MOONEY M20 SERIES SERVICE & MAINTENANCE MANUAL

APPLICABLE TO THE FOLLOWING AIRCRAFT

MODEL	SERIAL NUMBERS
MARK 21	
1962-M20C	S/N 1940 thru 2207, S/N 2209 thru 2255, S/N 2257 thru 2296, and S/N 1852
1963-M20C	S/N 2297 thru 2622, S/N 2208, and S/N 2256
1964-M20C	S/N 2623 thru 2741, S/N 2743 thru 2806
1965-M20C	S/N 2807 thru 3184 and S/N 2742
1966-M20C	S/N 3185 thru 3466
1967-M20C	S/N 670001 thru 670149
SUPER 21	
1964-M20E	S/N 101 thru 399, 401 thru 469
1965-M20E	S/N 470 thru 831, and S/N 400
1966-M20E	S/N 832 thru 1308
1967-M20E	S/N 670001 thru 670062

MODEL	SERIAL NUMBERS
MASTER	
1963-M20D	S/N 101 thru 200 and S/N 1
1964-M20D	S/N 201 thru 251
1965-M20D	S/N 252 thru 259
1966-M20D	S/N 260 Only
EXECUTIVE 21	
1967-M20F	S/N 660003, 660004, and S/N 670001 thru 670539

THIS REVISED EDITION SUPERSEDES ALL MOONEY M20C,D & E (1962-1965) SERVICE & MAINTENANCE MANUALS.

PART NUMBERS AND STATION CALLOUTS IN THIS MANUAL MAY NOT APPLY TO ALL MODELS.

ALL REFERENCES IN THIS MANUAL TO M20E MODEL AIRCRAFT ARE ALSO APPLICABLE TO M20F MODEL AIRCRAFT UNLESS OTHERWISE NOTED.

A SIX-DIGIT SERIAL NUMBER CODE WILL BE USED FOR ALL 1967 AND SUBSEQUENT M20 SERIES MODELS. CONSEQUENTLY, ALL FOUR-DIGIT (1962-1966) SERIAL NUMBER CALL-OUTS IN THIS MANUAL WITH "& ON" DESIGNATIONS SHOULD BE UNDERSTOOD TO INCLUDE ALL SUBSEQUENT FOUR-DIGIT AND SIX-DIGIT SERIAL NUMBERS FOR THE MODEL(S) SPECIFIED.

MOONEY AIRCRAFT CORPORATION
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KERRVILLE, TEXAS
78028

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MOONEY AIRCRAFT

TWELVE-MONTH

WARRANTY

Company warrants each new airplane manufactured by it to be free from defects in material and workmanship under normal use and service, provided, however. that this warranty is limited to making good at Company's factory any part or parts thereof which shall, within 12 months from date of original Airworthiness certificate, be returned to Company with transportation charges prepaid, and which upon Company's examination shall disclose to Company's satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and all other obligations or liabilities on the part of the Company, and Company neither assumes nor authorizes any other person to assume for it any other liability in connection with the sale of its airplanes. This warranty shall not apply to any airplane which shall have been repaired or altered outside of Company's factory which in the judgment of Company affects the airplane's stability or reliability, nor which in the opinion of Company has been subject to misuse, negligence or accident. Equipment and accessories not manufactured by seller are guaranteed only to the extent of the original manufacturer's guarantee.

SECTION

1

INTRODUCTION

SECTION I
INTRODUCTION

A. GENERAL

This manual contains service and maintenance information pertaining to all M20 series aircraft listed on the title page. All affected aircraft are identified by year of manufacture, model designation, and serial number grouping. When service and maintenance instructions in the body of the manual refer to a specific year and model, applicability of that information to an individual aircraft may be determined by referring to the title page serial-number listing.

If it becomes necessary to consult the factory concerning a specific maintenance problem, contact the Customer Service Department, Mooney Aircraft, Inc., Kerrville, Texas, 78028. Telephone, Area Code 512, 257-4043. When querying the factory or forwarding information, the model designation, serial number, and registration number of the aircraft concerned should be furnished. Total in-service time for the item in question should also be furnished.

Spare parts are available through the Mooney distributor in your area. Consult the Mooney Parts Catalog for the latest part numbers and the correct ordering procedure. Mooney manufactured parts were changed from a four digit to a six digit numbering system in March of 1962. New parts may be ordered by either their four or six digit numbers. A six-to-four digit cross reference index is included in the appendix.

B. SCOPE OF THIS MANUAL

For ready reference, this manual has been divided into eleven sections, each dealing with a major system or group of components. Sections II and X comprise the service portion of the handbook; the remaining sections are devoted to maintenance. Service instructions include ground handling, servicing, and periodic inspection. Maintenance instructions include trouble shooting, corrective maintenance and functional testing, and removal and installation of assemblies and components. Only qualified personnel should perform inspections and maintenance procedures described in this manual.

Basic information in this manual is limited to service and maintenance procedures peculiar to the aircraft concerned; no attempt is made to cover standard shop procedures. Refer to the applicable Owner's Manual for operating details. For more complete maintenance information concerning engines, propellers, and other vendor items, the manufacturer's handbooks should be consulted. An annual service information subscription or a complete back-issue file of Mooney service information is available from your local Mooney distributor.

C. DESCRIPTION

Mooney M20 series aircraft are designed and manufactured as high performance, low maintenance, versatile aircraft for the personal and business aviation field.

The M20 series aircraft discussed in this manual are four-place all-metal low-wing aircraft. All models are powered by Lycoming engines. Refer to Table 1 for propeller and governor specifications.

Conventional rudder pedals and control wheels are provided. Entrance to the cabin is made through the cabin door located on the right side of the airplane. The front seats fold forward to allow passenger entry to the rear seats. The baggage compartment is located aft of the rear seat and has an access door on the right side of the aircraft. During flight, the baggage compartment is accessible from the rear seat.

1. ENGINE

a. All M20C aircraft are powered by a Lycoming O-360-A1D engine equipped with a constant-speed propeller.

b. M20D aircraft (1963) are equipped with a Lycoming O-360-A1D engine having a governor control for a constant-speed propeller.

c. M20D aircraft (1964 thru 1966) are equipped with a Lycoming O-360-A2D engine having a fixed-pitch propeller. The O-360-A1D engine may be installed as optional.

d. Lycoming O-360-A1D and O-360-A2D engines are both rated 180 hp at 2700 rpm.

e. All M20E aircraft are powered by a Lycoming IO-360-A1A engine rated 200 hp at 2700 rpm.

f. All M20E aircraft are provided with a filtered-unfiltered ram induction air source. Filtered air is used during takeoff, landing, and under dusty conditions. Air source selection is made by manual control. An emergency induction air source is provided; in the event of filter icing, a spring-loaded valve, located behind the filter inside the engine compartment, will open automatically to maintain air flow to the engine. To prevent ice formation in the induction system, the power boost control must be set for filtered air if icing conditions are present.

2. PROPELLER

Those models with constant-speed propellers have low pitch setting capabilities for maximum take-off power. Propeller pitch is regulated by an engine-mounted governor that insures maximum power efficiency at cruising speeds. Engine oil pressure actuates the pitch changing mechanism.

3. WING

All M20 series aircraft have laminar-flow wings. Laminar air flow over the wings is insured by flush rivets attaching the leading edge of the "wrap-around" wing skins. Wing construction features multiple ribs attached to main and stub spars incorporating aluminum spar caps.

4. FUSELAGE

The cabin superstructure is built of 4130 tubular steel and covered with non-structural aluminum skins. The tail section (baggage compartment and aft structure) has a stressed-skin semi-monocoque design. Aluminum skins are riveted to heat-treated aluminum bulkheads with extruded aluminum stringers reinforcing the tail cone section.

5. EMPENNAGE

The empennage is constructed on optically aligned jigs to insure uniformity and close tolerance fit for all parts. Construction is of sheet metal, riveted to formed ribs and spars. To provide stabilizer trim, the entire empennage pivots around the tail cone attachment points.

6. LANDING GEAR

The landing gear is unique in that it is manually retracted by the pilot. Gear-assist springs in the wings, aided by bungee springs in the fuselage, make manual operation of the gear quite simple. Gear-mounted rubber discs are used for shock absorption. Grease fittings are provided at important lubrication points on the landing gear. The standard M20D has a fixed landing gear, but can be converted to a retractable gear identical to the M20C gear system. Electrically operated gear retracting systems are optional for all models.

7. BRAKE SYSTEM

Hydraulic disc brakes are featured on all models. The hydraulic fluid reservoir is located in the inside upper left-hand area of the firewall. Toe-actuated rudder pedals operate the left and right main gear brakes independently. Dual brake systems are optional for all models.

8. FLIGHT CONTROLS

The ailerons, elevators, and rudder are of an all-metal jig-built construction incorporating hinges of machined extrusions. Push-pull tubes, rather than the conventional cable systems, are used to actuate the control surfaces.

9. FLAP SYSTEM

The wide-span all-metal flaps are hydraulically controlled by a hand-operated pump which actuates a hydraulic cylinder. A relief valve is provided which releases hydraulic pressure at a slow rate as retraction springs (or air pressure) raise the flaps. The hydraulic fluid reservoir is common to both the brake and flap systems. Maintenance of the flap system is similar to the brake system.

10. TRIM SYSTEM

A small control wheel on the floor between the front seats actuates the adjustable stabilizer via a gear reduction box and torque tube linkage which actuates the empennage jack screw. The torque tubes are connected by universal joints and are supported by formica guide blocks.

11. FUEL SYSTEM

The fuel system consists of integral fuel tanks located in the front inboard portion of each wing. These tanks are formed by sealing off a portion of the wing through the use of a special sealing compound. Fuel is fed from the wing, to a tank selector valve, on to an electric boost pump and then to the engine-driven fuel pump and fuel injector or carburetor.

12. ELECTRICAL SYSTEM

The electrical system is provided with a 50-amp 12-volt generator and a 35-amp/hour battery. All electrical systems can be turned off with the master switch which actuates a relay located at the battery. Circuit breakers are provided on the lower right side of the instrument panel. Standard equipment includes a 250-watt landing light, navigation lights, interior lights, an electric starter, gear and stall warning systems, and an electric boost pump.

13. INSTRUMENT PANEL

The instrument panel has been designed to provide functional location of all flight, radio, and engine instrument groups. The flight instruments on the pilot's side are installed in a rubber shock-mounted panel to reduce vibration transmission to the instruments.

14. CABIN HEATING, VENTILATION, AND DEFROSTING SYSTEMS

Cabin heat is obtained from a muff which surrounds the engine exhaust manifold. From the muff a flexible duct transmits heated air to a junction box aft of the firewall on the co-pilot's side. Cold air is also ducted to this junction box from the flush air scoop on the right side of the airplane. The hot and cold air entering the junction box can be controlled to provide the combination required for the desired temperature. From the junction box, air is ducted to the pilot and co-pilot's feet, windshield defroster, and rear cabin.

15. SEATS

All seat backs are contour formed. The seats are padded with plastic polyfoam and covered with durable upholstery. The front seats have a three-position reclining adjustment and are adjustable fore and aft on the floorboard seat rails. The rear seat back may be removed to provide a larger cargo area.

D. SPECIFICATIONS OUTLINE

1. ENGINE

a. M20C:

Model	O-360-A1D
FAA Type Certificate	286
Rated Horsepower and Speed (RPM)	180 at 2700
Propeller Drive Ratio	1:1
Propeller Shaft Rotation	Clockwise
Bore (Inches)	5.125
Stroke (Inches)	4.375
Displacement (Cubic Inches)	361
Compression Ratio	8.50:1
Dry Weight (with Starter and Generator)	284
Dimensions: Height (Inches)	24.59
Width (Inches)	33.57
Length (Inches)	29.81
Oil Sump Capacity (Quarts)	8
Fuel Octane (Aviation grade)	91/96
Magnetos (Bendix)	S4LN-204 (Right) S4LN-200 (Left)
Tachometer Drive (Ratio to Crankshaft)	0.5:1
Rotation	Clockwise
Starter Drive (Ratio to Crankshaft at Bendix Drive)	13.55:1 (Counterclockwise)
Starter (Geared 3.38:1)	12 Volt
Generator Drive (Ratio to Crankshaft)	1.91:1
Generator (Delco-Remy, 12 V)	50 AMP
A-N Vacuum Pump Drive (Ratio to Crankshaft and Rotation)	1.30:1 (Counterclockwise)
Propeller Governor Drive	AN20010 (Type XX)
Ratio to Crankshaft and Rotation	866:1 (Clockwise)
Fuel Pump	AC (Type JT)

b. M20D: The O-360-A2D Lycoming engine is basically the same as the O-360-A1D engine except that the O-360-A2D engine has no constant-speed propeller governor.

c. M20E:

Model	IO-360-A1A
FAA Type Certificate	1E10
Rated Horsepower and Speed (RPM)	200 at 2700
Propeller Drive Ratio	1:1
Propeller Shaft Rotation	Clockwise
Bore (Inches)	5.125
Stroke (Inches)	4.375
Displacement (Cubic Inches)	361
Compression Ratio	8.7:1
Dry Weight (with Starter and Generator)	323
Dimensions: Height (Inches)	26.61
Width (Inches)	34.25
Length (Inches)	29.81
Fuel Injector (Bendix)	RSA-5AD1
Firing Order	1-3-2-4
Spark Occurance (Degrees BTC)	25
Valve Rocker Clearance (Tappets Collapsed)	0.028" to 0.080"
Oil Sump Capacity (Quarts)	8
Fuel Octane (Aviation Grade)	100/130
Magnetos (Bendix)	S4LN-204 (Right) S4LN-200 (Left)
Tachometer Drive (Ratio to Crankshaft)	0.5:1
Rotation	Clockwise
Starter Drive (Ratio to Crankshaft at Bendix Drive)	13.55:1 (Counterclockwise)

Starter (Geared 3.38:1)	12 Volt
Generator Drive (Ratio to Crankshaft)	2.50:1
Generator (Delco-Remy, 12 V)	50 AMP
A-N Vacuum Pump Drive (Ratio to Crankshaft and Rotation)	1.30:1 (Counterclockwise)
Propeller Governor Drive	AN20010 (Type XX)
Ratio to Crankshaft and Rotation	.866:1 (Clockwise)
Fuel Pump	AC (Type JT)

2. OVER-ALL DIMENSIONS

Wing Span	35 ft. 3 in.
Length (M20C,D&E)	23 ft. 3 1/2 in.
Length (M20F)	24 ft. 0 in.
Height	8 ft. 4 1/2 in.
Clearance (Propeller Tips)	9 3/4 in. (Approx.)

3. LANDING GEAR

a. Standard M20C,E,&F

Type	Manually Retracted
Tread	9 ft. 3/4 in.
Main Wheel Type	Cleveland Air Products
Main Tire	6 Ply, 6:00 x 6
Main Tire Pressure	30 pounds
Brake Type	Cleveland Hydraulic
Fluid Required	Hydraulic (MIL-O-5606 Red)
Nose Wheel Type	Cleveland Air Products
Nose Tire (M20C,D,&E)	4 Ply, 5:00 x 5
Nose Tire (M20F)	6 Ply, 5:00 x 5
Nose Tire Pressure (M20C,D,&E)	30 PSI
Nose Tire Pressure (M20F)	49 PSI

Electric gear retraction kits are available from Mooney distributors.

b. Standard M20D:

Type	Fixed

Other specifications are same as M20C & E aircraft. Retractable gear is optional on all M20D aircraft; conversion kits are available from Mooney distributors.

4. FUEL CAPACITIES

M20C (1962-1963)	48 gallons total
M20D (1963)	48 gallons total
M20C (1964 & ON)	52 gallons total
M20D (1964 & ON)	52 gallons total
M20E (1964 & ON)	52 gallons total
M20F (1967 & ON)	64 gallons total

5. WING

Span	35 ft. 0 in.
Length of Flap (Trailing Edge)	10 ft. 8 in.
Length of Aileron (Trailing Edge)	5 ft. 3 1/4 in.
Dihedral (Leading Edge)	5°30 minutes
Incidence	2°30 minutes
Airfoil Section at Root	NACA 63-215
Airfoil Section at Tip (M20C,D,&E)	NACA 64-412
Airfoil Section at Tip (M20F)	NACA 64-412 Mod.
Wing Area	167 sq. ft.
Aileron Area	11.2 sq. ft.
Flap Area	17.2 sq. ft.

6. EMPENNAGE

Vertical Fin Area	7.9 sq. ft.
Rudder Area (M20C,D,&E)	5.01 sq. ft.
Rudder Area (M20F)	6.23 sq. ft.
Horizontal Stabilizer Area	21.5 sq. ft.
Elevator Area	12.0 sq. ft.

TABLE 1 – PROPELLER AND GOVERNOR SPECIFICATIONS

	Std. for M20C 1962-1963 S/N 1940-2622	Opt. for M20C 1962-1963 S/N 1940-2622	Std. for M20C 1964 S/N 2623-2806	Opt. for M20C 1964 S/N 2623-2806
Manufacturer	Hartzell	McCauley	Hartzell	McCauley
Type	Constant Speed	Constant Speed	Constant Speed	Constant Speed
Hub	HC–22YK–1	2D34C53-A	HC–C2YK–1A	2D34C53–A
Blade	7666–2	74E–0	7666–2	74E–8
Prop. Governor	Hartzell:	Woodward:	Hartzell:	Woodward:
	D–1–4 (1940C-2400C)	210452	D–1–6 (2623C-2704C)	210452
	D–1–6 (2401C-2622C)	–	H–1 (2705C-2806C)	–
Blade Angle, Low	13°	12.7° ± 2°	13° ± 0°	12.7° ± 2°
Blade Angle, High	29° ± 2°	27.5° ± .05°	29° ± 2°	27.5° ± .05°
	Std. for M20C 1965 S/N 2807-3184	**Std. for M20C 1966 S/N 3185-3230**	**Std. for M20C 1966 S/N 3231-3466**	**Std. for M20C 1967 S/N 670001 & ON**
Manufacturer	Hartzell	Hartzell	Hartzell	Hartzell
Type	Constant Speed	Constant Speed	Constant Speed	Constant Speed
Hub	HC–C2YK–1A	HC–C2YK–1A	HC–C2YK–1B	HC– C2YK–1B
Blade	7666–2	7666–2	7666–2	7666–2
Prop. Governor	Hartzell:	Hartzell:	Hartzell:	Hartzell:
	H–1	H–1	H–1	H–1
	H–1L	H–1L	H–1L	H–1L
Blade Angle, Low	13° ± 0°	13° ± 0°	13° ± 0°	13° ± 0°
Blade Angle, High	29° ± 2°	29° ± 2°	29° ± 2°	29° ± 2°
	Std. for M20D 1963 S/N 101-200	**Std. for M20D 1964-1967 S/N 201-260**	**Opt. for M20D 1964 S/N 201-251**	**Opt. for M20D 1965 & ON S/N 252 & ON**
Manufacturer	Hartzell	McCauley	Hartzell	Hartzell
Type	Constant Speed	Fixed Pitch	Constant Speed	Constant Speed
Hub	HC–C2YK–1A	1C172	HC–C2YK–1A	HC–C2YK–1B
Blade	7666–2	MFA74–60	7666–2	7666–2
Prop. Governor	Hartzell:	–	Hartzell:	Hartzell:
	D–1–4 (101D-123D)	–	D–1–4 (101D–123D)	H–1
	D–1–6 (124D-220D)	–	D–1–6 (124D–220D)	H–1L
Blade Angle, Low	13° ± 0°	–	13° ± 0°	13° ± 0°
Blade Angle, High	29° ± 2°	–	29° ± 2°	29° ± 2°
	Std. for M20E 1964 S/N 101-469	**Std. for M20E 1965 S/N 470-831**	**Std. for M20E 1966 S/N 832-1308**	**Std. for M20E 1967 S/N 670001 & ON**
Manufacturer	Hartzell	Hartzell	Hartzell	Hartzell
Type	Constant Speed	Constant Speed	Constant Speed	Constant Speed
Hub	HC–2YK–1A	CHC–C2YK–1A HC–C2YK–1 Alternate	HC–C2YK–1	HC–C2YK–1
Blade	7666–2	7666–2	7666–2	7666–2
Prop. Governor	Hartzell:	Hartzell:	Hartzell:	Hartzell:
	D–1–6 (102E–303E)	H–1	H–1	H–1
	H–2 (304E–469E)			H–1L
Blade Angle, Low	14° ± 0°	14° ± 0°	14° ± 0°	14° ± 0°
Blade Angle, High	29° ± 2°	29° ± 2°	29° ± 2°	29° ± 2°
	Std. for M20F 1967 S/N 660003 S/N 670001 & ON			
Manufacturer	Hartzell			
Type	Constant Speed			
Hub	HC–2YK–1			
Blade	7666–2			
Prop. Governor	Hartzell:			
	H–1			
	H–1L			
Blade Angle, Low	14° ± 0°			
Blade Angle, High	29° ± 2°			

FIGURE 1-1 – M20C (1962-1964) THREE VI

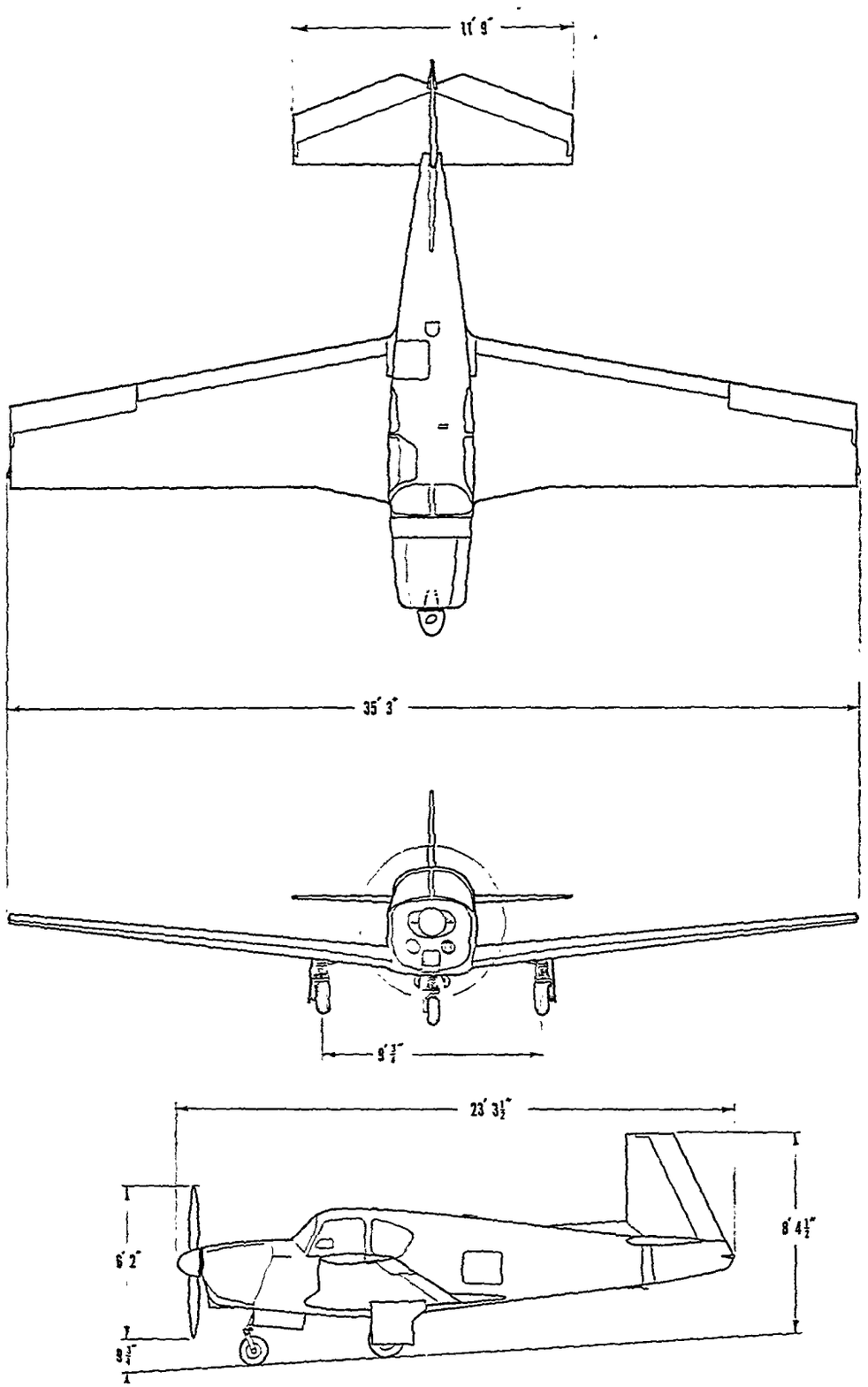


FIGURE 1-1A – M20D (1963-1964) THREE VIEW

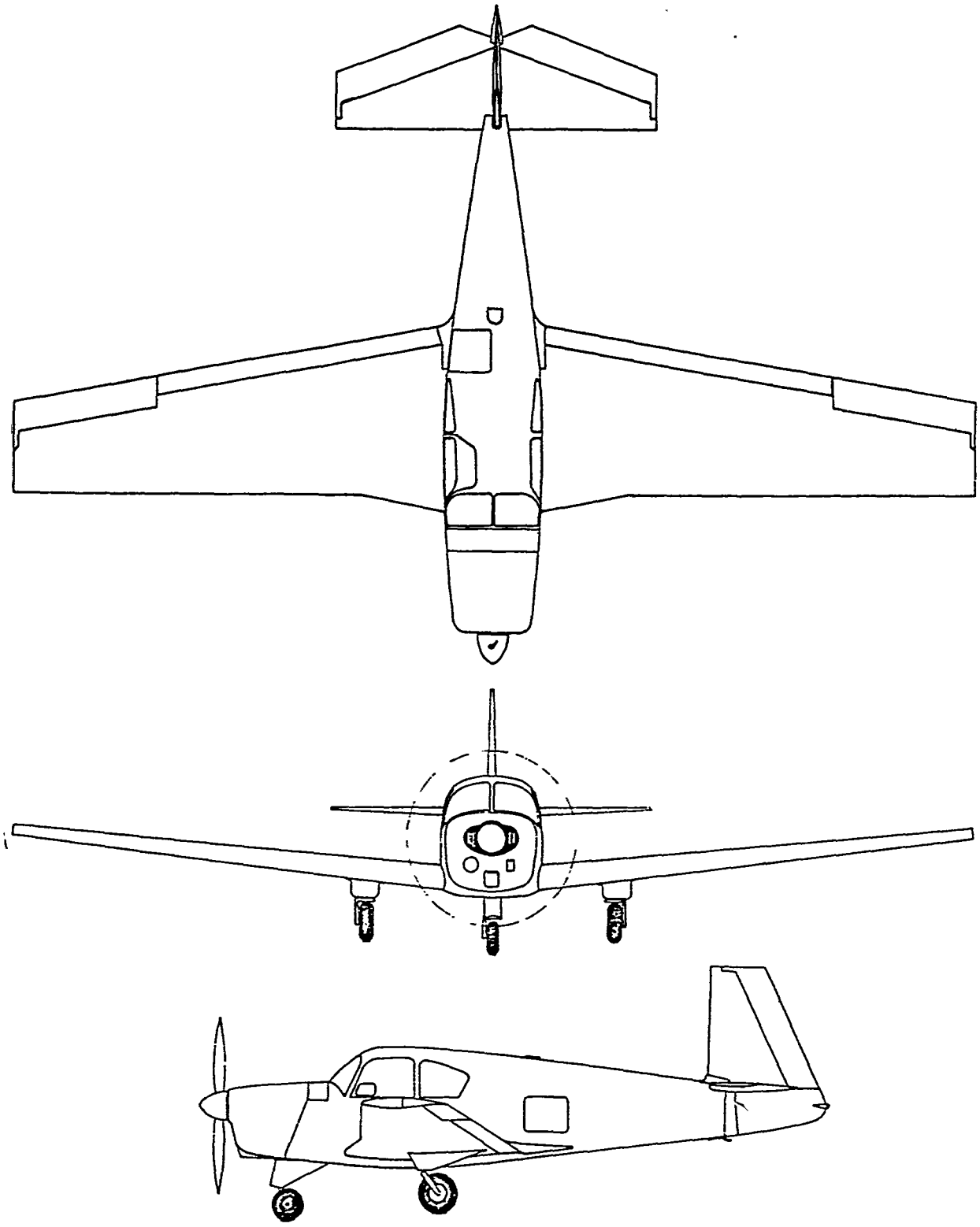


FIGURE 1-1B – M20E (1964-1965) THREE VIEW

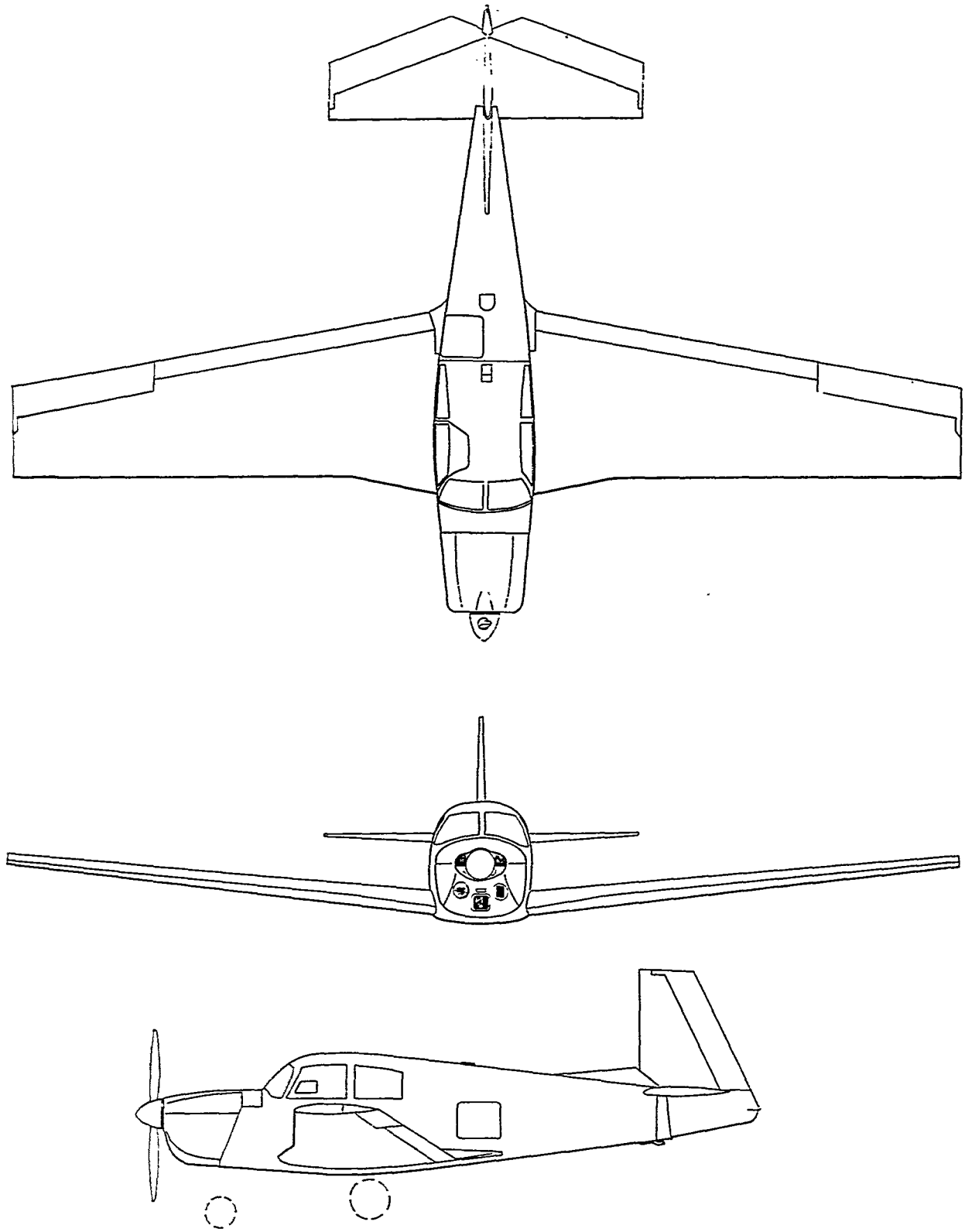


FIGURE 1-1C – M20C (1965) THREE VIEW

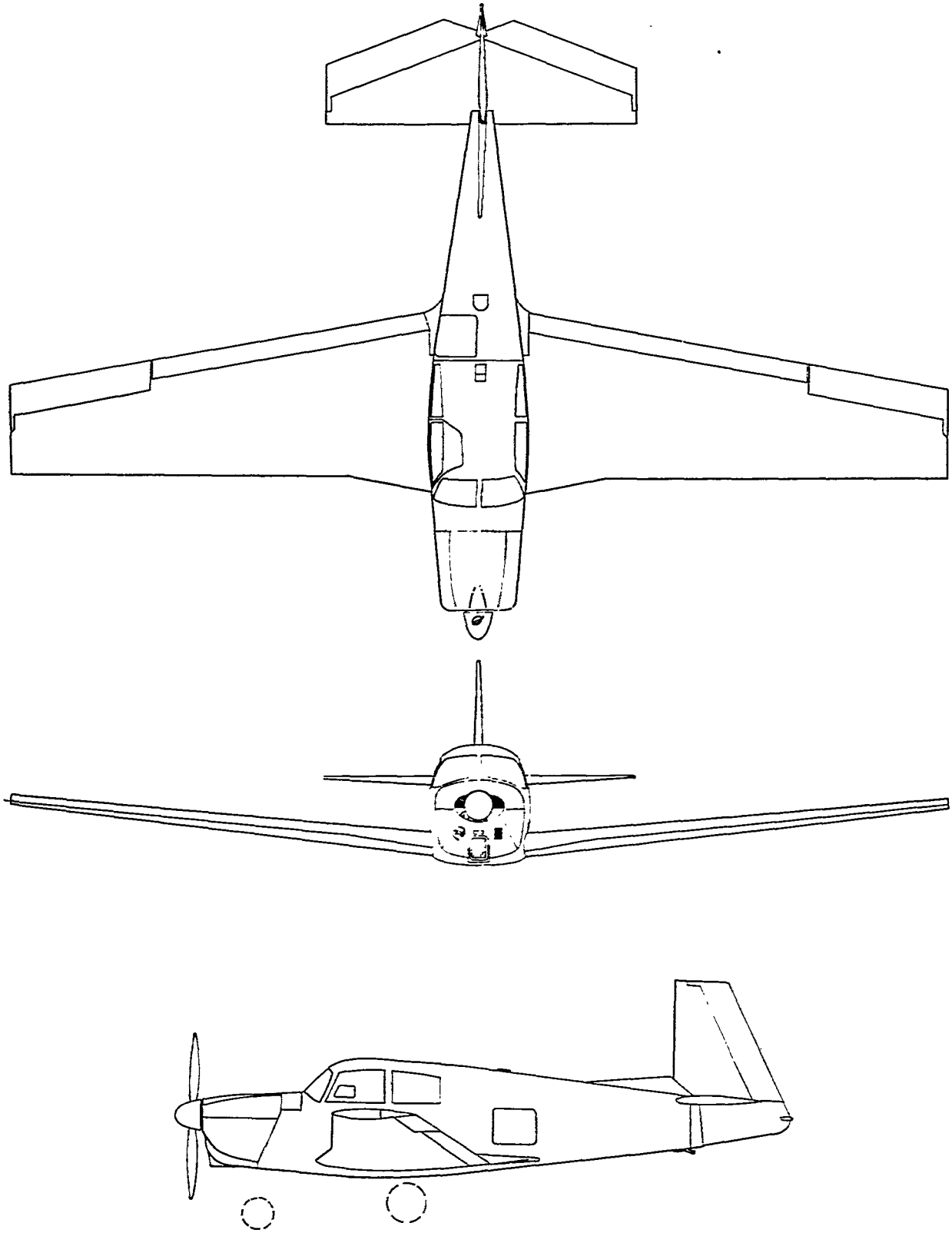


FIGURE 1-1D – M20D (1965) THREE VIEW

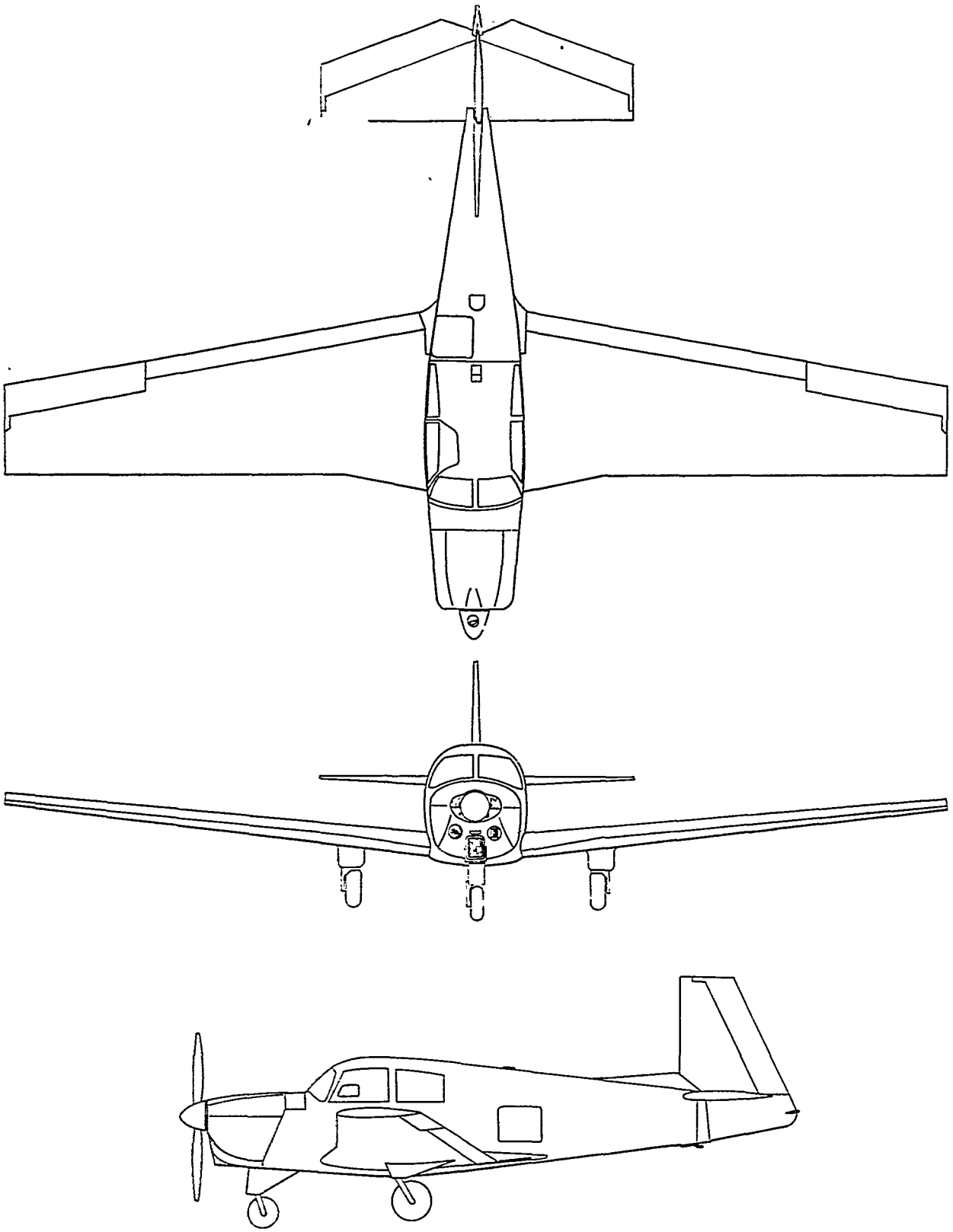


FIGURE 1-1E – M20C (1966 & ON) THREE VIEW

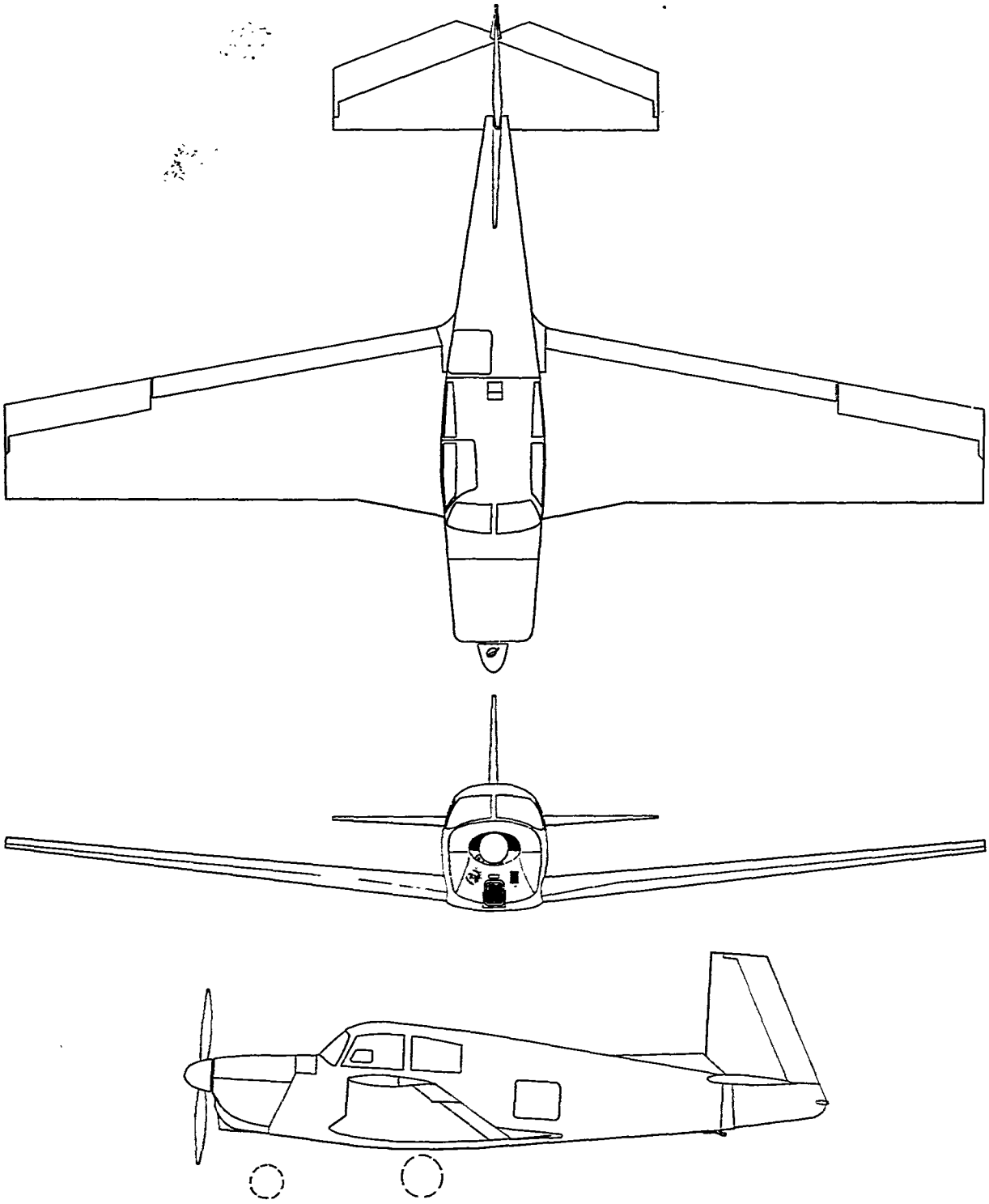


FIGURE 1-1F – M20D (1966 & ON) THREE VIEW

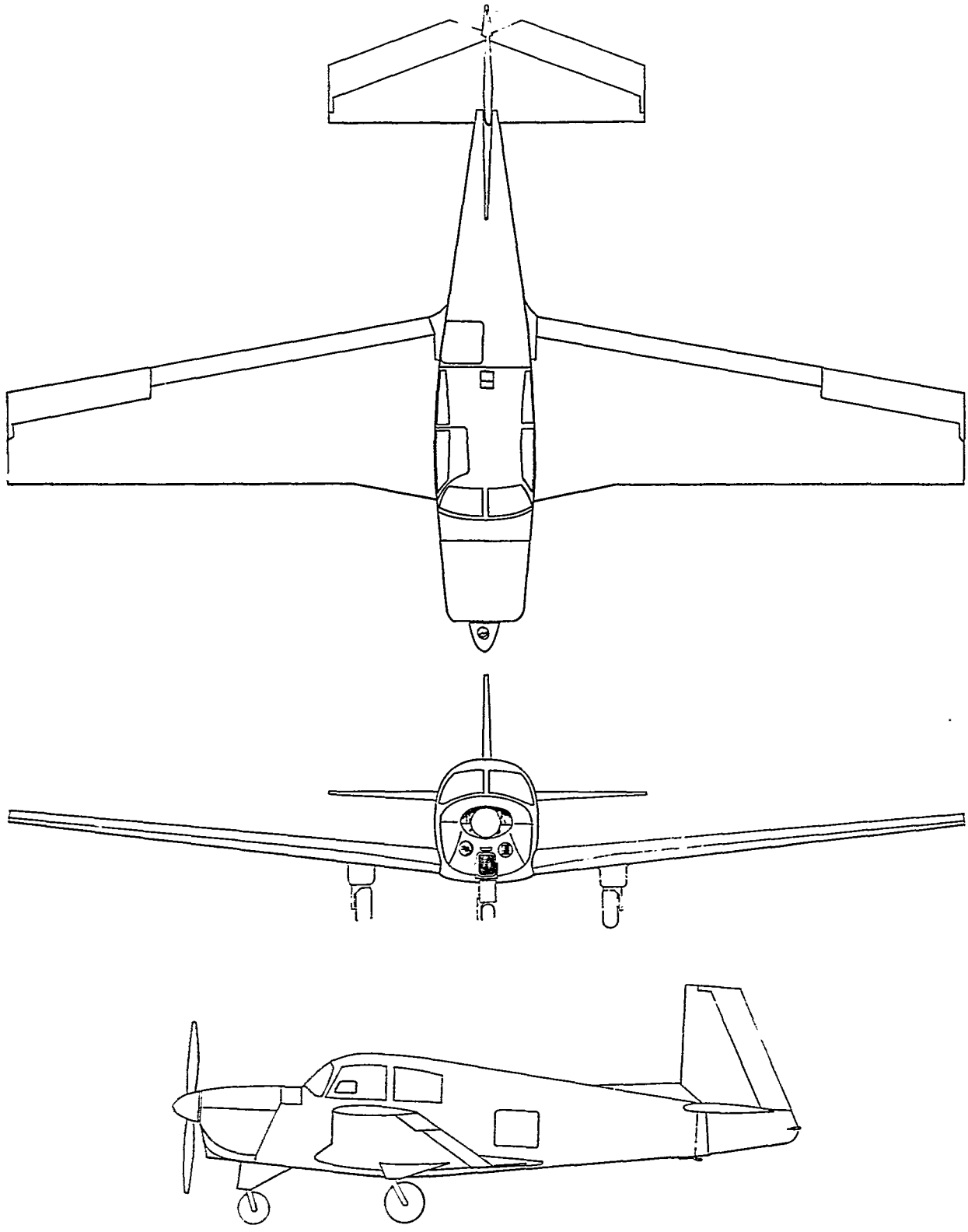


FIGURE 1-1G – M20E (1966 & ON) THREE VIEW

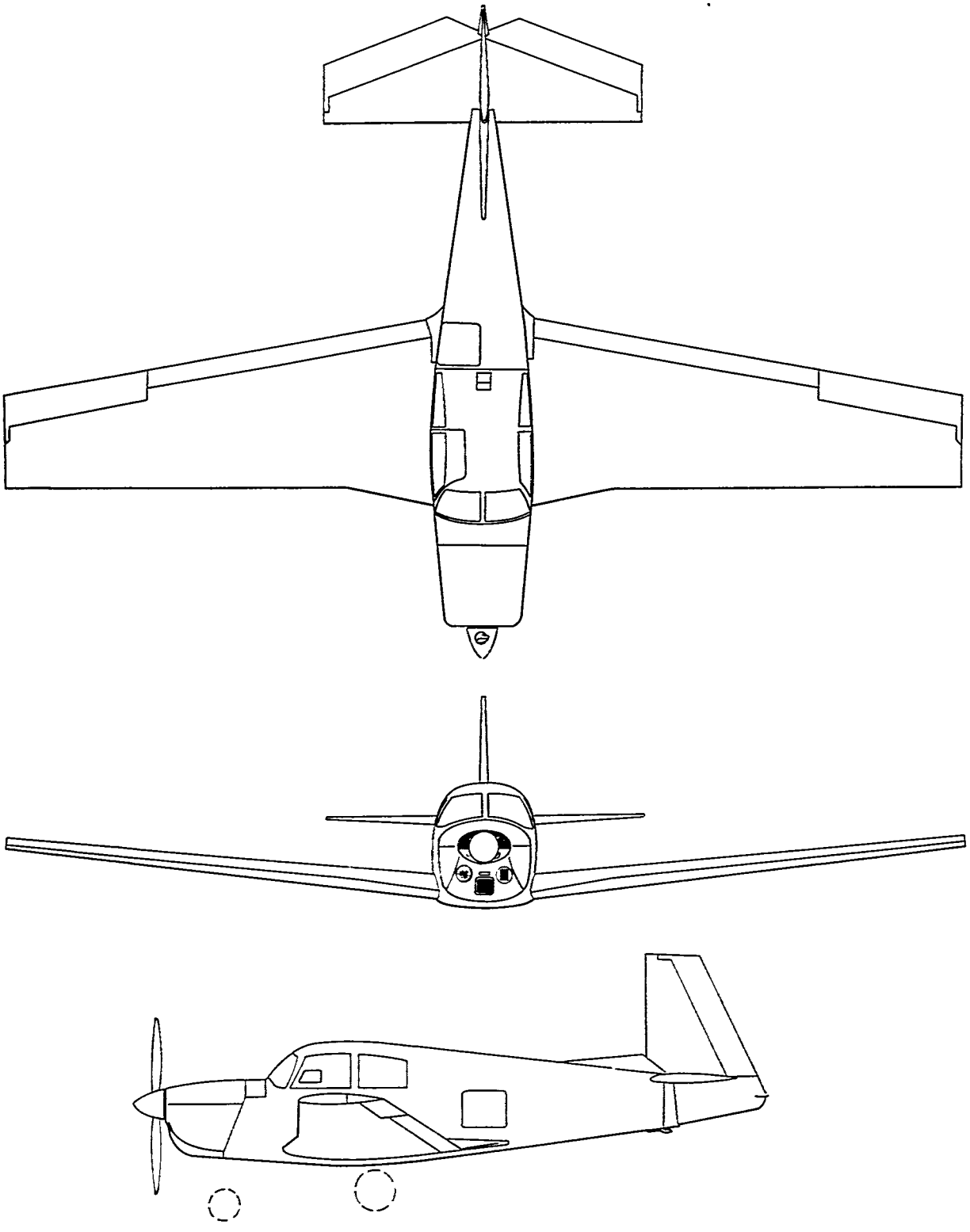
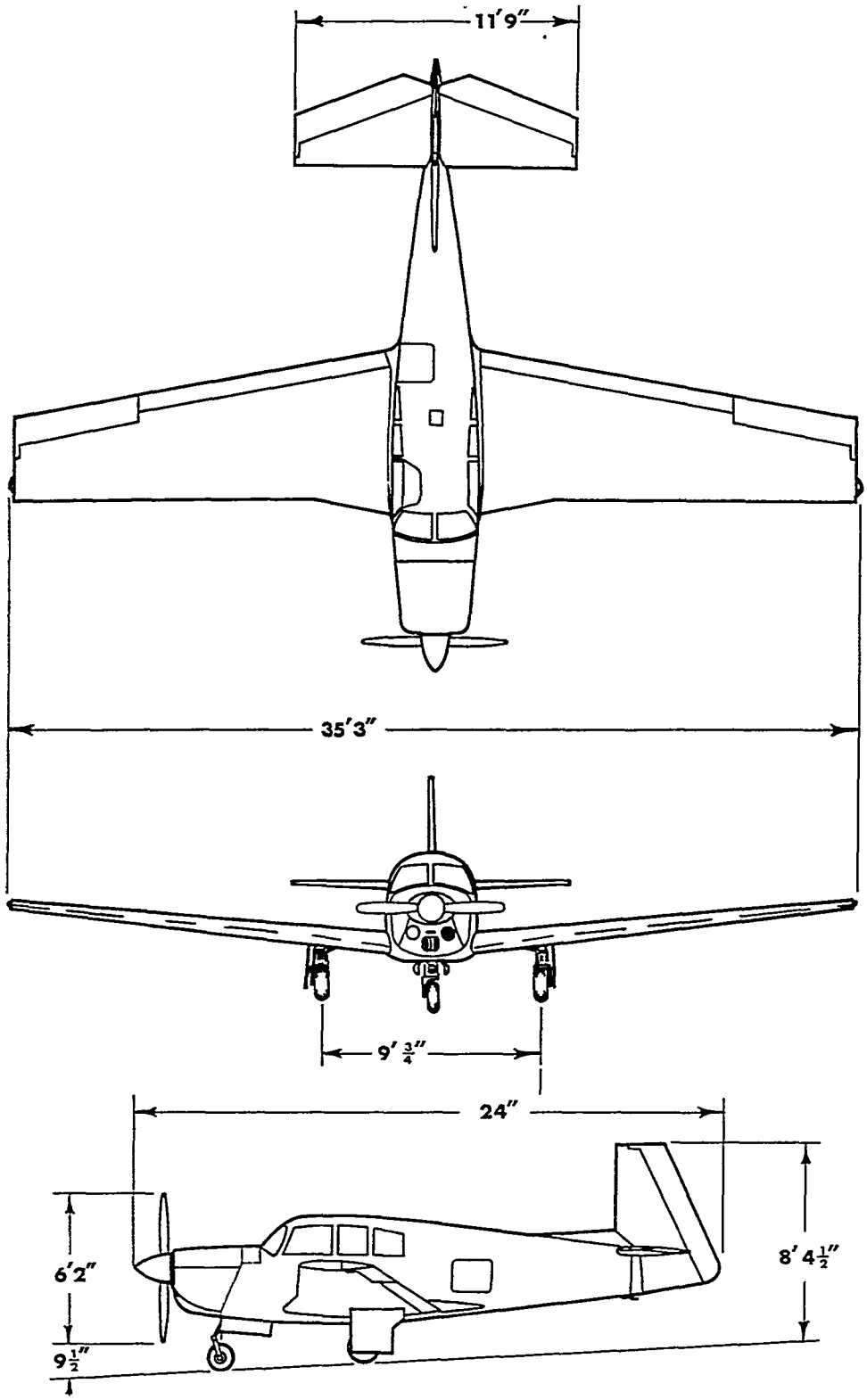


FIGURE 1-1H – M20F (1967 & ON) THREE VIEW



SECTION

2

HANDLING AND SERVICING

SECTION II
HANDLING & SERVICING

A. GENERAL

This section provides ground handling and servicing instructions.

B. ACCESS PROVISIONS

Figure 10-1 shows the location of the access panels and plates that provide access for purposes of service and maintenance.

C. GROUND HANDLING

The following instructions are recommended to avoid damage to the airplane during ground operations. If improperly handled, extensive damage to the airplane and its equipment may result. The airplane may be taxied as required for normal maneuvers. Brakes or rudder pedals may be used for turning. If a towbar is used, one man may move the airplane providing it is on a fairly smooth level surface. Points where pushing the airplane are permitted are leading edge of the wing, wing tips, and the inboard position of the propeller blades adjacent to the propeller hub.

1. Jacking

When it is desired to raise the airplane off the ground to check operation of the landing gear, the following jacking procedure is recommended. By using jack points provided outboard of each main gear (Figure 2-1), it is possible to use standard aircraft jacks to raise the main gear off the ground. A yoke-frame jack may be used under the propeller. Care must be taken not to damage the propeller or spinner. The nose may also be raised by anchoring the tail skid tiedown ring to a fixed point in the shop floor while jacking the aircraft at the wing hoist points.

2. Mooring

When mooring aircraft, the following method is recommended. Place chocks fore and aft of each main wheel. Stakes may then be driven in the ground outboard of each main gear, approximately three feet, and at the tail skid location. Tie down rings are provided, two feet outboard of each main gear, at the jack point. A tiedown ring is also provided at the tail skid location.

3. Towing

A suitable towbar is provided as standard equipment with each airplane. The lower bar of the towbar is placed through the gear spindle upper crossmember. Care must be exercised that the nose gear is not rotated past its normal swivel angels. Towing with a tractor or by other mechanical means is not recommended.

Note: See that parking brake is off before towing airplane.

FIGURE 2-1 – JACKING

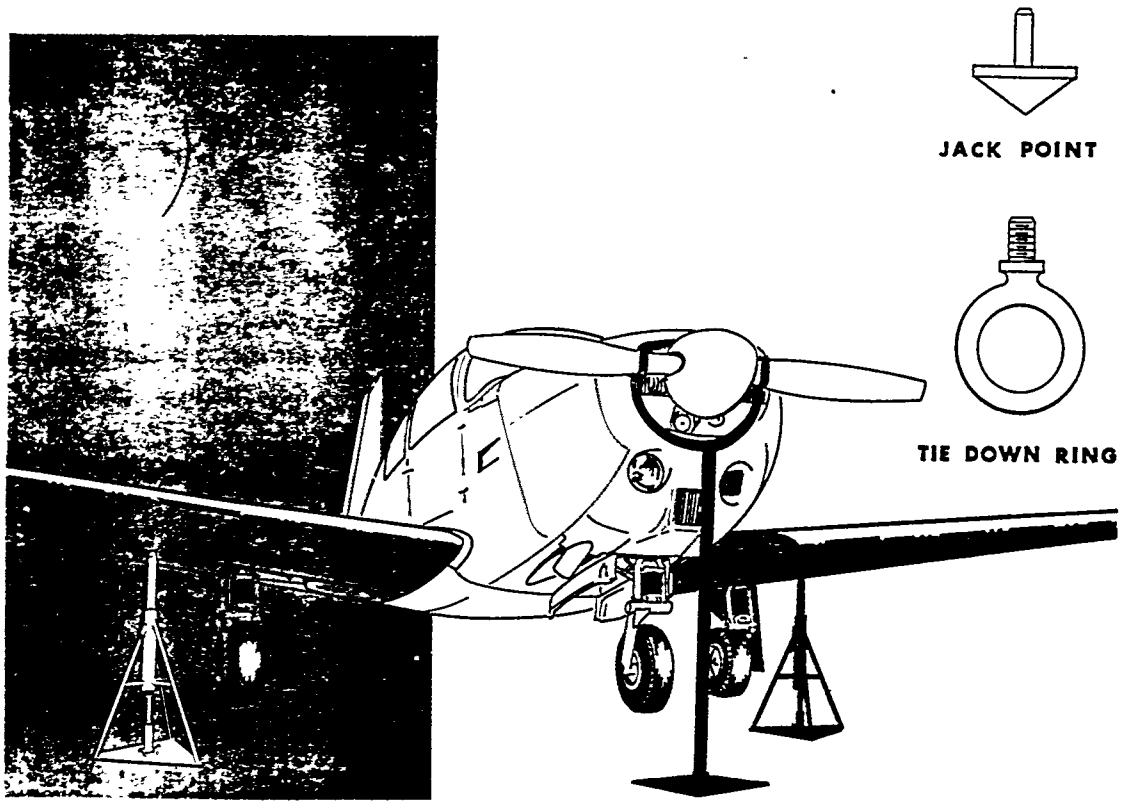


FIGURE 2-2 – LEVELING

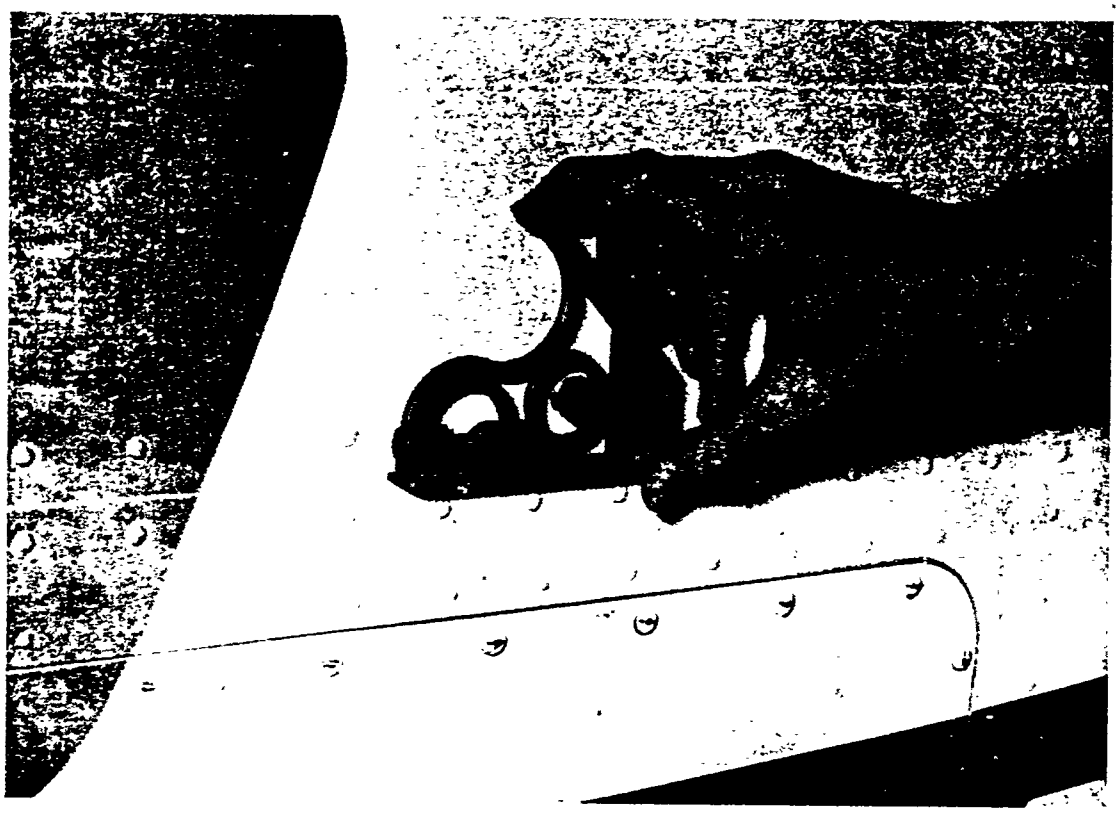
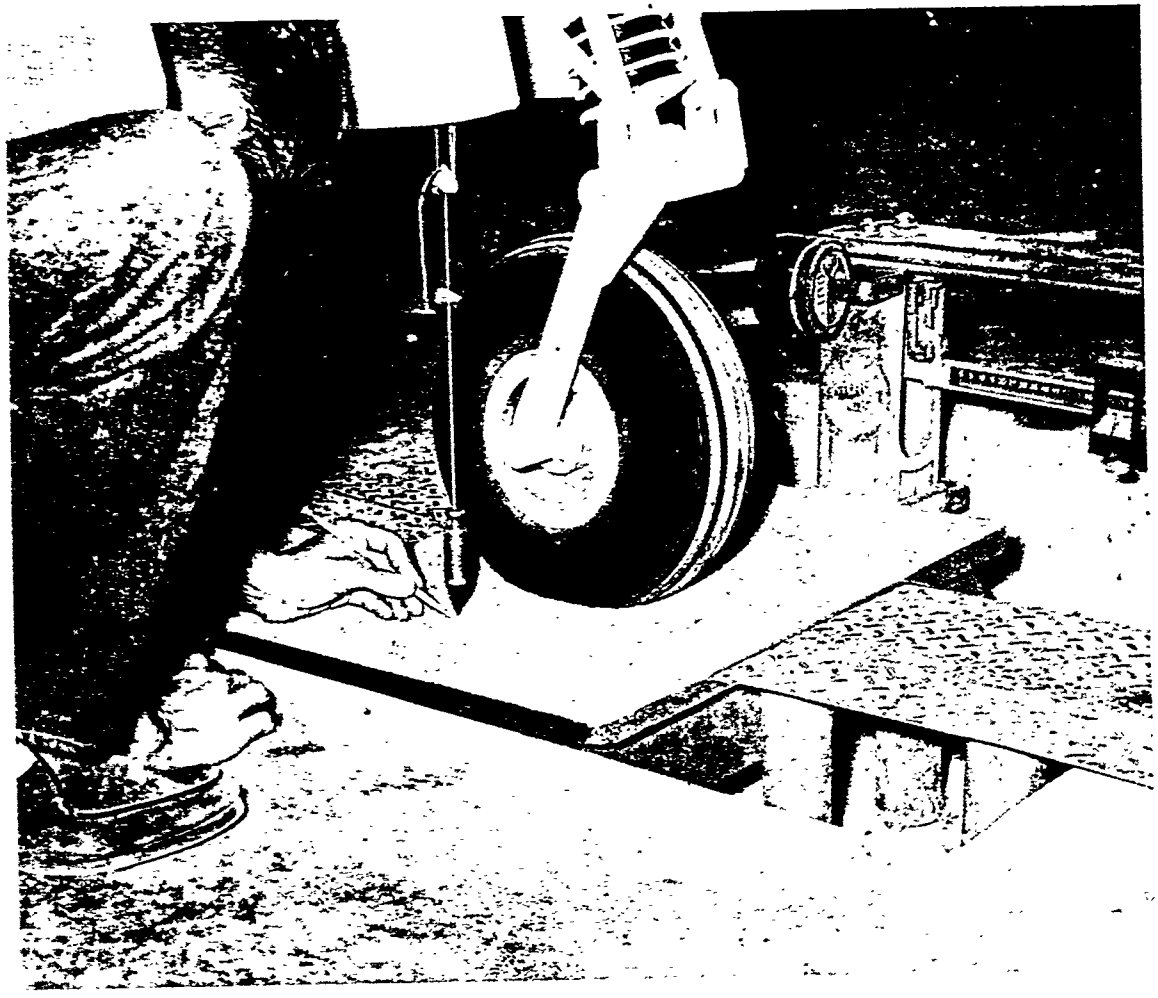


FIGURE 2-3 – PLUMBING



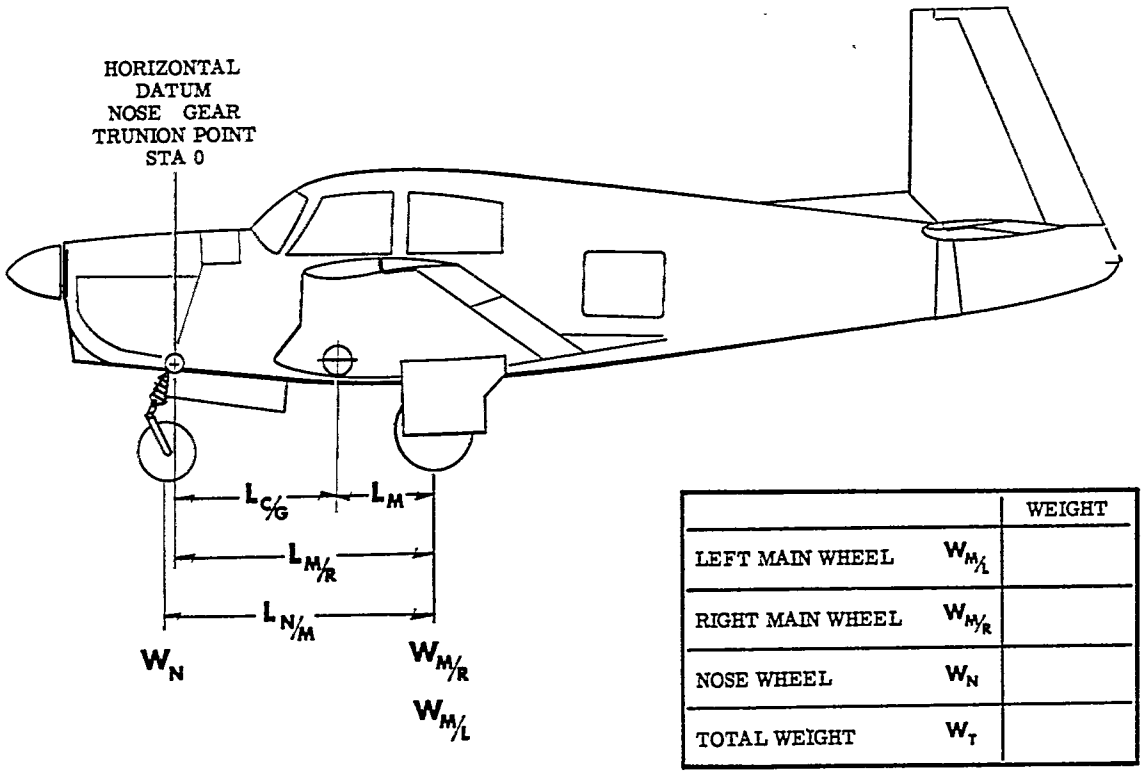
4. Leveling

Longitudinal leveling is determined by placing a spirit level on the tail cone skin splice above the access door. (Figure 2-2) Adjustments may be made by increasing or decreasing air pressure in the nose wheel tire when the airplane is on the ground or on a set of scales for weighing.

5. Weight & Balance (Fuel and Oil Drained)

Check installed equipment using the Equipment List in the Weight & Balance Data form or Weight & Balance Record. Position a scale in front of each of the three wheels. Place a ramp on each scale and tow the aircraft up onto the scales. Remove the ramps and proceed to weigh the aircraft when level. Find the datum by dropping a plumb bob from centerline of the nose gear attach bolts (retracting axis) and then mark the floor (see Figure 2-3). Measure axle locations from this mark (See Figure 2-3A or Figure 2-3B). Record the weight at each wheel as shown in Figure 2-3A and 2-3B. Total the weights. Record the distances between points as shown in Figure 2-3A and 2-3B. Compute the CG forward of the main wheels. Compute the CG's Fus. Sta. aft of datum. Post empty weight and CG in section III of Weight & Balance Record or equivalent Weight & Balance Data form.

FIGURE 2-3A – WEIGHT & BALANCE COMPUTATION (M20C,D,&E)



		WEIGHT
LEFT MAIN WHEEL	$W_{M/L}$	
RIGHT MAIN WHEEL	$W_{M/R}$	
NOSE WHEEL	W_N	
TOTAL WEIGHT	W_T	

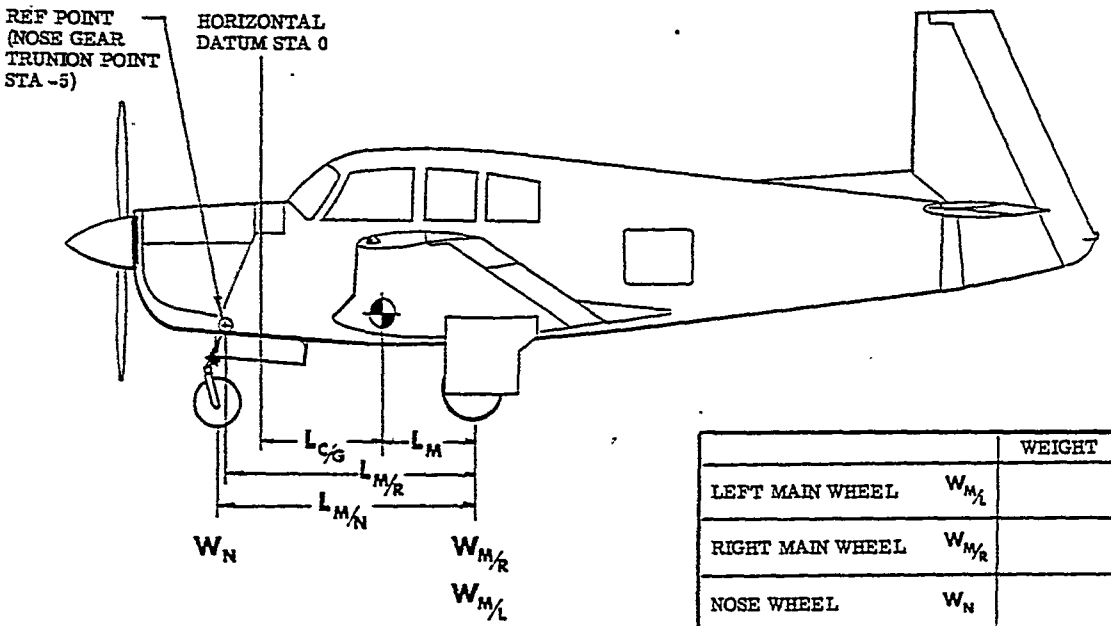
a. CG Forward of Main Wheels:

LBS. Weight of Nose	X	IN. Distance Between Main and Nose Wheel Axle Centers	/	LBS. Total Weight of Aircraft	=	IN. CG Forward of Main Wheels
(W_N)		$(L_{N/M})$		(W_T)		(L_M)

b. CG Aft of Datum (Station 0):

IN. Distance from Center Nose Gear Trunion to Center of Main Wheel Axles (Horizontal)	—	IN. Result of Computation Above	=	IN. CG (FUS. STA.) Distance Aft of Datum. (Empty Weight CG)
$(L_{M/R})$		(L_M)		$(L_{C/G})$

FIGURE 2-3B – WEIGHT & BALANCE COMPUTATION (M20F)



		WEIGHT
LEFT MAIN WHEEL	$W_{M/L}$	
RIGHT MAIN WHEEL	$W_{M/R}$	
NOSE WHEEL	W_N	
TOTAL WEIGHT	W_T	

a. CG Forward of Main Wheels:

LBS.		IN.		LBS.		IN.
Weight of Nose	X	Distance Between Main and Nose Wheel Axle Centers	/	Total Weight of Aircraft	=	CG Forward of Main Wheels
(W_N)		$(L_{N/M})$		(W_T)		(L_M)

CG Aft of Datum (Station 0):

IN.		5 IN.		IN.		IN.
Distance from Center Nose Gear Trunion to Center of Main Wheel Axles (Horizontal)	–	Distance from Nose Gear Trunion to Datum	–	Result of Computation Above	=	CG (FUS. STA.) Distance Aft of Datum. (Empty Weight CG)
$(L_{M/R})$		Constant		(L_M)		$(L_{C/G})$

D. SERVICING

1. FUEL SYSTEM

a. Filling the fuel tanks (1964 & ON)

Each wing integral fuel tank has a capacity of 26 U.S. gallons (32 gallons for M20F models) and is accessible for filling by flipping the filler cap latch up and turning it to release the cap. A vent is provided at the outboard forward corner of the tank to compensate for fuel expansion, depletion, and overflow. A fuel sump drain is located on the inboard corner of each wing tank. This is the lowest point of each fuel tank.

NOTE: Visual fuel level indicators at the 25 gallon level are installed in both tanks on M20F models S/N 670074 & ON.

1962-63 M20C & 1963 M20D
Each wing integral fuel tank has a capacity of 24 U.S. gallons and is accessible for filling by lifting a door and removing the expansion-type gas cap. A scupper-box drain is provided to drain off any gasoline spilled outside the filler neck opening.

CAUTION: Aircraft and fuel service vehicle must be grounded when refueling the aircraft. Ground servicing nozzle to aircraft wing. No smoking within 50 ft. of aircraft or vehicle.

b. Draining fuel system

To drain fuel from the system, disconnect fuel line at electric boost pump, attach another flex line leading to a drain barrel, and turn boost pump on. The fuel will be pumped out of the tanks through the boost pump. Fuel tanks may also be siphoned as an alternate method. Aircraft and barrel must be grounded. Allow no smoking or open flame within 50 ft. of aircraft. Fire extinguisher (foam type) should be immediately available.

c. Strainer removal

Remove and clean the following strainers every 50 hours:

GASCOLATOR (Located in the nose wheel well) ELECTRIC BOOST PUMP (Located under floorboard)	1962-63 M20C 1963 M20D	ONLY
FUEL-SELECTOR VALVE (Located beneath the floorboard in the front portion of the cabin)	Figure 2-4. All M20 series aircraft	

d. Draining selector valve and fuel tank sumps

To check for water and sediment in the fuel system or to completely drain the fuel system, the sumps may be drained as follows:

Wing Tanks: Insert prong of plastic cup (supplied with each aircraft) into the drain hole at the rear inboard side of the fuel tanks and press upward.

Selector Valve: Pull ring adjacent to selector valve inside the cabin. Switch valve handle to right and left tanks to drain respective lines. On 1962-63 M20C and 1963 M20D aircraft, drain fuel selector valve on under side of fuselage using the plastic sampling cup.

2. ENGINE LUBRICATION

a. Filling engine sump
Fill engine sump (Figure 2-5) with lubricating oil specified on the lubrication chart (Figure 2-9).

b. Draining engine sump

The engine sump can easily be drained by means of the oil quick drain that is installed on each engine as standard equipment (Figure 2-6).

FIGURE 2-4 – FUEL SELECTOR VALVE ASSEMBLY

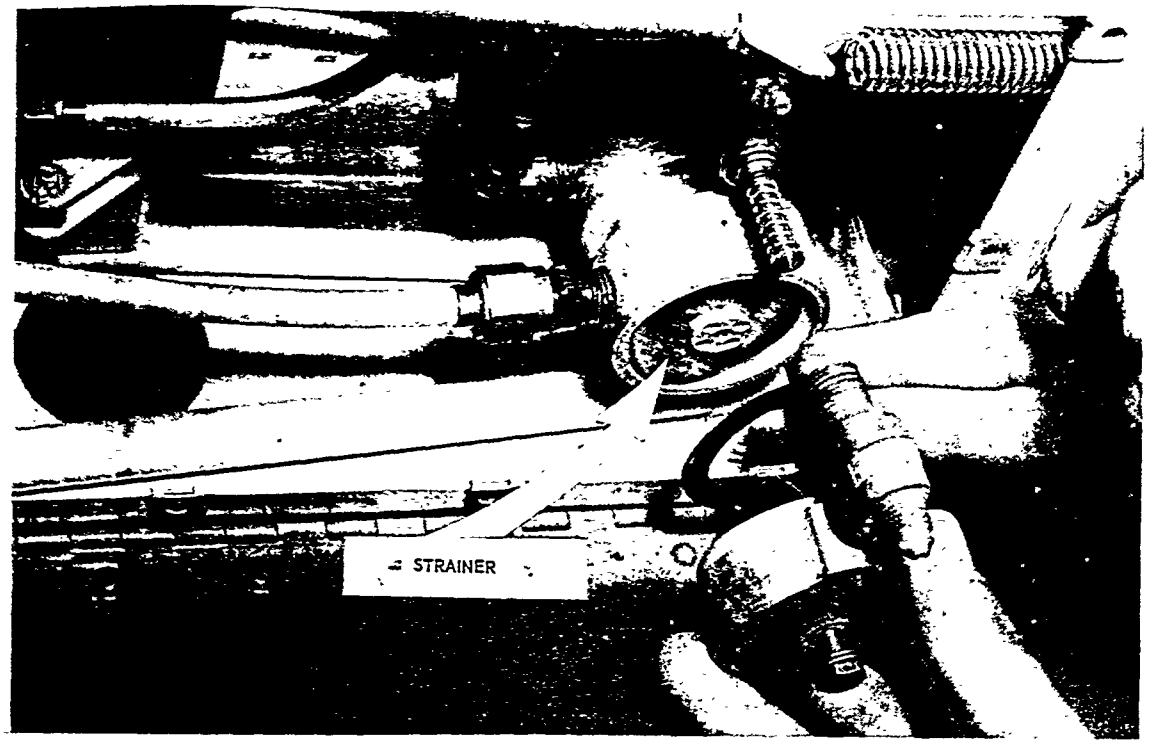


FIGURE 2-5 – OIL DIPSTICK ACCESS

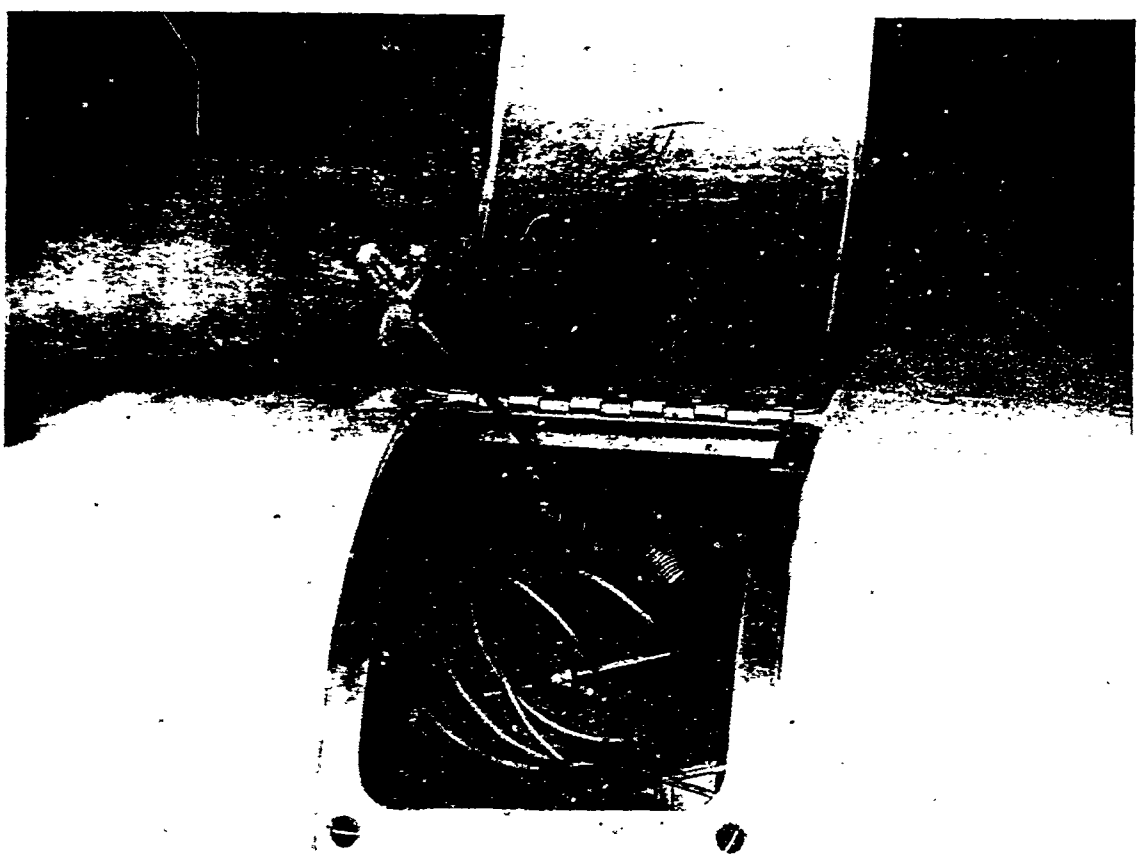
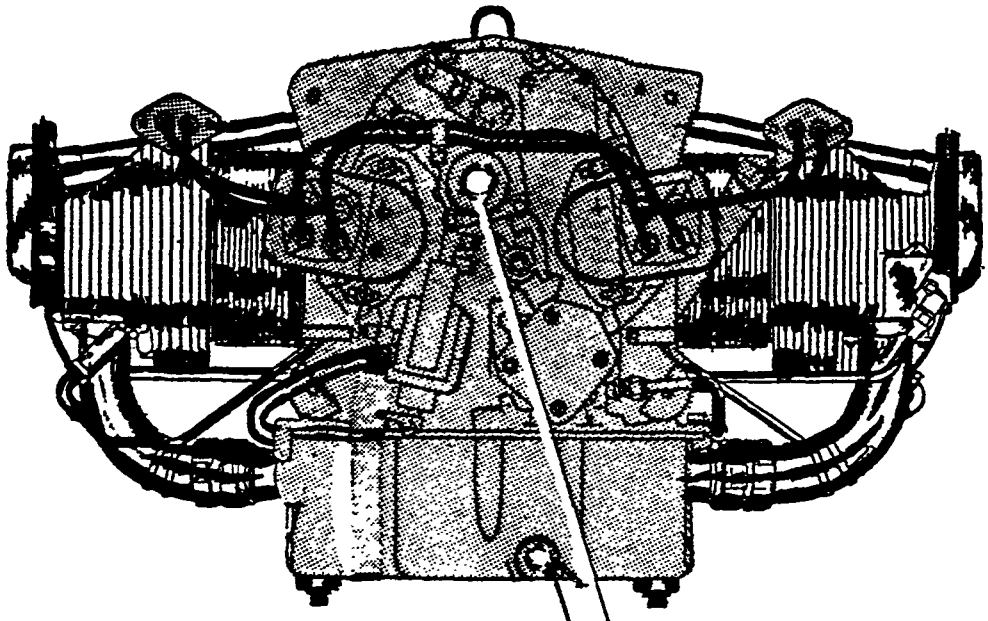


FIGURE 2-6 – OIL QUICK DRAIN (M20E)

FIGURE 2-7 – OIL SCREEN STRAINER LOCATIONS (M20E)



c. Cleaning oil screen strainers

Remove two strainers (Figure 2-7) and flush with kerosene every 50 hours or each time oil is changed. (M20E&F)

3. BRAKE SYSTEM

The brake cylinder reservoir must be filled with the brake fluid specified in Figure 2-9. The reservoir fluid level should be checked at every 50-hour inspection and replenished as necessary. After a periodic installation, the brakes require no adjustment during the service life of the brake lining.

CAUTION: Do not fill reservoir while parking brake is set or when flaps are extended. (See page 5-15 for brake bleeding procedure.)

4. BATTERY

Check battery fluid level and battery condition every 25 hours. Use only distilled water when servicing; avoid contamination of cells.

5. INDUCTION SYSTEM

Check air filter visually at each pre-flight inspection. If cleaning is necessary, remove filter and clean in accordance with Section III C. Check power boost door seal (M20E&F).

6. VACUUM STEP SYSTEM (1965 Models and subsequent)

A vacuum servo will raise the step when the engine is started and sufficient vacuum is produced. A spring will pull the step down when the engine is stopped and vacuum is relieved (Figure 2-8).

NOTE: To lubricate the step strut, spray a light coat of a Silicone-type lubricant on all four sides of shaft. This substance will not attract dust or soil clothing.

E. LUBRICATION

Refer to Lubrication Diagram (Figure 2-9) for instructions regarding lubrication points, intervals, and type of lubricant recommended. Grease fittings are provided on the nose gear and main gear. Bearings used in bell cranks, hinge points, and rod ends should be lubricated periodically to prevent corrosion. Avoid excessive application of lubricants. Excess lubricant on exterior surfaces of bearings tends to attract dirt and grit and may lead to malfunction of the unit.

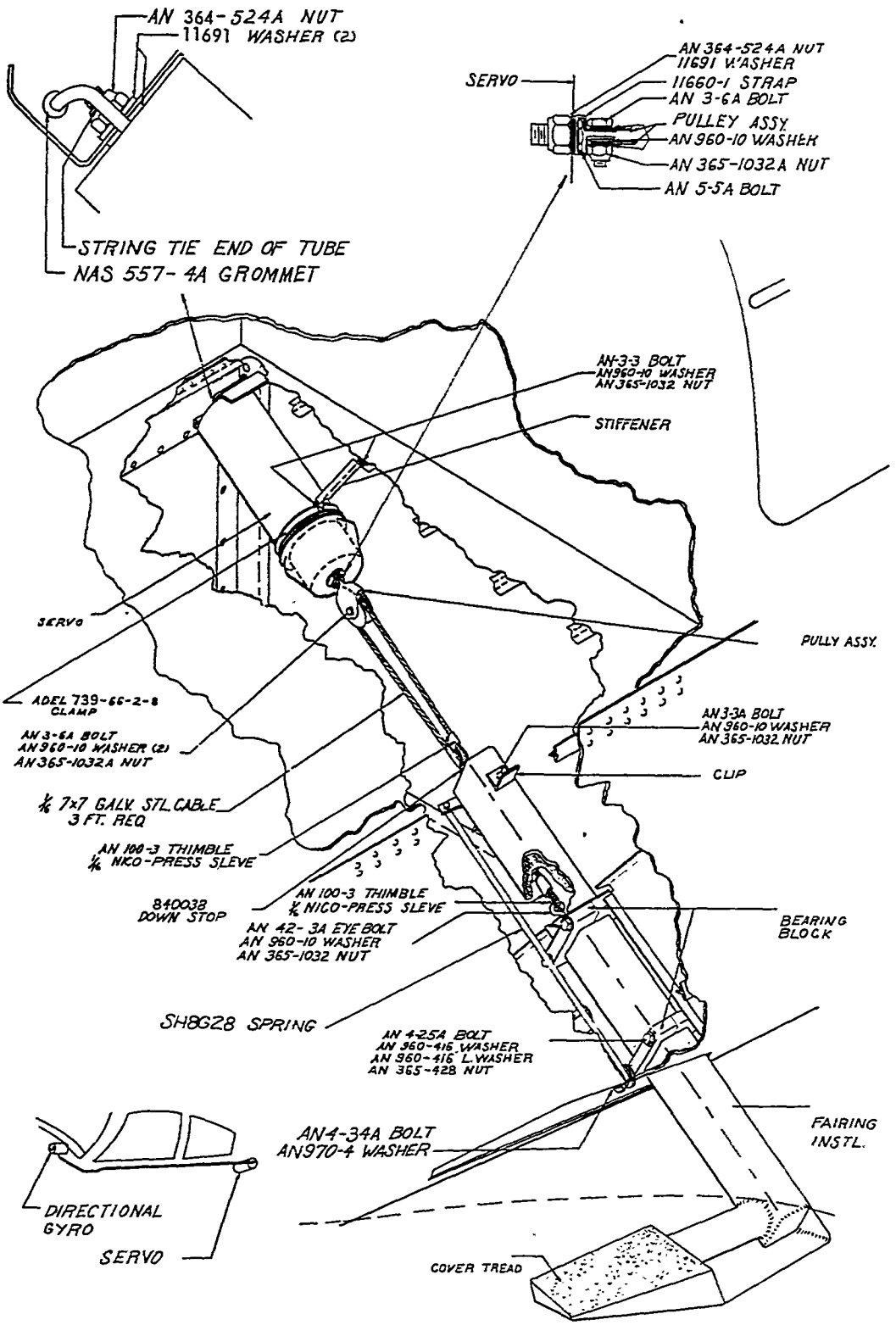
Where a reservoir is not provided around a bearing, apply the lubricant sparingly and wipe off excess. Remove wheel bearings from the wheel hub and clean thoroughly with a suitable solvent. When repacking with grease, be sure lubricant enters space between rollers and retainer ring. Do not pack grease into wheel hub. (See Figure 2-9 for recommended lubricant.)

Whenever specific instructions for lubrication of mechanisms are not available, observe the following precautions:

1. Apply oil sparingly, never more than enough to coat bearing surfaces.
2. At the regular inspection intervals, squeeze the magneto cam follower felts with the fingers. If oil appears on fingers, do not add oil to the felts. If felt is dry, moisten with light oil. Be careful not to add too much oil, because an excess will be thrown off during operation and will cause pitting and burning of magneto points.

Refer to Lycoming Service Instruction 1014 (latest revision) for engine oil specifications.

FIGURE 2-8 – VACUUM STEP SYSTEM INSTALLATION
(1965 MODELS AND SUBSEQUENT)



F. EXTERIOR & INTERIOR CARE

As with any paint applied to a metal surface, an initial curing period is required to develop the desired qualities of durability and appearance. Therefore, wax or polish should not be applied to the exterior until two or three months after delivery. Wax substances will seal the paint from the air and prevent curing. Hold buffing to a minimum until curing is complete and there is no danger of disturbing the undercoat.

Before washing the exterior, be certain the brake discs are covered, the pitot shield is in place, and both static air buttons are masked off. Loose dirt and mud deposits should be flushed away before washing the exterior with an aircraft detergent and cool water. Use soft cleaning cloths or a chamois and avoid harsh or abrasive detergents that might scratch or corrode the surface. To remove a heavy oxidation film, use a prewax cleaner (example: Harly Carnuba). For nonoxidized or precleaned surfaces, apply a good exterior-finish wax (example: Harly Wax) recommended for protection of acrylic-enamel finishes. Follow the manufacturer's instructions carefully. A heavier coating of wax on the leading edges of the wings, empennage, and nose section will help reduce drag and abrasion in these areas.

If fuel, hydraulic oil or any other fluid containing dyes ia found on the exterior paint, wash the area at once to prevent staining. Spilled battery acid must be flushed away immediately and the area treated with an alkali and water solution followed by a thorough washing with an aircraft detergent solution.

Household window cleaning compounds are not recommended, as some contain abrasives or solvents which could harm the Plexiglas. Furthermore, it is essential that all cleaning compounds and application cloths be free of abrasives, grit, or other foreign matter. Never use denatured alcohol, benzene, carbon tetrachloride, acetone, or leaded gasoline for cleaning Plexiglas or interior plastics. Before wiping the window surfaces, flush the exterior with clear water to remove particles of dirt. Grease or oil can be removed by wiping the panel with a cotton cloth saturated with unleaded gasoline or kerosene. An anti-static Plexiglas cleaner is recommended for cleaning and polishing the windshield and windows.

Normal household cleaning practices are recommended for routine interior care. The seats, rugs, upholstery panels, and headliner should be frequently vacuum cleaned to remove as much surface dust and dirt as possible. The fine leather or vinyl upholstery and kick panels need occasional washing with an aircraft detergent solution to prevent the working of dirt into the surface. Wipe clean with a slightly damp cloth and dry with a soft cloth. Never apply furniture polishes. Foam type shampoos and cleaners (example: Garry's VLP) for vinyl, leather, and plastic materials can be used to remove stains and to condition the entire interior. Spray-on dry cleaners are also recommended.

When using commercial cleaning and finishing compounds, carefully follow the manufacturer's instructions. Never saturate fabrics with a solvent which could damage the backing and padding materials. To minimize wetting of carpets, keep foam as dry as possible and rub gently in circles. To remove foam, use a vacuum cleaner. Royalite, vinyl, and metal surfaces may be cleaned with a damp cloth or an aircraft detergent solution. Do not use alcohol or strong solvents on Royalite plastics.

SHOP NOTES

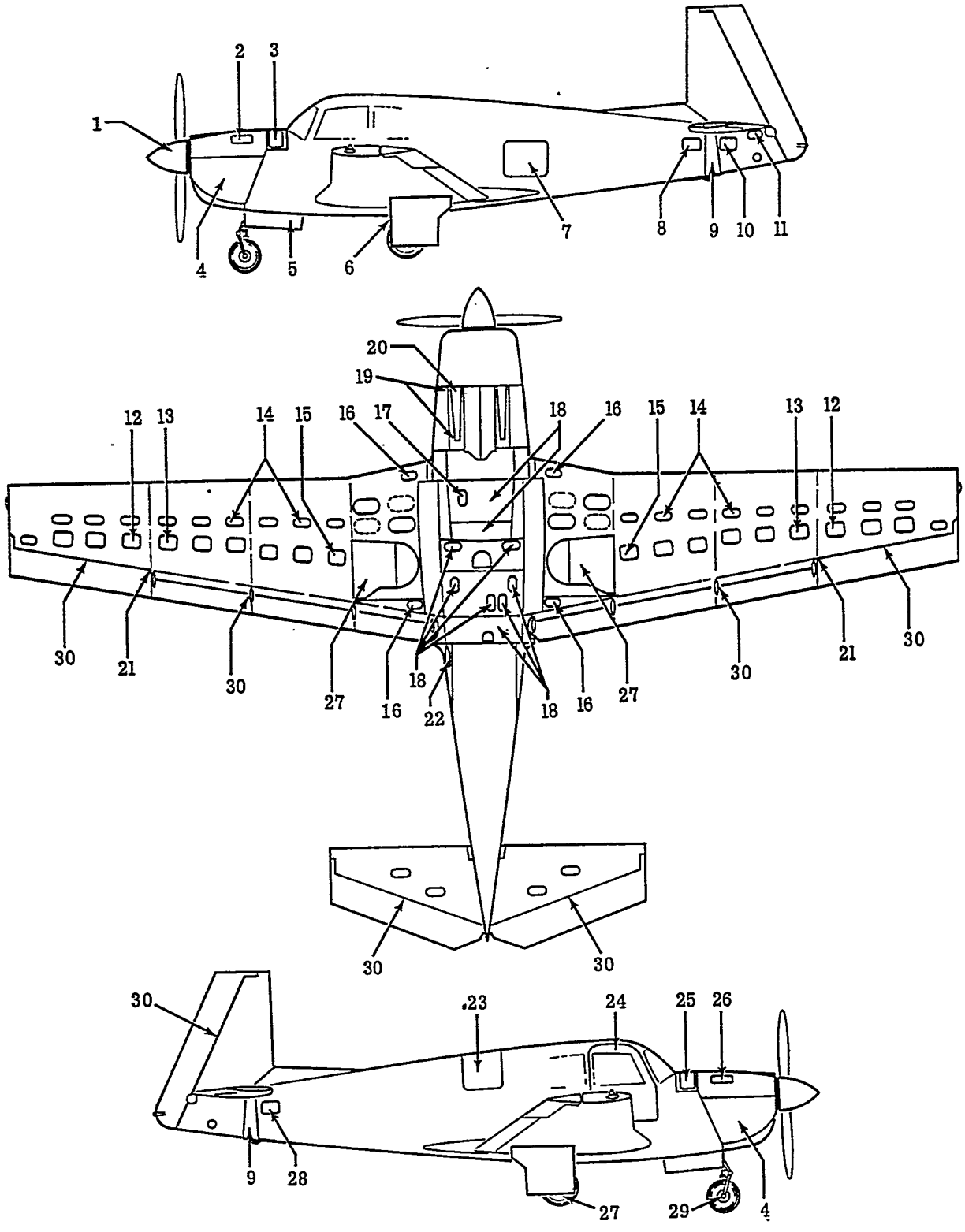


Figure 2-9. Service, lubrication, & inspection access guide.

ACCESS COVER IDENTIFICATION & LUBRICATION GUIDE

ITEM NO.	ITEM DESCRIPTION	LUBRICATION SYMBOL*	INTERVAL (HRS)
1	Propeller	⬡	100
	Starter Drive	⊠	20
2	BATTERY (M20 C & D)		
3	Flight Instruments		
	Positive Control Pilot Valve		
	Vacuum Regulator		
	Turn Coordinator		
	Vacuum Filters--Replace at		500
	Hydraulic Reservoir	○	50
	Control System Adjustments:		
	Control Column Bearing Ball	⊕	100
	Rod-End Bearings	■	100
	Universal Joints	▲	100
	Bell Cranks	▲	100
4	Engine Cowling		
5	Nose Gear Grease Fittings		100
	Retraction Tube		100
	Bell Cranks		100
	Bungees	▲	100
	Shock Absorber	■	100
	Gear Door Rod-End Bearings	■	50
6	Main Gear Grease Fittings	●	100
	Retraction Tube Rod-End Bearings	■	100
	Bell Cranks	▲	100
	Bungees	▲	100
	Gear Door Rod-End Bearings	■	50
	Electric Gear Actuator Gear Box	★	100
	Electric Gear Actuator Ball Screw	✡	100
7	Elevator & Rudder Controls:		
	Control Tube Rod-End Bearings	■	100
	Bell Cranks	▲	100
	P.C. Servos		
	Battery (M20E, F, & J)		
	Battery Relay (M20E, F, & J)		
	Retractable Step	■	100
	Stabilizer Trim Control Shaft:		
	Universal Joints	▲	100
	Guide Blocks	⬢	100
8	Elevator & Rudder Controls:		
	Control Tube Rod-End Bearings		100
	Bell Cranks	▲	100
	Stabilizer Trim Jack Screw	⬢	100
9	Empennage Attach Points	▲	100
	Stabilizer Trim Attach Point	▲	100
10	Elevator & Rudder Controls:		
	Control Tube Rod-End Bearings	■	100
	Trim Assist Bungee Attach Point	▲	100

*See last page of section for lubrication symbol legend.

ITEM NO.	ITEM DESCRIPTION	LUBRICATION SYMBOL*	INTERVAL (HRS)
11	Elevator & Rudder Controls:		
	Control Tube Rod-End Bearings	■	100
	Trim Assist Bungees	▲	100
	Elevator Down Springs	▲	100
12	Aileron P.C. Servos		
13	Aileron Controls:		
	Control Tube Rod-End Bearings	■	100
	Bell Cranks	▲	100
	Guide Blocks	⬢	100
14	Aileron Control Tube Guide Blocks	⬢	100
15	Main Gear Retraction Spring	▲	100
16	Wing Attach Points		
	Control Tube Guide Blocks	⬢	100
17	Hydraulic Flap Pump & Linkage	▲	100
	Stabilizer Trim Screw & Stops	⬢	100
	Indicator Adjustment Point		
	Stabilizer Trim Chain & Gears	■	100
18	Elevator & Rudder Controls:		
	Control Tube Rod-End Bearings	■	100
	Bell Cranks	▲	100
	Guide Blocks	⬢	100
	Hydraulic Flap Cylinder Rod-End Bearing	▲	100
	Flap Indicator Cable	▲	100
	Electric Flap Actuator Gear Box	✱	200
	Electric Flap Actuator Ball Screw	✡	100
19	Electric Boost Pump.		
	Fuel Selector Valve Detent Track & Ball	▲	100
20	Control Systems:		
	Control Tube Rod-End Bearings	■	100
	Control Yoke (Lower Section)	▲	100
	Nose Gear Steering Link	■	100
	Rudder Pedal Cross Shaft	▲	100
	Rudder-Aileron Bungee	▲	100
	Hydraulic Brake Cylinder Pedal Linkage	▲	100
21	Aileron Control Tube Rod-End Bearings	■	100
	Outboard Flap Stops		
22	Retractable Step	■	100
23	Baggage Compartment Door:		
	Hinges	▲	100
	Latches	△	100
	Seals	⊙	100
24	Cabin Door:		
	Hinges	▲	100
	Latches	△	100
	Seals	⊙	100
	Hold-Open Arm	■	100

*See last page of section for lubrication symbol legend.

ITEM NO.	ITEM DESCRIPTION	LUBRICATION SYMBOL*	INTERVAL (HRS)
25	Engine Instruments Radios		
26	Oil Dip Stick.	⊞	
27	Wheels & Brakes:		
	Wheel Bearings.	□	250
	Brake Pressure Plate Anchor Bolts.	■	50
28	Elevator & Rudder Control Stops		
29	Nose Wheel:		
	Wheel Bearings.	□	250
	Shock Absorber.	■	100
30	Control Surface Hinges	▲	100

LUBRICATION SYMBOL LEGEND

SYMBOL	MIL. SPEC. NO.	DESCRIPTION
▲	MIL-L-7870	Low Temperature Oil (General Purpose)
●	. . . . .	MIL-G-7711 or MIL-G-81322 Grease
□	MIL-L-3545	Grease (High Temperature)
⬡	. . . . .	MIL-G-23827 or Hartzell DG Grease
○	MIL-H-5606	Hydraulic Fluid (Red)
⊠	. . . . .	Graphite & Kerosene
⬢	. . . . .	Graphite & MIL-G-3278 Grease or MIL-G-23827
○	. . . . .	Powdered Graphite
■	. . . . .	Teflon Spray (Tri-Flon)
△	. . . . .	Stick Lubricant (Door Ease or Equivalent)
✱	. . . . .	Standard Oil Aviation Grease No. 5 With 10% by Volume Molybdenum Disulfide or MIL-G-23827 AM1
✡	. . . . .	Lubriplate 630AA (10% by Volume Molybdenum Disulfide Mixture Permissible)
⊙	. . . . .	Seal Dressing

⊞ ENGINE OIL RECOMMENDATIONS

For All Lycoming Aircraft Engines

Average Ambient Air Temperature for Starting (NOTE I*)	Single Viscosity Grades (NOTE II*)	Multi-Viscosity Grades (NOTE III*)	Operating Oil Inlet Temperature	
			Desired	Maximum
Above 60°F	SAE 50	SAE 40 or SAE 50	180°F	245°F
30° to 90°F	SAE 40	SAE 40	180°F	245°F
0° to 70°F	SAE 30	SAE 40 or 20W-30	180°F	225°F
Below 10°F	SAE 20	SAE 20W-30	170°F	210°F

*Refer to the following page for Notes I, II & III.

NOTES: ENGINE OIL RECOMMENDATIONS

MODELS AFFECTED: All Lycoming opposed series aircraft engines

TIME OF COMPLIANCE: Any time after initial 25 hour preservation run or when lubricating oil is changed or added.

Engine lubricating oil viscosity recommendations are shown on the previous page. However, the over-all acceptance of detergents, compounded, or additive lubricating oils is not sufficient reason for recommending their use in Lycoming aircraft engines. Inferior base oils are sometimes doctored with detergents to disguise their true characteristics; there are detergent oils that can cause spark plug fouling and preignition; and there are those that are incompatible with other oils. But, regardless of such factors, there are some aviation additive oils that appear to be superior in performance to straight mineral oil, and their use in Lycoming aircraft engines is recommended. Included in these oils are the multi-viscosity ashless dispersant oils essentially conforming to Specification MIL-L-22851 except for correct seasonal viscosity grade suitable to Lycoming series engines.

CAUTION.

Any lubricating oil, either straight mineral or compounded, must conform with Lycoming Specification No. 301E to be acceptable for use in Lycoming aircraft engines. Proof of such conformity is the responsibility of the lubricating oil manufacturer.

NOTES

I – AVERAGE TEMPERATURES – The listed ambient ground air temperatures are meant only as a guide. Actually a great deal of personal judgment must be used when selecting the seasonal grade oil to put into the engine. For example if a plane is to be flown into an area which is much warmer or much colder, only personal judgment on the part of the operator can determine what grade of oil to use. When oil inlet temperatures approach the maximum allowable during operation, it is a good indication that a higher viscosity oil should be considered.

II – SINGLE VISCOSITY GRADES – This classification of lubricating oils includes any aviation grade (straight mineral, detergent and dispersant) that is designated by a single viscosity number. The SAE Grades 20, 30, 40 and 50 shown in the chart are equivalent of Grades 55, 65, 80 and 100 respectively.

III – MULTI-VISCOSITY GRADES – This classification includes additive oils with viscosities the same as straight mineral oil at high temperatures, but which provide a lower viscosity at low temperatures. The additives in these oils extend operating temperature range, improving cold engine starting and lubrication of the engine during the critical warm-up period, thus permitting flight through wider ranges of climatic change without the necessity of changing oil. The multi-viscosity grades are recommended for aircraft engines subjected to wide variations in ambient air temperatures, particularly when cold starting of the engine must be accomplished at temperatures of 30°F. and below. The SAE Grades 20W-30, 40 and 50 shown on the chart are equivalent to multi-viscosity grades of 65, 80 and 100 respectively. It must not be presumed, however, that multi-viscosity oils will alleviate all of the problems encountered in extremely cold environments (below +10°F.). At these temperatures preheating of the engine and oil supply tank will be required regardless of the type of oil used.

OIL RECOMMENDATIONS FOR NEW ENGINE BREAK-IN

New, or newly overhauled engines should be operated on straight mineral oil during the first 50 hours of operation, or until oil consumption has stabilized. If an additive oil is used in a new engine, or a newly overhauled engine, high oil consumption might possibly be experienced. The anti-friction additives of some of these oils will retard the break-in of the piston rings and cylinder walls. This condition can be avoided by the use of straight mineral oil until normal oil consumption is obtained, then change to the additive type.

Preservative oil should be removed at the end of the first 25 hours of operation–it must never be used beyond 50 hours. When adding oil during the period preservative oil is in the engine, use only aviation grade straight mineral oil of the viscosity desired.

RECOMMENDATIONS FOR CHANGING OIL

In engines that have been operating on straight mineral oil for several hundred hours, a change to additive oil should be made with a degree of caution, the cleaning action of some additive oils will tend to loosen sludge deposits and cause plugged oil passages. When an engine has been operating on straight mineral oil, and is known to be in excessively dirty condition, the switch to additive or compounded oil should be deferred until after the engine is overhauled.

When changing from straight mineral oil to compounded oil, the following precautionary steps should be taken:

1. Do not add additive oil to straight mineral oil. Drain the straight mineral oil from the engine and fill with additive oil.

2. Do not operate the engine longer than five hours before the first oil change.

3. Check all oil screens for evidence of sludge or plugging. Change oil every ten hours if sludge conditions are evident. Resume normal oil drain periods after sludge conditions improve.

CAUTION

The terms "detergent", "additive" and "compounded" used herein are intended to refer to a class of aviation engine lubricating oils to which certain substances have been added to improve them for aircraft use. These terms do not refer to such materials commonly known as "top cylinder lubricant", "dopes", "carbon remover" which are sometimes added to fuel or oil. These products may cause damage to the engine and their presence in an engine will void the owner's warranty. Under no circumstances should automotive oil be used. The use of automotive lubricants in Lycoming engines is not recommended because its use could cause engine failure.

SECTION

3

POWER PLANT

SECTION III
POWER PLANT

A. GENERAL

The M20C and M20D are powered by a Lycoming O-360-A1D, 180 hp engine. The standard M20D is equipped with a Lycoming O-360-A2D, 180 hp engine, the O-360-A1D engine being optional for a constant-speed propeller. Both engines have a compression ratio of 8.5:1 and require a minimum grade of 91/98 octane fuel.

The M20E is equipped with a Lycoming IO-360-A1A, 200 hp engine having a constant-speed all-metal propeller. This engine must be serviced only with a fuel having a minimum grade of 100/130 octane.

Two Bendix magnetos are furnished, the left magneto being equipped with a set of retard breaker points for a starter vibrator which furnishes long duration, boosted spark for starting. The ignition switch combines both starting and ignition functions. To supress radio static, shielded spark plugs and ignition harness is furnished as standard equipment.

For detailed engine and propeller information, refer to manufacturers' handbooks.

B. TROUBLE SHOOTING

Refer to the appropriate Lycoming or Bendix manual for engine trouble shooting procedures.

C. INDUCTION AIR FILTER CARE

The incorporation of an induction air filter in the engine air intake system significantly increases engine life. Dust particles accumulate on the filter element and must be removed every 25 hours, or more frequently in dusty atmospheric conditions, to prevent obstruction of air intake during engine operation.

To clean induction air filter (paper element):
1. Remove filter from aircraft.
2. Direct a jet of air up and down the entire filter element (air nozzle must be kept at least 2 inches from filter).
3. Inspect filter for damage, holes, and presence of required gaskets before reinstalling.

To clean air-maze (oil) type filter:
1. Remove filter from aircraft.
2. Wash in solvent.
3. Apply a light coating of lubricating oil.
4. Reinstall on aircraft.

D. ENGINE REMOVAL

NOTE: Experience has proven that it is much easier to remove and reinstall this engine with the mount attached to it.

1. Remove the propeller
2. Remove the side cowls
3. Remove the top cowl
4. Remove the bottom cowl
5. Disconnect the following:
   a. ground cable from battery
   b. vacuum line
   c. landing light wires (2)
   d. oil radiator, oil lines. 4 bolts and clamps
   e. brace rods (connected to firewall)
   f. cowl flap control rods

g. cabin heat duct (from engine)
h. fuel vent line
i. tachometer drive shaft
j. oil temperature bulb
k. oil pressure line
l. fuel pressure line
m. manifold pressure line
n. cylinder head temperature gage thermocouple line

6. Disconnect the following controls:
   a. throttle control
   b. propeller governor control
   c. mixture control
   d. cowl flap control and spring
   e. carburetor hot air control
7. Disconnect ignition switch wires from magnetos (Ground Magnetos)
8. Disconnect the engine ground strap
9. Disconnect all voltage regulator wires
10. Disconnect 2 generator wires and 1 starter wire
11. Disconnect muffler, tail pipe, and support springs
12. Disconnect line from boost pump to engine fuel pump
13. Remove top engine baffle to expose hoisting hook and attach an "A" Frame type hoist or other suitable hoist to the engine hoisting hook and relieve the tension on the engine mount.
14. Disconnect four bolts from the engine mounts at firewall and slide engine forward slowly and carefully to check if any wires or cables are still connected to the engine. (If it is desirable to remove the mount from the engine, it can be accomplished easier at this time).

E. PROPELLER REMOVAL (CONSTANT SPEED TYPE)

1. Remove propeller spinner (M20E & F remove screws at forward bulkhead).
2. Remove 6 bolts and washers from propeller flange and gently remove propeller from the engine shaft. (When the propeller is removed from the engine crankshaft there will be a small amount of oil that will run out of the propeller hub and crankshaft.)
3. Carefully remove the "O" Ring from the engine shaft.

F. INSTALLATION OF ENGINE

Reverse engine removal procedure. All installations must be rechecked for proper torque and safetying. Fuel and oil lines must be pressure checked. Engine mount torque values: Eng. Shock Mts.: 450 - 500 inch pounds; At Firewall: Top & Bottom 50 - 70 inch pounds.

G. INSTALLATION OF PROPELLER (CONSTANT SPEED TYPE)

1. Install spinner adaptor ring to engine starter gear.
2. Clean engine shaft and propeller hub at flange.
3. Insert the "O" Ring into the groove located inside the flange mounting lubricating it liberally with clean lubricating oil.
4. Line up the small "O" mark on the hub flange outer diameter with the short bushing in the crankshaft flange.
5. Install propeller onto engine shaft. Torque the 1/2 in. studs to 60-70 ft. lb. Safety wire pairs of studs together.
6. Install spinner dome.

H. ENGINE CONTROL ADJUSTMENTS

Refer to appropriate Lycoming manual for idle mixture, adjustment, etc.

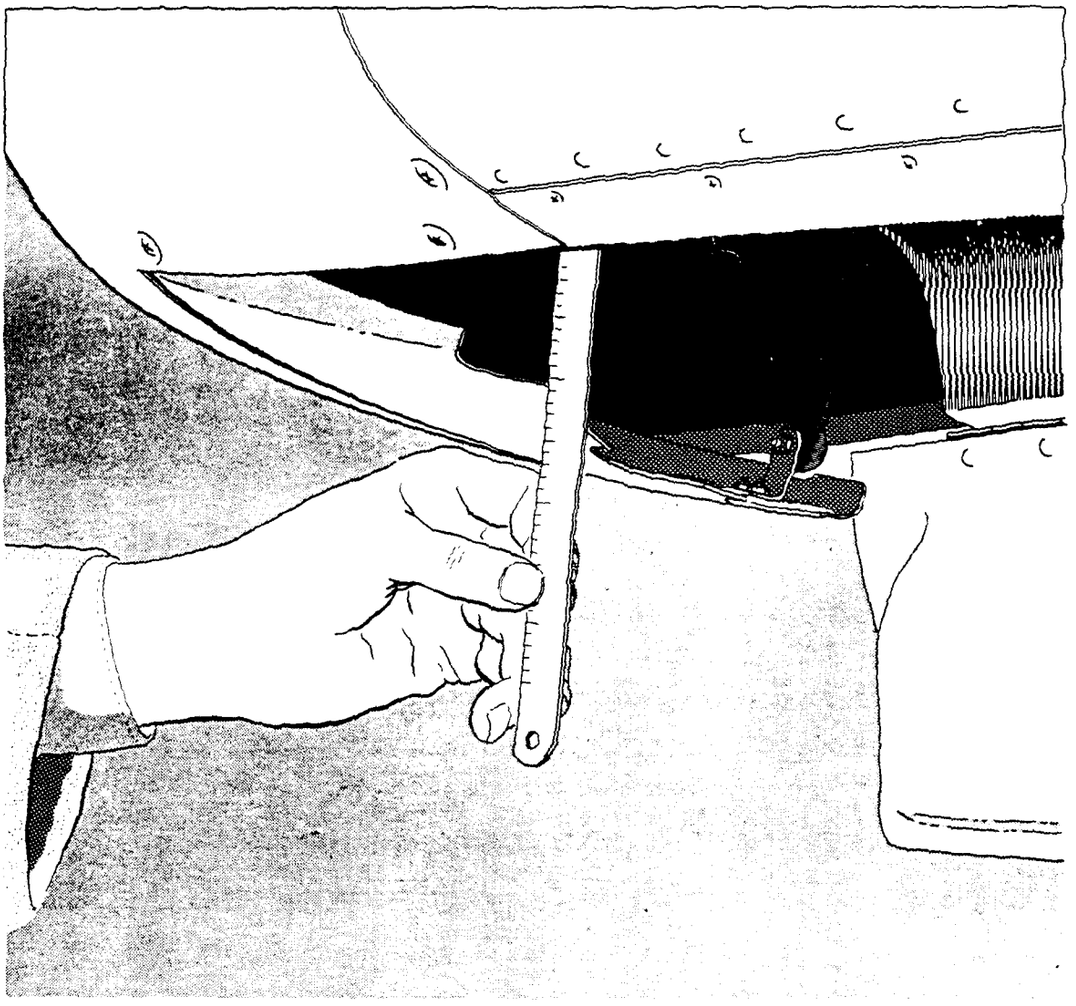
I. COWL FLAP OPENING ADJUSTMENT (See Figure 3-1)

1. For M20C, adjust left cowl flap opening for 1.1 in. $\pm$.1 in. measured at the trailing edge when fully extended.
2. For M20D, adjust left cowl flap opening for 2.4 in. $\pm$.1 in. measured at the trailing edge when fully extended.
3. For the 1964 & 1965 M20E, adjust left cowl flap opening for 2.00 in. measured at the trailing edge when fully extended.
   For 1966 and subsequent M20E aircraft, adjust left cowl flap opening for 1.65 in. measured at the trailing edge when fully extended.
4. For M20F, adjust left cowl flap opening for 1.65 in. measured at the trailing edge when fully extended.

J. COWL FLAP RIGGING

Rig right cowl flap to match left flap in up position.

FIGURE 3-1 – COWL FLAP OPENING ADJUSTMENT



NOTE: All measurements are made on left cowl flap only. Rig right cowl flap to match left flap in up position.

SHOP NOTES

SECTION

4

STRUCTURE

SECTION I V
STRUCTURE

A. GENERAL

Figures 4-2, 4-3, and 4-4 identify skin materials used on Mooney Aircraft. Repairs such as skin patching, welding, etc., may be made in accordance with the regulations given in Civil Aeronautics Manual 18. Skin repairs must result in a surface which is as strong as, or stronger than, the original skin. However, flexibility must be retained so that the surrounding areas will not receive extra stress.

B. REMOVAL OF WING COMPONENTS

The major subassemblies of the wing may be removed individually or the wing may be removed as a unit. To remove a wing, a fuselage supporting cradle is required.

1. Removal of Wing (Figure 4-1)

   a. Remove wing root fairings, and the bottom fuselage access panels.

   b. Drain all gas from the wing.

   c. Drain brake lines and reservoir. Disconnect at wing main spar.

   d. Remove front and rear seats. Remove 2 inspection plates under rear seat area.

   e. Set the airplane on jacks. (Use jack points as shown in Figure 2-1.)

   f. Set "A" frame on propeller.

   g. Remove the following:

      1. Two landing gear assist springs.
      2. Disconnect flap hydraulic line at pump fitting.
      3. Disconnect flap indicator housing in cabin.
      4. Aileron tubes – two.
      5. Disconnect trim link tube at station 59.3 and station 94.5.
      6. Main gear retraction tubes.
      7. Rudder tubes.
      8. Elevator tube.
      9. Elevator and rudder push-pull tubes – two.
      10. Disconnect floorboard.
      11. Disconnect seat rails.
      12. Stringer assembly doublers – one each side.
      13. Fourteen bolts from shear plates.
      14. Sixteen attach bolts – eight each side (AN3-4A).

15. Bolts, nuts, and washers from front attach fittings on both sides.

16. Gas lines and wires from wing root.

17. Airspeed indicator line, pitot lines, pitot heater wires if installed.

18. Rear mating bolts (two AN4-17A).

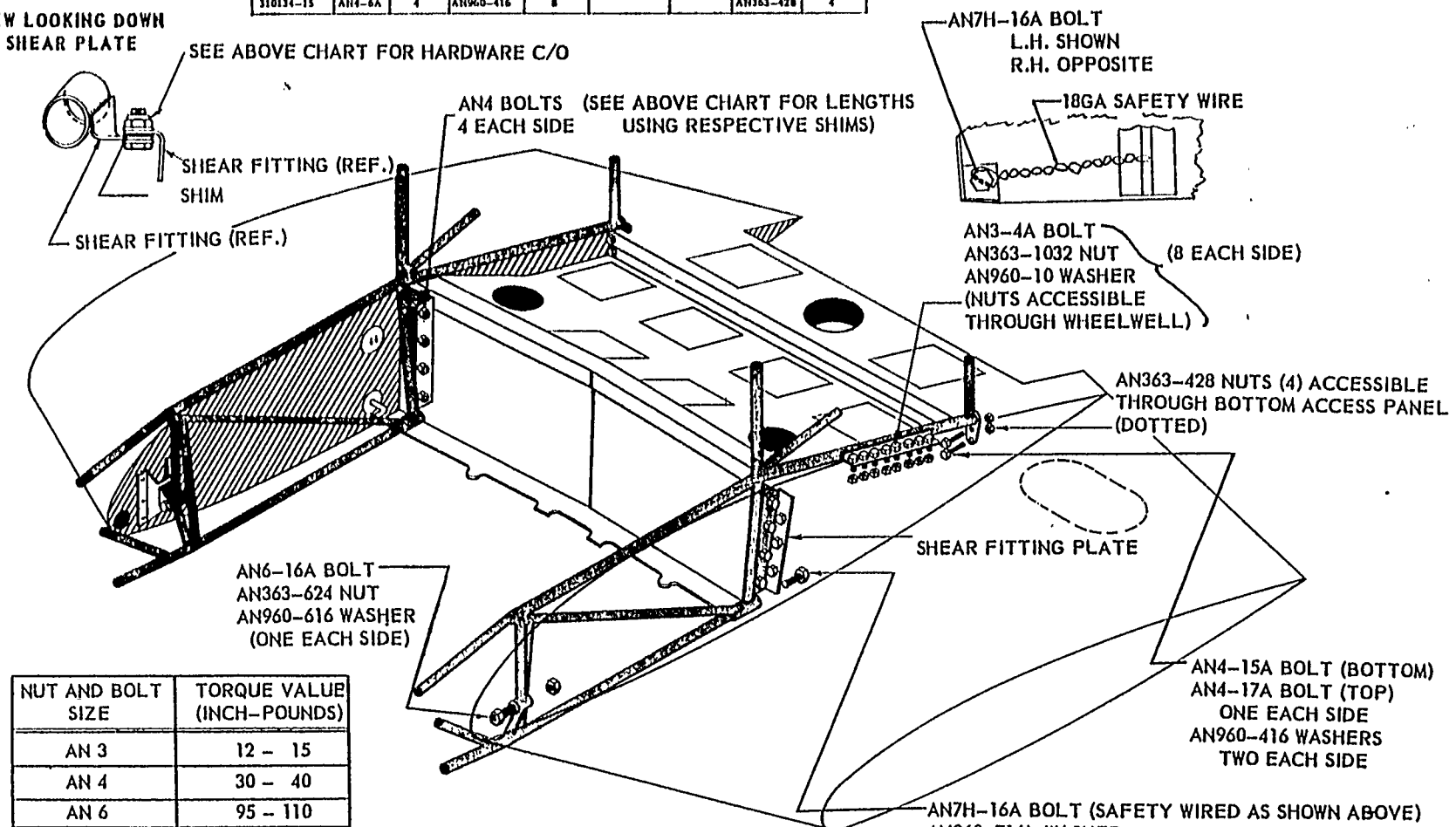
19. Two tension bolts (7H-16A).

NOTE: Have suitable cradle ready for fuselage before accomplishing last three steps of wing removal.

2. Installation of the wing assembly is direct reversal of removal.

SHOP NOTES

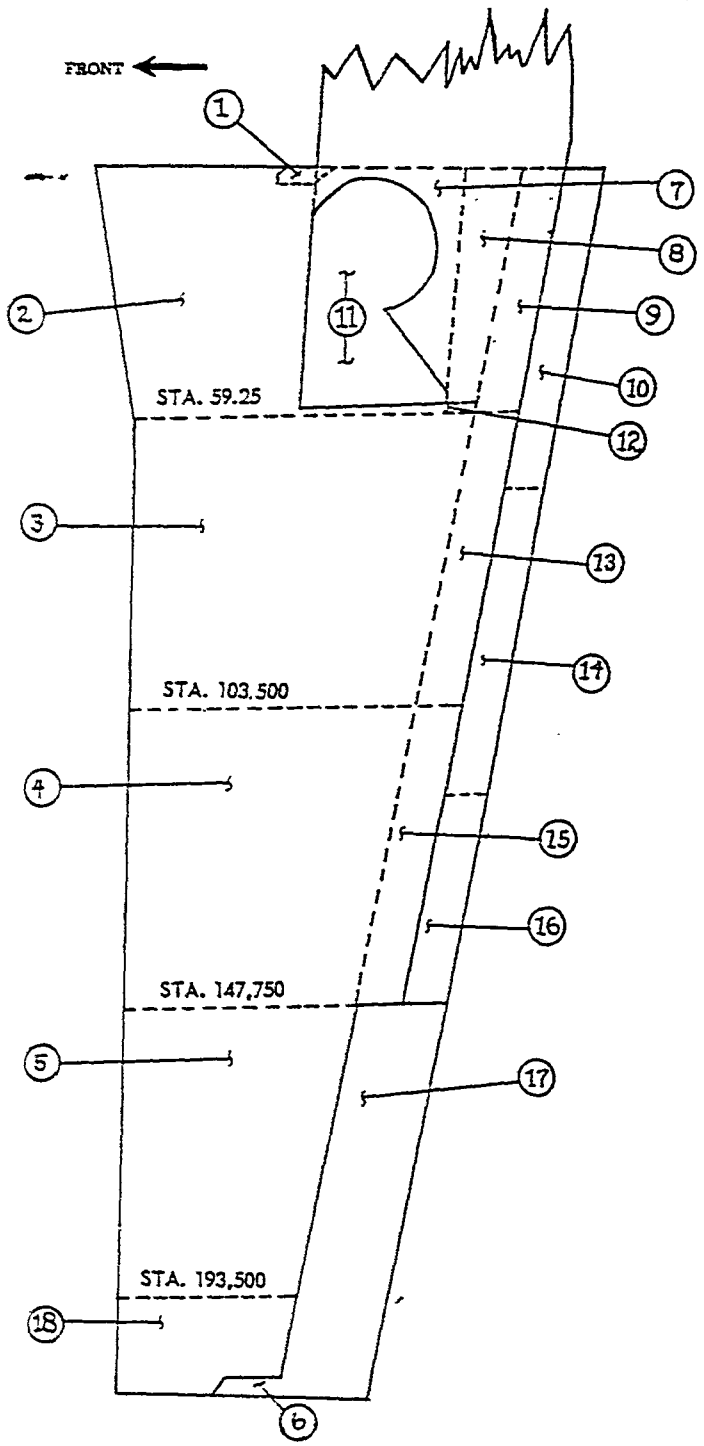
SHIM PART NO.	BOLT	NO. REQ'D PER SHIM	WASHER	NO. REQ'D PER SHIM	WASHER	NO. REQ'D PER SHIM	NUT	NO. REQ'D PER SHIM
310134-7	AN4-5A	4	AN960-416L	8			AN363-428	4
310134-9	AN4-5A	4	AN960-416L	8			AN363-428	4
310134-11	AN4-5A	4	AN960-416L	8			AN363-428	4
310134-13	AN4-6A	4	AN960-416	8	AN960-416L		AN363-428	4
310134-15	AN4-6A	4	AN960-416	8			AN363-428	4



NUT AND BOLT SIZE	TORQUE VALUE (INCH-POUNDS)
AN 3	12 – 15
AN 4	30 – 40
AN 6	95 – 110
AN 7	450 – 500

FIGURE 4-1 – WING & FUSELAGE MATING DIAGRAM

FIGURE 4-2 – WING & SKIN CHART



RIGHT BOTTOM WING SHOWING

NO.	THICKNESS	MATERIAL
1.	0.063	2024 T-3 CLAD
2.	0.050 (a)	2024 T-4 CLAD
3.	0.040	2024 T-3 CLAD
4.	0.032	2024 T-3 CLAD
5.	0.025	2024 T-3 CLAD
6.	0.032 (a)	2024 –O CLAD
7.	0.032 0.025 (e)	2024 –O CLAD 2024 T-3 CLAD
8.	0.040	2024 T-3 CLAD
9.	0.025	2024 T-3 CLAD
10.	0.020 (b) 0.025 (e)	2024 T-3 CLAD 2024 T-3 CLAD
11.	0.040 (c)	2024 T-3 CLAD
12.	0.032	2024 T-3 CLAD
13.	0.025	2024 T-3 CLAD
14.	0.020 (d)	2024 T-3 CLAD
15.	0.025	2024 T-3 CLAD
16.	0.020 (d)	2024 T-3 CLAD
17.	0.016 (d) 0.025 (e)	2024 T-3 CLAD 2024 T-3 CLAD
18.	0.025	2024 T-3 CLAD

(a) Heat Treated to T-42 condition after forming

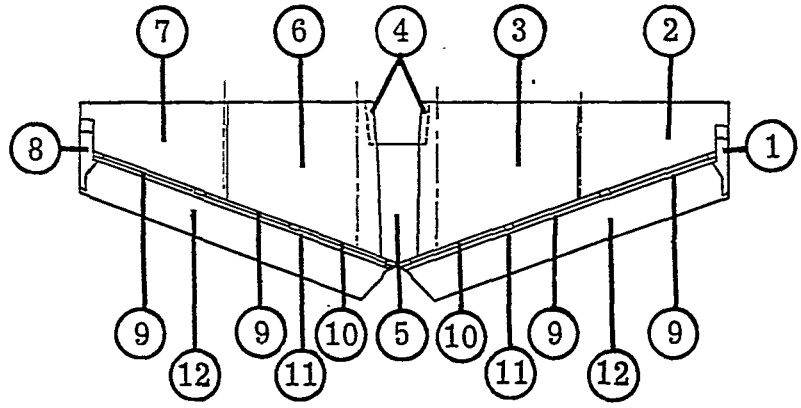
(b) 0.020 thickness on bottom side of flap.

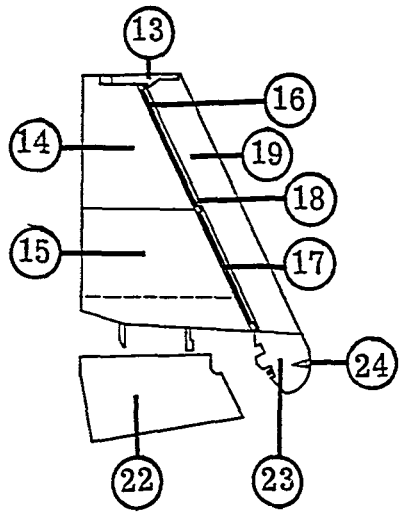
(c) Top of wing only.

(d) Same thickness on both sides.

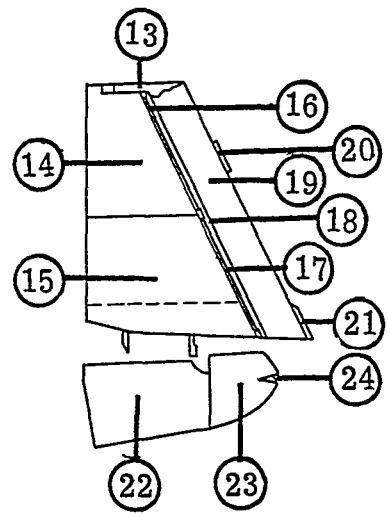
(e) Prior to 1965.

FIGURE 4-3 – TAIL SKIN CHART





M20F



M20C,D,&E

NUMBER	THICKNESS	MATERIAL
1.	0.040 (a)	2024 –O CLAD
2.	0.025	2024 T-3 CLAD
3.	0.025	2024 T-3 CLAD
4.	0.020	2024 T-3 CLAD
5.	0.025 (b)	2024 T-3 CLAD
6.	0.025	2024 T-3 CLAD
7.	0.025	2024 T-3 CLAD
8.	0.040 (a)	2024 –O CLAD
9.	0.012 (c)	2024 T-3 CLAD
10.	0.012 (c)	2024 T-3 CLAD
11.	Mooney Extrusion #4142	
12.	0.020	2024 T-3 CLAD

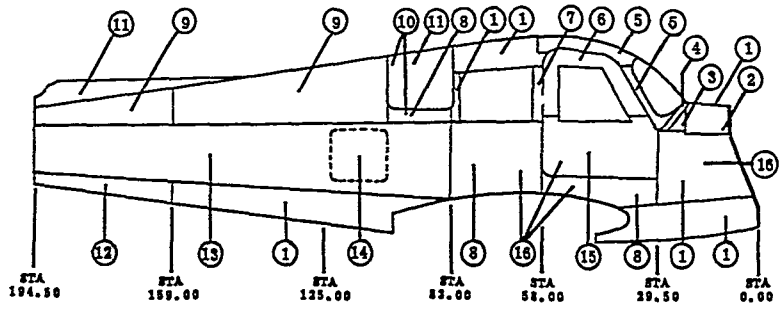
NUMBER	THICKNESS	MATERIAL
13.	0.040 (a)	2024 T-4 CLAD
14.	0.025	2024 T-3 CLAD
15.	0.025	2024 T-3 CLAD
16.	0.012 (c)	2024 T-3 CLAD
17.	0.012 (c)	2024 T-3 CLAD
18.	Mooney Extrusion #4142	
19.	0.020	2024 T-3 CLAD
20.	0.012 (c)	2024 T-3 CLAD
21.	0.025	2024 T-3 CLAD
22.	0.025	2024 T-3 CLAD
23.	0.020	2024 T-3 CLAD
24.	0.040	3003 -0

(a) Heat Treated to T-42 condition after forming.

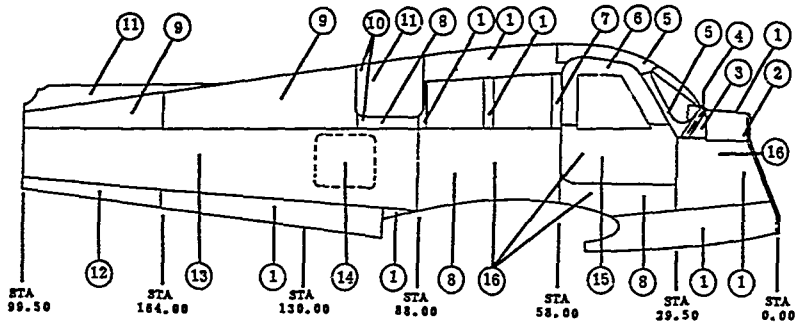
(b) Bottom 0.025 2024-O, H.T. to T-42 condition.

(c) 0.016 may be used as alternate.

FIGURE 4-4 – FUSELAGE SKIN CHART



M20C,D&E



M20F

NUMBER		THICKNESS		MATERIAL		
1.		0.025		2024 T-3		CLAD
2.		0.032		2024 T-3		CLAD
		0.020	(g)	2024-T-3		CLAD
3.		0.032		2024 –0	(a)	CLAD
4.		0.040		3003 –0		
5.		0.025		2024 –0		CLAD
6.	(e)	0.025	(c)	2024 T-4		CLAD
7.		0.025		2024 T-3	(d)	CLAD
8.	(e)	0.025		2024 T-3		CLAD
9.		0.020		2024 T-3		CLAD
10.	(f)	0.020		2024 T-3		CLAD
11.		0.025		2024 –0	(a)	CLAD
12.		0.025		2024 T-3		CLAD
		0.020	(g)	2024 T-3		CLAD
13.		0.032		2024 T-3		CLAD
14.	(f)	0.032		2024 T-3		CLAD
15.		0.032		2024 T-4		CLAD
16.	(f)	0.025		2024 T-3		CLAD

NOTES

(a) Heat Treat to T-42 condition after forming
(c) 0.032 can be used
(d) 2024 T-3 material on right side
(e) Right side only
(f) Left side only
(g) Prior to 1965

SECTION

5

LANDING GEAR AND BRAKE SYSTEM

SECTION V
LANDING GEAR & BRAKE SYSTEM

A. GENERAL

The landing gear is a tricycle gear type. It is constructed of heavy, chrome-molydenum tubular steel, heat treated for greater strength and resistance to wear. Neoprene rubber discs absorb the shock of normal taxiing and landing. The attaching points of the main gear are in metal bushings embedded in the gear-mounting box and attached to the spars. The nose wheel is mounted to the cabin's tubular-steel frame. The main gear wheels are equipped with hydraulic brakes.

B. REMOVAL OF LANDING GEARS

1. Main Gear, Retractable.

   a. Place aircraft on jacks. (Refer to Figure 2-1.)

   b. Unlock and move gear handle aft a short distance. Disconnect the gear doors, brake lines, and the retraction tube.

   c. Retract gear all the way.

   d. Remove the main gear retraction spring (see Figure 5-1).

   e. Extend gear to about 3 or 4 inches from down lock position and secure it or have someone hold it in this position.

   f. Remove two bolts from retracting truss bracket.

   g. Remove six bolts from rear landing gear at attachment bracket.

   h. Slide out rear part or bearing sideways.

   i. Slide front part of bearing aft and remove.

   j. Slide gear assembly aft slightly until clear of front bearing and carefully take out of wing.

   Main Gear – Fixed.

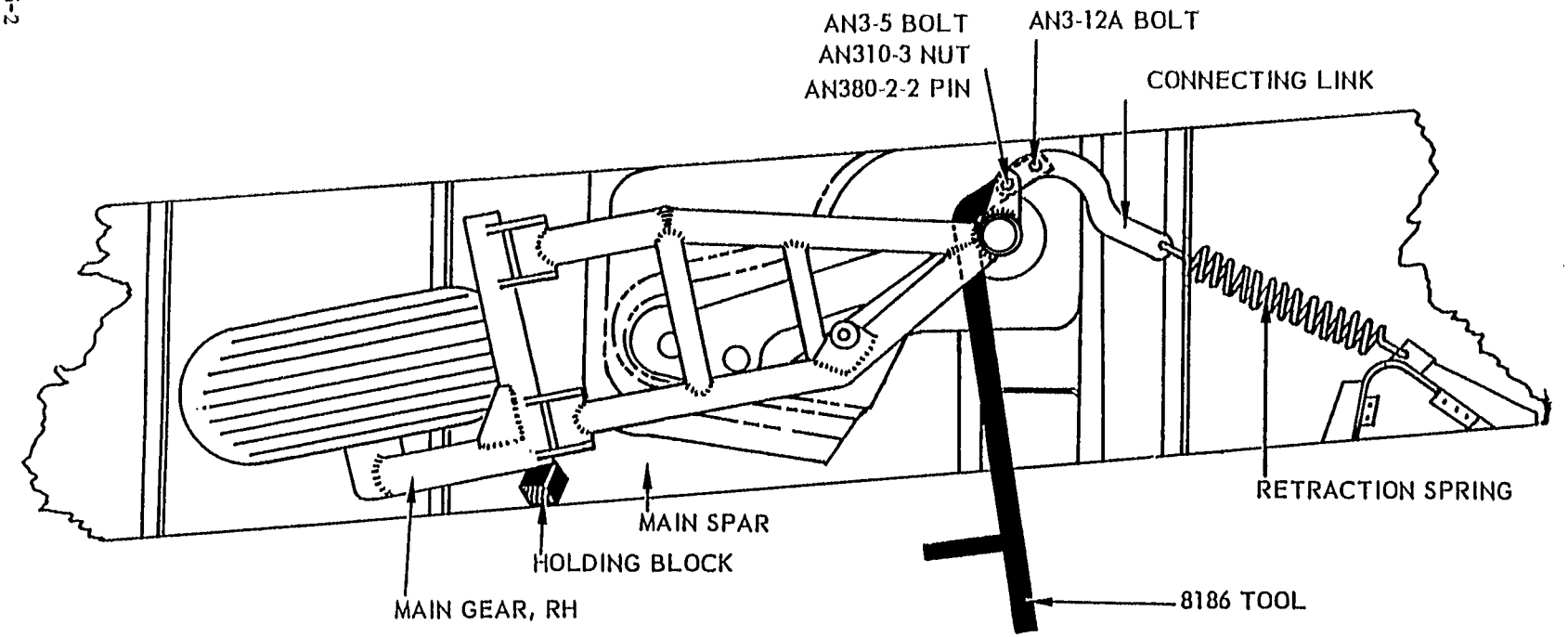
   After placing aircraft on jacks, remove fairing and link No. 510011-9. Repeat steps g through j in procedure above.

2. Nose Gear, Retractable.

   a. Set aircraft on jacks (Refer to Figure 2-1).

   b. Remove exhaust cavities.

   c. Remove bolt on aft end of retracting link.



VIEW LOOKING FWD. AT RETRACTED RIGHT HAND MAIN GEAR

FIGURE 5-1 – GEAR RETRACTION SPRING REMOVAL

PROCEDURE FOR USING 8186 TOOL:

Remove the gear door. Remove the cotter key and nut at the spring connecting link. Retract the gear and insert a 2"-thick wood block to hold the gear in the retracted position after detachment of the spring. Remove grease fitting in the gear attach bearing. Attach 8186 tool forward of the connecting link with an AN3-12A bolt as shown in the illustration. Rotate the tool in an outboard direction using the upper trunion shaft of the gear frame as a fulcrum. The link attach bolt (AN3-5) can be withdrawn by hand when sufficient leverage is applied to the tool.

NOTE: Installation of the gear retraction spring is the direct opposite of the removal procedure.

d. Partially retract nose gear by hand and remove bolt from nose gear steering horn.

e. Bend flange of firewall to clear bolts of support truss.

f. Remove right and left bolts of support truss.

g. Carefully remove nose gear assembly.

Nose Gear – Fixed.

Remove fairing and fixed links. Repeat steps "d" through "g" above.

C. REMOVAL AND DISASSEMBLY OF SHOCK DISCS (SEE FIGURES 5-2 AND 5-3)

D. REASSEMBLY AND INSTALLATION OF LANDING GEAR

Installation of the landing gear is essentially the reversal of removal. On reinstalling the main gear in the airplane, be sure to keep parts from the right and left gear separated. Do not attach gear door brackets to gear legs with sheet metal screws until doors are finally adjusted as explained in the following procedure.

1. Main Gear.

   a. Grease wheel bearings, retraction linkage, and fore and aft bearings which attach to the spar (See Figure 2-9 for recommended lubricants).

   b. Slide front end of gear leg into front bearing; slide bearing plate of rear attachment over rear end of main gear leg, spotfaced side forward.

   c. Slide rear part of attachment bracket between spar and landing gear.

   d. Line up holes in rear attachment and spar. Attach with six bolts.

   e. Attach retracting truss through retracting bracket with two bolts and secure with safety wire.

   f. Connect retraction tube and fully retract gear.

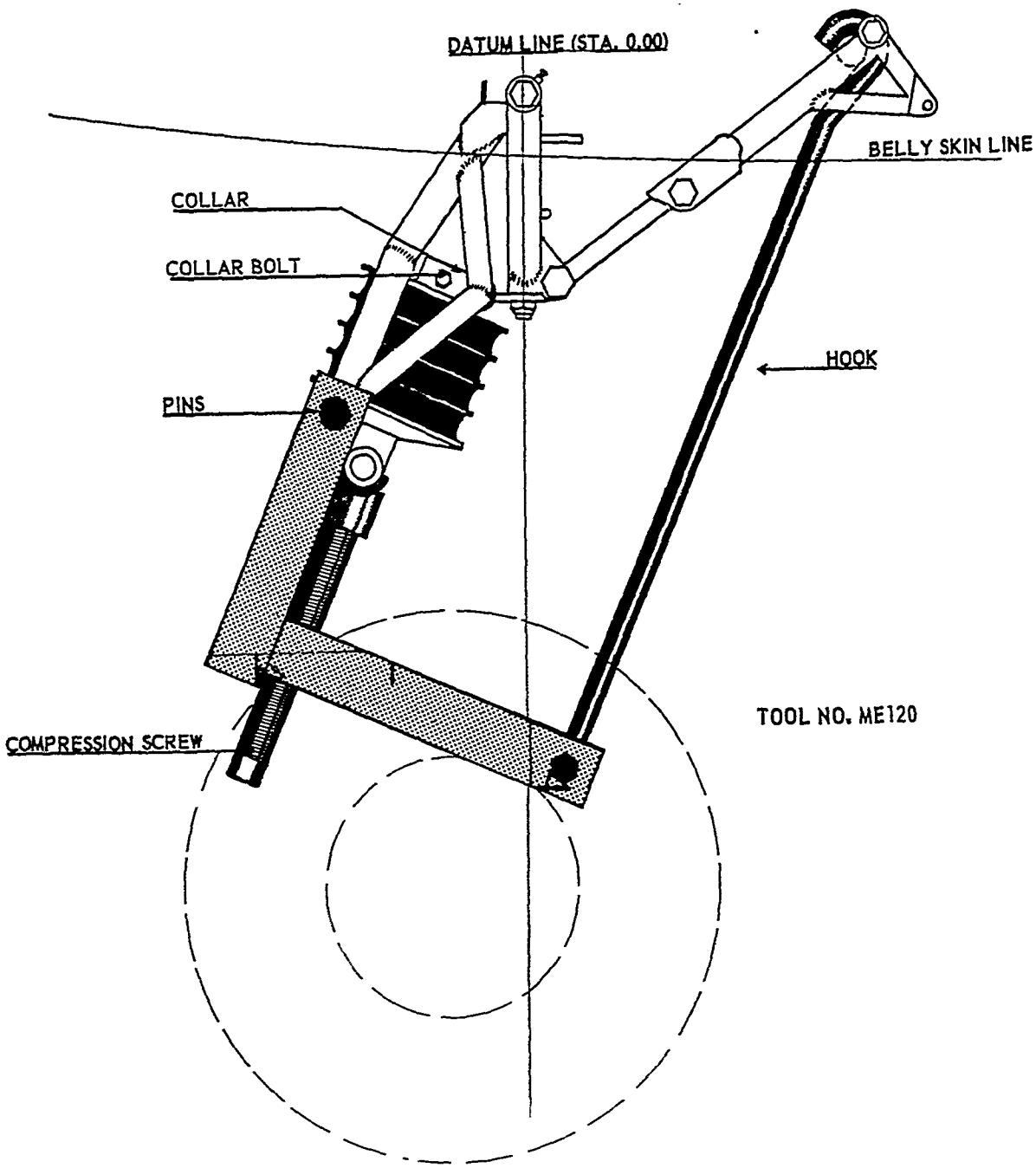
   g. Connect gear assist spring and lower gear.

   h. Attach gear door links to brackets on gear legs. Raise gear to see that there is no bind in door link bearings. Door edge should seat evenly against wing without excessive distortion where links attach to door. Adjustment may be made by slightly shifting the position of the gear door brackets on the gear leg or by changing the length of the links. This is a preliminary adjustment. Do not attach gear door brackets to gear leg with sheetmetal screws until door adjustment is rechecked after gear is rigged.

2. Nose Gear.

   Installation of the nose gear is a direct reversal of the removal procedure.

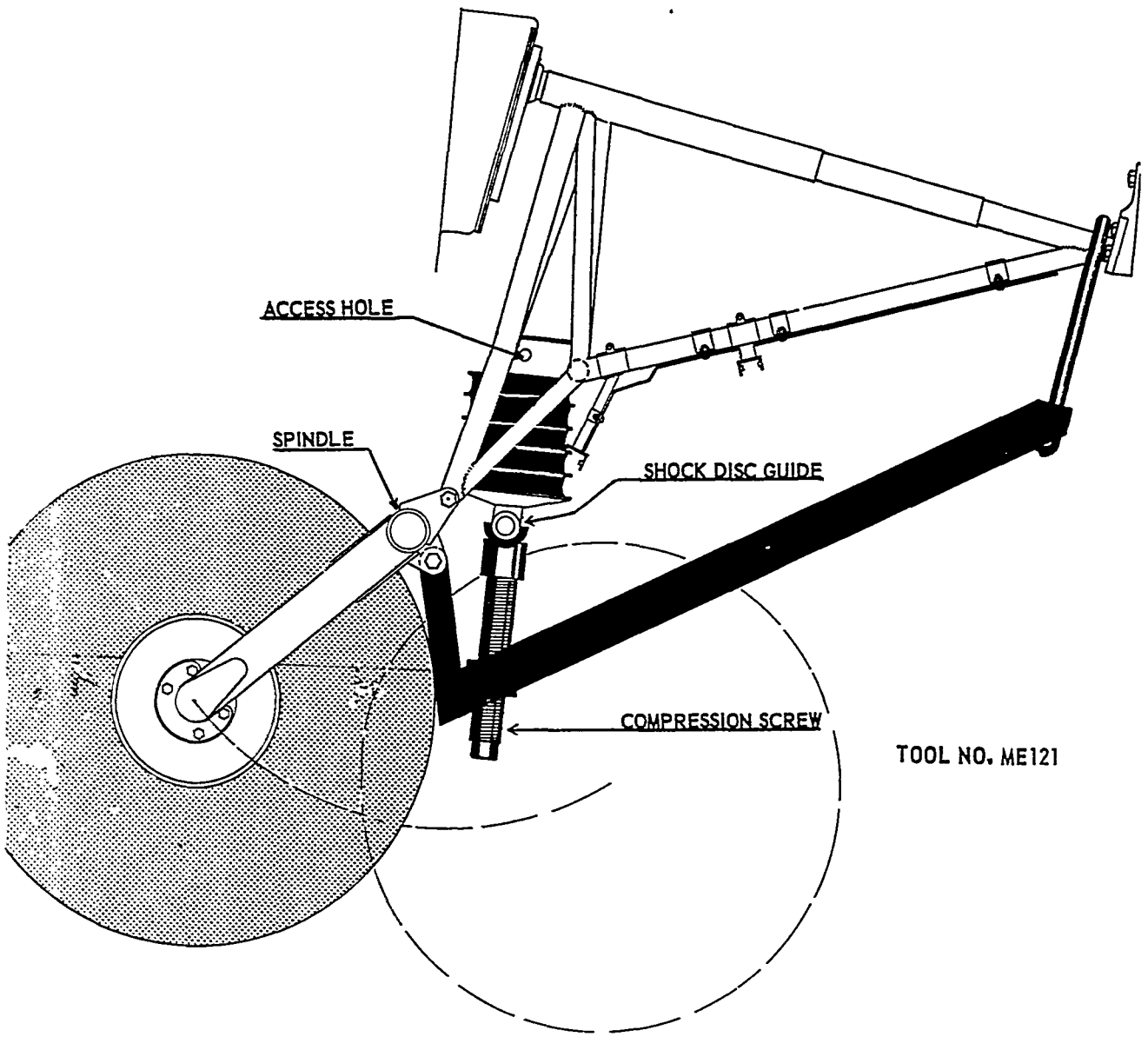
FIGURE 5-2 – NOSE GEAR SHOCK DISC REPLACEMENT TOOL APPLICATION



PROCEDURE FOR USING TOOL: Remove wheel and spindle. Attach tool as shown. Two pins (chained to tool) are placed in gear leg bolt holes. Turn compression screw clockwise until tension on collar is relieved. Remove collar bolt and collar. Relieve tension on shock discs by turning compression screw counter-clockwise. Shock discs may then be removed.

NOTE: Gear doors need not be removed.

FIGURE 5-3 – MAIN GEAR SHOCK DISC REPLACEMENT TOOL APPLICATION



PROCEDURE FOR USING TOOL: Remove spindle attach bolt at shock disc guide, swing wheel forward and attach tool as shown. Turn compression tool clockwise until collar bolt on collar is aligned with access hole. Remove collar bolt through access hole and relieve tension on shock discs by turning compression screw counterclockwise. Shock discs may then be removed.

NOTE: Gear doors need not be removed.

3. Instructions for rigging nose gear doors.

   a. Raise airplane off of ground by method described in Section II-C-1.

   b. Connect gear door links to gear doors (upper hole in bracket). Gear retraction system must be rigged before gear doors can be rigged properly.

   c. Gear doors must be timed to open and close correctly without contacting the gear. On 1962-1964 models, timing is accomplished by adjusting a screw on the cam. Turning the screw clockwise speeds closing. Turning the screw counterclockwise slows closing.

   d. M-20C & E Models (1965 & ON) incorporate door retraction arms on the nose gear retraction truss. To rig nose gear doors, adjust links shown in Figure 5-4.

   e. Doors must be checked for a tight fit when in the closed position. Play may be taken up by adjusting the gear door links.

   f. If the gear, in the retracted position, prevents the doors from closing completely, the eccentrics on the retract truss must be reset to raise the gear in the wheel well. The same applies for lowering if the gear is retracted too high in the wheel well.
   NOTE: If item "f" is incorporated, items "c" and "e" must be repeated.

E. BRAKE AND WHEEL MAINTENANCE

1. Brake lining inspection and replacement (Figure 5-5).

   Visually inspect the brake while it is installed on the airplane. No adjustment of brake clearance is necessary. If, after extended service, the brake linings become excessively worn, replace with new linings as follows:

   a. Remove dust cover from wheel.

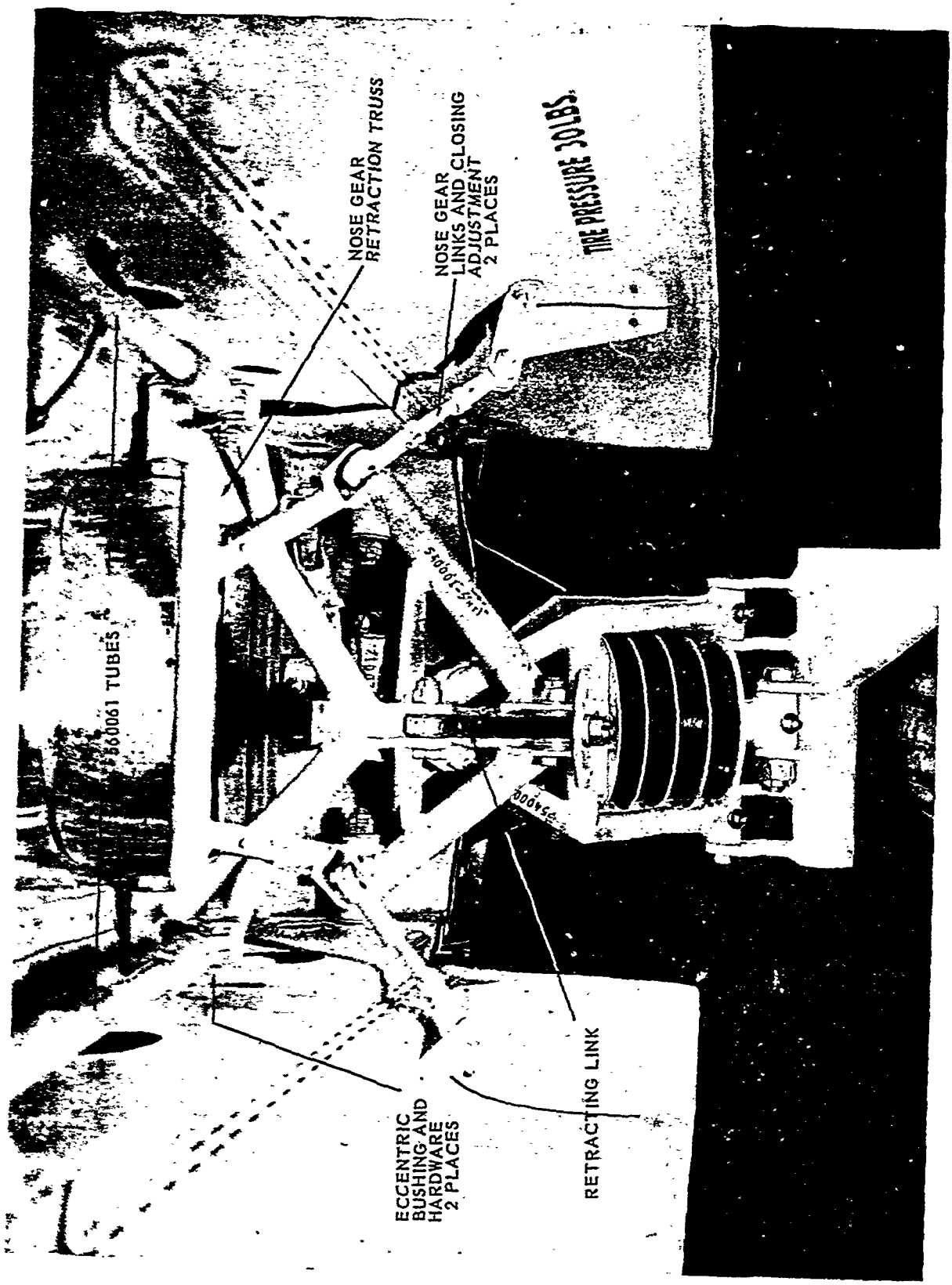
   b. Remove spindle nut from one side of wheel and two bolts from the other side (2 bolts that hold back brake plate stationary).

   c. Slide wheel out and remove pressure plate that has the worn lining on it.

   d. The linings can easily be replaced by drilling out three rivets from the pressure plate and three rivets from the back plate.

   e. Replace old linings with the new Cleveland brake linings and Cleveland 561 rivets. A 561-R rivet setting kit is available through your local Mooney distributor. This special rivet setting kit should be used, as rolling of the rivet is very important to get a tight fit between the rivet and the rivet hole.

FIGURE 5-4 – NOSE GEAR DOOR RIGGING DIAGRAM
(M20C & E 1965 & ON)



SHOP NOTES

FIGURE 5-5 – BRAKE CYLINDER ASSEMBLY

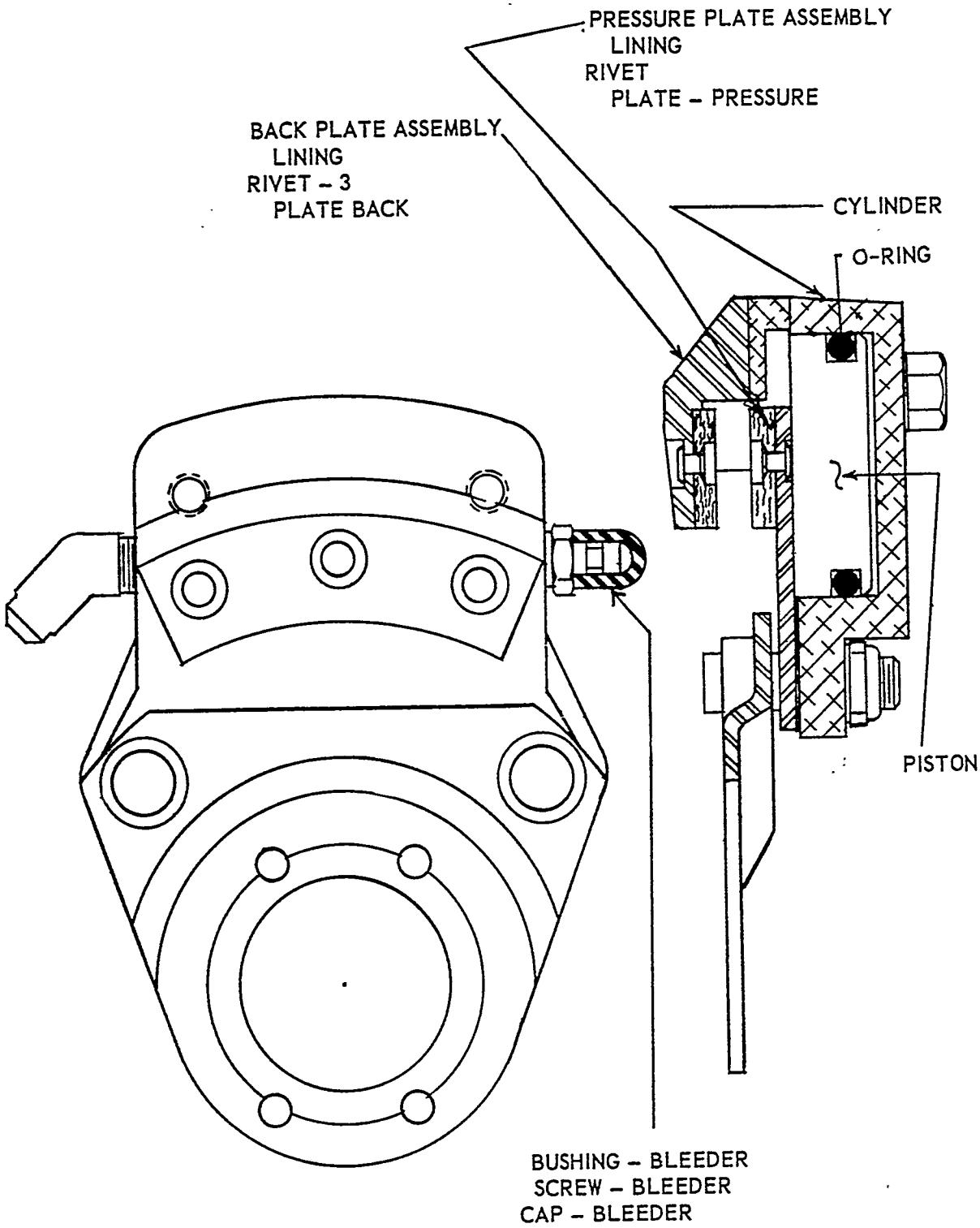
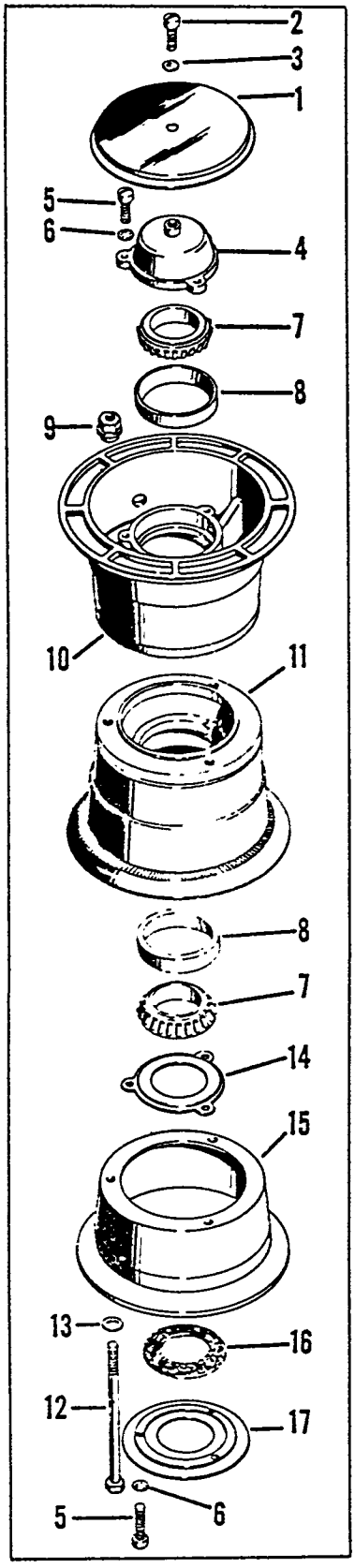
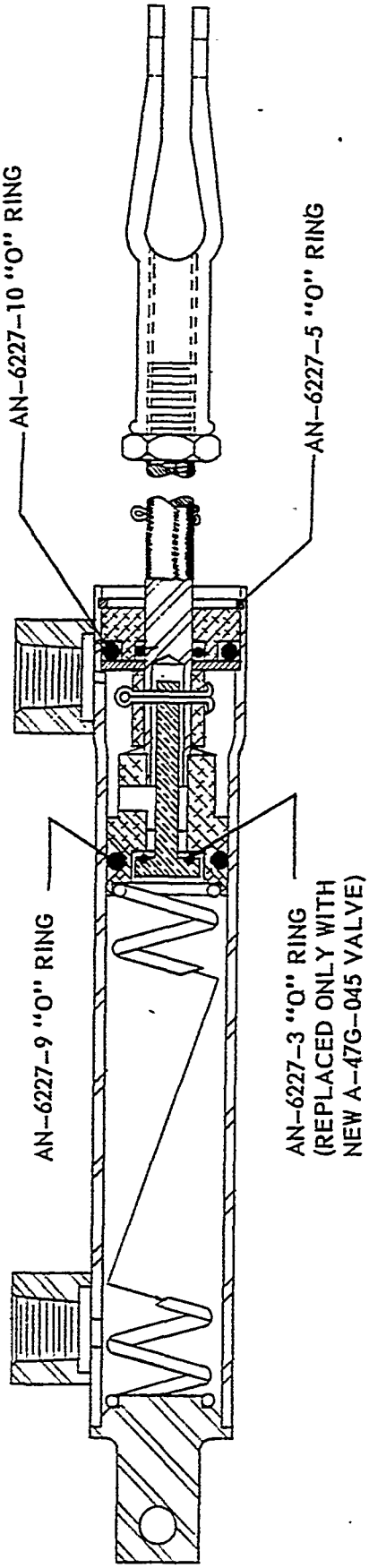


FIGURE 5-6 – WHEEL ASSEMBLY CHART



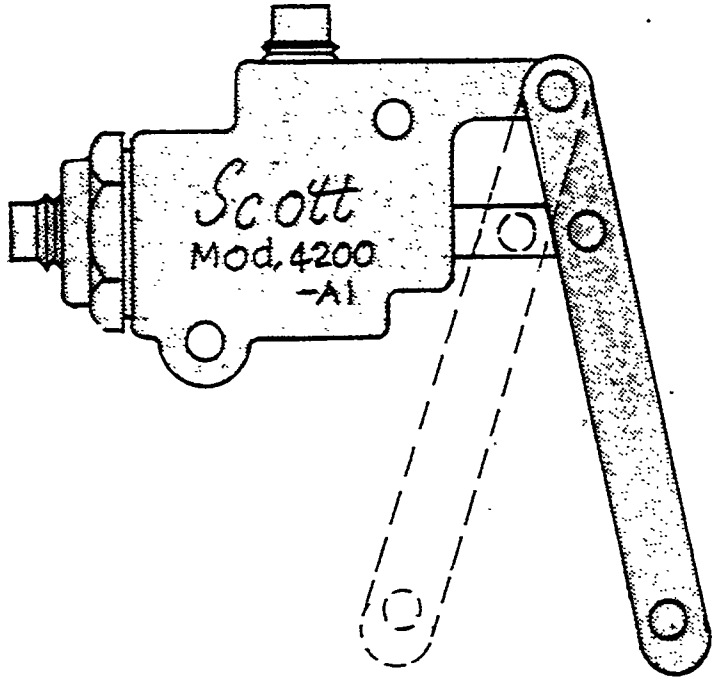
1. DUST SHIELD
2. SCREW
3. LOCKWASHER
4. HUB CAP
5. SCREW
6. LOCKWASHER
7. TIMKEN BEARING CONE
8. TIMKEN BEARING CUP
9. SPLINE-NUT (ESNA)
10. OUTER WHEEL HALF WITH BEARING CUP AND SPLINE-NUTS.
11. INNER WHEEL HALF WITH BEARING CUP
12. THROUGH BOLTS
13. WASHER
14. GREASE SEAL RING
15. BRAKE DISC ASSEMBLY
16. GREASE SEAL FELT WASHER
17. INNER DUST SHIELD

FIGURE 5-7 – HYDRAULIC BRAKE MASTER CYLINDER ASSEMBLY



MODEL V-1

FIGURE 5-8 – PARKING BRAKE VALVE ASSEMBLY



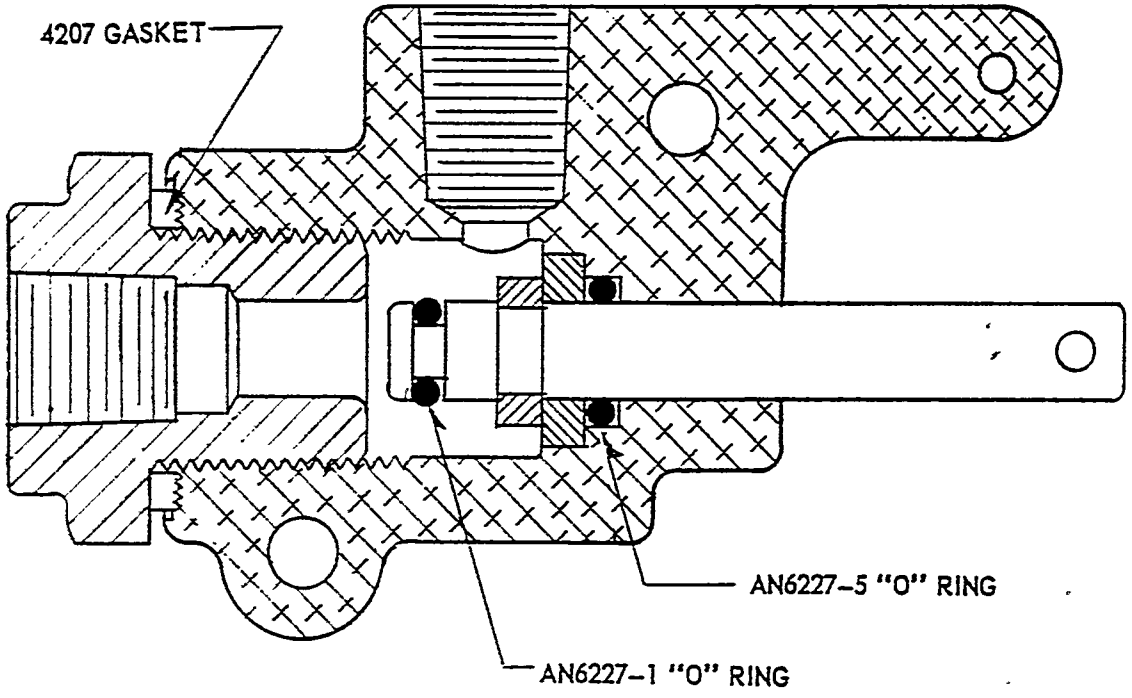
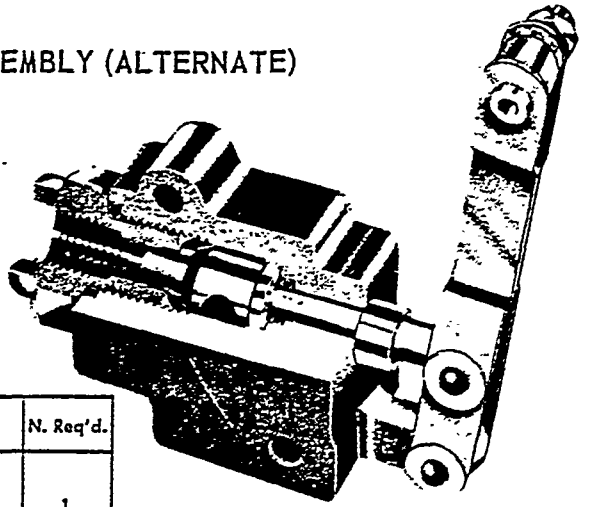


FIGURE 5-9 – PARKING BRAKE VALVE ASSEMBLY (ALTERNATE)

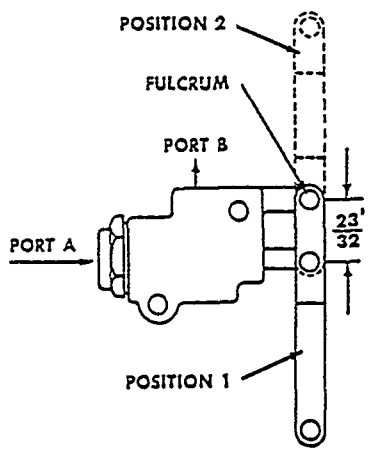
MODEL 4500-A1 USED AS ALTERNATE FOR 4200-A1.



Model 4500

PARTS LIST

No.	Part No.	Used On	Name	N. Req'd.
1	4501-2	4500 4500-A1 4500-A2	Body	1
1	4500-1	4500C 4500C-A1	Body	1
1	4501	4500S 4500S-A1 4500S-A2	Body	1
2	4504 4505 4506-1 4507 19649		Stem Assembly Stem — Included in Valve Head — Assembly No. Spring — 4504 Spring Pin	
3	4511-2	4500 4500-A1 4500-A2	Seat—Valve	1
3	4511-1	4500C 4500C-A1	Seat—Valve	1
3	4511	4500S 4500S-A1 4500S-A2	Seat—Valve	1
4	18048		O-Ring 3/4" O.D. x 9/16" I.D.	1
5	18033		O-Ring 3/8" O.D. x 1/4" I.D.	1
6	4503		Spacer (used with Arm Pos. 1)	1
6	4503-1		Spacer (used with Arm Pos. 2)	1
7	4208		Arm Assembly	1
8	18286		Rivet 3/32" x 5/8" R. H. Steel	2
9	4222		Washer — Burr, Steel	4



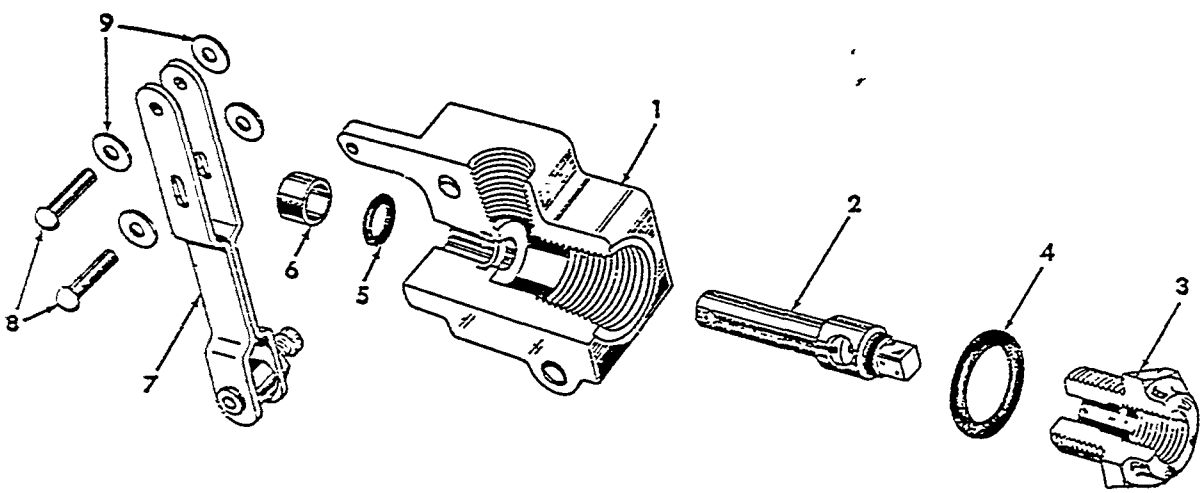
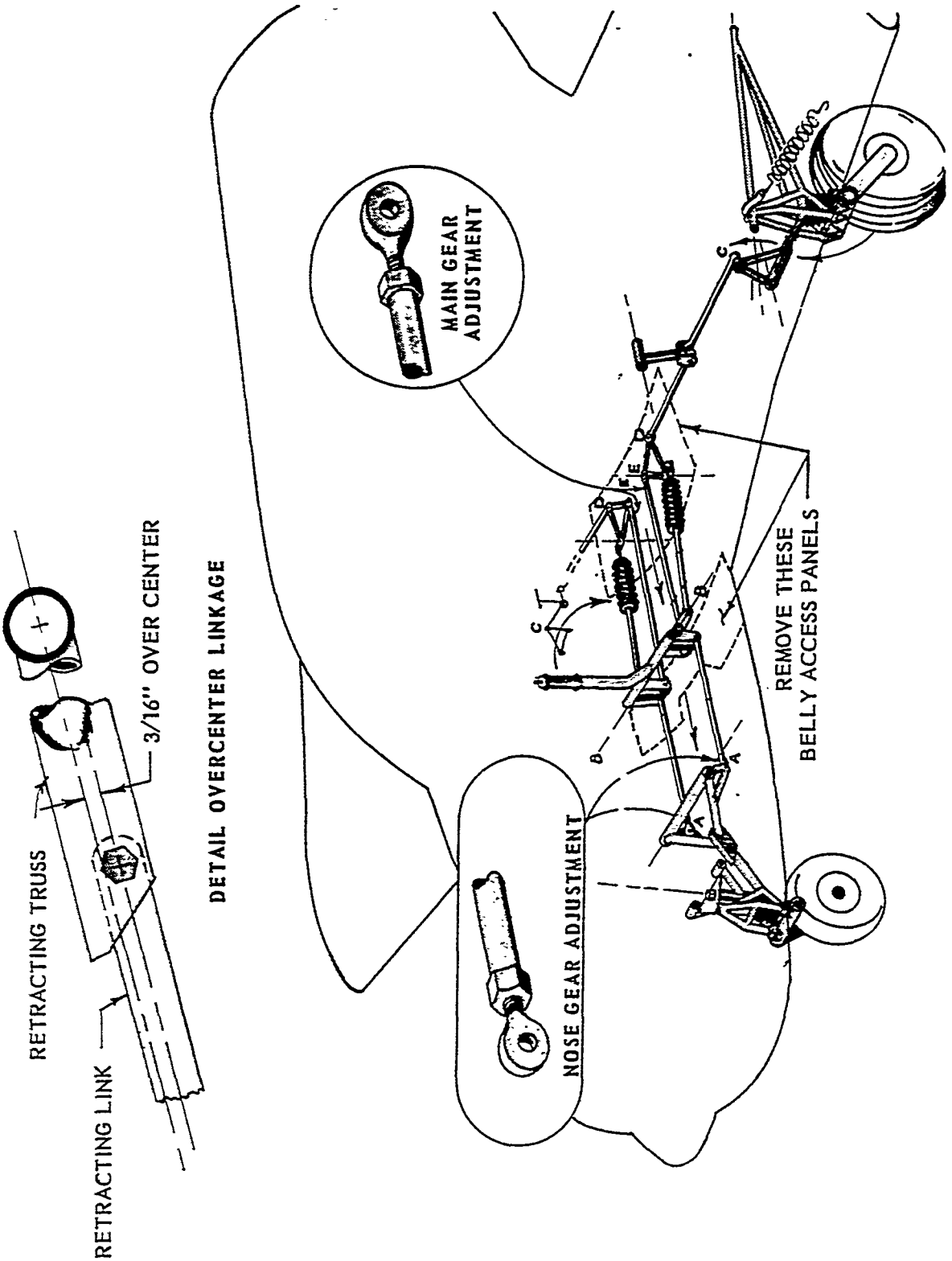


FIGURE 5-10 – GEAR RIGGING DIAGRAM



2. Brake Bleeding.

When braking action becomes spongy and erratic or when repairs require the replacement of actuating components, it will be necessary to bleed the hydraulic brake system. Best results are achieved with the use of a hydraulic fluid system bleeder (pressure pot) pressurized with air to approximately 35-40 lbs. When bleeding dual brake systems, both the pilot's and co-pilot's brakes must be depressed alternately during bleeding to reposition the shuttle valves.

First, remove the vent cap from atop the firewall fluid reservoir and attach a fitting and hose that will carry expelled fluid from the reservoir to a clean catch pan positioned next to the hose section. Remove the rubber cap at one of the main wheel brake cylinder assemblies, open the valve by backing off the small center pin, and attach the pressure pot hose. Air bubbles in the fluid being expelled from the reservoir will give the stream a milky appearance. When the fluid runs clear and transparent into catch pan, close the bleed valve, disconnect the pressure pot hose, and cap the bleed valve. Repeat the procedure with the other side of the system. After disconnecting the overflow tube from the reservoir, remove excess fluid from the reservoir through its side plug to re-establish the proper fluid level.

3. Wheel Assembly Inspection.

a. Place airplane on jacks (See Figure 2-1).

b. Remove axle nut and two bolts from back plate and slide the wheel off.

c. Check for bolt failure. Replace any bolts found to be defective (Figure 5-6).

d. Check the internal diameter of the felt grease seals. Replace the felt grease seal if surface is hard or gritty.

e. Inspect the casting for visible signs of cracks or corrosion. If there are any indications of cracks, the tire and tube should be removed and the wheel disassembled for a closer inspection.

f. Replace any wheel casting having visible cracks.

F. MANUAL LANDING GEAR RIGGING PROCEDURE

The gear retraction system is designed to hold the gear down-and-locked only when the retraction linkage is in the overcenter configuration. Collapse of the gear, at landing or during taxiing, due to a disengagement of the locking mechanism, can be caused by improper adjustment of the overcenter lock mechanism or by disengagement of the retraction handle from its down-lock block under the instrument panel.

1. Rigging Instructions.

a. Raise airplane and remove access panels shown in Figure 5-10.

b. Remove retraction handle from gear-down lock. Tie handle loosely to prevent bungee from forcing it down. In order to prevent damage to retraction tubes, do not move gear legs from outside until step C has been accomplished.

c. Disconnect retraction tubes at point B (Figure 5-10). Loosen bearing, check nuts on tubes at point E and on tubes at point A.

d. Check nose gear and main gears (2) for any binding at hinge points (Figure 5-10) while moving gear legs back and forth by hand. Tubes may be disconnected at point C during check of main gear. Lubricate gear retraction system at points indicated in Figure 2-9.

e. Place the retraction handle in the gear-down lock. Check for and remove any foreign matter lodged between the retraction truss and retraction link connection at points Z & S as shown in Figure 5-11. Place all gears in the down-and-locked position. It is recommended that C-clamps be attached at points X & R (Figure 5-11) to hold the retraction truss firmly in the overcenter configuration.

f. By turning tubes, adjust retraction tubes so that a 3/16" OD bolt can be inserted through retraction lever and bearings at point B (Figure 5-10). This will give a zero preload in the system with the handle in the gear-down lock.

g. By turning tubes, shorten retraction tubes two turns and lengthen retraction tubes two to two and one-half turns. Tighten check nuts (4) at points A and E (Figure 5-10).

h. Remove retraction handle from gear-down lock position and connect tubes. Replace retraction handle in gear-down lock position.

2. Inspection of System Preload.

a. Nose gear (see Figure 5-11).

1. Place rigging tool (8442) on retraction link with sloped edge aft. Hold tool in place against retraction link.

2. Place finger at point R.

3. Apply force on torque wrench and read torque at the instant point R first begins to move. Movement of retraction truss may be felt at point R and may be seen in area of Joint S. Practice this several times before recording torque. Torque should be between 100 and 130 inch pounds.

NOTE: Take reading on torque wrench when .005 to .010 inch movement is observed at points R and X (Figure 5-11).

4. After release of force, retraction truss should snap back to full overcenter and should bear tightly against retraction link at point S. This should be carefully checked by pulling down on retraction truss. If retraction truss moves down, then the preload in tubes is not sufficient.

5. Eccentric bushings at point A on the nose gear retracting truss may be rotated as required to obtain the proper gear-up travel and proper gear door rigging.

CAUTION: Nose gear downlock rigging must be rechecked after eccentric bushings are changed.

b. Main Gear (see Figure 5-11).

1. Place rigging tool (8444) as shown in Figure 5-11. Hold in place with thumb at point Y pressing forward.

2. Place finger at point X.

3. Apply force on torque wrench and read torque at instant that point X first begins to move. Movement of retracting truss may be felt at point X and may be seen in area of point Z. Practice this several times before recording torque. Torque should be between 240 and 280 inch pounds. The difference in left and right gear torque should register within ± 25 inch pounds of each other.

4. After release of force, retracting truss should snap back to full overcenter and should bear tightly against retracting link at point Z. This should be carefully checked by pulling down on retracting truss. If retracting truss moves down, the preload in tubes is not sufficient.

CAUTION: Do not attempt to rig the gear to increase or decrease gear-up travel.

3. Adjustment of Preload.

If the torque values do not fall within the limits specified. then the system preload should be changed by changing the lengths of retraction tubes. This is done by taking a turn on the rod end bearings in the proper direction. One-half turn is usually sufficient. Any adjustment made to the nose gear should be made identically to both retraction tubes since they should carry the same preload.

Since the retraction tubes from all gears are attached to the gear retraction lever, a change in preload in the retraction tube at one gear can affect the preload in the retraction tubes at the remaining gears. Therefore, after an adjustment is made at one gear, the other gears must be rechecked. This process must continue until the proper preloads are obtained in the retraction tubes at all gears.

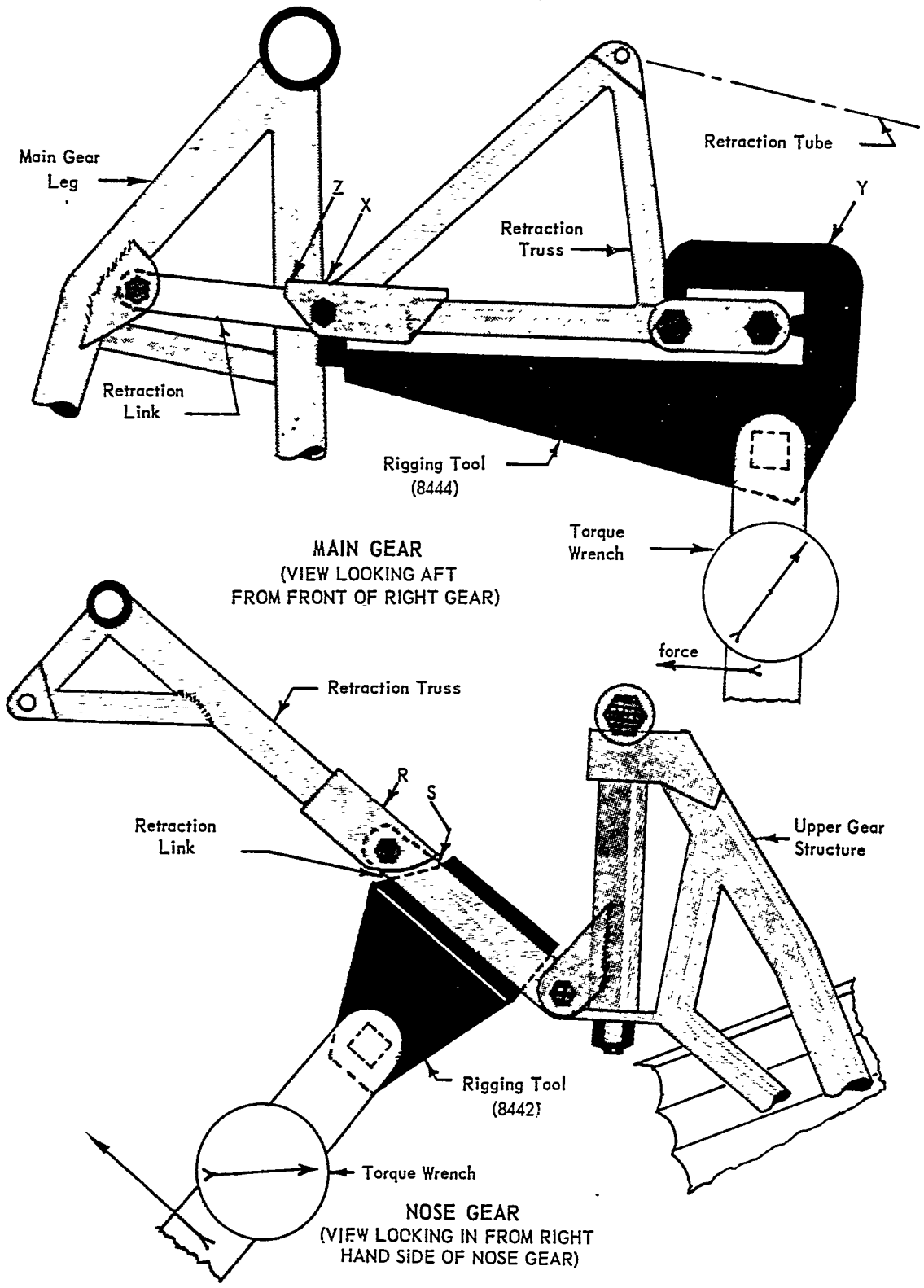
The amount of freedom of the gears (as determined from the check made under item 4 of rigging instructions above) will affect the torque readings. Gear systems with free joints will be adequately rigged when the torque is on the low end of the range while the gears that are stiffer may require torque values on the high end of the range for adequate preload.

A final check should be made of the force required to place the gear handle in the gear-down lock (gear extended position). If the force required to move the gear handle forward the last one to two inches is excessive, then the system preload may be reduced slightly within the prescribed torque limits. Check for and relieve any bind in the sliding hand grip at the top of the gear lever since a bind at this point may make it difficult to lock the gear handle in place.

NOTE: Gear rigging tools (8442, 8444, & 8186) may be purchased at a nominal cost through the Mooney dealer and distributor organization.

SHOP NOTES

FIGURE 5-11 – TORQUE WRENCH APPLICATION DIAGRAM



G. INSPECTION OF LANDING GEAR SHOCK

1. Rubber Discs.

If a landing gear shock unit fails to pass the inspection described in Figure 5-12 & 5-13, the rubber shock discs must be replaced.

NOTE: A check of the nose gear shock unit can also be accomplished by checking the propeller clearance as follows: With the unloaded aircraft on a flat surface and the tires inflated to the proper pressure, a 74-inch propeller should have a minimum of 9 1/2 inches clearance from the ground. Less clearance may indicate that the rubber discs are defective and that a more thorough check should be made.

2. Collars and Bolts.

a. Inspect landing gear shock absorber bolts and collare(See Figs. 5-12 & 5-13) for deformation or indications of failure.

b. Remove collars and bolts at each annual inspection and check for bends, wear, and cracks. Replace if necessary. It is suggested that spare parts be obtained prior to this inspection. Do not replace a bolt without replacing the collar, or a collar without replacing the bolt.

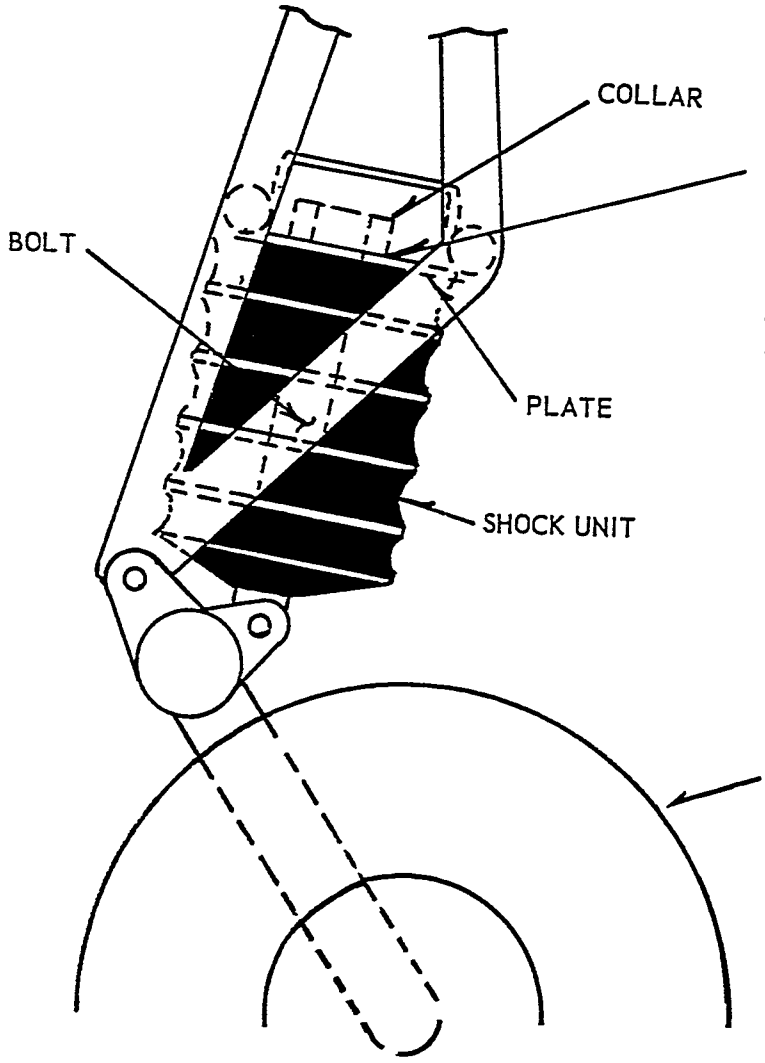
c. See Figures 5-2 and 5-3 for removal of shock discs and collar.

3. Nose Gear Snubber.

A hydraulic shock absorber is installed on the nose gear of 1966 & ON M20C,E,&F models. The shock absorber housing is sealed and the unit requires no maintenance. When worn to a degree that effectiveness is impaired, the entire unit should be replaced.

FIGURE 5-12 – LANDING GEAR SHOCK DISC INSPECTION DIAGRAM

1962-'65 M20C INSTALLATION
1963 & ON M20D INSTALLATION (WITH CONSTANT-SPEED PROPELLER)
1964-'65 M20E INSTALLATION



MAIN GEAR:
With the aircraft at static weight, the gap between th. main gear collar and plate should be 0.00 to 0.13 inches (Max. clearance of 1/8 inch).

NOSE GEAR:
With the aircraft at static weight, there must be no gap between the nose gear collar and plate.

NOTE: Static weight = full fuel, less passengers.

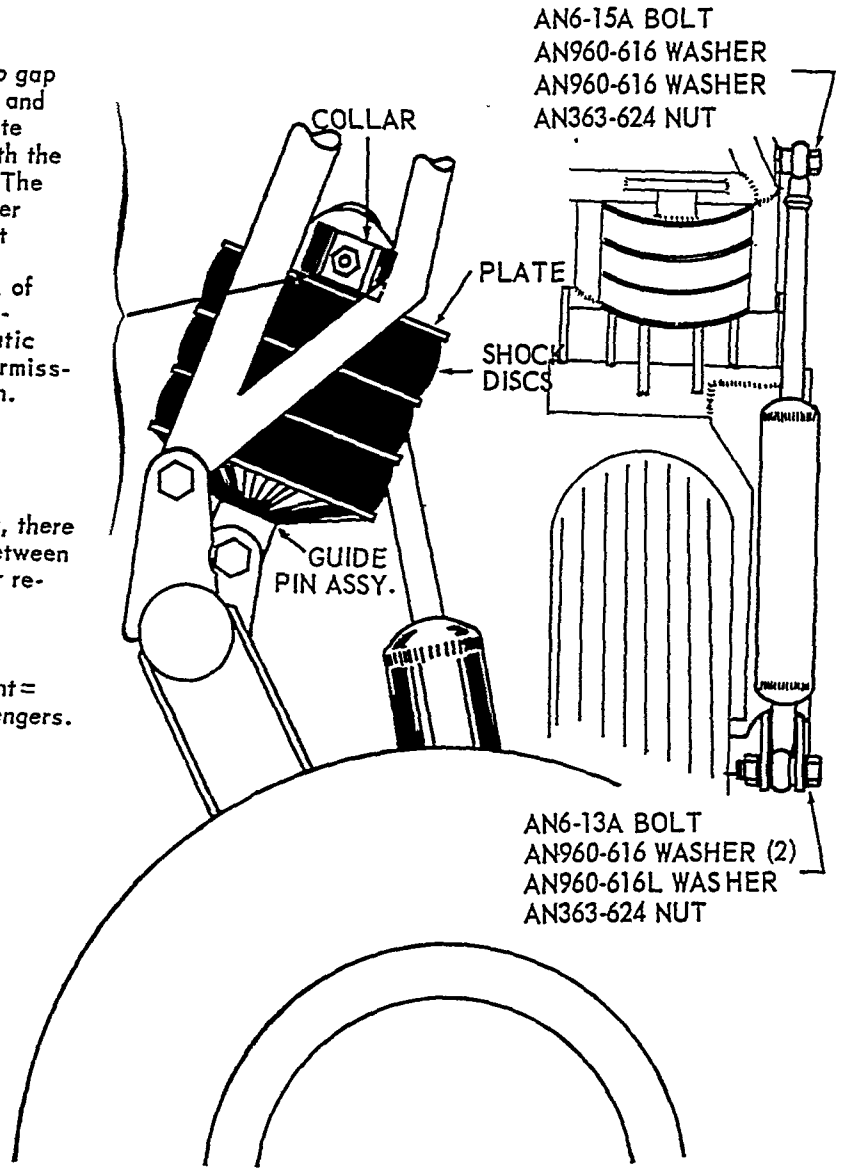
FIGURE 5-13 – LANDING GEAR SHOCK DISC INSPECTION DIAGRAM
1966 & ON M20C, E & F INSTALLATION
(ALSO LORD DISC RETROFIT INSTALLATION)

MAIN GEAR:
There should be no gap between the collar and upper retaining plate when inspected with the aircraft on jacks. The preload in the rubber discs must be great enough to maintain complete extension of the wheel during retraction. Under static weight, a gap is permissible (0.00 to 0.43 in. [7/16 in.]).

NOSE GEAR:

Under static weight, there should be no gap between the collar and upper retaining plate.

NOTE: Static weight = full fuel, less passengers.



H. ELECTRIC GEAR SYSTEM (OPTIONAL)

1. Operation.

The optional electrical landing gear retraction system is operated by the wheel-shaped switch knob on the upper portion of the flight panel. To raise the gear, the knob is pulled out and moved up to its upper detent. An "air switch" is incorporated in the electrical circuit which prevents landing gear retraction until a safe airspeed is attained (See NOTE). The action of the system may be monitored visually by watching the movement of the indicator mark through the glass in the floorboard aft of the nose wheel well. A limit switch will stop the gear in its retracted position. To lower the landing gear, the knob is pulled out, moved down, and placed in the lower detent. A limit switch will stop the gear extension when the proper locking force has been exerted to hold the gear down. There are three ways to check that the gear is completely down and locked:

a. The green "safe-to-land" indicator light (on the left panel) will come on.
b. The black indicator marks, as seen through the glass in the floorboard, will be aligned.
c. No audible warning horn sound will be heard when the throttle is retarded.

NOTE: An 80 mph air pressure equivalent must be applied to the pitot tube orifice to actuate the airspeed pressure switch which permits retraction of the gear. Attach a 12-inch length of 3/8-inch rubber hose (surgical tubing) over the pitot tube end and pinch the open end of the hose with a cotter pin. Rotate the cotter pin until the compressed air in the hose activates the air switch.

2. Manual Operation of the Electric Landing Gear System.

a. Pull landing gear circuit breaker OFF.
b. Put gear switch in the gear-down position.
c. Push crank engage handle forward.
d. Crank clockwise approximately fifty (50) turns to lower the gear.
e. Gear is down when green gear light is on-check gear position visual indication.

CAUTION: Do not retract gear with the manual handcrank. Use electrical retraction.

3. Electric Gear Inspection.

At each 100 hours of service, the electric gear system pivot points should be lubricated (See Figure 2-9) and test run with the aircraft on jacks (See Figure 2-1). Check the landing gear actuator for security of mounting, cleanliness, and indication of overheating or damage. Lubricate actuator ball screw with recommended lubricant every 100 hours.

a. After 500 hours of operation and each 200 hours thereafter:
   (1) Remove the actuator from the aircraft.
   (2) Remove the end cap and wipe excess grease from gears.
   (3) Visually inspect gears for wear as follows:
   With open end of actuator toward you, rotate jack screw shaft counter clockwise to remove all slack from ring and worm gears. Make an index mark on one gear tooth and on the inside of housing. Turn jack screw shaft clockwise until ring gear contacts worm gear and check index marks.
   Visible wear or backlash of 1/2 tooth or more requires immediate replacement of gears.
   ALTERNATE PROCEDURE: Measure backlash by using a .025" diameter wire or .025" thick shim as a feeler gage. If feeler can be inserted between gear teeth, replace gears.
   Repeat above procedure after rotating the ring gear thru 90°; 180°; and 270°.
   (4) Repack gear box with recommended lubricant.
   (5) Reinstall end cap and resafety.
   (6) Reattach heim bearing to bellcrank (refer to page 5-24 Section 5, paragraph B for proper actuator adjustment and reinstallation instructions).

4. Perform retraction test through at least two trouble-free cycles. Check for:
   Proper limit switch adjustments.
   Position indicator adjustment and operation.
   Excessive friction or binding.
   Nose and main gear rigging.
   Main and nose gear door-to-jamb rigging.

5. Electric Gear Rigging Procedure.

a. Jack aircraft (See Figure 2-1) and remove access panel (See Figure 5-10).

b. Disconnect all retraction tubes and the actuator heim end from the retraction bellcrank. Check the 7.50 actuator dimension (See Figure 5-14, Item 1). Adjust heim end as necessary to obtain the 7.50 dimension. Position the ball returns on the actuator barrel so that they face the actuator motor, then reinstall heim end on to the bellcrank.

NOTE: When installing heim bearing end in the bellcrank, position it freely so there will be no lateral bind on the jack screw. Place one AN960-716L washer next to the ball joint, (can be placed on either side) and shim remaining space with AN960-616 washers. This installation will prevent heim bearing from twisting too far, yet provide adequate movement.

NOTE: Previous installation may have contained one large AN960-916 washer next to the ball joint. This washer must not be reinstalled, the AN960-716L smaller and thinner washer described above is used as a replacement.

c. Rotate the emergency gear extension handcrank to obtain the 1.56 dimension (See Figure 5-14). Adjust the retraction tubes so they can be slipped in place with zero preload.

d. The bell crank is now in the gear down-and-locked position (green light on). Now adjust main gear retraction tubes so that the main gear rigging torque is between 240 and 280 inch pounds (refer to figure 5-11). The difference in left and right gear torque should register within 25 inch pounds of each other. Adjust nose gear retraction bungees so that they have a deflection of 0.060 inch in the down-and-locked position (Refer to paragraph VF2 and figure 5-14, items 2 and 3).

e. Position limit switch striker arm so that the gear-down light switch has just closed (green light on); secure the striker arm in this position. The gear is now rigged for the gear-down position with allowance for overrun of the actuator after cutoff.

f. With all gear doors disconnected, run the gear up until the main gear is 0.13 inch from the bumper pad. Position the gear-up limit switch striker arm so that the switch has just closed, then secure the striker arm in this position. The red gear-up light is now on and the gear is properly rigged in the gear-up position.

g. Extend gear to down-and-locked position. Adjust gear door linkage (Refer to paragraph VD 1h & VD 3 for door rigging instructions). Cycle the retraction system through at least two trouble-free test operations. Manually extend gear and recheck nose and main gear preload for limits specified in paragraph d. above. The gear is now properly rigged and ready for use.

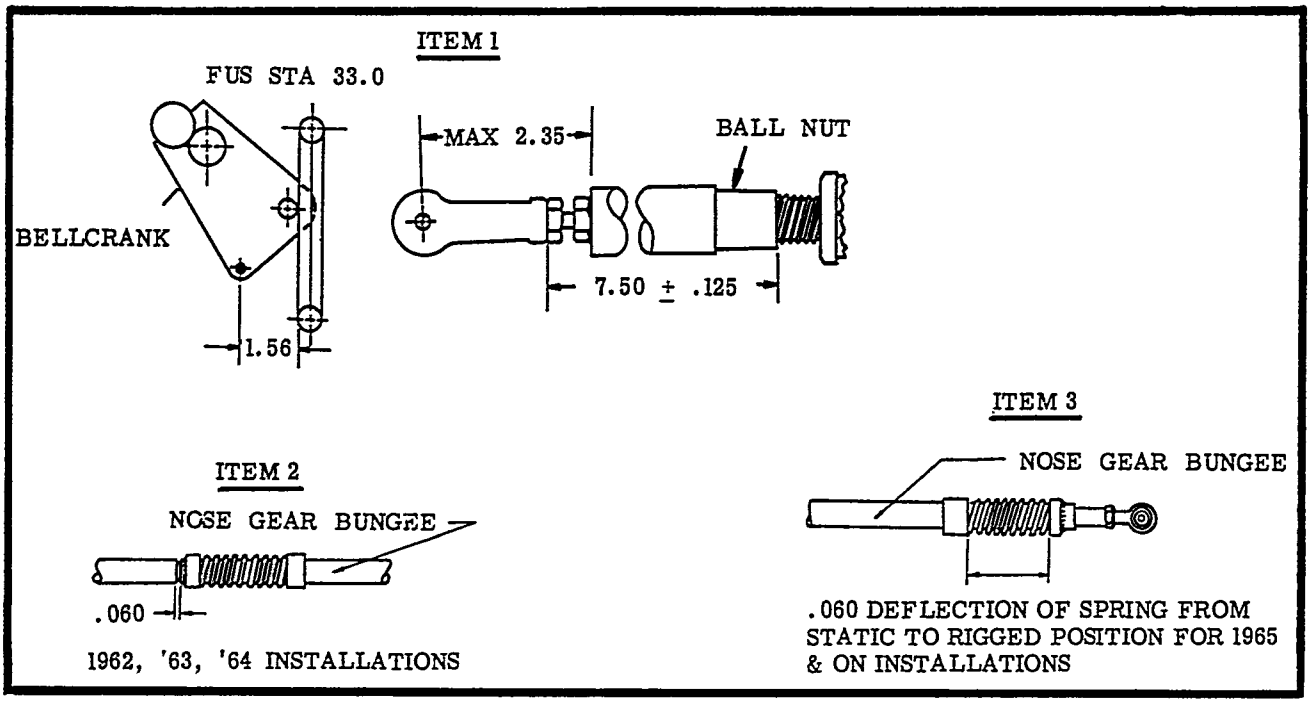
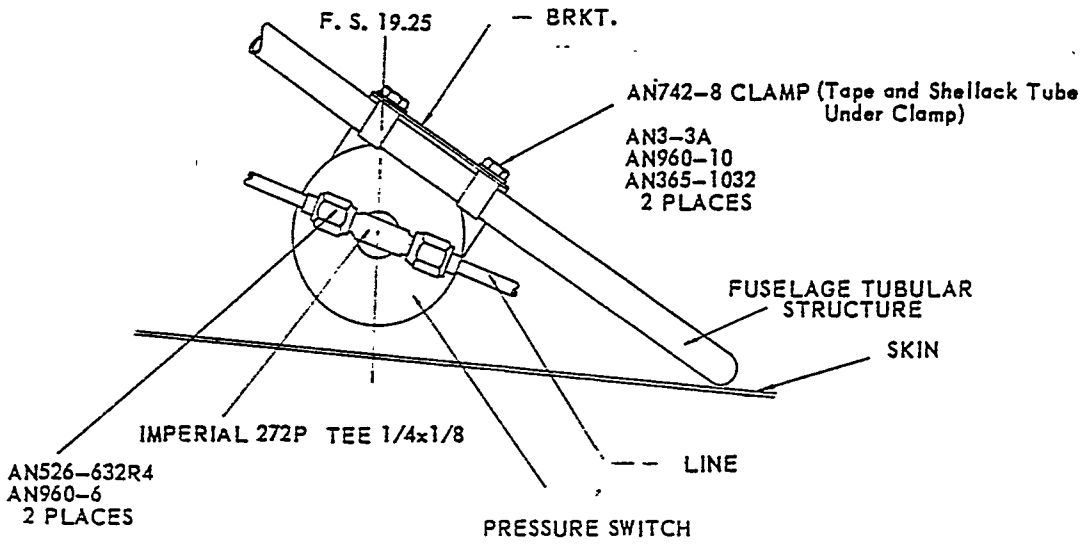


Figure 5-14

FIGURE 5-15 – SAFETY SWITCH & EMERGENCY GEAR CRANK INSTALLATION



SAFETY SWITCH

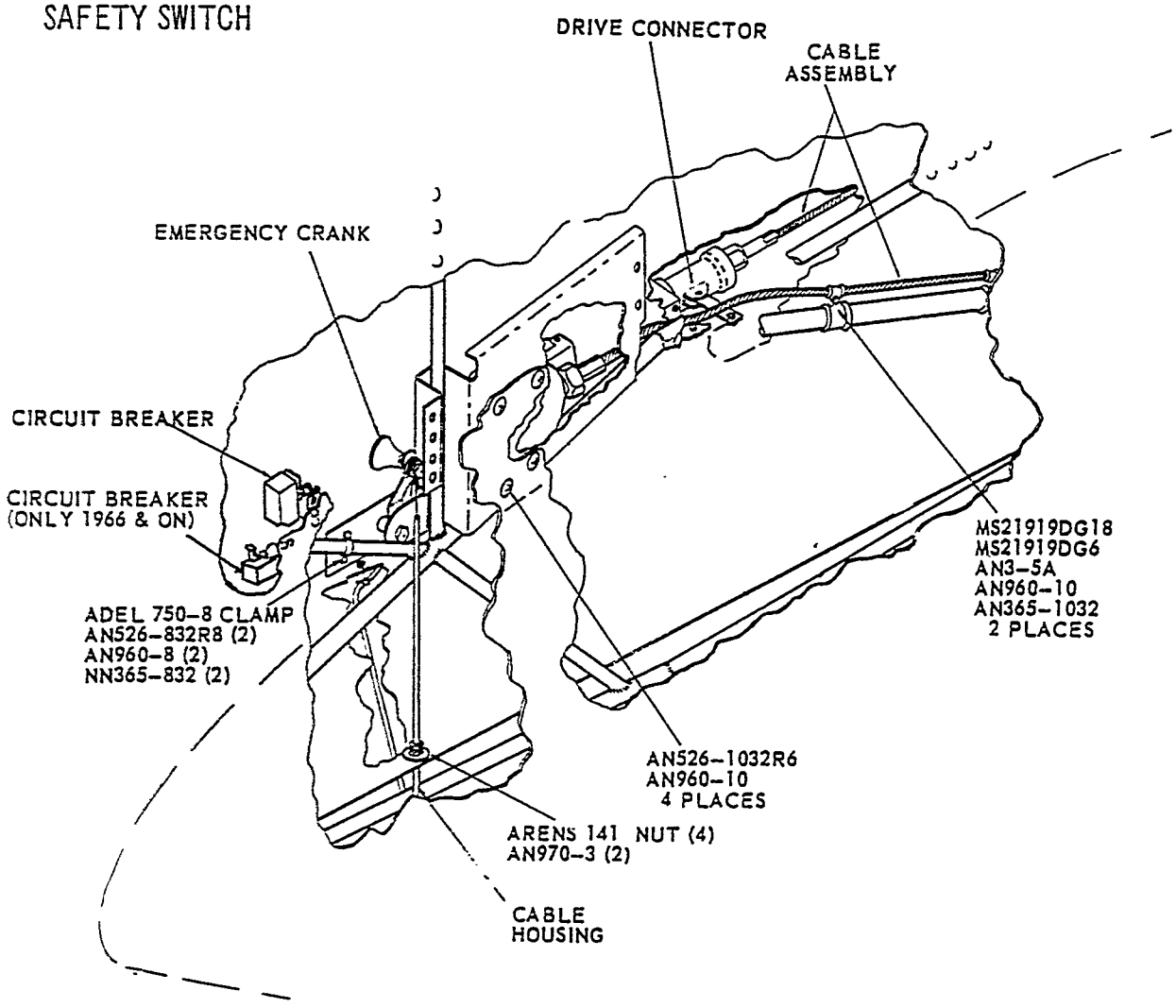
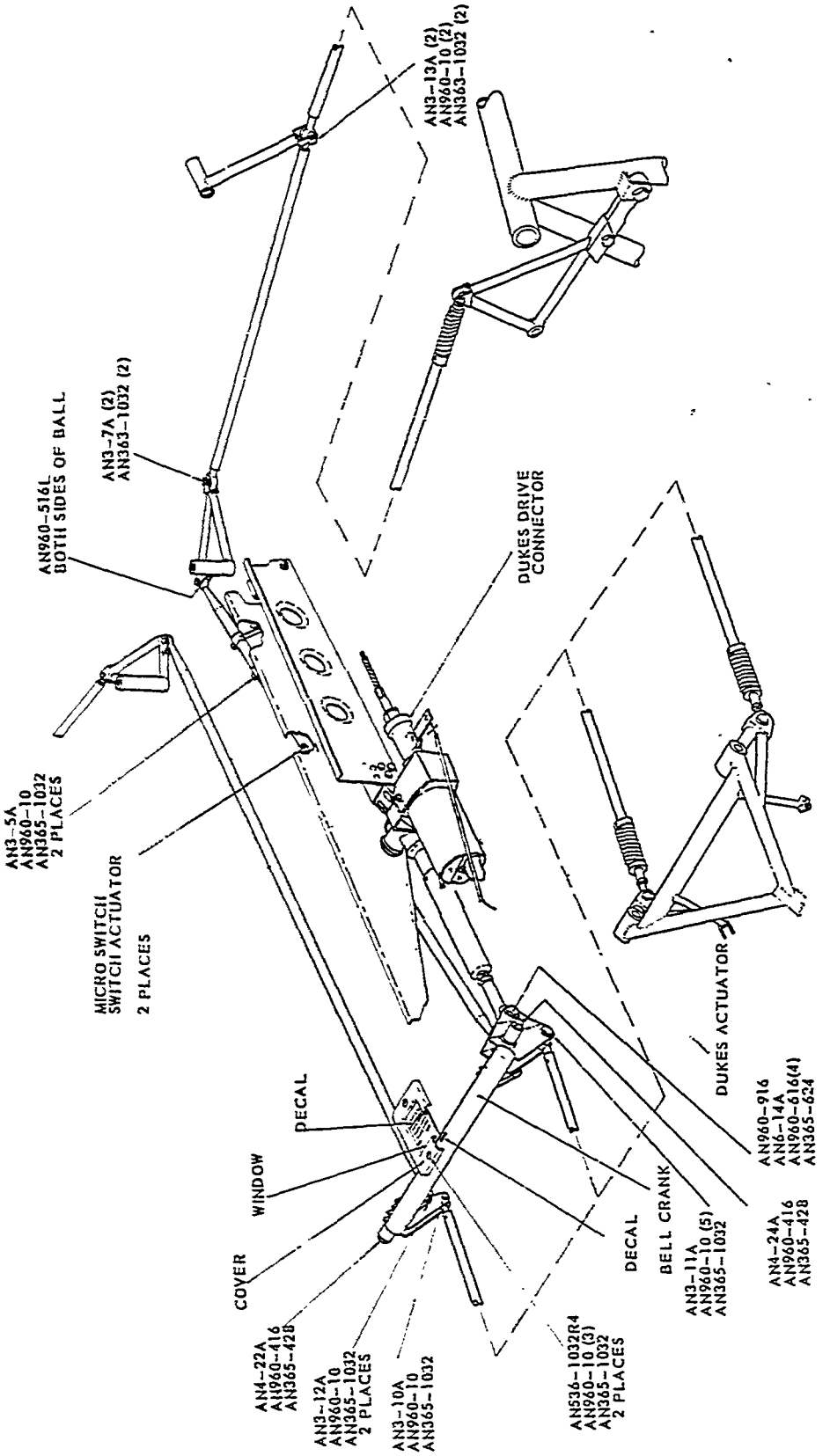
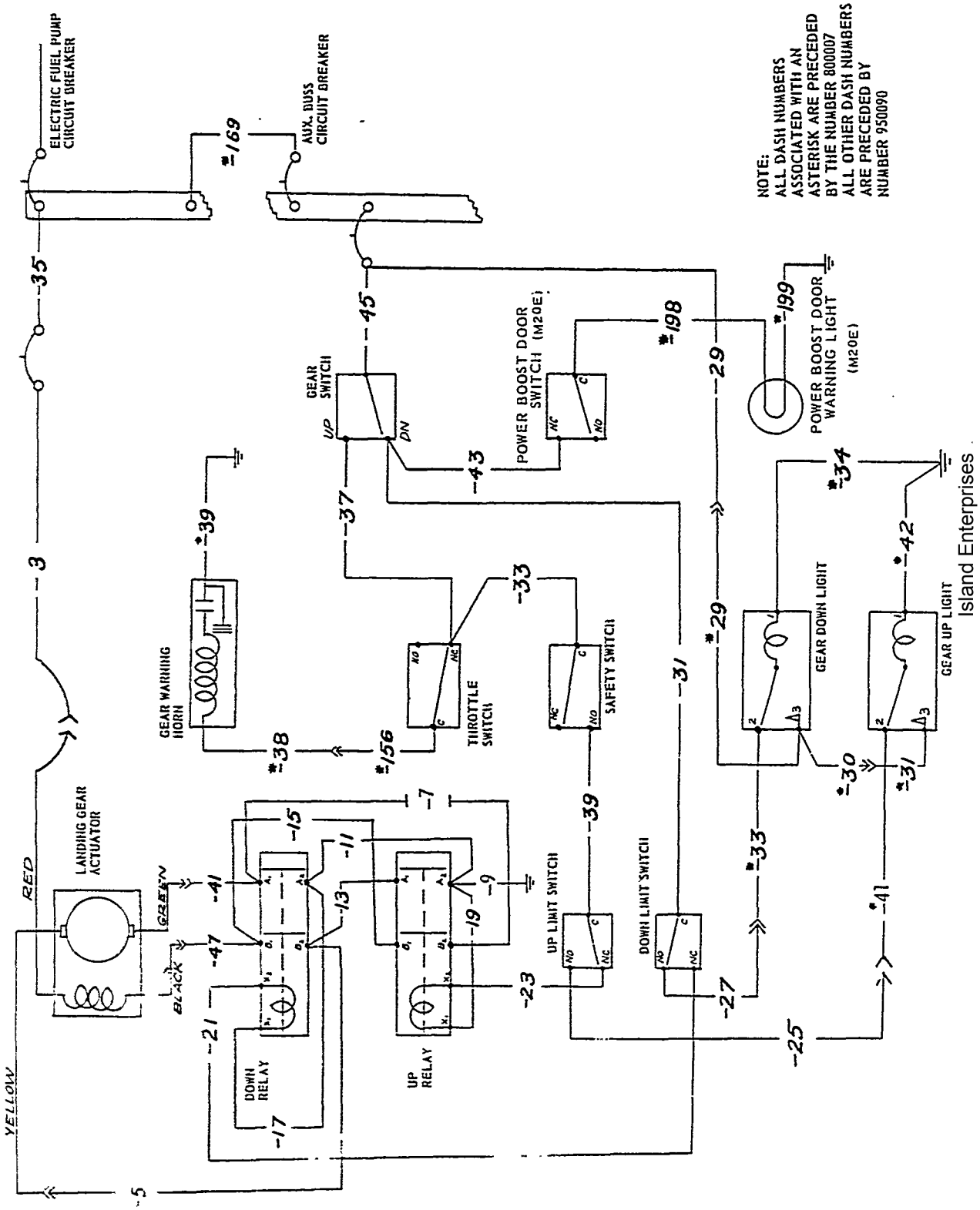


FIGURE 5-16 – ELECTRIC GEAR RETRACTION SYSTEM INSTALLATION



REVISED NOVEMBER 1966

FIGURE 5-17 – ELECTRIC GEAR WIRING SCHEMATIC (1965)



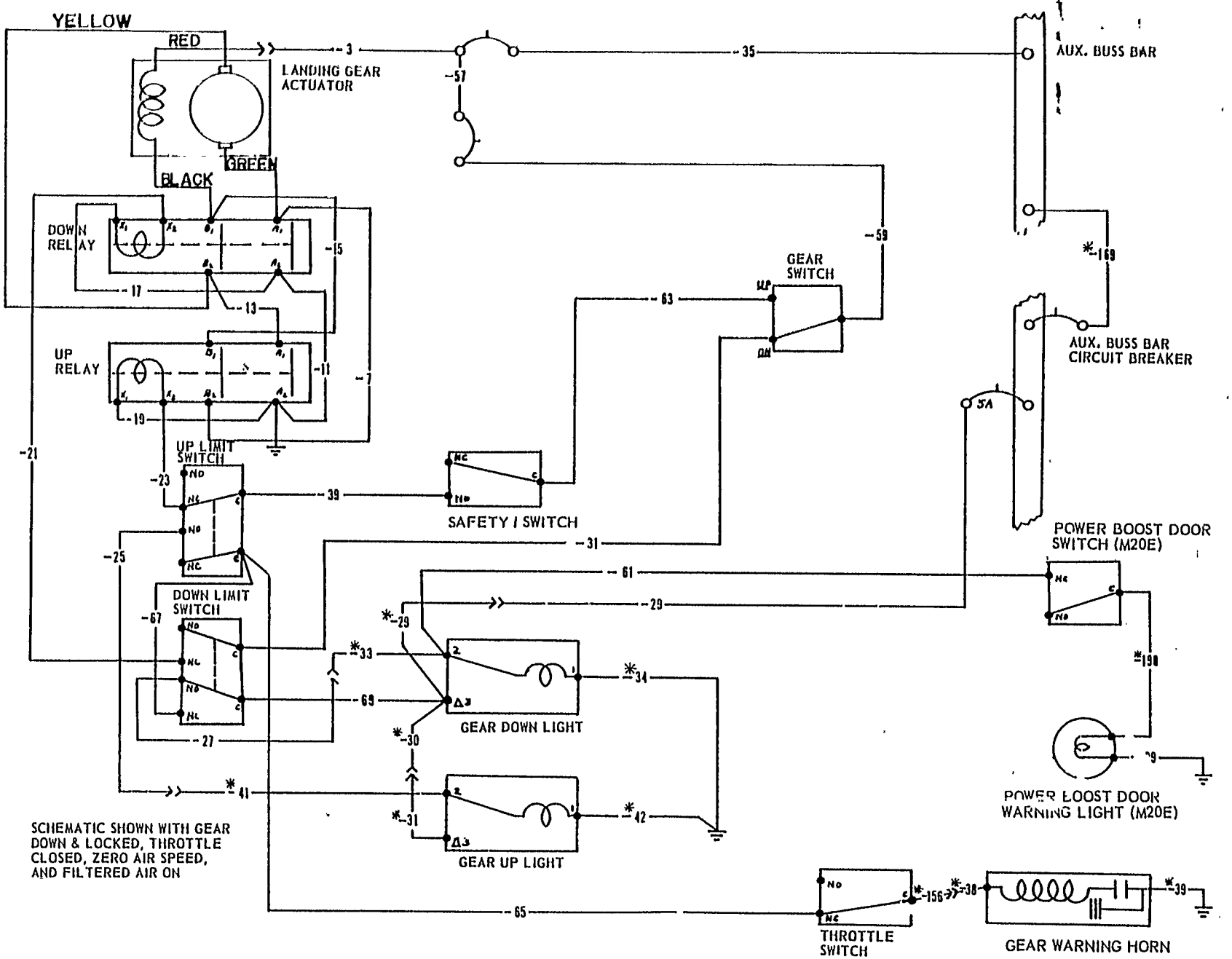
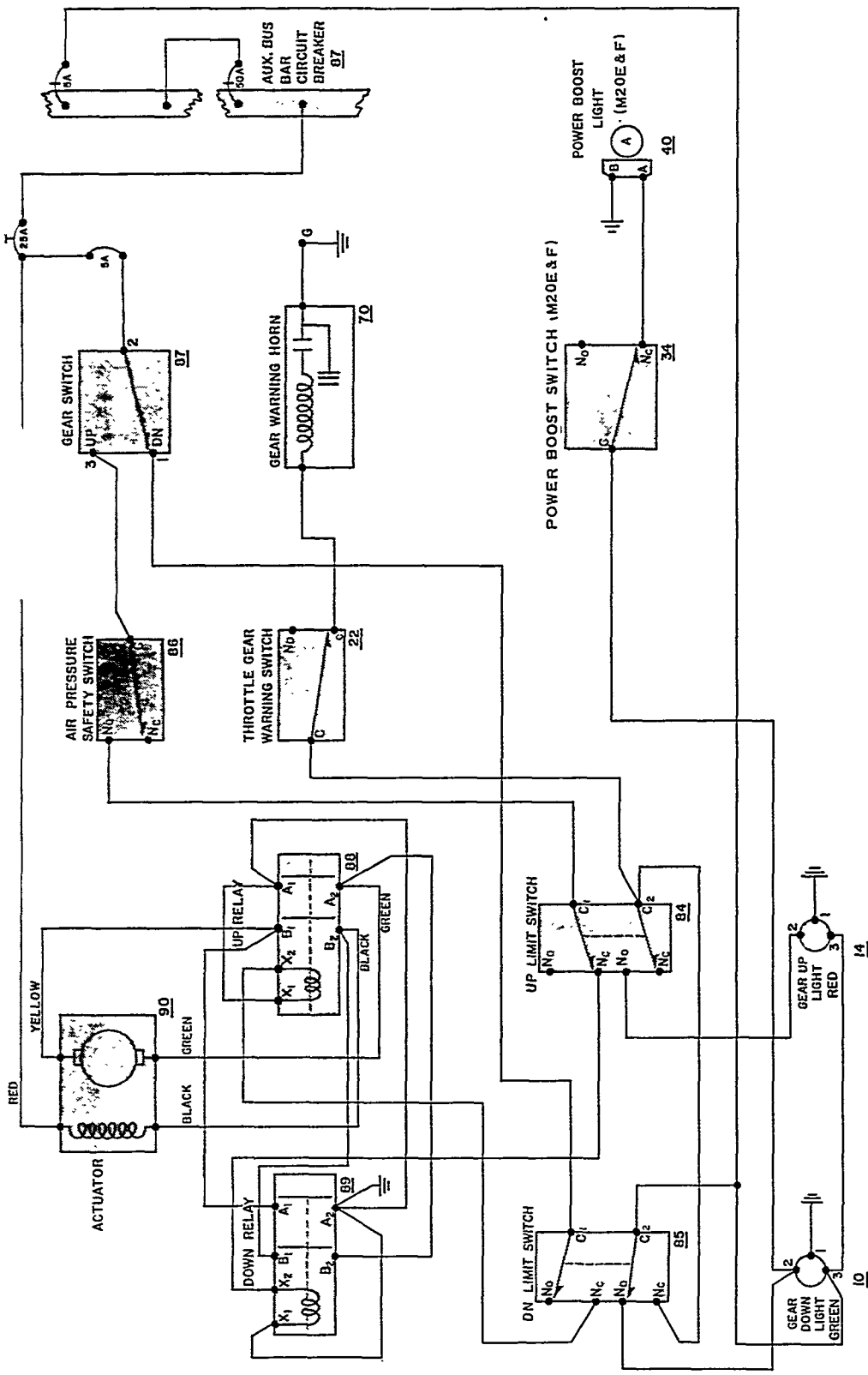


FIGURE 5-18 – ELECTRIC GEAR WIRING SCHEMATIC (1966)

FIGURE 5-19 – ELECTRIC GEAR WIRING SCHEMATIC (1967 & ON)



SHOP NOTES

SECTION

6

CONTROL SYSTEMS

SECTION VI
CONTROL SYSTEMS

A. GENERAL

The ailerons, flaps elevators, and rudder are of all-metal construction. They are jig-built, using hinges of machined extrusions. The elevator and rudder incorporate an unusual method of construction. The leading-edge spar of these controls consists of a specially designed extrusion that allows flush attachment of the skin. Lead counterweights are provided for dynamic balancing to prevent flutter.

Push-pull tubes, rather than the conventional cable system, are used to actuate the controls. Rod end bearings are used throughout the control system. These bearings are simple and dependable and require very little maintenance.

B. REMOVAL AND INSTALLATION

1. Removal and Installation of Aileron.

   a. Remove control tube attachment from inboard end of aileron.
   b. Remove bolts, nuts, washers from three attach hinges.
   c. Remove aileron by pulling straight back.
   d. Replacement is accomplished by reversing the above steps.
   e. Rig the ailerons in accordance with rigging instructions.

2. Removal and Installation of Rudder.

   a. Remove the rudder control tube attachment by taking off one bolt, nut and washer.
   b. Remove bolts, nuts and washers from three attaching hinges.
   c. Remove the rudder by pulling straight back.
   d. Replacement is accomplished by reversing the above steps.
   e. Rig the rudder in accordance with rigging instrucitons.

3. Removal and Installation of Elevators.

   a. Remove control tube and assist bungee attachments by taking off all attaching bolts, nuts and washers on each elevator.
   b. Remove bolts, nuts and washers from four attaching hinges on each elevator.
   c. Remove elevator by pulling straight back.
   d. Replacement is accomplished by reversing above steps.
   e. Rig the elevators in accordance with rigging instructions.

4. Removal and Installation of Flaps..

   a. Reomve wing-flap hinge fairing to expose flap link.
   b. Remove flap link attachment by taking off one bolt, nut, and washer from flap attachment.
   c. Remove hinge bolts.
   d. Remove flap by pulling down and out.
   e. Replacement is accomplished by reversing above steps.
   f. Rig the flaps in accordance with the rigging instructions.

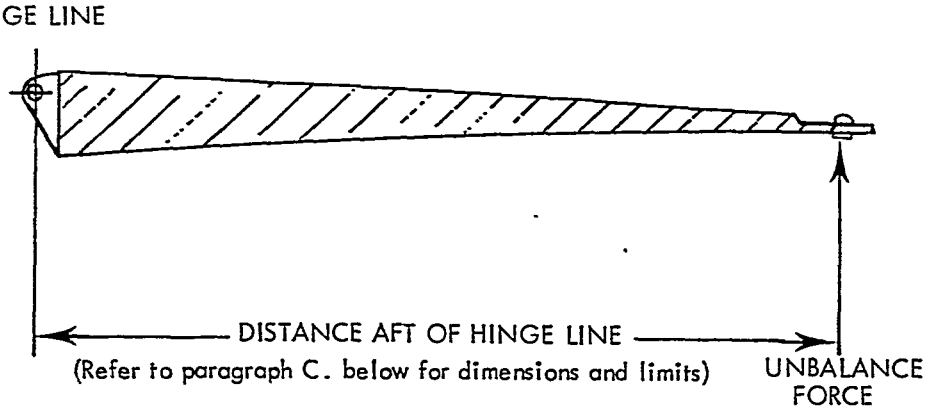
5. Removal and Installation of Empennage.

   a. Remove fairing from both sides of tailcone at empennage attaching point.
   b. Remove access panels from aft tail cone as needed to accomplish empennage removal.
   c. Disconnect electrical and antenna connectors and clear through bulkheads as needed.
   d. Remove elevator and rudder control attachments from aft side of bell cranks.
   e. Remove trim jack screw fitting from empennage fitting by taking off bolt, washers and nut.
   f. Remove hinge pin from lower hinge assy after removing cotter pin from one end of pin.
   g. Remove bolts, washers and nuts from upper hinge brackets, one on each side of empennage bulkhead while keeping weight of empennage neutralized by a cradle or man power.
   h. Set empennage in cradle until ready for replacing.
   i. Replacement is the reverse of the above steps..

CAUTION: Be certain the elevator and rudder rod ends are properly located when attachment bolts, washers and nuts are installed through bellcranks.

   j. Rig trim system, elevator and rudder in accordance with rigging instructions.

FIGURE 6-1 CONTROL SURFACE BALANCING DIAGRAM



C. CONTROL SURFACE BALANCING

CAUTION: When repairing or repainting the control surfaces, the following limits must not be exceeded.

Ailerons: M20D, S/N 101 thru 260, P/N 230000. M20C, S/N 1940 thru 2741, 2743 thru 2806. M20E, S/N 101 thru 399, 401 thru 469.
Maximum allowable static unbalance force: 9.6 inch/pounds
(.753 pounds or 12.00 ounces) at 12.75 inches aft of hinge line.
Balance weights: P/N 230009 - 1 & - 2.

M20C, S/N 2742, 2807 thru 3466, M20E, S/N 400, 470-1308, P/N 230015-1 & -2.
Maximum allowable static unbalance force: 7.282 inch/pounds
(.57 pounds or 9.1 ounces) at 12.80 inches aft of hinge line.
Balance weights: P/N 230016 - 1 & -2.

M20C & E, S/N 670002 & ON, P/N 230015 - 1 & -2.
Maximum allowable static unbalance force: 7.928 inch/pounds
(.62 pounds or 9.9 ounces) at 12.80 inches aft of hinge line.
Minimum allowable static unbalance force: 5.25 inch/pounds
(.41 pounds or 6.55 ounces) at 12.80 inches aft of hinge line.
Balance weights: P/N 260016 - 501 & - 502.

M20F, S/N 660002, P/N 230015 - 503 & - 504.
Maximum allowable static unbalance force: 12.00 inch/pounds
(.94 pounds or 12.5 ounces) at 12.80 inches aft of hinge line.
Minimum allowable static unbalance force: 10.0 inch/pounds
(.78 pounds or 12.5 ounces) at 12.80 inches aft of hinge line.
Balance weights: 230016 - 503 & -504.

M20F, S/N 66003 thru 370040, P/N 230015 - 503 & -504.
Maximum static unbalance force: 7.282 inch/pounds
(.57 pounds or 9.1 ounces) at 12.80 inches aft of hinge line.
Balance weights: P/N 230016 - 1 & -2.

M20F, S/N 670041 & ON, P/N 230015 - 503 & -504.
Maximum static unbalance force: 8.00 inch/pounds
(.625 pounds or 10.000 ounces) at 12.80 inches aft of hinge line.
Minimum static unbalance force: 5.25 inch/pounds
(.41 pounds or 6.55 ounces) at 12.80 inches aft of hinge line.
Balance weights: P/N 230016 - 501 & - 502.

Elevators: M20C, D & E.
Maximum allowable static unbalance force: 15.5 inch/pounds (1.22 pounds) at 12.75 inches aft of hinge line.

M20F.
Maximum allowable static unbalance force: 22.0 inch/pounds (1.725 pounds) at 12.75 inches aft of the hinge line.
Minimum allowable static unbalance force: 20.0 inch/pounds (1.57 pounds) at 12.75 inches aft of hinge line.

Rudder: M20C, D & E.
Maximum allowable static unbalance force: 6.9 inch/pounds (.57 pounds) at 12.12 inches aft of hinge line.

M20F.
Maximum allowable static unbalance force: 21.0 inch/pounds (1.733 pounds) at 12.12 inches aft of hinge line.
Minimum allowable static unbalance force: 13.0 inch/pounds (1.073 pounds) at 12.12 inches aft of hinge line.

D. RIGGING AND ADJUSTMENT

1. Aileron Rigging and Adjustment.

   a. Use a straight edge to line up control wheels. Adjust tubes linking control wheels to center cross shaft until wheels are level.

   b. Adjust vertical control tube so that the inboard aileron bell crank is located 1/16-in. to the left of center.

   c, Adjust control tubes in wings so that the center of the most outboard hole in outboard bell crank is 4 and 39/64 inches from the spar web.

   d. Adjust aileron push-pull tubes so that the ailerons are adjusted from 0° to 2° droop in the static position. All aileron travels are measured from the static position.

   e. The aileron stops are located at the outboard bell crank assembly and are accessible through the access panel outboard of Sta. 147.75.

   f. See Figure 6-4 (aileron travel jig which is used at wing Station 147.75).

   g. See Figure 6-7 for aileron control system drawing.

   h. See Figure 6-2 & 6-3 and Section VI-D.6. for wing-heavy correction procedure.

   i. See page 6-7 for travel and rigging information.

2. Trim Rigging and Adjustment.

   a. Set stops (located in the belly under the floorboard–accessible through the fuselage access panel) at trim wheel for extreme travel (Figure 6-9).

   b. Adjust screw at rear bulkheads (Sta. 194.0) so that trim travels in excess of specification requirements.

   c. Set stops at trim wheel to travels given in control surface specifications page 6-7.

   d. See Figure 6-8 for trim control system drawing.

3. Flap Rigging and Adjustment.

   a. Adjust inboard linkage and outboard hinge stop to obtain travels given in control surface specifications page 6-7.

   b. See Figure 6-10 for flap control system drawing.

   c. Adjust outboard hinge stop to align with aileron trailing adge.

4. Rudder Rigging and Adjustment.

   a. Raise aircraft nose (refer to Section II-C.1).

   b. Set trim control in neutral.

   c. Clamp co-pilot's rudder pedals in neutral.

   d. Adjust rod end bearing on nose wheel interconnect to center the nose gear.

   e. Adjust bungee in left exhaust cavity to neutral.

   f. Adjust rod end bearing of control tube at main spar and control tube at rear fuselage bulkhead and set rudder at approximately 1° to the right.

   g. Unclamp rudder pedal.

   h. Set stops of control tube (accessible through the access panels in the left side of the empennage) in stinger for rudder travels as given in Section VI-E.

   i. See Figure 6-5 for rudder control system diagram.

   j. See page 6-7 for travel and rigging information.

   k. See Figure 6-4 for travel jig.

5. Elevator Rigging and Adjustment.

   a. Adjust the rod end bearing of control tube at control column for clearance of control shaft to firewall and control column to fuselage structure.

   b. Set trim control in neutral with stabilizer parallel to centerline of airplane.

   c. Adjust rod end bearing of control tube at elevator attachment, and control tube at rear of bulkhead for excess travel of elevators.

   d. Set stops (accessible through the access panels in the left side of the empennage) in stinger for travels as given on page 6-7.

   e. Adjust bungees as described in Section VI-E.

   f. See Figure 6-6 for elevator control system diagram.

   g. See page 6-7 for travel and rigging information.

   h. See Figure 6-4 for travel jig.

6. Trailing Edge Trimming.

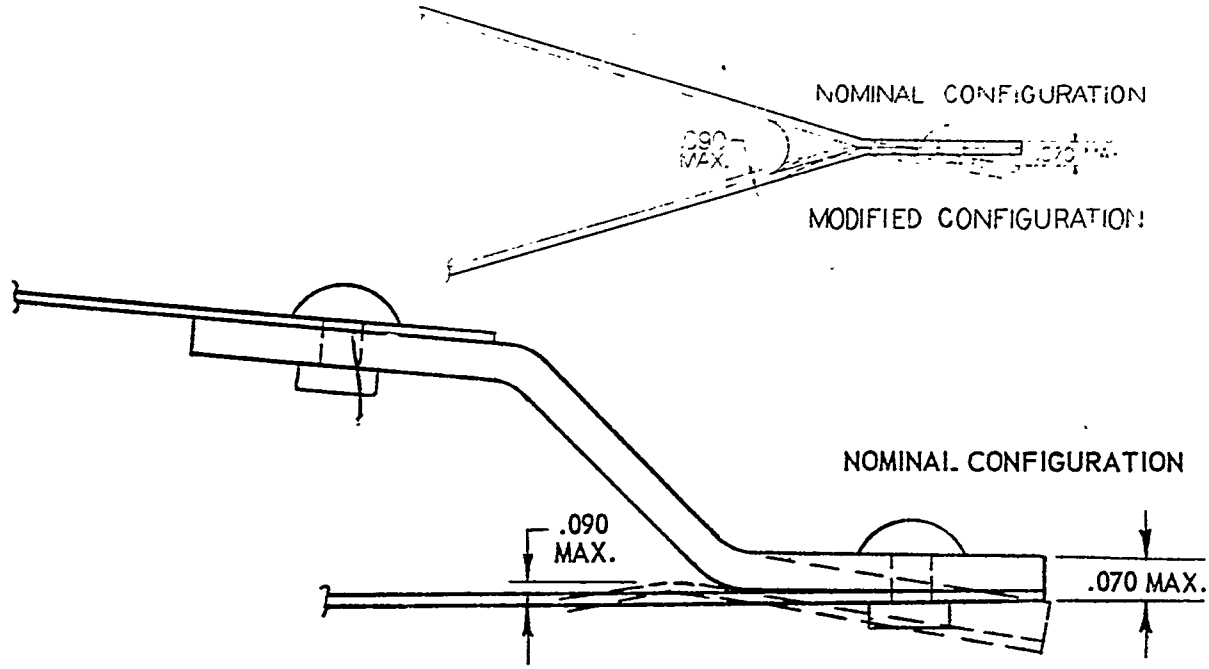
   A special pair of wide-nose vice-grip pliars are to be used to bend the trailing edges as necessary (Refer to Figures 6-2 and 6-3.). To correct for left wing-heavy condition, bend down trailing edge on right aileron; to correct for right wing-heavy condition, bend down trailing edge on left aileron.

7. Hydraulic Flap System Bleeding (See Figures 6-10, 6-11, and 6-12.).

   When flap action becomes erratic or when repairs require the replacement of actuating components, it is necessary to bleed the hydraulic flap system. Best results are achieved with the use of clean hydraulic fluid from a hydraulic fluid system bleeder (pressure pot) pressurized with air to approximately 35-40 lbs.

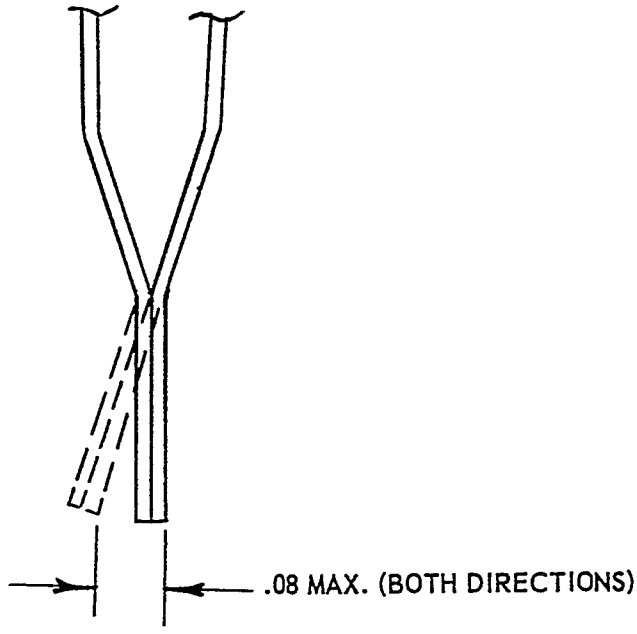
   a. Remove hydraulic fluid reservoir vent cap.
   b. Disconnect hydraulic cylinder piston rod from jack shaft.
   c. Open bleed valve in T-fitting at hydraulic cylinder.
   d. Pump actuating handle and observe flow of fluid from bleeder valve into catch pan.
   e. When fluid clears of bubbles and runs transparent, slide shaft and piston to bottom to expell air.
   f. Pump actuating handle to re-extend piston and shaft.
   g. Repeat steps e and f until all traces of air is removed from expelled fluid.
   h. Close bleed valve and
   i. Remove excess fluid from reservoir through side plug to re-establish proper level.

FIGURE 6-2 – TRAILING EDGE TRIMMING DIAGRAMS



NOTE: UNDER NO CIRCUMSTANCES MAY THE TRAILING EDGE BE BENT UP. ANY OPEN-HEAD RIVETS MUST BE REPLACED AFTER MODIFICATION.

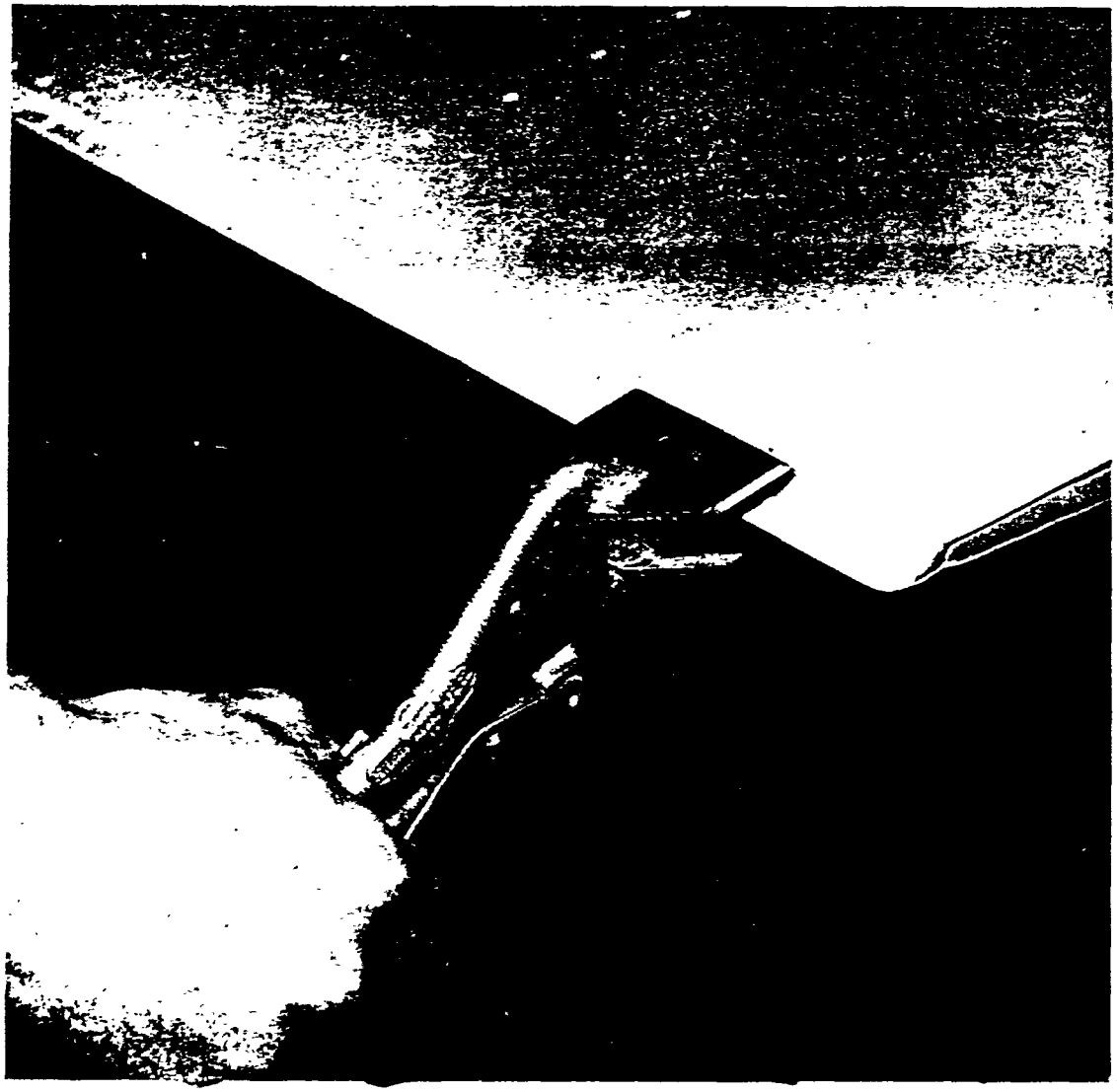
AILERON TRAILING EDGE TRIMMING



NOTE: ANY OPEN-HEAD RIVETS MUST BE REPLACED AFTER MODIFICATION.

RUDDER TRAILING EDGE TRIMMING

FIGURE 6-3 – APPLICATION OF TRAILING EDGE TRIMMING VICE-GRIP PLIARS



E. CONTROL TRAVEL AND RIGGING SPECIFICATIONS (SEE FIGURE 6-4)

1. WING FLAPS

Measured from wing chord with travel board at wing Station 147.75.

Up position 0° (align with aileron)	Tolerance ± 2°
Takeoff position 15° (M20C,E&F)	Tolerance ± 1°
Approach & landing position 33°	Tolerance + 0° −2°

2. AILERONS

Measured from aileron chord with aileron in the static position with travel board at wing Station 147.75.

Down travel, both ailerons 8°	Tolerance ± 1°
Down travel, both ailerons 8°	Tolerance ± 1°

Up travel, either aileron, may vary from 12½° to 17° with no additional tolerance.

Static position	from 0° to 2° down

3. RUDDER AND NOSEWHEEL

Measured from fin chord with travel board centered on rivet line at fin Station 13.5.

Left travel 23° Right travel 23° Tolerance −0° +2° for either

With rudder pedals in neutral and with trim assist unit at zero spring travel, rudder and nosewheel settings are approximately 1° right, ± 2° right.

4. STABILIZER

Maximum nose-down setting (M20C,D&E)	1° to 2½°
Maximum nose-down setting (M20F)	½° to 2°
Maximum nose-up setting (M20C,D&E)	4½° to 5°
Maximum nose-up setting (M20F)	5¼° to 5¾°

5. ELEVATORS

Measured from stabilizer chord with travel board centered on rivet line at stabilizer Station 16.0 and with stabilizer at 0° thrust line.

Up travel (M20C,D&E)	24°	Tolerance ± 1°
Up travel (M20F)	22°	Tolerance ± 2°
Down travel (M20C,D&E)	10½°	Tolerance ± 1°
Down travel (M20F)	22°	Tolerance ± 2°

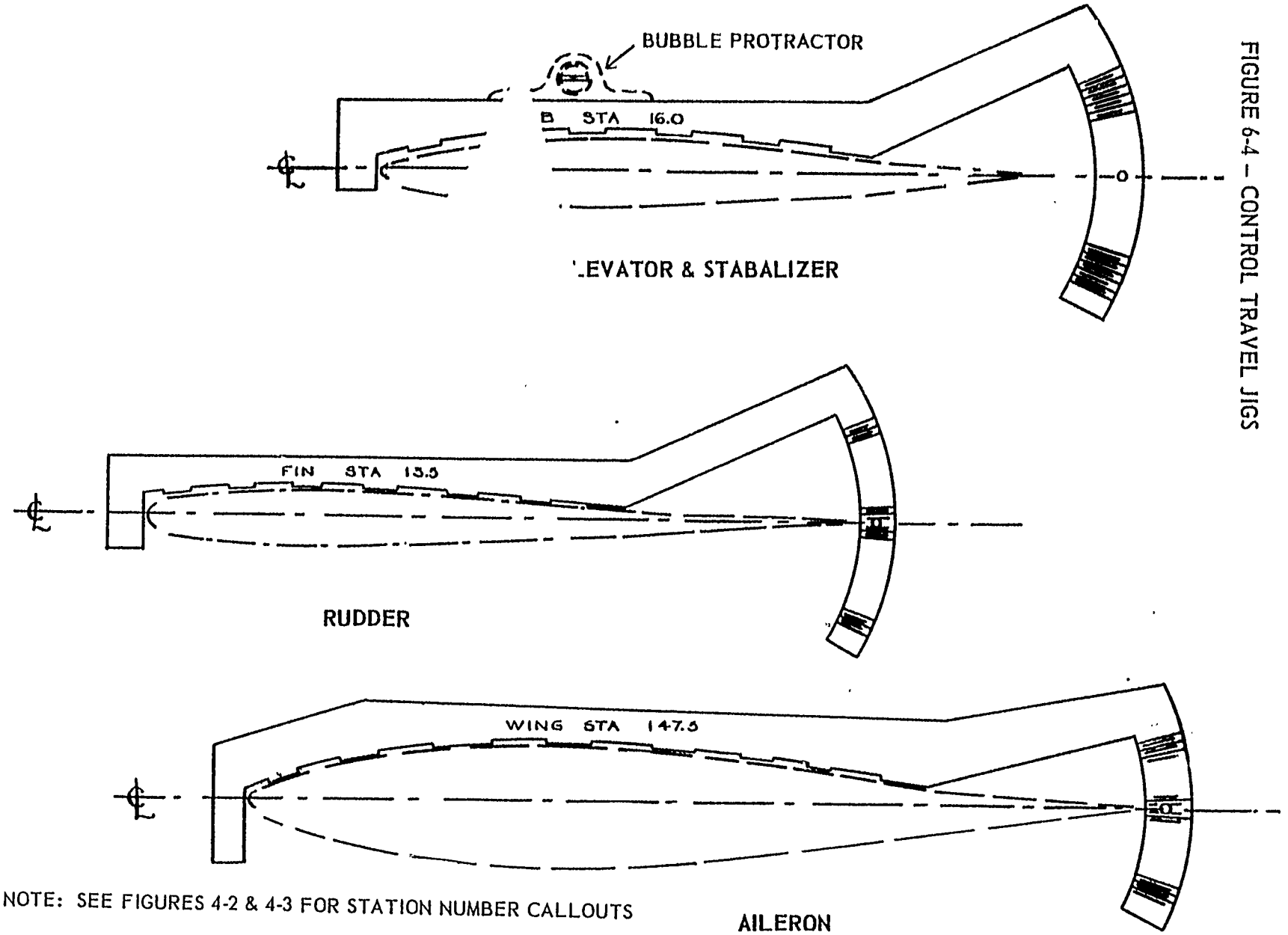
6. ELEVATOR TRIM ASSIST UNITS

M20C,D&E: (Retractable Gear) With stabilizer set at 3.5° for nose-up flight, adjust trim-assist units for elevator-up angle of 19° ± ½° at the zero spring-travel position. M20D (fixed gear) aircraft must have an elevator-up angle of 12½° ± ½° at the zero spring-travel position.

M20F: With stabilizer set at 3.5° for nose-up flight, adjust trim-assist units for elevator-up angle of 5½° ± ½° at the zero spring travel position.

7. ALLOWABLE FREE-PLAY LIMITS

Allowable fore and aft movement at stabilizer tip	.12"
Allowable vertical movement at stabilizer tip	.10"
Allowable vertical movement at rudder trailing edge	.08"



NOTE: SEE FIGURES 4-2 & 4-3 FOR STATION NUMBER CALLOUTS

FIGURE 6-4 – CONTROL TRAVEL JIGS

FIGURE 6-5 – RUDDER CONTROL SYSTEM INSTALLATION

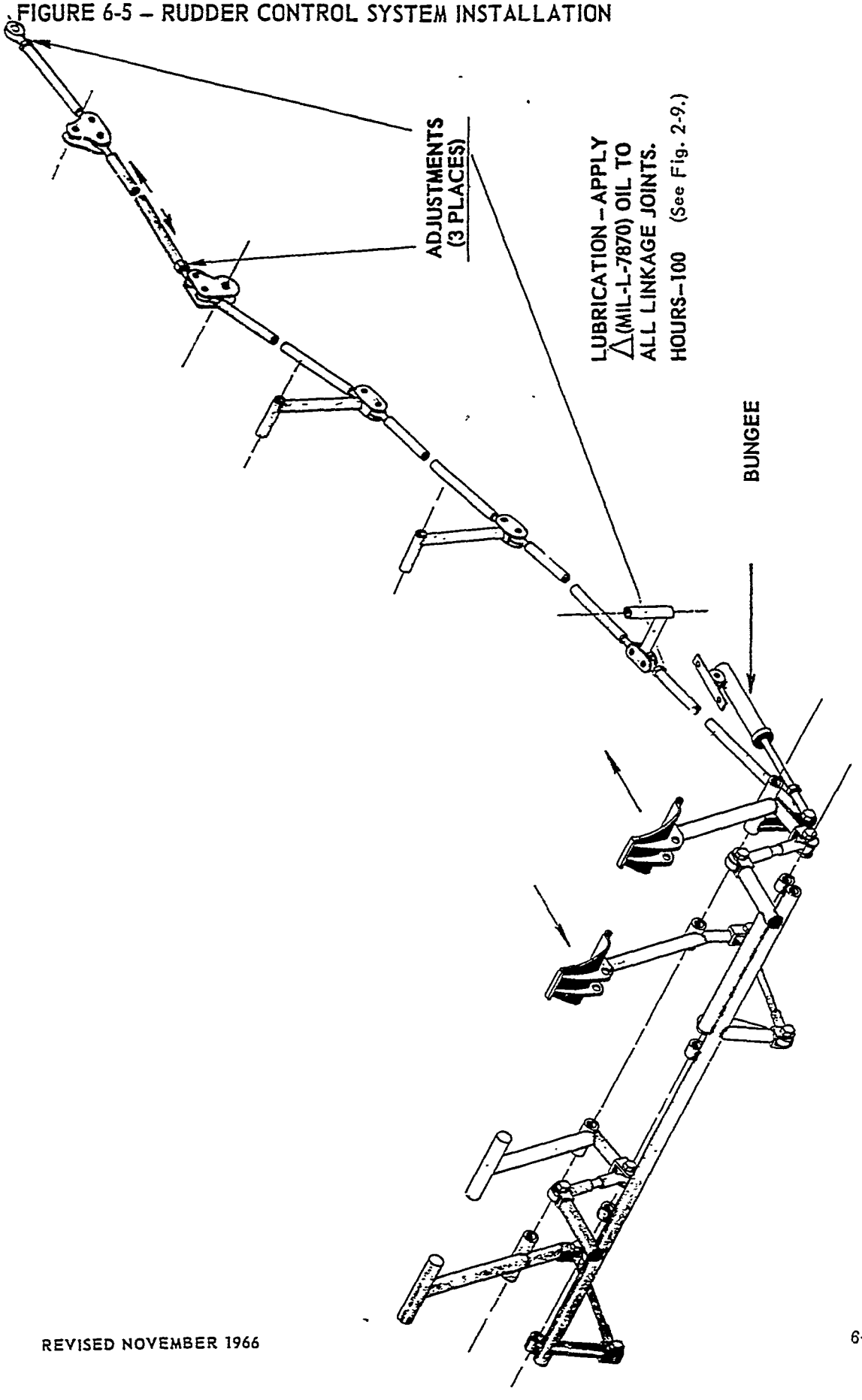


FIGURE 6-6 – ELEVATOR CONTROL SYSTEM INSTALLATION

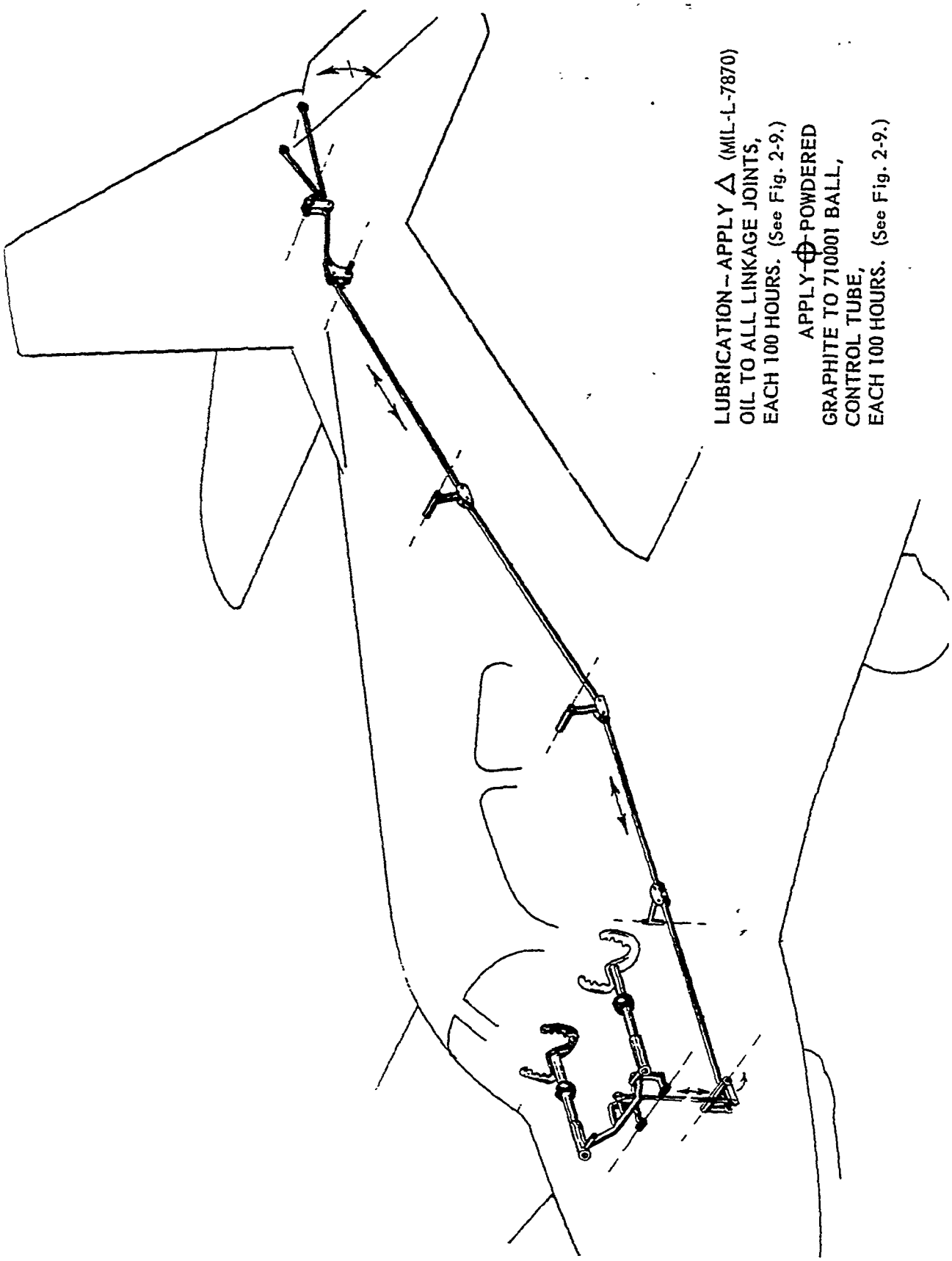


FIGURE 6-7 – AILERON CONTROL SYSTEM INSTALLATION

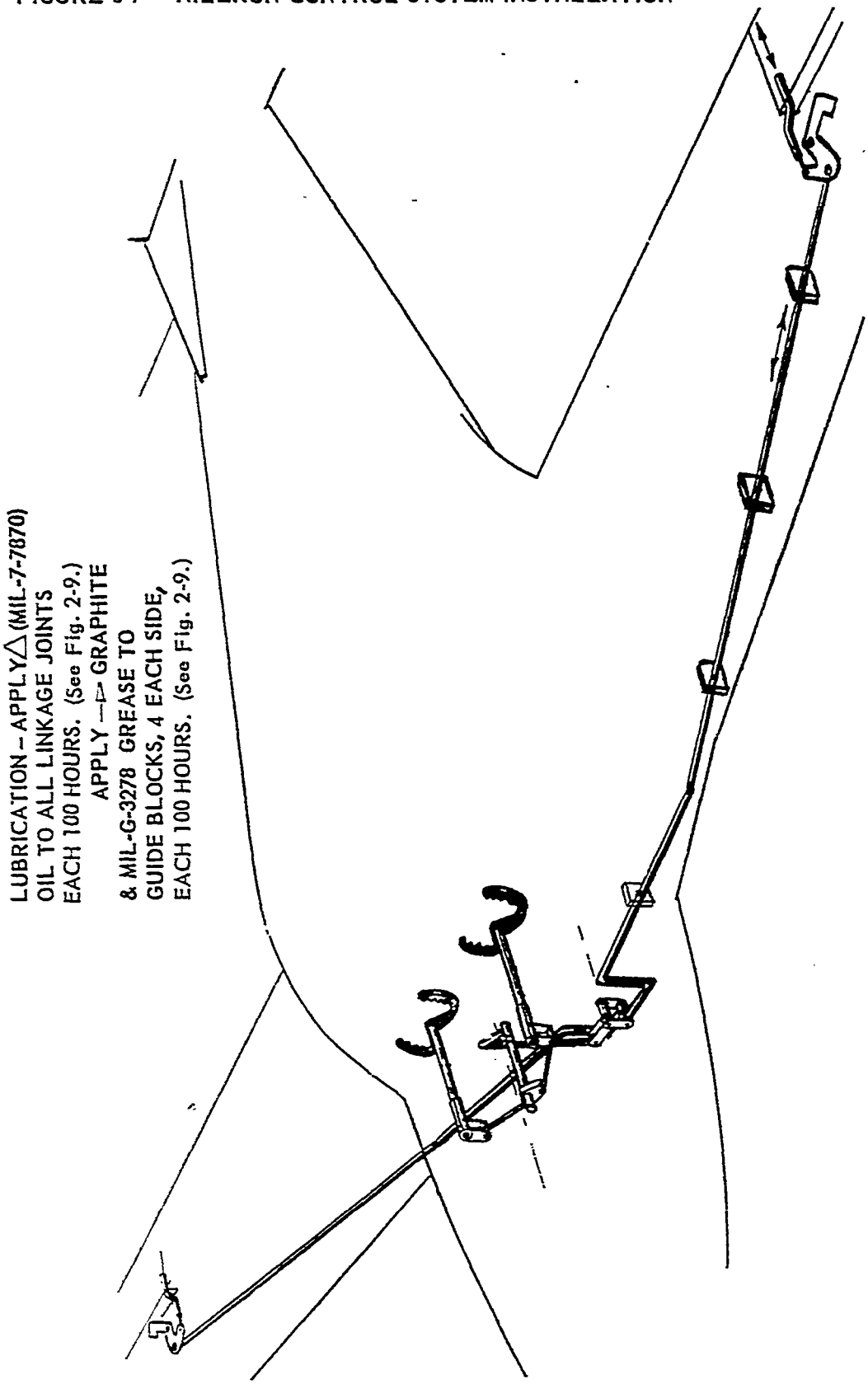
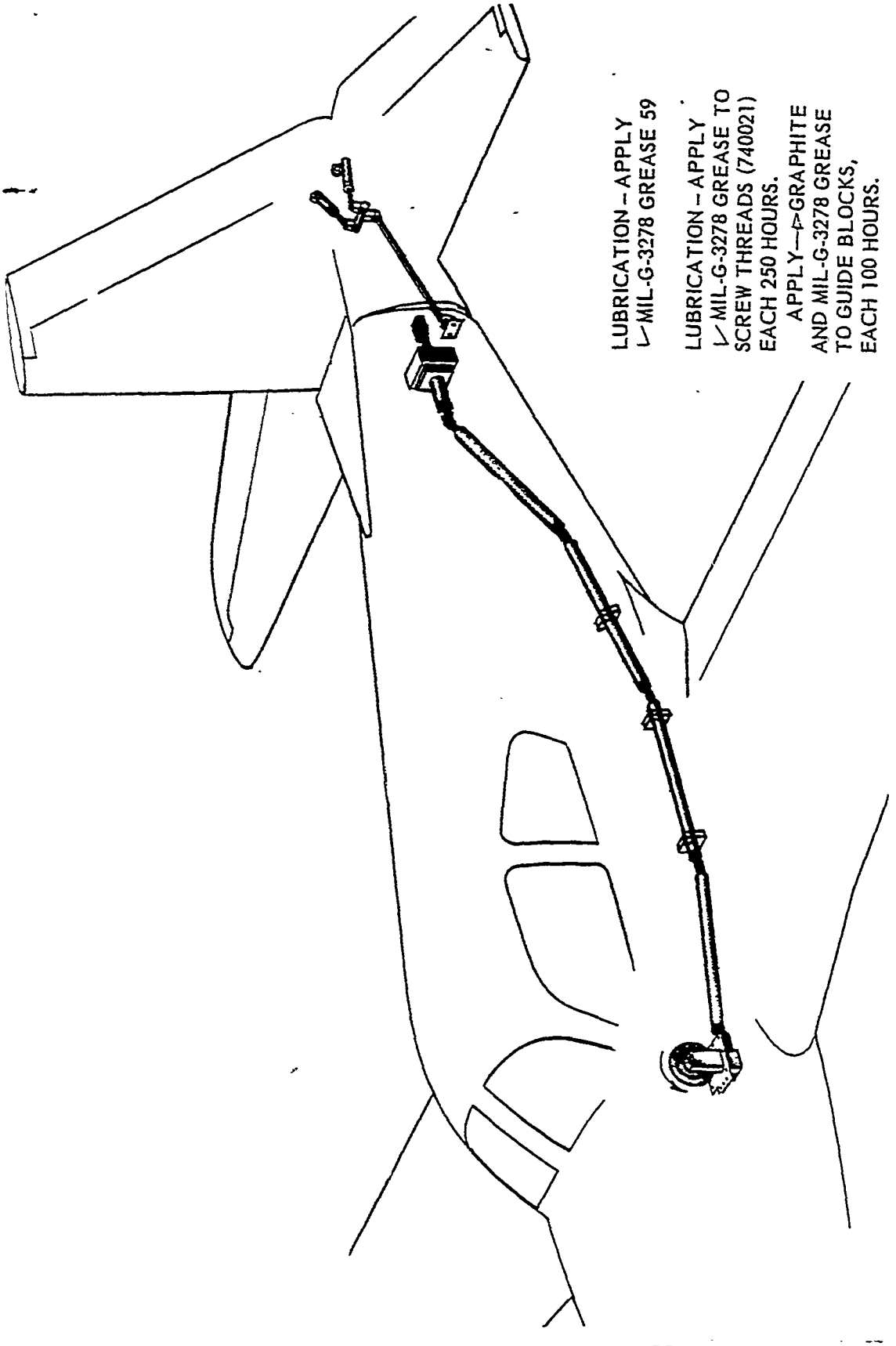


FIGURE 6-8 – TRIM CONTROL SYSTEM INSTALLATION



NOTES:

ON ASSEMBLY NOS. 740002 AND 740050–1, CHAIN ADJUSTMENT IS MADE BY LOOSENING SIX SCREWS AROUND SHAFT ON TRIM WHEEL AND ROTATING ECCENTRIC BUSHING.

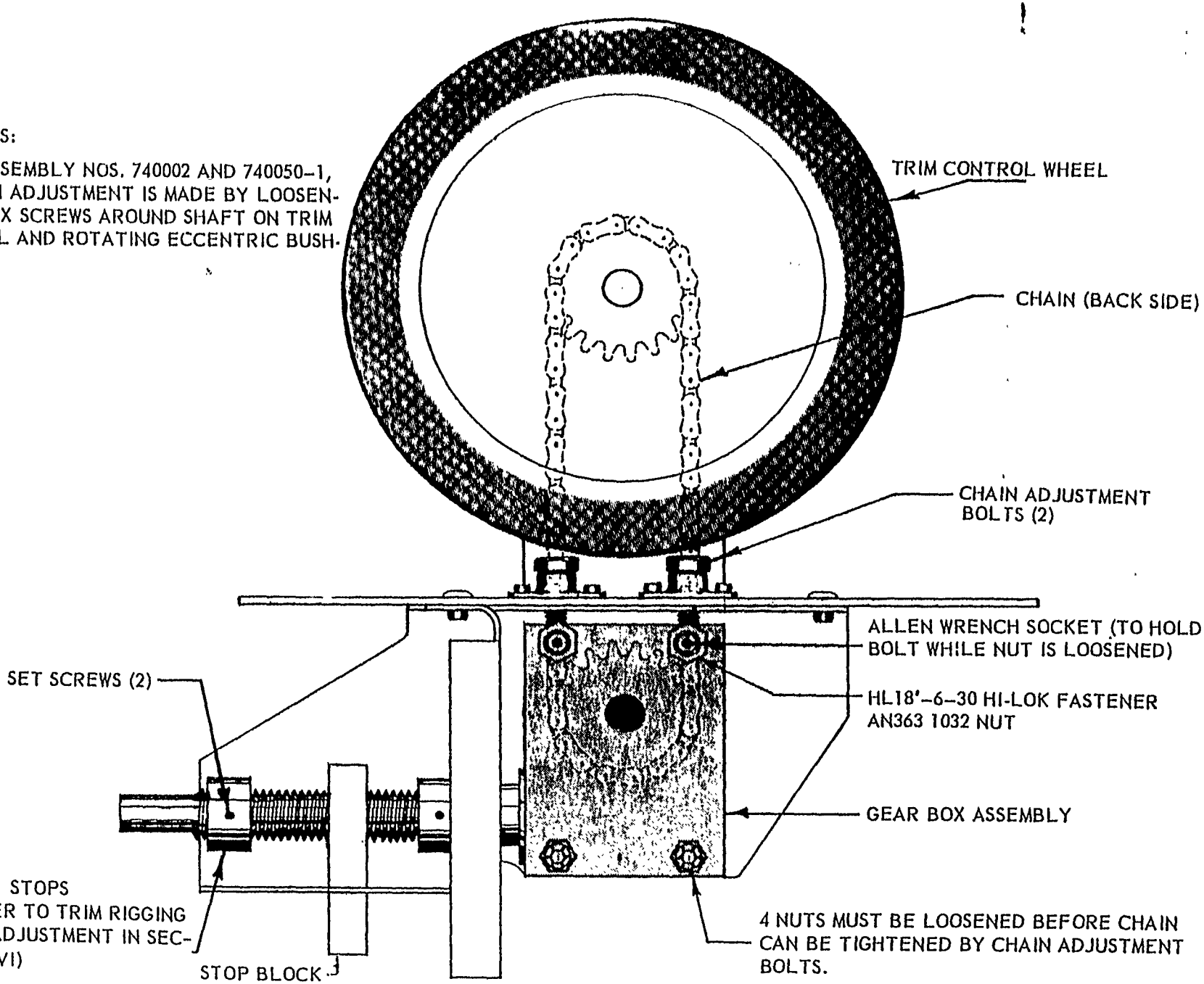
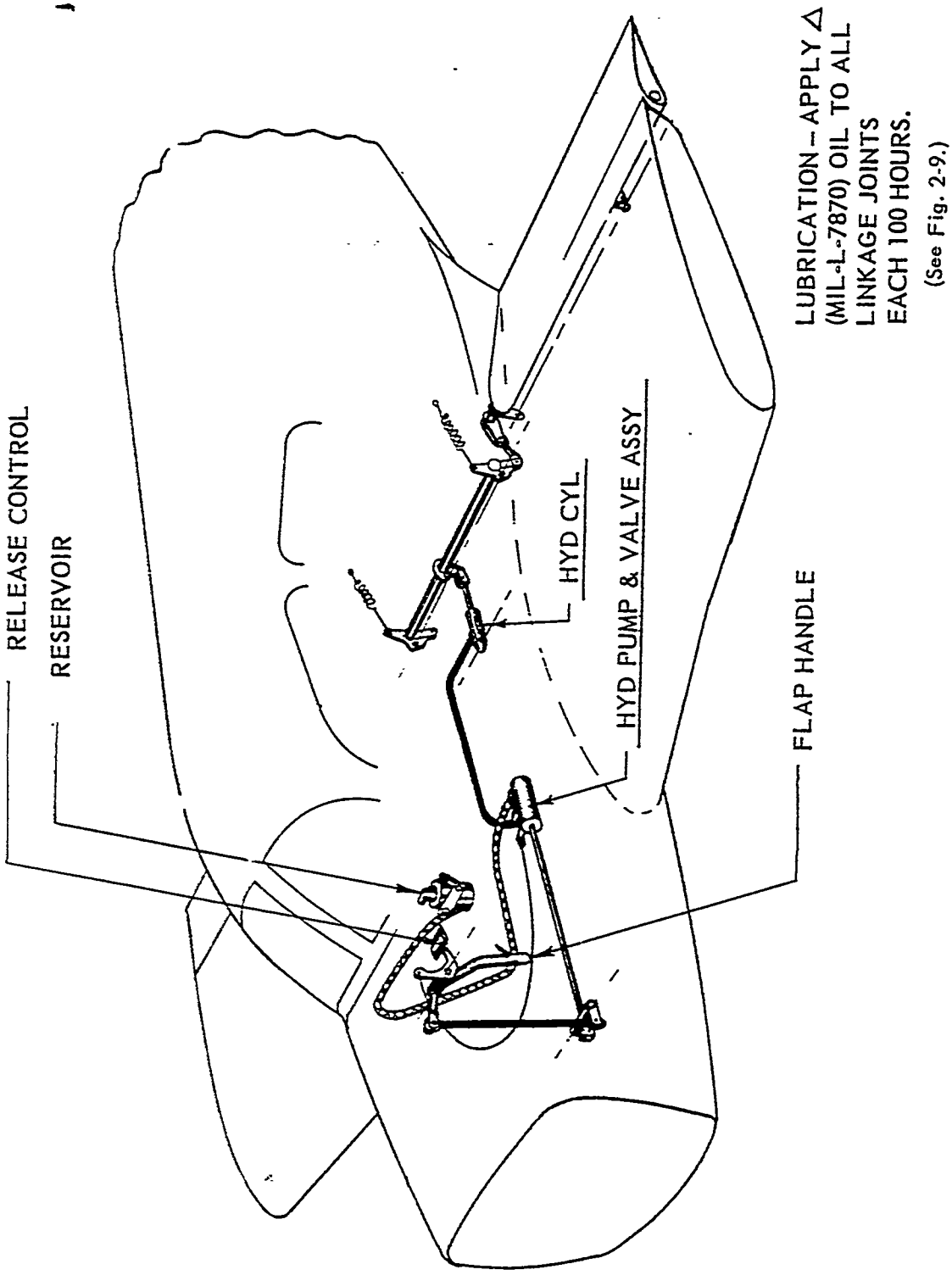


FIGURE 6-9 – TRIM CONTROL ACTUATOR ASSEMBLY

FIGURE 6-10 – FLAP CONTROL SYSTEM INSTALLATION



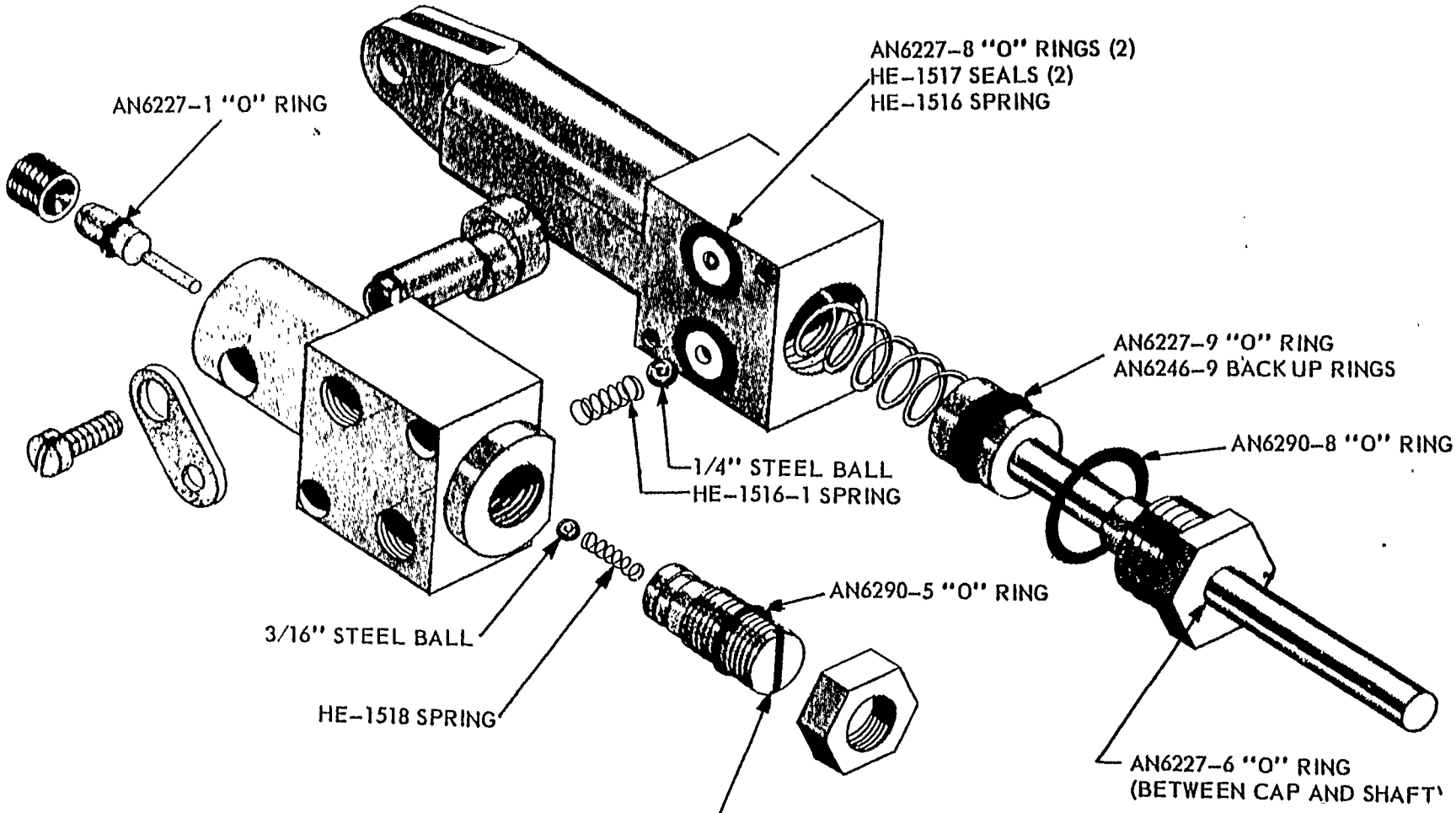
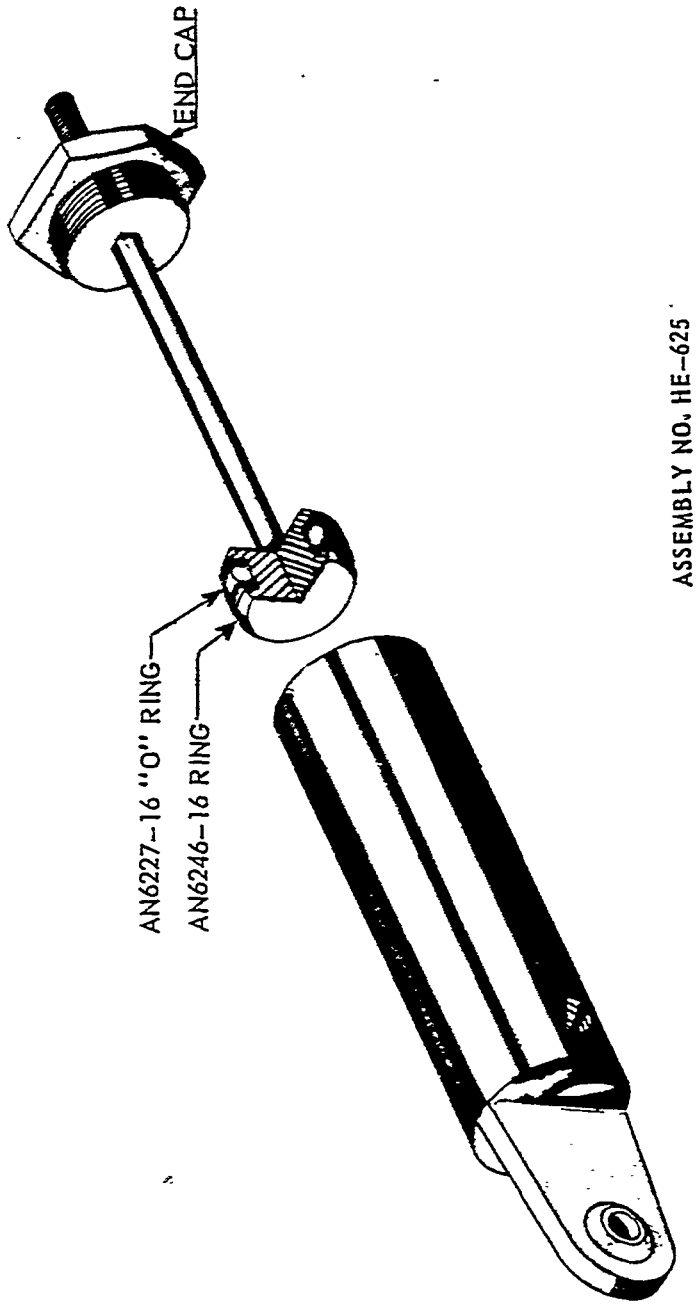


FIGURE 6-11 – FLAP PUMP AND VALVE ASSEMBLY

FIGURE 6-12 – FLAP CYLINDER ASSEMBLY



F. POSITIVE CONTROL SYSTEM

1. Introduction.

a. The purpose of this section is to assist service and maintenance personnel in testing and calibrating the Mooney PC System. Table 2 lists the most probable troubles that may be encountered and the procedures to be taken to isolate and correct the cause of malfunction. Para. 9 provides a step-by-step procedure for system analysis in the event that Table 2 does not cover the procedure.

b. Reference should be made to paragraph 3 (Ground Test Procedure) for ground checking of the unit for proper vacuum settings, leaks, and command functions. Reference should be made to paragraph 5 (Operating Instructions) for proper in-flight checking and setting of the unit.

c. This section deals primarily with the two-axis PC system. No reference is made to the Dynertial Pitch Control (elevator control) system or to the Magnetic Heading Lock, as both of these systems are dealt with in a separate Operation & Service Manual.

2. System Description.

a. General

The system is a pneumatically operated two-axis automatic-control device, which senses both roll and yaw while deriving its power from the aircraft engine-driven vacuum pump. The system consists basically of a gyro-sense element which meters vacuum pressure to a cylinder-piston servo assembly. On all aircraft in which this system is installed, these servos are attached to the aileron and rudder controls, providing for a dual-control system.

NOTE: The 1967 and subsequent M20C,E & F models have a turn coordinator which replaces the rate gyro and operates by vacuum and electrical power simultaneously. The turn coordinator also replaces the turn-and-bank indicator in these models.

b. Operation

1. Stability and control of the airplane about both the roll and yaw axes is obtained by tilting the rate-gyro (or turn coordinator) assembly to a predetermined angle. This permits a part of the roll rate and a part of the yaw rate to act on the sensitive gyro-rotor element, producing an output signal. In this manner, a single gyro element is sensing motion about two axes—roll and yaw—thereby providing basically a two-axis system.

2. Roll or yaw of the airplane caused by wind gusts, out-of-trim conditions, or airspeed changes displaces the rate gyro (or turn coordinator). The resulting output signal is coupled to a spool-sleeve rotary valve. The spool is rotated inside the sleeve in proportion to both yaw and roll rates of the airplane. The spool moves to a location between the vacuum-supply port and one of the output ports. The other output port is opened to atmosphere, bleeding the vacuum. The resulting vacuum differential is directed to the proper pneumatically operated servo so as to correct the original roll or yaw error. In straight-and-level flight, the vacuum differential is zero and the servos are balanced.

3. Desired roll and yaw rate proportions of the total signal are obtained by mounting the rate gyro (or turn coordinator) at a predetermined incline angle from true horizontal at cruise attitude. Changes in this angle, due to changes in the pitch attitude of the airplane, only partially compensate for the corresponding change in aircraft stability characteristics. For instance, as the aircraft pitches up to climb, the decreased airspeed and lower aerodynamic loads necessitate more aileron control motion to maintain stability. The corresponding change in rate-gyro (or turn coordinator) tilt angle produces increased roll-rate sensitivity, which partially compensates for the change in aircraft stability. The opposite occurs as the airplane pitches down and airspeed increases.

4. Provisions have been made in this system to allow for a roll trim pilot command function. This roll trim may be used to compensate for asymmetrical fuel and passenger loading and to optimize system performance in climb, cruise, and letdown configurations. During normal aircraft operation in low-speed climb, it is necessary to utilize a combination of right rudder/aileron control to maintain wings-level flight. Displacing the roll-trim knob to the right will partially compensate for this condition. Likewise, during high-speed descent the normal left rudder/aileron trim required may be accomplished by displacing the roll-trim valve to the left. However, the application of the roll-trim valve is not intended to substitute for proper rigging of the aircraft control system.

5. If the aircraft is properly trimmed by means of roll-trim adjustment, the unit will maintain an average heading over a fairly long period of time; however, the unit will not maintain an absolute preselected heading without the addition of a magnetic heading lock. For optimum performance the aircraft must be rigged to fly needle-ball (or turn coordinator) centered.

6. The system push-button disconnect, located in the control wheel, operates a pneumatic relay which provides vacuum to the gyro-sense element (or turn coordinator). When the push button is depressed, all servo vacuum supply is relieved and the system is immediately inoperative. The pilot may then command turns in the normal manner without overriding the system. Releasing the push button reactivates the system. However, normal maneuvers may be readily accomplished without disengaging the system, as over-power forces required are small and no damage will result to either the aircraft or the system.

c. System Performance.

The Mooney Lateral Stability Augmentation System is designed to be capable of maintaining aircraft equilibrium over the operational speed range under conditions that would otherwise cause rapid spiral divergence. The device is also intended to maintain lateral stability and prevent excessive changes in heading and airplane gyrations in turbulent air.

3. Ground Test Procedure.

Perform the following ground tests and procedures after completion of component replacement and prior to starting engine or conducting flight tests:

a. All vacuum lines must be free of kinks and sharp bends. Make certain that lines have been purged or blown free of foreign particles before operating the system.
NOTE: Do not operate the system at any time with lines disconnected from servo units. Also, do not fly aircraft with servo unit bibs capped or lines plugged when they are connected to servo units. Expansion within servo cylinder can block movement of ailerons when aircraft is flown to altitude.

b. Aircraft Vacuum (Primary Vacuum)

Start the engine and increase the rpm to 1700 (If desired, an external vacuum pump may be utilized if the vacuum source is attached to the engine side of the aircraft vacuum relief valve.). Adjust the vacuum-relief valve to 4.75 (± .25) in. Hg. on the gyro horizon or directional gyro case. The primary vacuum reading on the PC system will be approximately 1/2 in Hg. lower than that read at the gyro horizon (See Fig. 6-15 and Fig. 6-17, Sheet 2, PC 3.). Make certain that the vacuum relief valve and regulator are functioning properly.
NOTE: The vacuum-relief valve setting should be maintained on the high side of the limit.

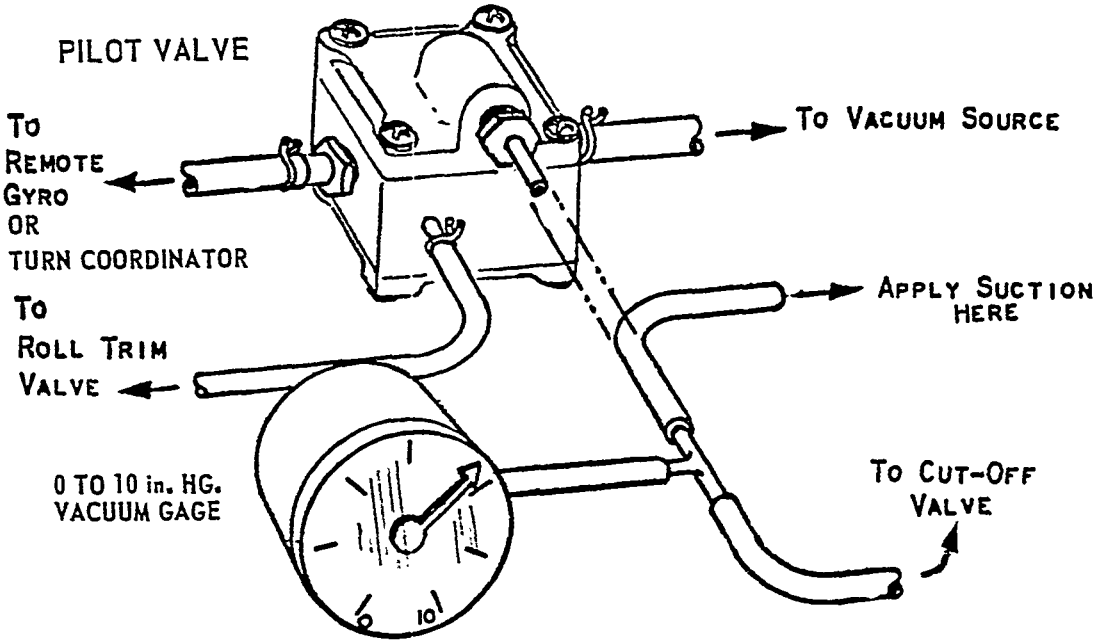
CAUTION

Permit no oil, grease, or thread lube, etc. to enter internal parts of the dry vacuum pump. Clean all lines before reinstalling. Do not use thread lube on fittings.

c. Cutoff Valve Operation

1. The pneumatic cutoff valve mounted in the control wheel actuates the pneumatic relay sequencing vacuum to the rate gyro valve (or turn coordinator).

FIGURE 6-13 – CUTOFF VALVE OPERATING CHECK DIAGRAM



2. Disconnect gray line at pilot valve. Insert a Tee as per Figure 6-13 with a suction gauge on one side and the other line open so that suction can be applied.

3. By mouth, apply about 5 in. Hg suction. Valve should not leak more than 2 in. Hg in 30 seconds.

4. Depress valve and vacuum should drop immediately, proving that tubes in control wheel and valve are not restricted.

5. Upon release of valve, button should return immediately to its normal position.

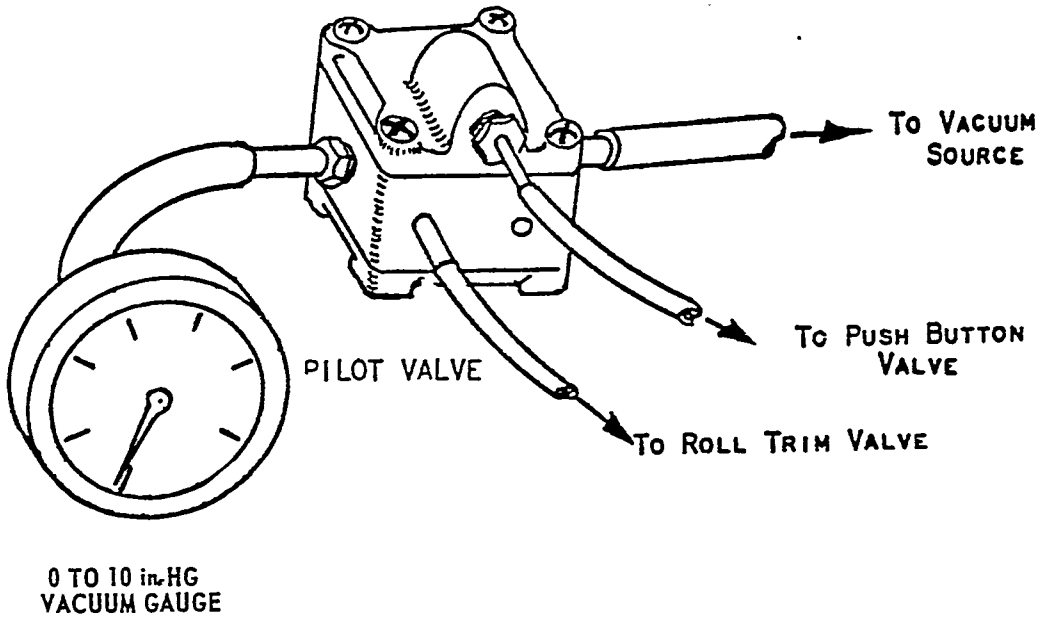
d. Pilot Valve–Operation

The pilot valve is in effect a pneumatic relay that shuts off the vacuum supply to the rate gyro valve (or turn coordinator) when cutoff valve is depressed and at the same time relieves the vacuum in the servos so that the system does not load the controls when system is cut off.

1. Proper Pilot Valve Operation

a. To test pilot valve. disconnect the gray line as shown in Figure 6-14 on the sequenced vacuum side and attach a 0-10 in. vacuum gauge. With vacuum on the system and the cutoff valve not depressed, the reading on gauge should be 4.0 in. Hg.+ (with primary vacuum at 4.75 in. Hg.).

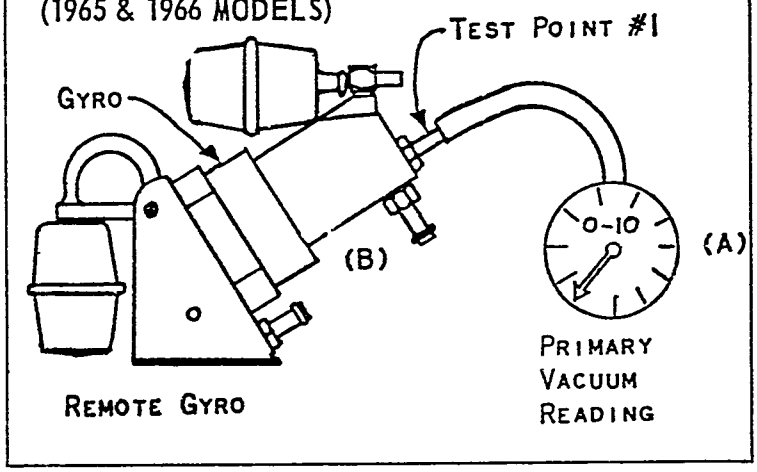
FIGURE 6-14 – PILOT VALVE OPERATING DIAGRAM



b. Upon depressing cutoff valve, gauge should drop to 0 in. Hg. If vacuum is not relieved and there still remains a reading on gauge, pilot valve is not shutting off completely and should be replaced.

e. Primary Vacuum Reading

FIGURE 6-15 – PRIMARY VACUUM READING DIAGRAM
(1965 & 1966 MODELS)



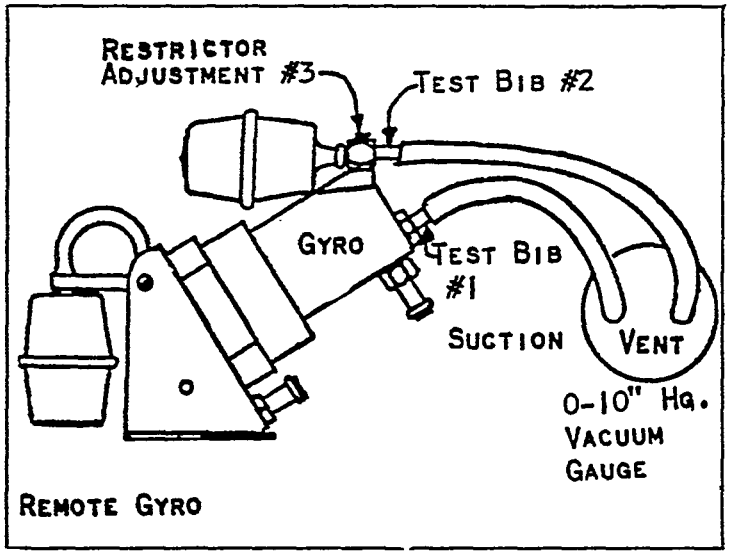
REMOVE CAP AND ATTACH 0-10 in. HG VACUUM GAUGE ON TO TEST BIB #1.

(A) Test vacuum gauge to read "primary vacuum".
(B) LSA-1 Gyro

f. Gyro Rotor Speed Adjustment (1965 & 1966 models)

To assure proper gyro response it is necessary that the gyro rotor be operated at the proper rotor speed. Fast rotor speed will cause over active corrections. Rotor speed can be checked by the following test: (A vacuum reading of 3.5 in. Hg., +1.0 in. -0 in. Hg., is recommended for proper operation.).

FIGURE 6-15A – GYRO ROTOR SPEED ADJUSTMENT (1965 & 1966 MODELS)



1. Install a 0-10 in. Hg vacuum gauge as shown in Figure 6-15A. Connect the vent side to test bib #2. Connect the suction side to test bib #1. The vacuum gage will indicate the vacuum (3.5 in. Hg, +1.0 -0 in. Hg) across the rotor which controls its speed.

2. To change the rotor speed, adjust point #3, shown in Figure 6-15A, to obtain the required 3.5 in. Hg (+1.0 -0 in. Hg) on the vacuum gauge. Also refer to Figure 6-17, Sheet 2, PC 2. Clockwise rotation of adjustment #3 on Figure 6-15A will decrease the vacuum reading.

NOTE: This adjustment is EXTREMELY IMPORTANT, and care should be taken to make certain this adjustment is accurate. With Group I and Group III autopilot installations, the differential vacuum reading across test bibs #1 and #2 (Figure 6-15A) should read 4 in. Hg.

3. For further Group I and Group III autopilot maintenance information covering 1965 & 1966 models, refer to Operation & Service Instruction manuals 11968-1 (Mooney Nav-coupler/Heading Lock) and 11968-2 (Mooney Pitch Control). Manuals 11990-1 and 11990-2 cover 1967 and subsequent models.

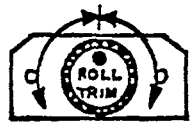
4. Replace the test bib caps and make certain that no leaks exist around these caps. Manually displace the roll-trim knob counter-clockwise as far as possible. The control wheel should tend to turn to the left. Turn the roll-trim valve fully clockwise and the control wheel should tend to turn to the right. Center the roll-trim valve. During taxi operations the control wheel will tend to turn opposite to the aircraft if the gyro is properly phased.

4. Roll-Yaw System.

a. Rate Gyro Valve Centering (1965 & 1966 models)

Vacuum differential may result from the rate-gyro valve being off center while the aircraft is stationary on the ground. Yawing the aircraft will precess the rate gyro. In this manner it may be determined whether or not the pneumatic null is permanently offset. If there appears to be a permanent offset to the right or left, greater than a .2 in. Hg differential, the rate-gyro valve should be repositioned. Only minute movements of the valve stub are required.

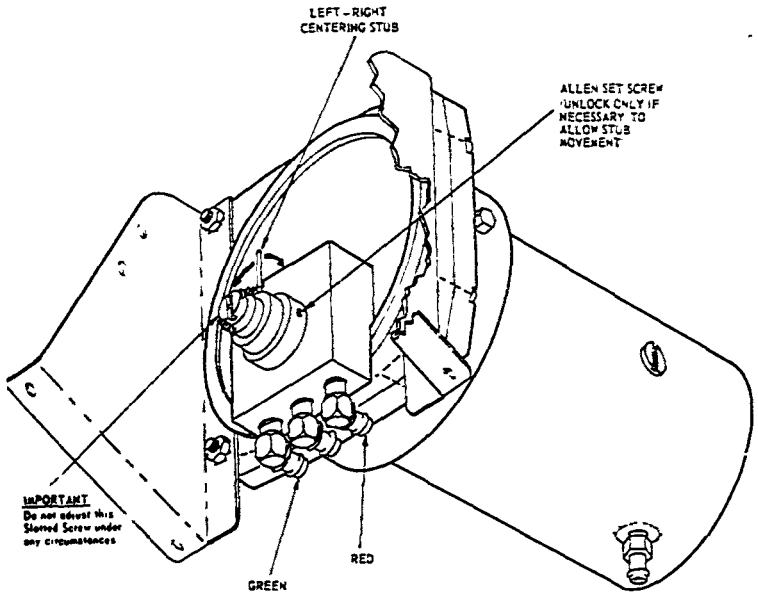
b. Roll-Trim Valve Centering



Roll trim valve stops are factory adjusted and should not be moved. The knob should be centered (dot at top) with same degree of rotation right and left (Figure 6-17, Sheet 2, PC 3).

NOTE: 1967 C, E & F models have a turn coordinator which has a roll-trim knob on the instrument front. If the turn coordinator is removed (requiring removal of the knob), the knob should first be centered for ease of relocation.

FIGURE 6-16 – RATE GYRO VALVE CENTERING DIAGRAM (1965 & 1966 MODELS)



NOTE: Make certain aircraft is in wings-level attitude for this check.

Adjust valve to center 10-0-10 in. Hg. differential gauge installed across red and green gyro bibs. It will be necessary to temporarily remove the red and green servo tubes for this test.

NOTE: The turn coordinator installed on 1967 & subsequent models is pre-centered and the gyro speed is preset at the factory. The instrument should be replaced when a malfunction is found that is attributed to the instrument itself.

c. Taxi the aircraft to check for proper movement of the controls. Yaw to the left to see if the control wheel moves to the right. Yawing to the right should make the control wheel turn to the left. If the rate gyro or turn coordinator phasing is reversed (control wheel moves in the direction of the turn) the tubing leading from the gyro or turn coordinator to the servos is reversed at the bulkhead fitting.

5. Operating Instructions and Flight Tests.

a. Before takeoff. check force required to overpower the vacuum servos. Depress the cutoff button to see if vacuum forces are relieved.

b. Climb to a safe altitude in smooth air and trim airplane for straight-and-level flight at cruise configuration. If it is apparent that aircraft is not properly rigged, rerigging will be necessary before continuing with the flight test.

c. Depress the control wheel mounted cutoff button; the system should become inoperative. Upon release of this cutoff button the system should re-engage. Depress the cutoff button and command a standard-rate turn. Release the cutoff button and the aircraft should recover smoothly.

d. Setting the PC roll trim control knob will normally compensate for asymmetrical fuel and passenger loads in cruise flight. Fully deflected roll trim settings generally will not bank the aircraft more than 2° to 3° or one fourth of a standard-rate turn.

NOTE: The roll-trim knob should be approximately centered during level flight. However, a roll-trim knob setting as much as 90° from center during wings-level flight does not necessarily indicate a PC system malfunction.

e. The PC system may easily be overpowered at any time. Since the system has no clutches or electric motors. it can be overridden indefinitely with no resulting harm.

f. Upon completing the flight test. make a log book entry showing that the PC (or autopilot) system has been test flown by an appropriately rated pilot (Ref. FAR Part 91.167A.).

6. Emergency Procedures.

a. If a malfunction should occur in the unit. it can be overridden merely with pressure on the flight controls. and the entire system can be disengaged by depressing the pushbutton.

b. If a loss of vacuum supply occurs as indicated by a low-vacuum warning light, the system will become inoperative. No adverse effect upon the air-worthiness of the aircraft will be encountered. A check for leaks in the entire vacuum system should be conducted as soon as possible. If no leaks are found, check the vacuum source (pump) and the aircraft vacuum-relief valve.

7. Maintenance.

a. Once the system has been adjusted, it should require no further maintenance other than inspection of the various units for security and general condition.

b. The gyro filter should be replaced as required. A partially clogged filter will produce a sluggish gyro sense-element response. However, the turn coordinator (installed on 1967 and subsequent models) will function by electric power should the vacuum filter become clogged.

c. If the high or low vacuum light illuminates, inspect the entire aircraft vacuum system for leaks, stoppages, etc.

8. Trouble Shooting.

Table 2 below lists the most likely-to-be-encountered flight control malfunctions, with causes and steps to be taken to isolate and correct the malfunction. In the event that a malfunction is not covered here, refer to paragraph 9.

TABLE 2 – POSITIVE CONTROL SYSTEM TROUBLE SHOOTING

MALFUNCTION	PROBABLE CAUSE	REMEDY
1. Hi or Lo vacuum light.	Faulty vacuum pump or relief valve. Faulty switch.	Perform Test #1 and adjust vacuum if necessary. Replace switch.
2. Aircraft hunts in flight.	(1) Partial closure or leaking servo vacuum line.	Perform Test #2.
	(2) Improper gyro operation.	Perform Test #3.
	(3) Improper vacuum supply to valves and instruments.	Perform Test #1 and adjust vacuum if necessary.
	(4) Faulty servo.	Perform Test #2.
3. Aircraft does not hold directional heading.	(1) Incorrect trim of aircraft.	Check aircraft rigging and adjust as required.
	(2) Excess friction in system.	Examine the primary control system to determine that no excessive friction exists. (Lubricate all hinge points as depicted in Figure 2-9.)
	(3) Improper vacuum to valves and instruments.	Perform Test #1 and #2 and adjust vacuum.
	(4) Faulty rate gyro.	Perform Test #3.

TABLE 2 (Continued)

MALFUNCTION	PROBABLE CAUSE	REMEDY
4. Aircraft recovers in one direction but not the other.	(1) Restriction or leak in servo vacuum line.	Perform Test #2.
	(2) Loose or disconnected servo cable.	Perform Test #2.
	(3) Inoperative servo.	Perform Test #2.
	(4) Faulty rate gyro or turn coordinator.	Perform Test #4. Replace turn coordinator.
5. Aircraft tends to roll to one side.	(1) Leak or partial restriction in servo vacuum line.	Perform Test #2.
	(2) Improper gyro operation.	Perform Test #3.
	(3) Faulty servo; loose or disconnected cable.	Perform Test #2.
	(4) Faulty rate gyro, valve off center.	Perform Test #4.
	(5) Faulty turn coordinator.	Replace turn coordinator.
6. Continuous wheel oscillation in smooth air.	(1) Gyro rotor speed improper.	Perform Test #3.
	(2) Too high vacuum setting.	Perform Test #1.
	(3) Inoperative rate gyro.	Perform Test #4.
	(4) Faulty turn coordinator.	Replace turn coordinator.
7. Slow recovery from turn in one direction.	(1) Excessive friction in primary control system.	Examine the primary control system to see if excessive friction exists. Lubricate all hinge points as depicted in Figure 2-9.
	(2) Leak or partial restriction in servo vacuum line.	Perform Test #2.
	(3) Loose or disconnected servo cable.	Perform Test #4.
	(4) Faulty servo.	Perform Test #2.
	(5) Improper rate gyro operation.	Perform Test #4.

9. Trouble Shooting Tests.

a. The following tests are to be conducted as directed in Table 2. As each of the tests is conducted, the reading or indication should be noted. If, in any test, the reading differs from the correct indication, follow the corrective measures as indicated.

In the event that malfunctions are not covered specifically in Table 2, the following tests should be used as a step-by-step procedure for thorough system analysis.

b. Test #1–Vacuum Settings

Start the engine and increase the rpm to 1700 (When desired, an external vacuum pump may be utilized if the vacuum source is attached to the engine side of the aircraft vacuum-relief valve.).

Adjust the aircraft vacuum-relief valve to produce 4.75 Hg (+.25 in. Hg) output as read at the case of either the gyro horizon or directional gyro (See Figure 6-15 and Figure 6-17, Sheet 2, PC 3.). Always adjust to the high side of the limit.

c. Test #2–Vacuum Line and Servo Leak Test

Visually inspect all lines to eliminate possible defects such as kinks, restrictions. or obvious breaks.

Disconnect line from the back of the gyro sense element and install vacuum-test gauge in the open end of the line (See Figure 6-15 and Figure 6-17, Sheet 2, PC 2.). Rotate aircraft controls so as to extend the piston of the respective servo. This will provide a vacuum in the system which may be read off of the test suction gauge. Hold the control surfaces solidly. making certain that the piston is stationary. If no leak in the system exists, the test suction gauge reading will remain constant. Exercise care that all tubing connections are tight and will not produce a leak. When checking that tubing which connects to the roll-trim valve, they must be removed from the valve and securely plugged. The valve has atmosphere-bleed ports which preclude this leak test unless the tubing is plugged.

d. Test #3–Gyro Rotor Speed

Refer to Figure 6-15A. Attach a 0-10 in. Hg vacuum gauge to test bib #1. With the vacuum relief valve set as described in paragraph 3.b., a reading of approximately 4.25 in. Hg should be obtained at this point. This reading will vary depending upon the setting within the tolerance of 4.75 in. Hg (+.25 in. Hg).

Uncap test bib #2 as shown in Figure 6-15A and Figure 6-17, Sheet 2, PC 2, and attach a line from the vent side of the suction gauge to test bib #2. Adjust the set screw called out in Figure 6-15A and Figure 6-17, Sheet 2, PC 2 to a reading of 3 in. Hg (+.5 in. Hg, −0 in. Hg).

e. Test #4–Rate Gyro Valve Centering

Refer to Figure 6-16. (1965 & 1966 models). Disconnect red and green tubing from back of rate gyro. Attach a differential gauge across the two bibs and rotate valve until a 0 in. differential is obtained.

Yaw aircraft and note needle deflection on differential gauge indicating rate gyro deflection. When aircraft stops yawing. gyro should come back to center within ± .2 in. Hg. The rate gyro or turn coordinator should be replaced if it does not center properly.

f. Test #5–Installation Inspection

Rotate the aircraft control wheel. The attachment to the respective servos must be tight and the servo piston extended with rubber seal not stretched (See Figure 6-17, Sheet 3, PC 4.).

Examine the primary control system to determine that no excessive friction exists. Lubricate all hinge points as depicted in Figure 2-9.

Also refer to Figure 6-17, Sheet 3, PC 4 when trouble shooting system. Be sure the chain between the aileron bell crank and the aileron servo does not have a twist. This can be corrected by repositioning the rubber boot on the servo.

Refer to Figure 6-17, PC 2. 3, 4, 5, 6, 7, and schematics for proper line routing and color coding.

SHOP NOTES

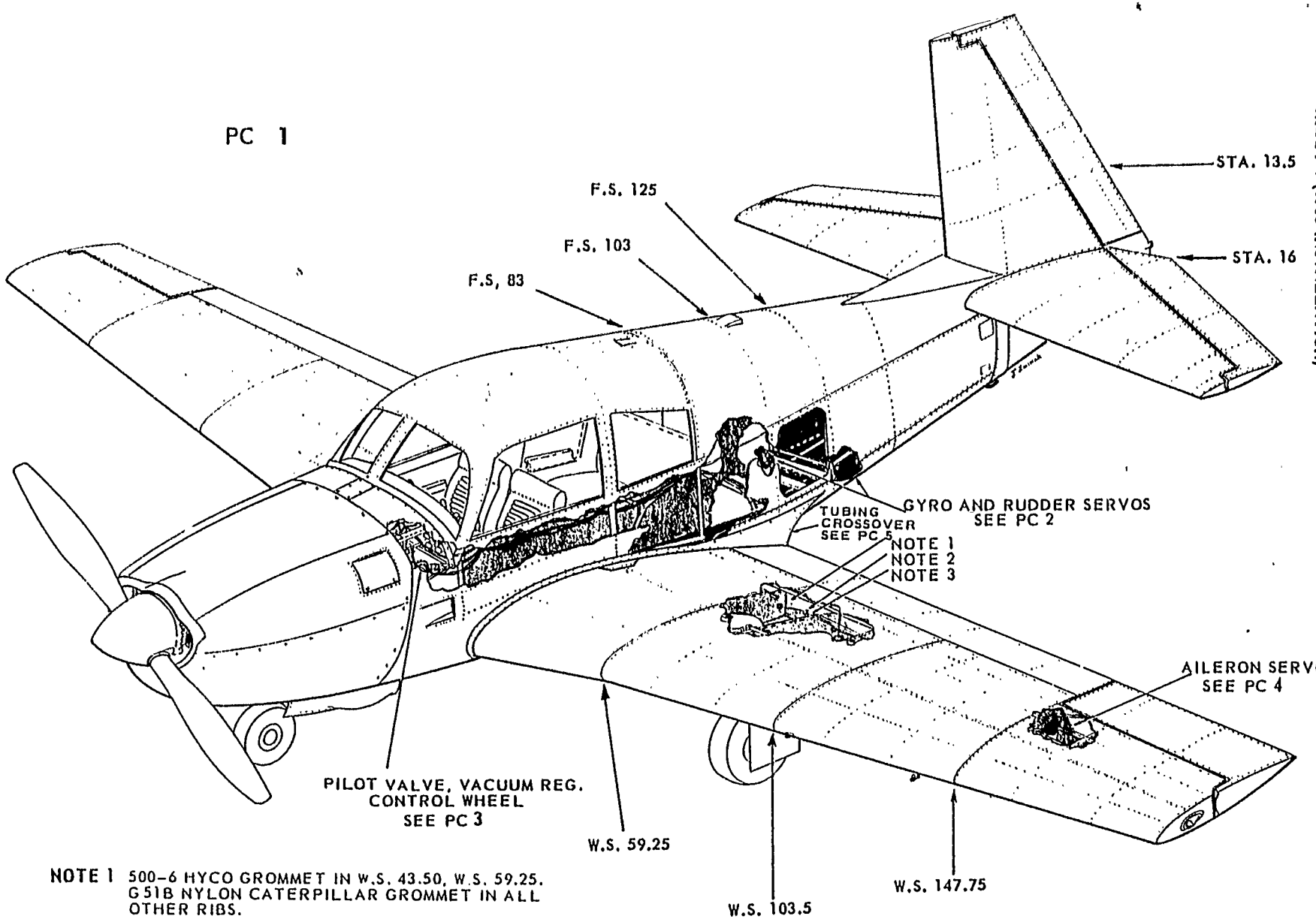


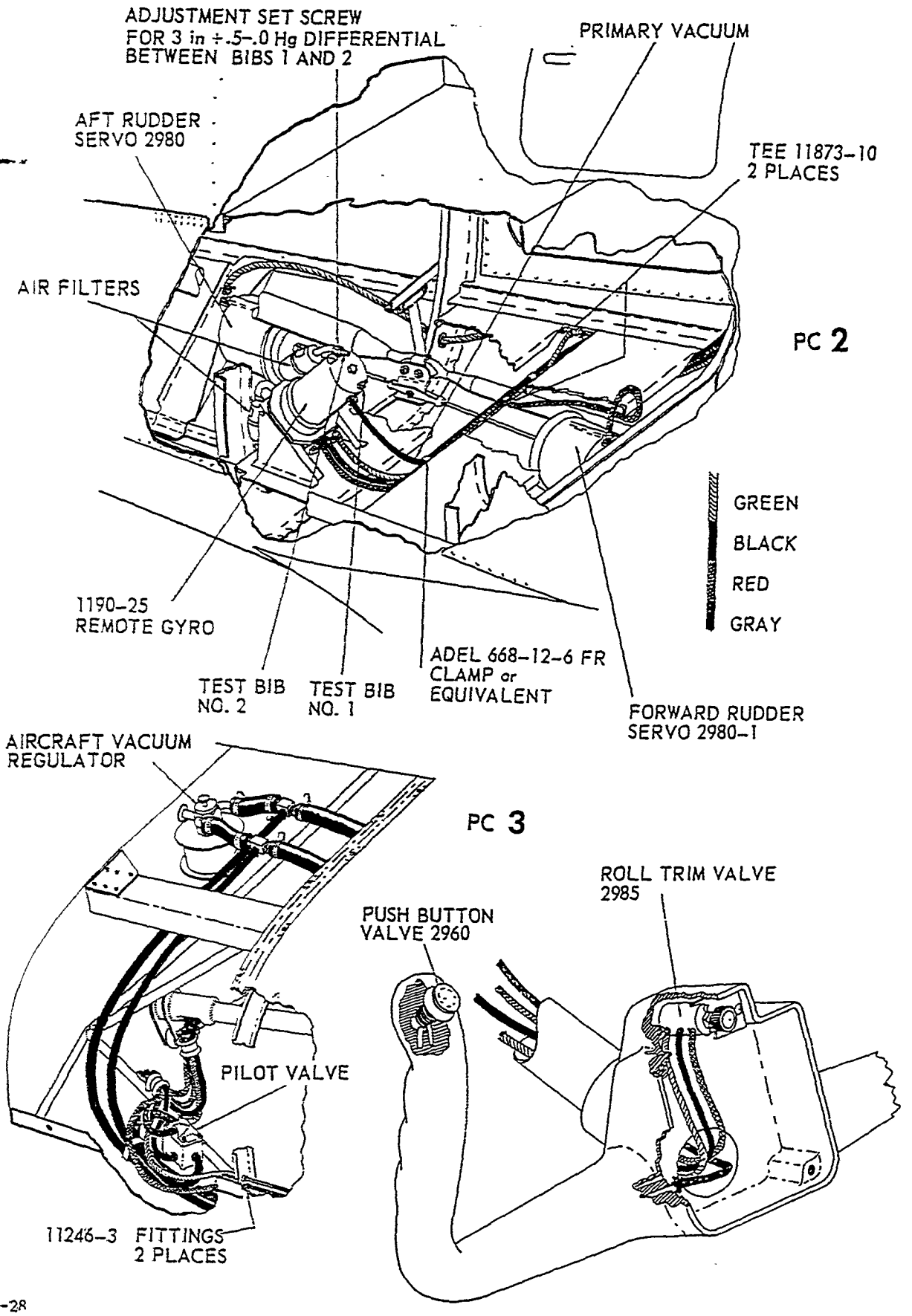
FIGURE 6-17 – POSITIVE CONTROL SYSTEM
SHEET 1 (1965 INSTALLATION)

NOTE 1 500-6 HYCO GROMMET IN W.S. 43.50, W.S. 59.25. G 51B NYLON CATERPILLAR GROMMET IN ALL OTHER RIBS.

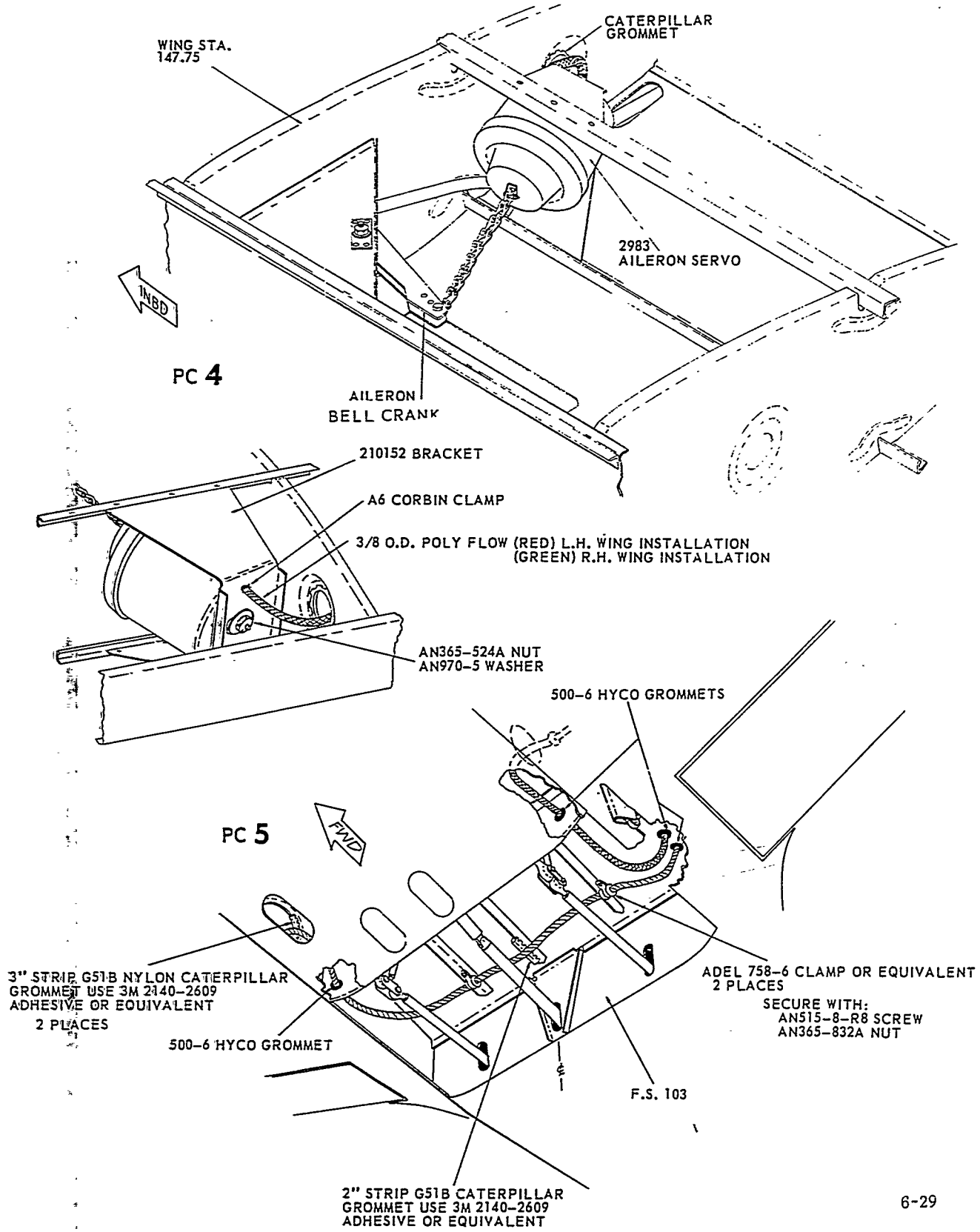
NOTE 2 AN742-60 CLIP, AN516-8-R7 OR EQUIVALENTS.

NOTE 3 3, 8" I.D. 7" LG SCUFF COVERING FLEXCO 4199 OR EQUIVALENT.

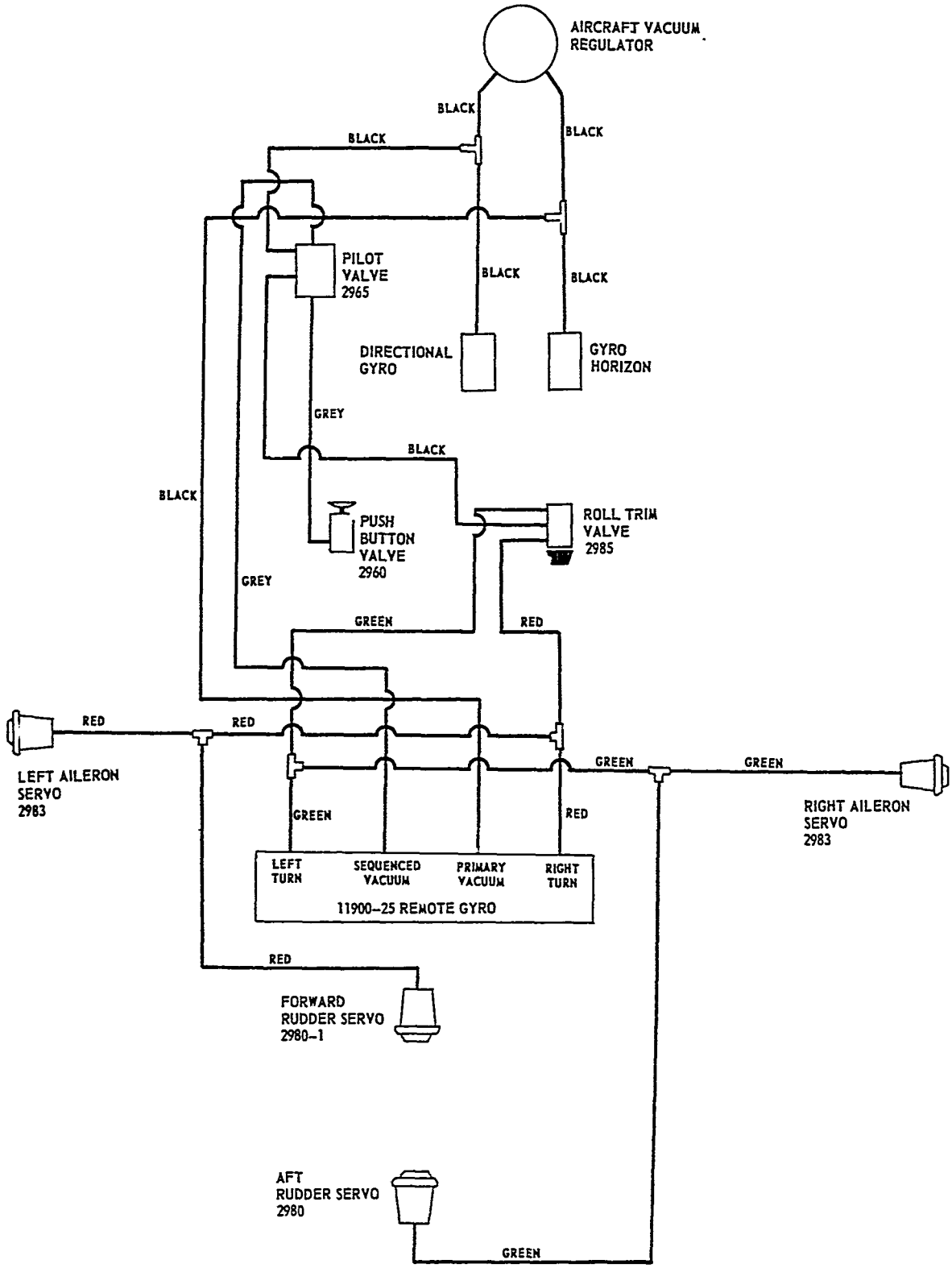
SHEET 2
(1965) INSTALLATION



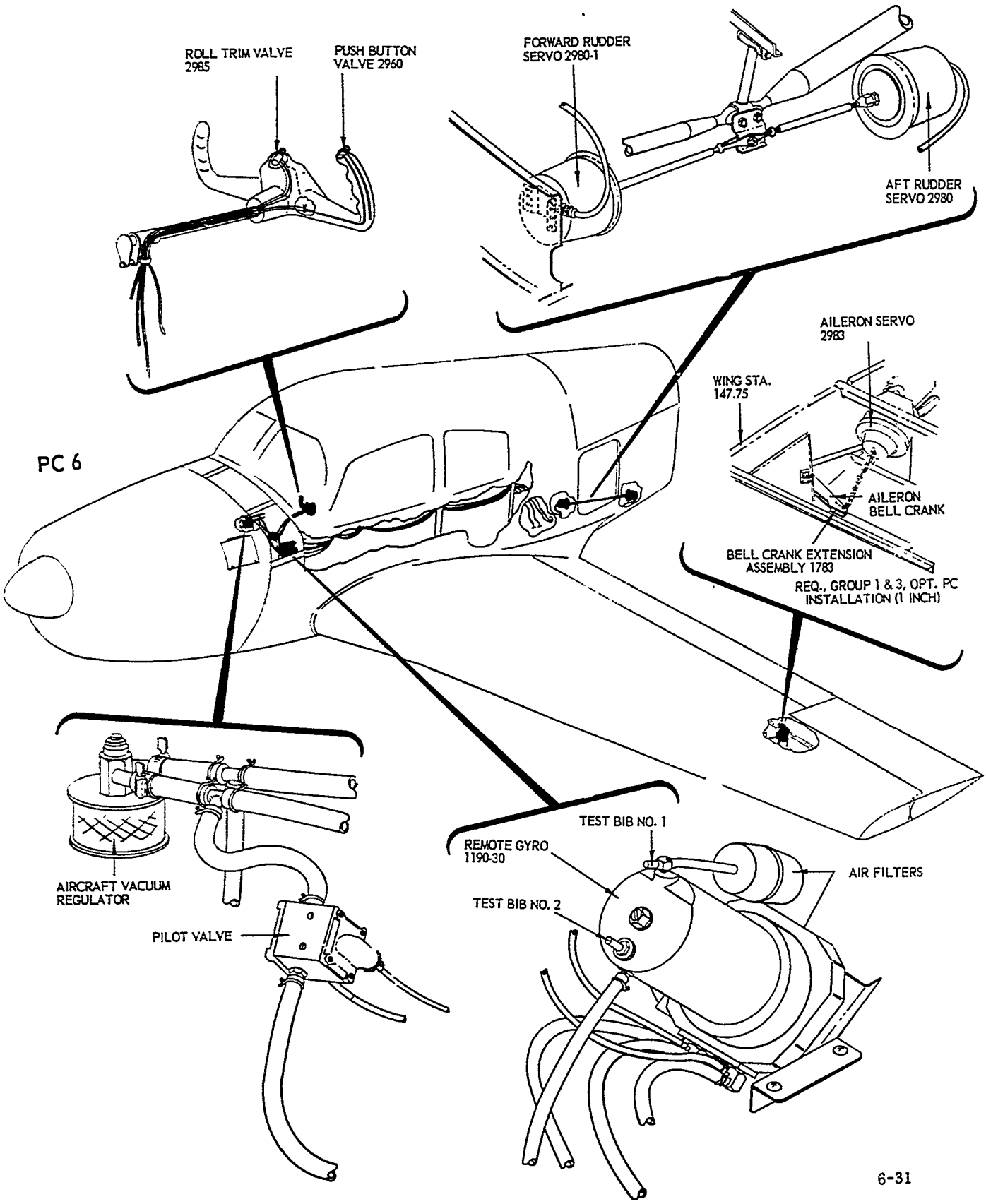
SHEET 3


WING STA.
147.75
CATERPILLAR
GROMMET
2983
AILERON SERVO
INBD
PC 4
AILERON
BELL CRANK
210152 BRACKET
A6 CORBIN CLAMP
3/8 O.D. POLY FLOW (RED) L.H. WING INSTALLATION
(GREEN) R.H. WING INSTALLATION
AN365-524A NUT
AN970-5 WASHER
500-6 HYCO GROMMETS
PC 5
FWD
3" STRIP G51B NYLON CATERPILLAR
GROMMET USE 3M 2140-2609
ADHESIVE OR EQUIVALENT
2 PLACES
500-6 HYCO GROMMET
ADEL 758-6 CLAMP OR EQUIVALENT
2 PLACES
SECURE WITH:
AN515-8-R8 SCREW
AN365-832A NUT
F.S. 103
2" STRIP G51B CATERPILLAR
GROMMET USE 3M 2140-2609
ADHESIVE OR EQUIVALENT

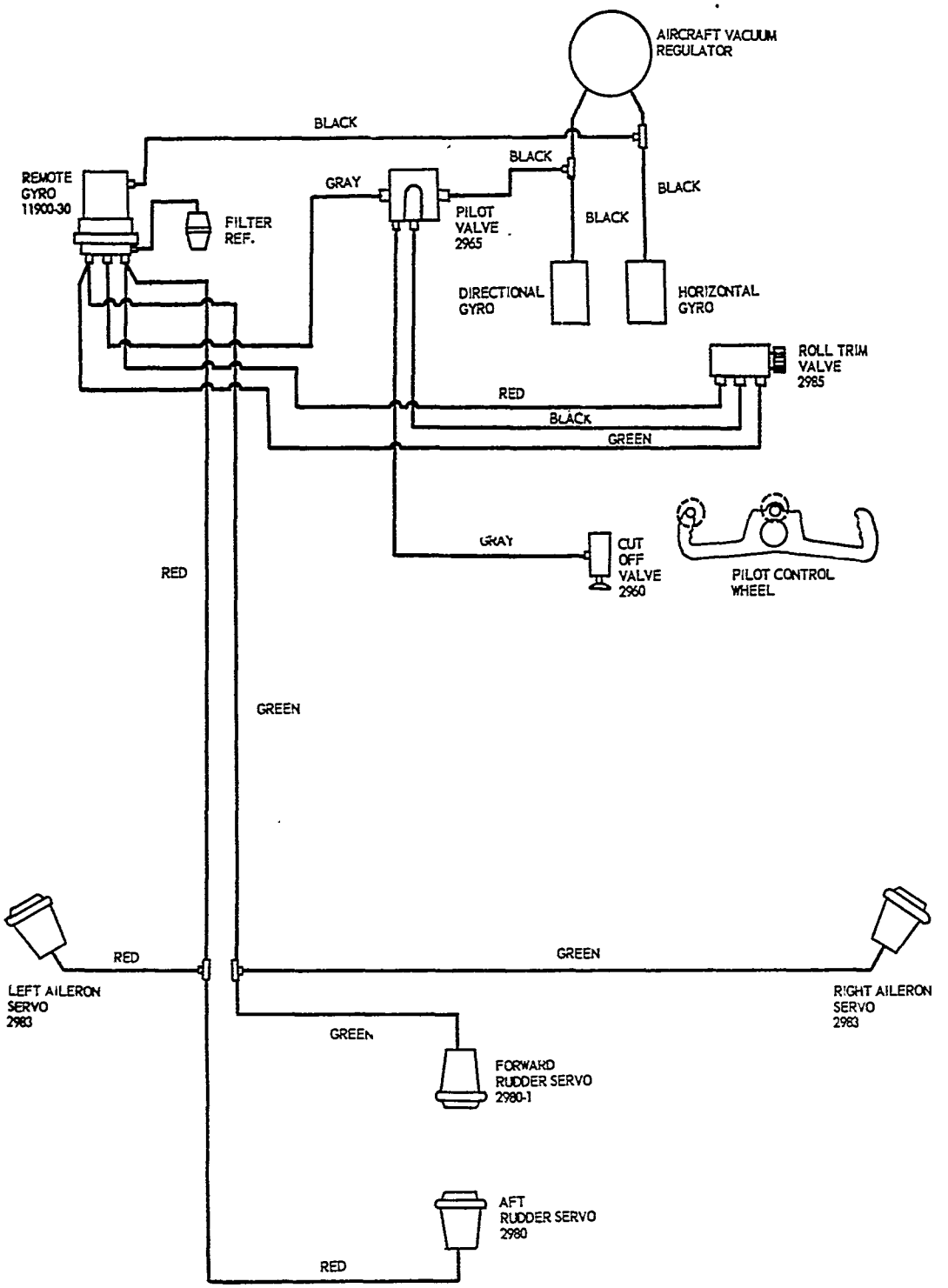
SHEET 4
(1965 PC SCHEMATIC)



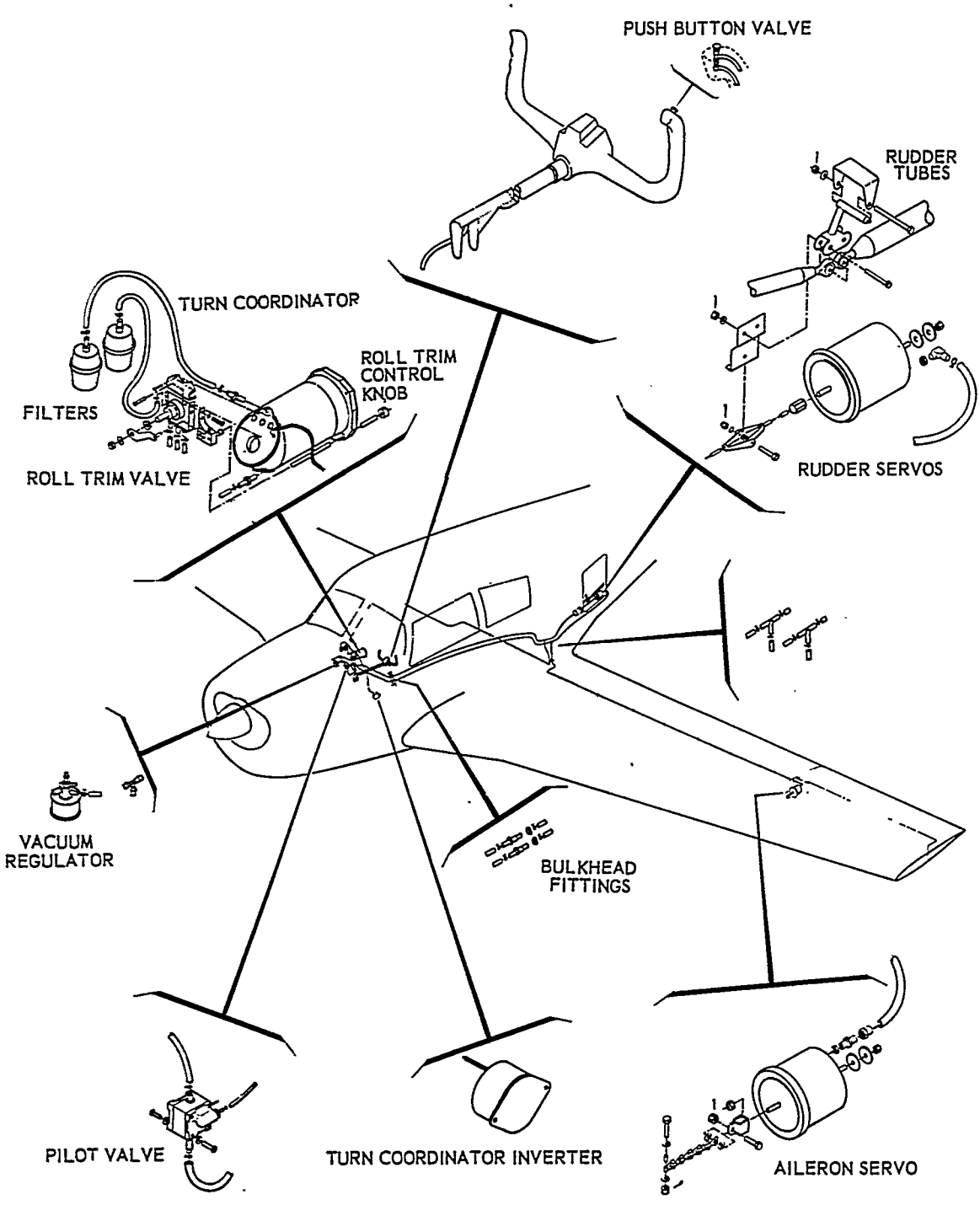
SHEET 5
(1966 INSTALLATION)



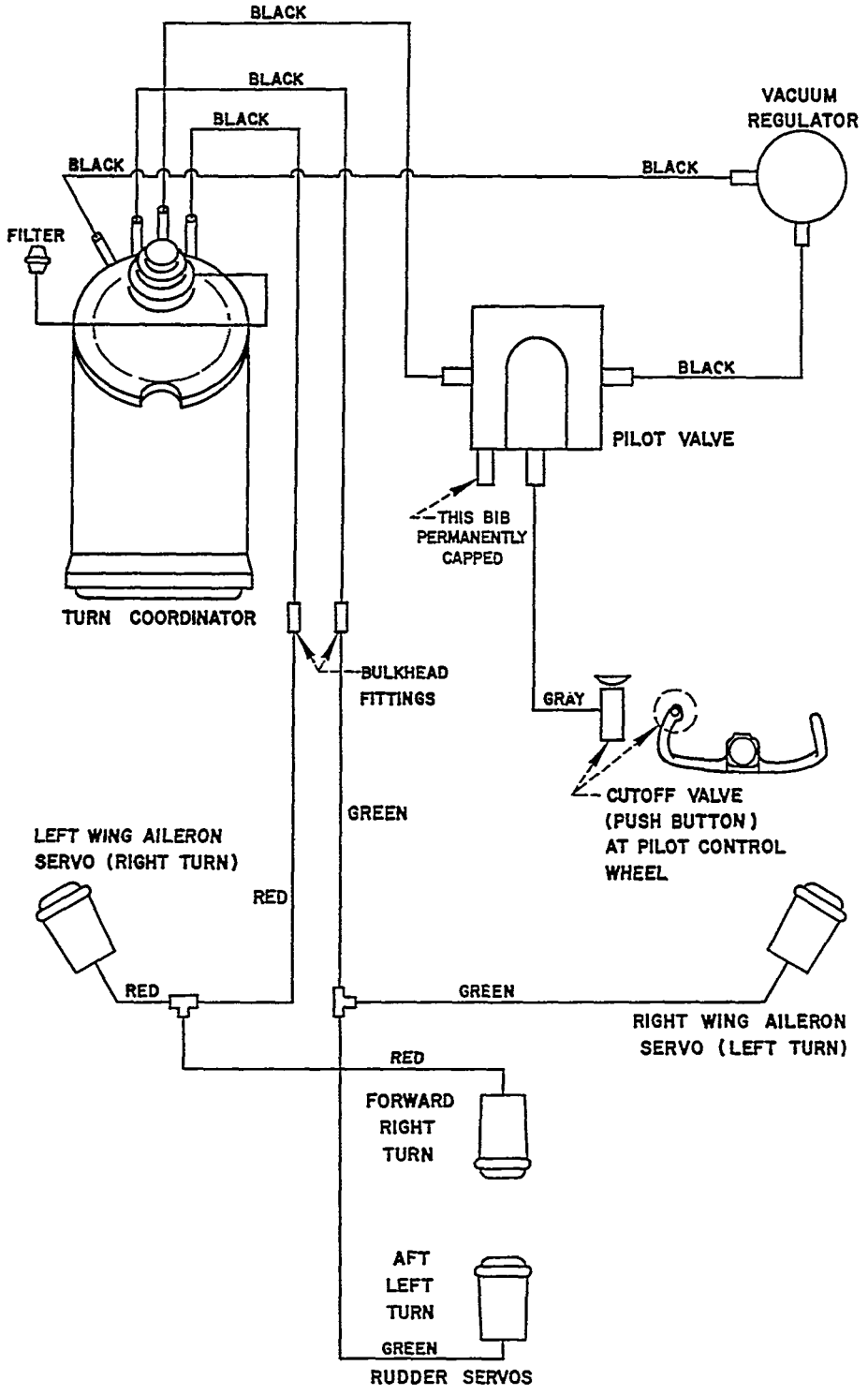
SHEET 6
(1966 SCHEMATIC)



SHEET 7
(1967 & ON INSTALLATION)



SHEET 8
(1967 & ON SCHEMATIC)



REVISED NOVEMBER 1966

SECTION

7

FUEL SYSTEM

SECTION VII
FUEL SYSTEM

A. GENERAL

The fuel system consists of integral sealed fuel cells located in the front portion of each wing. These cells feed to a selector valve which includes a strainer and sump drain. From the selector, fuel is fed to the electric boost pump, engine-driven pump, and then to the carburetor or fuel injector.

B. TROUBLE SHOOTING

Troubles peculiar to the fuel system are listed in Table 3 along with their probable causes and suggested remedies. When trouble shooting, check from the power supply to the items affected. If no trouble is found by this method, the trouble probably exists inside individual pieces of equipment; which may be removed from the aircraft and an identical unit, tested and known to be in good condition, should be installed in place.

TABLE 3 – FUEL SYSTEM TROUBLE SHOOTING

TROUBLE	CAUSE	REMEDY
Fuel gage not indicating.	Broken wire	Check and repair.
	Transmitting unit faulty	Replace.
	Float hung in fuel cell	Check and repair.
	Circuit breaker out	Check and reset.
Fuel gage indicates full when tanks are not full.	Incomplete ground	Check ground connections at fuel transmitter in tank.
No fuel pressure indication.	No fuel in tanks	Check and fill tanks.
	Defective fuel pump	Check pump for proper fuel pressure buildup. Check for obstruction in electric fuel pump screen. Check engine fuel pump diaphragm and check-valve.
Pressure low or pressure surge.	Obstruction in inlet side of pump	Check fuel lines and remove obstructions.
	Faulty diaphragm in engine pump	Replace pump. Check fuel lines and repair or tighten.

C. REMOVAL AND INSTALLATION OF FUEL PUMPS

1. Electric Fuel Pump Removal (1964 & ON).

   a. Remove the electrical lead at the knife disconnect.
   b. Disconnect ground wire.
   c. Disconnect outlet hose and drain line.
   d. Remove left exhaust cavity panel (310010).
   e. Disconnect pump inlet line (from inside).
   f. Remove jam nut and washer from pump inlet fitting.
   g. Remove clamp and lift pump off attach bracket.

2. Electric Fuel Pump Removal (1962-1963 M20C; 1963 M20D).

   a. Remove the electrical lead at the knife disconnect.
   b. Disconnect the inlet and outlet fuel lines.
   c. Remove two fuel pump mounting bolts and carefully remove pump.
   d. Hold the pump manually and turn the cover in a counterclockwise direction and remove core.
   e. Carefully remove the screen and rinse it in gasoline or kerosene to thoroughly clean it. If screen is badly distorted or collapsed, replace it.
   f. Clean fuel pump cover in the same manner as in Step "e".

3. Installation of Electric Fuel Pumps.

   Reverse procedure above.

4. Engine-driven Fuel Pump.

   Refer to the appropriate Lycoming overhaul manual for instructions in removal and assembly of the engine-driven fuel pump.

D. REMOVAL AND INSTALLATION OF FUEL SELECTOR VALVE

1. Removal (1964 & ON).

   a. Remove fuel selector valve handle.
   b. Unscrew quick drain pull ring.
   c. Disconnect right and left fuel inlet lines at valve body.
   d. Remove fuel outlet line at body.
   e. Remove four screws holding fuel valve assembly to mounting plate (610038). Fuel valve assembly can now be removed.
   f. See Figure 2-4 for illustration of fuel selector valve assembly.

2. Removal (1962-1963 M20C; 1963 M20D).

   a. Remove fuel selector valve handle and pointer.
      NOTE: Use caution when removing pointer plate as this plate releases the tension of the detent pin and spring.
   b. Remove detent mechanism (610021) carefully.
   c. Remove right and left fuel inlet lines at valve body.

d. Remove fuel outlet line at valve body.

e. Remove four screws holding fuel valve assembly to mounting plate. Fuel valve assembly can now be removed.

3. Installation.

Reverse the procedure above.

E. FIELD REPAIR OF FUEL TANKS

1. General.

This instruction establishes the procedure to be used in repairing the integral fuel tank. Tank repairs should not be attempted until these instructions are read.

2. Approved Materials.

a. Sealants: (NOTE: Sealant must meet U.S. Government specifications as indicated.)

PR1422-A1/2, A2 or CS3204-A 1/2, A2 (MIL-S-8802, Class A)	Brush coat sealant.
PR1422-B 1/2, B2 or CS3204-B 1/2, B2 (MIL-S-8802, Class B)	Filleting compound & wing-wall panel sealant.
PR1403-G-B2	Sealant-removable access panel.

b. PR1005-L (MIL-S-4383B) — Protecting-coat sealant.

c. Gloves-Polyethylene

d. Turco 657 Wipe Solvent

e. Cheese cloth

f. Turco Leak Detector

g. Methyl Ethyl Keyton (thinner for PR 1005-L)

All of the above materials may be obtained from your local Mooney distributor or dealer. Sealants may be obtained from either the Products Research Co., (PRXXX) at the following address: 5454 San Fernando Road, Glendale, California, 91209; or Chem Seal Co., (CSXXXX) at the following address: 11120 Sherman Way, Sun Valley, California, 91352.

3. Handling and Mixing Sealant.

   a. Sealant Material Characteristics:

      1. Application life is the time that the mixed compound remains suitable for application. Application life is always based on standard conditions of 75°F and 50% relative humidity. For every 10°F rise in temperature, application life is reduced by half, and for every 10°F drop in temperature, application life is doubled. High humidity at the time of mixing shortens the application life.

      2. Maximum unopened container storage life is six (6) months at 85°F.

TABLE 4 - TANK SEALANT APPLICATION LIFE AND CURING TIME

AT 75°F AND 50 PERCENT RELATIVE HUMIDITY: PR 1221 SEALANT			
Class A	Tack-free Time (in hours)	Curing Rate (in hours)	Application Life (in hours)
PR1422-A 1/2	10	30	1/2
PR1422-A2	36	72	2
CS3204-A 1/2	8	30	1/2
CS3204-A2	24	72	2
Class B			
PR1422-B 1/2	10	45	1/2
PR1422-B2	36	72	2
CS3204-B 1/2	8	30	1/2
CS3204-B2	24	72	2
PR1403-G-B2 ACCESS DOOR SEALANT			
Class B			
B-2	10	36	2

   b. Mixing of Sealants

      1. Hand mixing.

      2. Kits consisting of the proper proportions of base compound and accelerator should be used.

      3. Slowly stir, to avoid excessive air entrapment, the accelerator into the base compound and thoroughly mix approximately seven to ten minutes. Be sure to scrape the sides and bottom of the container in order to include all compound in the mixture and to insure uniform blending. Scrape mixing paddle periodically to remove unmixed compound.

4. Take a small amount of sealant from the mixture with a clean alumnium strip and spread the sealant, then visually examine the film of sealant to ascertain if the accelerator is visible in particle form. If particles of accelerator are visible, continue the mixing operation. If coarse particles of accelerator persist after mixing, the mixed batch and remaining accelerator will be rejected.

5. Put a small amount of sealant in the accelerator container and mix to assure that all of the accelerator is mixed into the sealant.

4. Sealant application Instructions.

The following instructions are for the reapplication of sealant removed in order to repair tank leaks.

a. Brush Sealant

1. Apply a brush coat of sealant compound PR1422-A 1/2, A2 or CS3204-A 1/2, A2 over seams, rivets, nuts, and bolts if removed for repair.

2. A one-inch stiff paint brush is recommended for this operation. Brush strokes should be parallel to seams forcing the sealant into all gaps. Use a circular brush action to deposit an even coat of sealant around rivets, nuts, and bolts. Coat should be approximately 1/32 of an inch thick.

3. Considerable brush action should be used to force sealant into all small crevices to obtain good adhesion. Air pockets trapped under the sealant due to improper application will open up in the form of a hole or void soon after it has been applied. Repair should be made by pressing the sealant in place with a spatula while it is still in the application life state.

4. In cases where the top of a flange is .040 inches or less and where application of a successful fillet would not be clearly defined, apply two brush coats of sealant compound in approximately 1/32 inch thick coats. Allow first coat to cure approximately four hours or until it becomes rubbery before application of the second coat. The second coat should extend 1/4 of an inch past the previous coat.

b. Fillet Sealing

1. General Requirements.

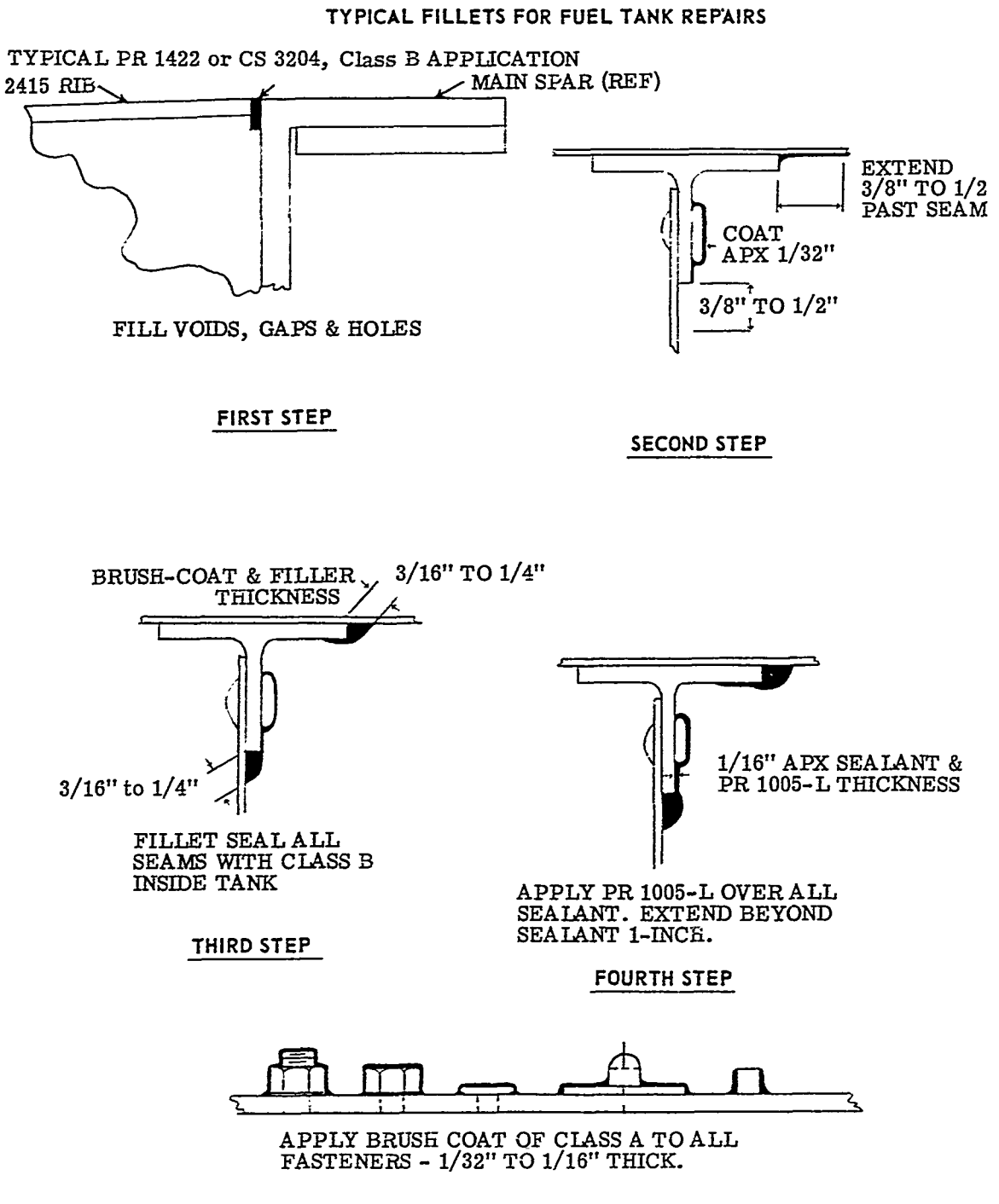
a. Filleting sealant (PR1422-B 1/2, B2 or CS3204-B 1/2, B2) must be tack free.

b. See Figure 7-5 for typical fillet size.

c. Filleting sealants laid on intersecting joints shall be joined together to produce a continuous fillet.

d. All difficult and hard to reach areas should be sealed first, to prevent the possibility of their being overlooked or incorrectly sealed.

FIGURE 7-1 – TANK SEALANT APPLICATION DIAGRAM



2. Application of Fillets.

   a. Use a spatula or extrusion gun with 1/8 inch to 1/4 inch nozzle openings for applying filleting compound on the edges of all seams.

   b. If an extrusion gun is used, hold gun perpendicular to seam when applying filleting compound so that extruded sealant will be packed tightly.

   c. Use a spatula to pack sealant firmly in place; work out air pockets and properly form each fillet.

c. Protective Coating Procedure (Brush).

   1. Brush on a smooth, continuous coat of PR 1005-L over sealant with a paint brush using short, even strokes. The film should extend one inch beyond the sealant on to the adjacent metal.

   2. Allow the top coat to cure 20 minutes at 75°F or until tack-free.

   3. Apply second brush coat of PR 1005-L.

   4. Every effort must be taken to obtain a complete bubble-free, continuous top coat. Do not try to rebrush over areas during the drying period as this will only cause dragging or will break the continuity of the coating.

d. Sealing of Removable Panels.

   1. General Requirements.

      a. Clean metal surfaces to be sealed with Turco 657 Wipe Solvent or M.E.K. Do not allow solvent to dry on surface; wipe off to prevent redeposit of contaminants.

      b. Cleaned surfaces need dry only 5 to 10 minutes before application of sealant. Sealant should be applied as soon as possible after cleaning.

      c. Parts should not be stored or handled in any manner which will allow fingerprints, dust, dirt, and other foreign substances to contaminate the surfaces to be sealed after the cleaning operation.

   2. Sealing Procedure (for upper right wing-walk access panel).

      a. Apply a coat of access door sealant PR1422-B 1/2 or CS3204-B 1/2, B2 to either faying surface using a short,stiff bristle brush, spatula or filleting gun. If the gun is used for application, the sealant must be smoothed with a brush or spatula.

      b. Cover the entire faying surface with a sealant coat of sufficient thickness (1/32 to 1/16 inch) to assure extrusion along the edges of the faying surface when the mating parts are assembled.

      c. Assemble parts immediately after application of sealant, tighten screws to obtain, as near as possible, a metal-to-metal contact.

      d. After fastener installation, remove the extruded sealant from the wing surface.

3. Sealing Procedure (for wing tank access panels other than wing-walk panels).

   a. Apply a coat of PR1403-G-B2 to either faying surface using a stiff, short bristle brush, a spatula, or filleting gun. If a gun is used for application, the sealant must be smoothed with a brush or spatula.

   b. Cover the entire faying surface with a sealant coat of sufficient thickness (1/32 to 1/16 inch) to assure extrusion along the edges of the faying surface when the mating parts are assembled.

   c. Assemble parts immediately after application of sealant; tighten screws to obtain as near as possible a metal-to-metal contact.

   d. After fastener installation, remove the extruded sealant from the wing surface.

5. Description of Leaks.

It is important to make careful periodic fuel tank inspections. These inspections are particularly important in confined areas of the airplane which are not exposed to air stream in flight. Classification of fuel leaks, which occur in both confined areas and open areas, is necessary to differentiate between those leaks which require repair before flight and those which do not constitute a flight hazard. The wetted area around a leak is an indication of the intensity of the leak. All leaks should be marked and the location and intensity of the leak should be recorded.

   a. Classification of Leaks as to Intensity and to Location.

      1. Classification as to intensity (See Figure 7-2).

         a. Stain is a slow fuel seepage which tends to dry as it is exposed to the air.

         b. Seep: A seep is a fuel leak which reappears in a short period of time after being wiped clean.

         c. Heavy seep: A fuel leak which appears immediately after being wiped clean.

         d. Running leak: A leak which flows steadily.

      2. Classification as to Location.

         a. Slow to heavy seeps occurring in open areas, such as the surfaces of the wing or wheel well which are exposed to the air stream in flight, are leaks which do not constitute a flight hazard. Such leaks need not be repaired before flight, providing the condition causing the leak cannot result in a leak of greater intensity after a flight is in progress. Seeps considered permissible for flight should be inspected frequently to see that an increase in tensity has not occurred.

         b. Leaks which constitute a flight hazard.

            1. A running leak and any leak in a confined area not exposed to the air stream should be repaired before the next flight. (See Figure 7-3.)

6. Leak Detection.

   a. External Leak Detection After Fueling.

      1. To be able to trace the leak from where it appears on the outer boundary to its true source inside the tank, the exact point where the fuel is escaping from the tank must be determined. Locating this point will help determine from which fitting or seam the leak originates.

      2. By using an air gun to blow and evaporate fuel from the seams and crevices of the leak area, the exact point where the fuel is escaping from the tank may be more clearly defined.

FIGURE 7-2 – FUEL LEAK CLASSIFICATION DIAGRAM

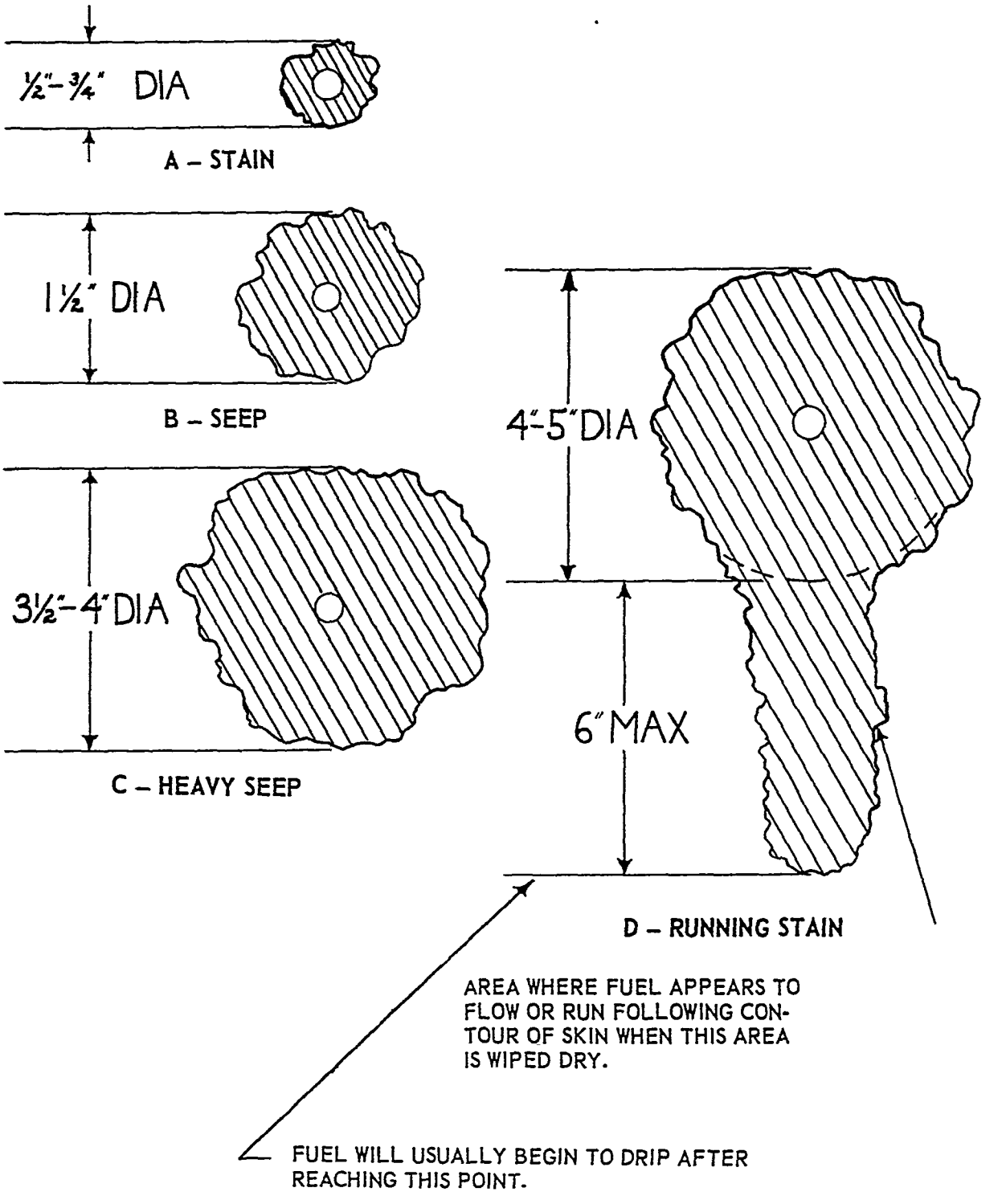
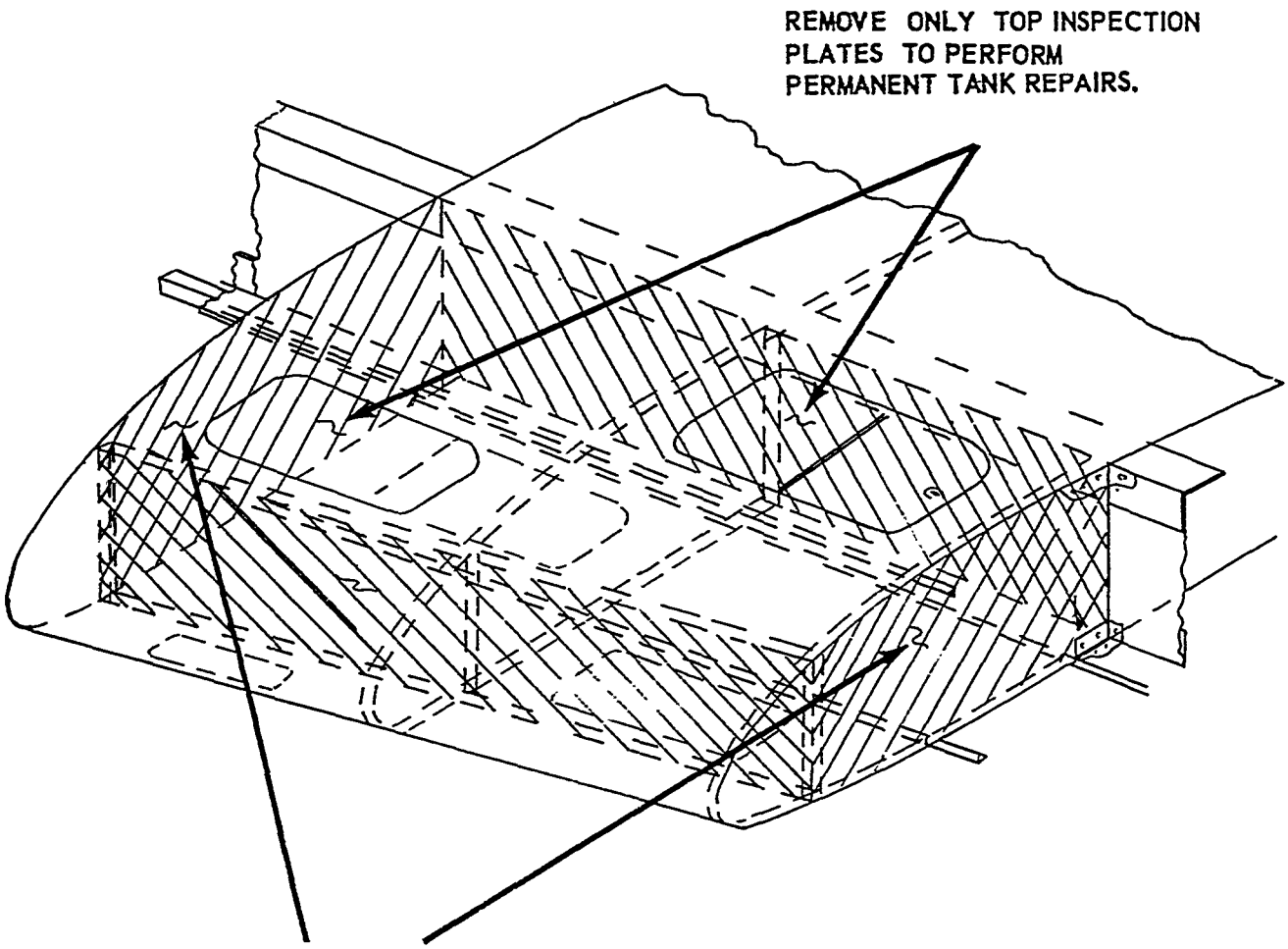


FIGURE 7-3 – TANK AREAS WHERE FUEL LEAK



3. Small seep leaks can be traced with the raw edge of torn paper. The fuzzy edge of torn paper adsorbs fluid and gives a good visual indication of the presence of any fuel when brought in contact with suspected leak points.

4. After the leak has been traced to its exterior source and marked, drain fuel from tanks.

b. Internal Leak Detection.

1. It is very important that the true source of the interior leak be found in order to make a permanent repair. The fuel tank is a network of seams, and fuel may flow through or along a seam, or from one seam to another and may channel a few inches or several feet to the point where it appears on the external boundary of the tank.

2. Enter the tank through the top inspection plates only (see Figure 7-3) and inspect the sealant in the general area of the outside leak point. Look first for bare seams, rivets, and bolts in difficult-to-seal areas. Inspect sealant for blisters, pin holes, cracks, splits, and loss of adhesion. Mark all flaws with masking tape.

3. Test each flaw inside the tank with 20 to 30 PSI air (filtered) line pressure by holding the air nozzle against the flaw and check the outside leak point closely for signs of fuel.

4. After testing all flaws in this manner, and if no leak source has been discovered, apply bubble fluid to outside of tank and again apply air pressure to flaws inside of tank.

5. See Figure 7-4 for suggested method of leak detection when a leak is suspected around a rivet or when the above methods have been unsuccessful.

7. Leak Repair Procedure.

a. Temporary Repair of Fastener Leaks.

1. Generally all leaks located in enclosed areas and running leaks in open areas constitute a flight hazard. Fastener leaks in these categories may be repaired temporarily by the application of a sealant fillet over the fastener head on the fuel tank exterior.

2. In order for satisfactory temporary repair of a leak to be made at a fastener, structural integrity must exist in the area of the leak.

3. Temporary repair procedure for fastener leaks.

a. Remove sufficient fuel to drop the fuel level below the leak.

b. Clean the head of the fastener and the adjacent surface with Turco 657 Wipe Solvent, or equivalent, and dry throughly. Fastener head and adjacent metal must be free from paint, dirt, and oil.

c. Apply 1/8 inch thick coat of PR 1422-B 1/2, B2 or CS3204-B 1/2, B2 over the head and around the fastener.

d. Cure the sealant until firm and rubbery.

e. Refill the tanks and carefully examine the repair periodically. If leak reoccurs, remove the sealant and either make a new temporary repair or make a permanent repair.

b. Permanent Leak Repair.

1. If the leak source is determined to be around a rivet or threaded fastener, the repair procedure shall be to restrike the rivet or retorque the fastener to the maximum torque valve permitted. Any rivet can be restuck only once. If the leak continues, the rivet must be replaced. Repair any sealant damage due to the restriking or retorquing operation.

2. Remove sealant in immediate area of leak source using a sharp non-metalic tool; a chisel-shaped formica tool is suggested. Bevel or slope end ends of existing sealant so that the new sealant can form a continuous and smooth tie-in.

3. Thoroughly clean repair area using a metal cleaning solvent to allow good adhesion. Wash one small area at a time. Then dry with a clean cloth before the solvent evaporates to prevent redisposition of oil and dirt on the surface. Always pour the solvent on the washing cloth to prevent contamination of the solvent supply.

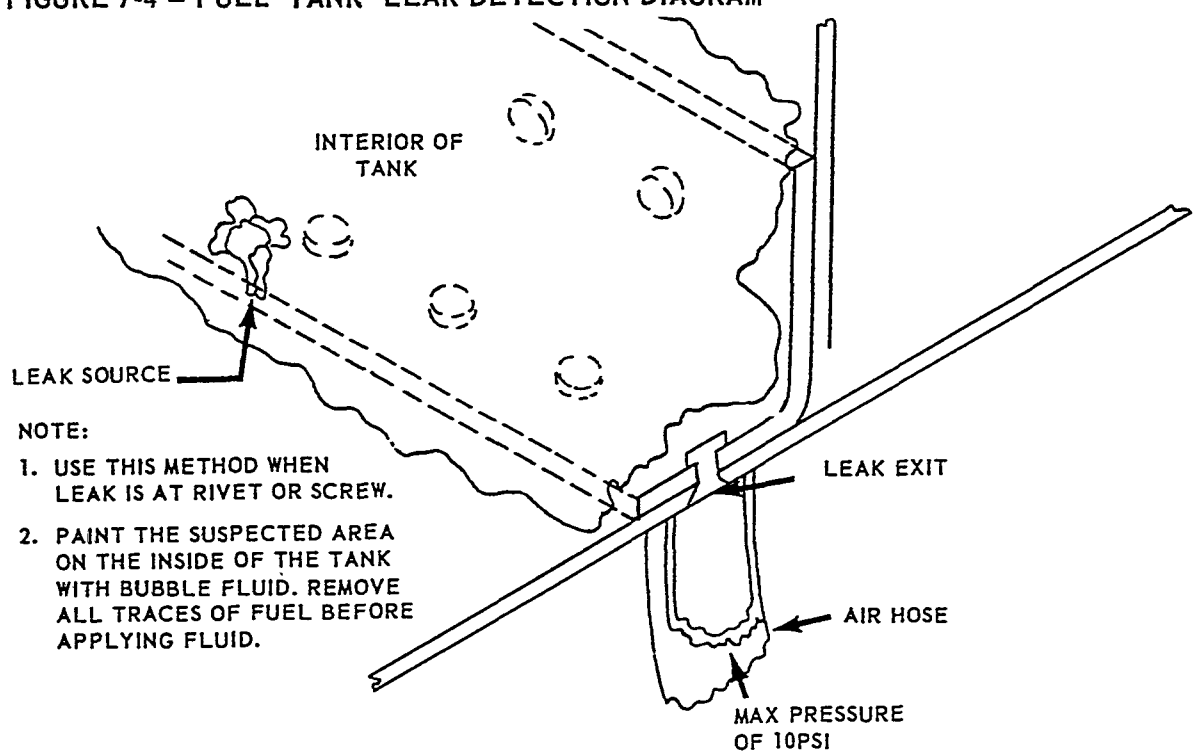
4. Cleaned area must be thoroughly dried by blowing filtered air over the immediate area until there is no possibility of solvent or fuel entrapment under adjacent sealant.

5. Apply sealant as required for repair (See Figure 7-1). Repaired fillets must be blended into existing fillets and worked with a filleting tool as required.

6. Allow all repaired sealant to cure to a tack-free condition, and apply two brush coats of PR 1005-L to the repaired area.

7. Recheck for leaks by applying a coating of Turco leak detector to the outside of the sealed tank with the tank cap and vent closed as the tank is pressure tested with 2 psi of filtered air for a minimum of 30 minutes. Do not exceed 2 psi pressure. Leaks will be indicated by the presence of bubbles in the Turco leak detector.

FIGURE 7-4 – FUEL TANK LEAK DETECTION DIAGRAM



SECTION

8

ELECTRICAL SYSTEM

SECTION VIII
ELECTRICAL SYSTEM

A. GENERAL

The M 20 series aircraft have a 12-volt electrical system. A 50-amp, heavy-duty generator provides adequate current so that, even when high electrical loads are placed on the system by multiple radios, a rotating beacon, and navigational lights, the heavy-duty 33- or 35-amp battery will remain at full charge. The 1962 M20C is equipped with a 33-amp battery.

The battery on the M20C and D is located at the forward left-hand side of the firewall. The circuit breakers, designed to relieve the electrical system of any over-loads, are located on the lower right-hand side of the co-pilot's instrument panel. The battery on the M20E & F is located aft of the baggage compartment and is accessible through the radio access door.

The master switch for the electrical system is located at the top left-hand side of the instrument panel.

B. TROUBLE SHOOTING

Malfunctions peculiar to the electrical system are listed in Table 6 along with their causes and suggested remedies. When trouble shooting, check from the power supply to the item affected. If no trouble is found by this method, the trouble probably exists inside an individual piece of equipment which may then be removed from the airplane and an identical unit or units, tested and known to be good. installed in its place.

1. Electrical Switches and Circuit Breakers.

Electrical switches and circuit breakers, located in the lower left and lower right instrument panels, control the navigation and instrument lights, landing light, electric turn-and-bank indicator, electric fuel pump, and other electrical components. The circuit breakers automatically break the electrical circuit if an overload is applied to the system, thus preventing damage to the electrical wiring. To reset the circuit breakers, simply push in the buttons. Allow sufficient time for cooling before resetting circuit breakers. When a circuit breaker has tripped a second successive time, the cause of the overload should be determined prior to attempting to reset the circuit breaker.

2. Battery.

The battery should be maintained in a fully charged condition at all times, and the water level should be checked at regular intervals; never add anything but distilled water. Do not overfill as the electrolite will overflow and corrode the belly of the airplane. A hydrometer check should be performed periodically to determine the percent of charge present in the battery (Refer to Table 5.). A fully charged battery will not freeze. All connections must be kept clean and tight. If the battery is not up to normal charge, recharge, starting with a rate of four amperes and finishing with two amperes. When cleaning the battery care must be exercised to avoid contamination of the electrolyte.

NOTE: Quick charges are not recommended.

3. Battery Charging System.

The charging rate of the battery depends upon the condition of the battery and the voltage regulator setting. With all loads off and the engine running at 2000 rpm or higher, the normal battery charging rate will be 5 to 35 amperes.

If the charging current is considered excessive, check the following:

a. Charging rate should slowly drop to 10 amperes or less after 15 to 20 minutes of flight.

NOTE: A very low battery will take longer to show a drop in charging current.

b. Too high a voltage regulator setting will cause excessive heating and loss of water.

NOTE: Measure the voltage with a voltmeter at "Batt" terminal of the voltage regulator. At 80° F., the voltage should be 13.8 to 14.8. This voltage will be higher if the temperature is less than 80° F, and lower if the temperature is higher than 80° F.

If charging rate is low, check the following:

a. The charging rate of a fully charged battery is normally from 1 to 4 amperes.

b. The regulator should not be considered defective because of a low charging rate until:

1. A voltmeter check indicates that the voltage at the "Batt" terminal is below requirements given in NOTE above.

2. A hydrometer check of the battery indicates that the battery is not fully charged. Refer to Table 5 for hydrometer reading vs. battery charge percent.

4. Voltage Regulator.

See Figure 8-1 for voltage and gap settings.

SHOP NOTES

TABLE 5 – HYDROMETER READING VS. BATTERY CHARGE PERCENT

Hydrometer Reading **	Percent of Charge
1280	100
1250	75
1220	50
1190	25
1160	Very little useful capacity
1130 or below	Discharged

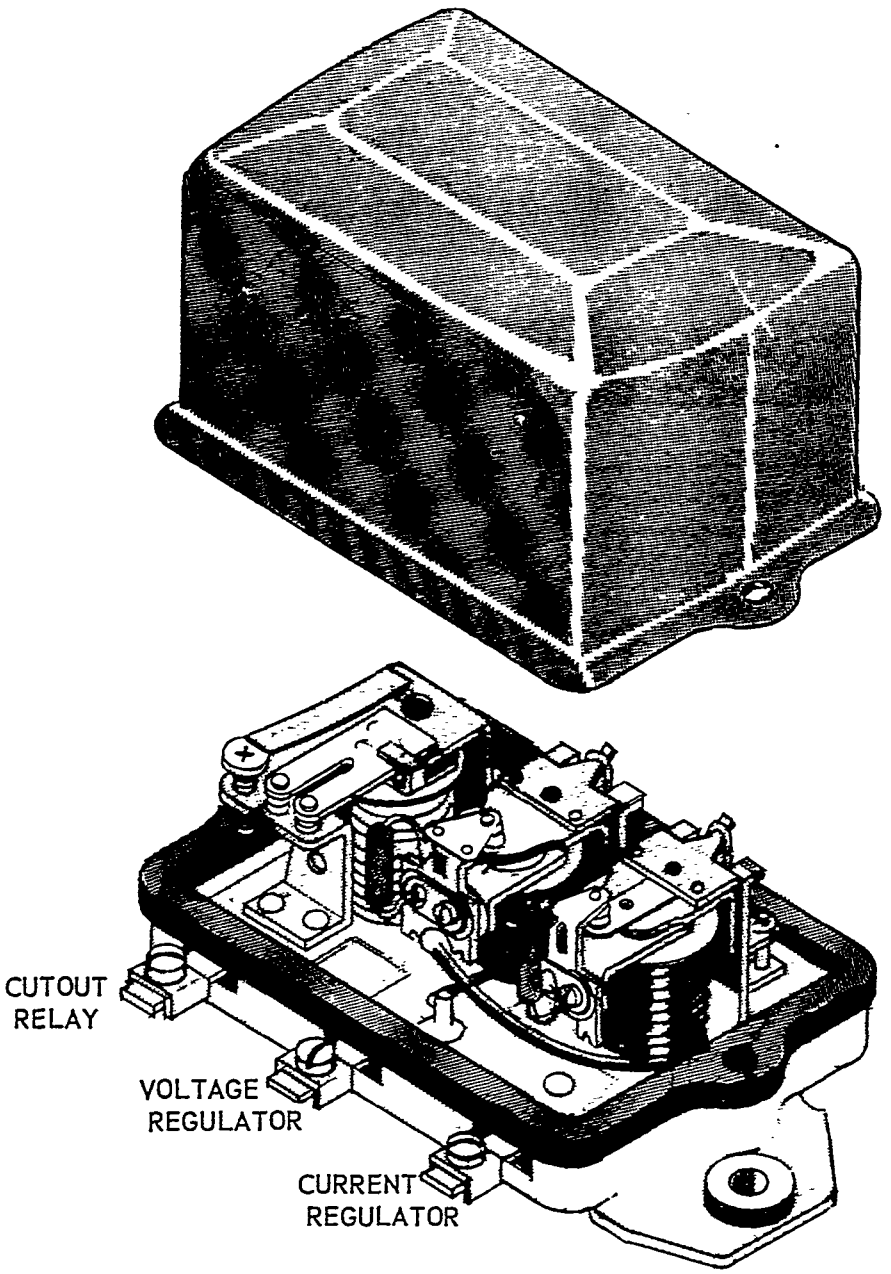
** Based on battery electrolyte temperature of 80° F.

If battery electrolyte temperature is below 80 ° F, subtract 4 points from the hydrometer reading for every 10 ° F below 80 ° F. If the battery acid temperature is above 80° F, add 4 points to the hydrometer reading for every 10° F above 80 ° F ;

Example: Hydrometer reading (1260)
Battery electrolyte temperature (30° F)
Subtract 30° from 80° = 50° (5 x 4 = 20)
Correct reading (1260 – 20 = 1240)

SHOP NOTES

FIGURE 8-1 – VOLTAGE REGULATOR SETTING CHART



#1119224 DELCO REMY VOLTAGE REGULATOR

GAP SETTINGS				
CUTOUT RELAY			VOLTAGE REGULATOR	CURRENT REGULATOR
AIR GAP	POINT OPENING	CLOSING VOLTAGE	AIR GAP	AIR GAP
.020	.020	11.8-13.5	.075	.075

TABLE 6 – ELECTRICAL SYSTEM TROUBLE SHOOTING

BATTERY		
TROUBLE	CAUSE	REMEDY
Discharged battery.	Battery worn out.	Replace battery.
"	Charging rate not set right.	Reset (Refer Lycoming Manual).
"	Discharging rate too great.	Remove load when generator is not charging and reduce use of starter, etc., on ground; use external power whenever possible.
"	Standing too long.	Remove and recharge battery.
"	Equipment left on accidentally.	Remove and recharge battery.
"	Impurities in electrolyte.	Replace battery.
"	Short circuit (ground) in wiring.	Check wiring.
"	Broken cell partitions.	Replace battery.
Battery life is short.	Insufficient electrolyte.	Maintain electrolyte level.
"	Heavy discharge.	Remove loads when generator is not charging.
"	Sulfation due to disuse.	Long slow charge for 60-100 hours at 1/2 regular charging rate.
"	Impurities in electrolyte.	Replace battery.
"	Low charging rate.	Adjust voltage regulator.
Cracked cell jars.	Hold-down bracket loose.	Replace battery and tighten.
"	Frozen battery.	Replace battery.
Compound on top of battery melts.	Charging rate too high.	Reduce charging rate by adjusting voltage regulator.
Electrolyte runs out of vent plugs.	Too much water added to battery and charging rate too high.	Drain and keep at proper level and adjust voltage regulator.
Excessive corrosion inside container.	Spillage from overfilling.	Use care in adding water.
"	Vent lines leaking or clogged.	Repair or clean.

TABLE 6 (Continued)

TROUBLE	CAUSE	REMEDY
"	Charging rate too high.	Adjust voltage regulator.
Battery freezes.	Discharged battery.	Replace battery.
"	Water added and battery not charged immediately.	Always recharge battery for 1/2 hour following addition of water in freezint weather.
Leaking battery case.	Frozen.	Replace battery.
Battery polarity reversed.	Connected backwards on airplane or charger.	Battery should be slowly discharged completely and then charged correctly and tested.
Battery consumes excessive water (in all cells).	Charging rate too high.	Correct charging rate.
Battery consumes excessive water (one cell only).	Cracked jar.	Replace battery.
	GENERATOR	
Generator operating within rated speed range but voltage output low.	If the voltage is low, generator is operating on residual magnetism.	Check for loose or high-resistance connections; clean and tighten.
"	Loose or high-resistance electrical connections.	Clean and tighten all electrical connections.
"	Brushes excessively worn.	When brush wears down to 1/2 inch, replace with new one. Caution: Do not use abrasives of any description in seating brushes.
"	Brushes binding in the brush box.	The brushes should be a free fit without excessive side play in the brush boxes. Binding brushes and brush boxes should be wiped clean with a cloth moistened in Varsol or unleaded gasoline.
"	Excessive side play of brushes in brush box.	Replace the brushes as outlined above.
"	Brushes not properly seated.	Reseat brushes as outlined above.
"	Low brush spring tension.	Brush spring should bear centrally on top of the brushes, insuring full brush contact with the face of the commutators.
"	Dirty commutator.	Clean the commutator with a cloth moistened in Varsol or unleaded gasoline.

TABLE 6 (Continued)

TROUBLE	CAUSE	REMEDY
"	Scored or pitted commutator.	Turn down commutator or replace.
"	Shorted or open armature cells.	Replace renerator or armature.
"	Improper operation of voltage regulator.	Adjust regulator or replace.
Generator operating within rated speed range but voltmeter indicates zero.	Wiring not properly connected.	See electrical system wiring diagram.
Generator operating within rated speed range, but voltage output is erratic.	Unstable operation of the voltage regulator. Same as "Generator operating within rated speed range but voltage output low", above.	Replace voltage regulator. Use remedy under "Generator operating within rated speed range but voltage output low, above.
Excessive sparking at generator brushes.	Same as "Generator operating within rated speed range but voltage output low," above.	Use remedy under "Generator operating within rated speed range but voltage output low".
Generator operating within rated speed range but system ammeter or loadmeter reads off scale.	Generator field magnetized in the wrong direction.	Flash field with a jumper wire on regulator 'between generator and battery.
System ammeter fluctuates excessively when indicating full rated load.	Generating system is overloaded.	Check the system for abnormal loads.
"	Improper operation of generator reverse-current relay.	Readjust to operate properly.
"	Loose connections.	Tighten connections.
Burned-out system ammeter or line fuse.	Discharged battery. Defective wiring.	Replace with fully charged battery. Re-Replace all defective wiring.
STARTER		
Motor fails to operate.	Low battery charge.	Check and recharge if necessary.
"	Defective or improper wiring or loose connections.	Refer to electrical wiring diagram and check all wiring.
"	Defective starter solenoid or control switch.	Replace faulty unit.

TABLE 6 (Continued)

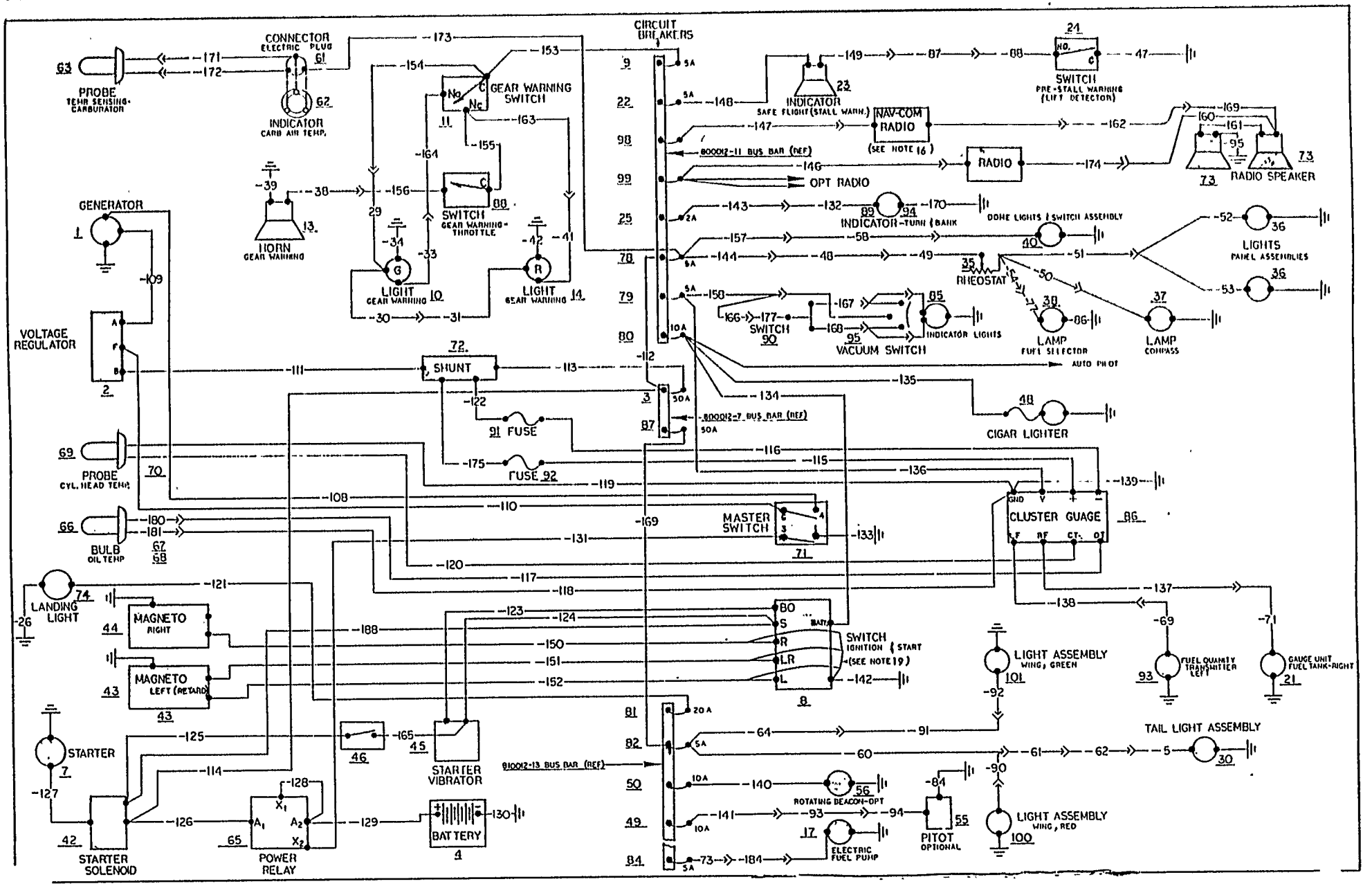
TROUBLE	CAUSE	REMEDY
"	Binding, worn, or improperly seated brush, or brushes with excessive side play.	Brushes should be a free fit in the brush boxes without excessive side play. Binding brushes and brush boxes should be wiped clean with a gasoline-moistened cloth. A new brush should be run-in until at least 50% seated; however, if facilities are not available for running-in brushes, then the brush should be properly seated by inserting a strip of No. .0000 sandpaper between the brush and commutator, with sanded side next to brush. Pull sandpaper in the direction of rotation, being careful to keep it in the same contour as the commutator. Caution: Do not use coarse sandpaper or emery cloth. After seating, clean thoroughly to remove all sand and metal particles to prevent excessive wear. Keep motor bearing free from sand or metal particles.
"	Dirty commutator.	If commutator is rough or dirty, smooth and polish with #0000 sandpaper. If too rough and pitted, remove and turn down. Blow out all particles.
"	Shorted, grounded, or open armature.	Remove and replace with an armature known to be in good condition.
"	Grounded or open field circuit.	Test and repair if possible or replace with a new part.
Low motor and cranking speed.	Worn, rough, or improperly lubricated motor or starter gearing.	Disassemble, clean, inspect, and relubricate, replacing ball bearing if worn.
"	Same electrical causes as listed under "Motor fails to operate".	Same remedies listed for those malfunctions.
Excessive arcing of motor brushes.	Binding, worn, or improperly seated brush or brushes with excessive side play.	See information above dealing with this malfunction.
"	Dirty, rough, pitted, or scored commutator.	Clean as outlined above.
Excessive wear and arcing of motor brushes.	Rough or scored commutator.	Remove and turn down commutator on lathe.
"	Armature assembly not concentric.	Reface commutator.

TABLE 6 (Continued)

ELECTRIC GEAR		
TROUBLE	CAUSE	REMEDY
Gear will retract but red indicator light (press-to-test) will not show.	Bulb burned out in red indicator light. Broken wire in indicator-light circuit. Up-limit switch inoperative.	Replace burned out bulb. Check indicator-light circuit and/or the down-limit switch.
Incomplete Retraction- Gear retracts to an intermediate position and stops short.	Bind in gear retraction system because gear is out of rig. Malfunction in gear electrical circuit, inoperative actuating motor, or weak battery.	Refer to Section V for landing gear rigging procedure description. Examine all movable retraction system parts for proper lubrication and freedom from binding. Check for actuator worm gear binding and lubricate as needed. Any malfunction can cause the 25-amp landing gear circuit breaker to trip. Check gear electrical circuit for loose connections, broken wires, or defective relay switches. Recharge battery if necessary.
Gear will not retract at or above 80 mph IAS (M20C&D). Gear will not retract at or above 70 mph IAS (M20E & F)	Insufficient airspeed, pressure switch inoperative, or circuit breaker tripped.	Check pitot tube and line for obstructions. Examine pressure switch for proper adjustment and operation. Reset circuit breaker.
Gear will extend but green indicator light (press-to-test) will not show.	Bulb burned out in green indicator light. Broken wire in indicator-light circuit. Down-limit switch is inoperative.	Replace burned out bulb. Check indicator-light circuit and/or the down-limit switch.
Actuating motor extends gear to an intermediate position and stops.	Same causes as listed with "Incomplete Retraction" above.	Same remedies as listed with "Incomplete Retraction" above.
Actuating motor will not initiate extension.	Same causes as listed with "Incomplete Retraction" above.	Same remedies as listed with "Incomplete Retraction" above. Also, check circuit breaker.
Gear will extend manually but green indicator light (press-to-test) will not show.	Gear switch is not in down position. Bulb burned out in green indicator light.	Place gear switch in down position. Replace burned out bulb.
Manual cranking will not lower gear.	Drive-connector is out of rig. Sheared female spline in drive-connector.	Adjust control-cable tension at drive-connector lever. Replace drive-connector assembly if female spline is stripped.

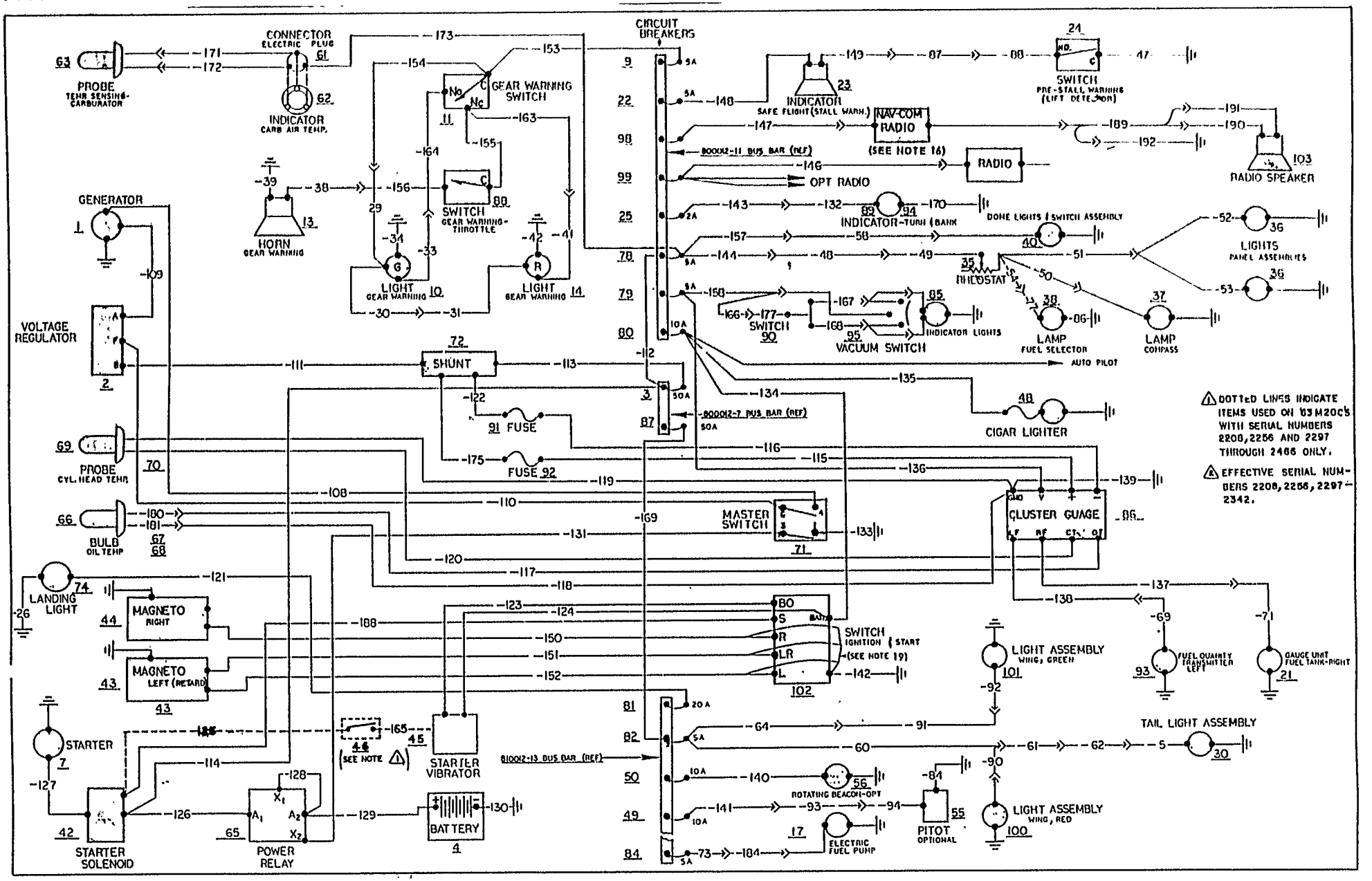
SHOP NOTES

FIGURE 8-2 – ELECTRICAL SYSTEM DIAGRAM (1962 M20C S/N 1940-2296)



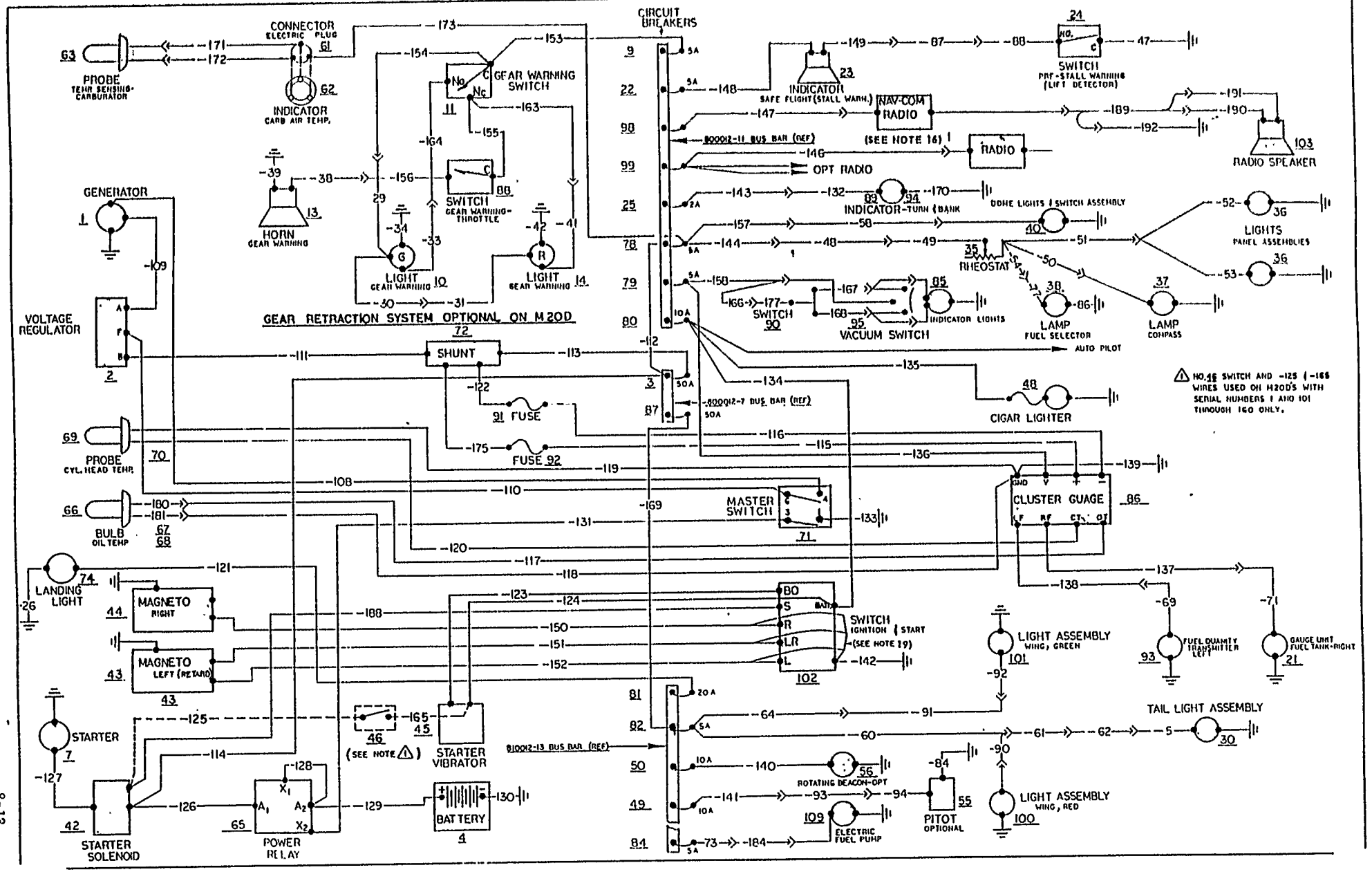
ALL ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPMENT LIST)

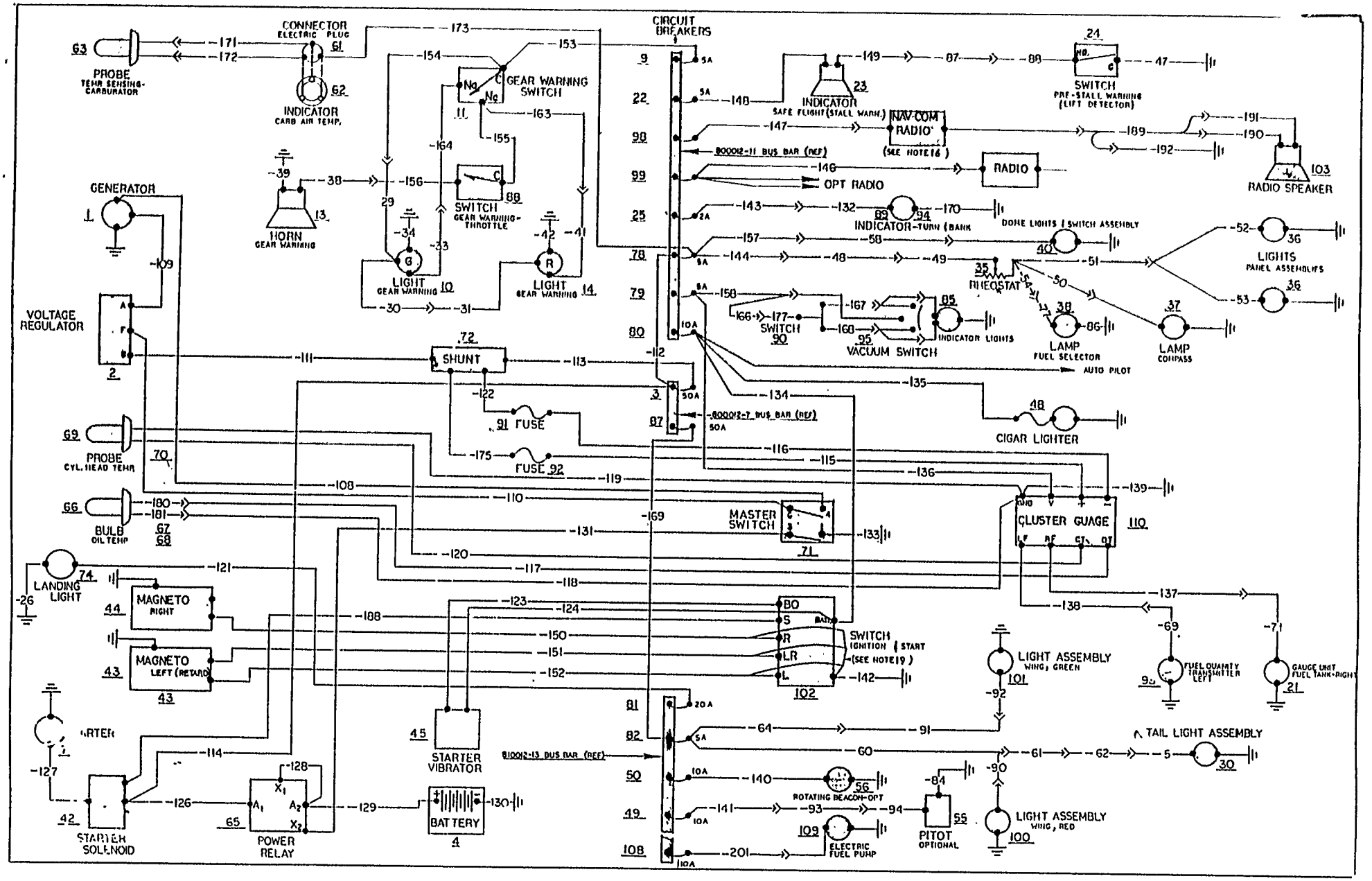
FIGURE 8-3 – ELECTRICAL SYSTEM DIAGRAM (1963 M20C S/N 2208, 2256, 2297 thru 2622)



NOTE: ALL ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPMENT LIST).

FIGURE 8-4 – ELECTRICAL SYSTEM DIAGRAM (1963 M20D S/N 101-200)





NOTE: ALL ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPMENT LIST).

FIGURE 8-6 – ELECTRICAL SYSTEM DIAGRAM (1964 M20C S/N 2657 thru 2741; 2743 thru 2806)

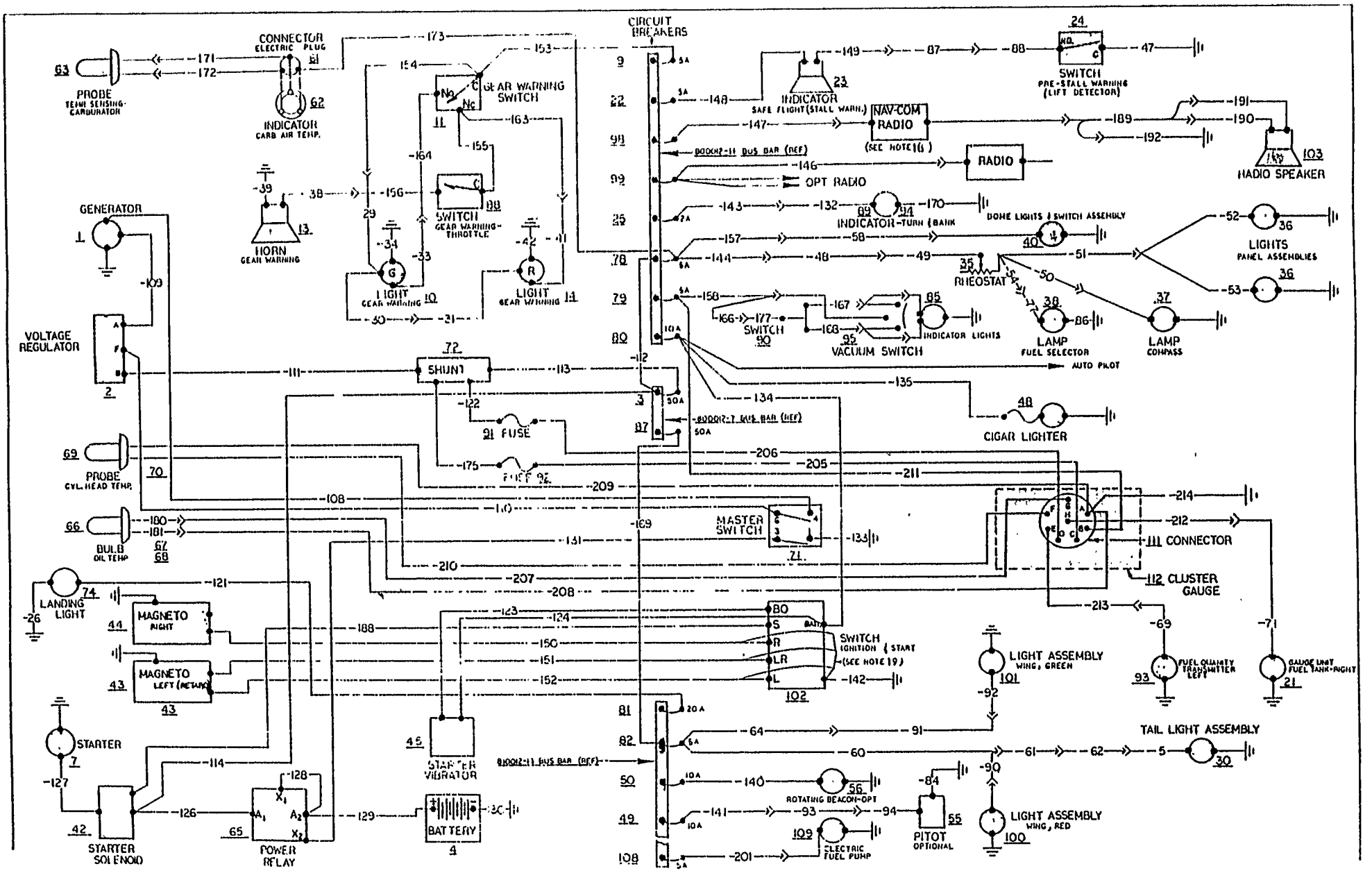
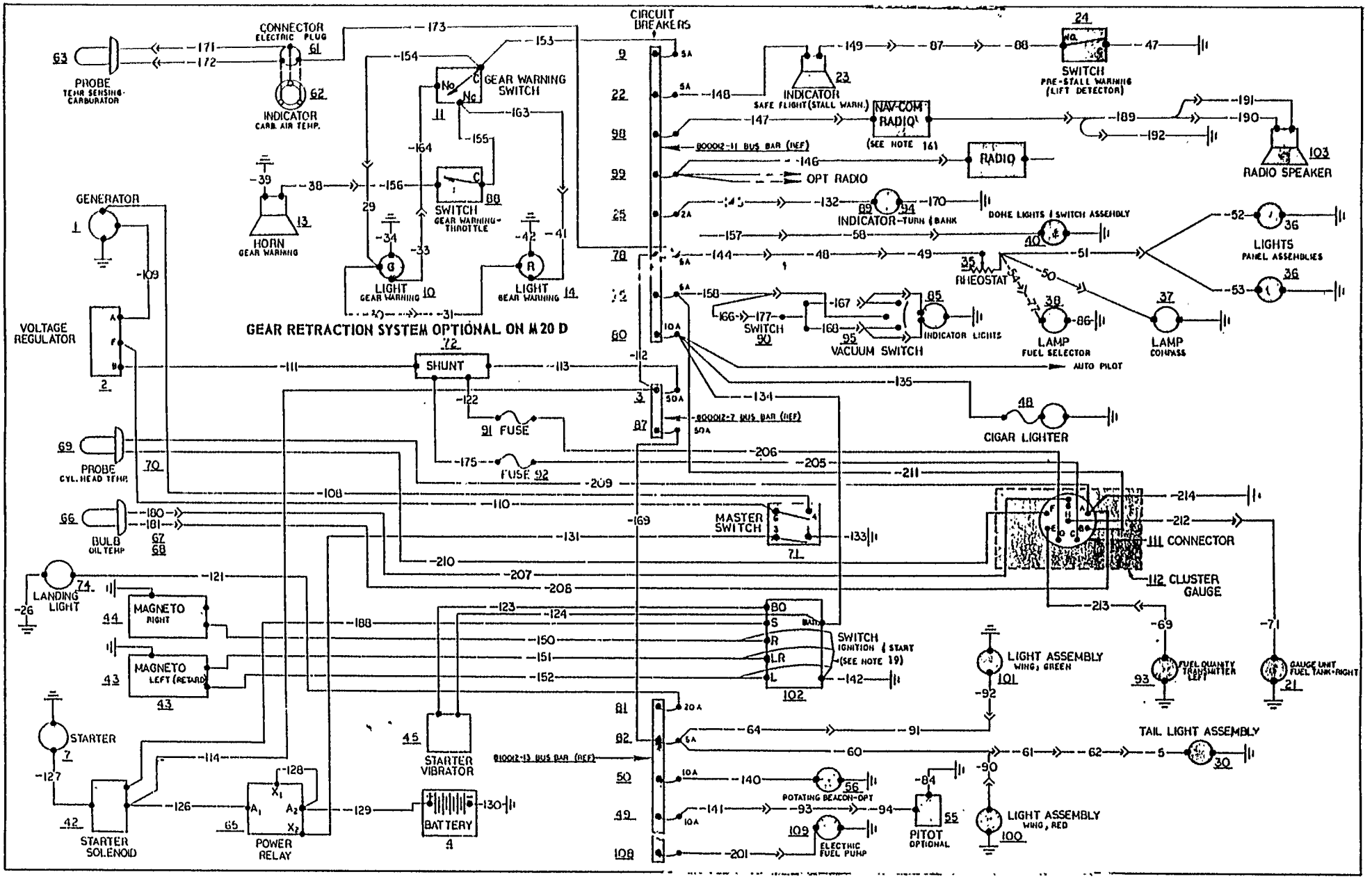


FIGURE 8-7 – ELECTRICAL SYSTEM DIAGRAM (1964 M20D S/N 202 thru 251)



NOTE: ALL ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPME

FIGURE 8-8 – ELECTRICAL SYSTEM DIAGRAM (1964 M20E S/N 104 thru 230 [S/N 101 thru 103 differs only in minor details])

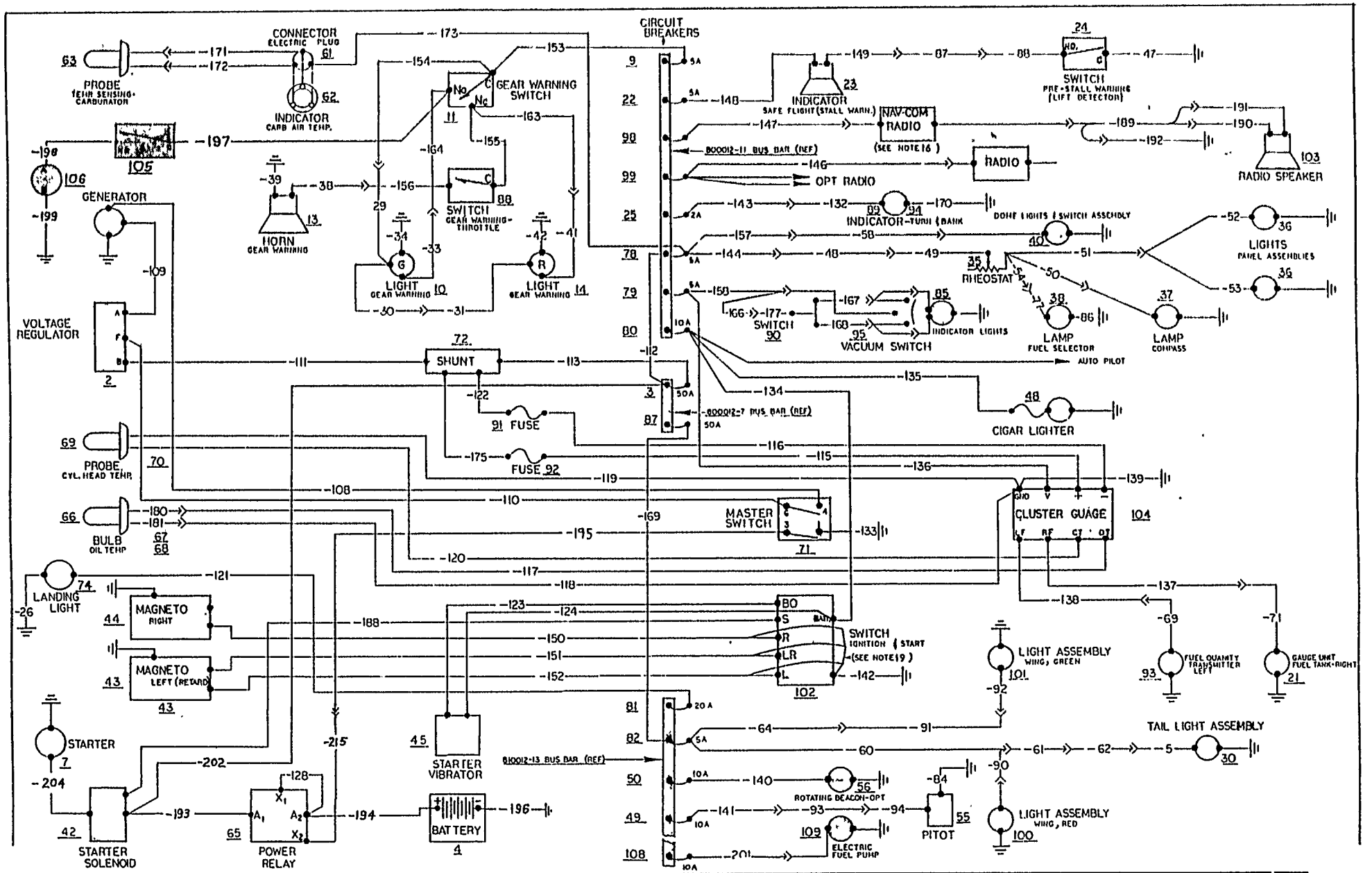
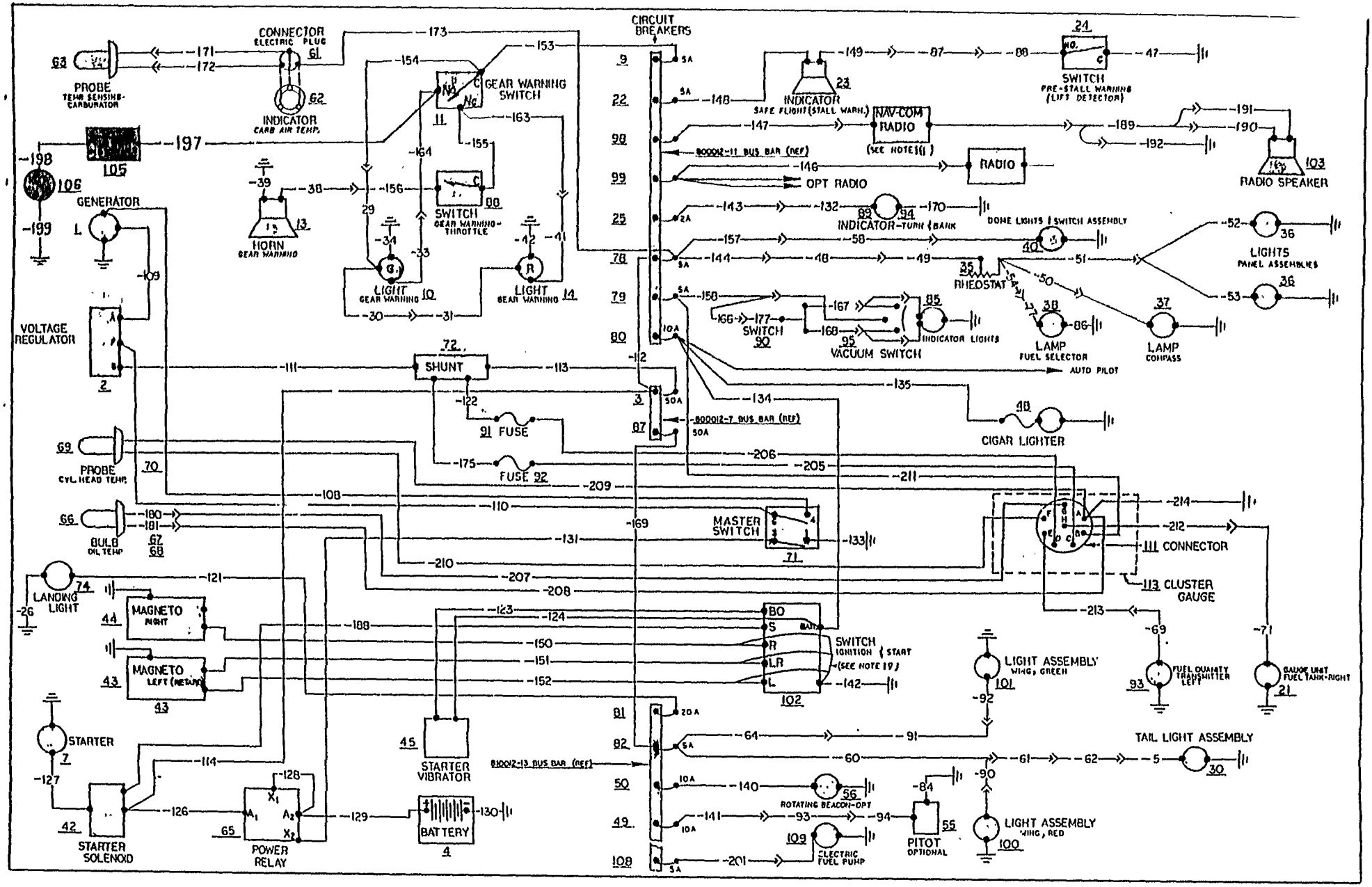
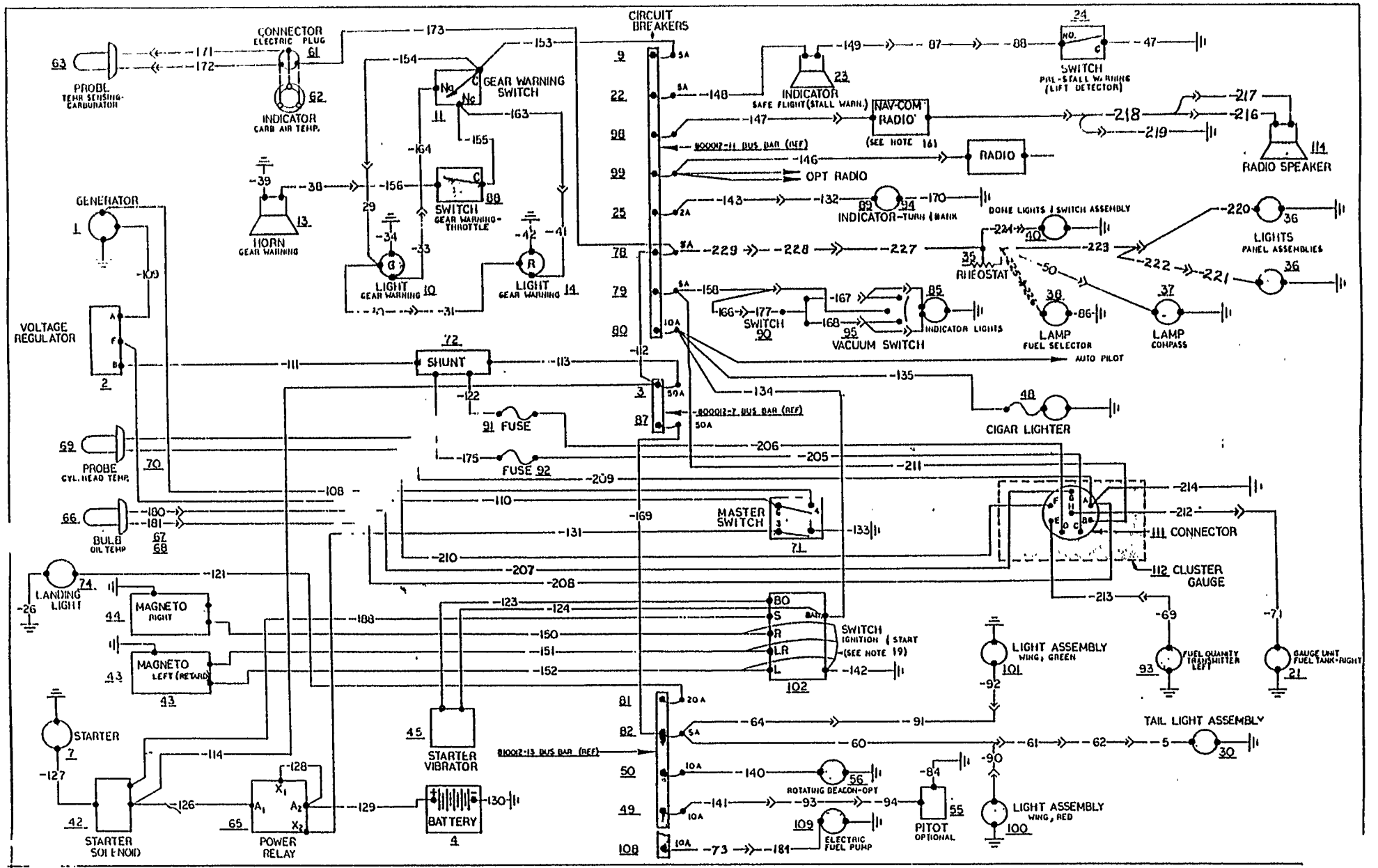


FIGURE 8-9 – ELECTRICAL SYSTEM DIAGRAM (1964 M20E S/N 231 thru 399; 401 thru 469)



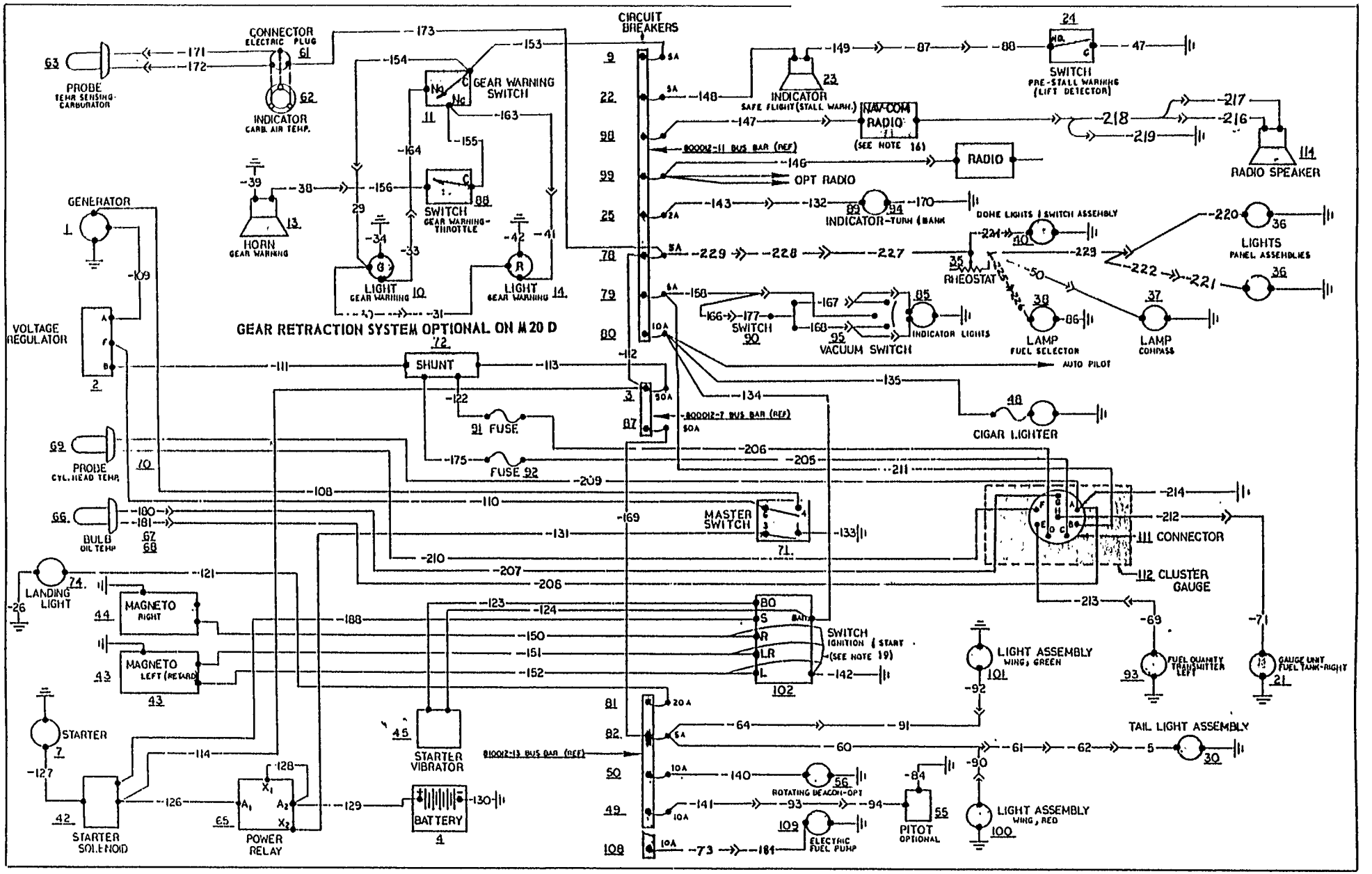
NOTE: ALL ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPMENT LI

FIGURE 8-10 – ELECTRICAL SYSTEM DIAGRAM (1965 M20C S/N 2742, 2807 thru 3184)



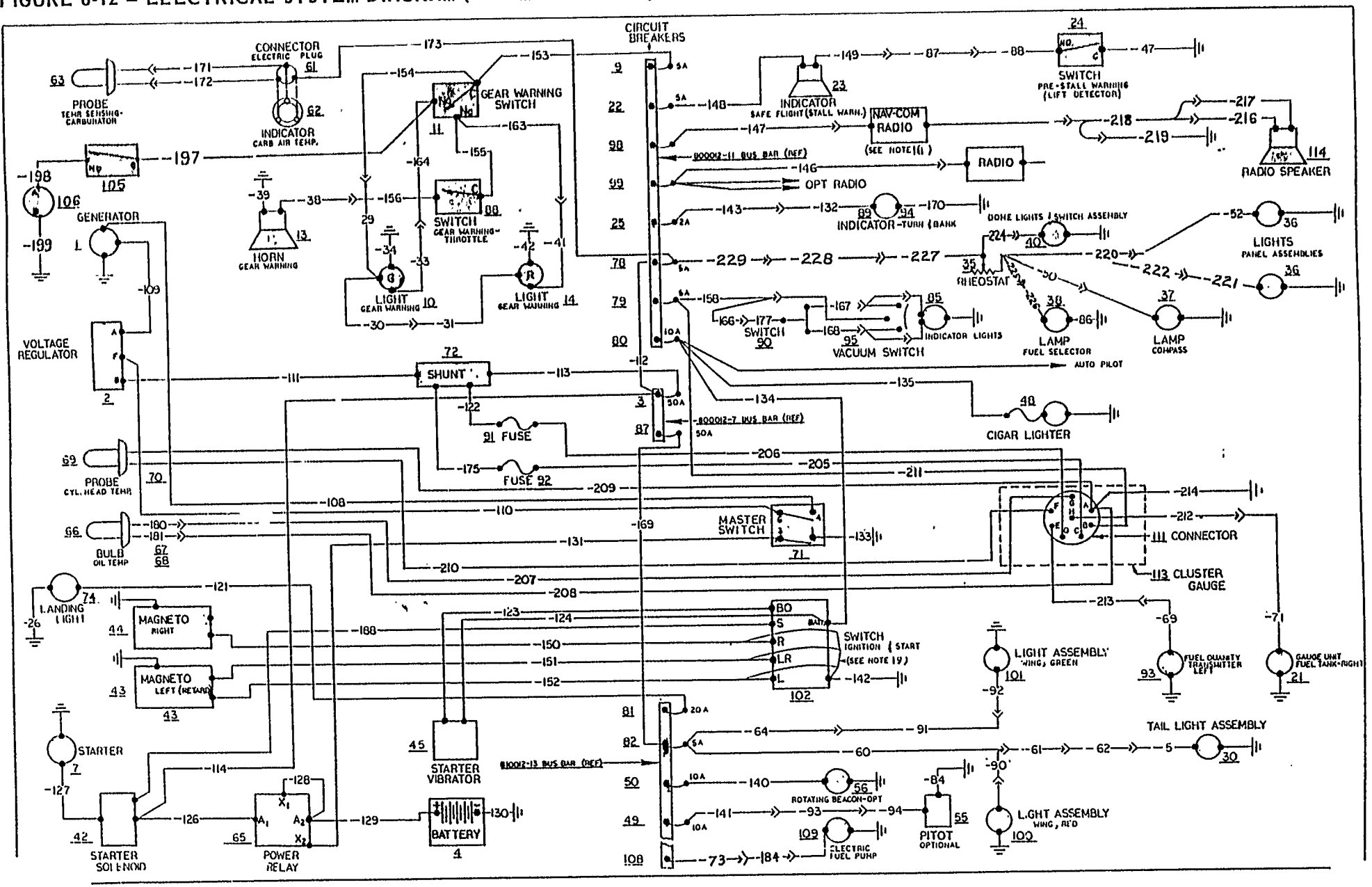
NOTE – ALL ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPMENT LIST).

FIGURE 8-11 – ELECTRICAL SYSTEM DIAGRAM (1965 M20D S/N 252 thru 259)



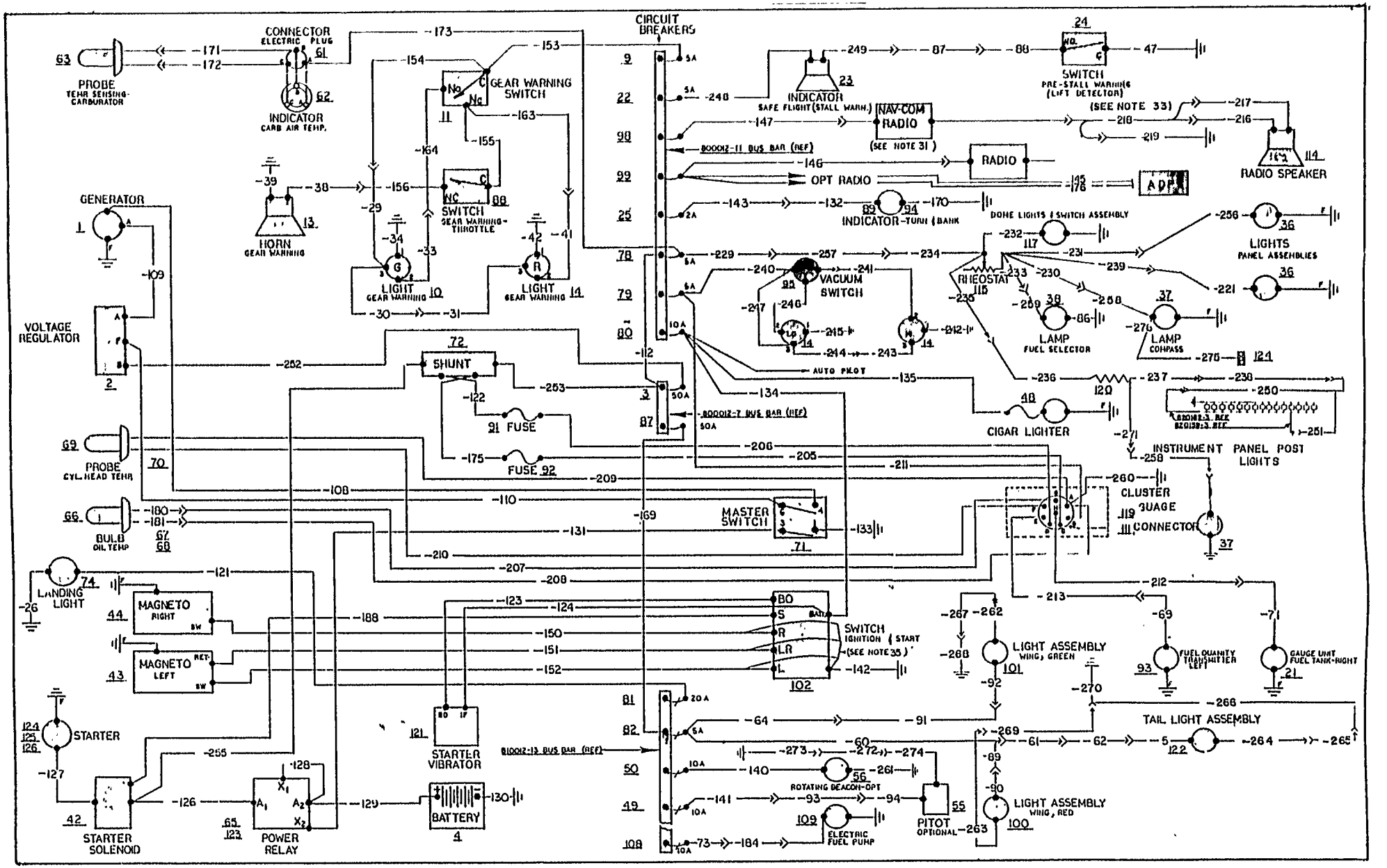
NOTE: ALL ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPMENT LIST).

FIGURE 8-12 – ELECTRICAL SYSTEM DIAGRAM (1965 M20E S/N 400, 470 thru 831)



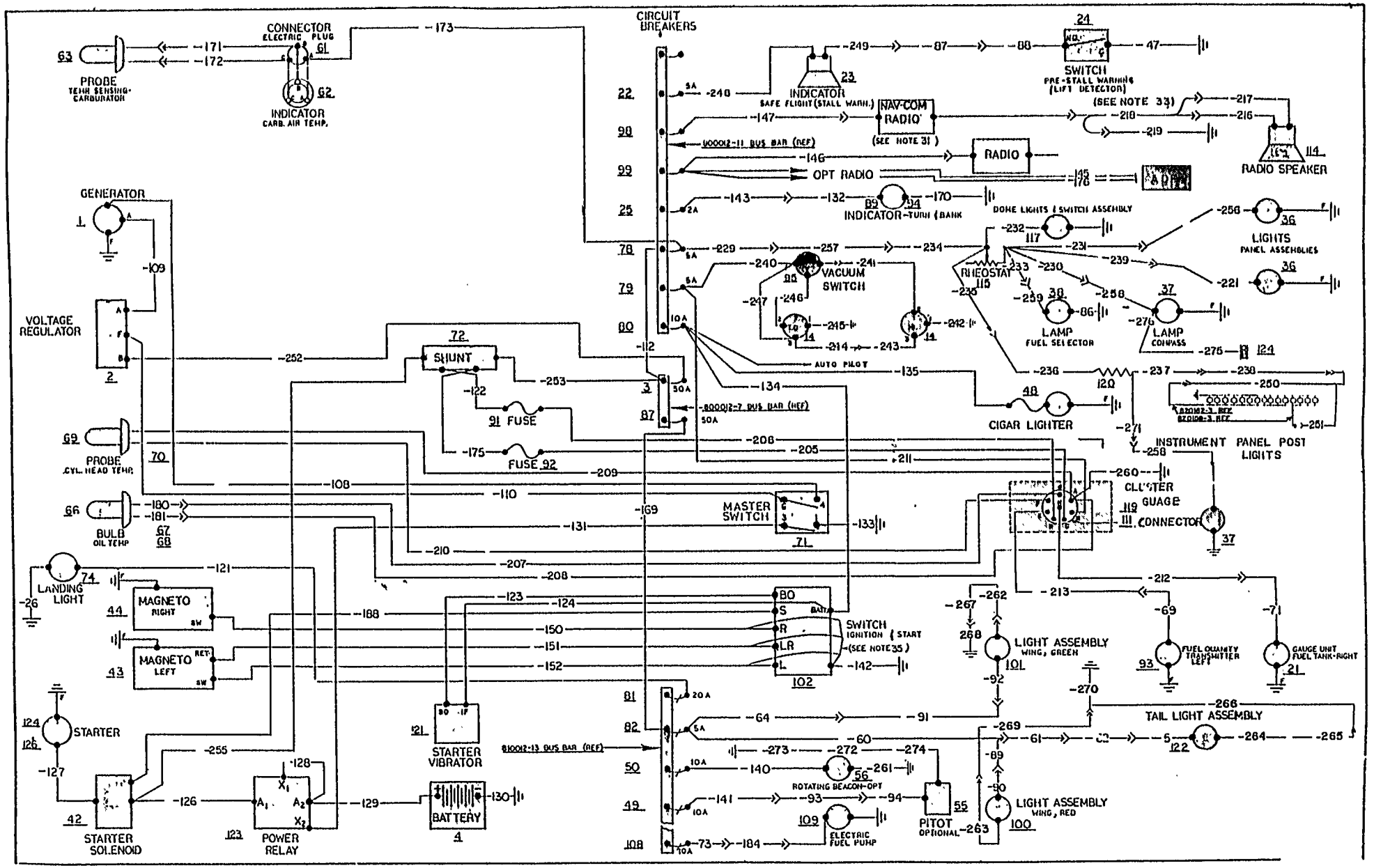
ALL ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPMENT LIST)

FIGURE 8-13 – ELECTRICAL SYSTEM DIAGRAM (1966 M20C S/N 3185 thru 3466)



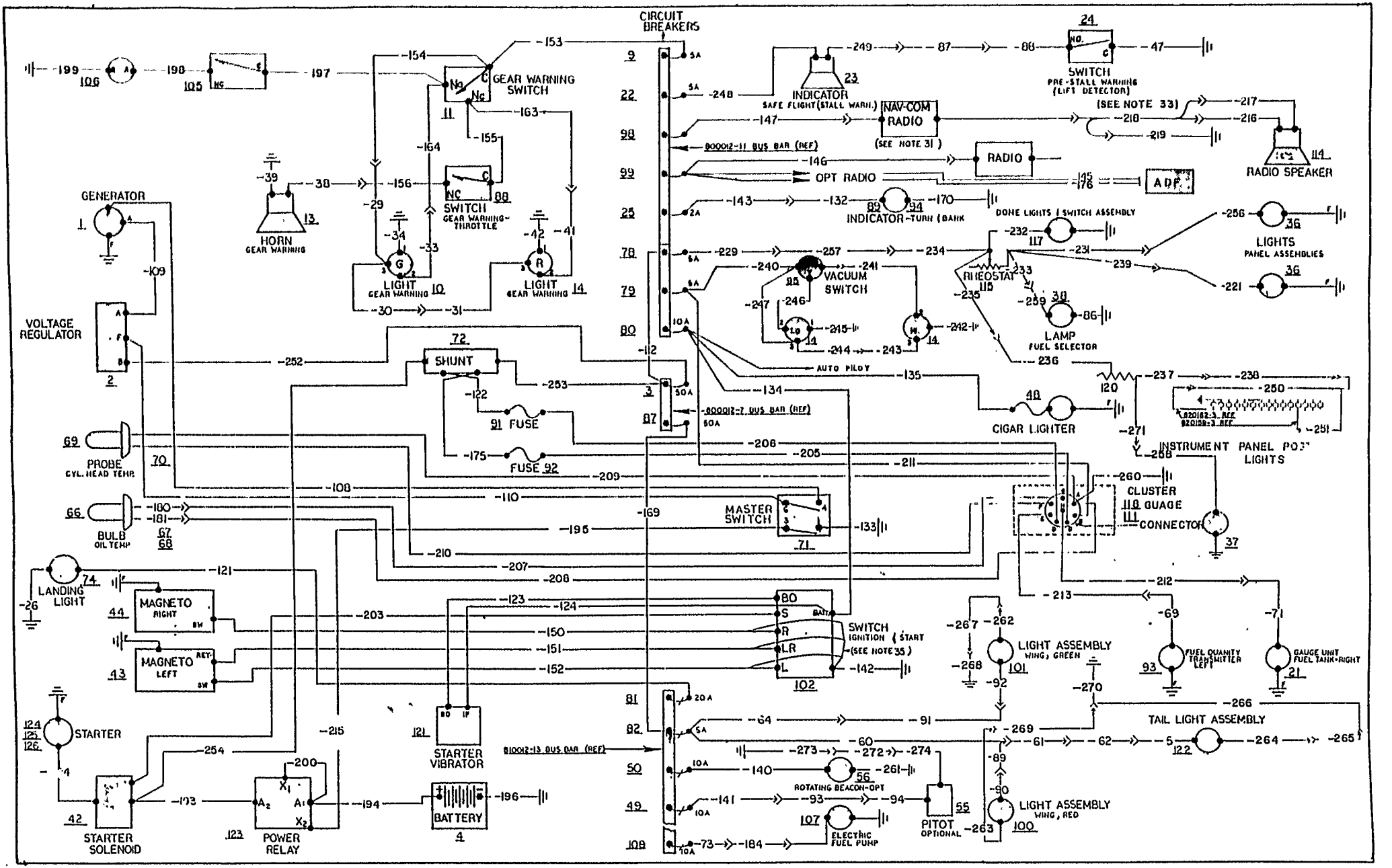
NOTE: ALL ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPMENT LIST).

FIGURE 8-14 – ELECTRICAL SYSTEM DIAGRAM (1966 M20D S/N 260 & ON)



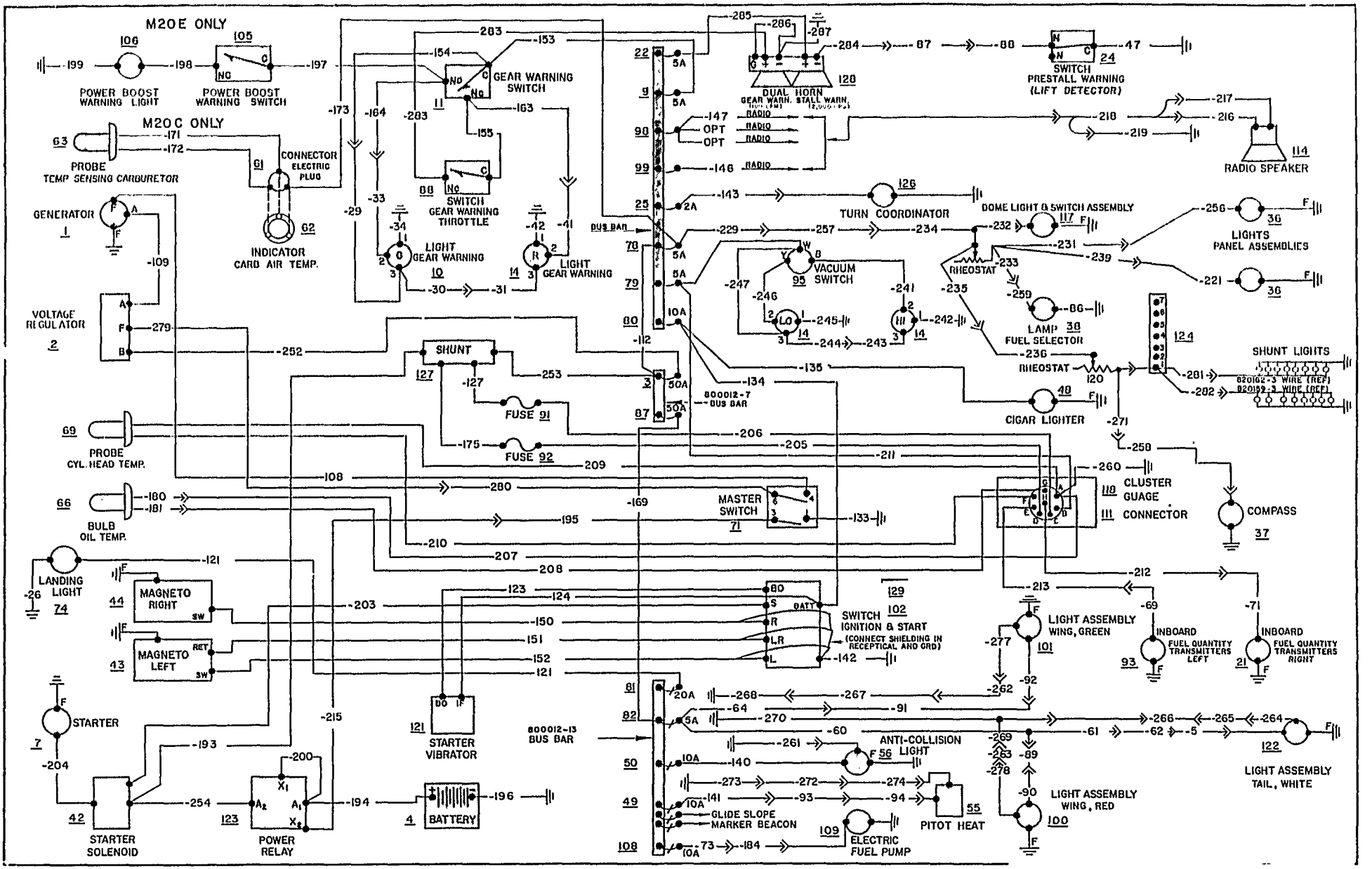
(1) ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPMENT LIST)

FIGURE 8-15 – ELECTRICAL SYSTEM DIAGRAM (1966 M20E S/N 514, 832 thru 1308)



NOTE: ALL ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPMENT LIST).

FIGURE 8-16 – ELECTRICAL SYSTEM DIAGRAM (1967 M20C&E S/N 670001 & ON)



NOTE: ALL ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPMENT LIST).

ELECTRICAL EQUIPMENT LIST (M20C, D & E)

NOTE: Item numbers refer to underlined numbers on ELECTRICAL SYSTEM DIAGRAMS

NO.	ITEM	QTY.	RATING	MANUFACTURER	MODEL/PART NO.
1	Generator	1	50A	Delco Remy	1101915
2	Voltage Regulator	1	50A	Delco Remy	1119224C
3	Circuit Breaker-Generator	1	50A	Wood	2350
4	Battery	1	35A	Auto-Lite	R-35
5	Switch-Generator	1	55A	—	AN3022-2
6	Switch-Master	1	55A	—	AN3023-2
7	Starter	1		Delco Remy	1109689
8	Switch-Ignition and Starter	1	—	Bendix	10-126690-1
9	Circuit Breaker-Gear Warning	1	5A	Klixon	PSM-5N
10	Light-Gear Warning (Green)	1	.08A	Dialco	VM911-M-3A
11	Switch-Gear Warning (Retr. Handle)	1	3A	Micro	BZ-7-RWT80
12	Switch-Gear Warning (Throttle)	1	25A	Micro	BZ-7-RQIT
13	Horn-Gear Warning	1	.7A	Edwards	319
14	Light-Gear Warning (Red)	1	.08A	Dialco	VM911-M-2A
15	Circuit Breaker-Fuel Pump	1	5A	Klixon	PSM-5N
16	Switch-Fuel Pump	1	40A	Micro	AN3021-2 (511TS1-2)
17	Pump-Fuel Electric	1	1.5A	Bendix	476087
18	Circuit Breaker-Fuel Gauge	1	5A	Klixon	PSM-5N
19	Gauge-Fuel Quantity	1		AC	5643860
20	Switch-Fuel Gauge	1	40A	Micro	AN3021-3 (511TS1-3)
21	Gauge Unit-Fuel Tank, Right	1	—	AC	5641991
22	Circuit Breaker-Stall Warning	1	5A	Klixon	PSM-5N
23	Indicator-Safe Flight (Stall Warning)	1		Safe Flight	164-R
24	Pre-Stall Warning Switch-Lift Detector	1		Safe Flight	C-46001
25	Circuit Breaker-Turn and Bank	1	2A	Klixon	PSM-2N
26	Indicator-Turn and Bank	1	4.2W	Schwein	NS27200-A1
27	Circuit Breaker-Nav. Lights	1	10A	Klixon	PSM-10N
28	Switch-Navigation Lights	1	40A	Micro	AN3021-2 (511TS1-2)
29	Lights Assembly-Wing	2	1.6A	Grimes	A1285
30	Light Assembly-Tail	1	1.15A	Grimes	A2064-12
31	Circuit Breaker-Landing Light	1	35A	Klixon	PSM-35N
32	Switch-Landing Light	1	55A	—	AN3021-2
33	Light-Landing	1	100W	—	#4537
34	Circuit Breaker-Panel Lights	1	5A	Klixon	PSM-5N
35	Rheostat (25r)-Panel Lights	1	—	Clarostat	#25-25
36	Light-Panel Assemblies	2	.63A	Grimes	A1425-R
37	Lamp Compass	1	.08A		330
38	Lamp-Fuel Selector	1	.08A	Dialco	83B1310-117
39	Circuit Breaker-Dome Lights	1	10A	Klixon	PSM-10N
40	Lights and Switch Assembly Dome	1	1.15A	Grimes	B3555-A-93
41	Ammeter	1	0.60A	AC	1502373
42	Solenoid-Starter	1		Delco Remy	001464
43	Magneto-Left	1	—	Bendix	S4LN200
44	Magneto-Right	1	—	Bendix	S4LN204

NO.	ITEM	QTY.	RATING	MANUFACTURER	MODEL/PART NO.
45	Vibrator-Starting	1	3A	Bendix	10-87998-1
46	Switch-Starter Solenoid Cutout	1	40A	Micro	AN3021-2 (511TS1-2)
47	Voltmeter-Turn and Bank	1		Weston Elec. Inst. Corp.	840 (or Equiv.)
48	Cigar Lighter	1	8A	Balcamp	#4-2272
49	Heated Pitot Circuit Breaker	1	10A	Klixon	D-7270-5-10
50	Rotating Beacon Circuit Breaker	1	10A	Klixon	D-7270-5-10
51	ADF Radio Circuit Breaker (For ADF-29)	1	2A	Klixon	PSM-2N
52	ADF Radio Circuit Breaker (For ADF T-12)	1	5A	Klixon	PSM-5N
53	Fuse and Fuse Retainer	1	10A	Little Fuse	10 AMP 31101Q and 155020A
54	Loud Speaker	1		Oxford	46 AMS
55	Pitot-Optional	1	8A	Aero Instrument	P.H. 502-12
56	Rotating Beacon-Optional	1	6.62A	Grimes	G-8400-8-12 or D-7080-1-12
57	Radio-Optional				
58	ADF Radio-Optional				
59	Receptical-External Power	1	–	–	AN2552-3A
60	Solenoid	1	–	Delco Remy	001464
61	Connector-Electric Plug	1	–	–	AN3106-14S-1S
62	Indicator-Carburetor Air Temp.	1	1.5 AMP	Richter	C-12
63	Probe-Temperature Sensing	1	–	Richter	B-5
64	Adaptor-Electrical Accessory to Cable	1	–	–	AN3057-6
65	Power Relay	1	100A	Cutler-Hammer	6041H34B
66	Bulb-Oil Temperature	1	–	–	AN5525-1
67	Plug-Connector	1	–	–	AN3106A-125-3S
68	Clamp-Cable	1	–	–	AN3057-4
69	Probe-Cylinder Head Temp.	1	–	–	AN5546-1
70	Adaptor	1	–	–	AN4076-1
71	Switch-Master	1	–	–	AN3027-2
72	Shunt	1	60A	Weston Elect.	105918
73	Speaker-Radio	2	–	Jensen	P4-W
74	Light-Landing	1	250W	G.E. or Equiv.	4522
75	Circuit Breaker-Radi o	2	10A	Klixon	PSM-10N
76	Circuit Breaker-Radio (For ADF-T29)	1	2A	Klixon	PSM-2N
77	Circuit Breaker-Radio (For ADF-T12)	1	5A	Klixon	PSM-5N
78	Circuit Breaker-Instrument and Dome Light	1	5A	Klixon	PSM-5N
79	Circuit Breaker-Instrument	1	5A	Klixon	PSM-5N
80	Circuit Breaker-Ignition	1	10A	Klixon	PSM-10N
81	Circuit Breaker-Landing Light	1	20A	Klixon	D7270-5-20
82	Circuit Breaker-Navigation Light	1	5A	Klixon	D7270-5-5
83	Circuit Breaker-Rotating Beacon	1	10A	Klixon	D7270-5-10

NO.	ITEM	QTY.	RATING	MANUFACTURER	MODEL/PART NO.
84	Circuit Breaker-Fuel Pump	1	5A	Klixon	D7270-5-5
85	Indicator Lights-High and Low Vacuum	1	.08A	Garwin	23-602
86	Cluster Gage	1	0.1A	Garwin	22-166-01
87	Circuit Breaker-Buss Bar	1	50A	Wood	2350
88	Switch-Landing Gear Warning-Throttle	1	10A	Micro	V3-1 (AN3234-1)
89	Indicator-Turn and Bank	1	.3A	Garwin	23-323-01
90	Switch-Press to Test High and Low Vacuum	1		SwitchCraft	974-TF
91	Fuse and Fuse Retainer	1	10A	Littlefuse	10 AMP 311010 and 155020
92	Fuse and Fuse Retainer	1	10A	Littlefuse	10 AMP 311010 and 155020
93	Fuel Quantity Transmitter-Left	1		AC	5642354
94	Connector-Electric Plug	1			MS 3108B 10 SL-3S
95	Vacuum Switch (High and Low Vacuum)	1		Garwin	22-1280-04
96	Indicator-Carburetor Air Temp.	1		Garwin	22-995-04
97	Connector-Electric Plug	1			AN3106B-14S-2S
98	Circuit Breaker	1	(See Notes 31 and 32)		
99	Circuit Breaker	As needed	(See Note 32)		
100	Light Assembly-Wing, Red	1	1.6A	Grimes	A1285-R-12
101	Light Assembly-Wing, Green	1	1.6A	Grimes	A1285-G-12
102	Switch-Ignition and Starter	1	—	Bendix	10-126680-2
103	Speaker-Radio	1	—	Dare	721120 (V5F43)
104	Cluster Gauge	1	0.1A	Garwin	22-166-04-A
105	Switch Alt. Air Warning (Alt. Air Control)	1	25A	Micro	V3-1 (AN3234-1)
106	Indicator Lamp	1	.08A	Dialco	39-14-371 7538-XP12 7538-XP51
107	Electric Fuel Pump	1	5A	Dukes Ast. Co.	4140-00-19
108	Circuit Breaker-Fuel Pump	1	10A	Klixon	D7270-5-10
109	Electric Fuel Pump	1	5A	Dukes Ast. Co.	4140-00-21
110	Cluster Gauge	1	0.1A	Garwin	22-166-05-A
111	Connector-Cluster Gauge	1			AN3106B-18-85 AN3057-10
112	Cluster Gauge	1	0.1A	Garwin	22-166-010
113	Cluster Gauge	1	0.1A	Garwin	22-166-09
114	Speaker	1	—	Tramm	SP-1
115	Rheostat Panel Lights	1	2.04A	Ohmite	919006-1
116	Lights-Panel Assemblies	2	.63A	Grimes	A-1425A-1-12
117	Light & Switch Assy-Dome	1	.58A	Grimes	B-3555A-89
118	Cluster Gage	1	0.1A	Garwin	660100 22-169-07
119	Cluster Gage	1	0.1A	Garwin	660099 22-169-08
120	Rheostat Post Lights	1	1.29A	Ohmite	919006-501
121	Starter Vibrator	1	2.75A	Garwin	31-324
122	Light Assy-Tail	1	1.52A	Grimes	A-2064-1777
123	Power Relay	1	100A	Cutler-Hammer	6041H231
124	Terminal Strip	1		Kulka	599-2002-6
125	Turn Coordinator	1		Brittain Ind.	TC100-12
126	Turn Coordinator	1		Brittain Ind.	2900TC100-12
127	Shunt	1		Garwin	22-370-60
128	Horn—Dual Warning	1		Safe-Flight	283
129	Switch—Ignition & Starter	1		Bendix	10-357201-1

NOTES

(ELECTRICAL SYSTEM DIAGRAM M20C D & E)

1. All splices are AMP knife disconnects or equivalent.
2. All circuit breakers are of a trip-free type
3. All terminals are AN659 (or equivalent), or wire ends are soldered together.
4. All unshielded cable is to conform to Spec MIL-W-5086 (See Note 24).
5. All terminals will be of a preinsulated type or will be insulated with vinyl tubing. Ampsulation #325134 may be used on #6 terminals; ampsulation #325137 may be used on #2 terminals.
6. Deleted
7. Leads without dash numbers are furnished with the equipment concerned.
8. Plastic resin-core solder is used.
9. Deleted
10. "F" symbol indicates grounding through frame (no wires).
11. "——→ ←——" symbol signifies a knife disconnect
12. Connect optional equipment wires to power source only when optional equipment is installed. Insulate terminals with Scotch #33 tape when terminals are not connected
13. Install items 49 or 50 (circuit breakers) only when heated pitot or rotating beacon is installed
14.. 15.. 16.. 17.. 18. Deleted

19. Wires, knife disconnects, gage, probe, and gage connectors are supplied in Rieter Carburetor Heat Probe Kit.
20.. 21., 22.. 23. Deleted

24. All #18 shielded electrical cable is to conform to specification MIL-C-7078 Type 2.
25.. 26.. 27. Deleted

28. Spare parts replacement for -58 wire should also include -157 wire. (S/N 1701-1851 & 1853-1939).
29. Spare parts replacement for -48 wire should also include -144 wire. (S/N 1701-1851 & 1853-1939).
30. An external power supply plug installation is available as optional equipment.
31. This circuit breaker is for one Nav/Com unit only. Do not add other equipment to this circuit
32. Deleted
33. Install ANP 32446 knife disconnect to shielding on each end of -189 or -218 wire from 1.00" to 1.50" from terminal ends of inner wire.
34. Shielding from wires -19, -20, and -21 is connected together in receptical AN659-5 and connected to ground terminal of item 8 (magneto switch).
35. Shielding from wires -150, -151, and -152 is connected together in receptical AN659-5 and is connected to ground terminal of item 8 or item 102 (magneto switches).
36. Autolite R-35 battery is interchangeable with R-33 and may be used as spare parts replacement on prior M20B and M20C models.
37. The high and low vacuum warning lights, with their wiring and switches, are optional equipment on the M20D, and are to be installed only in conjunction with the vacuum system installation.
38. Install AMP 327217 ampsulation (0.5" long) and AMP 327216 ampsulation on soldered connections at gear warning lights, and cover with AMP 327219 ampsulation (0.75" long)–effective M20C (S/N 2657 & ON); M20E (S/N 231 & ON). Also install AMP 327217 ampsulation (0.5" long) and AMP 327216 ampsulation on soldered connections at the vacuum warning lights–effective M20C (S/N 3185 & ON) and M20E (S/N 832 & ON).
39 The compass light shall be connected to the post-light rheostat when optional post lights are installed. The -230 wire, when not attached to the post lights, will be insulated at the knife disconnect with AMP 327217 ampsulation and also string tied with Airtex (Class 2) string.
40. The following pairs of wires will be twisted together counter-clockwise with a minimum of three (3) wraps per foot. (Effective M20C S/N 3287 & ON, M20D S/N 260 & ON, M20E S/N 951 & ON):

Wires -267 & -91	Wires -264 & -5
-262 & -92	-263 & -90
-268 & -64	-269 & -89
-270 & -60	-274 & -94
-266 & -61	-272 & -93
-265 & -62	-273 & -141
	-261 & -140

41. Use 919012 overhead light as replacement part on M20B S/N 1701-1851; 1853-1939, M20C S/N 1852 1940 & ON; M20D S/N 1. 101 & ON; M20E S/N 101 & ON. Use 919012-501 overhead light on M20B S/N 1701-1851, 1853-1939; M20C S/N 1852. 1940-3184; M20D S/N 1. 101-259; M20E S/N 101-831. Use 919012 overhead light on M20C S/N 3185 & ON. M20D S/N 260 & ON. and M20E S/N 832 & ON.

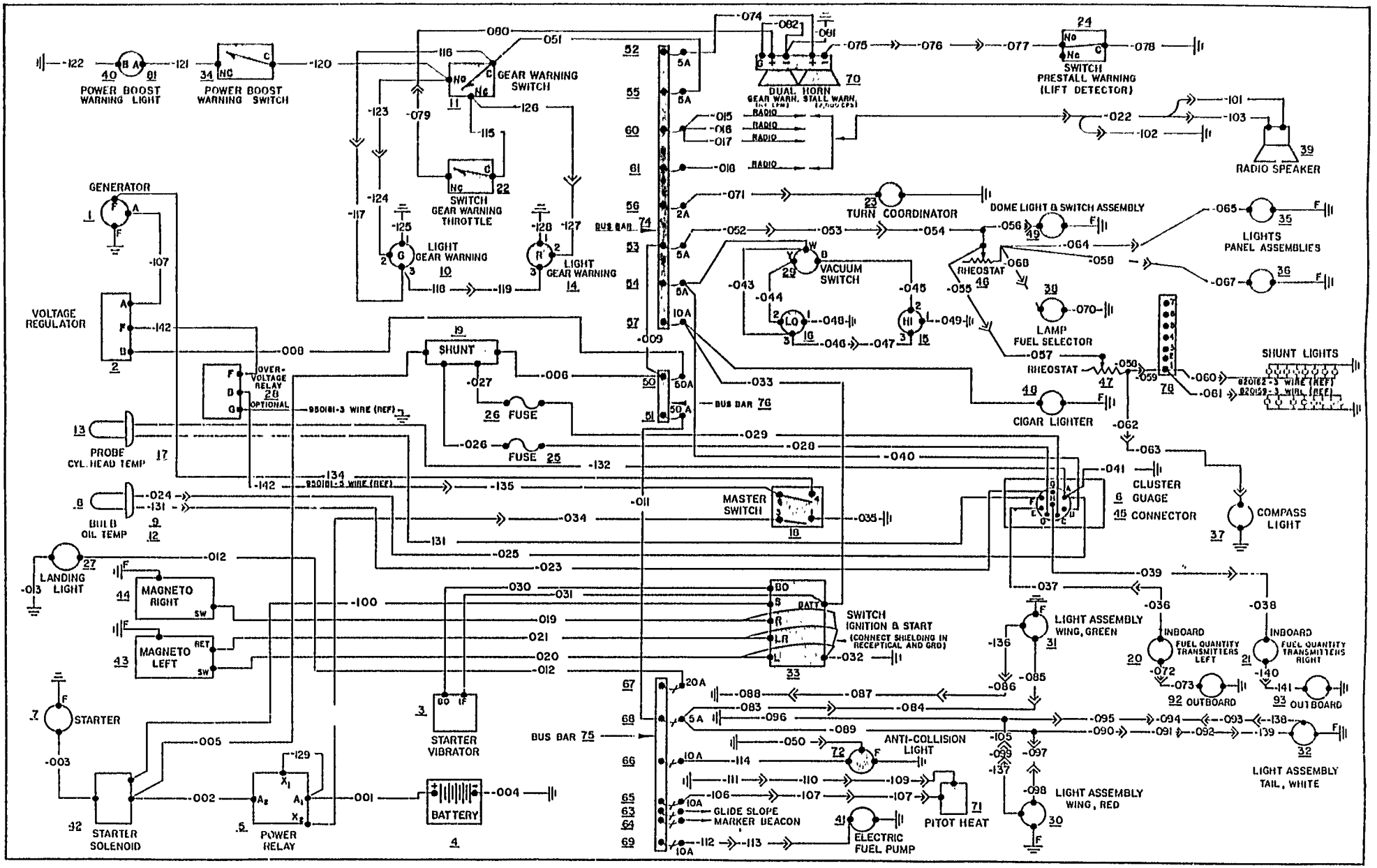
42. Item No. 125 may be used to replace Item No. 89 without changing wires or connector. (Effective M20C S/N 3185 & ON; M20D S/N 260 & ON; M20E S/N 832 & ON.

43. The polarity of wires 800007-180 and -181 is not critical.

44. On M20C, S/N 670001 & ON. and M20E, S/N 670001 & ON, wire 800007-143 connects to positive lead from Brittain turn coordinator Item No. 126.

45. Garwin shunt part no. 22-370-60 replaces shunt part no. 105918, effective M20C, S/N 670001 & ON, and M20E, S/N 670001 & ON.

FIGURE 8-17 – ELECTRICAL SYSTEM DIAGRAM (1967 M20F S/N 660003 & 670001 & ON)



NOTE: ALL ITEM NUMBERS ARE UNDERLINED (REFER TO ELECTRICAL EQUIPMENT LIST).

REVISED NOVEMBER 1966

ELECTRICAL EQUIPMENT LIST
(M20F)

NOTE. Item numbers refer to underlined numbers on M20F ELECTRICAL SYSTEM DIAGRAMS

NO.	ITEM	QTY.	RATING	MANUFACTURER	MODEL/PART NO.
1	Generator	1	12V 50A	Delco Remy	1101915
2	Regulator–Voltage	1	—	Delco Remy	1119224C
3	Vibrator–Starter	1	2.75A 12V	Garwin	31-324
4	Battery	1	35AHR	Rebat	R-35
5	Relay–Power	1	12V 0.67A	Cutler-Hammer	6041H231
6	Gage–Cluster	1	0.1A	Garwin Mooney P/N	22-169-07-1 660114
7	Starter	1	12V	Prestolite	MZ4206
8	Probe–Oil Temp.	1	—	——	AN5525-1
9	Plug–Oil Temp. Probe	1	—	——	MS3106A-125-35
10	Light–Warning (Gear Down)	1	12V 0.08A	Dialco	VM911M-3A
11	Switch–Gear Warning Handle	1	—	Mirco	BZ-7RWTBO
12	Clamp-Cable (Oil Temp. Plug)	1	—	——	MS-3057-4B
13	Probe–Cly. Head Temp.	1	—	——	AN-5546-1
14	Light–Warning (Gear up)	1	12V 0.08A	Dialco	VM911M-2A
15	Light–Warning (High Vacuum)	1	12V 0.08A	Dialco	VM911M-2A
16	Light–Warning (Low Vacuum)	1	12V 0.08A	Dialco	VM911M-2A
17	Adapter–Cylinder Head Temp. Probe	1	—	——	AN4076-1
18	Switch–Master	1	—	Mirco	512TS1-2 MS35059-22
19	Shunt	1	—	Garwin	22-370-60
20	Trans.-Fuel Qty. (L Tank Inbd.)	1	—	A-C	———
21	Trans.-Fuel Qty. (R Tank Inbd.)	1	—	A-C	———
22	Switch–Gear Warning				V3-1
	Throttle switch with actuator	1	—	Mirco	JV-5
23	Turn Coordinator	1	12V 0.75A	Brittain	820166
24	Switch–Warning pre stall	1	—	Safe Flight Mooney P/N	C-46001 800218
25	Fuse & Fuse Retainer	1	—	Littlefuse	311010 155020
26	Fuse & Fuse Retainer	1	—	Littlefuse	311010 155020
27	Light–Landing	1	250W 12V	GE or Equiv.	4522
28	Relay–Over Voltage	1	—	RBM Mooney P/N	136-8 800165
29	Switch–Warn (Hi & Low Vacuum)	1	—	Garwin	22-1280-04
30	Light–Position (Red)	1	1.6A 12V	Grimes Mooney P/N	A1285-R-12 800223–Basic
31	Light–Position (Green)	1	1.6A 12V	Grimes Mooney P/N	A1285-G-12 800223-501

NO.	ITEM	QTY.	RATING	MANUFACTURER	MODEL/PART NO
32	Light–Position-tail	1	1.6A 12V	Grimes Mooney P/N	A2064-1777 .800224
33	Switch–Ignition and Starter	1	—	Bendix	10-357210-1
34	Switch–Warning (Alt. Air Control)	1	—	Mirco	J3-1 JV-5
35	Light–Panel (left)	1	0.63A 12V	Grimes Mooney P/N	A1425A-1-12 919012–Basic
36	Light–Panel (Right)	1	0.63A 12V	Grimes Mooney P/N	A1425A-1-2 919012–Basic
37	Compass	1	0.08A	Airpath	C-2350-DL-4VF
38	Light–Fuel Selector	1	0.08A 12V	Dialco	203-1310-01117-201
39	Speaker	1	—	Tramm	SP-1
40	Light–Warning (Alt. Air Control)	1	0.08A 12V	Dialco	39-14-373
41	Pump–Electric Fuel	1	5.0A 12V	Dukes	4140-00-19A
42	Solenoid–Starter	1	3.0A 12V	Delco Remy	001466
43	Magneto–Left	1	—	Bendix	S4LN200
44	Magneto–Right	1	—	Bendix	S4LN204
45	Plug–Cluster Gage	1	—	———	MS3106A-18-85
46	Rheostat–Panel Lights	1	—	Ohmite Mooney P/N	H-8-F2-352A 919006-1
47	Rheostat–Post Lights	1	—	Ohmite Mooney P/N	H-8-F2-352A 919006-501
48	Lighter–Ciger	1	8.0A 12V	Balcamp	4-2272
49	Light–Dome	1	0.58A 12V	Grimes	B-3555A-89
50	Circuit Breaker–Generator	1	50A	Wood	109-250-101
51	Circuit Breaker–Buss Bar	1	50A	Wood	109-250-101
52	Circuit Breaker–Pre Stall Warning	1	5A	Klixon Mooney P/N	PSM-5N 919000-9
53	Circuit Breaker–Inst. & Dome Lights	1	5A	Klixon Mooney P/N	PSM-5N 919000-9
54	Circuit Breaker–Cluster Gage Vacuum Warning	1	5A	Klixon Mooney P/N	PSM-5N 919000-9
55	Circuit Breaker–Gear Warning	1	5A	Klixon Mooney P/N	PSM-5N 919000-9
56	Circuit Breaker–Torn Coord.	1	2A	Klixon Mooney P/N	PSM-2N 919000-5
57	Circuit Breaker–Ignition & Cigarette Lighter	1	10A	Klixon Mooney P/N	PSM-10N 919000-13
58	Circuit Breaker–Audio Cont.	1	2A	Klixon Mooney P/N	PSM-2N 919000-5
59	Circuit Breaker–Radio	1	—	Klixon Mooney P/N	———
60	Circuit Breaker–Radio	1	—	Klixon Mooney P/N	———
61	Circuit Breaker–Radio	1	—	Klixon Mooney P/N	———

NO.	ITEM	QTY.	RATING	MANUFACTURER	MODEL/PART NO.
62	Circuit Breaker–Gear Cont.	1	5A	Klixon Mooney P/N	PSM-5N 919000-9
63	Circuit Breaker Switch Glide Slope	1	—	Klixon	D-7270-5
64	Circuit Breaker Switch Mark Beacon	1	—	Klixon	D-7270-5
65	Circuit Breaker Switch Heat Pitot	1	10A	Klixon	D-7270-5-10
66	Circuit Breaker Switch A-C Light	1	10A	Klixon	D-7270-5-10
67	Circuit Breaker Switch Landing Light	1	20A	Klixon	D-7270-5-20
68	Circuit Breaker Switch Position Lights	1	5A	Klixon	D-7270-5-5
69	Circuit Breaker Switch Fuel Pump	1	10A	Klixon	D-7270-5-10
70	Horn–Dual Warning	1	0.4A 0.3A	Safe Flight Mooney P/N	283 800185
71	Pitot-Heated	1	8.0A 12V	Aero-Inst.	R.H. 502-12 AN 5812
72	Light–Anti Collision	1	6.62A 12V	Grimes	D-7080-1-12
73	Relay–External Power	1	0.69	Cole-Hersee	24059
74	Buss Bar–Main	1	—	Mooney P/N	800012-11
75	Buss Bar–Auxiliary	1	—	Mooney P/N	800012-13
76	Buss Bar–Power	1	—	Mooney P/N	800012-7
77	Buss Bar–Radio	1	—	Mooney P/N	800012-7
78	Terminal Strip–Shunt Lights	1	—	Joy Mfg. Co. Mooney P/N	520077-251 919008
79	Light Warning–Generator	1	0.08A	Sloan Mooney P/N	1065-R-F32 913067–Basic
80	Clamp–Cable (Cluster Gage)	1	—	———	MS3057-10B
81	Connector–Alt. Air	1	—	Dialco	7538-XP12
82	Speed Clip–Alt. Air light	1	—	Dialco	7538-XP51
83	Circuit Breaker–Gear Actuator	1	25A	Klixon	D7271-8-25
84	Switch–Up Limit (w/actuator)	1	—	Mirco Mirco	DT-2R-A7 MCD2711
85	Switch–Down Limit (w/actuator)	1	—	Mirco Mirco	DT-2R-A7 MCD2711
86	Switch–Gear Safety	1	—	Dukes Mooney P/N	3203-00 950161
87	Switch–Gear Control	1	——	Mirco	1TL149-30
88	Relay–Gear Up	1	0.50A 12V	Cutler-Hammer	6041H50A
89	Relay–Gear Down	1	0.50A 12V	Cutler-Hammer	6041H50A
90	Actuator–Landing Gear	–	12V	Dukes Mooney P/N	4196-00-1B 950158-501
91	Receptical–External Power	–	—	———	AN2552-3A
92	Trans.–Fuel Qty. (L. Otbd.)	–	—	A-C	———
93	Trans.–Fuel Qty. (R. Otbd.)	–	—	A-C	———

NOTES
M20F
(ELECTRICAL SYSTEM DIAGRAM)

1. All splices are AMP knife disconnects or equivalent.
2. All circuit breakers are of a trip-free type.
3. All terminals are AN659 (or equivalent), or wire ends are soldered together.
4. All terminals will be of a preinsulated type or will be insulated with ampsulation or equivalent material.
5. Wires without dash numbers are furnished with the equipment item.
6. "F" indicates grounding through frame (no wires).
7. "——→}——" symbol indicates a knife disconnect.
8. All mil-spec. wires may have any revision letter.
   Example: Mil-W-5086 may be Mil-W-5086A
9. The symbol "△10" signifies optional equipment that may be installed as desired.
10. The following pairs of wires must be twisted together counter-clockwise with a minimum of three wraps per foot:

Wires	-085 & -086	Wires	-139 & -138
	-084 & -087		-097 & -105
	-083 & -088		-098 & -099
	-089 & -096		-050 & -114
	-090 & -095		-106 & -111
	-091 & -094		-107 & -110
	-092 & -093		-108 & -109

SECTION

9

INSTRUMENTS

SECTION I X
INSTRUMENTS

A. GENERAL

The instrument panel has been designed to provide functional location of all flight, radio, and engine instrument groups.

All flight instruments are grouped on a shock-mounted panel directly in front of the pilot. They are located in such a manner as to provide maximum efficiency for instrument cross-check, a most important item for IFR flying. A radio panel is located in the center of the instrument panel and has sufficient room for two radios. The glove compartment slot serves as a mounting area for a third radio. All of the engine instruments are grouped on the co-pilot's panel.

B. TROUBLE SHOOTING

When trouble shooting instruments having an electrical power source, check from the power supply to the instrument affected. If no malfunction is found, the trouble probably exists inside the individual instrument. The instrument then should be replaced by an identical instrument, tested and known to be operating properly. See Table 7 for instrument trouble shooting procedures.

SHOP NOTES

TABLE 7 – INSTRUMENT TROUBLE SHOOTING

TROUBLE	CAUSE	REMEDY
	COMPASS	
Excessive card error.	Compass not properly compensated.	Compensate instrument. Refer to Service Instruction M20-23.
"	External magnetic interference or aircraft structure magnetized.	Locate magnetic interference and eliminate if possible. Demagnetize structure.
Excessive card oscillation.	Improper mounting on instrument panel.	Align instrument.
"	Insufficient liquid.	Replace instrument.
Card Sluggish.	Weak card magnets.	Replace instrument.
"	Excessive pivot friction or broken jewel.	Replace instrument.
"	Instrument too heavily compensated.	Remove excess compensation. and compensate instrument.
Liquid leakage.	Loose bezel screws. Broken cover glass. Defective sealing gaskets.	Replace instrument. Replace instrument. Replace instrument.
Discolored luminous markings or damping liquid.	Age.	Replace instrument.
Defective light.	Burnt out lamp or broken circuit.	Check lamp or continuity of wiring.
	TACHOMETER	
No reading on indicator (either permanent or intermittent).	Broken Shaft. Springs weak.	Replace shaft Replace instrument.
Pointer oscillates excessively.	Rough spot or sharp bend in shaft.	Repair or replace.
"	Excessive friction in instrument.	Replace instrument.

TABLE 7 – (Continued)

TROUBLE	CAUSE	REMEDY
ALTIMETER		
Excessive scale error.	Improper calibration adjustment.	Replace instrument.
Excessive pointer oscillation.	Defective mechanism	Replace instrument.
High reading.	Improper venting.	Eliminate leak in static pressure system.
Setting knob is hard to turn.	Wrong lubrication or lack of lubrication.	Replace instrument.
Inner reference marker fails to move when setting knob is rotated.	Out of engagement.	Replace instrument.
Setting knob setscrew loose or missing.	Excessive vibration.	Tighten instrument screw, if loose. Replace screw, if screw is missing.
Cracked or loose cover glass.	Excessive vibration.	Replace instrument.
Dull or discolored luminous markings.	Age.	Replace instrument.
Barometric scale and refernence markers are out of synchronism with pointers	Shift in mechanism.	Reset pointers and recalibrate.
Barometric scale and refernce markers out of synchronism.	Slippage of mating parts.	Replace instrument.
AIRSPEED INDICATOR		
Pointer of instrument does not indicate properly.	Leak in instrument case or in pitot lines.	Check for leak and seal.
Pointer of instrument oscillates.	Leak in instrument case or in pitot lines.	Check for leak and seal.
HEATED PITOT TUBE (IF USED)		
Tube does not heat or clear itself of ice with swich ON.	Circuit breaker switch tripped. Defective breaker.	Reset. Replace.

TABLE 7 – (Continued

TROUBLE	CAUSE	REMEDY
"	Open circuit.	Repair.
"	Excessive voltage drop between battery and pitot head.	Check voltage at pitot head.
"	Heating element burned out.	Replace pitot head.
TURN AND BANK INDICATOR *		
Pointer fails to respond.	Foreign matter lodged in instrument.	Replace instrument.
"	No electric circuit.	Check for voltage at instrument.
Incorrect sensitivity.	Misadjustment of sensitivity spring.	Adjust by means of sensitivity spring screw. If this pulls the pointer from zero, replace instrument.
Pointer does not set on zero.	Gimbal and rotor assembly out of balance.	Replace instrument.
"	Pointer incorrectly set on its staff.	Replace instrument.
"	Sensitivity adjustment pulls pointer off zero.	Replace instrument.
Vibrating pointer.	Gimbal and rotor assembly out of balance.	Replace instrument.
"	Pitted or worn pivots or bearings.	Replace instrument.
In low temperature, pointer fails to respond or does so sluggishly and with insufficient deflection.	Oil has become too thick. Insufficient bearing clearing.	Replace instrument. Replace instrument.
Pointer sluggish in returning to zero and does not set on zero when sationary.	Oil or dirt detween damping pistons and cylinders.	Replace instrument.
"	Excessive clearance between rotor and rotor pivots.	Replace instrument.
Ball inclinometer does not center.	Instrument out of alignment on panel.	Correct alignment.

*NOTE: Turn and bank indicators have been replaced by turn coordinators on all models (1967 & ON). Refer to Section VI for turn coordinator trouble shooting procedures.

TABLE 7 – (Continued)

RATE OF CLIMB INDICATOR		
Pointer does not set on zero.	Aging of diaphragm.	Reset pointer to zero by means of setting knob. Tap instrument while resetting.
Pointer fails to respond.	Obstruction in static line.	Disconnect all instruments connected to the static line. Check individual instruments for leaks. Test lines for leaks.
Pointer oscillates.	Leaks in static line.	Disconnect all instruments connected to the static line. Check individual instruments for leaks. Reconnect instruments to static line and test installation for leaks.
"	Defective mechanism.	Replace instrument.
MANIFOLD PRESSURE INDICATOR		
Excessive error at existing barometric pressure.	Pointer shifted.	Replace instrument.
Excessive error when engine is running.	Line leaking.	Tighten line connections.
Sluggish or jerky pointer movement.	Improper damping adjustment.	Adjust damping screw.
Broken or,loose cover glass.	Vibration or excessive pressure.	Replace glass and reseat case.
Dull or discolored luminous markings.	Age.	Replace instrument.
Incorrect reading.	Moisture or oil in line.	Disconnect lines and purge with air.

SHOP NOTES

TABLE 7 – (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
DIRECTIONAL GYRO INDICATOR		
Excessive drift in either direction.	1965: Instrument air filter dirty (high vacuum indicated). 1966: Vacuum regulating valve filter dirty (high vacuum indicated).	Inspect filter. Replace if necessary.
	Excessive vibration	Test with vibrometer. If amplitude is more than .004 inch, examine shock mountings and note whether connections are pulling on instrument.
	Insufficient vacuum. If vacuum indication is below 3.5 inches Hg, check as follows:	Correct for insufficient vacuum as follows:
	1. Vacuum regulating valve improperly adjusted.	1. Adjust vacuum regulating valve.
	2. Faulty vacuum gage	2. Check calibration of gage.
	3. Pump failure	3. Repair or replace pump.
	4. Vacuum line kinked, leaking, or too long for its diameter	4. Locate and, if defective, replace or repair vacuum line. Check for collapsed inner wall of flexible hose.
	Defective mechanism (worn or dirty pivots and bearings)	Replace indicator.
Dial spins continuously in one direction.	Operating limits have been exceeded	Cage and reset the instrument with the aircraft level.
	Defective mechanism	Replace indicator.

GYRO-HORIZON INDICATOR

TROUBLE	PROBABLE CAUSE	REMEDY
Horizon bar fails to respond.	1965: Instrument air filter dirty (high vacuum indicated). 1966: Vacuum regulating valve filter dirty (high vacuum indicated).	Examine filter. Clean or replace if necessary.

TABLE 7 – (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Horizon bar fails to respond. (Continued)	Insufficient vacuum – resulting from the following:	Correct insufficient vacuum as follows:
	1. Vacuum regulating valve improperly adjusted	1. Adjust vacuum regulating valve.
	2. Faulty vacuum gage	2. Check calibration of gage.
	3. Pump failure	3. Repair or replace pump.
	4. Vacuum line kinked, leaking, or too long for its diameter	4. Locate and repair. Check for collapsed inner wall of flexible hose.
Horizon bar does not settle.	Defective mechanism	Replace indicator.
	Insufficient vacuum	Correct for insufficient vacuum as outlined above.
	Excessive vibration	Test with vibrometer. If amplitude is more than .004 inch, examine installation to determine whether flexible hose connections are restricting movement of instrument; examine shock mountings and replace if necessary.
Horizon bar oscilates or vibrates excessively.	1965: Instrument air filter dirty (high vacuum indicated). 1966: Vacuum regulating valve filter dirty (high vacuum indicated).	Correct for excessive vacuum as follows: Examine filter, and clean or replace if necessary.
	Vacuum regulating valve improperly adjusted	Adjust vacuum regulating valve.
	Faulty vacuum gage	Check calibration of gage.
	Defective mechanism	Replace indicator.
	Excessive vibration	Test with vibrometer. If amplitude is more than .004 inch, examine installation to determine whether flexible hose connections are restricting movement of instrument; examine shock mountings and replace if necessary.

SHOP NOTES

SECTION

10

INSPECTION

SECTION X
INSPECTION

A. GENERAL

This section provides instructions for conducting routine periodic inspections. Repair or replacement instructions for those components found to be unserviceable at inspection may be found in the section covering the application aircraft system.

WARNING: When working on engines, ground the magneto primary circuit or remove all the spark plug leads before performing any checks on the ignition system.

B. PREFLIGHT INSPECTION

This inspection is required to determine the general condition of the airplane and to detect any damage or maladjustment which might interfere with flight reliability. The following safety procedure instructions must become an integral part of the aircraft owner's operating routine and/or preflight inspection. The airplane should be visually inspected to determine any obvious defects or damage to the following components:

Wings	Landing gear
Fuselage	Fuel tanks (Check for evidence of leaks.)
Empennage	Engine cowling
Control surfaces	Fuel tank filler caps

Check the operation of the following control surfaces for full travel and smooth operation:

Ailerons	Rudder	Empennage trim system
Elevators	Wing flaps	

Check the following electrical equipment for proper operation:

Transmitter and receiver	Landing light
Position lights	Fuel quantity gages for both fuel tanks

Check the following power plant items:
Carburetor heat control (Check M20E power boost door seal for leaks.).
Engine oil for quality and quantity.
Air filter for cleanliness.
Fuel and oil system for any evidence of leakage.
Ignition wiring for tightness of connections and conditions of wires.
Engine in general for any loose or missing nuts, palnuts, and for proper safetying of all plugs.
Magnetos for rpm drop at approximately 1700 rpm or 50 to 65% rated power as indicated on manifold pressure gage. The normal drop from both magnetos to one magneto is not to exceed more than 125 rpm.
Oil pressure (minimum idle–25 psi).
Fuel Pressure (0.5 to 6.0 psi, M20C & D; 14. to 30. psi, M20E).
Engine for proper tune up (650 to 1860 rpm).

Visually inspect the following parts of the propeller:
Hub: All bolts and nuts for tightness.
Blades: Excessive loss of grease from bearings.
If propeller runs rough, check the pitch of the blades (±0.5° allowable difference) and blade track (1/16 in. allowable difference).

C. 25-HOUR INSPECTION GUIDE

This inspection is required to determine the general condition of the airplane and to detect any damage or maladjustment which might interfere with flight reliability. The following inspection guide is recommended by the factory and should be performed only by qualified personnel.

25-HOUR INSPECTION GUIDE

Remove both engine side cowls.
Clean engine.
Remove and clean air filter. (Check power boost door seal for leaks on all M20E models.)
Inspect engine compartment for oil and fuel leaks. Check for security and condition of all equipment in accessory section.
Check wing, fuselage, and tail section for dents or damage.
Check complete airplane for any damage to control surfaces.
Check all instruments for operation, dials for proper markings, and placards for legibility.
Check static and pressure system for leaks or stoppage.
Inspect airplane in general for security of all bolts, nuts, screws, etc.
Check the battery.

D. 50-HOUR INSPECTION GUIDE

Complete all steps in the 25-hour inspection plus the following:

Engine: (Refer to Lycoming Operator's Manual for other 50-hour inspection items.)
Drain oil; inspect and clean screens.
Check engine for oil leaks.
Check ignition harness for fray, wear, etc.
Check throttle, carburetor heat, mixture, and propeller governor control for general condition, travel, and free operation (M20C & D). Inspect power boost control on M20E models.
Check engine mount structure and engine rubber dynafocal mounts.
Check exhaust stacks for general condition.
Check engine baffles for wear or cracks.
Check fluid in brake reservoir.
Check battery and cables.
Check cowl for cracks, loose or missing screws, etc.

Propeller:
Remove and inspect spinner.
Check propeller for oil leaks and general condition.
Inspect blades for nicks and cracks.
Clean and reinstall spinner.

Cabin:
Check parking brake cylinder for leaks.
Check trim operation.
Check cabin door and pilot window for damage and proper operation.
Check cabin, navigation, instruments, and landing lights.
Check fuel-selector valve for proper operation.

Landing Gear:
Check tires for freedom from excessive wear and proper inflation. (Refer to Section I page 1-5.)
Check for general condition.
Check collars and bolts for damage (Refer to Section V-G).

Wing:
Check surfaces and tips for damage.
Check ailerons, aileron attachments, and bell cranks for damage and operation.
Check flaps and attachments for damage and operation.
Lubricate controls as directed in Figure 2-9.

Fuselage and Empennage:
Check stabilizer, fin. and rudder surfaces for damage.
Check rudder and elevators for proper attachment.
Lubricate controls and trim systems as directed in Figure 2-9).

E. 100-HOUR INSPECTION GUIDE

Perform all steps in 25-and 50-hour inspection plus the following:

Engine: (Refer to Lycoming Operator's Manual for other 100-hour inspection items.)
Remove engine cowl and clean engine. Perform a hot engine differential compression check.
Check and/or replace spark plugs as required.
Check magneto points for proper gap. Reset or retime if necessary.
Clean fuel strainers and check fuel system for leaks.
Check vacuum pump.
Check condition of flex fuel lines.
Check engine and electric fuel pumps for proper operation.
Flush battery box.
Remove and check exhaust stacks and heater muff.

Propeller:
Rotate blades and check for tightness.
Visually inspect hub parts for cracks.
Check propeller mounting bolts for 60-70 foot pounds of torque.
Check spinner and bulkhead for cracks and general condition.
Check for adequate grease level in hub.

Cabin:
Remove instrument access panels.
Check control wheels and linkage.
Check instruments. lines. and attachments. (Check vacuum filter on all 1966 and subsequent models.)
Check upholstery for tears.
Check seats. belts, securing brackets and bolts.

Landing Gear:
Remove and repack wheel bearings. (Refer to Figure 2-9 for recommended lubricant.)
Check brake shoes and discs for wear.
Check brake lines.
Check wheels for alignment.
Check gear doors and attachments.
Check nose gear steering-control linkage and travel.
Check shock discs (Refer to Section V-G).
Check M20D gear fairings.

Check tire pressure (Refer to Section I. page 1-5).
Lubricate in accordance with Figure 2-9.
Check and rig gear (Refer to Section V-F.).

Wing:
Remove inspection plates and fairings, and check wing for general condition (Refer to Figure 10-1.).
Check fuel sells for leaks.
Check wing-attach bolts for security.

NOTE: A reasonable amount of care should be exercised when installing the dimpled inspection plates on the wings of those airplanes having dimpled screw holes in the wing skins. The use of improper screws or over-torquing of screws is not recommended as this could result in cracking of the wing skins in the dimpled area.

Fuselage and Empennage:
Check stabilizer bearings, bungees, and horns for damage and proper operation.
Check rudder, horns, and attachments for damage and proper operation.
Check trim mechanism.
Check bulkheads and stringers for damage.
Check electrical wiring, loops, loopmounts, and antennas.
Check fuel lines, valves, and gages for damage and proper operation.
Lubricate in accordance with Figure 2-9.

F. OVERLIMITS INSPECTION GUIDE

If the aircraft has been operated so that any of its components have exceeded their maximum operational limits, check with the appropriate manufacturer's manual.

G. POST-INSPECTION CHECK

Following the 50- and 100-hour inspections, start the engine and check the following items for proper functioning:

Check fuel pump and fuel tank selector valve.
Check fuel quantity and pressure gages.
Check oil pressure and temperature gages.
Check generator output.
Check manifold pressure.
Check operation of carburetor heat control. (Inspect power boost control on M20E & F models.)
Check parking brake.
Check gyros for noise and rough operation.
Check cabin heater operation.
Check magneto switch for grounding at idle RPM.
Check magneto rpm variation (Maximum allowable variation is 50 RPM).
Check throttle operation.
Check propeller for smoothness of operation.
Check propeller governor action.
Check radio operation.
Check engine idle at 650 rpm.

GENERAL:
See that aircraft conforms to FAA Aircraft Specifications 2A3.
See that FAA Airworthiness Directives have been complied with.
See that Manufacturers' Service Bulletins have been complied with.
See that aircraft logs and certificates are in proper order.
See that the Weight & Balance Record is up to date and in the aircraft.
See that the Owners Manual (1967 and subsequent editions) or the Airplane Flight Manual is complete and in the aircraft.

H. ELECTRIC GEAR INSPECTION (OPTIONAL INSTALLATION)

Raise aircraft on jacks to allow operational testing of both the electrical and emergency gear extension systems. (Refer to Section V-H.).

An 80 mph air pressure equivalent must be applied to the pitot tube orifice to activate the airspeed pressure switch to permit retraction of the gear. Attach a 12-inch length of 3/8-inch plyable rubber hose (surgical tubing) over the pitot tube end and pinch the open end of the tube with a cotter pin. Rotate the cotter pin until the compressed air within the rolled tube activates the airspeed pressure switch (located in the cabin near the hydraulic reservoir). Then raise the gear electrically.

Refer to page 5-23 for emergency gear extension instructions (Manual Operation of the Electrical Landing Gear System). Test emergency gear extension. Do not retract the gear with the emergency handcrank; to do so will damage the flexible drive shaft.

Thoroughly inspect and lubricate both the electrical and emergency gear extension systems (See Lubrication Diagram, Figure 2-9 for proper lubricant)

The drive connector should be removed from the actuating motor and inspected for a worn or stripped female spline. Clean and lubricate the motor worm gear.

Test the drive connector to check for proper functioning.

NOTES

If the pilot experiences difficulty with gear extension or retraction, the gear system should be lubricated and the malfunction corrected before the next flight. Raise the aircraft on jacks, locate and correct the trouble, and cycle-test gear operation. Refer to page 5-23, Section H, paragraph 3 for periodic lubrication and inspection specifications for the electric gear system actuator.

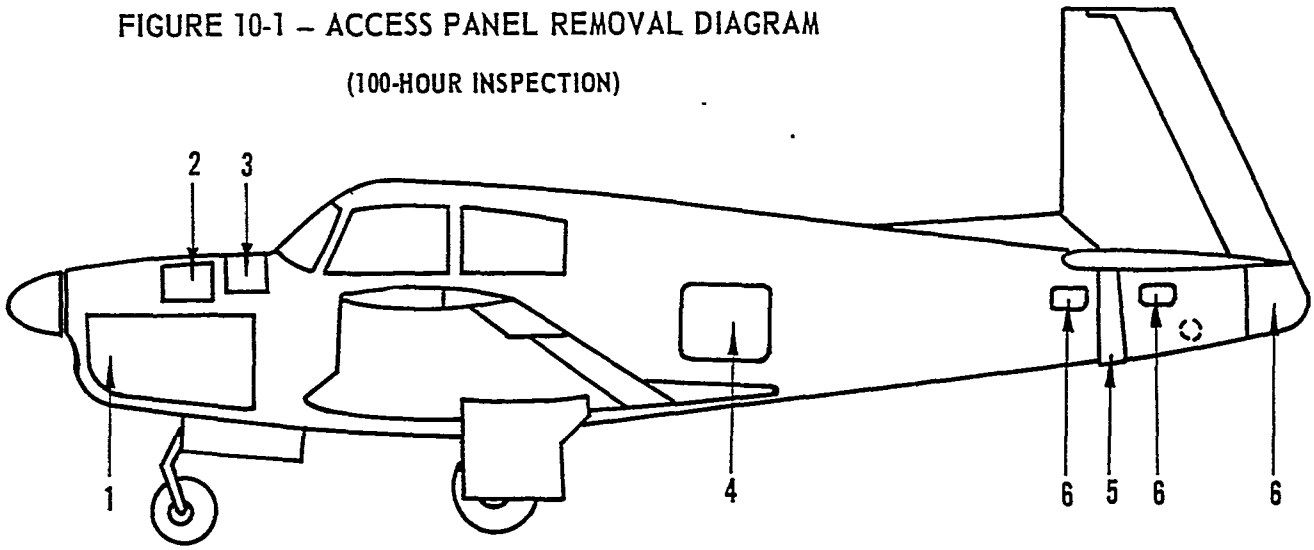
Always make certain the handcrank is fully disengaged before operating the gear electrically.

In trouble shooting the system, remember that a binding or maladjusted gear door may overload the actuating system. Remove the belly panels to examine the knife disconnects under the floor boards for loose or faulty connections. An electrical overload in the system can be discovered by connecting an ammeter in the actuating motor circuit (red wire leading from the actuating motor to the electric fuel pump circuit breaker) beneath the floor boards. Open the red wire knife disconnect and connect the ammeter poles to the disconnect terminals. During gear extension, the ammeter should read 15 to 18 amp; during retraction, 25-30 amp. An amperage reading exceeding the maximum indicates a faulty motor or electrical circuit and/or a binding in the gear action due to improper rigging or misalignment of the gear actuator and its mounting bracket.

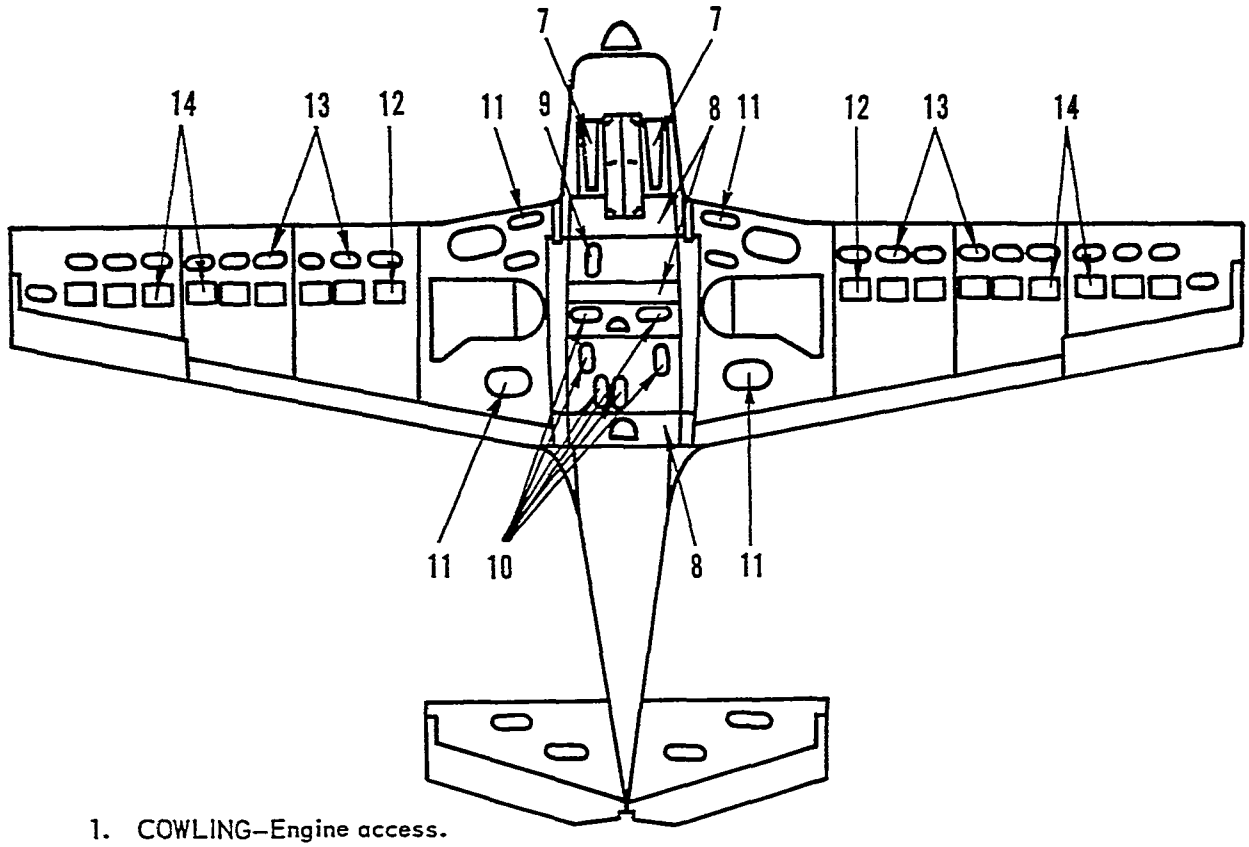
Dual warning horns (1967 & ON models) replace the landing gear-throttle warning horn and prestall indicator installed on 1962-1966 models. The low-pitch, interrupted (beep), 100 CPM horn is wired to the landing gear-throttle switch. The high-pitch, continuous, 2000 CPS warning horn is wired to the prestall warning switch.

FIGURE 10-1 – ACCESS PANEL REMOVAL DIAGRAM

(100-HOUR INSPECTION)



NOTE: M20F access panel locations are the same as M20E.

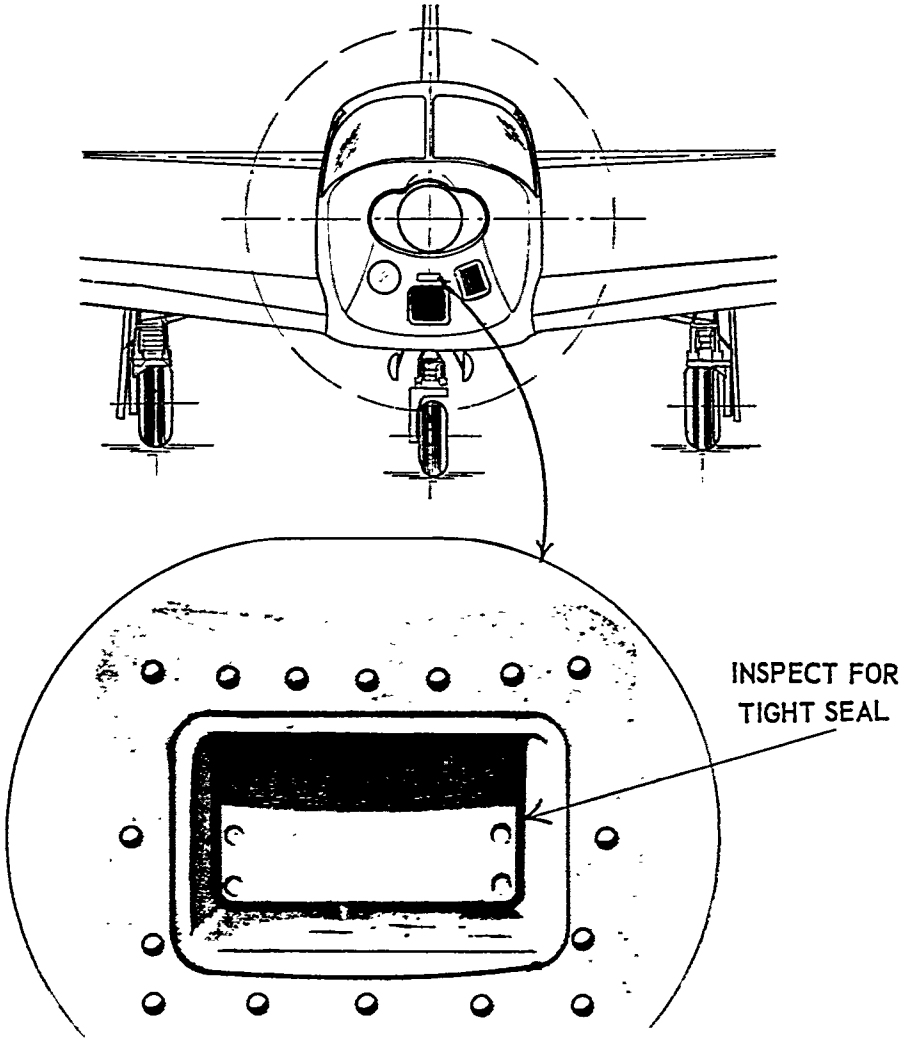


1. COWLING–Engine access.
2. ACCESS DOOR–Electrical storage battery (M20C&D)
3. ACCESS COVER–Flight instruments, hydraulic fluid reservoir and parking brake valve, PC rate gyro (1966, M20C&E)

   NOTE: The turn coordinator replaces the rate gyro and turn and bank indicator on all models 1967 & on.

4. ACCESS COVER–Electrical storage battery (M20E), PC gyro and servos, pneumatic step, control tubes, trim guide blocks.
5. FAIRINGS–Empennage attach bearings, trim jack screw.
6. INSPECTION COVERS & STINGER–Control bungees, elevator and rudder stop adjustments.
7. EXHAUST CAVITY FAIRINGS–Electric boost pump (1965 Models & On), selector valve and sump drain, fuel lines, control tubes and bungees, brake cylinders and lines.
8. ACCESS PANELS–Control tubes, main spar, flap indicator cable.
9. INSPECTION COVER–Hydraulic flap pump, stabilizer trim stop & indicator adjustment.
10. INSPECTION COVER–Control tubes & guide blocks, hydraulic flap cylinder, flap indicator cable.
11. INSPECTION COVERS–Wing attach, control tube guide blocks.
12. INSPECTION COVERS–Main gear retraction spring.
13. INSPECTION COVERS–Control tube guide blocks.
14. INSPECTION COVERS–Aileron bellcranks and stop assemblies, control tubes.

FIGURE 10-2 – POWER BOOST DOOR SEAL INSPECTION DIAGRAM (M20E)



CAUTION: To prevent engine damage during ground or dusty air operation, induction air through the Ram Air Scoop must be shut off completely so that the engine is forced to receive its air through the filter. Therefore the Seal around the Shut-Off Door must be INSPECTED REGULARLY FOR LEAKS to insure that unfiltered air cannot bypass the door when the Power Boost Control is in the "OFF" position.

SAMPLE

MOONEY AIRCRAFT, INC.
KERRVILLE, TEXAS

(For Company Use Only)
SRR No._____
Probable Cause of Malfunction: Confirmed ☐
Unconfirmed ☐

UNSATISFACTORY REPORT

Model _____ Serial No. _____ Reg. No. _____
Geographical Location
(By state or country) _____ Engine Model & Serial No. _____

Propeller Model & Serial No. _____ Total Time Since Overhaul _____

Total Time on Airplane _____ Total Time on Malfunctioning Part _____

Part No. (Mooney) _____ Manufacturer (if other than Mooney) _____

Model No. (if vendor part) _____ Serial No. (if vendor Part) _____

Warranty Replacement . . . . Yes ☐ No ☐

Airplane Owner's Name & Address _____

_____

Brief Narrative of Malfunction (or accident) _____

_____

_____

_____

_____

Probable Cause of Malfunction _____

_____

_____

_____

_____

Corrective Action Taken _____

_____

_____

_____

_____ _____
Date Signature

Mooney Rep. ☐ Service Center ☐
Distributor ☐ Owner ☐
Dealer ☐ Pilot ☐

ENG. FORM 109

SAMPLE

MOONEY M20B – M20C – M20D – M20E – M20F

100-HOUR INSPECTION GUIDE

Date.....

Owner's Name.....Address.....

Reg. No..... A/C Serial No.....Aircraft tach. time.....Hrs. Date of last periodic.....

Engine Model and Serial No.....Prop design and Serial No.....

Engine time.....hrs. Brand of oil and weight used.....

1. Is approved owners or flight manual in aircraft? --- Yes – No Current and in proper condition? --- Yes – No
2. Are current log books in aircraft? ---------- Yes – No Current and in proper condition? --- Yes – No
3. Is Registration Certificate in aircraft? --------- Yes – No Current and in proper condition? --- Yes – No
4. Is Airworthiness Certificate in aircraft? -------- Yes – No Current and in proper condition? --- Yes – No
5. Is all factory service information complied with? ---------- Yes – No
6. Are all applicable FAA Airworthiness Directives complied with? ---------- Yes – No
7. Is Weight & Balance Record current? ---------- Yes – No

ENGINE SECTION: (Refer to Lycoming Operator's Manual and Mooney Service & Maintenance Manual.)	Mechanic's Initials	Inspector's Initials
1. Remove and clean engine cowling and baffling; inspect for cracks and wash engine ----------	.....	.....
2. Perform a hot engine differential compression check: cyl. reading 1._____ 2._____ 3._____ 4._____ ----------	.....	.....
3. Lubricating System (Refer to Lycoming Operator's Manual.)		
a. Drain sump and change oil filter (if installed) ----------	.....	.....
b. Remove pressure and suction screens. Check for metal particles ----------	.....	.....
c. Clean and inspect screens. Reinstall and safety screens ----------	.....	.....
d. Check engine for oil leaks (note & correct) ----------	.....	.....
e. Inspect condition of oil cooler ----------	.....	.....
f. Service engine with recommended lubricating oil (Refer to Mooney S & M Manual.) ----------	.....	.....
4. Ignition System (Refer to Lycoming Operator's Manual.)		
a. Inspect spark plugs, replace or clean and regap ----------	.....	.....
b. Inspect ignition harness for general condition and freedom from fraying or chaffing ----------	.....	.....
c. Inspect magnetos and points; check magneto timing ----------	.....	.....
5. Electrical System (Refer to Mooney S & M Manual.)		
a. Inspect battery for security, battery box for corrosion, and vent for obstruction ----------	....	.....
b. Inspect generator and accessories ----------	.....	.....
c. Inspect electrical components and wiring ----------	.....	.....

	d. Inspect starter and starter drive; lubricate starter drive. (Refer to Lycoming Operator's Manual and Figure 2-9, Mooney S&M Manual) - - -	.....	.....
	e. Inspect landing light and navigation lights for security and operation -	.....	.....
	f. Inspect panel lights and dimming system for operation - - - - - - - - - - - - - - - -	.....	.....
6.	Fuel System, M-20B,C,D (Refer to Mooney S & M Manual.)		
	a. Inspect carburetor, clean screens, and check fuel flow - - - - - - - - - - - - - - -	.....	.....
	b. Inspect carburetor heat system for leaks and proper operation - - - - - - - - - - -	.....	.....
	c. Remove, clean, inspect, and reoil air filter -	.....	.....
	d. Inspect carburetor airbox and induction system for condition - - - - - - - - - - - -	.....	.....
	e. Inspect fuel selector valve for operation and proper pointer indication - - - - - -	.....	.....
	f. Operate boost pump; check pressure and all lines for leaks - - - - - - - - - - - -	.....	.....
	g. Clean electric fuel pump screen (1963 and previous models) - - - - - - - - - - - -	.....	.....
	h. Drain fuel sumps and fuel selector valve (R & L tanks) - - - - - - - - - - - - - - -	.....	.....
6A.	Fuel System, M-20E (Refer to Mooney S & M Manual.)		
	a. Inspect fuel injection system, clean screens, and injector nozzles (Refer to Bendix Service Manual.) -	.....	.....
	b. Check power boost system for proper operation and door seal for leaks - - - - - -	.....	.....
	c. Remove, clean, and inspect dry-air filter -	.....	.....
	d. Inspect air induction system and alternate-air valve - - - - - - - - - - - - - - - -	.....	.....
	e. Inspect fuel selector valve for operation and proper pointer indication - - - - - -	.....	.....
	f. Operate boost pump; check pressure and all lines for leaks - - - - - - - - - - - -	.....	.....
	g. Drain fuel sumps and fuel selector valve (R & L tanks) - - - - - - - - - - - - - - -	.....	.....
7.	Remove heater jacket and inspect exhaust system for leaks and cracks. Remove exhaust cavities and inspect area -	.....	.....
8.	Inspect fire wall for proper sealing and freedom from cracks - - - - - - - - - - - - - -	.....	.....
9.	Inspect engine mount, bolts, and rubber mounts for security - - - - - - - - - - - - - - -	.....	.....
10.	Lubricate engine controls and inspect for security, full travel, and free movement -	.....	.....
11.	Lubricate cowl flaps and inspect for proper opening and operation - - - - - - - - - - -	.....	.....
12.	Remove propeller spinner and check for cracks and general condition - - - - - - - - -	.....	.....
13.	Inspect propeller hub for grease leakage; check hub bolts and mounting bolts for proper torque; inspect blades for cracks, nicks, and dents; lubricate as needed (Refer to appropriate manufacturers' handbooks.) - - - - - - - - - - - - - - - - - -	.....	.....

AIRFRAME SECTION (Refer to Mooney Service & Maintenance Manual.)

1.	Inspect exterior and interior of aircraft for general condition, collision damage, loose rivets, dents, and corrosion -	.....	.....
2.	Inspect wings and empennage for general condition, collision damage, loose rivets, dents, and corrosion -	.....	.....
3.	Inspect control surfaces for security of attachment, proper rigging, free movement, collision damage, loose rivets, dents, and corrosion - - - - - - - - - - - - -	.....	.....
4.	Lubricate flight control system guide blocks, hinge points, rod end bearings, and bell cranks (Refer to Mooney S & M Manual, Figure 2-9.) - - - - - - - -	.....	.....
5.	Inspect all wing, fuselage, and empennage drain holes for obstruction - - - - - - - - -	.....	.....
6.	Inspect empennage trim system for proper operation and rigging. Lubricate in accordance with Figure 6-8 in Mooney S & M Manual - - - - - - - - - - - -	.....	.....
7.	Inspect flap system (M-20B, mechanical; M-20C,D,E, hydraulic) for proper operation and rigging. Lubricate in accordance with Figure 2-9 in Mooney S & M Manual -	.....	.....
8.	Inspect flight instruments, filters, and vacuum system for proper operation, marking, and condition. Clean vacuum air filter (1966 and subsequent models) - - -	.....	.....

9.	Inspect cabin lights, circuit breakers, and electrical components for proper operation	.....	.....
10.	Inspect PC system components for security, leaks, and proper operation. (Refer to Mooney S & M Manual)	.....	.....
11.	Inspect vacuum step for security and proper operation. (Lubricate in accordance with Mooney S & M Manual)	.....	.....
12.	Inspect wing interior in fuel tank area for fuel leaks, fuel tank vents for obstruction, and fuel filler caps for security and proper operation	.....	.....
13.	Inspect cabin and baggage doors for condition, proper operation, and sealing	.....	.....
14.	Inspect windshields and windows for cracks, crazing, scratches, and distortion	.....	.....
15.	Inspect seats and seat belts for security, proper operation, and condition	.....	.....
16.	Inspect compass and compass deviation card for proper indication and compensation. (Refer to Mooney Bulletin No. 8 [Service Instruction M20-23]).	.....	.....
17.	Inspect radio equipment for proper installation and operation	.....	.....
18.	Inspect cabin for proper sealing	.....	.....

LANDING GEAR OPERATION CHECK (Refer to Mooney S & M Manual.)

1.	Raise aircraft on jacks. (Refer to Mooney S & M Manual.)	.....	.....
2.	Inspect brakes, hydraulic brake cylinders, and hydraulic system for leaks and general condition	.....	.....
3.	Remove wheels, inspect, repack, reinstall, and safety. Lubricate brake guide pins using Silicone-base lubricant. Check wheels for free rotation and proper brake action. (Refer to Mooney S & M Manual.)	.....	.....
4.	Lubricate and inspect landing gear pivot points and moving parts. (Refer to Mooney S & M Manual, Figure 2-9.)	.....	.....
5.	Manual gear retraction system: check operation, rigging, gear warning system (lights & horn), down-lock preload, and doors for proper closing. (Refer to Mooney S & M Manual.)	.....	.....
5A.	Electric gear retraction system: check operation, rigging, gear warning system (lights & horn), up-lock mechanism, air-pressure safety switch, down-lock preload, and doors for proper sequencing and sealing	.....	.....
5B.	Lower gear with the emergency gear extension system. Do not attempt gear retraction using emergency system. (Refer to Mooney S & M Manual.)	.....	.....
6.	Inspect shock absorbers (main & nose gears) in accordance with Figures 5-12 or 5-13, Mooney S & M Manual	.....	.....
7.	Fixed gear: inspect landing gear fairing (M-20D)	.....	.....
8.	Check operation of stall warning system	.....	.....
9.	Check air seals in flap and wheel well areas	.....	.....
10.	Operate flap system. Service hydraulic reservoir. (Refer to Mooney S & M Manual for fluid specifications.)	.....	.....

POST-INSPECTION OPERATION CHECK (Refer to Mooney Owner's Manual.)

1.	Check propeller governor operation with engine running at 2000 rpm and pitch control at low pitch (high rpm); when propeller control is pulled out to high pitch (low rpm), engine speed should decrease at least 500 rpm	.....	.....
2.	Check ease of operation for all engine controls with engine running	.....	.....
3.	Check generator output indication	.....	.....
4.	Check oil pressure indication	.....	.....
5.	Check fuel pressure indication	.....	.....

6.	Check fuel quantity indication	.....	.....
7.	Check cylinder head temperature indication	.....	.....
8.	Check oil temperature indication	.....	.....
9.	Check idle rpm, idle mixture, and idle cutoff	.....	.....
10.	Check propeller pitch through range	.....	.....
11.	Check cabin and panel lights	.....	.....
12.	Check radio operation	.....	.....
13.	Check autopilot operation	.....	.....
14.	Check magneto drop and ground	.....	.....
15.	Check brake operation	.....	.....
16.	Check fuel selector valve operation	.....	.....
17.	Test vacuum warning lights and instruments for proper operation	.....	.....
18.	Flight check gear-up warning horn at 12" manifold pressure	.....	.....
19.	Flight check aircraft rigging and PC system for proper operation	.....	.....
20.	Make a cabin ventilation and heating system carbon monoxide check	.....	.....

SECTION

11

PAINTING AND PREVENTION OF CORROSION

SECTION X I
PAINTING & PREVENTION OF CORROSION

A. GENERAL

This section lists paint materials and recommended painting procedures. Corrosion control techniques are also discussed along with suggested procedures for zinc chromating internal airframe surfaces.

B. PAINTING

The exteriors of all new M20 series aircraft are painted with acrylic enamel. This finish should be frequently cleaned with an aircraft-type washing compound when exposed to salt air or an atmosphere having corrosive fallout. Aircraft should be hangared when not in use.

1. Materials.

   a. #3319 (Code 033650) solvent-type cleaner, Dupont Prepsol

   b. Cheesecloth; Sandpaper, 3M, 180-400-600 grit.

   c. T-657 cleaning solvent
   3094 (Code 035210) wash thinner, Enmar

   d. Body putty or aerodynamic filler (Taylor & Art Plastics, Flax-Bond "C" or 3M Co. Flex)

   e. EX1858A (Code 034150) filler/primer, Enmar Gray
   MX22B (Code 035130) dope and lacquer thinner

   f. EX2016G (Code 034175) vinyl-type zinc chromate primer, Enmar
   EX2016G (Code 035120) vinyl-type reducer

   g. 82A25414 (Code 030730) exterior base acrylic enamel, Enmar Ermine White
   T1866A (Code 035170) acrylic enamel thinner

   h. Refer to Table 8 for exterior color coat material callout.

   i. Refer to Table 8 for exterior trim material callout.

   Factory recommended replacement exterior trim finish:
   61P-34929, P-38502 Enmar Sierra Gold (synthetic finish)
   C-85 thinner
   Do not use sealcoat with synthetic finish.

   j. T1411 (Code 035150) burn-down thinner

   k. 27H25414 (Code 033550) lacquer, Enmar Ermine White (tubular steel structure)
   MX22B (Code 035130) dope and lacquer thinner
   8585A (Code 034105) low moisture sensitive zinc chromate primer

   l. EX-1707 (Code 033130) acid-resistant black paint (battery case and exhaust areas)
   MX22B (Code 035130) dope and lacquer thinner

   m. Refer to Table 8 for interior trim material callout.

2. Procedures

a. For uniformity of finish appearance, prepare only entire skin panels for repainting. First, clean the area to be repainted with the solvent-type cleaner. Wipe on, then wipe off cleaner with cheese cloth or clean towels until surface is dry. Second, sand areas to be painted as needed–start with No. 400 grit (wet or dry) and finish with 600 to 800 grit. Third, reclean entire area to be painted with the solvent-type cleaner, wipe clean, and mask-off adjoining areas that will not be painted.

b. To fill dents, use a flexible plastic welding compound (body putty or aerodynamic filler). Carefully follow instructions printed on the container.

c. All spray-applied paints must be mixed in a one-to-one proportion (50-50) with their appropriate thinners. When using a large compressor unit and regulator, maintain a 60 PSI spraying pressure and be sure intake air is properly filtered. A portable spray pot should be set to maintain a 40 PSI minimum spray pressure. Work only in a dust and moisture controlled painting area.

d. Use a face respirator to prevent inhalation of paint dust. It is recommended that the workman apply a light coat of vaseline to his hair and exposed skin to allow easy removal of paint stains with a mild soap solution.

e. Always test-spray a new paint mixture on masking paper before proceeding with the application. Hold the spray nozzle eight to ten inches from the surface. Spray in cross patterns with vertical stroke movements first and then with horizontal movements over the same area.

f. Apply vinyl-chromate primer mixed with vinyl-type reducer to newly installed unpainted skins. Apply one coat of appropriately thinned gray primer (Enmar filler) to previously painted surfaces that have been properly prepared for repainting. Allow primer to dry run-free, then spray three coats of the properly mixed finish paint.

g. All acrylic enamel paints have a tendency to "orange peel" when sprayed too close to the panel or when the paint viscosity is too high. The addition of an equal part of burn-down thinner to the thinned finish paint will eliminate orange peel effect due to improper thinning.

h. Apply three coats of white base and/or color finish allowing three to five minutes between coats depending upon weather conditions. Allow five to ten minutes between coats in cold, dry weather; in humid weather, each coat should dry in fifteen minutes.

i. Do not thin acid-resistant black paint or exterior finish touch-up paint for brush-on application. Use a small round watercolor brush trimmed to a point for application of undiluted touch-up paint to small scratches and bare spots. A handy rack for touch-up paint storage can be made from babyfood jars mounted in a wooden rack.

TABLE 8 – EXTERIOR PAINT CHART

YEAR	MODEL	PART NO.	DESCRIPTION		LOCATION
1962	M-20C	82A-28378	TITIAN RED,	Acrylic Enamel	Exterior Trim
1962	M-20C	82A-27633	BLUE METALIC,	Acrylic Enamel	Exterior Trim
1962	M-20C	82A-28161	DARK GOLD,	Acrylic Enamel	Exterior Trim
1962	M-20C	82A-27630	BLUE METALIC,	Acrylic Enamel	Exterior Bottom
1962	M-20C	82A-28303	ROMAN RED,	Acrylic Enamel	Exterior Bottom
1962 & 1963	M-20C	27H-20800	SPICE BROWN,	Acrylic Enamel	Interior Trim
1962 & 1963	M-20C	82A-26183	LIGHT GOLD,	Acrylic Enamel	Exterior Bottom
1963	M-20C	82A-29626	GUNMETAL,	Acrylic Enamel	Exterior Trim
1963	M-20C	82A-29629	FROSTED TURQUOISE,	Acrylic Enamel	Exterior Bottom
1963	M-20C	82A-29744	FROSTED GREEN,	Acrylic Enamel	Exterior Bottom
1963	M-20C	82A-29745	FROSTED COPPER,	Acrylic Enamel	Exterior Bottom
1963	M-20C	82B-29801	FROSTED RED,	Acrylic Enamel	Exterior Bottom
1963	M-20D	82A-29801	FROSTED RED,	Acrylic Enamel	Exterior Bottom
1964	M-20C,D&E	82A-31499	METALLIC ORANGE,	Acrylic Enamel	Exterior Bottom
1964	M-20C,D&E	82A-32014	SILVER BLUE, Met.	Acrylic Enamel	Exterior Bottom
1964	M-20C,D&E	82A-32015	LIGHT EMERALD, Met.	Acrylic Enamel	Exterior Bottom
1964	M-20C,D&E	82A-32016	BERLY BLUE, Met.	Acrylic Enamel	Exterior Bottom
1964	M-20C,D&E	27H-23455	SAND BEIGE,	Acrylic Lacquer	Interior Trim
1964	M-20C,D&E	27H-20800	SPICE BROWN,	Acrylic Lacquer	Interior Trim
1964	M-20C&D	82B-31885	CANYON GOLD, Met.	Acrylic Enamel	Exterior Trim
1964	M-20E	82A-32264	DARK CANYON GOLD, Met.	Acrylic Enamel	Exterior Trim
1965	M-20C,D&E	82B-34923	YELLOW,	Acrylic Enamel	Exterior
1965	M-20C,D&E	82B-34924	BLUE,	Acrylic Enamel	Exterior
1965	M-20C,D&E	82B-34925	RED,	Acrylic Enamel	Exterior
1965	M-20C,D&E	82B-34929	SIERRA GOLD,	Acrylic Enamel	Exterior
1966	M-20C,D&E	82B-37781	GREY,	Acrylic Enamel	Exterior
1966	M-20C,D&E	82B-37778	RED,	Acrylic Enamel	Exterior
1966	M-20C&D	82B-37780	BLUE/GREEN,	Acrylic Enamel	Exterior
1966	M-20E	82B-37775	BRILLIANT BLUE,	Acrylic Enamel	Exterior
1966	M-20E	82B-37776	BRILLIANT GREEN,	Acrylic Enamel	Exterior
1967	M20C,E,&F	82B34925	POPPY RED	Acrylic Enamel	Exterior
1967	M20C,E,&F	82B39276	BRITE ROSE	Acrylic Enamel	Exterior
1967	M20C,E,&F	82B39283	BRITE ORANGE	Acrylic Enamel	Exterior
1967	M20C,E,&F	82B39295	GOLD	Acrylic Enamel	Exterior Trim
1967	M20C,E,&F	82B40054	MOONEY WHITE	Acrylic Enamel	Base Color
1967	M20C,E,&F	82B37781	GRAY	Acrylic Enamel	Exterior Trim
			MISCELLANEOUS PAINTS & MATERIALS		
ALL	ALL	82B-25414	WHITE,	Acrylic Enamel	General Exterior
ALL	ALL	MX-11-43	OVERCOAT,	--	General Exterior
ALL	ALL	MX-22B	THINNER,	Lacquer	General Exterior
ALL	ALL	MIL-5044	BLACK,	Non-skid Wing Walk	General Exterior
ALL	ALL	#633	TAPE,	Gold Decorating	General Exterior
ALL	ALL	#630	TAPE,	Chrome Decorating	General Exterior
ALL	ALL	MX-144B	BLACK,	Temporary Marking	--
ALL	ALL	MIL-D-8585A	PRIMER,	Zinc Chromate	Structure
ALL	ALL	EX-1707	BLACK,	Acid Proof	Structure
ALL	ALL	E-6889	PRIMER,	Zinc Chromate (spray can)	Structure
ALL	ALL	EX-2016G	PRIMER,	Zinc Chromate (vinyl type)	Structure
ALL	ALL	#23-622	BLACK,	Lacquer	Structure
ALL	ALL	EX-1858-A-60	PRIMER,	Light Gray	Structure
ALL	ALL	T-6070	THINNER,	Zinc Chromate	Structure
1965	M20C,D,&E	EX-6176	BEIGE	Baked Enamel	Interior Trim
1965 & 1966	M20C,D,&E	#4205	LAREDO TAN	Lucite	Interior Trim
1966	M20C,D,&E	27H-25988	ECRU	Lacquer	Interior Trim
1966	M20C,D,&E	27H-3808	GRAY	Lacquer	Interior Trim
1966	M20C,D,&E	27H-24697	CARPET BEIGE	Lacquer	Interior Trim

NOTE: 1967 and 1966 M20D paints and materials are identical.

C. CORROSION DETECTION & PREVENTION

Most metalic fabrication materials are susceptible to corrosion. Corrosion may occur on aircraft in any climate, but it will be a problem more often in areas where the aircraft is exposed to salt air or high humidity, or where there are industrial contaminants in the atmosphere. The aircraft should be inspected frequently to detect and correct corrosion before serious damage occurs.

1. Types of corrosion.

Corrosion normally appears in one or more of four forms. Each type of corrosion can be precluded or controlled by a preventative maintenance program.

a. Chemical corrosion

Chemical corrosion normally occurs where battery acid or exhaust gases come in contact with metal surfaces. A few simple precautions will prevent chemical corrosion.

1. Be sure that the battery vent is free from obstruction at all times.

2. All scratches and worn spots, found in areas painted with acid-resistant paint, should be repainted at once.

3. If acid is spilled on metal surfaces, flush the entire area with sodium bicarbonate add water. The solution should be rinsed away at once and the area dried by driving all water from crevices with an air hose before wiping the surface dry with a clean cloth.

4. Frequently clean exhaust gas deposits from metal surfaces.

b. Local-cell corrosion

Local-cell corrosion is easy to detect. On bare metal surfaces, in an early stage of development, it appears as a light, whitish powder deposit. Surface pits warn of advanced local-cell corrosion. On painted surfaces, the first indication of corrosion will be evidence of paint blistering.

Any form of corrosion should be removed at once upon detection. If it is necessary to remove paint, only an approved aircraft paint remover should be used. Care should be taken that paint removing substances are not allowed to remain in metal crevices, for this will cause further corrosion. Turco 2662C or 3002 will remove corrosion and treat the metal surface in one application.

c. Concentration cell corrosion.

Corrosion forming under rivet heads, along faying surfaces, or at skin to longeron contact surfaces is called concentration cell corrosion. Detection requires close inspection. Rivets must be removed and skin laps must be separated to remove concentration cell corrosion. Use aluminum wool soaked in kerosene to scour corrosion deposits from the surface before painting both faying surfaces with zinc chromate primer and reassemblying.

d. Galvanic corrosion

Galvanic corrosion sometimes occurs between dissimilar metals such as stainless steel and aluminum. To remove this form of corrosion, separate the parts, remove the corrosion, and paint both surfaces with zinc chromate primer before reassembling.

Further recommended procedures for corrosion control are outlined in Turco Products Technical Data Bulletin #184. Write Turco Products, Inc., P.O. Box 1055, Wilmington, California.

2. Hints on preventing corrosion.

   a. Thoroughly examine unpainted metal surfaces at inspections and check corrosion when found. Carefully examine seams, lap joints, and crevices where moisture or dirt can collect. Areas exposed to exhaust gases require frequent inspection and cleaning.

   b. Corrosion may attack metal even though the surface is painted. Inspect painted areas for a blistered or scaly appearance that warns of corrosion below the paint layer.

   c. Use only aircraft detergents to wash the exterior airframe. Cover vent scoops when the aircraft is being washed. Rinse the exterior after exposure to salt air or industrial fallout.

   d. Since moisture promotes corrosion, areas where water is apt to collect must be inspected thoroughly and frequently. Use an air hose to drive water from crevices before wiping the exterior surface dry after washdown.

   e. Hangar the aircraft when not in use.

   f. If battery acid is spilled on any part of the aircraft, wash the area immediately with a solution of sodium bicarbonate in water. Rinse with water and dry with clean towels.

3. Zinc chromating.

   Zinc chromating internal surfaces of the airframe will greatly retard corrosion. However, chromating will not eliminate the necessity of periodic inspection aimed at detection of trouble spots, especially in those areas where it is impracticable to apply zinc chromate (skin laps, fayings, etc.). If deep corrosion is found, it should be removed by sanding with emery cloth of approximately 320 grit. Aluminum etching compounds are not recommended for corrosion removing, because they cannot be readily neutralized.

   a. Materials

      1. Cleaning solvents

         a. T-657 cleaning solvent–Turco Products, Inc., 6135 South Central Avenue, Los Angeles, California.

         b. #394 wash thinner – Enmar, Inc., 25th & N.Y. Avenue, Wichita, Kansas.

      2. Zinc chromate

         a. #EX13924 zinc chromate primer (Mil. Spec. P-8585A)–Enmar, Inc., 25th & N.Y. Avenue, Wichita, Kansas.

      3. Safety mixing can

         a. #10308 Justrite Manufacturing Co., Chicago, Illinois.

   b. Procedure

      1. Cleaning

         a. Pour a portion of the cleaning fluid into the safety mixing can.

         b. Wipe the area to be cleaned with a clean rag dipped in the cleaning fluid.

         c. Wipe the cleaned area with a rag dipped in the cleaning solvent. The entire area to be painted should be cleaned before application of the primer.

            CAUTION: Wipe solvent is toxic and flammable. Do not smoke within 25 feet of the exposed solvent. Force air through the painting area and use only explosion-proof lights.

SHOP NOTES

APPENDIX

SERVICE SHOP TOOLS & EQUIPMENT

I. AIRFRAME

SOURCE	TOOL	PART NUMBER
Commercial	Jack and stand	
Mooney Distributors	Gear retraction spring replacement tool	8186
Mooney Distributors	Landing gear retracting truss torque tool	010011 010008
Mooney Distributors	Travel boards	010013001—Rudder 010012001—Elevator 010007001—Flap
Mooney Distributors	Shock disc replacement tools	ME 120 ME 121
Commercial	Torque wrench	TQ-51-A (or equiv.)
Peterson Mfg. Co., DeWitt, Neb.	Wide-jaw vice grips for control surface trimming (See Figure 6-3 in Mooney Service & Maintenance Manual)	
Brittain Industries	Positive Control system test kit	TS-100
Mooney Distributors	AMP connector kit	
Mooney Distributors	Solderless terminal tool (3 sizes available)	
Commercial	Battery charger	
Commercial	OHM meter	
Commercial	AMP meter	
Commercial	Grease gun	
	Tools for sheet metal work:	
Commercial	Rivet gun	
Commercial	Air drill	
Commercial	Cutters	

Note: No. 5 and 6 huckrivet tool for landing gear conversion or wing spar repair can be obtained from Aircraft Tools, Inc., 9030 Bellanca Ave., Los Angeles 45, California.

II. ENGINE AND ACCESSORIES

Commercial	Differential compression tester	
Commercial	Spark plug cleaner	
Commercial	Gap setting tool	
Commercial	Growler	
Lycoming	Cylinder base nut wrench	64943-64942
Lycoming	Valve spring compressor	1130-B
Lycoming	Ring compressor	
Bendix	Timing kit (Bendix)	11-8150
Bendix	Timing light (Bendix)	Model A1D (or equiv.)
Bendix	Piston position indicator	

MOONEY AIRCRAFT PART NUMBER

CROSS REFERENCE INDEX

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110001	8585
110002	7344
110003	7345
110004	7274
110009	8610
120000	8062
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120002	8282
120003	8704
120004	8531
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130044	8345
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130055	8596
130056	8671
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130058	8310
130065	8504
130066	8576
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140069	8035
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140073	3658
140074	3663
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150004	6458
150011	8519
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150013	8521
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160003	8654
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210030	2210
210031	2209
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210045	2185
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210051	2244
210052	2216
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210054	2213
210055	2165
210056	2166
210057	2212
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210092	2281
210093	2284
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210095	2270
210096	2267
210097	2231
210098	2238
210099	2235
210100	2240
210101	223
210102	2214
210103	2323
210104	2220
210105	2249
210106	2219
210107	2181
210108	2277
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210110	2276
210111	2275
210112	2307
210113	2313
210114	2326
210115	7302
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210117	7232
210118	7252
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210121	2315
210122	2243
210123	2258
210124	2318
210125	2319
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240009	2268
240010	2269
240011	2298
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310000	3011
310001	3016
310002	3032
310003	3037
310004	3038
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310008	3123
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New No.	Old No.	New No.	Old No.	New No.	Old No.
310020	3185	310076	3358	310132	3984
310021	3192	310077	3361	310133	3988
310022	3193	310078	3364	310134	3990
310023	3194	310079	3336	310135	3991
310024	3196	310080	3367	310136	3992
310025	3197	310081	3368	310137	3995
310026	3200	310082	3369	310138	3996
310027	3212	310083	3370	310139	3997
310028	3214	310084	3371	310140	3524
310029	3215	310085	3372	310149	3359
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