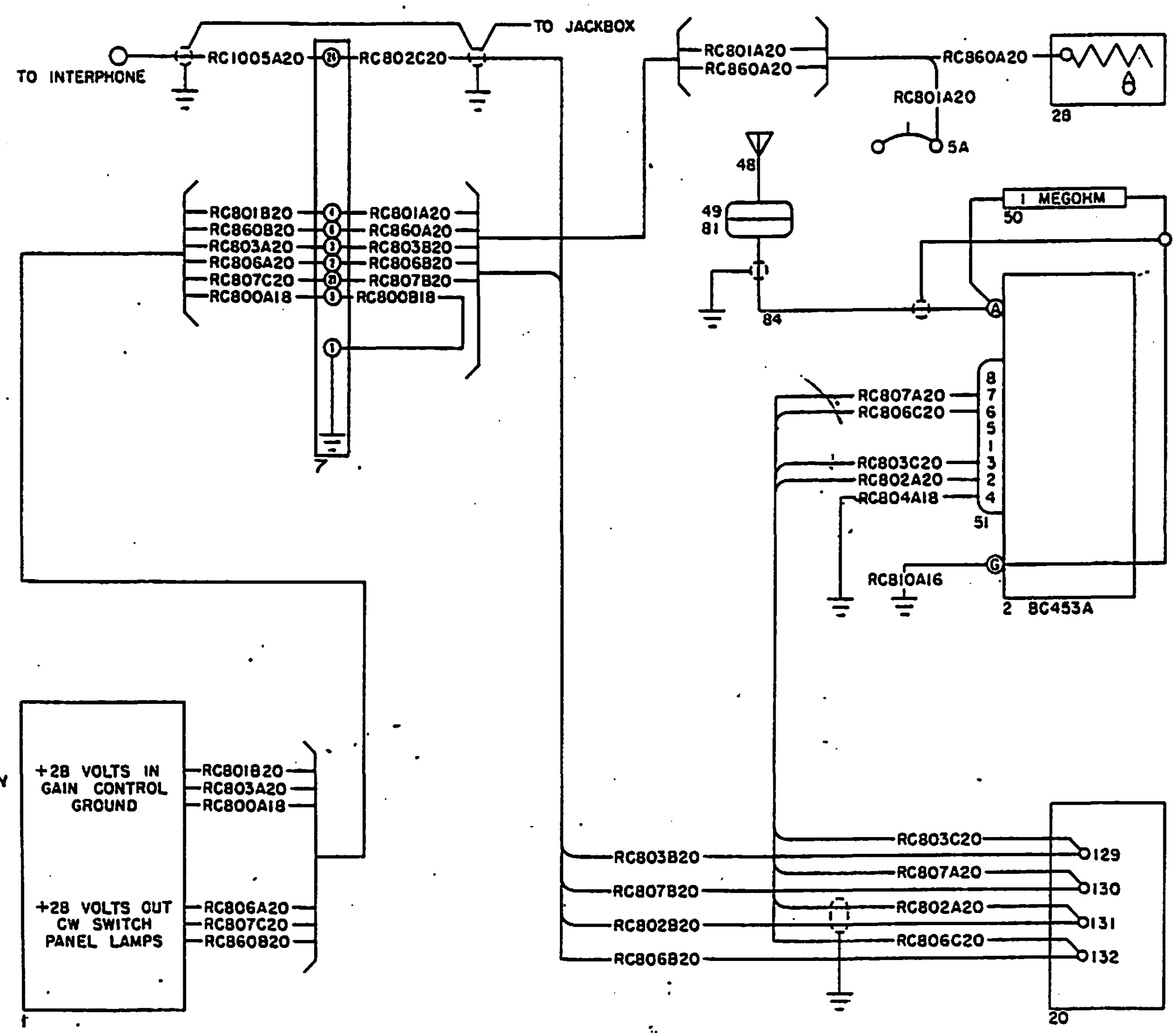


Figure 10-25. VHF Receiver and Transmitter Circuits



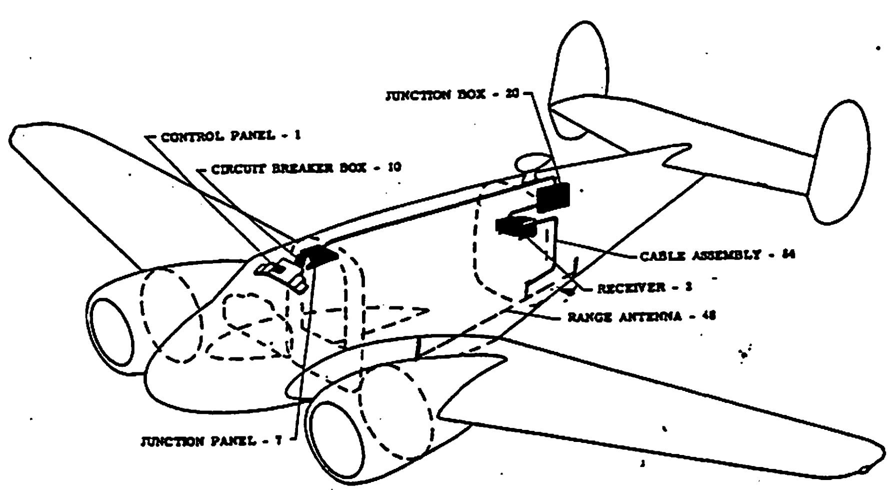


Figure 10-26. Low Frequency Range Receiver Circuit

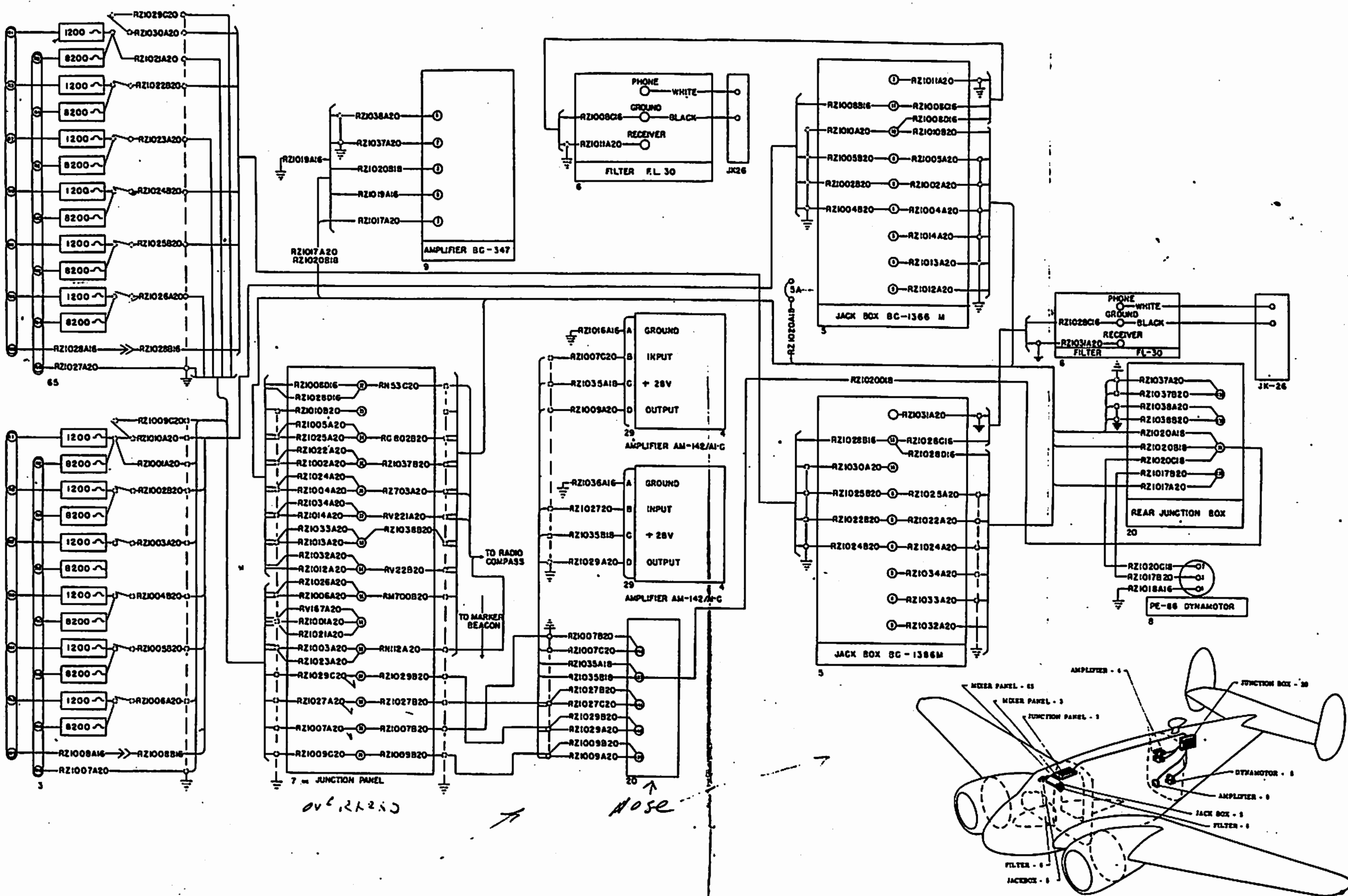


Figure 10-30. Interphone Circuit

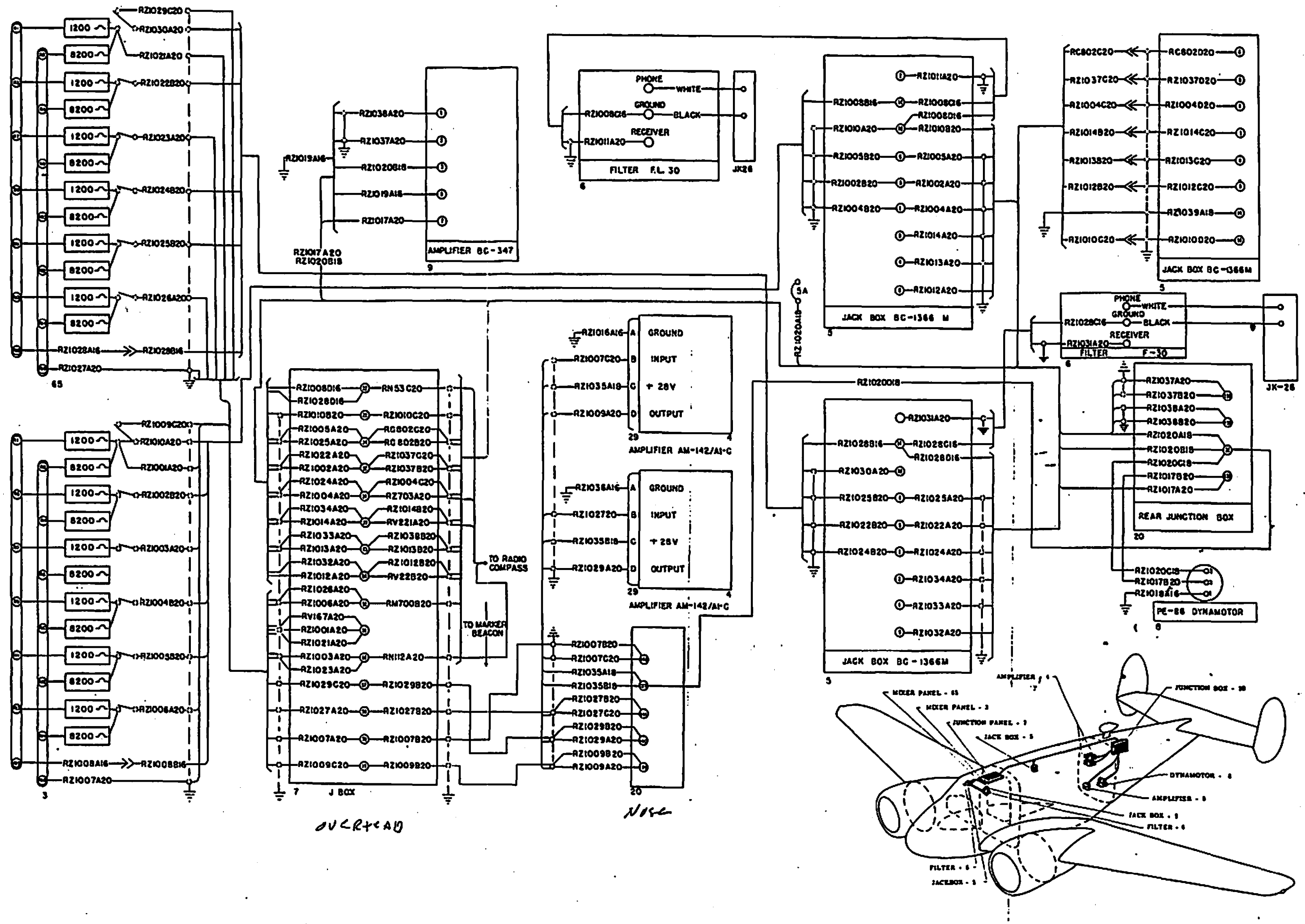


Figure 10-32. Interphone Circuit

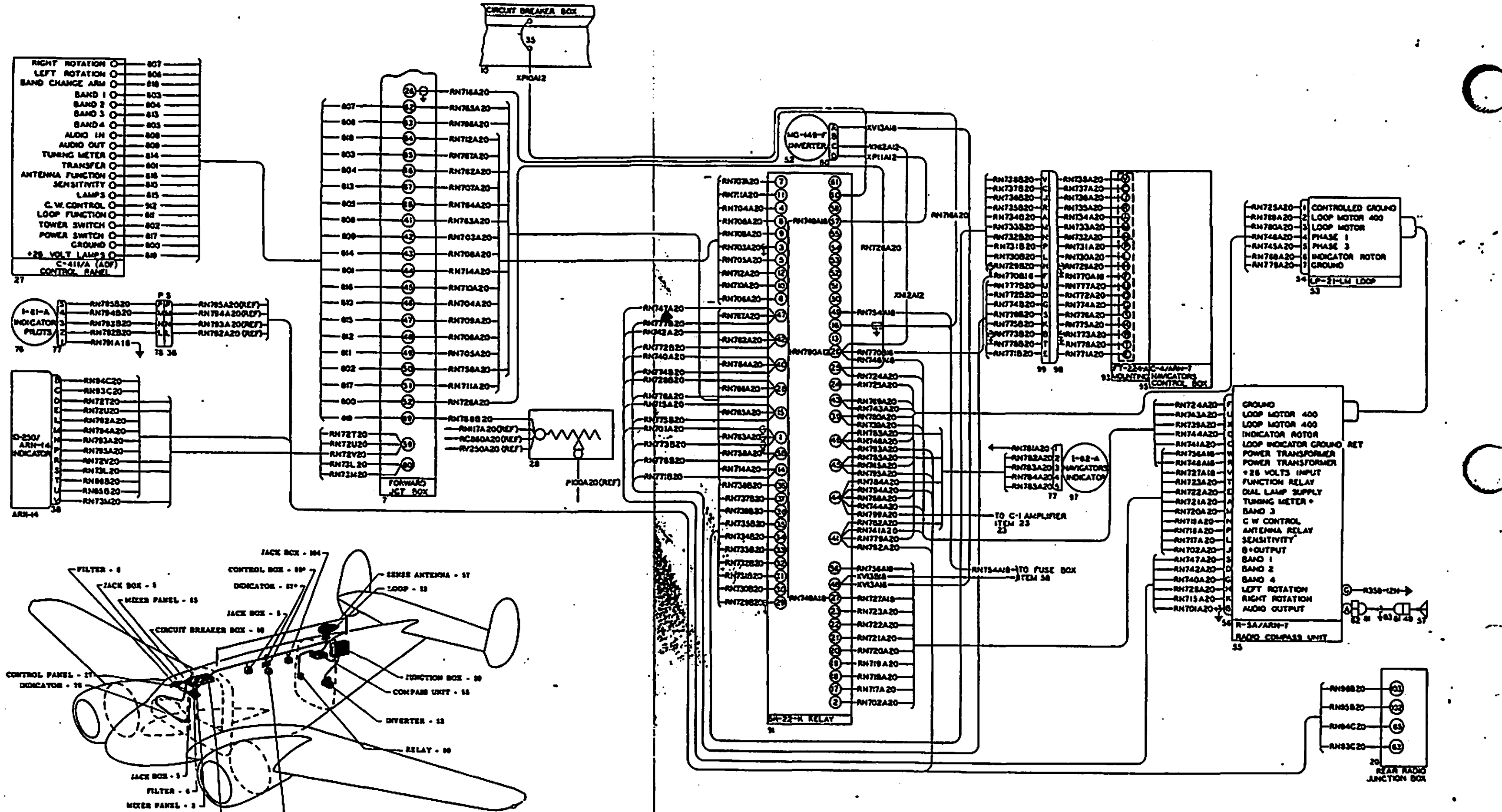


Figure 10-33. Radio Compass Circuit

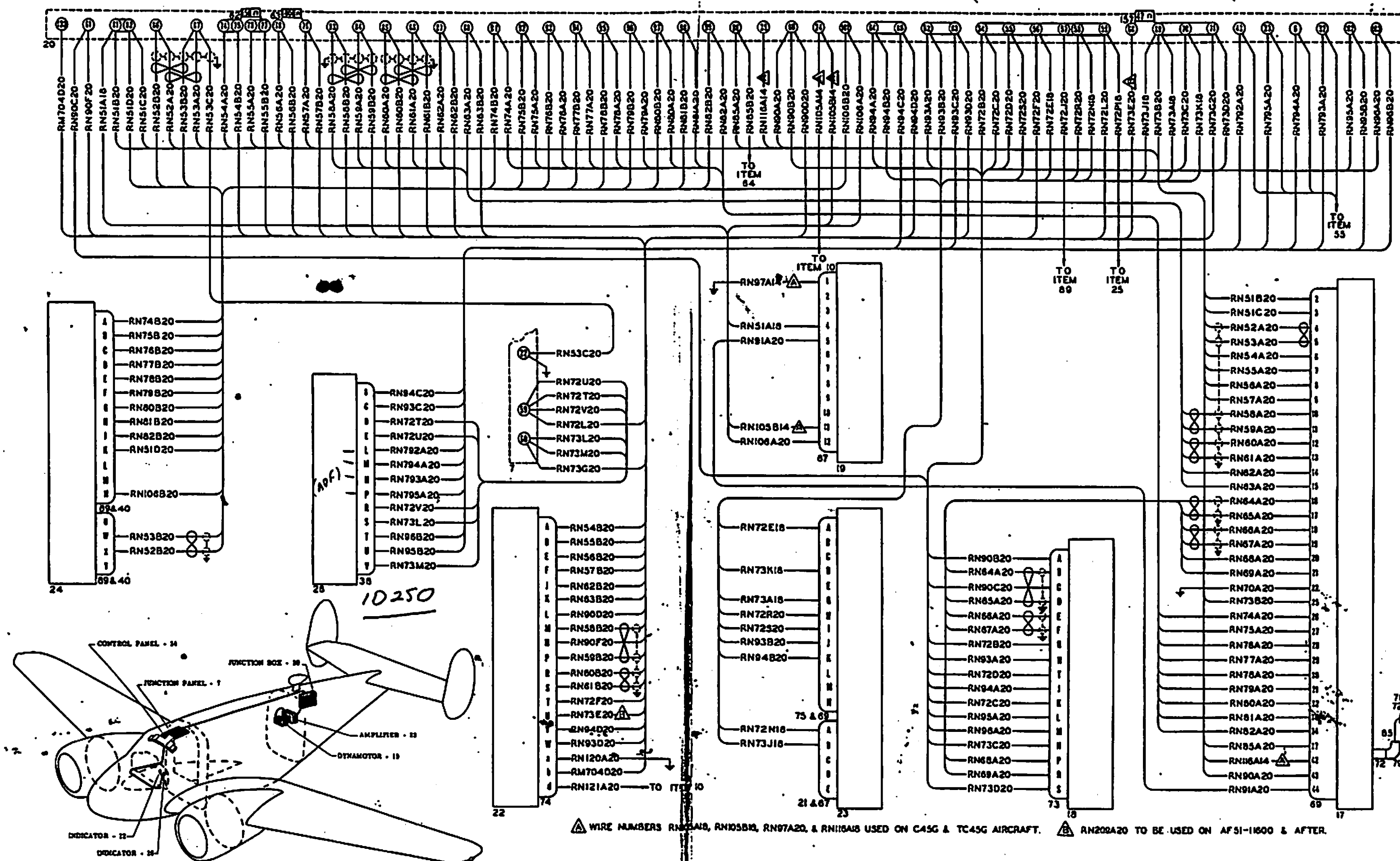


Figure 10-31. ARN-14 Radio Circuit

INDEX

A

Access and Inspection Provisions 1
Ailerons 40
Antenna Installation 265
Anti-Icer System 127

B

Battery, Servicing 20
Battery System 244
Brake Bleeding 77
Brake, Hydraulic 68
Brake, Master Cylinder 72
Brake, Parking 14
Brake, Parking Operation 14

C

Carburetors 161
Center Section 32
Chains, Retract, Landing Gear 88
Circuit Protection 250A
Cleaning 24
Clutch, Landing Gear 87
Compartment, Cabin 28
Compartment, Lavatory 29
Compartment, Nose 28
Compartment, Pilot's 28
Compartment, Pilot's Sliding Window . . 32
Compartment, Tail 29
Control Lock, Surface 14
Control System, Aileron 46
Control System, Aileron Tab 50
Control System, Elevator 57
Control System, Elevator Tab 59
Control System, Flap 52
Control System, Rudder 61
Control System, Surface 46
Converters, Windshield Wiper 126
Cowl and Mount, Engine 147
Cowling, Ring 147
Cowling, Tail 29
Cowling, Wrapper Sheets 147

D

Deicer System 114
Doors, Landing Gear and Tail Wheel . . . 83
Drag Leg, Landing Gear 80
Drag Leg, Servicing 18

E

Elevator 45
Engines 131
Engine Build-Up 134
Engine Cockpit Check 144
Engine Cold Weather Maintenance of Oil System 167
Engine, Control of Removal 205
Engine Depreservation 143
Engine, Foreign Material in Oil System . . . 209
Engine Installation 141
Engine, Metal Particles in Oil 206
Engine, Oil Consumption 208

E

Engine Oil System Desludging 167
Engine Operation 144
Engine Overspeeding 208
Engine, Spark Plugs 214
Engine, Spark Plug Copper Run-Out 209
Engine, Test for Metal Particles 208
Engine Warm-Up 144
Equipment 24
Exhaust, Cabin Air 114
Exhaust Collector Ring 177

F

Fire Extinguisher, Engine 116
Fire Extinguisher, Hand Operated 121
Flaps 42
Flap Electrical System 52
Flaps, Engine Cowl 147
Fuel System 157
Fuselage 28

G

Gage, Fuel Level 159
Gage, Fuel Liquidometer Transmitter . . . 159
General Description 1
Generator System 245
Generators, Paralleling 247

H

Handling, Ground 9
Heating System 111
Hoisting 7
Hot Air Control Valve 113

I

Ignition System 170
Induction System, Air 177
Induction Vibrator 170
Instruments, Engine 217
Instruments, Flight 217
Instruments, Miscellaneous 221
Instruments, Navigation 219
Instruments, Navigation Training (TC-45G) . . 220
Instrument Panel, Floating 229
Intensifier Tube 112
Interphone System 264

J

Jacking 7

L

Landing Gear 66
Landing Gear Electrical System 95
Leveling 7
Light, Anti-Collision 250A
Lights, Clearance 250A
Lights, Landing 249
Light, Passing. 250A
Lights, Position 249

INDEX (CONT)

L

Lighting, Interior 248
Lighting System, Exterior 249
Lines, Fuel 160
List, Electrical Equipment 272
List, Radio Equipment 277
Lock Controls, Tail Wheel 84
Lubrication 24
Lubrication, Notes - Special 24
Lubrication System (Engine) 163

M

Marker Beacon Receiver, R-122/ARN-12 262
Mooring Instructions 12
Motor, Landing Gear 85
Motor Gearbox, Landing Gear 86
Mount, Engine 147

N

Nacelles, Engine 33

O

Oil Dilution System 166
Oxygen System 123
Oxygen System 19

P

Parking Instructions 12
Pilot, Automatic 230
Position Indicator System, Landing Gear 97
Pressure System, Pitot and Static 230
Primer System 162
Principal Dimensions 1
Propellers 142
Pump Assembly, Anti-Icer 128
Pump, Booster Fuel 158
Pump, Fuel 160

R

Radiator Air Ducts and Oil Radiators 165
Radio Compass, AN/ARN-7 261
Range Receiver, BC-453-B 263
Regulator (Automatic) Oxygen 124
Regulators, Oxygen (Demand Type) 123
Regulator, Voltage 246
Relay, Dynamic Brake, Flap 53
Relay, Dynamic Brake, Landing Gear 97
Relay, Field Control 248
Relay, Overvoltage 247
Relay, Reverse-Current 247
Reservoir Fluid, Automatic Pilot 16
Reservoir, Brake Fluid 17
Retract System, Landing Gear 85
Rheostat, Flap 54
Rudder 46

S

Servicing 14
Servo Units, Automatic Pilot 232
Shock Absorber Assembly, Landing Gear 79
Shock Strut Servicing, Landing Gear 18
Slide Assembly, Landing Gear 94
Slide Tubes, Landing Gear and Tail Wheel 92
Stabilizer, Horizontal 43
Stabilizer, Vertical 44
Starting System 176
Supercharging 176
Supercharging, Air Induction and Exhaust System 176
Switch, Flap Position 52
Switch, Fuel Level Gage Selector 160
Switch, Limit, Landing Gear 98
Switch, Magnetos and Ignition 170
Switch, Position Indicator, Landing Gear 100
Switch, Safety, Landing Gear 96
Switches, Warning Horn, Landing Gear 101

T

Tail Gear Assembly 82
Tail Gear Truss Assembly 82
Tank, Anti-Icer 127
Tank Capacities 24
Tank, Fluid, Anti-Icing 18
Tanks, Fuel 157
Tanks, Main, Auxiliary and Nose 16A
Tanks, Oil 163
Tanks, Oil 16A
Tie-Down Accessories 13
Tire Inflation 20
Tools, Special 24
Torque Value 24
Towing 14
Tubing and Cylinders, Oxygen 124
Tubing Identification 24

V

Vacuum System, Instrument 228
Valve, Brake Shuttle 76
Valve, Carburetor Alternate Air 178
Valve, Check Anti-Icer 128
Valve, Cold Air Control 114
Valve, Deicer Distributor 116
Valve, Oil By-Pass 168
Valve, Parking Brake 76
Ventilating System 114
VHF Radio Equipment, AN/ARC-3 259

W

Wheel, Tire and Tube, Tail Gear 82
Wheels, Tires and Tubes, Landing Gear 66
Windshield Wiper System 126
Wing Fitting 35
Wing Panel, Outer 33
Wing Tips 40