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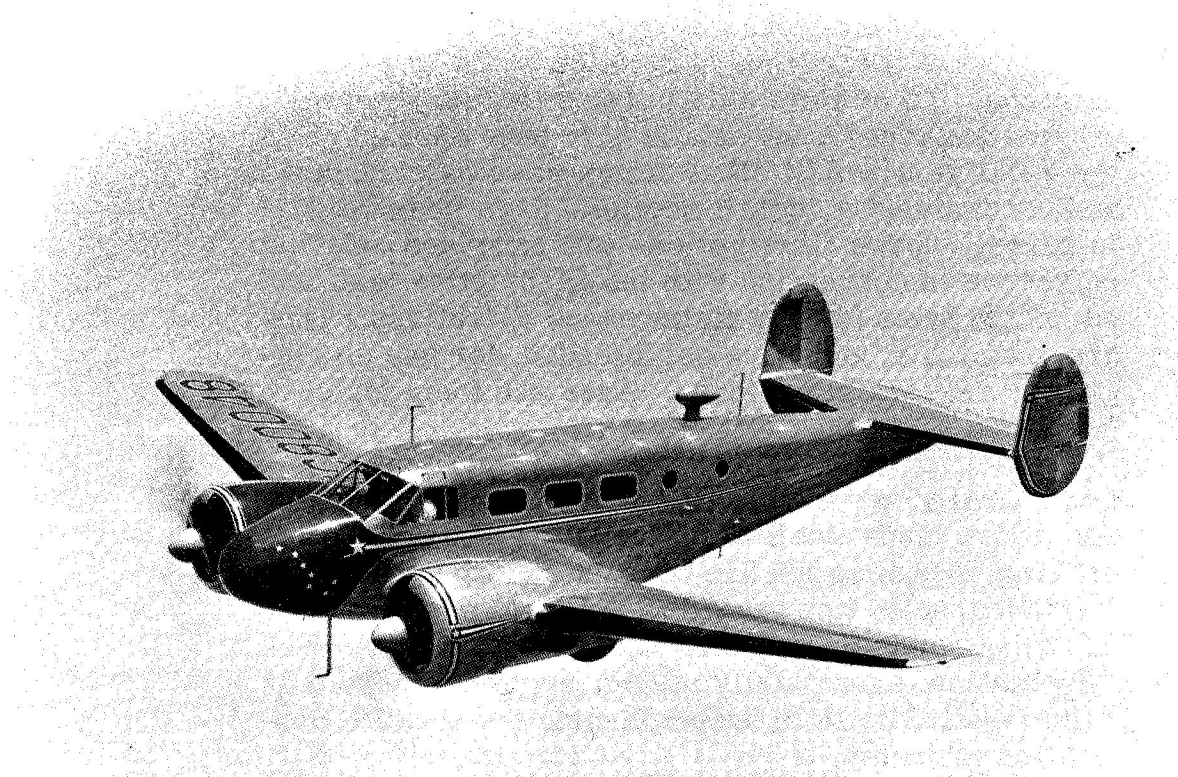
MODEL D18 MAINTENANCE MANUAL



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WARNING

The illustrations in this manual which show the routing of cables, plumbing and wiring harnesses are intended to give the reader a simplified, overall picture of the systems portrayed, in relation to the rest of the airplane. To achieve this purpose within the limits of a printed page, many details have been omitted while the relative sizes of other items have been changed and, occasionally, detail sections have been rotated in plane. These illustrations are provided only for reference in connection with the descriptive text, and not as the basis for any maintenance operations. They are unsuitable, and were not intended, for use as rigging or reassembly guides. Never use them for such purposes.

Occasionally, when a specific adjustment or assembly procedure lends itself to pictorial presentation a line drawing or photograph has been used, with specific information on its face regarding points of measurement, adjusting points or procedures, or similar data. Such information, specifically stated, may be accepted as valid for direct use in accomplishing the specific procedures indicated.

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Kit No. D18-60 Date: February 20, 1952

THIS KIT IS SUPPLIED IN COMPLIANCE WITH SERVICE BULLETIN D18-60

Handbook revisions are issued by the Beech Aircraft Corporation to keep owners, distributors, and operators fully informed on the latest equipment design changes and service techniques. Insert those pages in the Model D18S and D18C Maintenance Manual in accordance with instructions printed on each page.

This kit of revised pages (Kit D18-60) may be ordered through your BEECHCRAFT distributor at a list price of $5. This price also includes the mailing and handling charges for any further revisions issued during the current calendar year. The date on the title page of your manual must be specified when ordering revision kits.

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* The asterisk indicates pages revised, added or deleted by the current revision.

INTRODUCTION

This Service and Maintenance Manual is issued for the guidance of those operating and servicing the Beechcraft Models D18S, D18C, and D18CT. The information contained herein does not supersede any instructions given in existing Civil Aeronautics Regulation. Other specific information not contained in this manual will be gladly furnished by the Engineering Service Division.

Complete instructions for the service and maintenance of the Beechcraft D18S, D18C, and D18CT are contained in this manual. This information is the summation of experience gained in the operation of these models through many varied conditions. If the need arises to vary from these instructions, the Engineering Service Division of Beech Aircraft Corporation should be contacted before deviating from the information contained herein.

Wherever reference is made to the Model D18C which is licensed under Civil Aeronautics Authority, Part 03, it should be understood that reference is also made to the Model D18CT, which is licensed under Civil Aeronautics Authority, Part 04. In addition all models are referred to in General Information as Model D18 airplanes.

GENERAL INFORMATION

The D18S and D18C airplanes are twin engine, land monoplanes of all metal semi-monocoque construction, powered by two radial, air-cooled engines. The D18S is powered by 450 HP Pratt and Whitney Wasp Jr. engines, with each engine driving a two bladed Hamilton Standard counterweight Propeller. The D18C is powered by 525 HP Continental engines, that are equipped with Hamilton Standard Quick Feathering Propellers. The Model D18 airplanes are equipped with electrically operated retractable landing gear, dual flight controls, and hydraulic brakes. A baggage space is provided in the nose compartment and is accessible through the nose door. Additional baggage space is provided, in the lavatory compartment, at the aft end of the cabin. The capacity of the baggage compartment varies with the seating arrangements and the equipment in the nose compartment. Access to the cabin is made on the left side of the fuselage, just aft of the wing. For emergency purposes, the cabin door may be completely removed from the airplane by following the placarded directions; an emergency exit on the right side of the cabin may be removed by a similar operation.

GENERAL CHARACTERISTICS

The Model D18 airplanes have excellent flight characteristics, that are insured by quick response to control movement. The airplanes have demonstrated good landing characteristics, even in a strong cross wind if proper precautions are taken. The wing flaps should be lowered approximately 25°, and the throttle should be set to compensate for the cross wind. Stall warning is given by a tail buffeting, that is set up at approximately 10 MPH above the actual stall. The single engine operation of the D18 is exceptionally good with the Hamilton Standard Hydromatic Quick Feathering Propellers. It is suggested that ground turning be made by using the brakes in conjunction with the throttles, and the tail wheel lock, that is provided for take-off and landing, must be unlocked when turning. Unlimited vision, gives the pilot a complete view of the runway and adjacent areas of the fligh path, when landing.

CONTROL SURFACES

The Model D18 airplanes have conventional control surfaces, that are constructed of aluminum alclad frame and are fabric covered. The flaps are operated electrically and have provisions for manual operation, in case of electrical failure. The rudders, elevator, and left aileron is equipped with an adjustable trim tab. The rudder and aileron tabs have mechanical position indicators, while the elevator tabs and wing flaps have variable resistance units, that show their position by dial indicators mounted adjacent to their respective controls. The tab controls are easily accessible to both the pilot and co-pilot and operate in a natural direction for the desired reaction of the airplane. The elevator, rudders, and wing flaps are coupled to stationary surfaces by ball bearing type hinges while the ailerons are attached to the outboard wings by piano-type hinges that extend the full length of the aileron.

FLIGHT CONTROL SYSTEM

The dual system of flight controls is conventional. Toe-brake pedals are mounted on both the pilot's and co-pilot's rudder pedals, thereby enabling the co-pilot as well as the pilot to execute landings or take-offs.

INTERIOR FURNISHINGS

The Model D18 provides various passenger capacity and seating arrangements. In addition to the various seating arrangements, the customer has his choice of two types of comfortable form fitting chairs; the adjustable reclining chair or the rigid non-reclining chair. To accommodate the individual size of the pilots flying the airplane, the pilot's and the co-pilot's seats are adjustable; thereby permitting the pilots to sit in a relaxed and comfortable position. Each passenger may control the temperature of the fresh air in his vicinity by regulating the air outlets adjacent to his seat. The hot air outlets are on the cabin walls near the floor line, and the cold air outlets are in the cabin wall just above the cabin windows. For further passenger convenience, window curtains that may be pulled together to exclude the light, individual ash trays, and reading lights are provided; also a chemical toilet is in the enclosed baggage compartment. The customer also has a choice of the quality and the color combinations of upholstery for the cabin and the pilot's compartment. In addition, the pilot's compartment and the cabin are completely sound proofed to diminish engine noise to such an extent that normal conversation is permitted.

INSTRUMENTS

The modern and efficient instrument panel is equipped with complete engine and flight instruments for normal day or night flying. Additional instruments are available upon request.

LANDING GEAR

The landing gear is of the conventional type with all wheels retracting simultaneously. The gear is retracted electrically or may be operated manually in case of a failure in the electrical system. The landing gear consists of an air-oil shock absorber with the piston supporting the wheel; this shock strut design gives a long stroke to the piston, permitting taxiing over rough ground and landing with greater ease. A 360° full swiveling tail wheel is installed with a lock that holds the tail wheel in position for take-off or landing. The landing gear doors are opened and closed mechanically being actuated by the operation of the landing gear. Red and green warning lights, on the left fixed panel, give the position of the landing gear; in addition a warning horn will sound if the throttles are closed and the gear is in the retracted position. The single disc type hydraulic brakes are self compensating and require no brake clearance adjustment during the life of the brake linings. A parking brake handle is located on the control pedestal; the brakes may be set by operating the pilot's toe-brake pedals to pressurize the system, before pulling and locking the parking brake handle.

ELECTRICAL SYSTEM

The Model D18 airplanes are equipped with a 24-volt DC electrical system having two generators and storage batteries connected in parallel to furnish the power. The batteries are connected to the electrical system by solenoid switches that are controlled, from the sub-panel of the pilot's compartment, by the battery master switches. In case of an emergency, the battery master and the generator master switches may be snapped off simultaneously be the bar like master switch. The electrical system has incorporated three types of switches; toggle, micro, and solenoid. All operational switches are labeled as to their circuit and operation. All electric circuits are protected from electrical overloading by fuses or manual reset circuit breakers. Spare fuses are carried in the spare fuse box under the pilot's seat. Retractable landing lights are installed in the underside of each wing and are controlled by separate toggle action switches. The lights automatically turn on when they are nearly extended and automatically turn off when they start retracting. When the lights are in the fully extended position, they may be turned off by placing the control switches in the neutral position.

RADIO

The radio equipment may be selected by the customer from the current lists of available transmitting, receiving, and navigation equipment.

POWER PLANT

The major difference between the D18S and D18C is the power plant. The power plants of both models are similar inasmuch as they use two 9 cylinder, radial, air-cooled, direct drive, single stage blower type engines, but differ in make and horse power rating. The power for the D18S is supplied by two Pratt & Whitney Wasp Jr. engines developing 450 HP at 2300 RPM, drawing 36.5 inches of manifold pressure. The bore and stroke of the Wasp Jr. is 5.1875 inches. The D18C is powered by two Continental engines developing 525 HP at 2300 RPM, drawing 43 inches of manifold pressure. The Continental engine has a bore of 5.00 inches and stroke of 5.50 inches.

CARBURETOR

The carburetor on the two types of engines differs in that the Pratt & Whitney engine uses a float type carburetor, while a fuel injection carburetor is used on the Continental engine. The float type carburetor has a manual mixture control, while the pressure injection carburetor utilizes an altitude compensator which automatically regulates the mixture for changes in altitude and atmospheric conditions.

IGNITION

Both type engines use similar magnetos. The two magnetos on each engine supply a high tension current for the ignition system. The magneto switch, located on the pilot's right sub-panel, consists of a toggle type master ignition switch and a three position switch for the two magnetos of each engine. Each ignition system has an induction vibrator to aid in starting the engine. The ignition harness and spark plugs are shielded to prevent radio interference.

STARTER

An electrical starter is mounted on the accessory section of each engine. The starter is energized when the solenoid switch is closed by the operation of the engine selector switch, that is located on the pilot's left sub-panel.

GENERATOR

An engine driven generator is also mounted on the accessory section of each engine. They are wired in parallel and furnish the power for the electrical system and restore the batteries to full charge. The output of the generator varies with the speed of the engines and the setting of the voltage regulators.

PROPELLERS

The D18S, is equipped with Hamilton Standard Counterweight Propellers, but Hamilton Standard Quick Feathering Propellers may be installed, if requested by the customer. The Hamilton Standard Quick Feathering Propellers are standard equipment on the D18C. Both the counterweight and the hydromatic quick feathering propellers have governors that use engine oil under governor pressure, to maintain constant engine speed. The hydromatic propellers utilize electrically driven auxiliary pumps to supply engine oil under sufficient pressure to feather or unfeather the propeller blades. A permanent oil reserve is provided to assure quick feathering of the propellers.

FUEL SYSTEM

Both the D18S and D18C have a normal

fuel capacity of 202 gallons. An 80 gallon bladder type nose tank may be installed, if desired for the D18S, to increase the fuel capacity to 282 gallons. A 50 gallon metal nose tank may be installed to increase the usable fuel of the D18C to 252 gallons. A 76 gallon front tank and a 25 gallon rear tank is installed in each of the center section wings. Each fuel tank has a liquidometer which registers the quantity of fuel on the fuel quantity gauge. A fuel gauge selector, on the left fixed panel of the pilot's compartment, is used to obtain the individual tank reading on the fuel quantity gauge. Through the use of the fuel selector valves and the suction cross feed valve, fuel from any one tank is available for either engine. The suction cross feed system differs from that of the pressure cross feed system in that only one fuel pump may be utilized for each engine.

OIL SYSTEM

Each engine has an 8 gallon oil tank in the upper section of the nacelles. The oil tank caps are placarded as to the tank capacity and are equipped with graduated stick gauges. On the airplanes that have hydromatic propellers a standpipe in the oil tank assures approximately a $1\frac{1}{2}$ gallon reserve of oil to feather and unfeather the propeller blades, thereby leaving approximately $6\frac{1}{2}$ gallons of usable engine oil.

OPTIONAL EQUIPMENT

The Models D18S and D18C are complete airplanes upon delivery, but additional equipment may be purchased, to meet the special requirements of an individual customer, from the optional equipment list as follows:

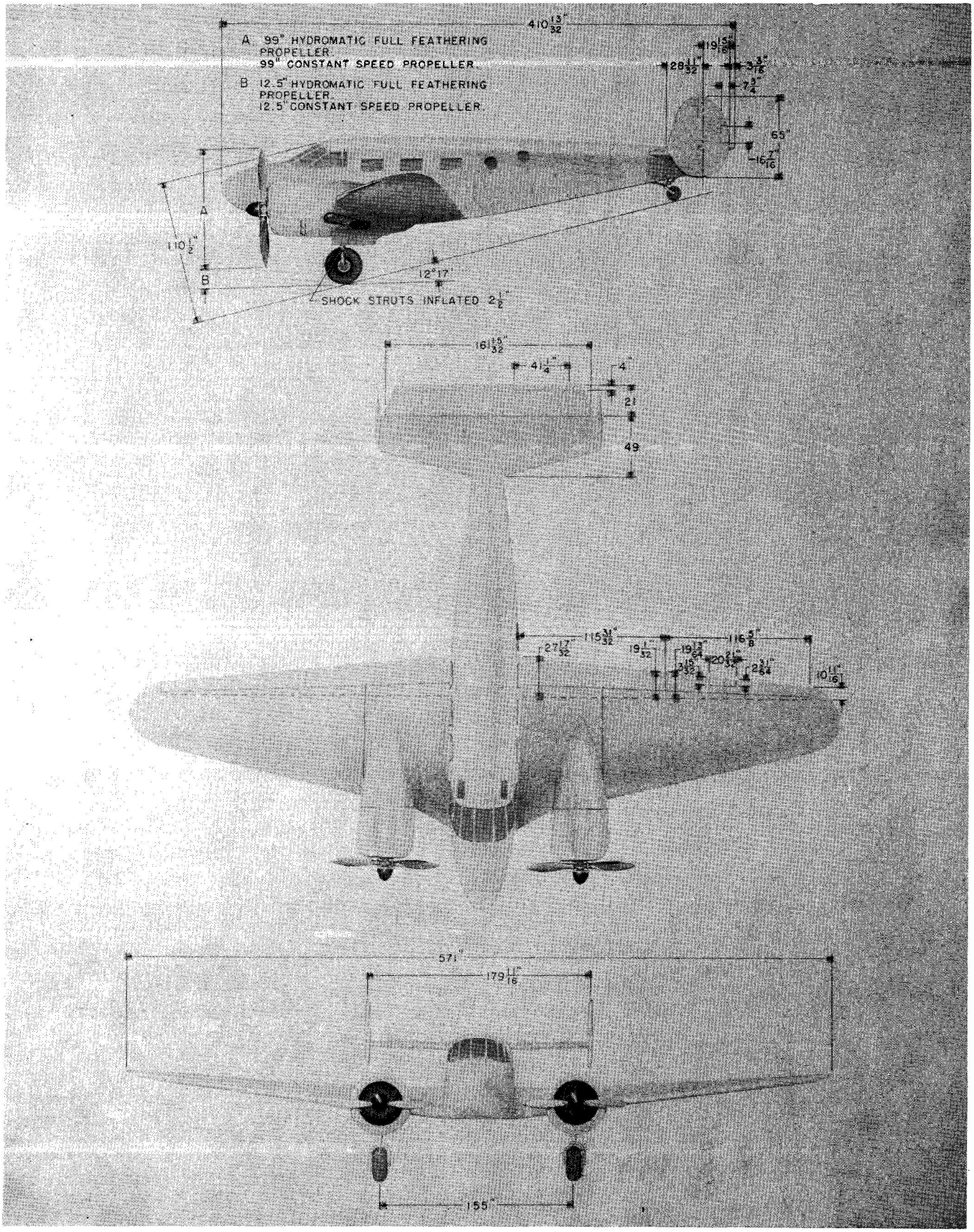
- De-Icer Equipment
- Anti-Icer Equipment
- Auxiliary Fuel Tank
  - 80 gallon nose bladder type D18S
  - 50 gallon nose metal type D18C
- Dust-Proof Spinner (not used on hydromatic propeller)
- Hydromatic Quick Feathering Propellers (optional - D18S only)
- Windshield Wiper Assembly
- Pilot's Relief Tube
- Thermos Jugs and Holders (for 1 or 2, two quart bottles)
- Radio Equipment (from current lists)
- Chair Protector
- Rug Pad Installation

Additional instruments may be installed on D18S and D18C. The D18CT's have a complete air line instrument panel as required by C.A.A.

Insert this page after Page 6.

FUEL SYSTEM

On later model airplanes (Serial A537 and after) the fuel gauge selector switch has been moved onto the floating instrument panel.


A 99" HYDROMATIC FULL FEATHERING PROPELLER.
99" CONSTANT SPEED PROPELLER.
B 12.5" HYDROMATIC FULL FEATHERING PROPELLER.
12.5" CONSTANT SPEED PROPELLER.
SHOCK STRUTS INFLATED 2½"
12°17'
410 13/32"
65"
21
49
4"
571"
179 11/16"
155"

SECTION I
Specifications

The dimensions and general specifications of the airplane are listed in the following table:

TABLE OF SPECIFICATIONS

OVERALL SPAN	47 ft. 7 in.
OVERALL LENGTH	34 ft. 2-13/32 in.
OVERALL HEIGHT (Three Point Position)	9 ft. 2-1/2 in.

WINGS

Airfoil Section at Root	NACA Modified 23018
Airfoil Section at Tip	NACA 23012
Chord at Tip (Theoretical at outer end of tip)	42 in.
Chord at Root (Theoretical at C.L. of fuselage)	135.116 in.
Angle of Incidence at Root	3.922°
Angle of Incidence at Tip	.384°
Dihedral (at 25% of chord aft of leading edge)	6°
Sweepback (at 25% of chord aft of leading edge)	7.083°
Wing Area (including ailerons; flaps)	349 sq. ft.
Aileron Area (including tabs)	22.6 sq. ft.
Flap Area	37.6 sq. ft.

EMPENNAGE

Tail Surface Overall Span (From centerline of each vertical stabilizer)	14 ft. 11-11/16 in.
Tail Surface Maximum Chord	5 ft. 10 in.
Horizontal Stabilizer Setting	2° neg.
Horizontal Stabilizer-Angular Movement	None
Vertical Stabilizer-Offset	None
Horizontal Stabilizer Area (without elevator)	38.18 sq. ft.
Elevator Area (including tabs)	27.22 sq. ft.
Vertical Stabilizer Area (two)	16.30 sq. ft.
Rudder Area (two, including tabs)	17.28 sq. ft.

MOVABLE CONTROL SURFACE TRAVELS

		D18S	D18C
Aileron	Up	38½ ± 1	37½ ± ¼
	Down	21 ± 1	20 ± 2
Flap	Down	45 ± 1	*45 ± 2
Elevator	Up	35 ± 1	35 ± 2
	Down	25 ± 1	25 ± 2
Rudder	Right	25 ± 1	25 ± 2
	Left	25 ± 1	25 ± 2
Aileron Trim Tab	Up	22 ± 1	20 ± 2
	Down	19 ± 1	20 ± 2
Elevator Trim Tab	Up	18 ± 1	20 ± 2
	Down	13 ± 1	14 ± 2
Rudder Trim Tab	Right	31 ± 1	30 ± 2
	Left	32 ± 1	30 ± 2

* D18C-T Flap Travel 25° ± 2

Insert this page after Page 10

On airplanes equipped with BEECHCRAFT oleo drag leg, the following specifications are applicable:

OLEO DRAG LEG

Type	Combination, air, oil, and spring
Manufacturer	Beech Aircraft
Fluid Required	AAF3580D or AN-VV-0-366b
Inflation	50 psi

Note: All references to hydraulic fluid specification throughout this manual should be changed to read Specification MIL-0-5606.

MAIN LANDING GEAR

Type	Electrically retractable
Tread (measured from tire centers)	12 ft. 11 in.
Shock Strut-Type	Combination air and oil
-Manufacturer	Beech Aircraft
-Fluid Required	AAF 3580D or AN-VV-0-366b
-Inflation (exposed piston)	$2\frac{1}{2}$ in.
Wheel	Goodyear 11:00 x 12

(Tire pressure; inflate until axle center is 13 inches from the ground)

TAIL WHEEL ASSEMBLY

Type	Electrically retractable
Style	Full swivel with lock
Shock Strut-Type	Combination air and oil
-Manufacturer	Beech Aircraft
-Fluid required	AAF 3580D or AN-VV-0-366b
-Inflation (exposed piston)	3 in.
Wheel	Goodyear 14.50

(Tire pressure; inflate until axle center is 6 inches from the ground)

ENGINES - D18S

Number	Two
Designation	(P & W) R985 Wasp Jr.
Gear Ratio	None; direct drive

ENGINES - D18C

Number	Two
Designation	Continental R-9A
Gear Ratio	None; direct drive

PROPELLERS

CONSTANT SPEED D18S

Manufacturer	Hamilton Standard
Hub Number	2D30 - 237
Blade Design	6167A - 15 or 6167 - 16
Pitch Setting (42" Station)	High 29°, Low 14°
Blade Design	6101A - 21 or 6101A - 22
Pitch Setting (42" Station)	High 28°, Low 13°
Diameter	99"

For interchangeable models see
Propeller Spec. No. 206 (Note 6)

HYDROMATIC D18S

Manufacturer	Hamilton Standard
Hub Numbers	22D30 - 49 or 69
Blade Design	6531A - 15 or 6531A - 16
Pitch Setting . . . (42" Station)	High 86°, Low 13°
Diameter	99"

HYDROMATIC D18C

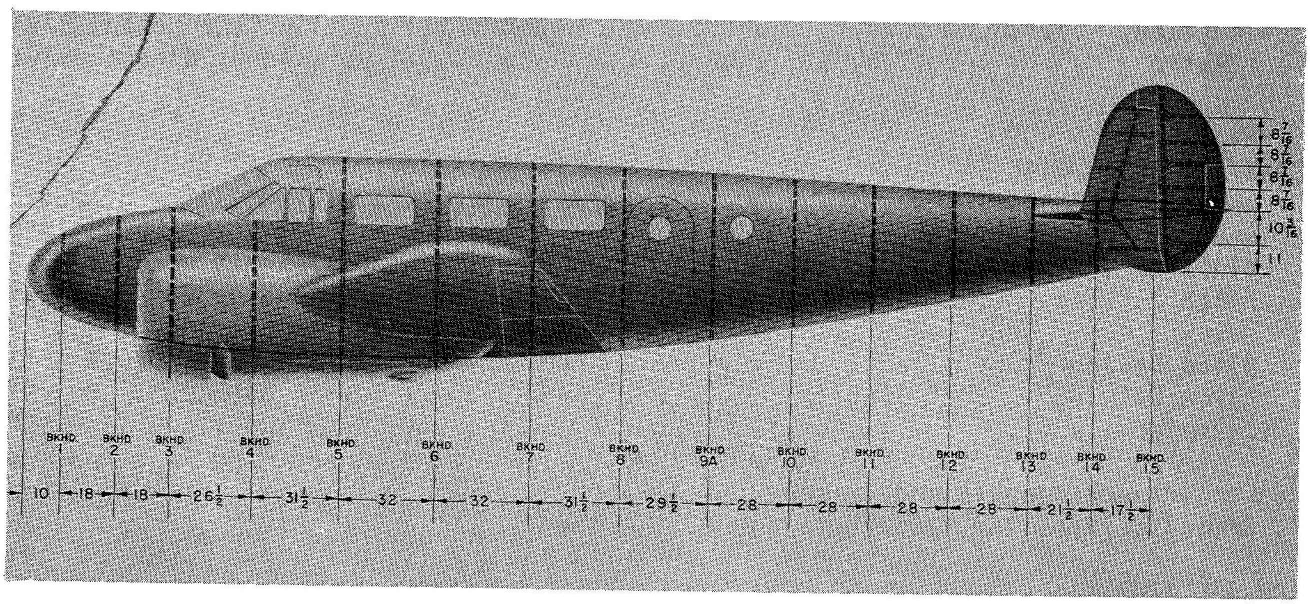
Manufacturer	Hamilton Standard
Hub Numbers	22D30-33-49-67 or - 79
Blade Design	6597A - 24
Pitch Setting (42" Station)	High 86°, Low 14°
Diameter	96"

HYDROMATIC D18CT

Manufacturer	Hamilton Standard
Hub Numbers	22D30-33-49-67 or - 79
Blade Design	6597A - 21
Pitch Setting (42" Station)	High 86°, Low 16°
Diameter	99"

TANK CAPACITIES

	U.S. Gallons	Imperial Gallons	Liters
Fuel			
Front Wing Tanks-two	76	63.3	287.6
Rear Wing Tanks-two	25	20.8	94.625
Nose Tank (optional)	80	66.7	302.80
Total (without nose tank)	202	168.2	764.6
Total (with nose tank)	282	234.8	1067.4
Oil			
Nacelle Tanks-two	8	6.7	30.28
Total	16	13.3	60.56



Stations Diagram

SECTION II
Ground Operations

HANDLING

During ground operations it is possible to damage the airplane and its equipment unless proper precautions are taken. The following procedures are recommended to avoid such accidental damage.

TOWING

To facilitate towing the airplane, a lug is provided on the inboard side of each landing gear fork. The use of a tow bar is the only recommended method for towing the airplane. (See Fig. 1) The tail wheel must be unlocked before towing.

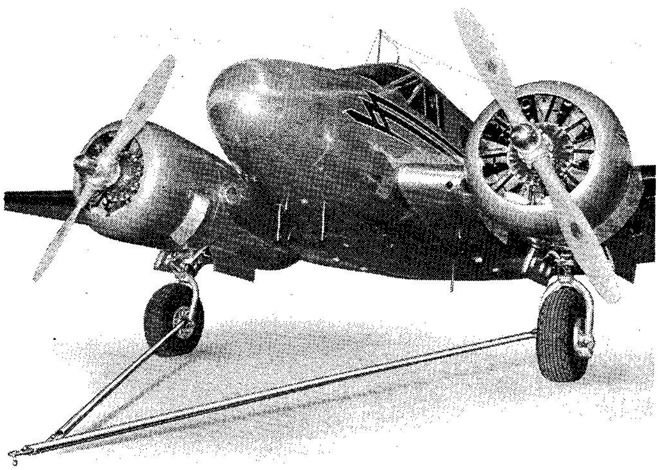


Fig. 1 Towing

LIFTING

The tail of the airplane may be lifted by inserting a steel bar (maximum diameter, 3/4 inch) through the 'LIFT' holes located in the side of the fuselage near the tail of the airplane. (See Fig. 2) Do not attempt to raise the tail of the airplane by lifting against the horizontal stabilizer as the ribs and stringers may be seriously damaged.

JACKING

The main jack points are located on the underside of the wing center section between the fuselage and each nacelle. Three rubber Ford plugs must be removed and the jack pads (Part No. 84-180930) installed. These pads are supplied with each airplane. (See Fig. 3) Individual wheel jack points are provided on the inboard side of each main land-

Fig. 2 Lifting

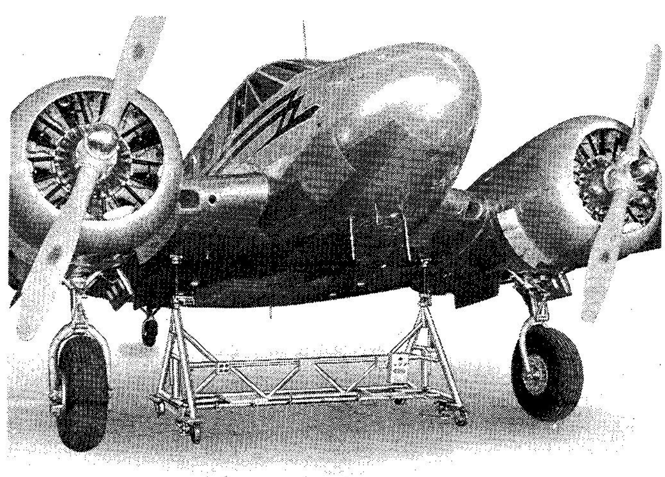


Fig. 3 Main Wheel Jacking

ing gear fork. The tail jack point is located just aft of the tail wheel. (See Fig. 4) When using jacks, be sure the jack is suitable for the jack point. Care must be exercised, especially when using wheel

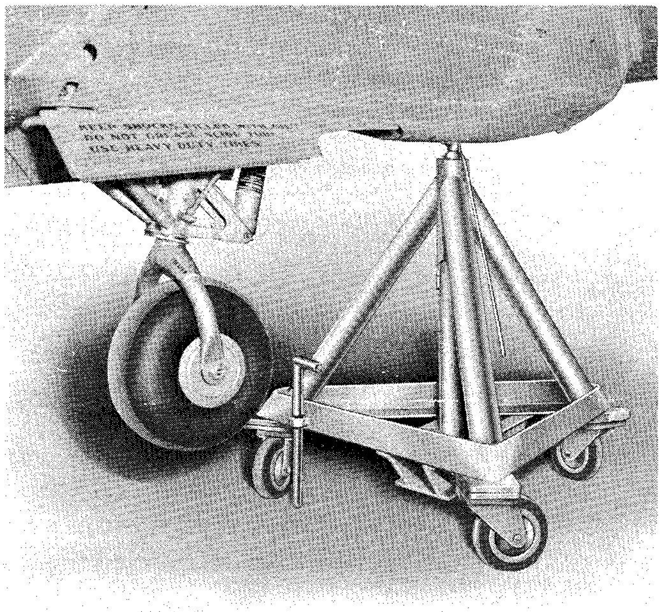


Fig. 4 Tail Wheel Jacking

jacks, to prevent the airplane from slipping from the jacks. When checking the operation of the landing gear be sure the tail wheel is clear of the floor as it retracts in conjunction with the main landing gear. Apply approximately 200 lbs. to the tail of the airplane to keep it from nosing over.

CAUTION: Be sure the tail wheel is in the correct position for entry into the wheel well before retracting the gears.

HOISTING

Points for hoisting the airplanes are located on the upper center section at the inboard junction of the nacelle and the center section, and are made accessible by removing the covering tape. If two hoists of at least 3 ton capacity are used, the vertical lift eyebolts, as shown in Detail 'A' (Fig. 5) may be used. If one 5 ton capacity hoist is to be used, bolt the attaching brackets to the truss. The chains and cables used in the single point suspension should clear the cabin approximately two inches so that a direct pull will be placed on the lugs. (See Fig. 6) This will prevent the lugs from being bent. A weight of approximately 200 pounds must be applied to the tail to keep the airplane from nosing over.

LEVELING

Points of longitudinal leveling are located on the top of the fuselage, just forward of the cabin door. The lateral leveling points are located on the underside of the fuselage at the center section truss.

ACCESS DOORS

The location of all access doors that are provided for inspection and maintenance of the airplane are diagramed in Fig. 7 and 8.

SERVICING

The following service instructions provide the necessary information for proper servicing of the airplane:

FILLING FUEL TANKS

The filler necks for the wing fuel tanks are made accessible by lifting the Dzus fastened doors and removing the caps at each of the four tanks. If a nose tank is installed, the nose baggage door must be opened (on some models) or the filler neck cover on the right side of the nose lifted, before the filler neck is accessible. The capacity of the nose tank is 80 U.S. gallons; the front wing tanks, 76 U.S. gallons each; and each rear wing tank holds 25 U.S. gallons. Service with 91/96 octane fuel; avoid over-filling of the tanks. A static ground is provided near the filler necks and should be used when servicing the airplane with fuel.

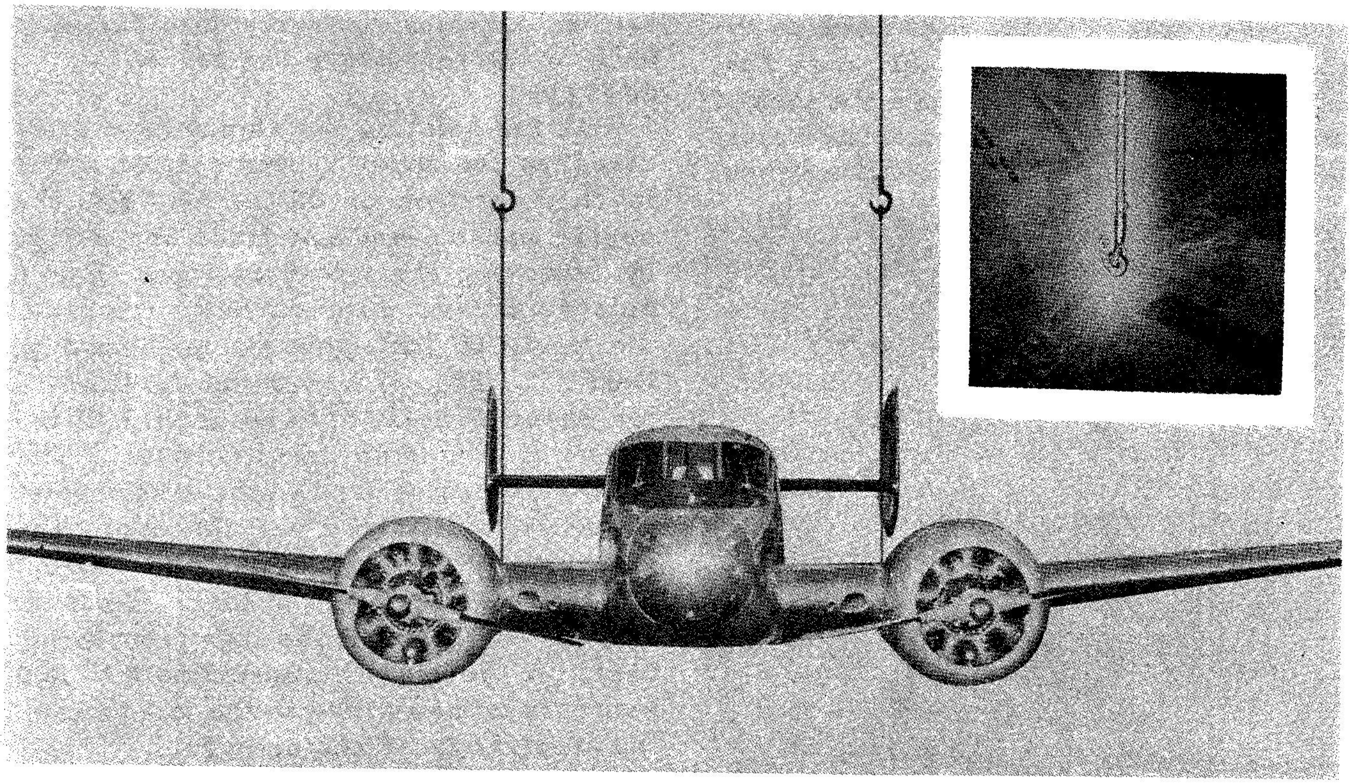


Fig. 5 Hoisting Using Two Hoists

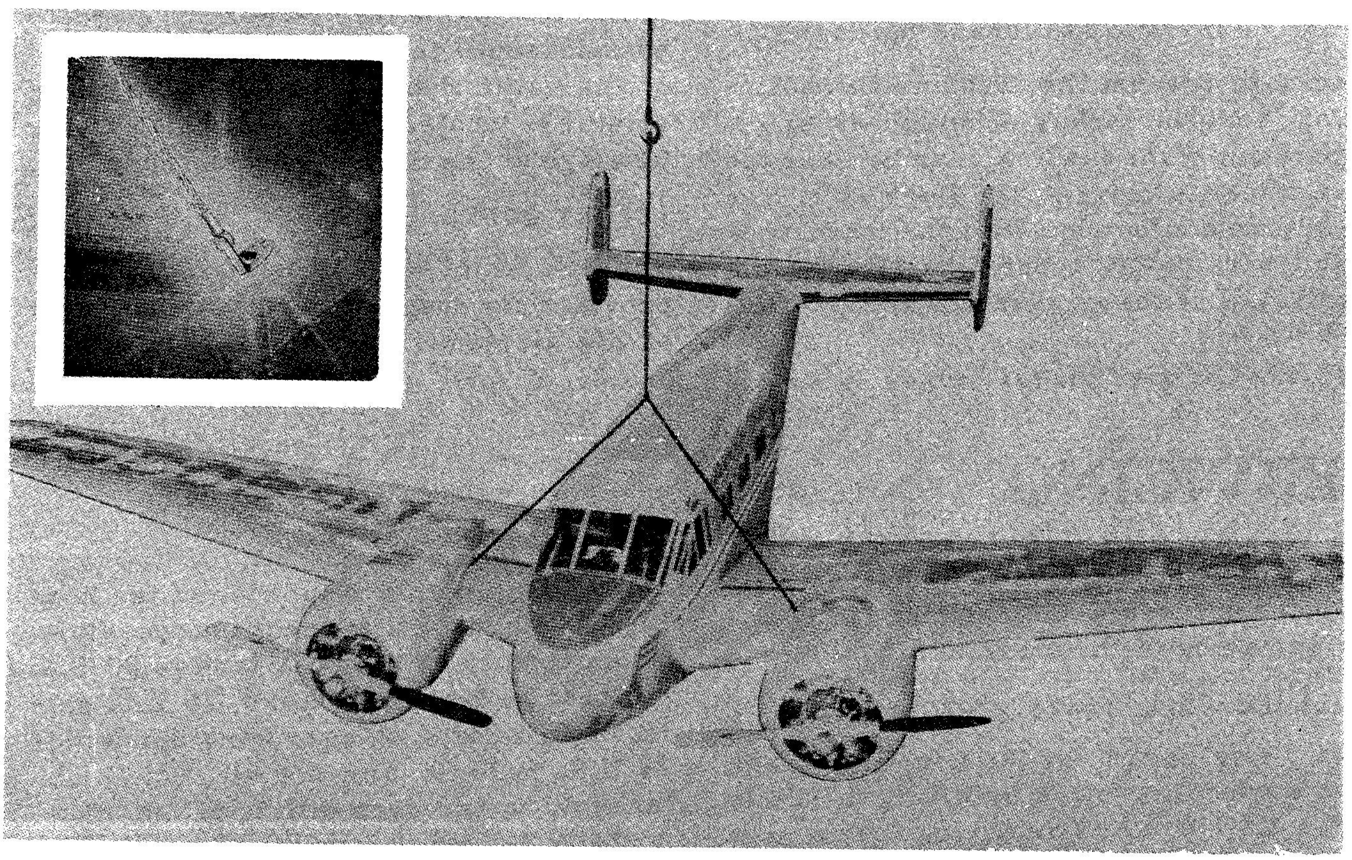
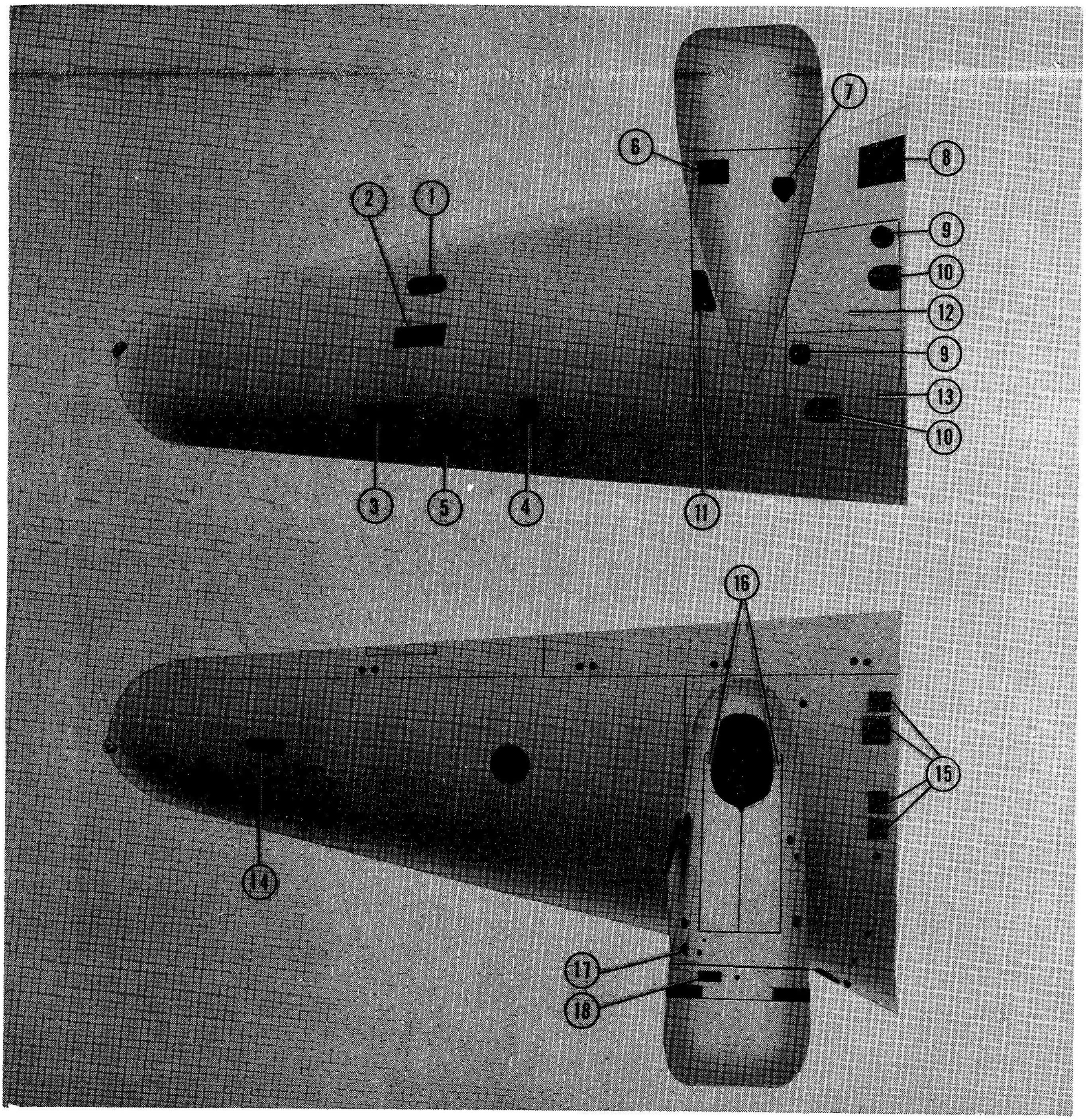
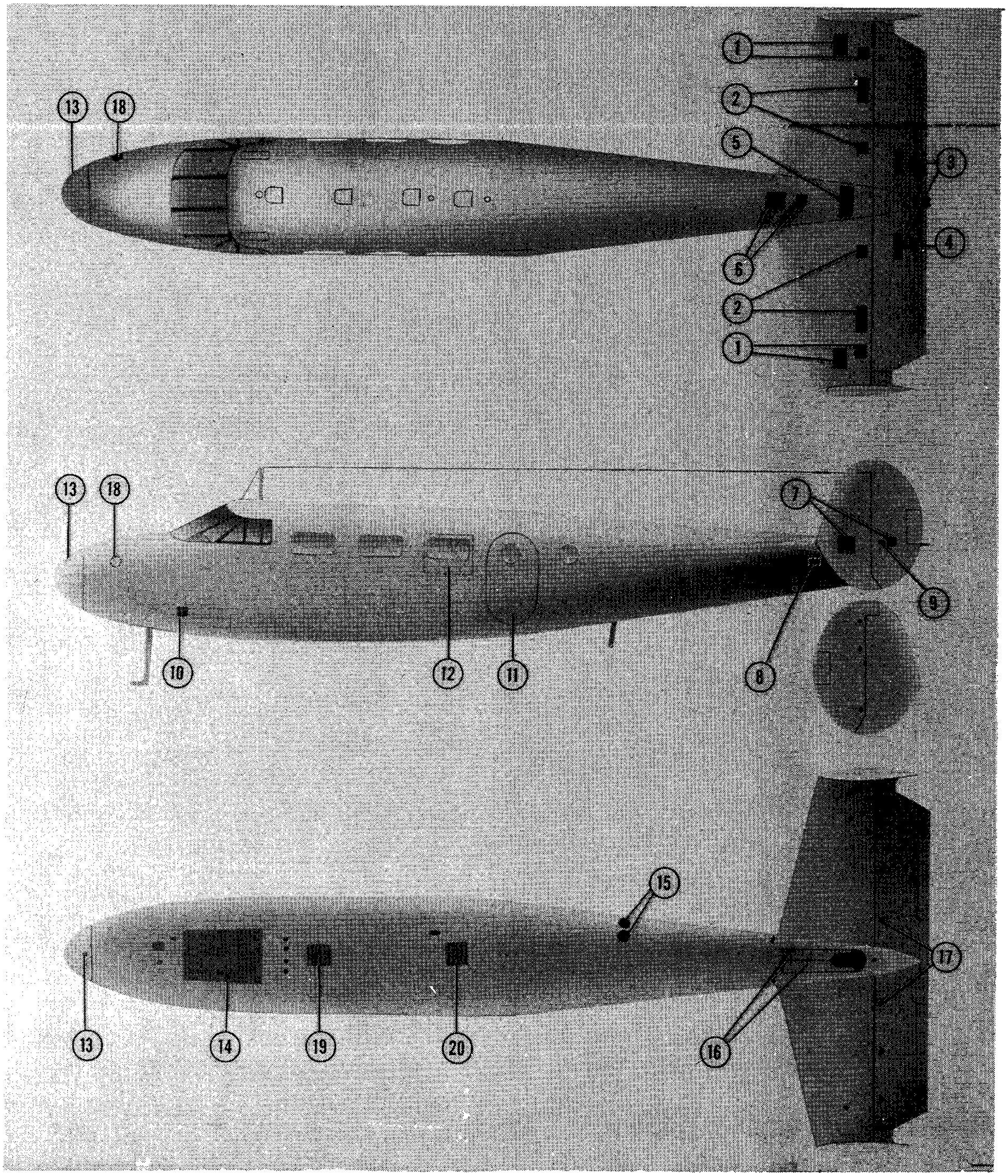


Fig. 6 Hoisting Using Single Hoist



1. *Aileron Cables Inspection*
2. *Aileron Pulleys*
3. *Aileron Bellcrank*
4. *Aileron Tab Mechanism*
5. *Aileron Tab Actuator*
6. *Oil Dilution Solenoid Valve*
7. *Oil Tank Filler Neck*
8. *Battery Compartment*
9. *Fuel Tank Filler Neck*
10. *Liquidometer Adjustment*
11. *Wing Hinge Pins*
12. *Front Fuel Tank*
13. *Rear Fuel Tank*
14. *Internal Wing Inspection*
15. *Fuel Tank Sumps*
16. *Landing Gear Well*
17. *External Power (Left Only)*
18. *Fuel Strainer*

Fig. 7 Access Doors



1. Rudder Bellcrank
2. Rudder Turnbuckles
3. Elevator Tab Mechanism
4. Elevator Tab Rheostat
5. Rudder Pulleys
6. Stabilizer Attachment
7. Rudder Tab Mechanism
8. Tail Shock (Right Side)
9. Rudder Tab Mechanism Inspection
10. Rudder Pedal Shaft and Linkage Assembly
11. Cabin Entrance
12. Emergency Exit (Right Side)
13. Baggage Compartment
14. Belly Inspection
15. Flare Chute
16. Tail Wheel Well
17. Elevator Tab Mechanism Inspection
18. Nose Tank Filler Neck

Fig. 8 Access Doors

Insert this page after Page 18.

The following sentence should be added to the paragraph on "DRAINING OIL TANKS":

The oil tank sump may be drained by removing the drain plug on the bottom of the oil tank.

DRAINING FUEL TANKS

The drain cocks for the wing fuel tanks are located on the underside of the center section. A drain is also provided on the underside of the nose section if a nose tank is installed. The wing drain assemblies should be removed every three hundred hours, and cleaned.

FILLING OIL TANKS

Each engine is provided with an eight gallon oil tank located in each nacelle immediately behind the firewall. On the inboard top side of each nacelle there is located in access door for filling the tank. The tank caps are provided with a graduated stick-gauge for checking the oil quantity. Fill tanks to the 'Full' mark with engine oil, Aviation Grade 1120 (SAE 60) for Pratt and Whitney R-985 Wasp Jr. engines, or Aviation Grade 1100 (SAE 50) for Continental R-9A engines. Airplanes, equipped with hydromatic propellers, have approximately $6\frac{1}{2}$ gallons supply of usable engine oil; a stand pipe in the 8 gallon tank reserves approximately $1\frac{1}{2}$ gallons of oil to feather and unfeather the propellers.

DRAINING OIL TANKS

The oil tanks may be drained at the 'Y' valves, located on the aft side of the firewall, and are accessible from the landing gear wheel wells.

FILLING BRAKE RESERVOIR

Hydraulic fluid is supplied to the brakes from a reservoir in the nose section of the airplane and is accessible through the nose baggage compartment or the pilot's compartment. A visible fluid level should be maintained at all times. When servicing, use hydraulic fluid AAF 3580D or AN-VV-0-366b and fill the tank to approximately two inches from the top.

FILLING ANTI-ICER TANK

The propeller anti-icer fluid supply tank, on airplanes so equipped, is installed immediately aft of the pilot's seat and is filled from the pilot's compartment. The tank has a three gallon capacity and is equipped with a fluid-guage. Fill the tank with isopropyl alcohol, specification AN-F-13. To drain the system, remove the plug located on the underside of the fuselage, directly below the supply tank.

CAUTION: The anti-icer tank should be maintained at full capacity to insure proper operating for extended periods of time. Operation of the motor on an empty tank, will cause severe damage to both the anti-icer pump and the motor. See Electrical System.

FILLING SHOCK ABSORBER STRUTS

The air-oil type shock struts on the main and tail wheels are filled with AAF 3580D or AN-VV-0-366b hydraulic fluid. To fill the main struts, back the filler plugs off slightly to allow the air to escape. (Do not depress the valve stems to release the air.) Block up the strut ·3/4· of

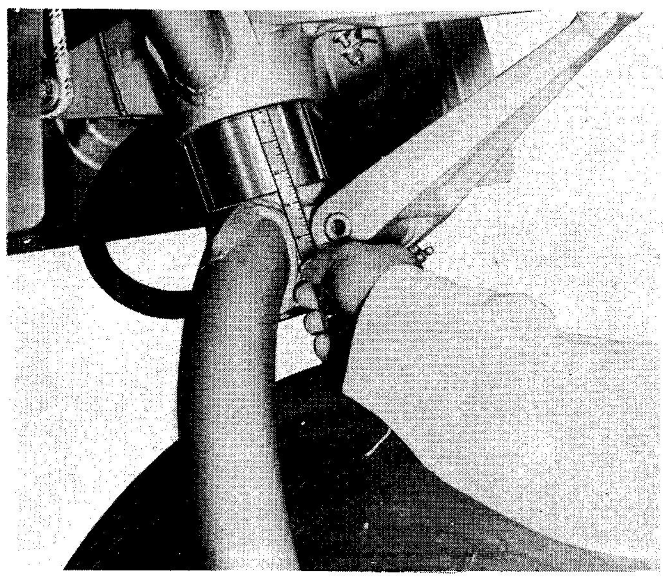


Fig. 9 Main Strut Inflation

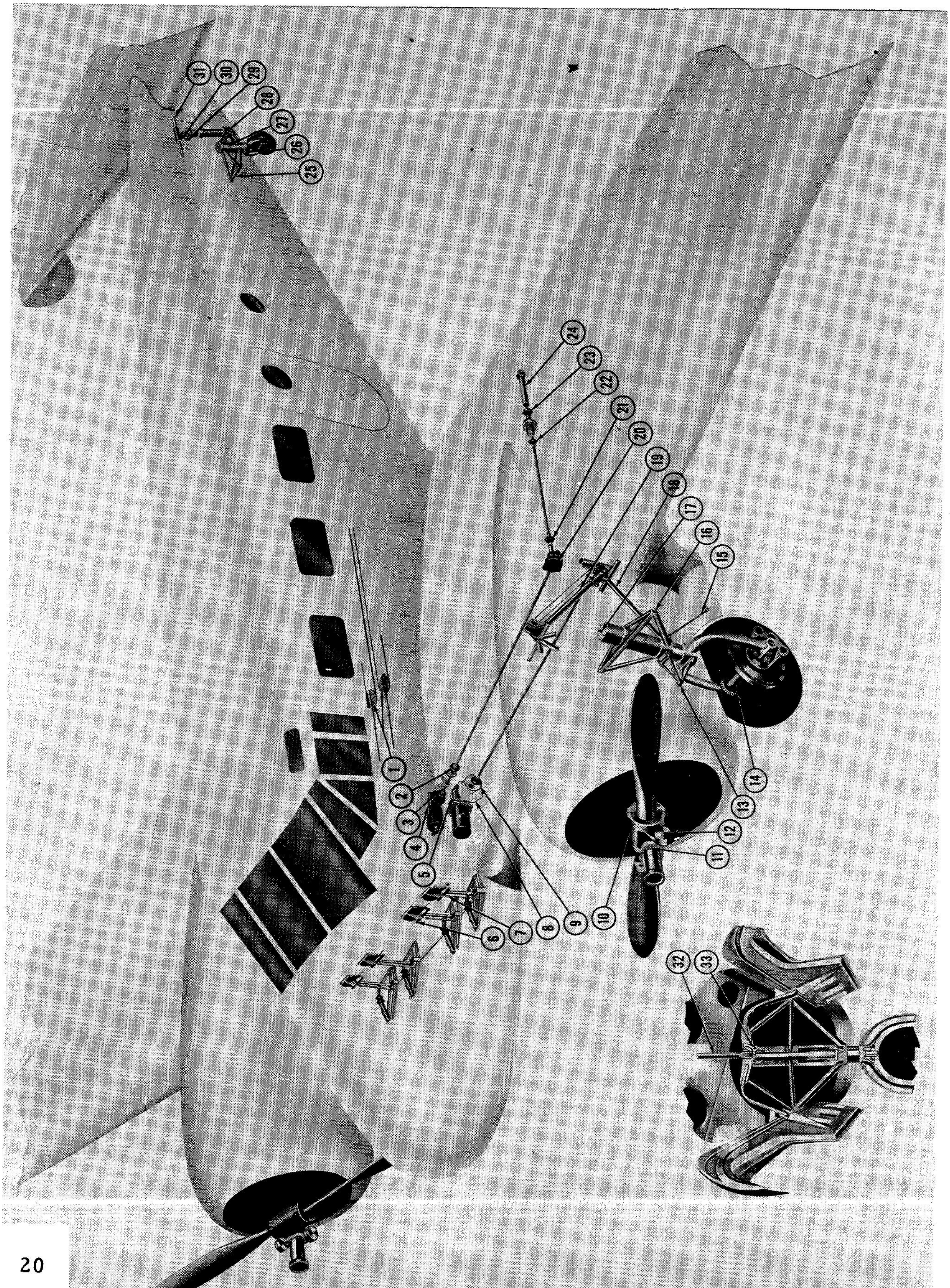


Fig. 10 Lubrication Chart

Insert this page after Page 20.

The following data should be added to the Lubrication Chart:

Item No.	Location	Interval	Lubricant	Application	Total Gr. Points
18a	Oleo Drag Leg	As required	AAF3580D or AN-VV-O-366b		

Service Note

Hydraulic fluid, Specification AAF3580 and AN-VV-O-366b has been superseded by Specification MIL-O-5606.

Item No.	Location	Interval	Lubricant	Application	Total Gr. Points
1.	Rudder Reduction Pulley Slides	100 hr.	Graphite (powdered)	Brush or blow gun	2
2.**	Flap Shaft Universals	Overhaul	AN-G-15	Pack	5
3.	Flap Travel Nut	100 hr.	Graphite (powdered)	Brush or blow gun	1
4.	Flap Motor Gear Box	100 hr.	AN-G-15	Pack	1
5.	Landing Gear Clutch Release Arm	100 hr.	SAE 20 Engine Oil	Squirt Can	1
6.	Rudder Pedal Hinge	100 hr.	SAE 20 Engine Oil	Squirt Can	8
7.	Brake Pedal Actuator	100 hr.	SAE 20 Engine Oil	Squirt Can	4
8.	Landing Gear Motor Gear Box	100 hr.	Gargoyle No. 6 or equivalent	Zerk Gun (6½ oz.)	1
9.**	Landing Gear Operating Universals	Overhaul	AN-G-15	Pack	4
10.*	Propeller Spider Hub (Constant Speed)	25 hr.	AN-G-15	Zerk Gun	2
11.*	Propeller Piston (Constant Speed)	25 hr.	SAE 20 Engine Oil	Squirt Can	2
12.*	Propeller Counter Weight Shaft Bearings (Constant Speed)	25 hr.	AN-G-15	Pack	2
13.	Landing Gear Torque Knees	50 hr.	AN-G-15	Zerk Gun	12
14.	Landing Gear Wheel Bearings	100 hr.	AN-G-15	Pack	4
15.	Landing Gear Door Linkage (D18S)	50 hr.	SAE 20 Engine Oil	Squirt Can	4
16.	Landing Gear Truss Hinge Point	100 hr.	AN-G-15	Zerk Gun	4
17.	Main Shock Absorber Filler Plug	As required	AAF3580D or AN-VV-O-366B		2
18.	Landing Gear Rear Leg	50 hr.	AN-G-15	Zerk Gun	4
19.	Landing Gear Slide Tube	50 hr.	Graphite (Powdered)	Brush or blow gun	2
20.	Flap Gear Box	100 hr.	AN-G-15	Zerk Gun	2
21.	Flap Shaft Universals	Overhaul	AN-G-15	Pack	2
22.	Flap Shaft Universals	Overhaul	AN-G-15	Pack	2
23.	Flap Shaft Universals	Overhaul	AN-G-15	Pack	2
24.	Flap Shaft Jack Screw	Overhaul	AN-G-15	Pack	2
25.	Tail Wheel Hinge Points	50 hr.	AN-G-15	Zerk Gun	2
26.	Tail Wheel Bearings	100 hr.	AN-G-15	Pack	2
27.	Tail Wheel Swivel	50 hr.	AN-G-15	Zerk Gun	1
28.	Tail Wheel Shock Absorber Bushing - Lower	50 hr.	AN-G-15	Zerk Gun	1
29.	Tail Wheel Shock Absorber Filler Plug	As required	AAF3580D or AN-VV-O-366B		1
30.	Tail Wheel Shock Absorber Bushing - Upper	50 hr.	AN-G-15	Zerk Gun	1
31.	Tail Wheel Slide Tube	50 hr.	Graphite (powdered)	Brush or blow gun	1
32.	Landing Gear Door Slide Tube (D18C-CT)	50 hr.	Graphite (powdered)	Brush or blow gun	2
33.	Landing Gear Door Latching Mechanism (D18C-CT)	50 hr.	SAE 20 Engine Oil	Squirt Can	2
	***Engine Oil (Pratt & Whitney)	50 hr.	Aviation Grade 1120 oil		
	***Engine Oil (Continental)	50 hr.	Aviation Grade 1100 oil		
	Brake System	As Required	Fluid Specification AAF3580D or AN-VV-O-366B		

*Used on constant speed installation only.
**Leather covered universals checked every 100 hrs.
***Do not mix different brands of lubricating oil.

an inch from the fully compressed position. Remove the filler plug and fill the strut with the correct type hydraulic fluid. Remove the blocks and fully compress the strut. The fluid level should be even with the bottom of the short tube in the filler hole. Remove any excess fluid. Replace the filler plug and inflate the strut with air until 2½ inches of the piston is exposed. (See Fig. 9) Rock the airplane while inflating the struts to overcome any friction caused by the shock strut seals. The tail wheel strut must be completely deflated before filling. Inflate until 3 inches of the piston is showing.

HYDRAULIC FLUID

Hydraulic fluid specification AAF 3580D is recommended for use in the brakes and struts when the temperature is above 0° F. Hydraulic specification AN-VV-0-366b is recommended for use in the brakes and struts when the temperature is consistently 0° F or below. Under no circumstances should the airplane be serviced with a different type of fluid than that recommended.

LUBRICATION

The lubrication chart (See Fig. 10) contains information necessary to properly lubricate the airplane. It also gives the location, time interval, and method of application. The ball bearings used in pulleys, bellcranks, hinge points, and rod ends are of the sealed impregnated type and require no periodic lubrication. Landing gear and flap universals are enclosed in rubber or leather covers and require repacking as specified in the lubrication chart. Avoid any excess application of lubricant as this is detrimental rather than helpful to the operation of the airplane.

TIRE INFLATION

The main wheel tires should be inflated so the distance between the centerline of the axle and the ground is 13 inches. (See Fig. 11) The tail wheel tire should

Fig. 11 Main Wheel Tire Inflation

be inflated so the centerline of the axle is 6 inches above the ground (See Fig. 12).

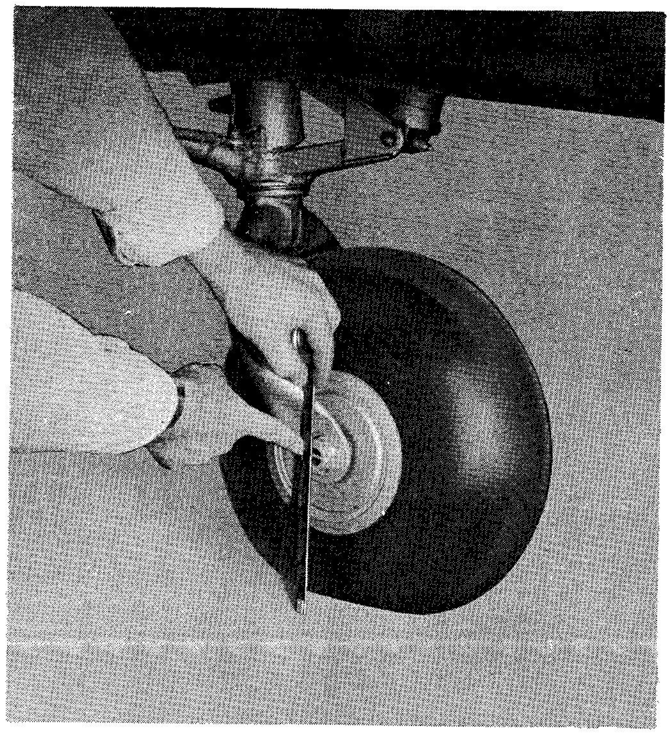


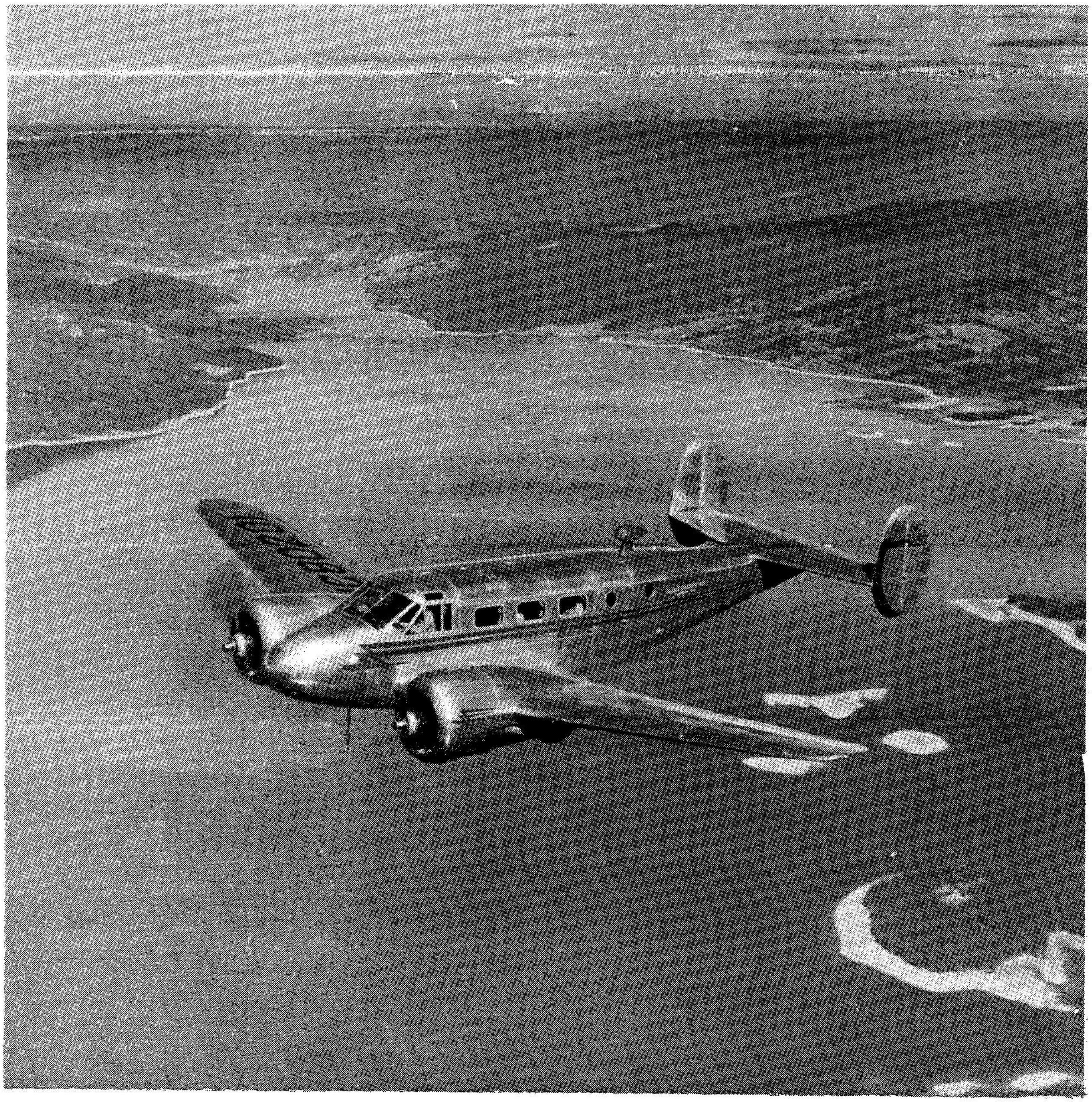
Fig. 12 Tail Wheel Tire Inflation

CLEANING PLASTIC WINDOWS

Ordinary cleaning of the plastic windows in the pilot's compartment will cause severe damage to the surfaces and will result in limited vision or costly replacements. To prevent scratching, crazing, or distortion of the plastic windows, special care must be taken when cleaning them. Flush the surface with clean water, using the bare hand to dislodge any dirt or abrasives. This will prevent the possibility of scratching the surface during the washing procedure. Wash thoroughly with a mild soap solution, taking care that the water is free from all possible abrasives. A soft cloth, sponge, or chamois may be used to apply the soap solution. Light films of oil or grease may be removed with trisodium phosphate completely dissolved in water. Stubborn oil or grease on the surface may be removed by rubbing lightly with a clean cloth dampened with hexane, naptha, or methanol. Flush with clean water and then dry the surface with a clean damp chamois. After the surface is dry, continuous rubbing should be avoided as it is likely to cause scratches, also it builds up a static charge which attracts dust particles to the surface. If the surface should become charged, patting or gently blotting with a clean damp chamois will remove the dust and the charge.

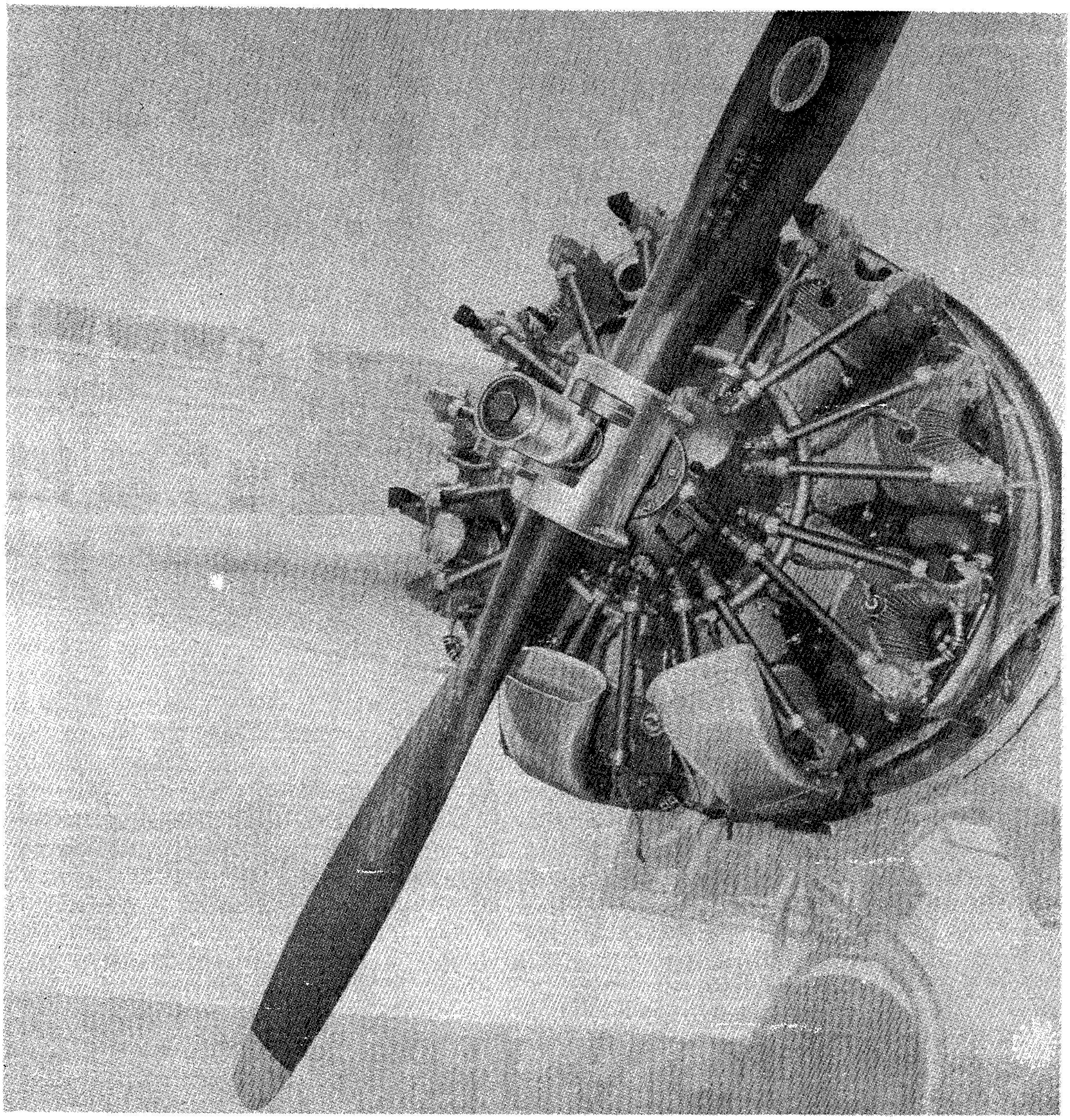
CAUTION: Do not use gasoline, benzene, acetane, carbontetrachloride, fire extinguisher fluid, de-icing fluid or lacquer thinners on plastics as they have a tendency to soften and craze the surface.

Special care should be taken when painting stripes on the fuselage, to carefully mask the plastic surface to prevent the possibility of paint creeping behind the tape and drying on the plastic. In the event paint is allowed to dry on the plastic surface, use methanol, hexane, or naptha to remove the paint from the window.



SECTION III
Maintenance and Adjustments

D18S POWER PLANT



D18S Power Plant

ENGINES

Power is supplied by two Pratt and Whitney Wasp Jr., nine cylinder air-cooled, single stage blower engines. Accessories include starter, generator, fuel pump, vacuum pump, and a tachometer generator. Engines are supported by welded steel tubular frames, which are mounted to the main truss of the airplane.

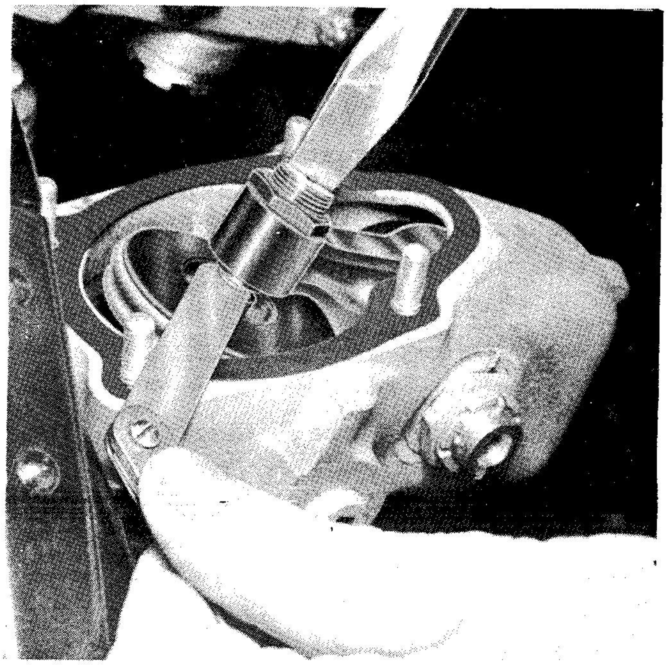


Fig. 13 Valve Clearance Adjustments

VALVE CLEARANCE ADJUSTMENTS

If the adjustment becomes necessary between normal overhaul periods, the following instructions are recommended:

1. After the engines have cooled, remove the rocker box covers and the front spark plugs from all cylinders. Adjust the valves in the order of cylinder firing (1-3-5-7-9-2-4-6-8). Turn the propeller in the normal direction of rotation until the desired piston is at the top dead center of its compression stroke.

2. Loosen the adjusting screw locknut three or four turns. Using a .010 feeler gauge between the valve stem and the ball end of the adjusting screw, set the adjusting screw so that there is a slight drag on the feeler gauge. (See Fig. 13).

3. Lock the screw in this position, tightening the locknut with approximately 275 inch-pounds torque. Recheck the valve clearance.

4. Reinstall rocker box covers and replace gaskets that may be in bad condition. Tighten the rocker box cover nuts to a torque of 60 to 75 inch-pounds.

MAGNETO BREAKER POINT ADJUSTMENT (Scintilla)

The contact points on the Scintilla magneto must be adjusted to open at the proper position of the cam in relation to the timing marks at the breaker end of the magneto and not for any fixed clearance between the contact points. If the points are breaking at this position, the clearance between the points will automatically be cared for. The adjustments may be accomplished by turning the propeller shaft until the timing mark on the distributor housing and a straightedge (See Fig. 14) placed on the flat step on the breaker cam is in alignment with the two marks on the breaker housing. In this position the breaker contacts should be just opening to fire the No. 1 cylinder. If the straightedge which has been placed on the flat step of the breaker cam, is more than 1/8 inch out of alignment with the markings on the breaker housing, the contact points should be adjusted so that they may open when the straightedge is in alignment with the marks. To make this adjustment, hold the cam in alignment as indicated by the straightedge;

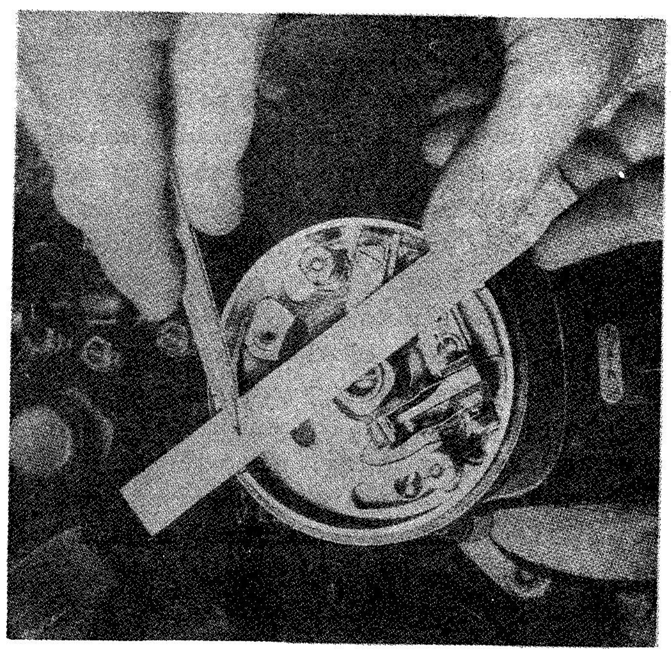


Fig. 14 Magneto Breaker Point Adjustment (Scintilla)

loosen the two locking screws in the plates which hold the breaker in place, and adjust the opening of the breaker contacts with the eccentric adjusting screw. After the adjustment has been made, tighten the two locking screws.

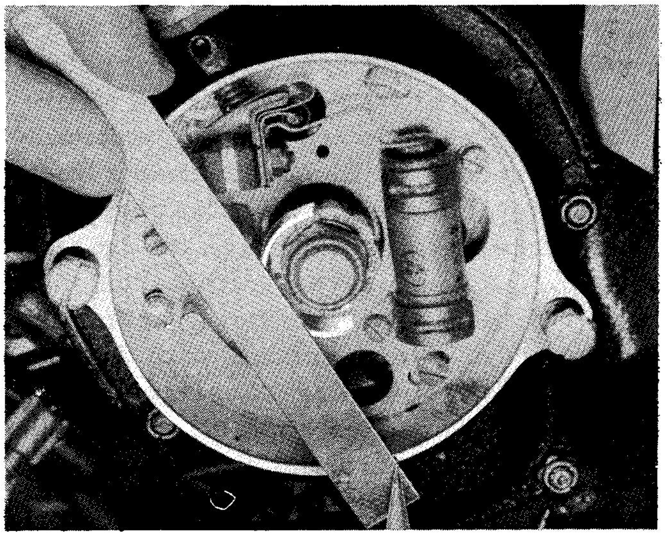


Fig. 15. Magneto Breaker Point Adjustment (Bosch)

MAGNETO BREAKER POINT ADJUSTMENT (Bosch)

The contact points on the Bosch magneto should always be adjusted so that they are about to open when a straightedge placed across the cam step lines with the registering marks on the breaker housing and when the cam follower is on No. 1 cam lobe (indicated by a red dot). The contact points are initially set at .008 to .010 inches when they are fully open and under normal conditions should never have to be reset between overhauls, solely to correct gap clearance. Adjustment of the contact points for the proper opening position is accomplished by turning the propeller shaft until the straightedge, (See Fig. 15), placed across the cam stop lines up with the registering marks on the rim of the breaker housing. Loosen the adjustable contact locking screw and shift the contact bracket by turning the eccentric screw until the contact points are in such a position that the slightest movement of the propeller in a counterclockwise direction will open the points.

MAGNETO TIMING AND SYNCHRONIZATION

The two magnetos must synchronize, that is, both sets of breaker points must open simultaneously so that the timing of the two magnetos is identical. To determine whether or not the magnetos are synchronized, proceed in the following manner:

Remove the front spark plugs from the cylinders and install PWA-3252 vent plugs. Install a PWA-2537 top dead center indicator or any other suitable indicator in the front spark plug bushing of No. 1 cylinder. Secure a pointer on the propeller shaft, the propeller hub, or the propeller spinner. The No. 1 cylinder must be on the compression stroke, with both the valves closed. If the indicator uses an indicating light, proceed as follows: Turn the propeller shaft in the normal direction of rotation until the indicator light just flashes on. Mark a line on the thrust bearing cover under the pointer. Again turn the propeller in the normal direction of rotation, until the indicator light just goes off. Mark another line on the thrust bearing cover. Make a mark equidistant between these two lines. Then turn the propeller until the pointer lines up with this mark. No. 1 piston is now on top dead center. Attach a template as shown in Figure No. 16 to the front case of the engine. Line up the timing pointer (do not turn the propeller) with the top center (T.C.) mark on the template. Turn the propeller about 90° opposite the normal direction of rotation and insert a .0015 feeler gauge between the points on each magneto. Turn the propeller back in the normal direction of rotation until a very slight pull will move the feeler guage. At this point, the timing pointer should line up with the S.A. mark on the template. If the two feeler gauges do not loosen simultaneously and at the proper point, one or both of the magnetos must be retimed to the engine. If the feeler gauge shows that the breaker points are opening before the pointer aligns with the S.A. mark, remove the rubber coupling; then turn the rubber coupling clockwise one or two notches on the magneto coupling. Reinstall the magneto and recheck the timing. If the pointer has passed the spark advance mark, and the feeler gauge is not loosened, turn the rubber coupling counterclockwise one or two notches at the magneto coupling.

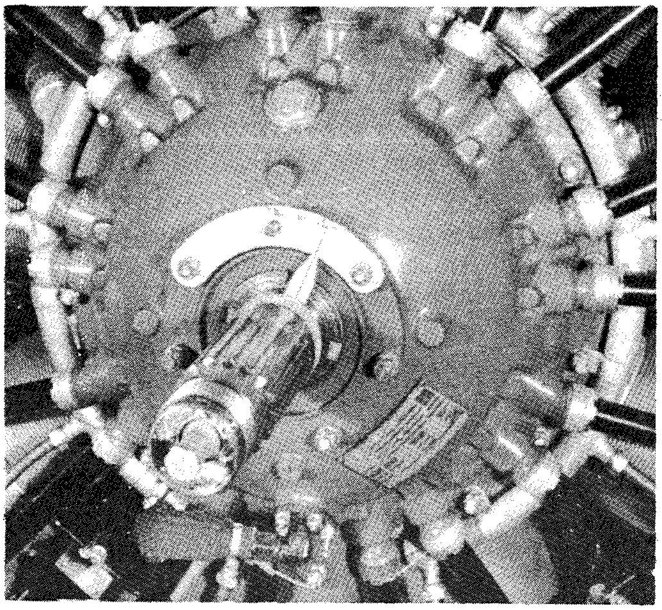


Fig. 16. D18S Engine Timing Template

Service Note
A timing light may be used instead of the feeler gauge to show the breaker opening. For the D18S timing template, See Appendix - Figure 90.

CARBURETOR IDLING ADJUSTMENT

All carburetors incorporate an idle mixture adjustment to provide for smooth engine operation at idling speed under varying atmospheric conditions and altitude changes. The carburetor idling adjustment should be made whenever a carburetor is installed, and whenever rough engine operation is experienced at low RPM. The relation of the airplane to the direction of the prevailing wind will have an effect upon the propeller load and on its RPM, so it may be advisable to make the idle setting with the airplane crosswind. To make this adjustment, proceed as follows after the engine has been thoroughly warmed:

1. Check the magnetos in the usual manner. If the RPM 'drop off' is excessive, check for fouled spark plugs. If the RPM drop is normal, proceed with the idle adjustment.
2. Close the throttle to idle at approximately 600 RPM. If the RPM increases appreciably after a change in the idle adjustment during the succeeding steps, readjust the throttle stop to restore the desired RPM.
3. When the speed has stabilized, move the mixture control lever momentarily, but with a smooth, steady pull, into the 'idle cut-off' position and observe the tachometer for any change in the RPM during the leaning process. Caution should be exercised to return the mixture control to the 'Full Rich' position before the engine cuts out. An increase of more than 10 RPM while 'leaning out' indicates an excessively rich

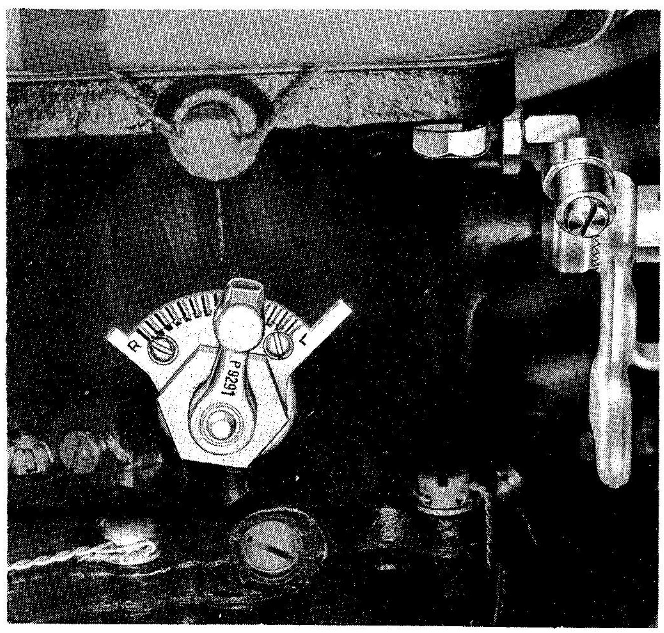


Fig. 17. Carburetor Idling Adjustment

idle adjustment. An immediate decrease in the RPM (not preceded by a momentary increase) indicates the idle adjustment is too lean.

4. If steps 2 and 3 indicate that the idle adjustment is too rich or too lean, turn the idle adjustment one to two notches in the direction required for correction, and check this new position by repeating steps 2 and 3. Make additional readjustments as necessary until a check with steps 2 and 3 result in a momentary 'pick up' of approximately 5 RPM (never more than 10 RPM).

5. Each time that the adjustment is changed, the engine should be run up to 2000 RPM to clear the spark plugs before proceeding with the RPM check.

6. Make the final adjustment of the throttle stop to obtain an idling RPM of 450 with throttle closed.

7. This method aims at a setting that will obtain maximum RPM with minimum manifold pressure. In case the setting does not remain stable, check the idle linkage of which any looseness would cause erratic idling. In all cases allowance should be made for the effect of weather conditions upon the idling adjustment.

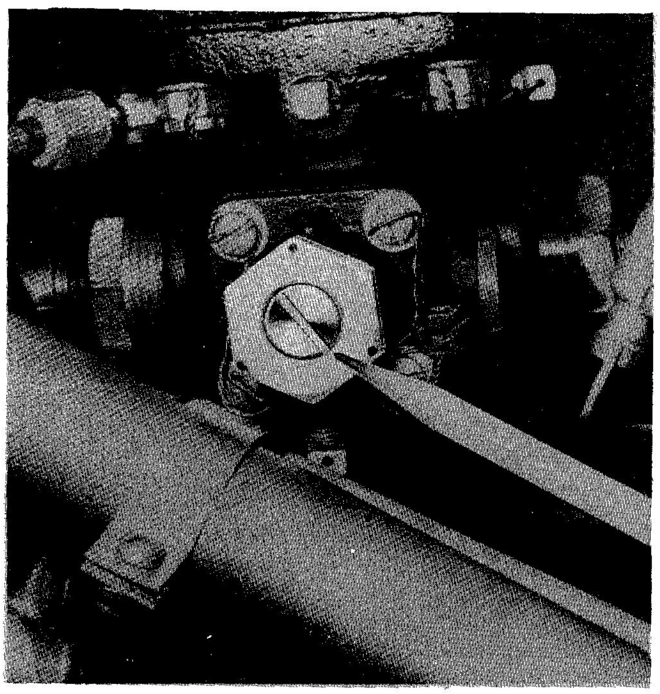


Fig. 18 Fuel Pressure Adjustment

FUEL PRESSURE ADJUSTMENT

The fuel pressure adjustment screw is incorporated with the fuel pressure relief valve, which is located on the fuel pump. (See Fig. 18) The adjustment should be made as follows:

1. Loosen the lock nut on the adjusting screw.

2. Operate the engine at 1800 RPM and turn the adjusting screw until 4 pounds pressure is registered on the fuel pressure gauge. (Turn the adjusting screw clockwise to increase the pressure and counterclockwise to decrease the pressure).

3. Tighten the lock nut and safety.

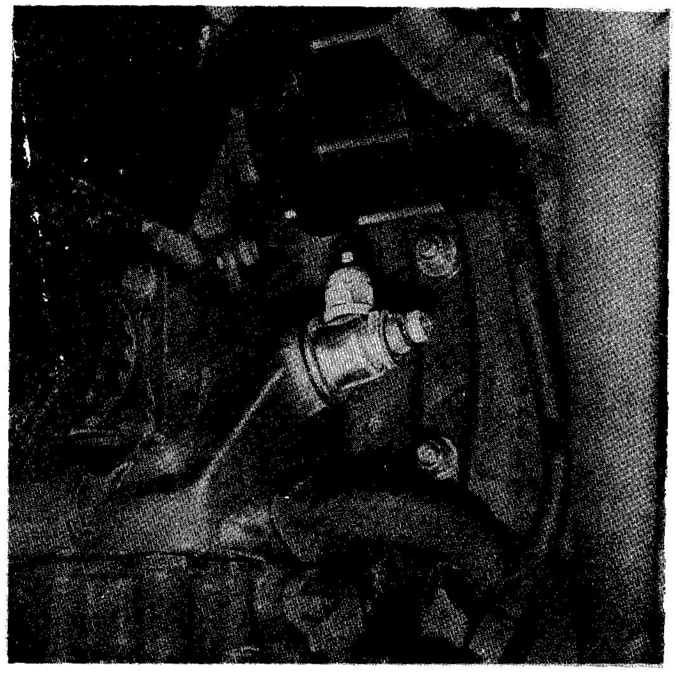


Fig. 19 Oil Pressure Adjustment

OIL PRESSURE ADJUSTMENT

The oil pressure adjustment screw is located at the oil pressure relief valve. (See Fig. 19) Make the adjustment as follows:

1. Remove the cap from the oil pressure relief valve and loosen the lock nut on the adjusting screw.

2. Operate the engine at 1800 RPM with the oil temperature at 156° F.

3. Set the adjustment screw until 80 pounds pressure is registered at the oil pressure gauge. Turn the adjustment screw clockwise to increase the pressure, and counterclockwise to decrease the pressure.

4. Tighten the lock nut, replace the cap, and safety.

PROPELLER

Hamilton Standard Constant Speed or Hamilton Standard Hydromatic Propellers are used on the airplane. Both types are controlled by governors which maintain the RPM as selected by the pilot. The hydromatic propeller employs an electric motor-driven oil pump to build up the auxiliary pressure necessary for feathering the propeller blades.

GOVERNORS

The constant speed control used with the Hamilton Standard Counterweight type propeller is a type 1A2. The governor for the Hydromatic type Constant Speed Control is a type 4B2-P6 or 4B2-P8. These controls are self contained governors which automatically direct the adjustment of the propeller blade angle necessary to maintain a constant engine speed under varying flight conditions. The hydromatic type governor also contains a pressure-operated transfer valve which on feathering installations allows high pressure oil from an auxiliary pump to shunt out the governor when the propeller is being feathered and unfeathered. For overhaul and repair information refer to Hamilton Standard Propeller Manual No. 121B.

GOVERNOR ADJUSTMENTS

The maximum RPM setting (2300) is regulated by contact between a bracket type stop on the pulley and the high RPM ad-

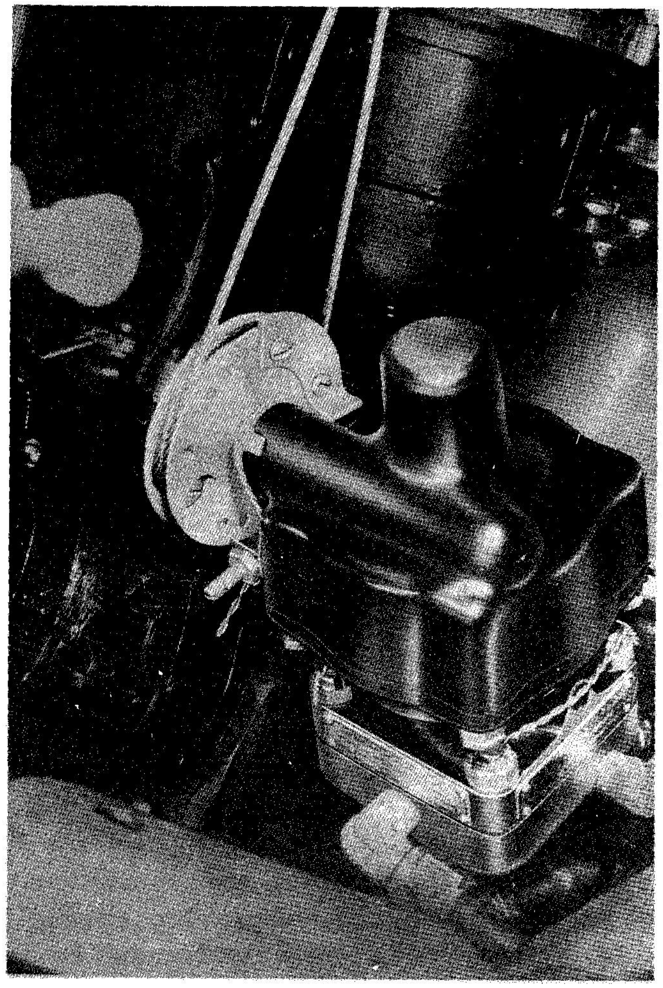


Fig. 20 Governor Adjustments

justment on the head. Moving the stop from one hole to an adjacent hole varies the maximum governing speed, approximately 250 RPM. The adjustment screw is located in the tapped boss on the head. One complete turn of the screw will change the setting approximately 25 RPM. The tab lock plate, located between the boss and the securing nut, locks the adjustment screw to the head. (See Fig. 20)

PROPELLER GOVERNOR CONTROL. (Constant Speed)

Install the cable on the propeller governor pulley, but do not tighten retaining screw. Hold the center of the control rod end 3-1/4 $\pm$ 1/16 inch from the firewall and tighten the cable retaining clamp on the firewall pulley. Adjust the control so that it will have 3-1/4 $\pm$ 1/16 inch travel between the barrel and rod end, and holding the control end at the extremity of its travel, (3-1/4 $\pm$ 1/16 inch from the end of the barrel) rotate the pulley on the propeller governor until it strikes the external stop and tighten the cable retaining screw on the propeller governor pulley.

FULL FEATHERING
Adjust the propeller governor control so that the pulley on the governor hits the external stop, and lacks 1/16 inch hitting the internal stop.

ENGINE CONTROLS

The following types of engine controls may be used on the airplane: American Chain and Cable or Shakespeare. The controls consist of an actuating unit inside of a flexible wound-wire housing.

ADJUSTMENT
To align the control levers and obtain the proper pedestal clearance, loosen the bolts in the phenolite blocks located behind the control pedestal. Move the cable housing as required to align each pair of the control levers and to allow 1/4 inch pedestal clearance in the full back position. Tighten the blocks sufficiently to prevent the cable housing from slipping, but avoid over-tightening, which may result in broken blocks, restricted cable movement or crushed cable housing.

MIXTURE CONTROL
Adjust the jam nut on the mixture control rod to have 1/8 inch clearance from the end of the barrel with the control in the closed position.

THROTTLE CONTROL
Adjust the jam nut on the throttle control rod to have 1/8 inch clearance from the end of the barrel with the control in the closed position. An initial idle adjustment may be made at this time by holding the throttle arm on the carburetor in the closed position and backing off the idle adjusting screw until the screw just leaves the stop, then turn the screw in seven notches, which will slightly open the throttle.

MANIFOLD HEAT CONTROL
Adjust the manifold heat control so that the actuating arm and rod end are 1/16 inch forward of the rear edge of the carburetor heat valve casting, and the end of the control barrel is against the rod jam nuts. The jam nuts on the rod contact the barrel and act as a stop for the open position of the control.

COWL FLAP CONTROL
Adjust the cowl flap control to have 1/4 inch spring back from the closed position, measured at the control handle in the pilot's compartment. This is to assure complete closing and eliminate excessive vibration of the cowl flaps in flight.

Service Note
If the operation is faulty, check the controls for binds caused by sharp bends, broken outer-housing or over-tightened supporting clamp. The controls should never be oiled because dirt and dust will collect in the housing causing binding and excessive wear of the controls. Lubricate the controls with powdered graphite, by mixing powdered graphite with naptha and applying along the housing with a squirt can.

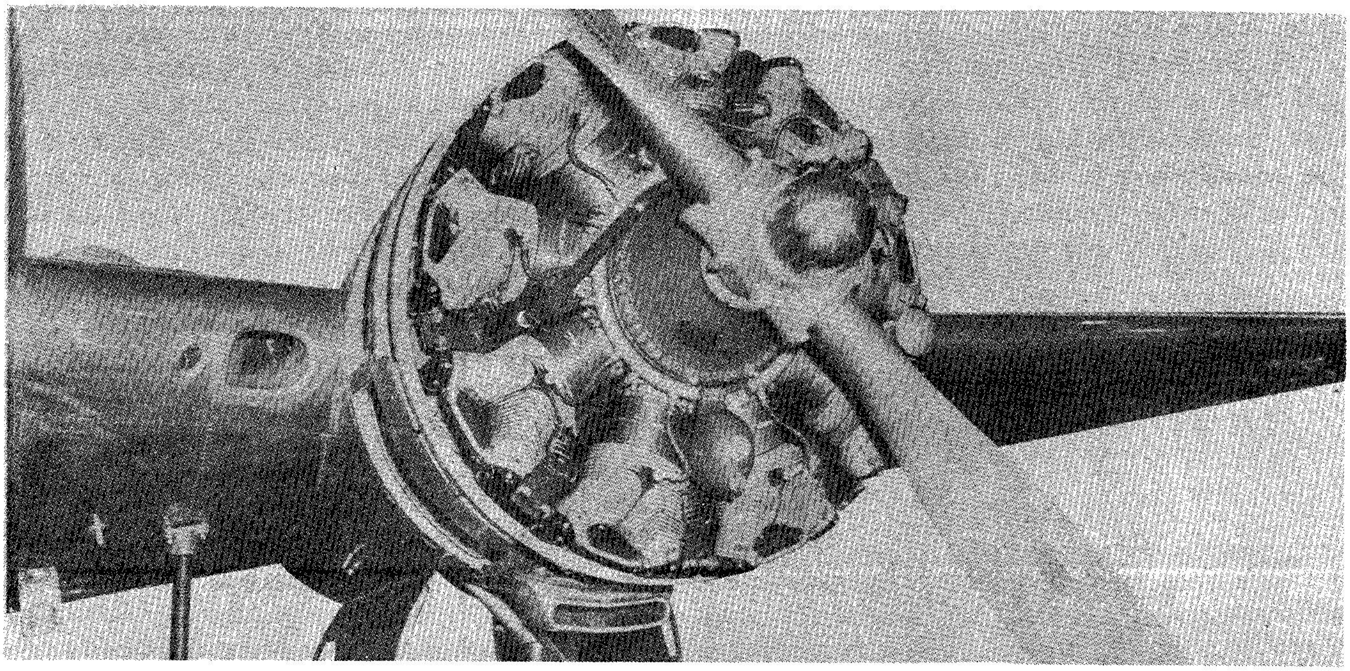
Insert this page after Page 32.

The paragraph "FULL FEATHERING" should be deleted and the following inserted:

HIGH RPM SETTING (Constant-Speed Propellers)

In some cases, it is impossible to obtain full engine rpm on the ground: therefore, it will be necessary to adjust the governor high-rpm stop by trial and flight test. Immediately after take-off, adjust the propeller control to obtain rated, or take-off, rpm. Do not change the propeller setting, but ease the throttles back in order to prevent overspeeding of the engines. Land the airplane with the propeller control still in the rated rpm position. Turn the adjusting screw in until it just contacts the flange on the governor control wheel. One complete turn of the adjusting screw will change the engine speed approximately 25 rpm.

D18C POWER PLANT



D18C Power Plant

ENGINES

Power is supplied by two Continental R9A direct drive, nine - cylinder air-cooled, single - stage blower engines. Accessories include starter, generator, fuel pump, vacuum pump, and a tachometer generator. Engines are sustained by dynamic suspension mounts, supported by welded steel tubular frames, which are attached to the main truss of the airplane.

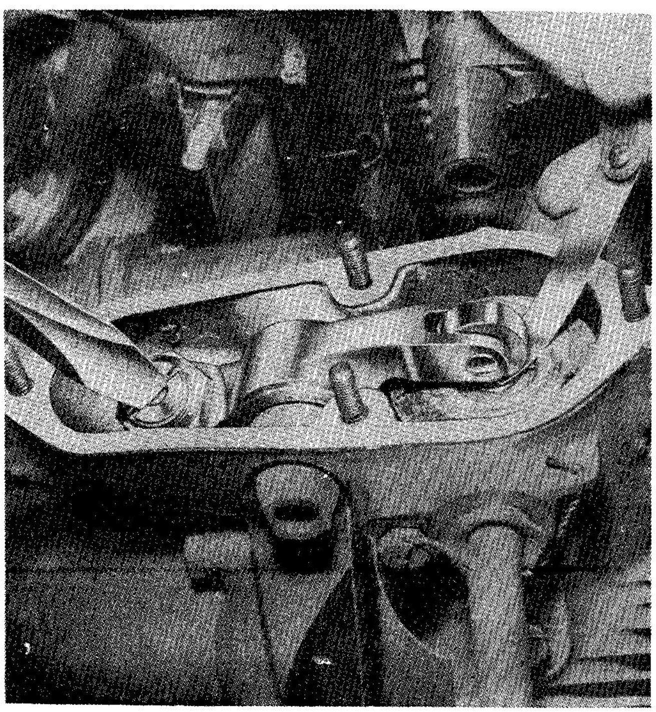


Fig. 21 Valve Clearance Adjustment

VALVE CLEARANCE ADJUSTMENTS

If an adjustment becomes necessary between normal overhaul periods, the following procedure is recommended:

1. With the engine cool, remove the rocker box covers and the front spark plugs from all the cylinders. Adjust the valves in the order of cylinder firing (1-3-5-7-9-2-4-6-8). Turn the propeller in the normal direction of rotation until the desired piston is at the top dead center of its compression stroke.

2. Loosen the adjusting screw-lock-nut three or four turns. Using a .010 feeler gauge between the valve stem and the rocker arm roller, set the adjusting screw so that there is a slight drag on the feeler gauge. (See Fig. 21)

3. Lock the screw in this position,

tightening the locknut with approximately 275 inch-pounds torque. Recheck the valve clearance.

4. Reinstall the rocker box covers and the gaskets. Replace any gaskets that may be in bad condition. Tighten the rocker box cover nuts to a torque of 60 to 75 inch-pounds.

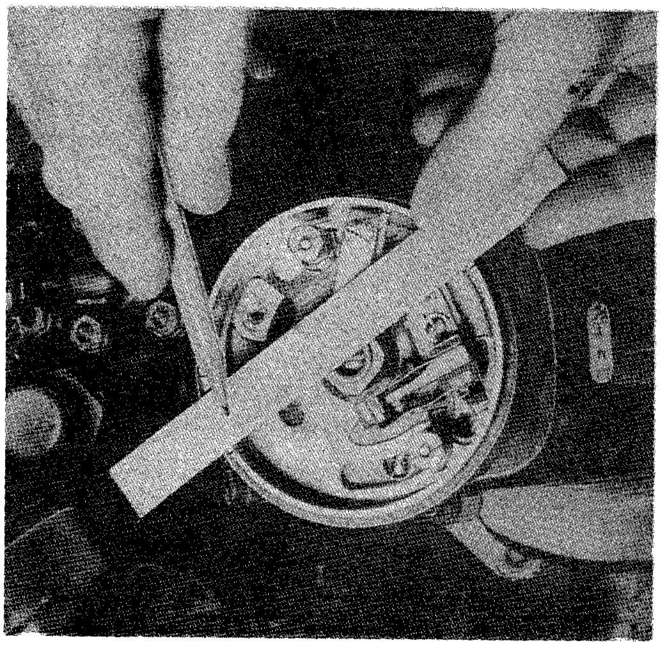


Fig. 22 Magneto Breaker Point Adjustment (Scintilla)

MAGNETO BREAKER POINT ADJUSTMENT (Scintilla)

The contact points on the Scintilla magneto must be adjusted to open at the proper position of the cam in relation to the timing marks at the breaker end of the magneto and not for any fixed clearance between the contact points. If the points are breaking at this position, the clearance between the points will automatically be cared for. The adjustment may be accomplished by turning the propeller shaft until the timing mark on the distributor housing and a straightedge placed on the flat step on the breaker cam is in alignment with the two marks on the breaker housing. (See Fig. 22) In this position the breaker contacts should be just opening to fire the No. 1 cylinder. If the straightedge, which has been placed on the flat step of the breaker cam, is more than 1/8 inch out of alignment with the markings on the breaker housing, the contact points should be adjusted so that they open when the straightedge is in alignment with the marks. To make this adjustment, hold the cam in alignment, as indicated by the straightedge; loosen the two locking screws in the plates which hold the breaker in place, and adjust the opening of the breaker contacts with the eccentric adjusting screw. After the adjustment has been made, tighten the two locking screws.

TIMING MAGNETOS TO ENGINE

The magnetos must be timed to the engine so that the right magneto fires the front plugs at 29° before top dead center and the left magneto is timed to the engine to fire the rear plugs when the piston is 26° before top dead center. Remove one spark plug from each cylinder. Install any suitable top dead center indicator in the front spark plug bushing of No. 1 cylinder. Secure a pointer on the propeller shaft, the propeller hub, or the propeller spinner. The No. 1 cylinder must be on the compression stroke. Both the valves

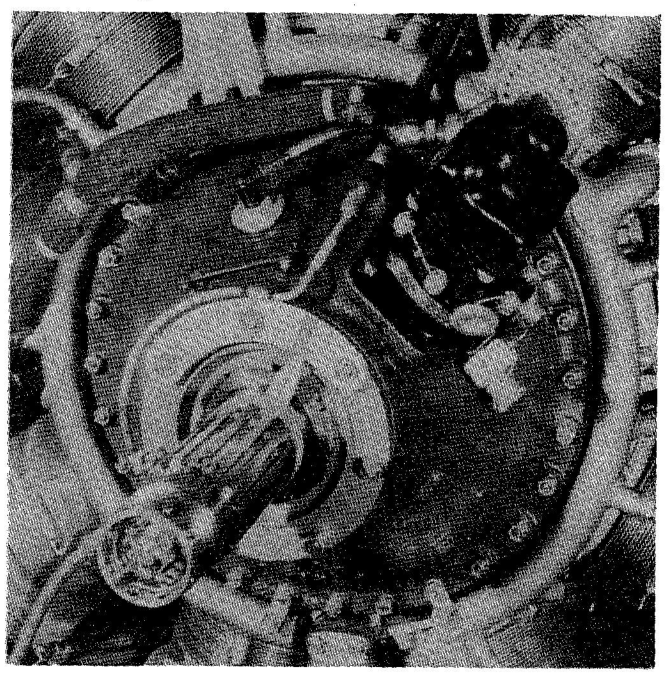


Fig. 23 D18C Engine Timing Template

(intake and exhaust) will be closed. If the top dead center indicator is connected through a light, turn the propeller in the normal direction of rotation until the indicator light just flashes on, then mark a line on the thrust bearing cover under the pointer. Continue turning the propeller in the same direction until the indicator light goes off, then mark another line on the cover. Make a line equidistant between the two lines. Turn the propeller shaft until the pointer lines up with the center mark. The No. 1 cylinder is now on top dead center. Attach a timing template (See Fig. 23) to the thrust bearing cover. Line up the timing pointer (do not turn the propeller) with the top dead center (TC) mark on the template. Then turn the propeller about 90° opposite the normal direction of rotation. Insert a .0015 feeler gauge between the points on each magneto. Turn the propeller shaft in the normal direction of rotation until a very slight pull will move the feeler gauge on the right magneto. At this point, the timing pointer should line up with the S.A. mark on the right magneto or 29° on the template. Continue to turn the propeller until the feeler gauge between the points of the left magneto is loosened. The pointer should then line up with the S.A. mark for the left magneto or 26° on the template. If the feeler gauge shows that either magneto is not timed properly, loosen the nuts holding the magneto to the rear case and rotate the magneto in the desired direction. The magneto, in most cases, can be rotated on the mounting studs sufficiently to pick up slight timing discrepancies. If however, it is necessary to remove the magneto, it may be reinstalled in the following manner:

1. Set the No. 1 cylinder at 29° B.T.C.
2. Hold the right magneto by the base.
3. Rotate the magneto drive shaft until the timing marks on the magneto housing are in alignment with the straight-edge placed on the flat steps of the breaker cam.
4. Holding the magneto frame and the gear, insert the driven magneto splined member into the female splined member of the engine.
5. Install the washer and the nuts just snug enough to prevent accidental movement of the magneto.
6. Insert the feeler gauge or the timing light across the points.
7. Rotate the magneto in the direction necessary to loosen the .0015 feeler gauge or until the light goes out.
8. Tighten and safety the magneto mount nuts.
9. Duplicate the above steps for the left magneto except set the No. 1 piston at 26° B.T.C.

Service Note

A timing light may be used instead of a feeler gauge to show the breaker point openings. For the D18C timing template, See Appendix, Figure 90.

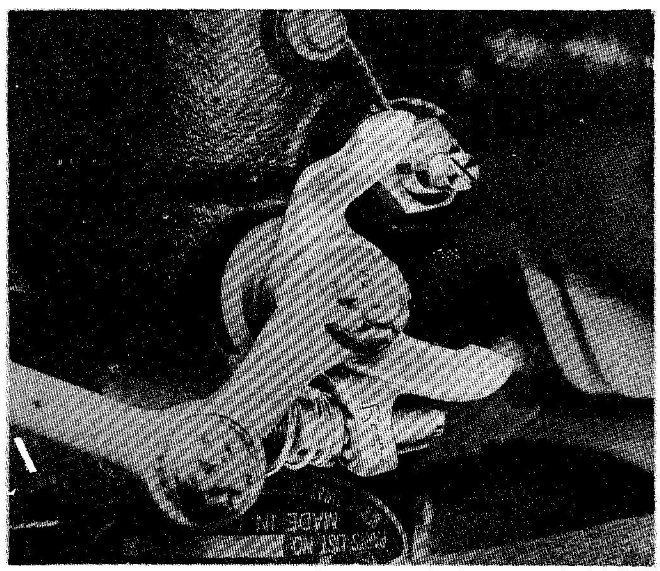


Fig. 24 Carburetor Idling Adjustments

CARBURETOR IDLING ADJUSTMENTS

All carburetors incorporate an idle mixture adjustment to provide for smooth engine operation at idling speed under varying atmospheric conditions and altitude changes. The carburetor idling adjustment should be made whenever a carburetor is installed, and whenever rough engine operation is experienced at low RPM. The rotation of the airplane to the direction of the prevailing wind will have an effect upon the propeller load and on its RPM, so it may be advisable to make the idle setting with the airplane crosswind. To make this adjustment, proceed as follows after the engine has been thoroughly warmed: (See Fig. 24)

1. Check the magnetos in the usual manner. If the RPM 'drop off' is excessive, check for fouled spark plugs. If the RPM drop is normal, proceed with the idle adjustment.

2. Close the throttle to idle at approximately 600 RPM. If the RPM increases appreciably after a change in the idle mixture adjustment during the succeeding steps, readjust the closed throttle stop to restore the desired RPM.

3. When the speed has been stabilized, move the mixture control lever momentarily, but with a smooth, steady pull, into the 'idle cut-off' position and observe the tachometer for any change in the RPM during the leaning process. Caution should be exercised to return the mixture control to the 'auto-rich' position before the engine cuts out. An increase of more than 10 RPM while 'leaning out' indicates an excessively rich idle adjustment. An immediate decrease in the RPM (not preceded by a momentary increase) indicates the idle adjustment is too lean.

4. If steps 2 and 3 indicate that the idle adjustment is too rich or too lean, turn the idle adjustment one or two notches in the direction required for correction, and check this new position by repeating steps 2 and 3. Make the additional adjustments as necessary until a check with steps 2 and 3 result in a momentary 'pick up' of approximately 5 RPM (never more than 10 RPM).

5. Each time that the adjustment is changed, the engine should be run up to 2000 RPM to clear the spark plugs before proceeding with the RPM check.

6. Make the final adjustment of the throttle stop to obtain an idling RPM of 450 with the throttle closed.

7. This method aims at a setting that will obtain the maximum RPM with the minimum manifold pressure. In case the setting does not remain stable, check the idle linkage of which any looseness would cause erratic idling. In all cases allowance should be made for the effect of weather conditions upon the idle adjustment.

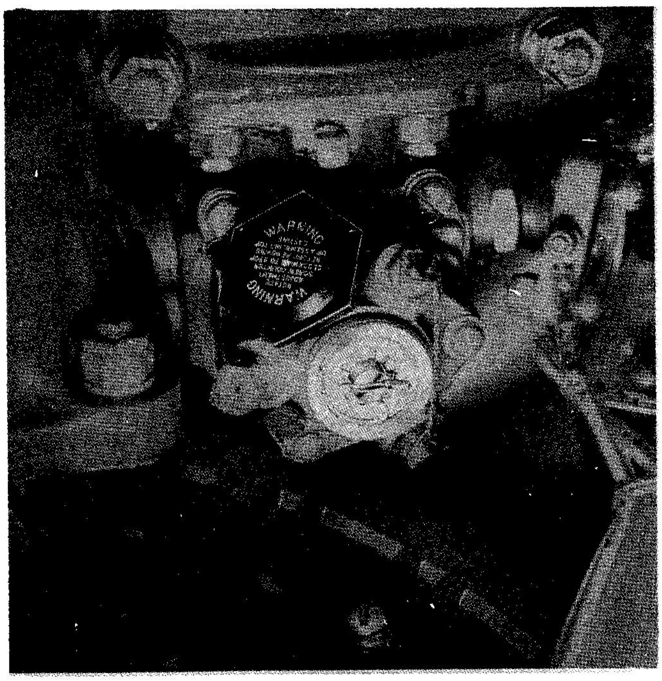


Fig. 25 Fuel Pressure Adjustment

FUEL PRESSURE ADJUSTMENT

The fuel pressure adjustment screw is incorporated with the fuel pressure relief valve, which is located on the fuel pump. (See Fig. 25) The adjustment should be made as follows:

1. Remove the cap covering the adjustment screw.

2. Operate the engine at 1800 RPM and turn the adjusting screw until 12

pounds pressure is registered on the fuel pressure gauge. Be sure that the lock on the screw is in one of the retaining slots after making the adjustment.

3. Replace the cap and safety.

OIL PRESSURE ADJUSTMENT

The oil adjustment screw is located at the oil pressure relief valve. (See Fig. 26) Make the adjustments as follows:

1. Remove the cap from the oil pressure relief valve and loosen the locknut on the adjusting screw.

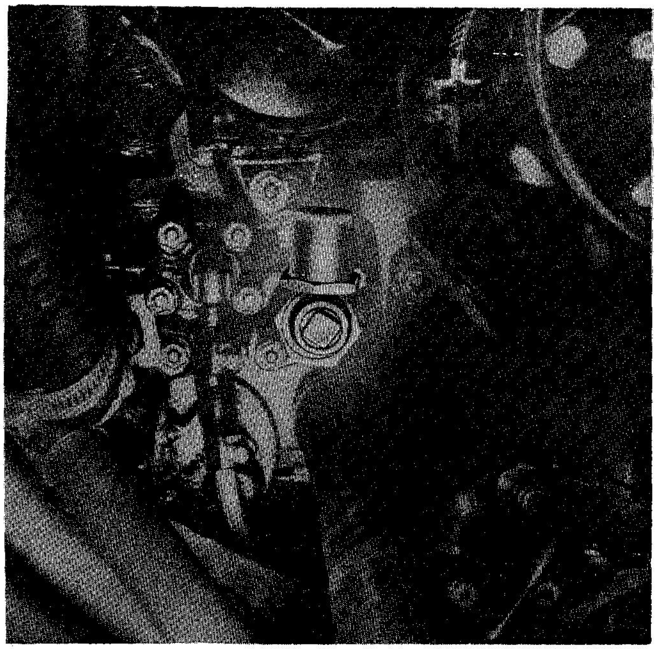


Fig. 26 Oil Pressure Adjustment

2. Operate the engine at 1800 RPM with the oil temperature at 156° F.

3. Set the adjustment screw until 75 pounds pressure is registered at the oil pressure gauge. Turn the adjusting screw clockwise to increase the pressure, and counterclockwise to decrease the pressure.

4. Tighten the locknut, replace the cap, and safety.

PROPELLER

Hamilton Standard Hydromatic Propellers are used on the airplane. The hydromatic propellers are controlled by governors which maintain the RPM setting as selected by the pilot. The hydromatic propeller employs an electric motor driven oil pump to build up the auxiliary pressure necessary for feathering and unfeathering the propeller. The feathering pump is a Hamilton Standard No. 66094-1.

GOVERNORS

The Hydromatic propeller governor consists of a gear pump, which boosts the pressure of the oil taken from the engine lubrication system, a valve which allows pressurized oil to shunt out the governor during feathering and unfeathering and a relief valve which limits the output of the gear pump. Consult the manufacturer's manual for overhaul procedures.

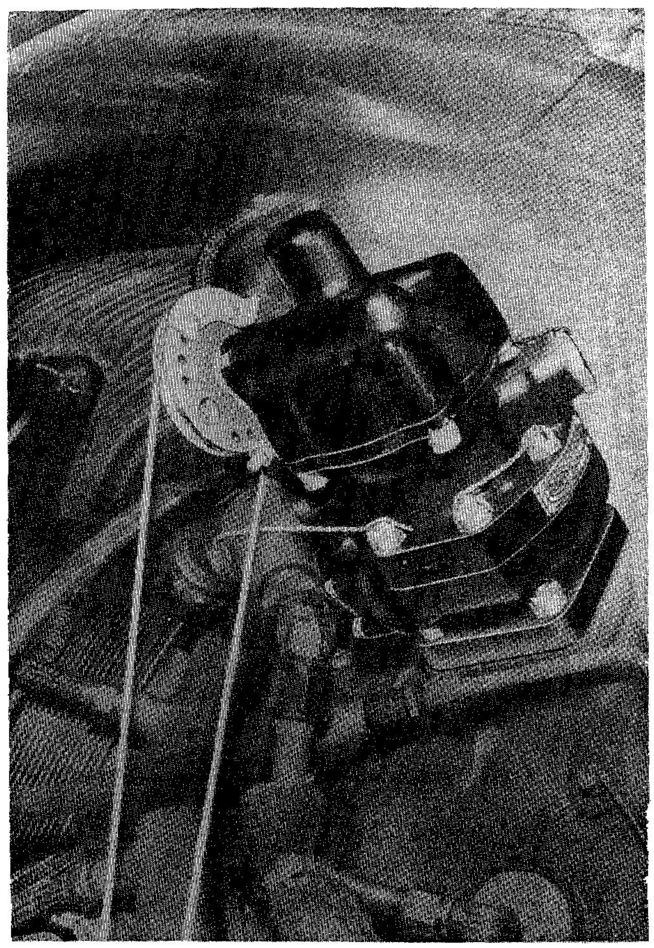


Fig. 27 Governor Adjustments

GOVERNOR ADJUSTMENTS

The maximum RPM setting (2300) is regulated by the contact between a bracket type stop on the pulley and the high RPM adjustment on the head. Moving the stop from one hole to an adjacent hole varies the maximum governing speed, approximately 250 RPM. The adjustment screw is located in the tapped boss on the head. One complete turn of the screw, will change the setting approximately 25 RPM. The tab lock plate, located between the boss and the securing nut, locks the adjustment screw to the head. (See Fig. 27)

ENGINE CONTROLS

Controls used for the engines are American Chain and cable or Shakespeare, consisting of an actuating unit inside of a flexible wound-wire housing. The control may be removed by disconnecting the ends, loosening the supporting blocks and pulling the control out.

ADJUSTMENT

To align the control levers and obtain the proper pedestal clearance, loosen the bolts in the phenolite blocks behind the control pedestal. Move the cable housing as required to align each pair of control levers to allow 1/4 inch pedestal clearance in the full back position. Tighten the blocks sufficiently to prevent the cable housing from slipping, but avoid over-tightening, which may result in broken blocks, restricted cable movement or crushed cable housing.

Service Note

If the operation is faulty, check the controls for binds caused by sharp bends, broken outer-housing or over-tightened supporting clamps. The controls should never be oiled since dirt and dust will collect in the housing and cause binding and excessive wear of the controls. Lubricate the controls with powdered graphite, by mixing powdered graphite with naptha and applying along housing with a squirt can.

Insert this page after Page 38.

The following paragraph is added after "GOVERNOR ADJUSTMENTS".

FULL FEATHERING (Hydromatic Propellers)

Adjust the propeller governor control so that the pulley on the governor hits the external stop and lacks 1/16 inch of hitting the internal stop.

LANDING GEAR SYSTEM

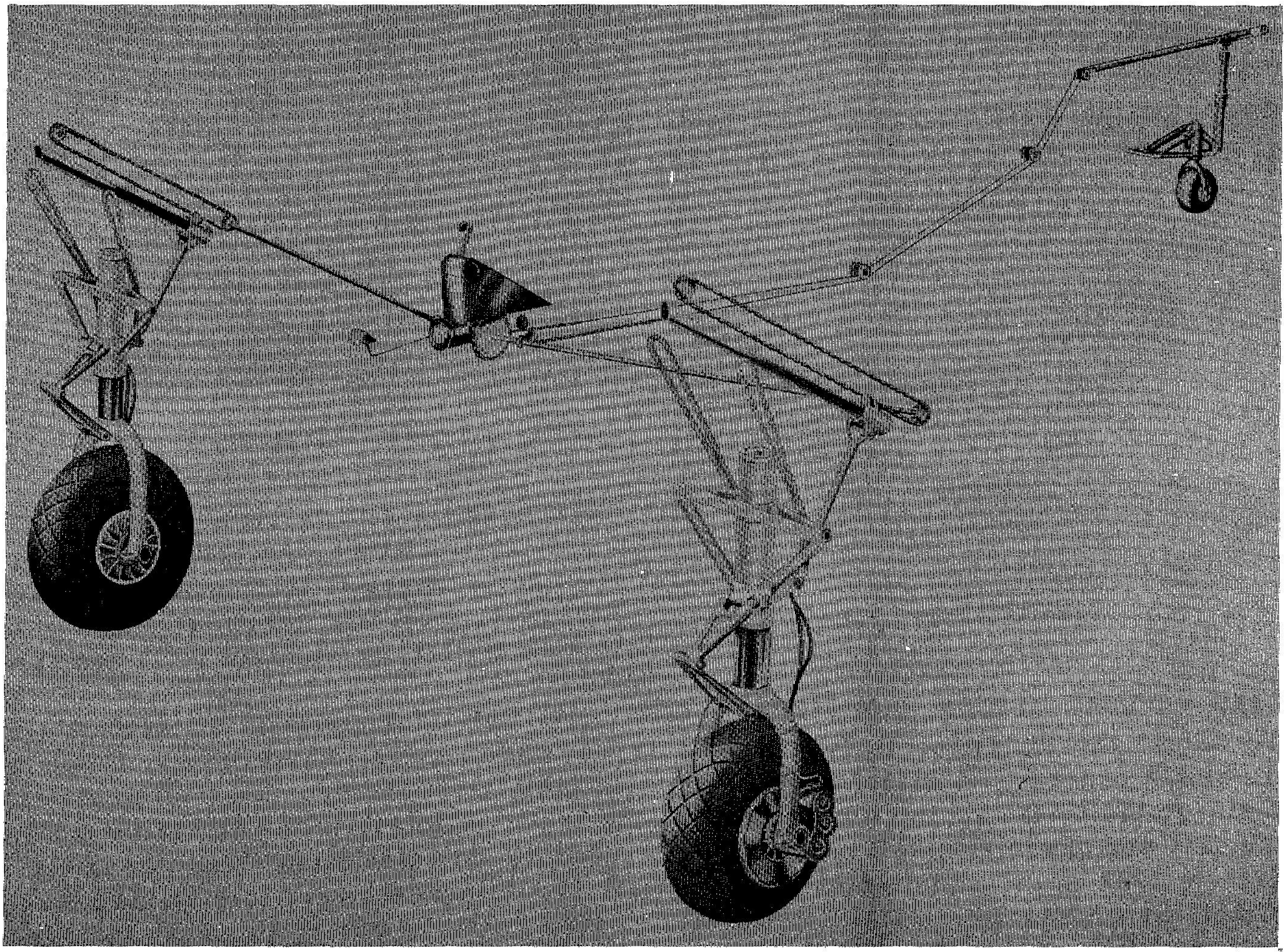


Fig. 28 Landing Gear System

The landing gear system consists of two forward main wheels and a tail wheel. (See Fig. 28) The three units are equipped with air-oil type shock absorbers and are simultaneously retracted, either electrically or by an auxiliary handcrank. The main wheels are equipped with hydraulic brakes.

RETRACTION MECHANISM

An electric motor, driving an irreversible gear, furnishes power for the retraction of the landing gear. Torque shafts connect the motor assembly to the chain-driven slides in each of the mainwheel nacelles. The tail wheel retraction slide is operated by cables connected to a chain drive at the motor assembly. A spring-loaded, disc type, overload clutch is installed in the motor drive-unit to protect the system from operating with an overload and to absorb the shock of sudden starting and stopping. A disengaging clutch operated from the pilot's compartment, releases the motor and gear unit from the system for manual operation.

LANDING GEAR CLUTCH CABLE

The landing gear clutch pedal is located on the floor to the left side of the control pedestal and is connected to the landing gear clutch arm by the landing gear cable. The landing gear clutch arm disengages the retract mechanism from the landing gear motor and gear box, allowing the landing gear to be operated manually.

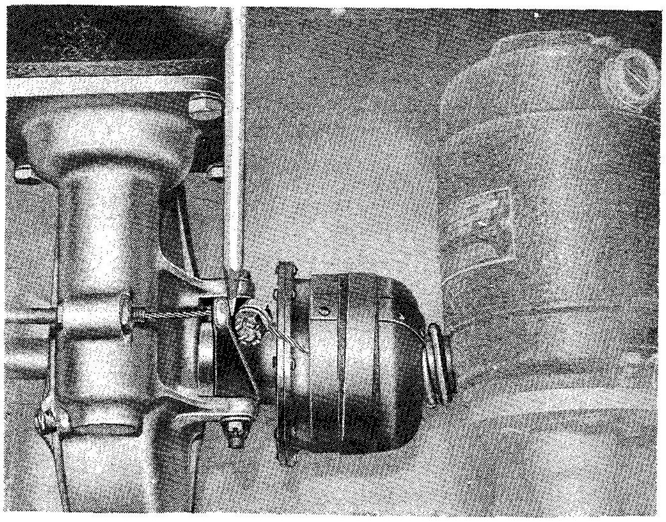


Fig. 29 Landing Gear Clutch Cable Adjustment

LANDING GEAR CLUTCH ADJUSTMENT

To adjust the clutch cable length, hold the clutch pedal in the extreme aft position. Pull the top of the clutch arm to the left and place the bolt on the cable 1/16 $\pm$ 1/32 of an inch distant from the clutch arm (See Fig. 29) Tighten the bolt securely and safety. Actuate the clutch pedal several times and check the bolt for slippage.

OVERLOAD CLUTCH ADJUSTMENT

The adjustment of the overload clutch is checked with a spring-scale connected to the handcrank. The adjustment is made in the following manner:

1. Place jacks under the airplane and raise until the wheels clear the floor, then retract the gear.
2. Engage and pull the handcrank (in the direction to retract the gear), push and disengage the foot pedal. Then crank the gear down until the bungee cords offset the weight of the gear.
3. Remove the foot from the pedal to

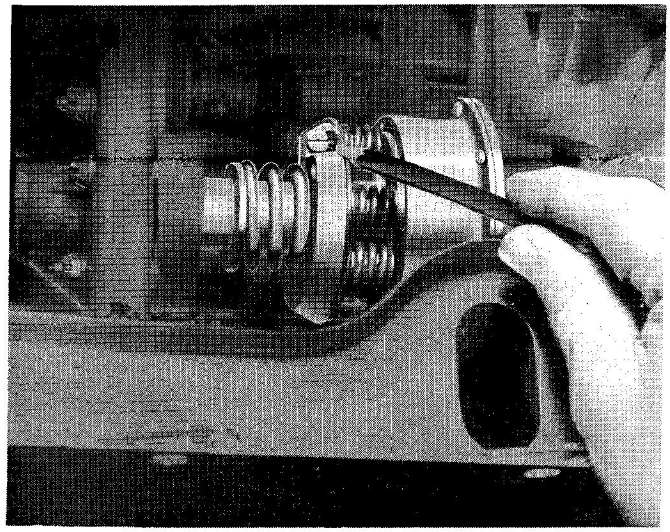


Fig. 30 Landing Gear Overload Clutch Adjustment

re-engage the clutch teeth.

4. Set the handcrank handle forward, with teeth engaged to the landing gear sprocket, hook the large spring-scale to the handle at an angle of 90° from the floor.
5. Pull up steadily on the scale until the clutch slips, which should be at a reading of 130 $\pm$ 10 pounds. If the clutch does not slip within the allowable scale reading, an adjustment should be made.
6. Remove the wrap lock and the dust cover from the clutch housing and loosen the lock screw in the tension nut. (See Fig. 30) To increase the clutch tension, tighten the tension nut; to decrease,

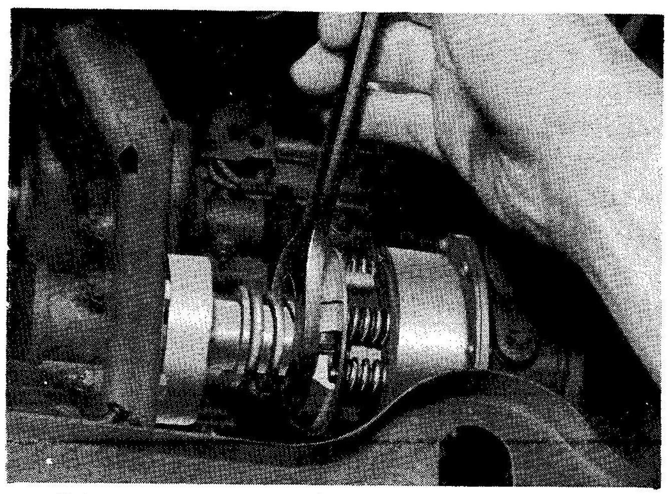


Fig. 31 Landing Gear Overload Clutch Adjustment

loosen the tension nut. (See Fig. 31) (The overload clutch wrench, Part No. 180131 is provided with the airplane.)

7. Tighten the lockscrew in the tension nut and safety. Replace the dust cover and install the wrap lock.

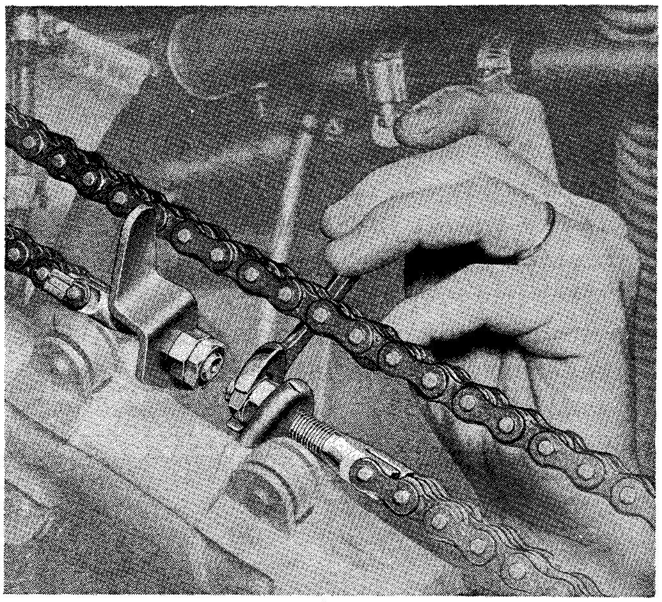


Fig. 32 Landing Gear Chain Adjustment

MAIN LANDING GEAR CHAIN ADJUSTMENT

To obtain the proper tension on the retract chains and to synchronize the main gears, perform the following steps:

1. Place jacks under the airplane and raise the airplane until the wheels have cleared the floor.

2. Raise the gear up with the handcrank approximately four or five inches from the lower stop. The measurement from the lower stop must be the same on each slide.

3. If they are not the same equalize the slides by changing the adjustment at the eyebolts. The slide may be raised by tightening the chain at the upper eyebolt and loosening the chains at the lower eyebolt. To lower the slide, loosen the chain at the upper eyebolt and tighten the opposite eyebolt. (See Fig. 32)

4. Check the chain tension by pressing the lower chain to the upper with the thumb and forefinger. Satisfactory tension is indicated if the chains will barely touch. (See Fig. 33)

5. Tension on the chain may be increased by tightening it at the upper and lower eyebolts of the slide, or the tension may be relieved by the opposite procedure. In either case the chain must be adjusted the same amount at each eyebolt to maintain synchronization.

Service Note

The retract chains should be checked at regular intervals for possible wear. Check the measurement of thirty-six links from the center of the link pins. The measurement should be 18 to 18-1/8 inches. If over 18-1/8 inches, the chain should be replaced.

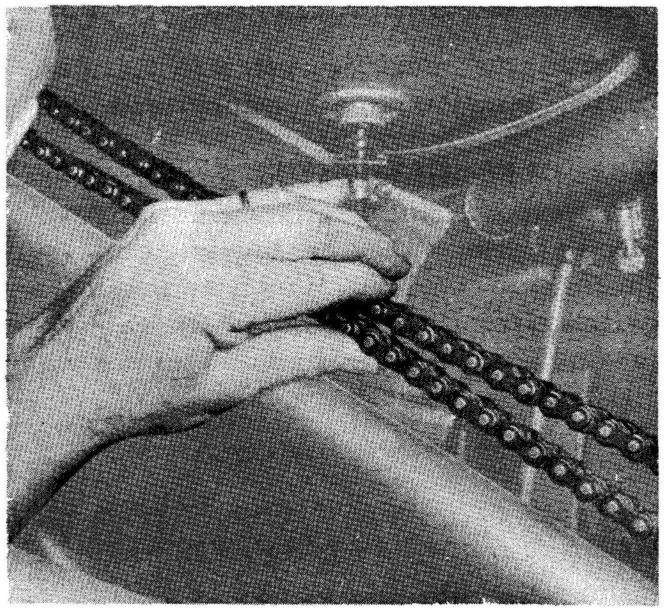


Fig. 33 Landing Gear Chain Tension

LIMIT SWITCH ADJUSTMENT

The lower limit switch, located in the left nacelle, is adjusted by resetting the locking nuts on the threaded barrel of the switch:

1. Place jacks under the jack points and raise the airplane until it has cleared the floor.

2. Loosen the locknuts on the lower limit switch until the plunger is free from the lug on the slide. Then tighten

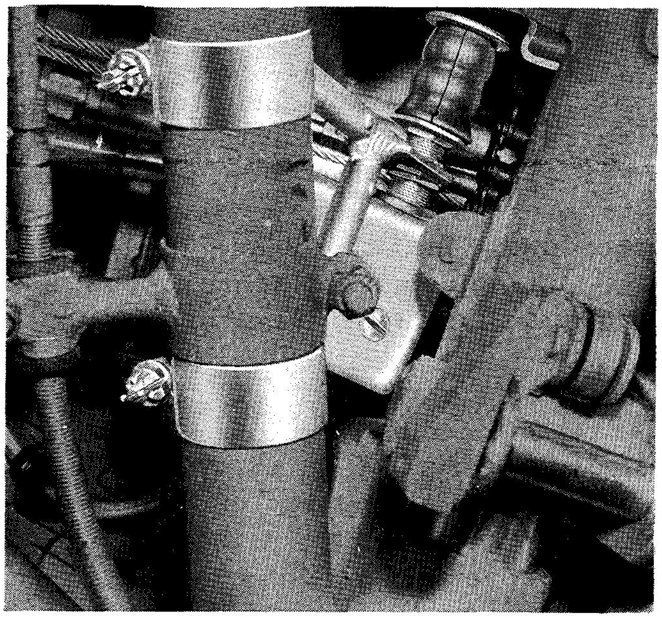


Fig. 34 Lower Limit Switch Adjustment

the upper nut, until the switch just clicks. Lock the switch in this location. (See Fig. 34)

3. Manually retract the gear approximately one inch. Then extend the gear, making sure that the lug is actuating the limit switch sufficiently to make the switch click (open circuit). Operate the gear electrically and make minor adjustments as necessary.

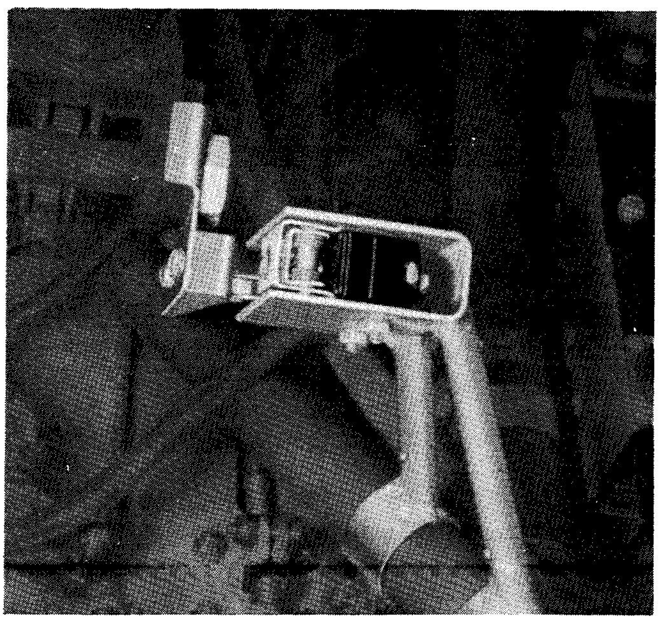


Fig. 35 Upper Limit Switch Adjustment

Service Note
The landing gear motor has a dynamic brake circuit, which stops the electric motor immediately, when either limit switch is actuated.

The upper limit switch is mounted on a truss tube near the top of the left nacelle. The switch is operated by the camming action of the actuator lug mounted on the slide assembly. The actuator lug is slotted to permit minor adjustments of the upper travel limit; major travel adjustments require relocation of the switch mounting bracket. Adjust the upper limit switch to obtain a distance of 1/16 to 1/8 inch between the slide and the upper stop. (See Fig. 35)

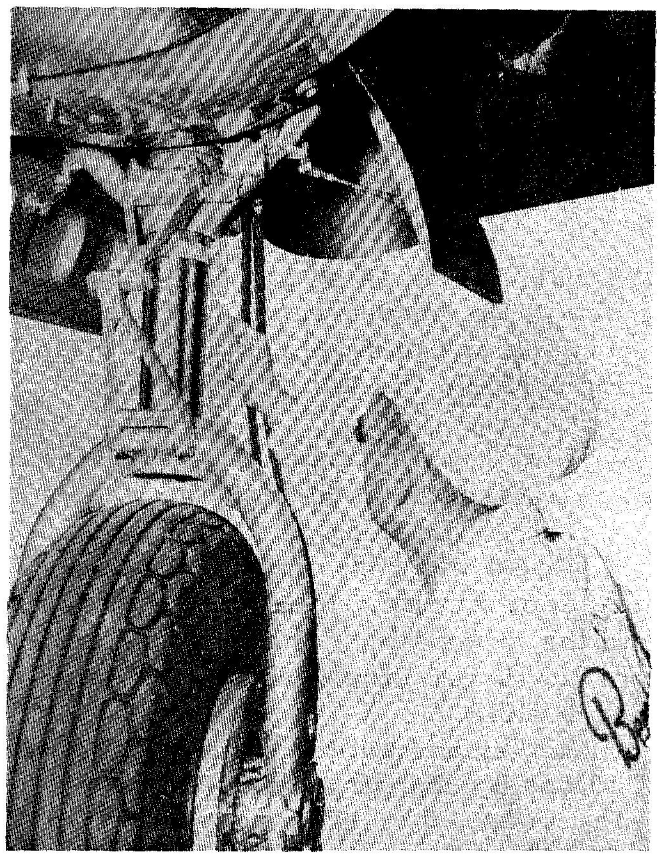


Fig. 36 Safety Switch Adjustment

SAFETY SWITCH ADJUSTMENT

The landing gear safety switch is located on the left shock strut and may be adjusted as follows:

1. Place jacks under the jack points

and raise the airplane to clear the floor.

2. Measure down 1/2 inch from the top of the polished piston and mark with a piece of tape. (See Fig. 36)

3. Raise the wheel with a small jack, compressing the piston, until the tape is even with the lower edge of the cylinder.

4. Adjust the bolt on the switch actuator bracket so that the switch is actuated as the piston passes this mark.

TAIL WHEEL CABLE ADJUSTMENT

The tail wheel retracts simultanously with the main landing gear. Its travel is regulated by adjusting the cable turnbuckles in the tail section of the airplane. To adjust the turnbuckles:

1. Raise the airplane with jacks until all the wheels have cleared the floor.

2. Check the landing gear to be sure it is in the fully extended position.

3. Adjust the upper retract cable to a tension of 70 $^{+5}_{-5}$ pounds. This should place the tail wheel slide firmly against the lower stop. Adjust the lower cable to a tension of 50 $^{+5}_{-5}$ pounds.

Service Note

The tail wheel retract cables are attached to the slide assembly by a special dural bolt which will shear, if the tail wheel should jam, permitting the main gear to operate. This bolt should not be replaced with a steel bolt.

SHOCK ABSORBER ASSEMBLIES

MAIN SHOCK STRUT

The Beech manufactured landing gear uses an air-oil type shock absorber (See Fig. 37). The torque knees, interconnecting the main cylinder and the piston, hold the main wheel in alignment. The bearing caps, securing the axle to the strut fork, are not interchangeable. The markings are stamped on the four caps, and on the corresponding location on the strut, to designate their location.

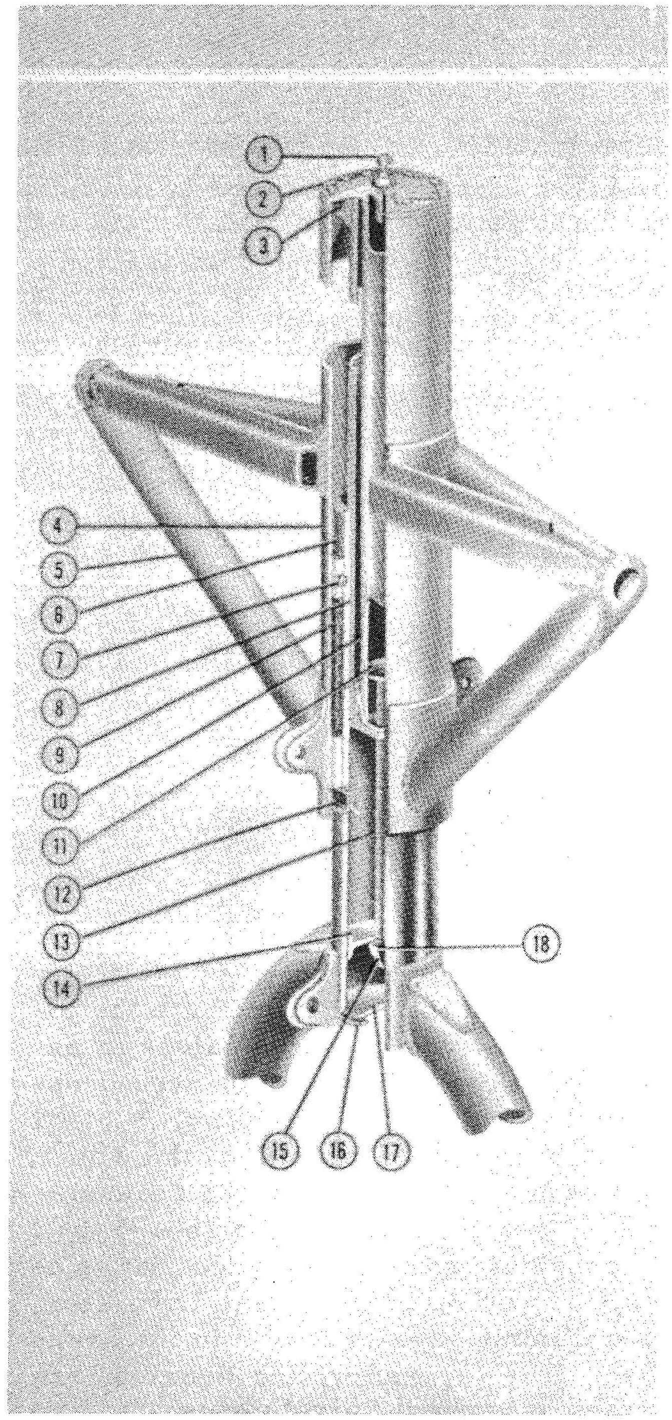


Fig. 37 Main Landing Gear. Shock Absorber

TAIL WHEEL SHOCK STRUT

The tail wheel shock strut is of the air-oil type, using AAF 3580D or AN-VV-0-366b red color hydraulic fluid. The upper fitting of the strut is attached to the slide assembly, and the lower fitting attaches to the tail-wheel fork brace assembly.

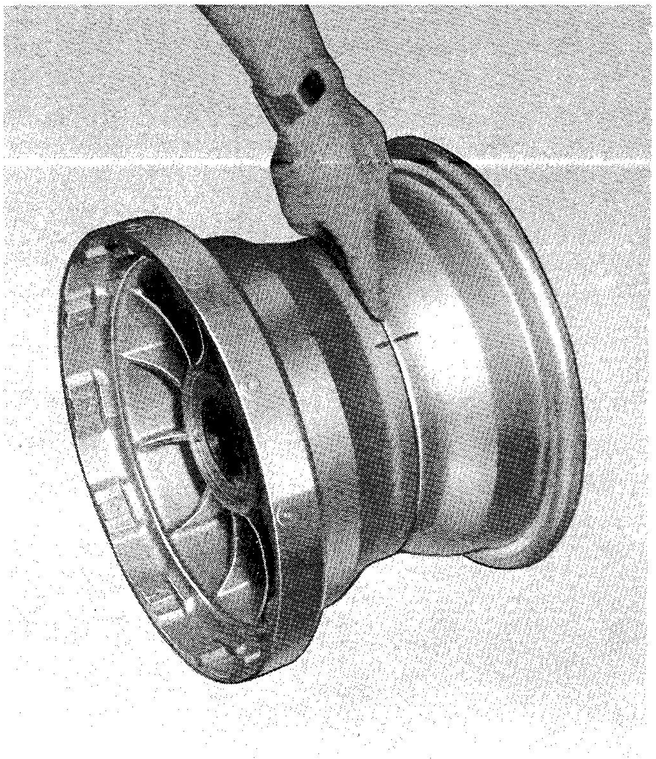


Fig. 38 Main Wheel Balance Mark

WHEELS

MAIN WHEELS

The Goodyear split wheel is statically balanced and marked to indicate the location of the two balanced halves in relation to each other, which insures proper balance, when reassembling. A black line, painted on each half of the wheel, serves as a matching point for reassembling. (See Fig. 38) The outboard half is provided with an extended flange equipped with hardened steel drive keys, to accommodate the slots, in the brake disc. The tapered roller bearings are seated in hardened steel cones.

WHEEL AND TIRE INSTALLATION

Before installing the tire on the wheel, the wheel must be assembled with the balance mark of each section aligned with each other. Synthetic tubes and the inside of the synthetic tires must be coated with a vegetable oil soap for increased life of both the tire and the tube. To install the wheel assembly perform the following:

1. Install the steel disc in the brake housing and place the axle in the wheel (See Fig. 39).
2. Slide the slots of the wheel brake disc onto the wheel drive keys.
3. Adjust the bearing retaining nut until the axle assembly no longer turns, then back the nut off until the assembly rotates freely.

Service Note

Tire slippage may be checked by comparing the red line on the outboard side of the wheel flange with the mark on the tire. Completely deflate the tube before disassembling the wheel or changing the tire. Do not over-tighten bearings as this may result in a cracked bearing or wheel.

TIRE MOUNTING AND DISMOUNTING

The following information is given to facilitate mounting and dismounting of the tires as quickly as possible. Methods for the proper and safe use of tools to prevent damage to the casing, tube, and

Fig. 39 Brake and Axle Assembly in Wheel

Insert this page after Page 44.

In the descriptive paragraph "MAIN WHEELS," the following should be added:

On later model airplanes the two halves of the split wheel are individually statically and dynamically balanced. On this newer type wheel, there is no marking on the wheel halves. As each wheel section is balanced separately, it is not necessary to match them for reassembly.

wheel are also included:

NOTE: Before mounting any tire on a wheel, make sure there are no cracked or damaged parts. Burrs or nicks in the wheel should be removed with a file, to prevent any possible damage to the tire or tube. The tire and tube should be carefully inspected for damage or signs of possible failure.

Use no lubricants on the tire beads or on the bead seats of the wheel since it may result in slippage of the tire on the wheel. Tire talc will facilitate mounting and prevent chafing of the tube in the tire.

To properly seat the tire beads and to remove wrinkles and prevent pinching of the tube, completely inflate and deflate the tire several times before finally inflating it to the correct pressure. This also aids in eliminating the possibility of one portion of the tube being stretched more than the balance of the tube, thus helping to prevent thinning out of the tube in one area.

WARNING: Before dismounting the tires, always be sure the tire is completely deflated.

NOTE: Care should be exercised not to injure the beads of the tire or the relatively soft metal of the wheel. Even with approved tools, extreme care must be taken.

DISMOUNTING TIRES

1. Remove the valve core and fully deflate the tube.

2. Lay the tire flat and break the beads loose from both rim flanges. Usually this can be accomplished (See Fig. 40) by driving a flat tire iron between the rim flange and the bead or by pushing against the sidewall of the tire near the bead with the hands or the feet. A combination of these methods can also be used.

NOTE: Special tire irons may also be used where beads are frozen to the flanges and the above methods do not properly loosen them.

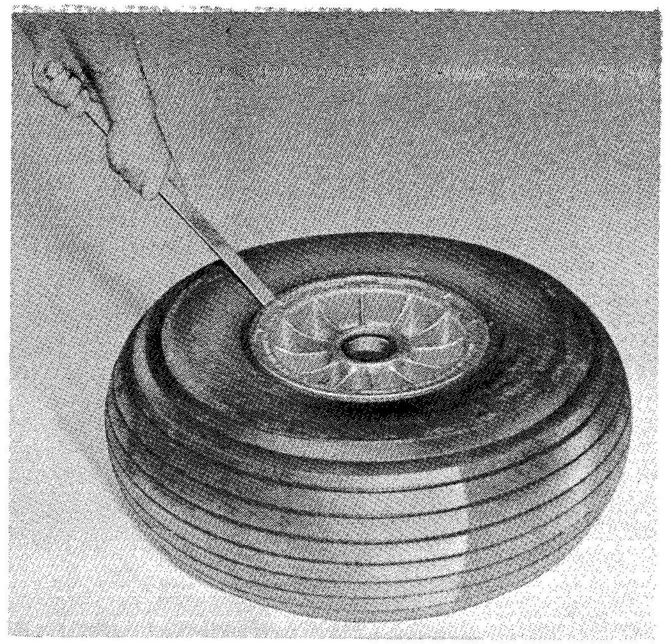


Fig. 40 Dismounting Tire

3. Remove the locknuts (See Fig. 41) from the wheel and pull out both parts of the wheel from the tire.

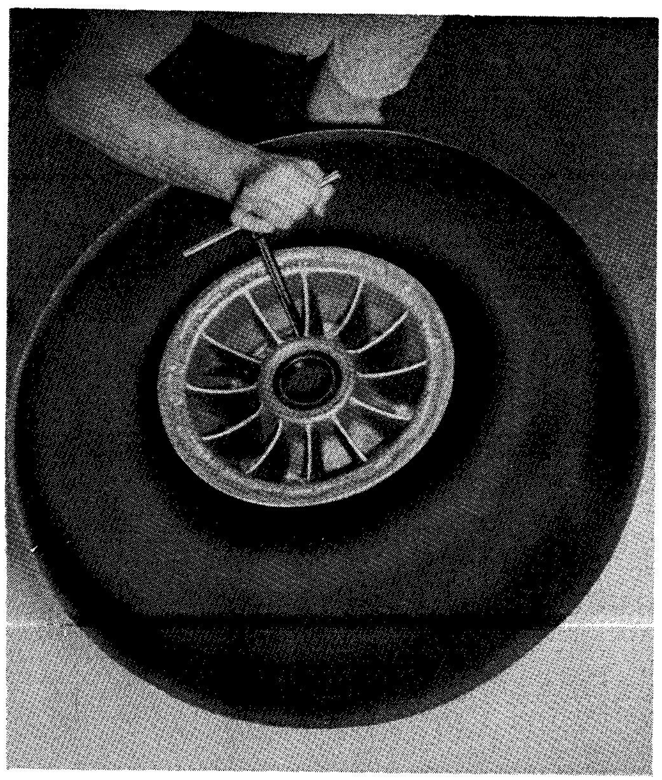


Fig. 41 Removing Locking Nuts

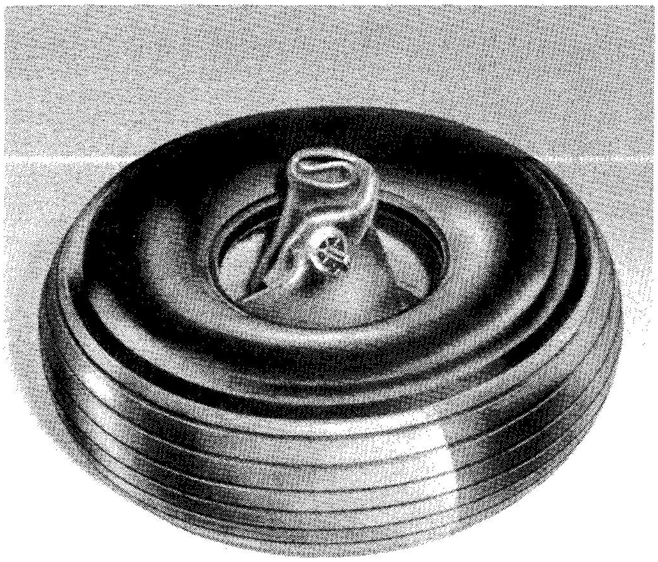


Fig. 42 Tube Insertion and Inflation

MOUNTING TIRES

1. With the tube entirely deflated, insert it in the tire (folding makes this easier, particularly in small diameter tires), and inflate until the tube is just rounded out. The valve core should be in the valve during this operation (See Fig. 42).

2. Insert the valve hole section of the wheel into the tire, pushing the valve through the valve hole in the wheel (See Fig. 43).

3. Insert the other side of the wheel, holding the valve in position.

NOTE: care should be used not to pinch the tube between the wheel sections.

4. Install the locking nuts and tighten them securely with equal torque.

5. Inflate the tube to approximately 30 pounds and install the valve cap. After the tire and wheel are installed on the airplane, inflate the tire until the centerline of the axle is 13 inches above the ground. Tighten the valve cap, finger tight.

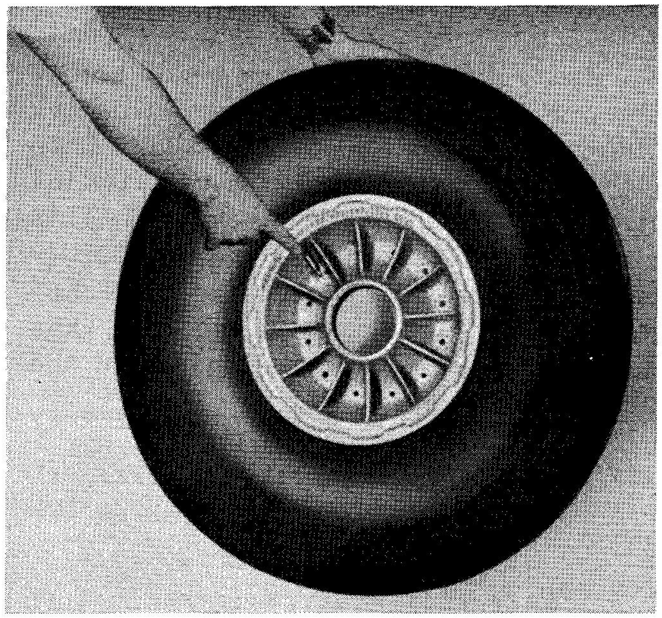


Fig. 43 Assembling Tire and Tube to Wheel Section

Insert this page after Page 46.

Step 4 in the paragraph "MOUNTING TIRES" should read as follows:

4. Install the bolts and the retaining nuts and torque to 175 inch-pounds.

Insert this page after Page 46A.

The second paragraph under "BRAKE SYSTEM," concerning parking brakes should read as follows:

The parking brake handle is located on the control pedestal. Separate parking brake control valves are interconnected between the pilot's master cylinder fluid lines and wheel brakes. Application of the parking brake requires operation of the pilot's toe brakes to pressurize the system, pulling out the parking brake handle and holding it, releasing the brake pedals and then the parking brake handle. This will set the parking brakes. To release, either depress the pilot's toe brake pedals or push in the parking brake handle.

BRAKE SYSTEM

The hydraulic brake system consists of Goodyear single disc brakes operated by dual, toe-brake controls. The toe-brake pedals actuate individual master cylinders by means of toggle-action linkage assemblies. Dual fluid lines connect the pilot's and co-pilot's master cylinders to the wheel brakes. Shuttle valves are installed at the inlet of each brake housing to close the opposite brake line when either the pilot's or co-pilot's brake pedals are operated.

The parking brake handle is located on the control pedestal. Separate parking brake control valves are interconnected between the pilot's master cylinder fluid lines and wheel brakes. Application of the parking brakes requires operation of the pilot's toe-brake to pressurize the system. Then by pulling the parking brake handle and turning to lock, the parking brakes are set. To release, compress the pilot's toe-brake pedals, turn parking brake handle and push in. Release toe-brake pedals.

NOTE: With parking brake set, it is impossible to apply additional pressure to brake system by pumping toe brakes. To apply additional brakes with parking brake engaged, it is necessary to release parking brake and pump pedals. After sufficient pressure has been pumped up, reset parking brake.

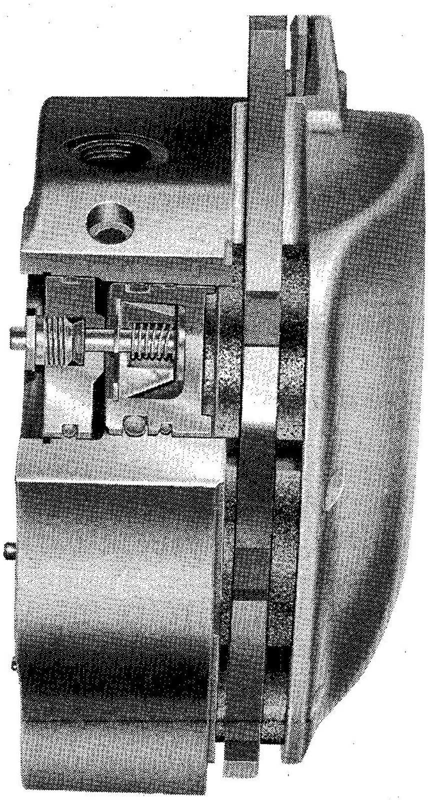


Fig. 44 Brake Assembly Cutaway

BRAKE ASSEMBLY

The Goodyear single disc brake assembly, located on each main landing gear wheel, consists of two main parts: the housing assembly and the disc. The housing assembly contains three pressure cylinders, each equipped with a piston assembly and movable circular-segment lining. (See Fig. 44) As the brakes are depressed, the hydraulic fluid pressurizes the cylinders simultaneously, causing the pistons in the cylinders to press the linings against the steel disc. The disc is then forced laterally against the stationary circular segment linings on the opposite side of the housing, causing braking action on the disc.

ADJUSTMENT (Brake Assembly)

The Goodyear disc brake is a self-compensating type. This eliminates lining clearance adjustment. An increased volume of fluid between the cylinder head and piston compensates for lining wear during the life of the brake lining. Brake pedals require no adjustment but remain constant regardless of lining wear. Brake pedal setting can be changed at the attaching brake rod clevis.

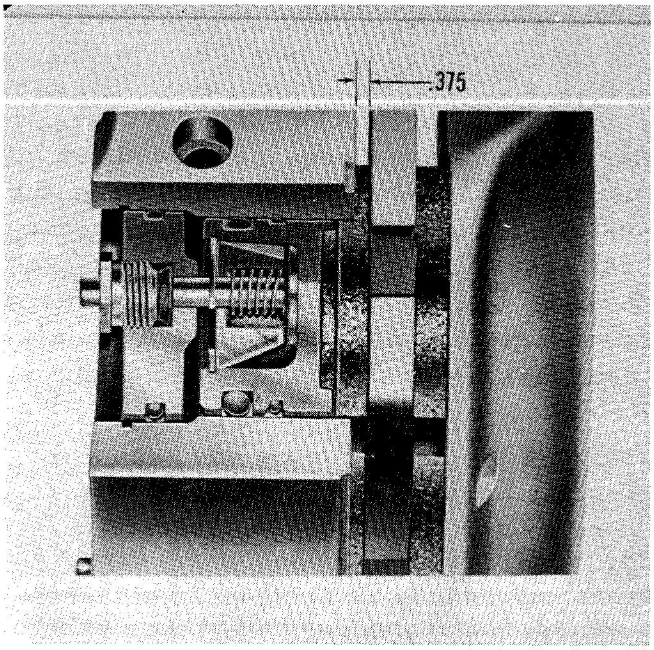


Fig. 45 Determining Lining Wear

DETERMINING LINING WEAR (Fig. 45)
The brake lining wear is indicated by the position of the adjusting pin. Excessively worn linings are indicated when the adjusting pin is almost flush with the adjusting pin packing nut. The following procedure is recommended for checking the wear of individual segments: A maximum clearance is specified for checking the wear on the inboard lining. This requires a feeler gauge of .375 inch thickness. With the brakes applied, insert the feeler gauge between the outboard housing and the steel disc at the center of the brake housing near the wheel hub. If the gauge can be inserted, the inboard linings are worn thin and are not considered safe for further use. If the feeler gauge cannot be inserted, continued service of the lining is recommended. If the visible thickness of the outboard linings is 1/16 inch or less, replacement is necessary. A 1/16 inch thickness guage may be held against the face of the steel disc and visual reference made as a comparison. The stationary lining within the wheel is referred to as the inboard lining.

REPLACEMENT OF BRAKE UNIT PARTS
When obvious leakage is noted around the adjusting pin, it will be necessary to check the torque, (25 inch pounds), on the adjusting pin packing nut. (See Fig. 46) If leakage continues the adjusting pin packing gasket must be replaced. The brake cylinders must be disassembled for 'O' ring seal replacement or other obvious trouble. All seals should be replaced if

Fig. 46 Brake Packing Nut Torque Adjustment

damaged, shrunk, or found to be leaking. The brake piston dust seal should be replaced if worn. Damaged parts must be replaced.

REPLACEMENT OF BRAKE LININGS OR DISC
If the brake linings are excessively worn, replacement is necessary. The steel disc should be replaced if it is found to be warped or dished. Either replacement will require the following disassembly:

1. Remove the wheel assembly from the shock strut fork. (Use AT506 wrench) It will not be necessary to remove brake lines if wheel assembly and lines are handled carefully. Removing the lines

Insert this page after Page 48.

The 25 inch-pound torque on the adjusting pin packing nut of the Goodyear single-disc brake listed under "REPLACEMENT OF BRAKE UNIT PARTS" should read "(25 foot-pounds)" or "(300 inch-pounds)". This setting should be used on all D18S and D18C brake assemblies.

Insert this page after Page 48A.

The 25 inch-pound torque called out in paragraph on "REASSEMBLING (BRAKE)" should read "25 foot-pounds" or "300 inch-pounds".

will necessitate bleeding the system.

2. Remove the brake axle from the wheel.

3. Remove the floating steel disc from the brake housing slot, allowing the brake segments to fall free.

To install disc and brake segments, place the lining segments in the piston side of the housing cavities first, then install lining segments in the stationary side of the brake housing; hold them apart, and place the steel disc between the linings. To keep the linings apart while inserting the disc, place a piece of rubber tubing of suitable size, between the linings. Remove the tube as the disc is inserted in the slot.

DISASSEMBLY OF BRAKE UNITS

Disassembly of brake units may be accomplished by uncoupling the dual hydraulic lines from the shuttle valve at the brake inlet port. (Place the free lines in a clean glass receptacle to drain the system.) Remove the cylinder head bleeder screw and lockring, back off the adjusting pin packing nut and pull the cylinder head and piston free. Removal of the piston head lockring will allow the piston to be disassembled for removal of the adjusting pin, movable plate, and spring. Replace damaged seals or parts and flush lines and supply tank; wash all parts with alcohol.

REASSEMBLING (Brake)

Reassembling consists of lubricating the cylinder walls and dipping the 'O' ring seals in hydraulic fluid, installing the 'O' ring seals on the piston and cylinder head, and installing a dust seal felt in the piston. Replace the piston in the cylinder, install and properly seat the cylinder head below the lockring position, replace the lockring and bleeder screw. Replace the adjusting pin packing washer, gasket, and nuts using 25 inch pounds torque on the packing nut. The cylinder head should be held stationary during torquing operation. Care should be taken to properly seat the lockring in the groove. Bleeder screws must be set at the top position, in each cylinder, to insure positive release of trapped air in the brake cylinder. Bleed the system and apply the brakes to check for proper operation of the system. Safety all bleeder head screws.

Service Note

Glazed brake linings, worn slightly, are considered serviceable. Spongy pedal action indicates air in the lines and brake assemblies making it necessary to bleed the system. Check the reservoir for sufficient fluid supply by visible inspection (2" from the top). Blow foreign particles and dirt out of the brake housing with compressed air. Wash the brake piston seals and all the brake parts with denatured alcohol or petroleum base hydraulic fluid only. Extreme care must be taken to prevent dirt or other particles from entering into the system. Should this occur, locked or dragging brakes may result. Brakes should be checked over carefully, for corrosion or broken parts, during inspection periods. All lines and connections should be inspected for indications of leakage and security.

MASTER CYLINDERS

The master cylinders are of the compensating barrel type, (See Fig. 47) designed to maintain constant and correct volume of fluid in the system. Small amounts of fluid lost through leakage is automatically replaced. The piston and cylinder, actuated by the mechanical linkage, pressurizes the fluid in the chamber, the dual lines, and the wheel brake cylinders. The seals in the master cylinders insure positive fluid pressure and prevent leakage. The main spring in each master cylinder provides for the return of the piston and the toe-brake assembly. The

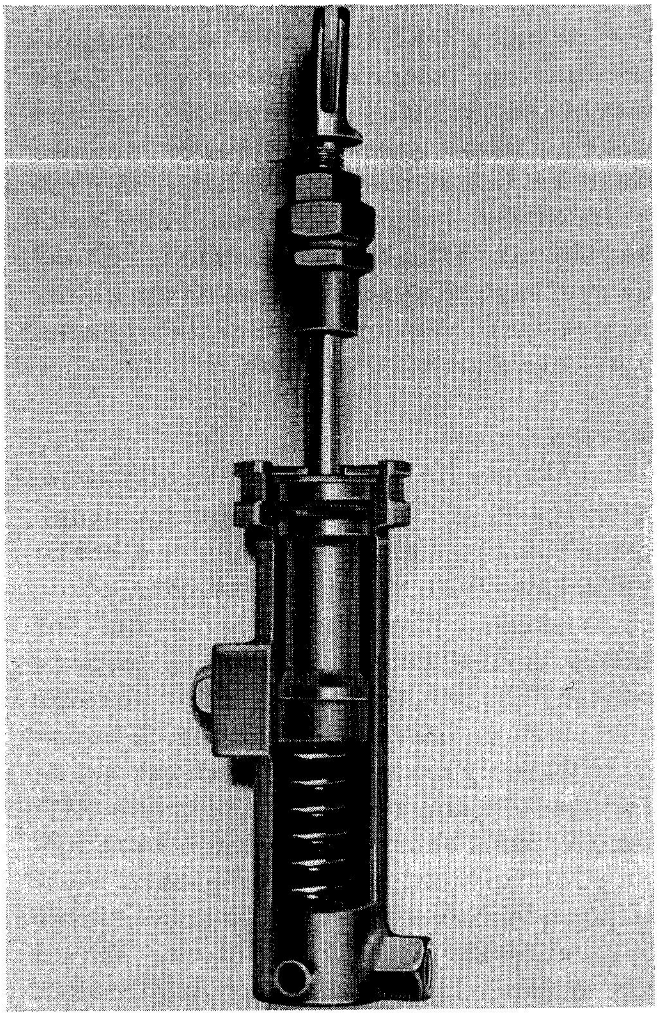


Fig. 47 Cutaway View of Master Cylinders

cylinders actuate in the toggle-action linkages, below the pilot's compartment floorboards, and receive a direct supply of hydraulic fluid from a reservoir tank located on the aft side of bulkhead No. 3.

REPLACEMENT OF THE MASTER CYLINDER SEALS

To replace the seals, it will be necessary to disassemble the master cylinder. Drain the system and disconnect the cylinder from the toggle linkage and lines. Remove the rubber dust cover and lockring, then remove the washer, piston, seal, and spring from the barrel of the cylinder. Wash and clean the cylinder and parts with alcohol or equivalent. Replace all damaged parts. To reassemble the master cylinder, lubricate the seals and the cylinder barrel with brake fluid. Install the spring with the spring cap resting in the cup end of the seal, and replace the piston with the notched end of the piston against the back of the piston seal. Snap the lockring in place and replace the dust cover. Adjust the cylinder in the brake linkage, to insure the piston cup clearing the compensating port when in the full back or neutral position. Bleed the brake system and fill the reservoir tank within two inches of the top. Check the brakes for proper operation.

MASTER CYLINDER LINKAGE ADJUSTMENT

To limit the down travel of the master cylinder, adjust the bolt stop on the toggle arm. (See Fig. 48) Loosen the locknut, and turn the bolt until it is $\frac{1}{2}$ inch out from the toggle arm. Tighten the locknut against the toggle arm. Actuate the linkage to check for over travel of the master cylinder, which would cause the linkage to lock in the down position. In case of over travel, the $\frac{1}{2}$ inch dimension may be increased.

TOE-BRAKE PEDAL ADJUSTMENT

The toe-brake pedal adjustment is located at the attaching point of the brake rod to the toe-brake pedal. (See Fig. 49 for the correct points to align when adjusting the toe-brake pedal.) The toe-brake pedal is set at 90° to the floorboards with the rudder pedals in neutral position. A pin may be installed between the rudder pedals to hold them in neutral position.

Service Note

The flexible boot dust protectors on the master cylinders, should be replaced, if worn or damaged. Weak or broken return springs should be replaced, and seals inspected for damage if leakage at the master cylinders is noted. No lubrication is necessary on the brakes. Improper fluid will rapidly deteriorate the

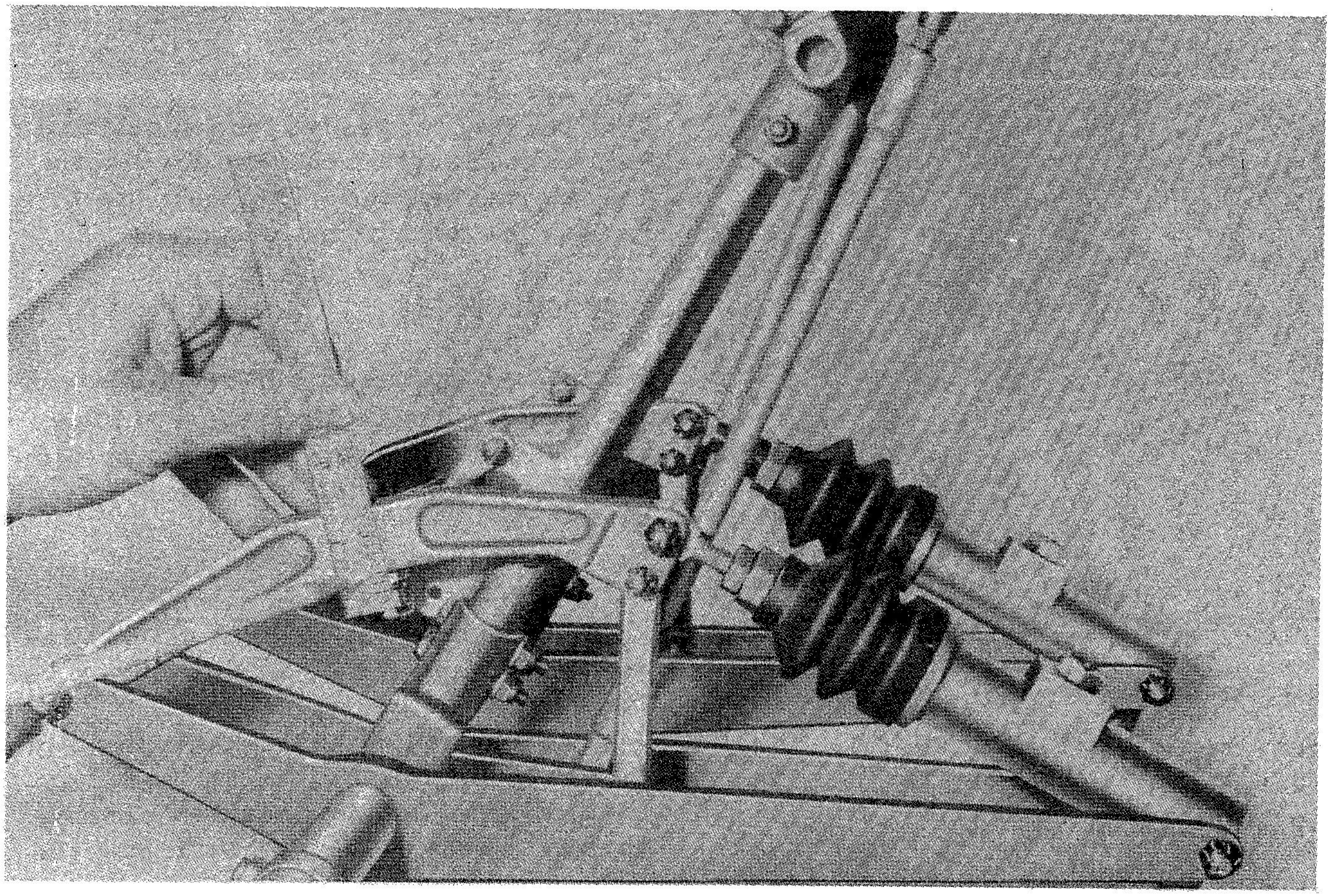


Fig. 48 Master Cylinder Linkage Adjustment

seals of both the brake and master cylinders. If improper fluid is used, flush the system and replace all the seals. The correct fluid to be used with synthetic seals is AAF 3580D or AN-VV-0-366b.

SHUTTLE VALVES

The valves, located at the inlet port of each brake housing, shuttle the brake operation between the pilot's and co-pilot's brake system. The small pistons, sliding back and forth, prevent the flow of the fluid to the inoperative brake and master cylinders (See Fig. 50).

Service Note

If evidence of internal leakage is indicated, the shuttle valve should be disassembled and the seals replaced if worn or deteriorated. Internal leakage is indicated by the gradual loss of brake fluid

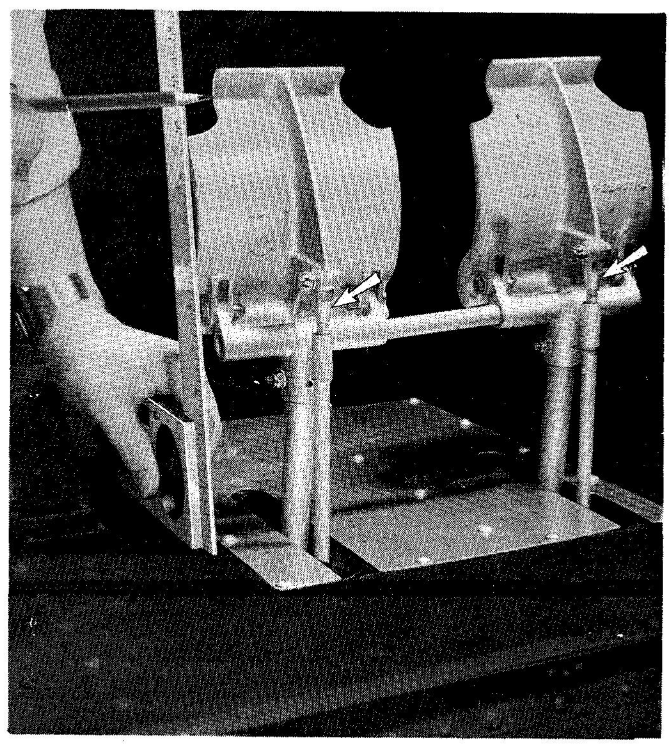


Fig. 49 Toe Brake Pedal Adjustment

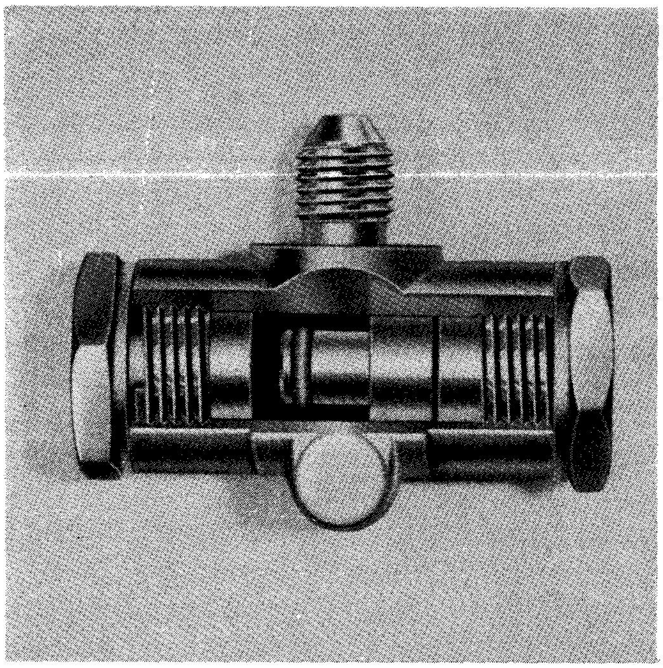


Fig. 50 Cutaway View of Shuttle Valve

pressure.

PARKING BRAKE VALVES

Two valves are located below the pilot's floorboards, to the right of the pilot's master cylinder linkage. These valves are the lever type and are actuated simultaneously by pulling out on the parking brake handle, (See Fig. 51) which serves to lock pressure in the pilot's

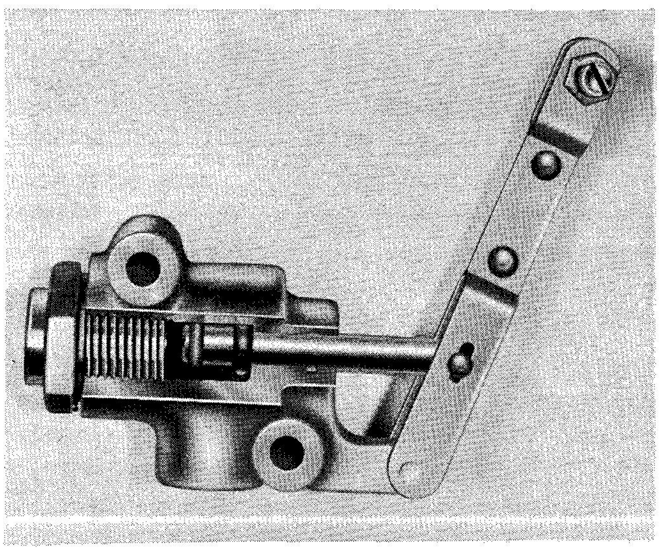


Fig. 51 Cutaway View of Parking Brake Valve

brake lines.

Service Note

If the parking brake pressure should fail, the valves should be checked for internal and external leakage. The seals must be replaced if worn or deteriorated.

BRAKE BLEEDING

The following procedure is recommended as the most satisfactory method of bleeding trapped air from the brake system (See Fig. 52).

EQUIPMENT (Brake Bleeding)

1. Pressure pot (2 or 3 gallons capacity) equipped with a shut-off valve and a pressure gauge.
2. Fluid supply hose (approximately 10 feet in length).
3. Bleeder hose and adapter (approximately 2 feet in length) to fit over the bleeder adapter.
4. Fluid receptacles (approximately 1 gallon capacity).

PROCEDURE (Brake Bleeding)

1. Disconnect the brake fluid supply line at the main reservoir. Connect the pressure pot hose to the fluid supply line.
2. With a hand air pump, apply a pressure of 40 pounds per square inch to the pot.
3. Attach the adapter and the bleeder hose to the left wheel brake bleeder port. Place the hose into the fluid receptacle and open the bleeder port.
4. Turn on the pressure pot and allow the fluid to flow for a few minutes. Pump the pilot's and then the co-pilot's left toe-brake pedals forcing the fluid through the left brake system. Close the bleeder port and operate the pilot's left toe-brake several times in order to open the shuttle valve to the pilot's brake line.

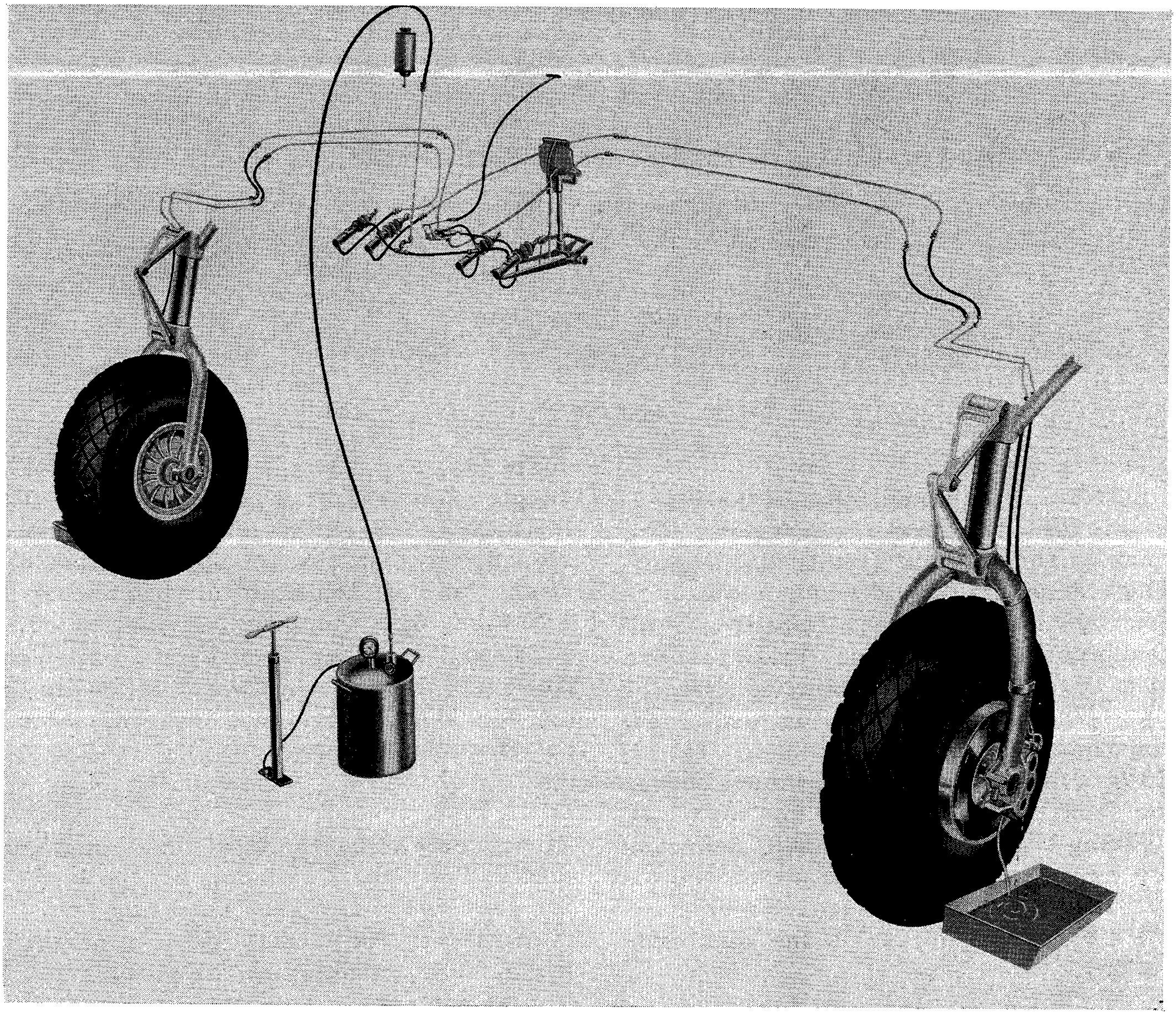


Fig. 52 Brake Bleeding Diagram

5. With the bleeder port closed, pump the pilot's left toe-brake and actuate the parking brake. Release toe-brakes and allow the parking brake to hold the brake fluid pressure. Then compress the toe-brake and release the parking brake, open the bleeder port and allow the fluid to flow.

6. Place a low flat container under the brake housing. Then with the bleeder port slightly open, loosen or remove the lower bleeder screw and allow the fluid to flow until air bubbles are no longer visible. Pump the pilot's and co-pilot's left toe-brake while the lower screw is loose or removed. Close the lower bleeder screw. Then loosen or remove the second and third bleeder screws and allow the fluid to flow until air bubbles are no longer visible. Tighten the bleeder screws and the main bleeding port. Pump the pilot's and co-pilot's left toe-brake, if the pedal pressure is firm the left brake system is satisfactorily bled.

7. The pilot's and co-pilot's right brake system is bled in the same manner as described for the pilot's and co-pilot's left brake system. Maintain a pressure of 40 pounds throughout the

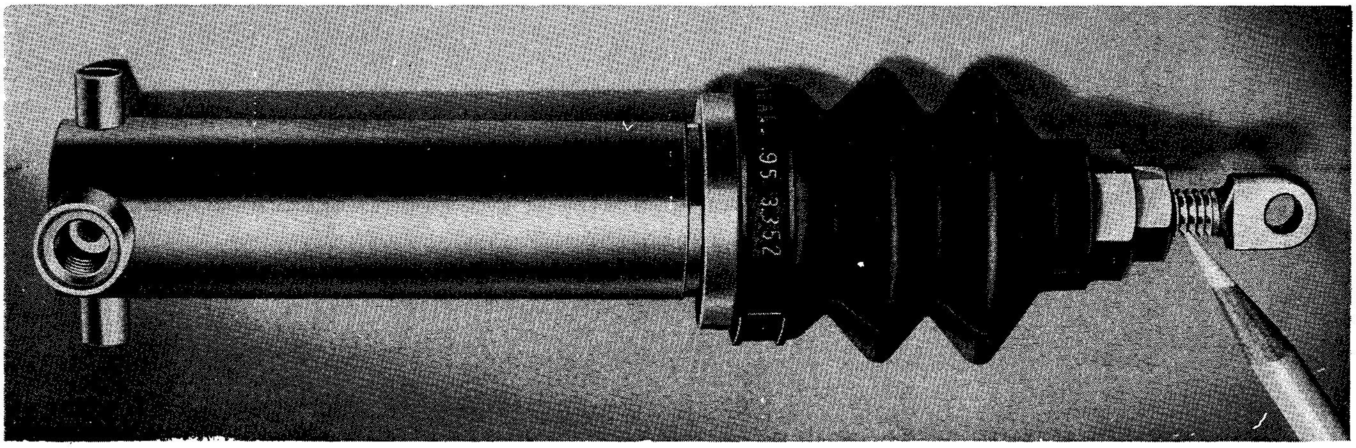


Fig. 53 Master Cylinder Clevis Adjustment

bleeding procedure.

8. Upon the completion of the bleeding, check the brake operation. The wheels should hold firmly and evenly. The toe-pedals should require equal operating pressure and should be free of all sponginess. The brake fluid pressure may be adjusted at the master cylinder rod. The normal setting is with 5 to 7 complete threads showing. (See Fig. 53) To vary, the brake fluid pressure loosen the lock nut on the piston rod terminal. Turning the piston rod in will decrease the pressure, turning the piston rod out will increase the pressure. Seven complete threads showing is the maximum setting.

LANDING GEAR DOORS

The landing gear doors cover the wheel wells when the landing gear is in the retracted position. The doors should operate freely and fit snugly enough so as to avoid excessive vibration. The landing gear doors, for the D18S, are adjusted by varying the length of the actuating rods which are attached to the shock strut and the door. The D18C landing gear doors are adjusted by varying the length of the actuating arms and the proper positioning of the striker and the stops.

LANDING GEAR DOOR ADJUSTMENT

To properly adjust the D18S landing gear door, (See Fig. 54) see that the doors fit snugly when retracted and clear approximately 1/8 inch at the center when closed. Adjust the linkage to cause a slight bow in the door (approximately 1/8 inch) with the gear fully retracted. This will eliminate vibration in flight. However, the bolts in the attaching linkage should not be tightened to impair free action of the linkage.

To properly adjust the D18C landing gear doors, (See Fig. 55) disconnect the landing gear doors from the actuating arms; then retract the landing gear to permit the striker, mounted on the shock strut, to just contact the actuating mechanism. Adjust the striker inboard or outboard as required to properly center it in the latching mechanism. Lower the gear and connect the landing gear doors to the actuating arms. The actuating arms connected to the doors are slotted to permit adjustment as required to properly close the doors when the landing gears are in the retracted position. The doors, when properly adjusted, should bow approximately 1/8 inch upward and be spaced 1/8 inch apart. With the doors open, adjust the landing gear door actuating arm stops, mounted on the nacelle 'U' channels, to exert a slight pressure on the arms. The stops are slotted to allow for proper travel adjustment for both doors.

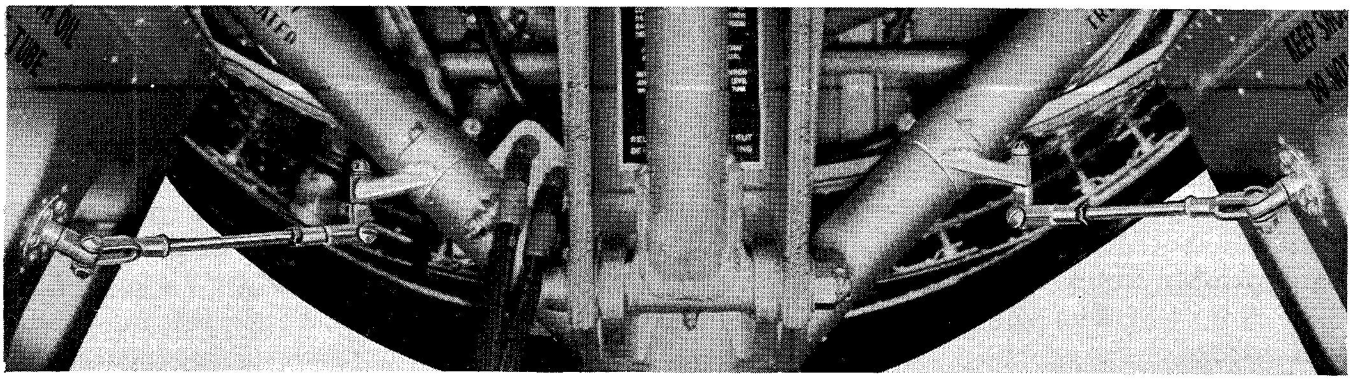


Fig. 54 D18S Landing Gear. Door. Linkage

NOTE: Do not file the latching fingers and the cam catch as this will impair proper function of the release mechanism and cause severe damage to the landing gear doors.

LANDING GEAR BUNGEE CORDS

Oil and grease deteriorates shock cords rapidly; care should be taken to keep the cords clean. Leather chafe boots are provided to protect the cords where they pass over the 'V' - brace assembly. If replacement is necessary, the leather chafe boots should be sewed or tied only through the outside covering of the shock cord. Marked distortion of the outer woven braid, or obvious irregularities in the diameter of the cord, indicates breaking of the rubber strands. Replace all the cords that are found to be in this condition.

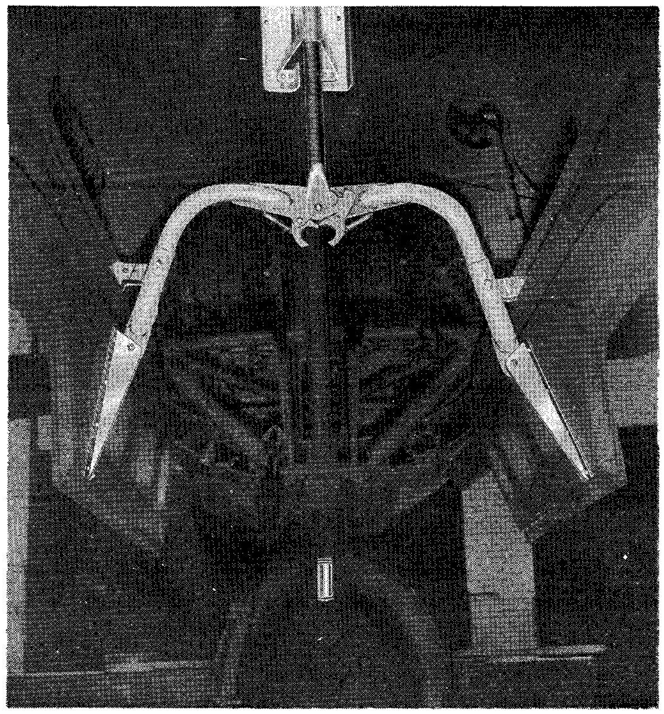


Fig. 55 D18C Landing Gear. Door. Linkage

FLIGHT CONTROL SYSTEM

Dual controls operate the movable surfaces through a system of steel cables and bellcranks. The left aileron, elevator, and both rudders are equipped with controllable trim tabs. The position of the trim tabs are shown by the position indicators.

AILERON AND AILERON TAB CONTROL SYSTEM

The control wheels are interconnected by the balance cables and chains. The main aileron cables attach to the connection at the balance cables and to the bellcrank at each aileron.

The aileron trim tab, installed on the left aileron only, is operated by a control knob on the pilot's pedestal. The cables are routed through the center section into the outer wing panel where they connect to a chain and flexible drive which actuates the trim tab.

AILERON RIGGING

1. Relieve the tension on the main aileron cables, by loosening the turnbuckles located in the nacelles. (See Fig. 57)
2. Align the control wheels with a straightedge taped in place as shown in Fig. 56.
3. Adjust the balance cables to a 35 ± 5 pound tension.
4. Place the aileron in neutral position, using the aileron contour jig (See Fig. 58) or align the trailing edge of the aileron with the trailing edge of the wing flaps. The wing flaps must be raised to extreme position and lowered one sixth turn with the handcrank to locate the neutral position.
5. Adjust the main aileron cable turnbuckles to a tension of 50 ± 10 pounds. Check to see that the ailerons remain aligned with the flaps.
6. Remove the straightedge and operate the control wheels from the extreme left several times.
7. Check the tension of the cables and the alignment of the surfaces.
8. Set the travel of ailerons with a bubble protractor. (See Fig. 59) Variation is made by adjusting the bolt in the bell crank stop. (See Fig. 60) The aileron travel for the D18S is $38\frac{1}{2} \pm 1$ degree in the up position and 21 ± 1 degree in the down position. The aileron travel is $37\frac{1}{2}\, {}^{+1}_{-\frac{1}{4}}$ degree in the up position and 20 ± 2 degrees in the down position for D18C and D18CT.

AILERON TAB RIGGING

1. Lower the flaps, and remove the fabric patch from the rear spar lightening hole immediately outboard of the center flap hinge.
2. From this access hole, set the turnbuckles directly over each other.

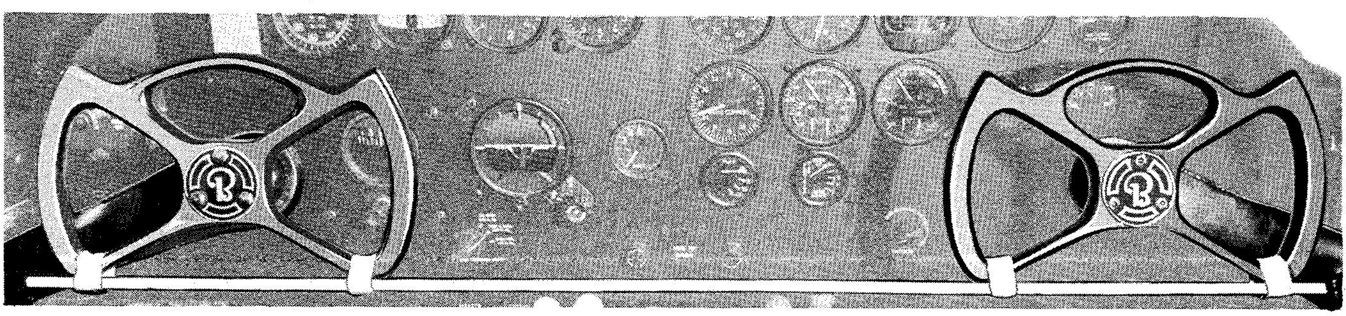
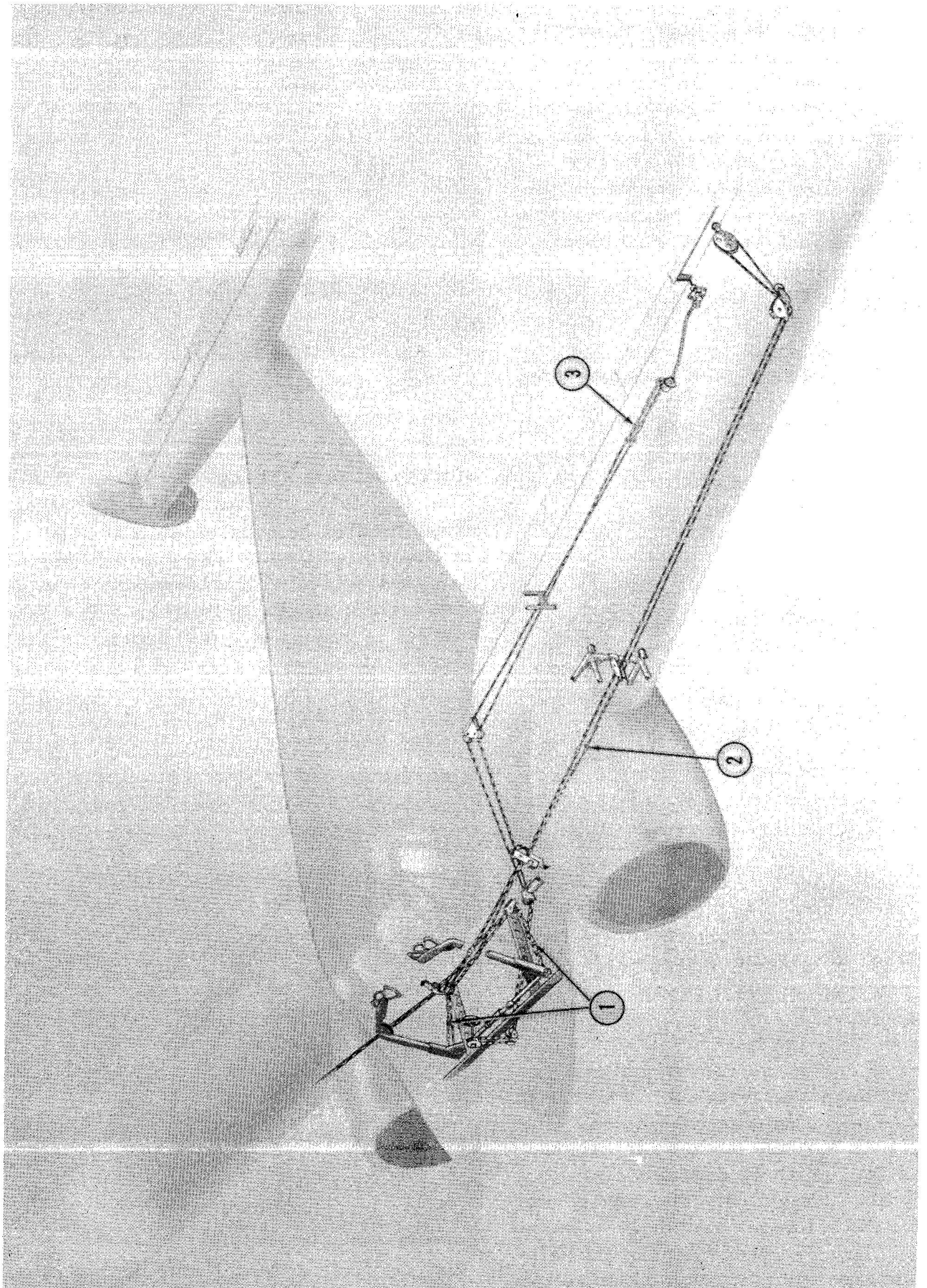


Fig. 56 Aileron Control Wheel Alignment



1. Aileron Balance Cable Turnbuckles 2. Main Aileron Cable Turnbuckles 3. Aileron Tab Cable Turnbuckles

Fig. 57 Aileron Control System

(See Fig. 57)

3. Disconnect the aileron tab actuating arm from the aileron tab.

4. Adjust the clevis on the actuating arm so that when the tab and actuating assembly are connected, the tab aligns with the trailing edge of the aileron.

5. Tension on the cable should be approximately 10 pounds or enough to prevent the turnbuckles from rubbing each other or catching on the wing ribs.

6. For the D18S the travel of the tab is 22 ± 1 degree up and 19 ± 1 degree down. The aileron tab travel for the D18C and D18CT is 20 ± 2 degrees up and 20 ± 2 degrees down. (See Fig. 61)

7. Operate the tab through the full range of the travel. Check for ease of operation. Check the position indicator for the correct position.

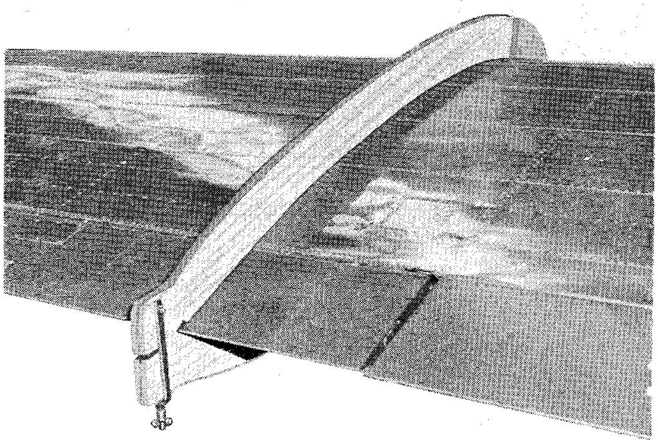


Fig. 58 Aileron Contour Jig

ELEVATOR AND ELEVATOR TAB CONTROL SYSTEM

The lower end of the control column extends through the floorboards where it joins the elevator control cables. The cables attach to the horn on the control column torque shaft and are routed aft under the fuselage floorboards where they join the bellcrank assembly at bulkhead number 15. Movement of the bellcrank is transferred through a connecting

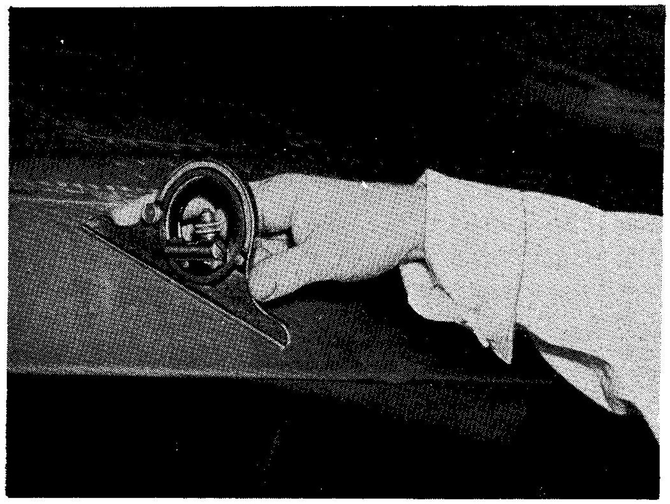


Fig. 59 Aileron Position Setting

link to the elevator surface. The elevator is equipped with two tabs operated simultaneously through a system of cables and drive chains from the control wheel located below the cabin door sill, on the #5 bulkhead. The chain drives a sprocket wheel which is mounted on a cross shaft in the stabilizer. The tab control surfaces are connected to the cross shaft by universals and 90° drives.

ELEVATOR RIGGING

1. Check the elevator travel for the

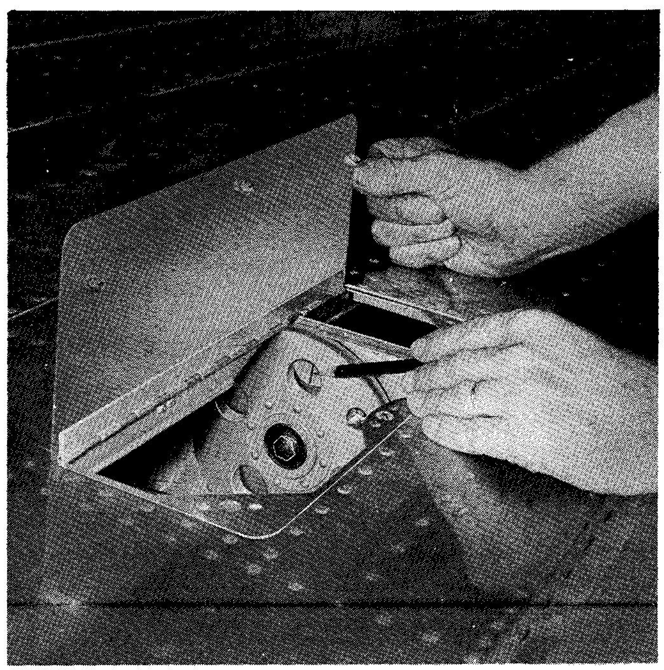


Fig. 60 Aileron Travel Stop Adjustment

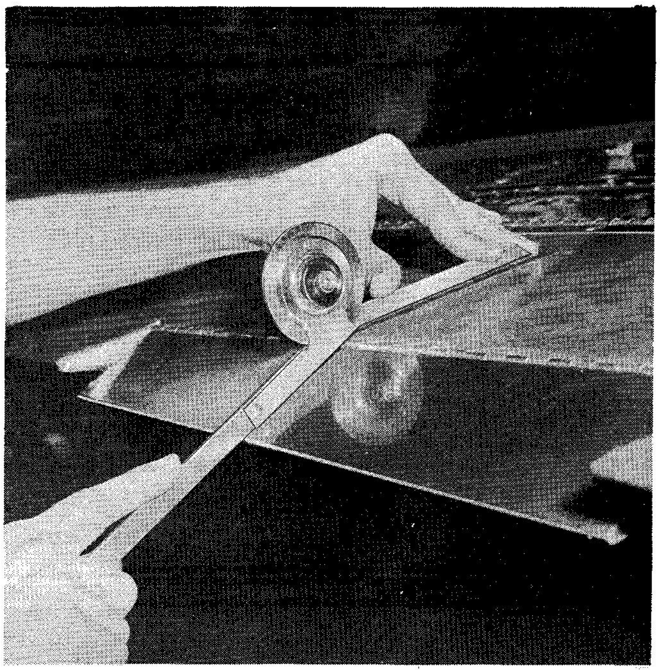


Fig. 61 Aileron Tab Position Setting

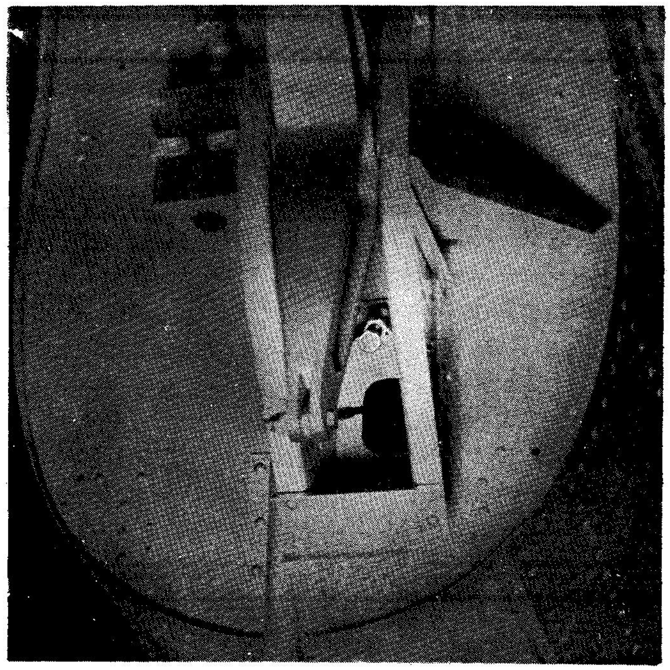


Fig. 63 Elevator Travel Stop Adjustment

D18C and D18CT with a bubble protractor and adjust to 35 $\pm$ 2 degrees in the up position and 25 $\pm$ 2 degrees in the down position. Check and adjust the elevator travel for the D18S to 35 $\pm$ 1 degree in the up position and 25 $\pm$ 1 degree in the down position. (See Fig. 62) The adjusting bolts at bulkhead number 15, should be screwed either in or out as required.

2. Secure the elevator in the neutral position. The neutral position is secured by placing a contour jig around the elevator and stabilizer. (See Fig. 64)

3. Adjust the turnbuckles, (See Fig. 65, Item 1) accessible at the belly inspection door until the center line of the control column is $9\frac{1}{2} \pm 1/8$ inch from the floating panel. (See Fig. 66)

Maintain this measurement and adjust the turnbuckles until a tension of 120 $\pm$

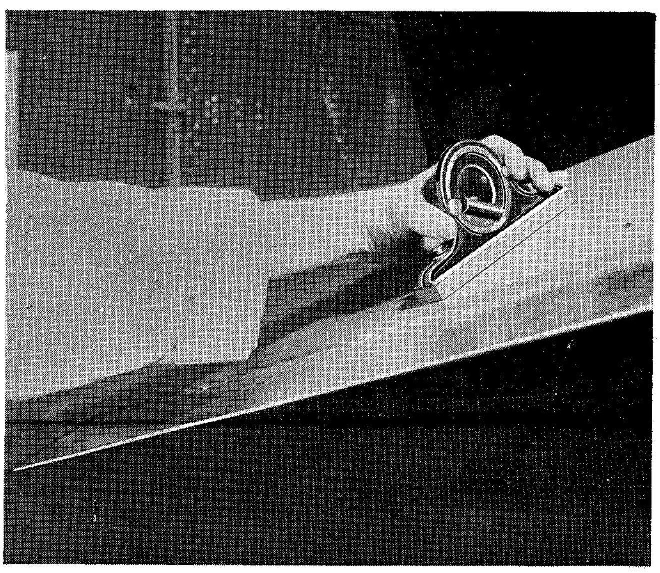


Fig. 62 Elevator Travel Position Setting

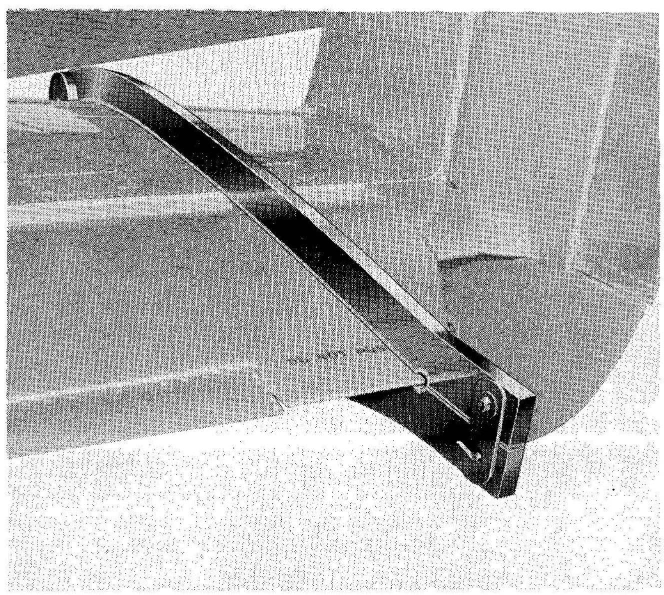


Fig. 64 Elevator Contour Jig

10 pounds is obtained on both the upper and lower cables.

4. Check the elevator operation. The surface should move easily and travel the full range to each stop.

5. Safety the turnbuckles.

ELEVATOR TAB RIGGING

1. Operate the elevator control to the extreme up position. With a protractor, (See Fig. 67) check the travel of the right tab surface for 18 $\pm$ 1 degree travel for the D18S. The travel for the D18C and D18CT is 20 $\pm$ 2 degrees. If adjustment is necessary, disconnect the actuator arms and turn clockwise to decrease or counterclockwise to increase the travel. The down travel is automatically set at 13 $\pm$ 1 degree for the D18S. For the D18C and D18CT the down travel is 14 $\pm$ 2 degrees.

2. Adjust the left tab actuating arm in the same manner, making certain the lug on the actuator arm is on top to facilitate attaching the position indicator rheostat cord. Refer to Section IV for the position indicator adjustment.

3. Adjust the turnbuckles, located in the tail section (See Fig. 65, Item 2) of the airplane, tight enough to keep them clear of the fuselage structure. Tension of approximately 10 pounds will suffice.

4. Check the direction of the tab movement, in relation to the control wheel. The tab should move up when the top of the control wheel is moved forward.

RUDDER AND RUDDER TAB CONTROL SYSTEM

The rudders are controlled by a dual set of pedals mounted on separate cross shafts. Cables from the rudder pedals are connected to two reduction pulleys in the belly. Separate cables attach to the reduction pulleys, route aft to the stabilizer, and attach to each rudder bellcrank. The rudder bellcranks are interconnected by balance cables. Both rudders are equipped with trim tabs which are operated by a crank attached to the ceiling of the pilot's compartment. The cables then route aft into the fuselage where they connect, through a chain medium, to a 90° drive. The tabs are actuated by flexible shafts passing through the vertical fins to the rudders.

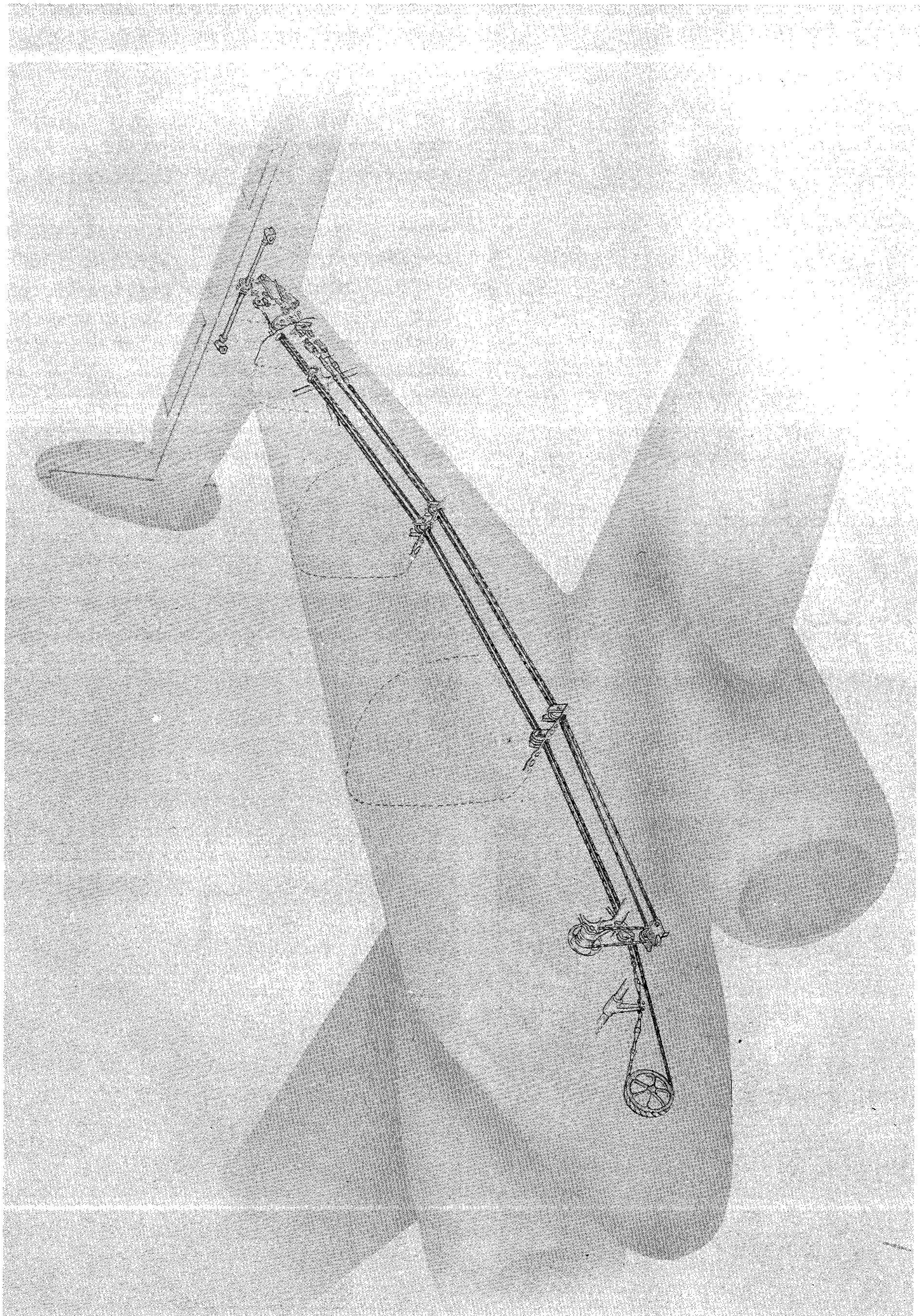


Fig. 65 Elevator Control System

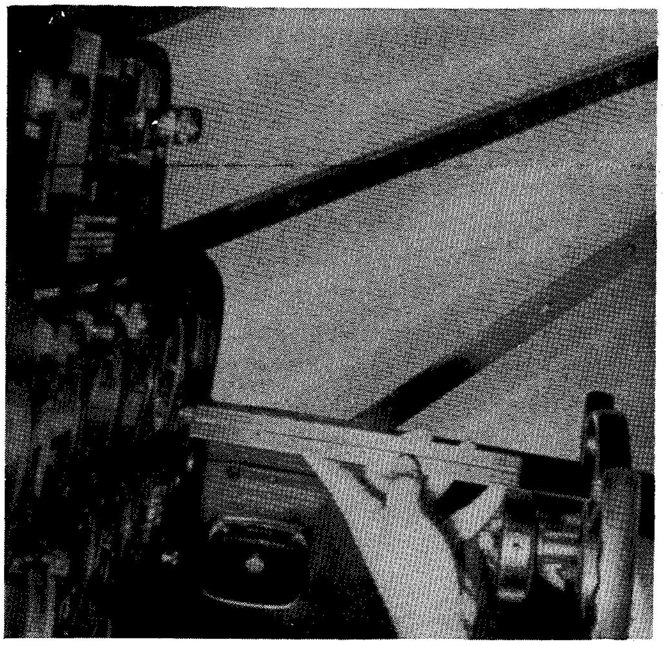


Fig. 66 Control Column Neutral Position

RUDDER RIGGING

1. Place the left rudder in neutral position, using a contour jig. (See Fig. 68)
2. Relieve all tension from the main rudder cables.
3. Check the rudder for proper travel. (See Fig. 70) Adjust the travel to 25 $\pm$1 degree right for the D18S, D18C, and D18CT, by removing or installing fixed shims that are shown in Fig. 71.
4. Adjust the forward and aft cables in the stabilizer (See Fig. 72) so that the left rudder is in the neutral position and the forward tip of the right rudder balance horn is 1/16 inch outboard of alignment with the fin. Adjust the tension to 45 $\pm$ 10 pounds. Do not safety the turnbuckles.
5. Using the rudder rigging block (See Fig. 73), or 'C' clamps, secure the reduction pulleys so that the aft edge of each pulley is 5/32 inch from the aft end of the slot in the slide.
6. Adjust the main rudder cables, extending from the reduction pulleys to the rudder bellcrank, to 30 lbs. $\pm$10 pounds tension. Check the alignment of both the rudders. Check the tension of the rudder balance cables in the stabilizer. The

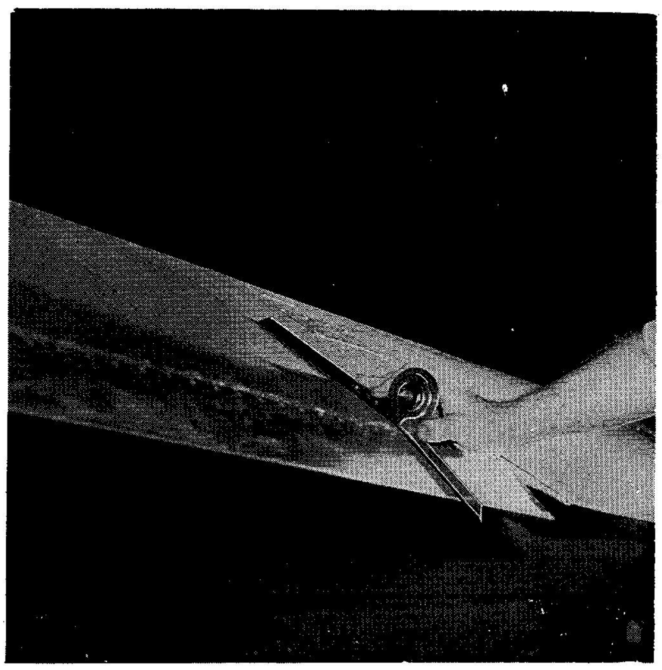


Fig. 67 Elevator. Tab Position Setting

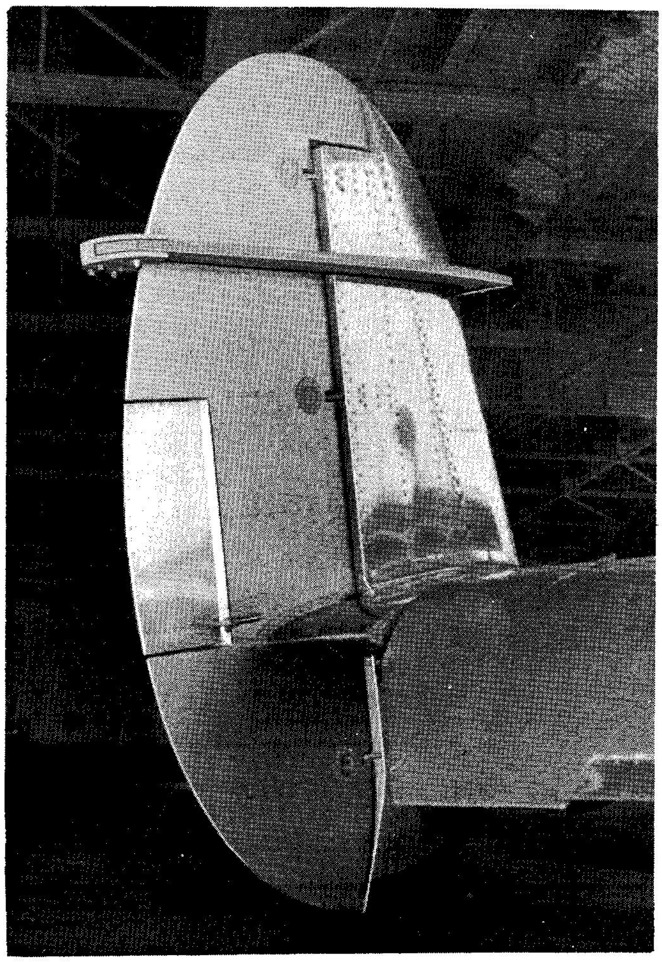
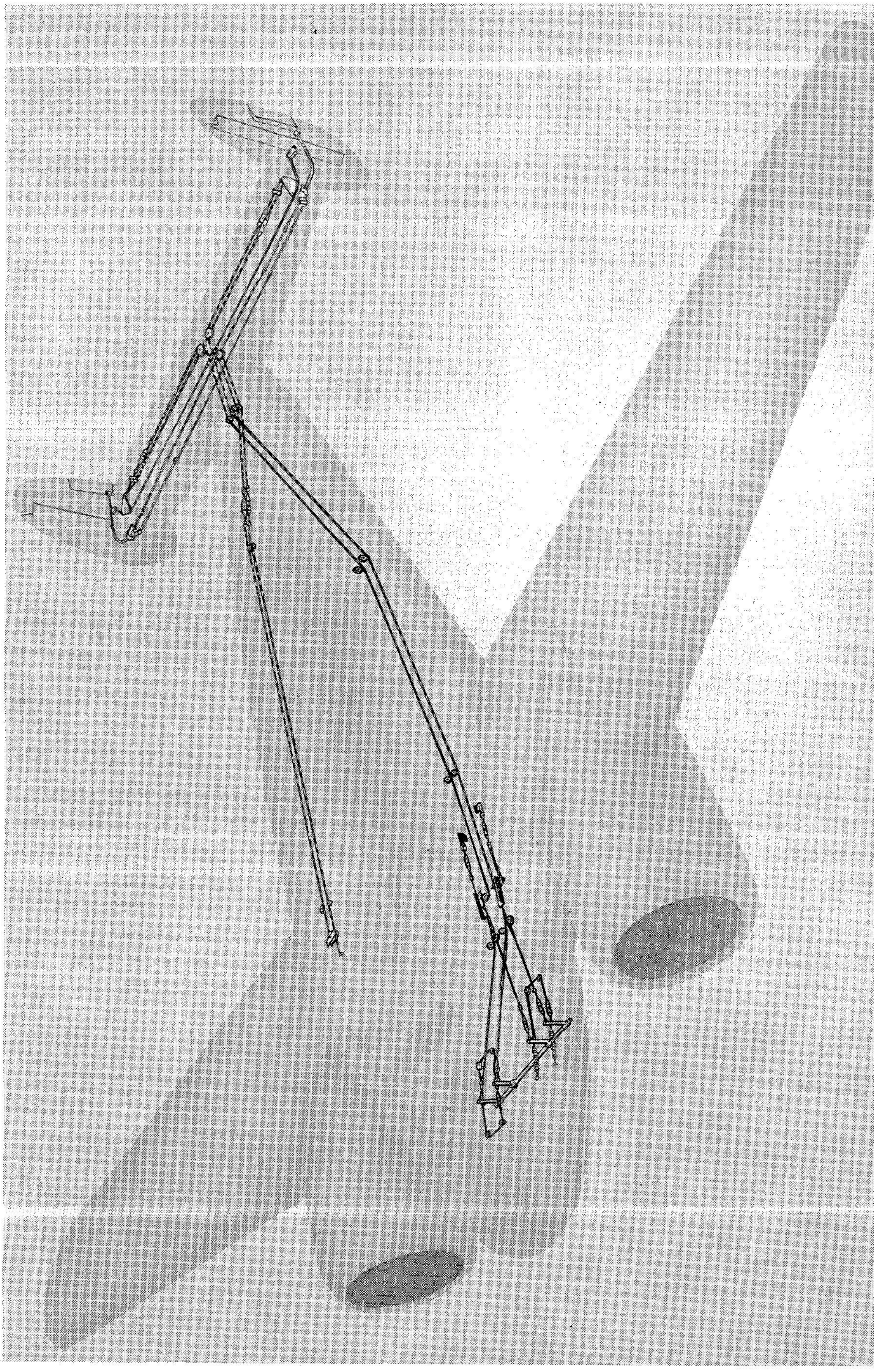


Fig. 68 Rudder Contour. Jig



1. *Main Rudder Cable Adjustment*
2. *Rear Balance Cable Adjustment*
3. *Front Balance Cable Adjustment*
4. *Rudder Tab Cable Adjustment*
5. *Pedal Balance Cable Adjustment*

Fig. 69 Rudder Control System

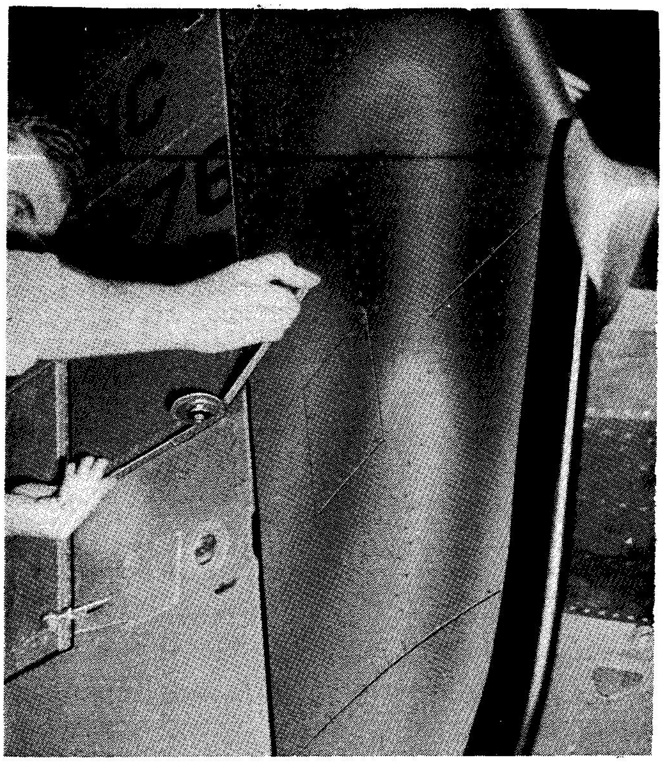


Fig. 70 Rudder Position Setting

forward cable should have 60 ± 10 pounds tension, and the aft cable 30 ± 10 pounds tension. Minor adjustments may be made at the various turnbuckles. Safety all the turnbuckles.

7. Release the tension on the co-pilot's rudder pedal balance cables and the cable between the co-pilot's rudder pedals and the reduction pulleys. Place the rudder pedals in the neutral position. The neutral position is obtained by setting the pedals $12\text{-}1/4 \pm 1/8$ inch from the front edge of the floorboard. (See

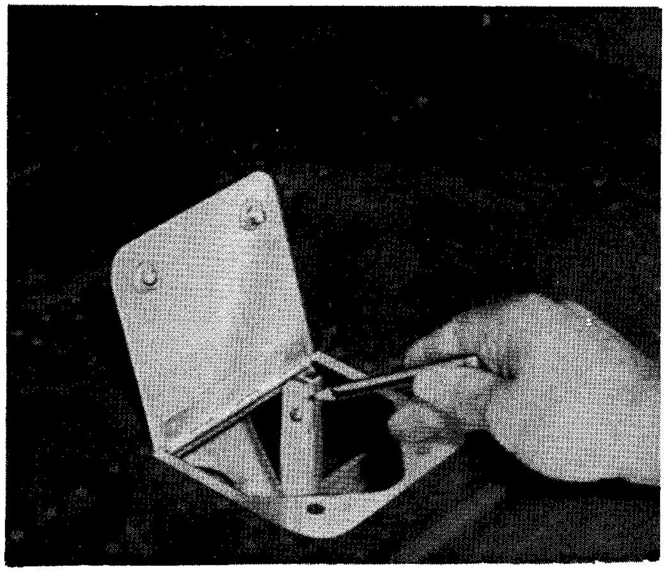


Fig. 71 Rudder Travel Adjustment

Fig. 74) Adjustment of the pedals is made by varying the length of the rudder pedal balance and brake pedal balance cables. Tighten the balance cables to 60 ± 10 pounds tension. Safety the turnbuckles.

NOTE: A pin may be installed through the inboard side openings at the rudder pedals as an aid to hold them in neutral position.

8. With the co-pilot's rudder pedals in neutral position, and the rudders in the neutral position, tighten the cable between the co-pilot's rudder pedals and reduction pulleys until the rigging blocks are free. Safety the turnbuckles.

9. Adjust the pilot's pedals in the same manner as the co-pilot's, except

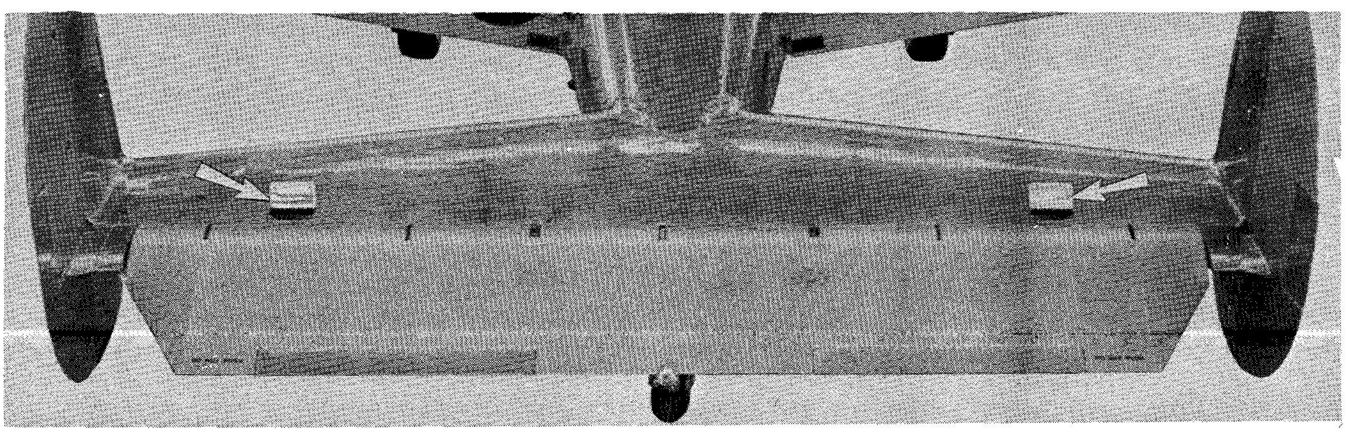


Fig. 72 Rudder Balance Cable Location

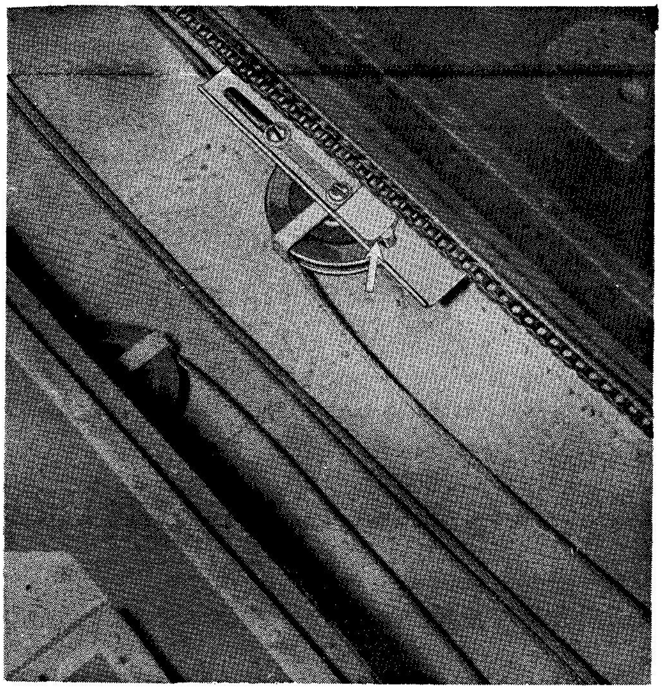


Fig. 73 Rudder Reduction Rigging Blocks

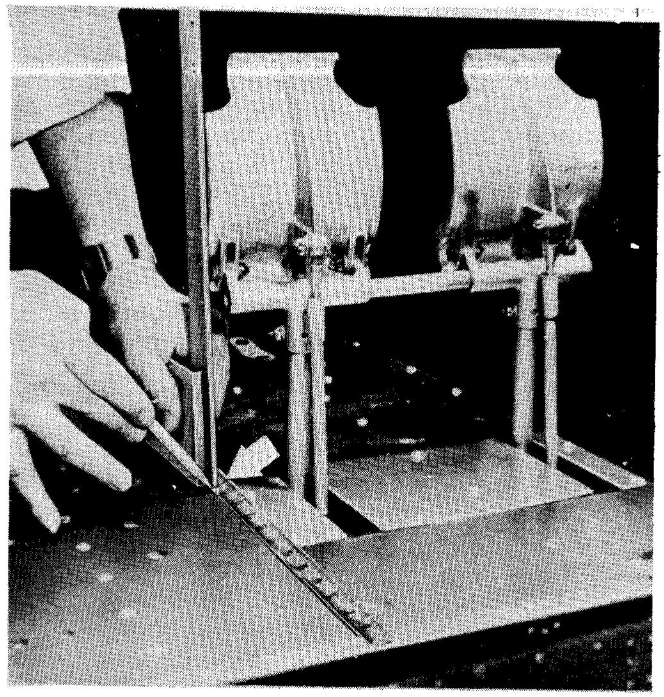


Fig. 74 Rudder Pedal Setting

adjust the brake balance cable tension sufficiently to pull the pedals aft to the 11½ dimension. (See Fig. 74) Safety the brake balance cable turnbuckle. Adjust the cables between the pilot's pedals and the reduction pulleys to the same tension as that on the brake balance cable. (The tension will be low because it is maintained by two coil springs.) Safety all the turnbuckles.

10. Remove the 'C' clamps, or the rudder spacer blocks, from the reduction pulley side.

11. Actuate the rudders and check for freedom of movement. All the turnbuckles must be safetied. Recheck the cable tensions.

RUDDER TAB RIGGING

1. Set the turnbuckles that are located aft of the No. 9 bulkhead, even with each other.

2. Adjust the cable tension so that the cables do not drag on the lightening holes in the stabilizer, but not tight enough to cause stiff operation. The cable tension will be approximately 10 pounds.

3. Adjust the actuating arm of each tab so the trailing edge of the tabs will be in line with the trailing edge of the rudders or neutral position.

4. The correct travel of the tabs is 31 ± 1 degree right and 32 ± 1 degree left for the D18S. For the D18C and D18CT the tab travel is 30 ± 2 degrees right and left. A scale dimension as shown in Fig. 75 may be used.

Fig. 75 Rudder Tab Position

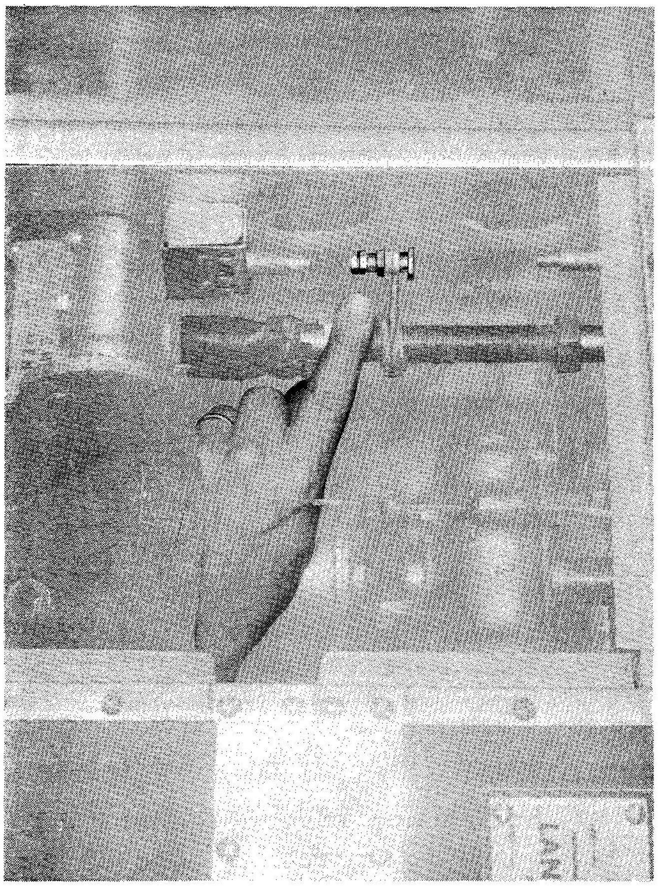


Fig. 76 Flap Limit Switch Adjustment

WING FLAP SYSTEM

The wing flaps are electrically operated by a system of gear boxes, universal joints, and shafts which are driven by a centrally located motor. The motor assembly includes a cone-type clutch set to slip when the pressure on the flap torque shafts becomes too great. Flap travel is determined by limit switches located at the motor assembly. The flaps may also be operated manually by an auxiliary handcrank, mounted on the pilot's compartment floorboard, to the right of the pilot's seat.

LIMIT SWITCH ADJUSTMENTS (Flap)

This adjustment is made at the actuator arm bolts. Adjust the switches to stop the traveling arm at a distance of 1/6 turn of the handcrank from each limit stop. (See Fig. 76) To adjust the actuator bolts, loosen the jam nut on the bolts and turn the actuator bolt in or out until the desired setting is made. Access to the actuator bolts may be made, by removing the inspection cover in the pilot's floorboards, located between the pilot and co-pilot seats.

CLUTCH TENSION ADJUSTMENT (Flap)

The tension is regulated by an adjusting nut in the motor gear box. Correct tension is determined by the use of an ammeter.

1. Run the flaps up electrically and remove the circuit fuse from the subpanel.
2. Connect the leads of an ammeter to each side of the fuse clip.
3. Slip the flap clutch by engaging and holding the handcrank and running the flaps down electrically. The ammeter should show a reading of 19 amperes with the clutch slipping. Adjust the proper tension if necessary.
4. To adjust, remove the small cover from the drive motor gear box (See Fig. 77).
5. Back off the large locking nut and loosen or tighten the tension nut as required. The tension will increase by tightening, or decrease by loosening the

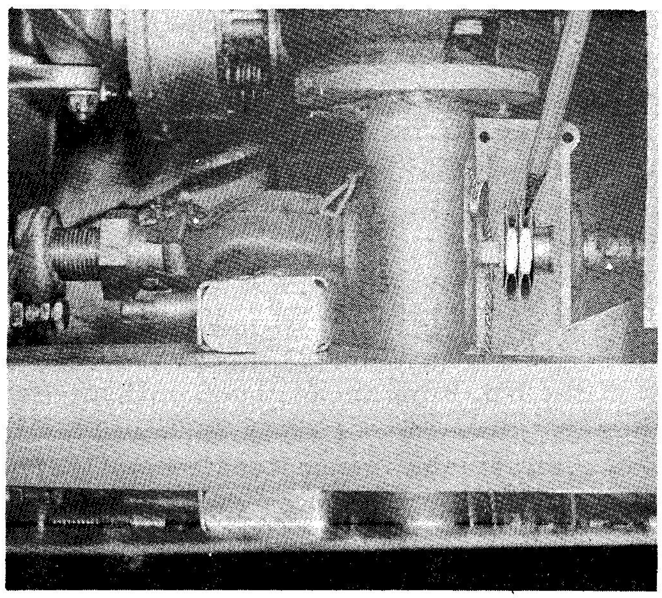


Fig. 77 Flap Clutch Adjustment

Insert this page after Page 66.

To simplify maintenance and production, the cone-type clutch in the flap motor gearbox has been eliminated on D18S airplanes, Serials A-301 and after. On airplanes prior to Serial A-301, it is permissible to tighten the clutch adjustment until the clutch is inoperative. This applies only to D18 airplanes having a dynamic brake relay in the flap electrical circuit.

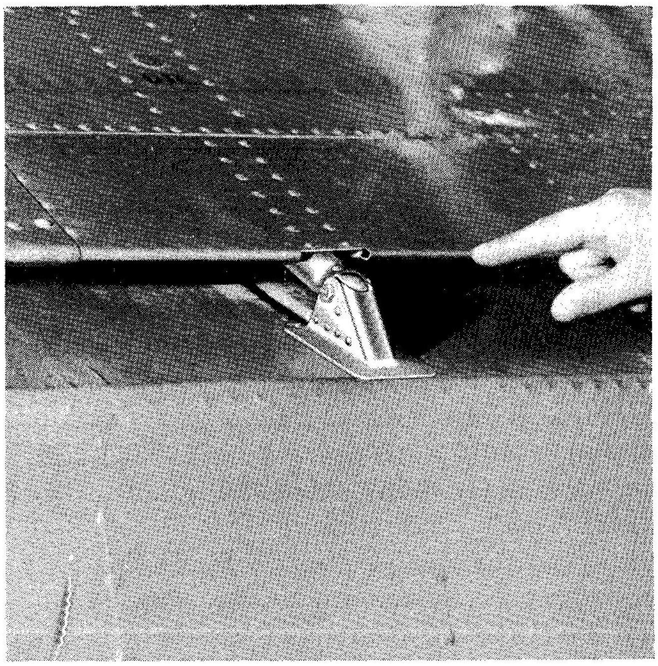


Fig. 78 Flap Travel Adjustment

Fig. 79 Flap Contour Jig

nut. Adjust as necessary to obtain an ammeter reading of 19 amperes.

WING FLAP RIGGING

The flaps must align to the true contour of the wing when in a neutral position. Do not align the flap with the fuselage fillet. The fillet may be distorted and will not give the true contour setting of the flap. To find the neutral position run the flaps manually to the up limit stop and then back off 1/6 turn of the handcrank (one side of the hexagonal stop nut). If the flap rigging has not been changed from the factory setting, the flaps will be in the neutral position, aligned with the contour of the wing. The full flap travel is $45^\circ \pm 1$ degree for the D18S and D18C and $25^\circ \pm 1$ degree for the D18CT. To change the rigging of the flaps, disconnect and turn the flap screws either in or out until the flaps are in the neutral position (See Fig. 78), and at the same time the handcrank must be set 1/6 of a turn down from the full up position. The neutral position is secured by the use of a flap contour jig. (See Fig. 79) Without a contour jig, it will be necessary to set the flaps by trial and check by test flight.

SPECIAL EQUIPMENT

DE-ICER

The Goodrich external type de-icer boots may be installed on the leading edges of the wings and the horizontal stabilizer. The boots are inflated by air pressure from the pressure side of the engine driven vacuum pump. A rotary valve, that is driven by an electric motor, controls the sequence of operation. A pressure relief valve in the system is set at $7\frac{1}{2}$ pounds per square inch, which is the maximum pressure allowed in the system.

A three way valve is provided to by-pass the air from the vacuum pumps when the de-icing system is not in operation. Air check valves are installed in the lines so that the system will continue to function in case one of the vacuum pumps fails. When the system is not in use, a vacuum of four inches of mercury is maintained in the system, to hold the boot firmly against the surfaces.

RESURFACING (De-Icer)
Resurface the de-icer boots when necessary, with Goodrich Prenite Graphite or equivalent when one or more of the following conditions are prevalent.

1. The surface material has been abraded off.
2. The surface has developed cracks.
3. The conductivity is low.

CLEANING (De-Icer)
The de-icer boots should be washed with soap and water frequently as oil should not be allowed to remain on the boots.

REMOVAL AND STORAGE (De-Icer)
The removal, installation and maintenance of the de-icer boots are important to help insure the proper de-icer performance. Resurfacing or patching should be made, when necessary, before the boots are placed in storage. If the boots have been cold patched, the boot should be removed from the airplane periodically, the cold patches removed, and all damaged places vulcanized.

To properly remove the de-icer boots, the following procedure is recommended:

1. Remove all the screws and fairings (Tag each fairing strip for its correct location).
2. Disconnect the hose and remove the de-icer boots. Tag the hose and secure them inside the wings or fuselage. Install summer plugs or caps in the holes in the wing and stabilizer fairing.
3. Install plug screws in the rivnuts to prevent foreign matter from entering the wings. The damaged or worn rivnuts should be replaced. Phillips B-458 or Reed and Prince B-226 plug screws may be used. When the de-icer boots are to be placed in storage, the following instructions are recommended:

1. Carefully clean and repair the de-icer boots. Stretching the rubber during inspection will aid in locating the small jobs. Worn areas may be covered by spraying with a light coat of Goodrich Prenite - Graphite or equivalent, on the area affected. Allow to dry thoroughly before placing in storage.
2. Roll the boots into a 4 to 6 inch diameter coil with the outer (black) side out. Before rolling, tape the ends of the metal beads and connections to prevent injury to the rubber boot. Start the roll from the connection end on the wing boots. The horizontal stabilizer de-icer boots should be rolled from the tip end.
3. Be sure the boots are clean and free from wrinkles. Wrap in heavy paper and store in a cool, dry, dark place.

INSTALLATION (De-Icer)
For airplanes that are equipped for de-icer boots. To install the de-icer boots, the following instructions should be followed:

1. Apply talc to the leading edges of the surfaces and to the back side of the boots. The talc is used as a lubricant and must be dry.
2. Pull the hose through the proper holes in the wing and insert the de-icer boot connection into the hose. Wrap one turn of friction tape around the hose. Install two separate wraps of safety wire around the friction tape. Make two complete turns of safety wire in each wrap. Adjust the connections in the holes in the wing.
3. Install pegs through the boot into the upper rivnut hole for a distance of approximately 2 feet, in the vicinity of the connections. Check the connections again to see if they are properly seated. Pull the bottom side of the boot into place and install pegs. Alternately pegging a few

holes, first along one edge and then along the other until the attachment to the straight portion is completed.

4. When the straight portion has been pegged in place, the fairing strips should be placed in position and the pegs replaced by screws.

5. To install the de-icer along the curved tip, slip the boot along its bead wire until the de-icer matches the actual curvature of the tip and the holes in the boot aligns with the rivnuts. Then alternately peg a few holes along one edge then along the other, until the attachment to the curved portion is completely pegged in place.

6. Place the curved fairing strips in their correct location and replace all the pegs with screws. Always tighten the screws starting from the inboard end and working progressively toward the tip to prevent the bead wire from twisting.

7. Stabilizer de-icers are installed in a manner similar to that described for the wing de-icers. The air line extends out of the stabilizer fairing and attaches to the connection on the face side of the de-icer boot. After this connection is made the procedure for the installation of the stabilizer de-icer is the same as that described for the wing de-icer.

Do not exceed 10 pounds air pressure at any time in the de-icer boots. Use caution when tightening the Reed and Prince screws or the screw driver may slip and damage the boot.

ANTI-ICER

The anti-icer system provides fluid, which prevents the formation of ice on the propeller blades. The anti-icer rheostat is located on the floating instrument panel on the co-pilot's side.

The equipment consists of a three gallon fluid supply tank, a pump, slinger rings for each propeller, and necessary tubing and connections. The anti-icer tank and pump are located in the pilot's compartment. The tank, located directly behind the pilot's seat, connects to the pump under the seat.

Service Note

If trouble develops in the motor, check the brushes and measure their length. If they are under 5/16 inch in length they must be replaced.

WINDSHIELD WIPERS

The windshield wiper mechanism is installed inside the nose baggage compartment. An electric motor is coupled to a converter by a flexible shaft. The converter is used to change the rotary motion of the electric motor to an oscillating motion. Extending outboard from the converter are two flexible cables incased within rigid housings. The ends of these cables are attached to the windshield wiper actuating shafts. The actuating shafts are provided with splined ends so the position of the wiper blades, in relationship to the windshield, may be altered. An alignment rod is also provided so the proper position of the wiper blade to the wiper arm can be maintained.

ADJUSTMENT (Windshield Wipers)

In the event that one, or both, of the wiper blades are hitting on the sides of the windshield, remove the nut holding the wiper arms to the windshield wiper actuating shaft. Slip the wiper arms from the actuating shaft and reinstall one notch away from the point where it was hitting. Remove the cotter pin from the clevis end of the alignment arm. Lengthen or shorten the alignment arm, as the case may be, to bring the wiper blade in a position parallel to the wiper arm. Reinstall the alignment rod and safety with a cotter pin. Test the wiper assembly to see if it is now in the correct position. If necessary, repeat the above operation until the wiper is no longer hitting the edges of the windshield. No other adjustments will be required. The assembly is packed with grease at the factory and will need no further lubrication.

Insert this page after Page 69.

LANDING GEAR OLEO DRAG STRUT

A shock absorbing landing gear oleo drag strut is available as special equipment. This unit is designed to greatly reduce the landing loads transmitted to the airframe structure and results in softer - smoother landings. The unit is a self-contained, double-acting oleo shock absorber with an exposed return spring. It is interchangeable with the solid drag strut on all D18S airplanes.

BEFORE INSTALLATION (Landing Gear Oleo Drag Strut)

Before installing, bleed as follows:

1. Apply 10-20 pounds pressure through the air valve.

2. Lay the leg horizontal with the bleeder plug at the large end up, open the bleeder plug very slightly and allow any trapped air to escape.

Service Note

If any appreciable amount of fluid is lost, it will be necessary to refill the strut. Refer to Item 2 under Servicing.

3. Apply approximately 50 pounds air pressure through the air valve.

4. The oleo drag leg should be kept in a vertical position with the small end of the cylinder up. This is to prevent air bubbles entering the piston chamber.

Insert this page after Page 70.

INSTALLATION (Landing Gear Oleo Drag Strut)

1. Place airplane on jacks and raise main and tail wheels approximately two inches from the floor.

2. Remove the present leg by removing the 404-188466 bolt at the top and the NAS149A-92 bolt at the lower end.

3. Install the oleo drag leg with the small end at the top attached to the retract slide assembly and the large end attached to the shock strut. The air valve at the upper end of the oleo drag strut must be pointing forward and up and the drain plug on the lower housing must be pointing aft and down. The original attaching bolts should be discarded. New lower bolts, NAS149A-92, should be installed with NAS143-9 washers under the nut. New upper bolts, Part 404-188466, should be installed. New bushings, Part 404-188444, should be installed in the lower drag leg attaching fitting.

4. Slowly retract the landing gear and check for proper operation and clearance.

SERVICING (Landing Gear Oleo Drag Strut)

1. To fill struts with hydraulic fluid, remove strut from airplane.

2. Remove air valve and with strut held at an angle of 30 degrees, which is approximately the position it is installed on the airplane, fill with hydraulic fluid conforming to Specification MIL-O-5606.

Insert this page after Page 70A.

3. Install the air valve, tighten and apply 50 pounds of air pressure to strut.

4. Lay strut in a horizontal position with the lower drain plug up. Loosen lower drain plug and allow entrapped air to escape. Tighten plug as soon as air is released.

5. Place strut in position as described in Paragraph 2, remove air valve and refill strut.

Service Note

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

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

Service Note

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

SECTION IV
Electrical System

Power is furnished on the D18S airplane by two M-3, 50 ampere generators and two 24 volt D-C batteries, connected in parallel. The D18C airplanes are equipped with two 1298-1, 75 ampere generators and two 24 volt D-C storage batteries connected in parallel. The generators are mounted, one on each engine accessory case; the storage batteries, one in each center section wing next to the fuselage. Power is distributed to the electrical equipment through a single wire. ground return system. The electrical system may be connected directly to an external power source at the receptacle provided in the outboard side of the left nacelle.

SWITCHES

The electrical equipment in the airplane is controlled by three types of switches, the toggle switch, the micro switch, and the solenoid switch. The toggle switch, used in the pilot's compartment is a hand operated device for interrupting or reversing the current flow. Micro snap action type switches are used in the landing gear and flap system. These switches are designed to operate on a movement of 1/64 to 1/32 inch. The micro switches in the left nacelle are limit switches, limiting the up and down travel of the landing gear and are normally closed. Normally closed micro switches are also used in the flaps system. The landing gear safety switch, located on the left torque knee, the warning horn throttle switches in the right nacelle are normally open switches. The lower switch in the right nacelle is a double throw type and operates in both the landing gear warning horn and the landing gear down-position indicator light circuit. The normal position of the switch closes the warning horn circuit and opens the position light circuit. Solenoid switches are installed in the starter and battery circuits and are remotely operated from the pilot's compartment. The use of solenoids makes it possible to shorten the length of the large cables necessary to carry the heavy current.

DYNAMIC BRAKE RELAY

The dynamic brake relays are installed in the flap and landing gear circuits. The reversible motors, used in the landing gear and flap circuits, have two field windings, one for each direction of rotation. The dynamic brake relay operates to open the circuit to the field that is running the motor, and to ground out the current present in the opposite winding. This action provides a dynamic braking effect to stop the motor, eliminating the variable over travel resulting from the normal coasting stop.

CIRCUIT PROTECTION

The circuits are protected from electrical overload damage by fuse or circuit breaker. The fuse panel is located in the pilot's left sub-panel and contains fuses of 10 to 30 amperes as required by the different circuits. The fuse panel door is placarded to identify the circuits and the size of fuse required. The landing gear motor circuit includes a thermal type circuit breaker mounted on the pilot's compartment floorboard. The circuit breaker is manually reset. The generator circuits also employ thermal type circuit breakers which are installed at each generator control box.

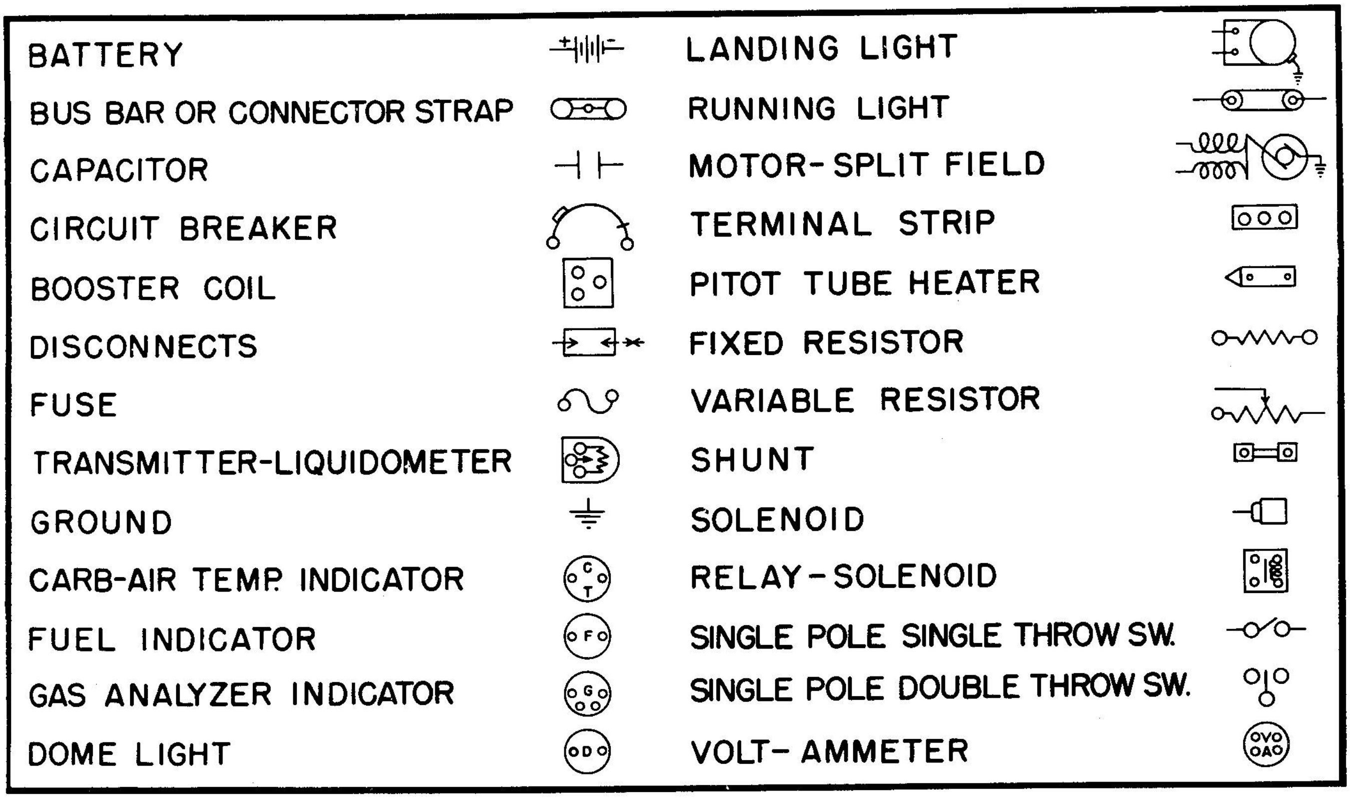
As an aid in correctly interpreting the diagrams, a group of electrical symbols is given on the following page.

CONTINUITY TESTING

A point by point continuity check is invariably the quickest way of finding trouble. The continuity test is accomplished by checking the circuit with a test light,

Insert this page after Page 72.

In the paragraph "BATTERY MASTER SWITCH CIRCUIT", the sentence which reads, "The battery master switches are connected to ground through the ignition switch," should be deleted.



Electrical Symbols

voltmeter, or ohmmeter. The test light may be 6 to 12 volts used in conjunction with a proper battery source, or a 24 volt light may be used on circuits carrying the full airplane system voltage. It is necessary to use an ohmmeter when testing a circuit containing resistors such as the flap indicator or elevator tab indicator circuits.

WIRING DIAGRAMS

Separate wiring diagrams of each individual circuit are provided in this section. Production wiring changes have necessitated including two or more diagrams for some circuits, however little trouble should be encountered in choosing the diagram applicable to a particular airplane since an endeavor has been made to label the diagrams satisfactorily. Each diagram identifies, gives the routing, and locates the access points of the wires used.

BATTERY MASTER SWITCH CIRCUIT

The two 24 volt batteries are connected in parallel, to the electrical system through solenoid switches, which are remotely controlled by battery master switches located in the pilot's sub-panel. The battery master switches are connected to ground through the ignition master switch.

Trouble Shooting

1. No power indicated with master switch on: test to ground at solenoid energizing terminal with 24 volt test light. Test for open circuit between solenoid energizing terminal on master switch. Test ground connection at master switch. Check operation of solenoid switch. Examine solenoid switch contacts.

2. Power on with master switch off:

test for ground between solenoid energizing terminal and master switch. Test operation of solenoid switch.

STARTER CIRCUIT

One electrical starting motor is directly connected to each engine. Each motor is operated by a solenoid switch installed in the nacelle junction box. The solenoids are energized by a double throw, spring switch located on the pilot's right subpanel. The solenoid energized circuit is connected at the solenoids and grounded at the operating switch. The starter switch. The starter operating circuit connects to power at the main terminal in the belly of the airplane and grounds at the starting motor.

Trouble Shooting

1. Both starters inoperative: check battery master switch operation. Test ground connection at starter switch center terminal. Examine circuit connections at main power terminal.
2. One starter inoperative: test continuity from starter switch terminal to solenoid terminal of inoperative circuit. Test energizing connection and operation of solenoid switch. Test continuity of motor circuit between main terminal and solenoid, between solenoid and motor. Test ground connection at starter motor.

If the starter solenoid has a tendency to flutter when the starter is turned on, the battery is probably low.

Fused points on the induction vibrator will cause the circuit fuse to burn out.

When changing a starter, be sure that an insulated washer is installed at the starter wire terminal post.

IGNITION CIRCUIT

High tension current is furnished to the engine system by two magneto units installed on each engine. The magneto switch is mounted on the pilot's right sub-panel. It consists of a toggle type master switch and a three position switch for each set of magnetos.

INDUCTION VIBRATOR ADJUSTMENT

Connect an 0-5 ammeter in series with an energizing lead of the vibrator. Adjust the vibrator to show a drain on the ammeter of 2.3 to 2.8 amperes. The relay points on the vibrator should have a clearance of .015 to .020 inch with the relay armature plate resting flatly against both arms. (See Fig. 80)

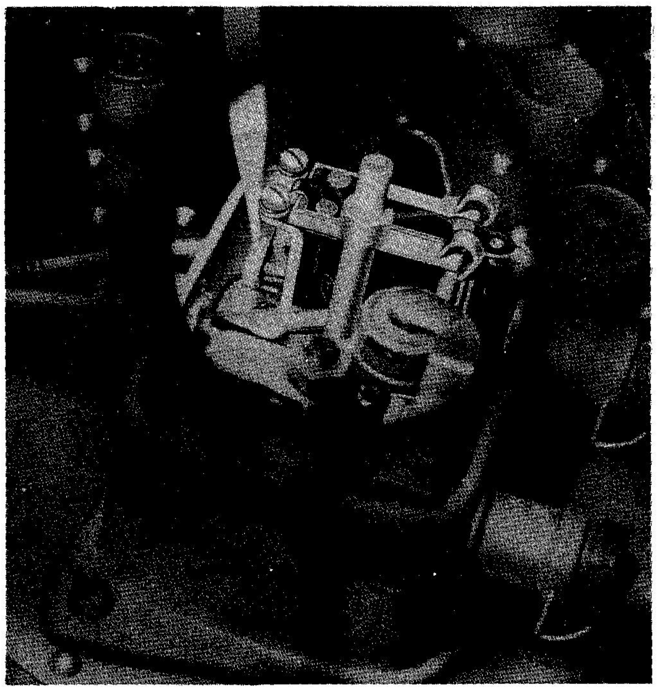
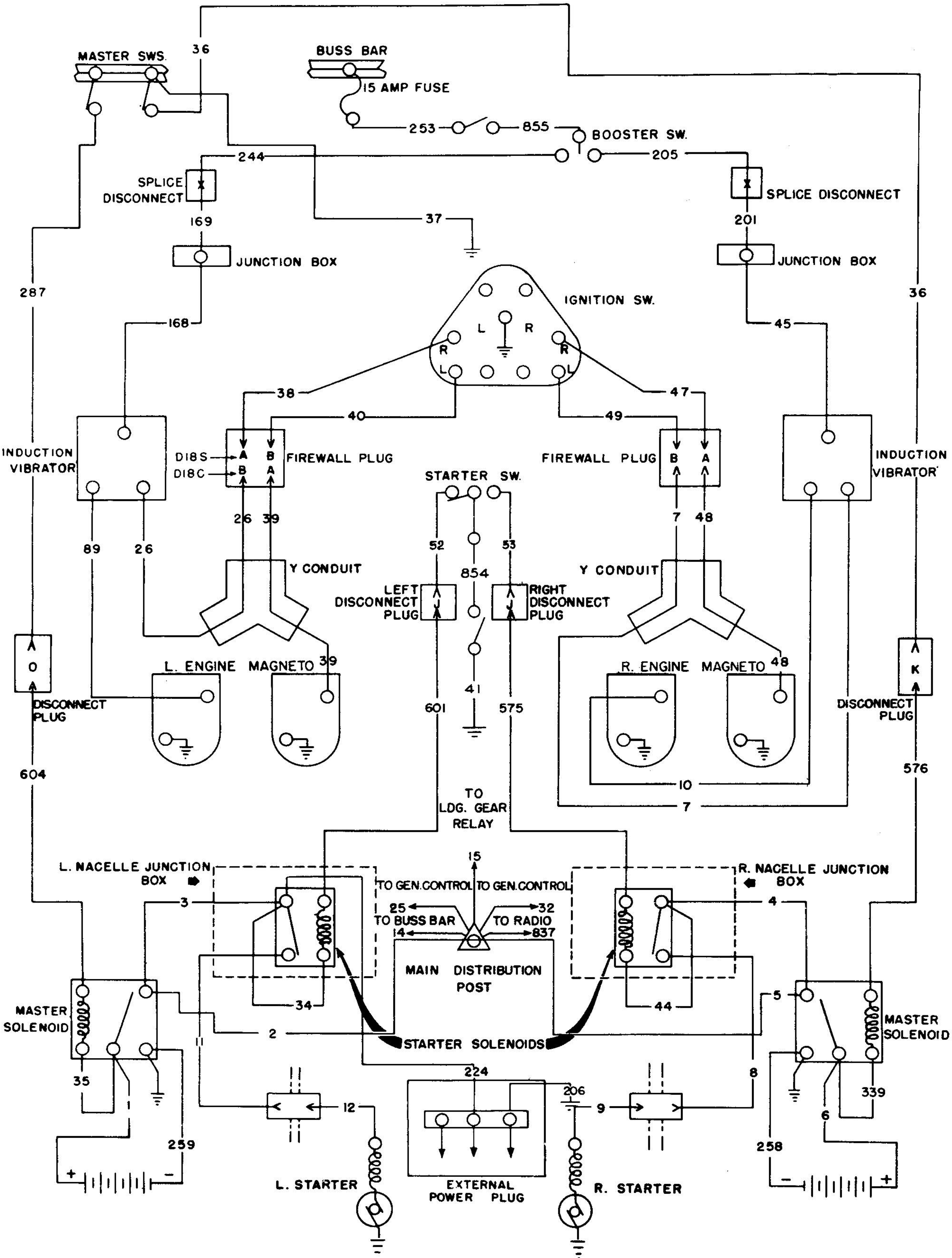


Fig. 80 Induction Vibrator Adjustment

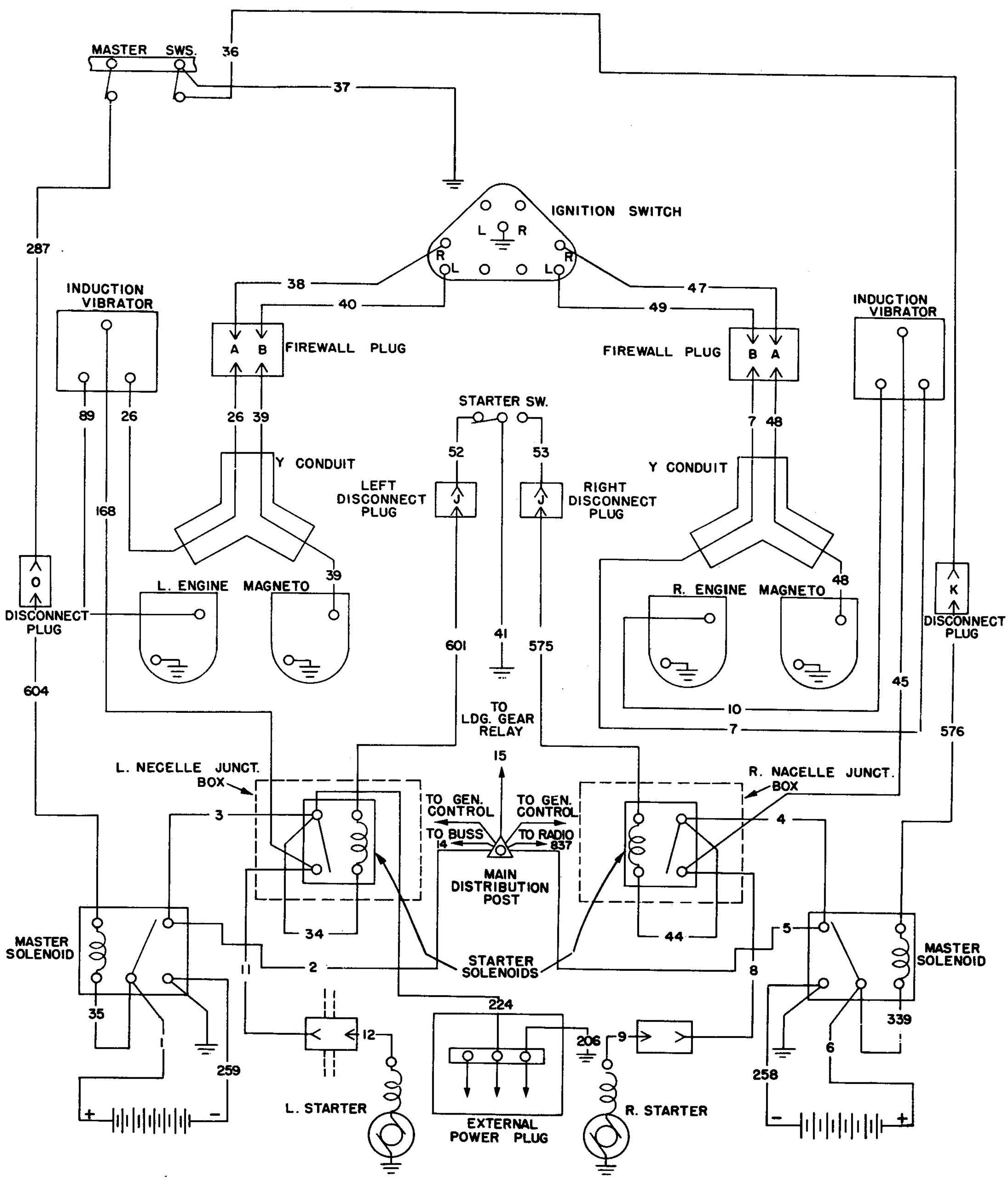
Trouble Shooting

Trouble in the ignition circuit, other than the magnetos, is generally found to be grounded switch wire.

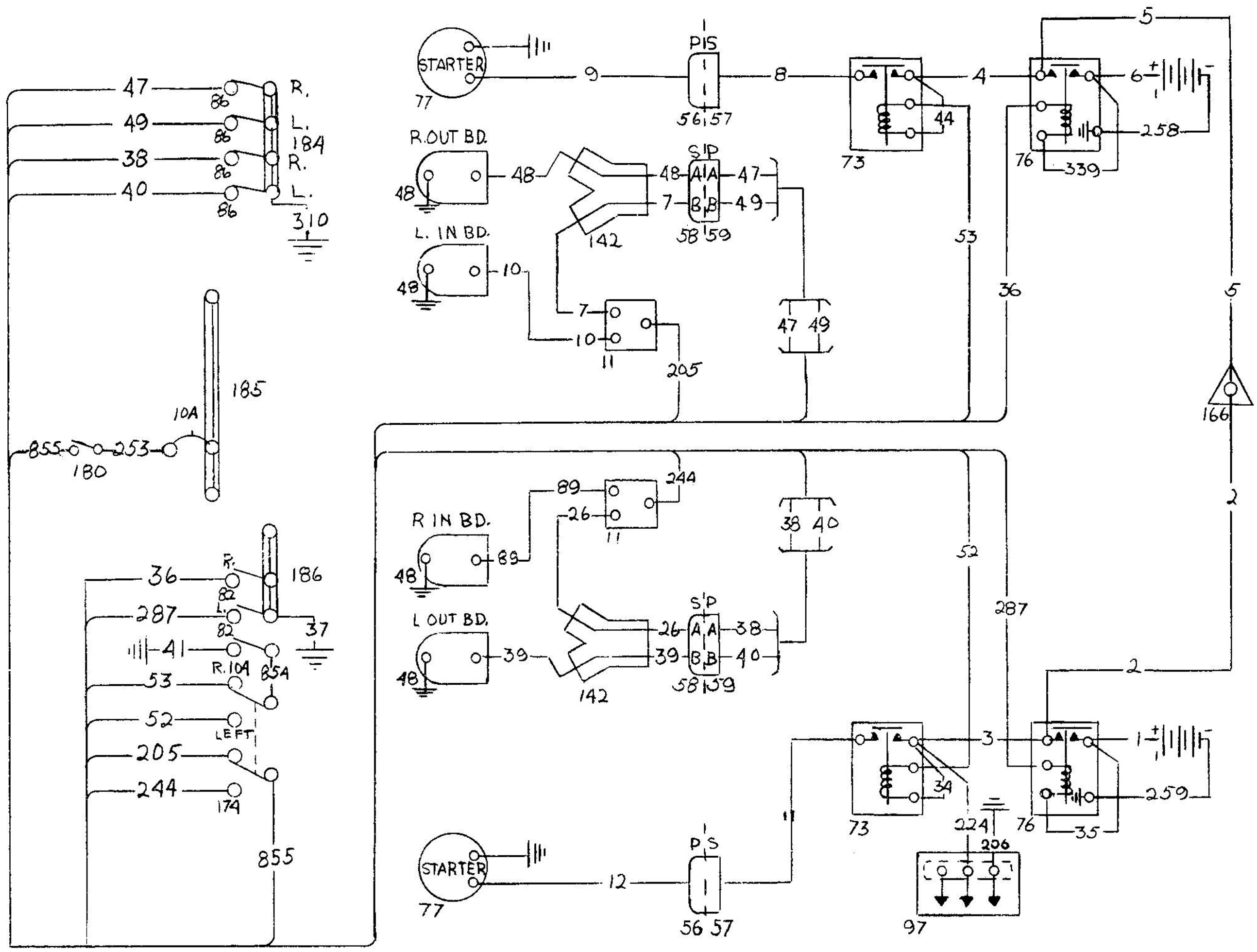
1. Disconnect the magneto conduits at the firewall disconnect plugs.
2. Turn the ignition master switch on, the battery master switches off, and using a battery powered test light, make the



Ignition and Battery Circuit with Booster Switch



Ignition and Battery Circuit without Booster Switch



Battery, Starter, and Ignition Circuits
Aircraft Serials A-537 and After

following check:

CONNECT TEST LIGHT TO:	Turn Magneto Switch to	Test Light Will be
Left Firewall Plug Pin A & Ground	Left Off	On
Left Firewall Plug Pin A & Ground	Left R	Off
Left Firewall Plug Pin A & Ground	Left L	On
Left Firewall Plug Pin A & Ground	Left BOTH	Off
Left Firewall Plug Pin B & Ground	Left Off	On
Left Firewall Plug Pin B & Ground	Left R	On
Left Firewall Plug Pin B & Ground	Left R	Off
Left Firewall Plug Pin B & Ground	Left BOTH	Off
Left Engine Mag. Plug Pin A & Ground		On
Left Engine Mag. Plug Pin B & Ground		Off
Right Firewall Plug Pin A & Ground	Right Off	On
Right Firewall Plug Pin A & Ground	Right L	On
Right Firewall Plug Pin A & Ground	Right R	Off
Right Firewall Plug Pin A & Ground	Right BOTH	Off
Right Firewall Plug Pin B & Ground	Right Off	On
Right Firewall Plug Pin B & Ground	Right L	Off
Right Firewall Plug Pin B & Ground	Right R	On
Right Firewall Plug Pin A & Ground	Right BOTH	Off
Right Engine Mag. Plug Pin A & Ground		Off
Right Engine Mag. Plug Pin B & Ground		On

GENERATOR CIRCUITS

The D18S airplanes use type M3 generators to supply electrical power for the various circuits and the D18C uses 1298-1 generators. In earlier model airplanes the generator control panels are located in boxes mounted on No. 5 bulkhead, just aft of the pilot's and co-pilot's chairs and accessible from the cabin. The later models have the control panels mounted in the wing stubs aft of the battery wells. These boxes contain the reverse current relays, carbon pile voltage regulators, energizing relays, ammeter shunt, and thermal circuit breakers. Two combination volt ammeters are provided for use in the generator circuits and are located on the left side of the pilot's sub-panel. An 'On-Off' switch for each generator is mounted on the pilot's left sub-panel.

The generators furnish electrical energy to the voltage regulators when the engines are operating, but they are not connected to the electrical system until the generator switches are turned on. When the generator switches are turned on, the circuit is completed through the reverse current relay (providing the generator output is between 26 and 27 volts at which point the reverse current relay cuts in) to the main terminal post in the belly of the airplane. The circuit will be maintained until the generator switches are turned off, or the generator output drops below the rated voltage, at which time the reverse current relay automatically breaks the circuit.

In order to give better efficiency in the maintenance of the reverse current relays and voltage regulators the following suggestions should be adhered to:

1. Never allow anyone to adjust or tamper with the generator control panels

except qualified electricians. The generators control panels are tested and properly adjusted when the airplane leaves the factory. The adjustments are very critical and must be made under closely controlled conditions by qualified personnel.

2. Do not, at any time, attempt to restore residual magnetism in the generator field by manually closing the reverse current relay contactor. This method, while it will restore the residual magnetism, will also severely damage the contactor contacts and the voltage regulator. This could result in unexpected failure in flight and early replacement of both the reverse current relay and the voltage regulator.

VOLTAGE REGULATOR ADJUSTMENT

The voltage regulators may be adjusted by using a portable precision D-C voltmeter as follows:

1. Connect an accurate portable voltmeter between the 'B' and 'G' terminals of the voltage regulator base. Open the generator switch. Run up the engine until the generator is operating above its minimum rated speed. This would be approximately 1800 RPM engine speed.

2. Allow the generators to run above minimum rated speed until their respective regulators are hot. This procedure is necessary to insure that the control boxes are adjusted for parallel operation at normal operating temperatures.

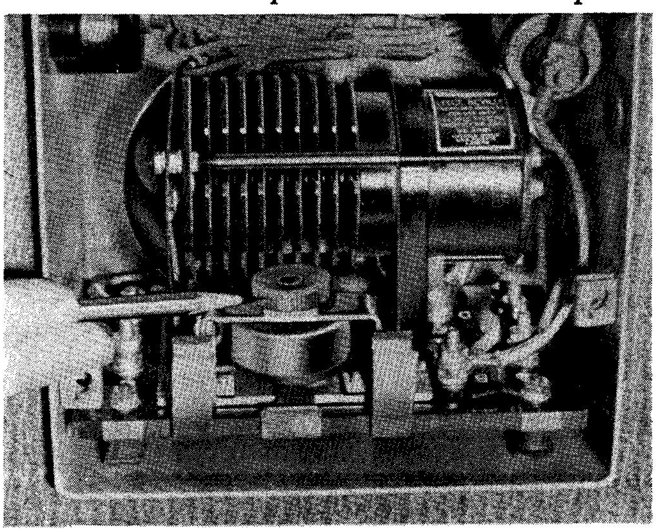


Fig. 81 Voltage Regulator Adjustment

3. Adjust the voltage regulator to 28 volts, as indicated on the portable voltmeter, by turning the rheostat adjusting knob clockwise, (to increase voltage) or counterclockwise, (to decrease voltage). (See Fig. 81) In order to simplify the paralleling adjustment, it is very important that each voltage regulator be adjusted to exactly the same no load voltage.

REVERSE CURRENT RELAY ADJUSTMENT

To check the relay setting, connect the accurate volt ammeter between the generator post and ground. Slowly raise the generator speed and read the voltage at which the relay operates the contactor. As shipped from the factory, this setting is 26.0 and 27.0 volts. Now lower the generator speed and note the reverse current when the relay opens. This should be 25 to 26 volts.

As an alternate method instead of varying the generator speed, a variable resistor of approximately 40 ohms and having fine steps may be temporarily connected in series with the generator field and used to adjust the voltage for test. Minor adjustments of the relay setting may be easily made. It should not be necessary to change the spring adjustment unless the relay has been taken apart or otherwise tampered with. However, see that the bent end of the spring rests solidly in the hole in the end of the adjusting screw. If it does not, recheck the voltage and reverse current settings carefully.

It is suggested that the generator switches be kept in 'Off' position during idling, taxiing, and landing operations because the vibrations present in the airplane structure, while the airplane is in operation, are transmitted to the contacts and induces them to chatter when the generator output drops below 26 volts.

PARALLELING ADJUSTMENTS

After the above procedures have been accomplished, both generator voltage regulators must be adjusted for parallel operation.

1. Close both generator switches.
2. Switch on a D-C load equivalent to the full load rating of one generator.
3. Check the generator ammeters. Each generator should take its share of the load within 5 amperes. If such is not the case, readjust the regulators as follows:

a. Turn the rheostat adjusting knob on the regulator of the generator which is carrying the most load, one notch only in a counterclockwise direction.

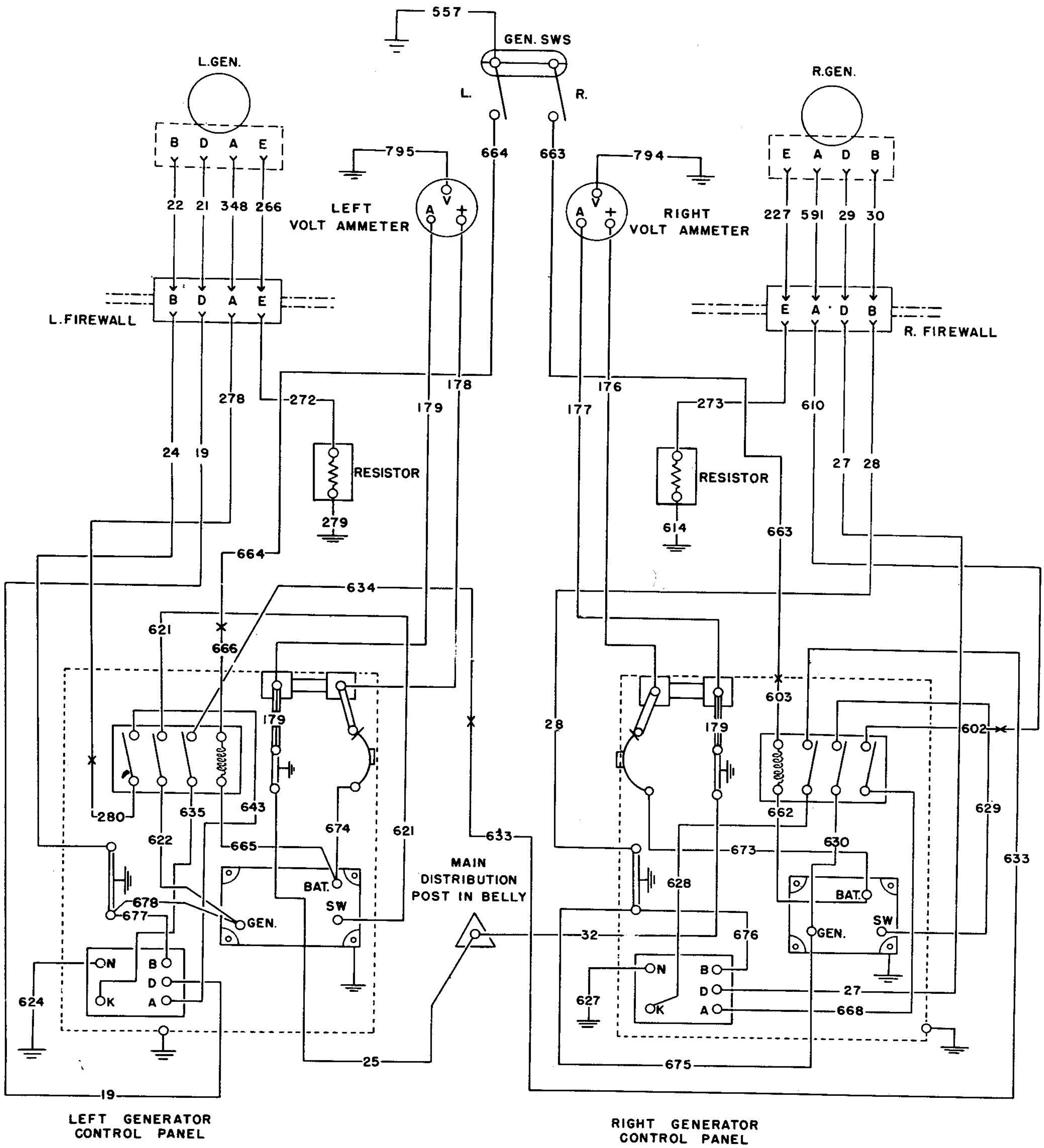
b. Turn the rheostat adjusting knob on the regulator of the generator which is carrying the least load, one notch only in a clockwise direction.

NOTE: A change in the rheostat setting on any one regulator will alter the amount of load carried by each generator, Therefore, rheostat adjustments should be made one notch at a time and both generator ammeters should be checked for proper division of load after each rheostat adjustment.

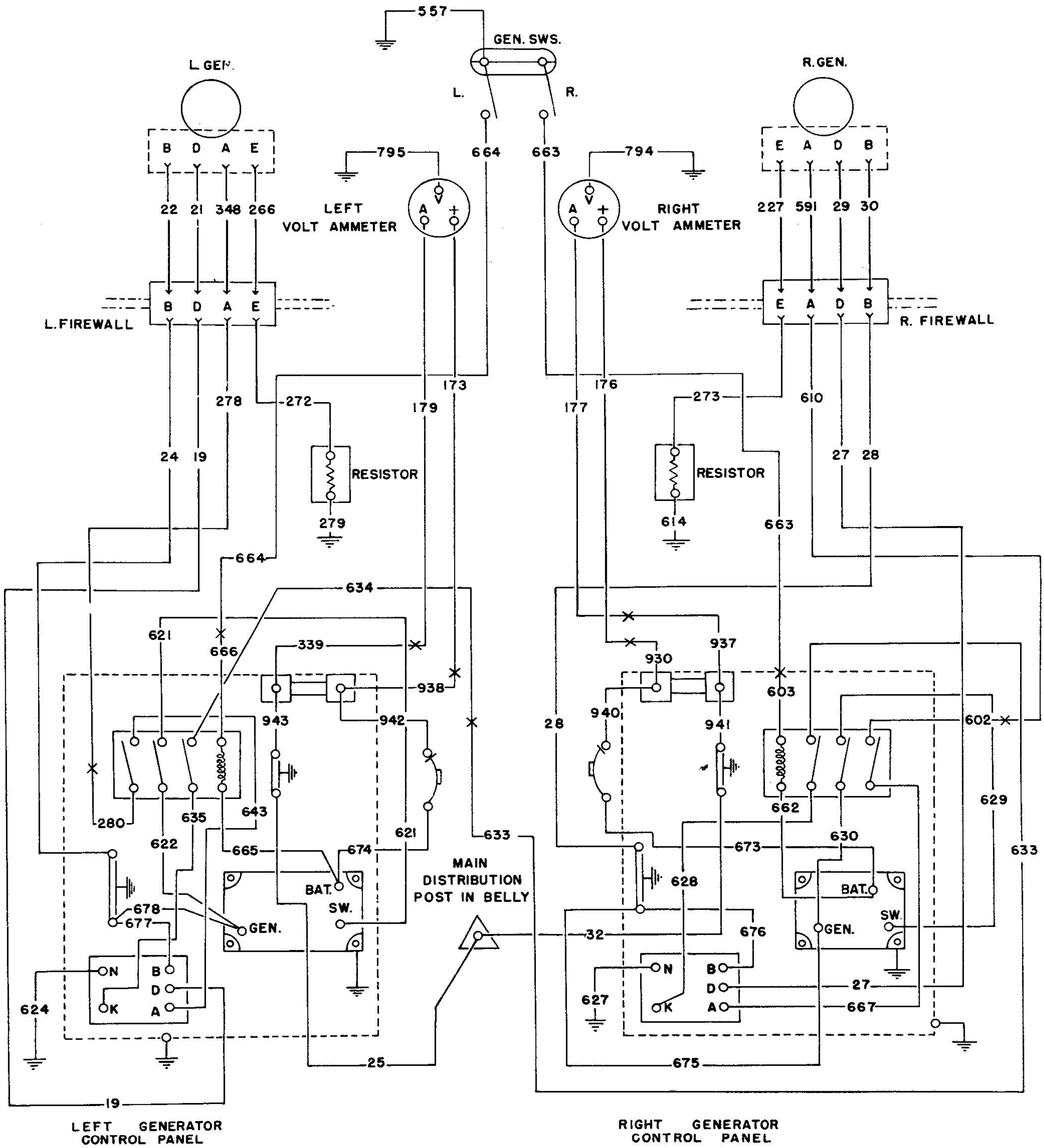
4. Repeat the adjustments outlines above until each generator assumes its full share of the load within 5 amperes.
5. Apply as much load as possible to the full rated load per generator.
6. Check the reading of both generator ammeters. At full load, each generator should take its share of the load within 5 amperes. If such is not the case, readjust both regulators using the method described above and continue until the load divides within the proper limits.
7. After the paralleling has been completed, the voltage should again be checked. Connect the portable voltmeter between the positive buss bar and ground.
8. Switch off all load except that which is permanently connected to the buss bar. Take a reading on the portable voltmeter and if the voltage is not at its proper value (28 volts), turn the rheostat adjusting knob of both regulators, one notch at a time in the same direction, clockwise to increase the voltage, and counterclockwise to decrease the voltage. Continue this procedure until the proper voltage setting is reached.
9. Again switch on maximum load up to full load per generator and check both generator ammeters. If the generators do not divide the load within the proper limits, repeat the entire procedure until, with both regulators adjusted for proper division of load, the voltage as measured with the portable voltmeter at the buss bar is at the proper value.

Trouble Shooting

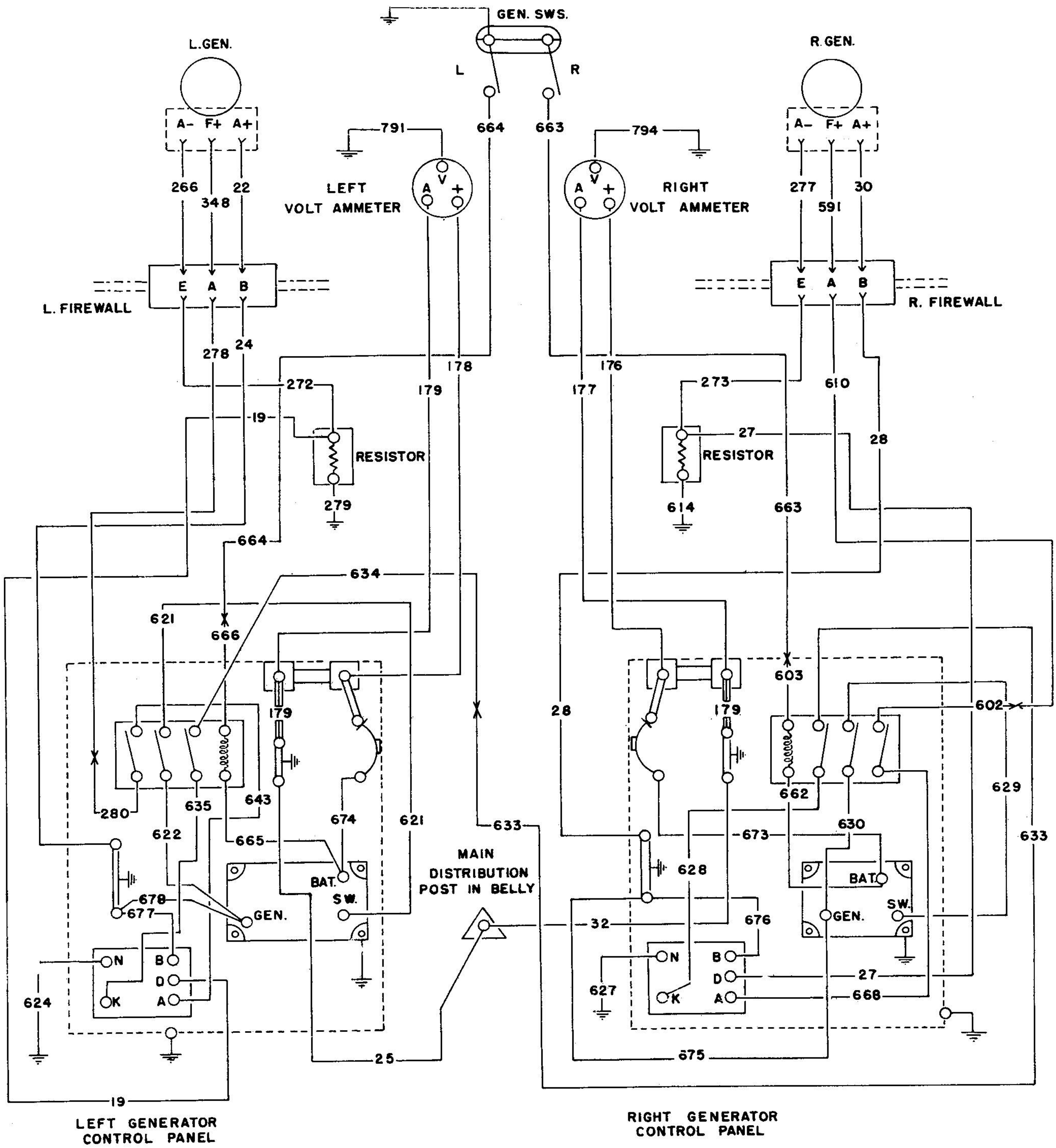
1. No voltage indicated: check volt ammeter and connections. Test continuity of circuit from volt ammeter through the switch to 'B' terminal of the voltage regulator base. Test the field resistance of the generator between the terminal at the voltage regulator and the ground. The resistance should be approximately 3 ohms. Test the field resistance between the terminals 'A' and 'E' on the generator. Resistance should be approximately 3 ohms.
2. No amperage indicated: check ammeter (with some electrical load turned on). Test reverse current relay.
3. General continuity test: remove the voltage regulator from the base when testing continuity in these circuits. Test for ground from pin 'E' at the engine firewall through the equalizing resistor in the nacelle. Test from pin 'D' terminal at the voltage regulator; from pin 'B' to



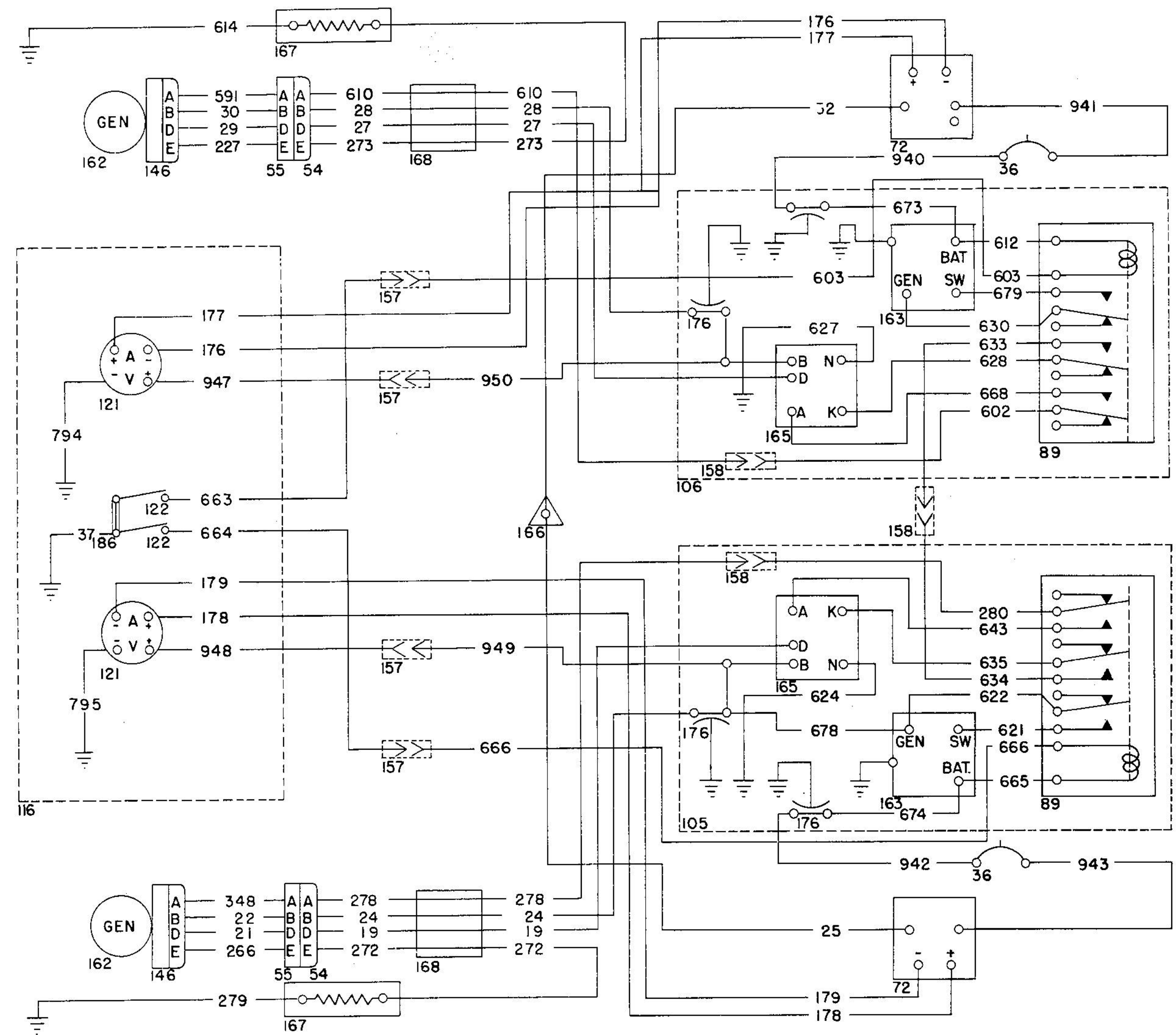
D18S Generator Circuit with Voltage Regulator on Bulkhead 5



D18S Generator Circuit with Voltage Regulator in Wing Stub



D18C Generator Circuit



Generator Circuit with Voltage Regulator in Wing Stub
Aircraft Serials A-351 and After (D-18S),
A-26 and After (D18C and D18CT)

'B' terminal; from 'A' to 'A' terminal. Test 'K' terminal of one voltage regulator with both generator switches on.

4. Loss of residual magnetism: if the generator fails to build up voltage it may be caused by loss of residual magnetism. This is correct by 'flashing' the field of the generator. Never flash the field by manually closing the relay contacts.

FLASHING GENERATOR FIELD

Remove or disconnect the voltage regulator and attach a test lead to a point in the generator control box at which battery voltage is available. With the generator switches in 'Off' position and the engine operating at 1600 RPM, touch the test lead to the 'A' terminal of the voltage regulator base. Remove the test lead, replace the voltage regulator, and test the voltage build up of the generator. If, after the flashing operation, the generator still fails to build up voltage, connect a jumper wire between terminals 'A' and 'B' of the voltage regulator. A voltage build-up now will indicate a defective voltage regulator that must be replaced.

Service Notes

Generator brushes should be inspected frequently, especially if the airplane is used for high altitude flying. Maximum allowable wear on the generator brushes is 1/4 inch from a new length of 3/4 inch. If the commutor is coated or dirty, smooth up with 000 sandpaper. Blow out loose particles with dry compressed air- Do not use emery cloth or coarse sandpaper. If this procedure will not satisfactorily clean the commutator, resurface as prescribed by the generator manufacturer.

TACHOMETER CIRCUIT

The tachometer circuits are not connected with the electrical system of the airplane. A small generator at each engine produces a three-phase alternating current which energizes a small synchronous motor in the indicator. As the speed of the engine, the speed of the synchronous motor in the dual indicator changes accordingly and registers the engine RPM. The tachometer generators are directly connected to the engines. The dual indicator is wired to both generators with one internally grounded lead.

Trouble Shooting

Make continuity and ground checks as follows:

D18S

Left Tachometer

Indicator	Generator
A	A
B	B
C	C

Right Tachometer

Indicator	Generator
A	B
B	A
C	C

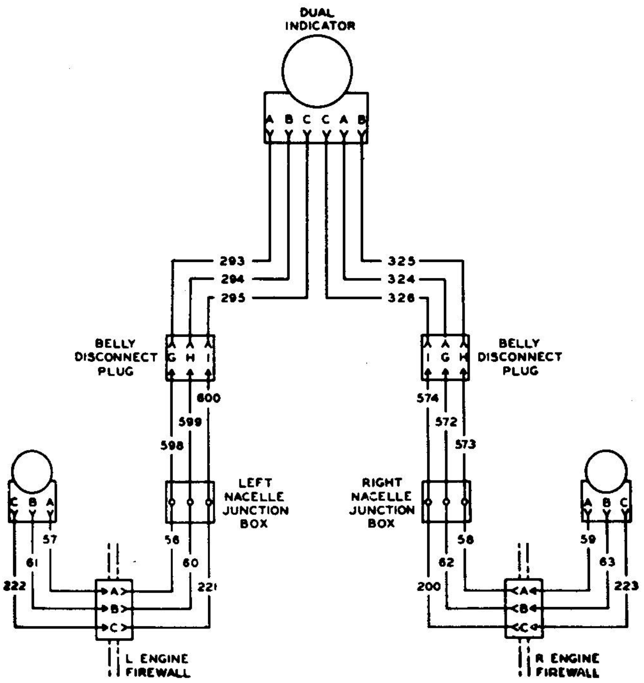
D18C and D18C-T

Left Tachometer

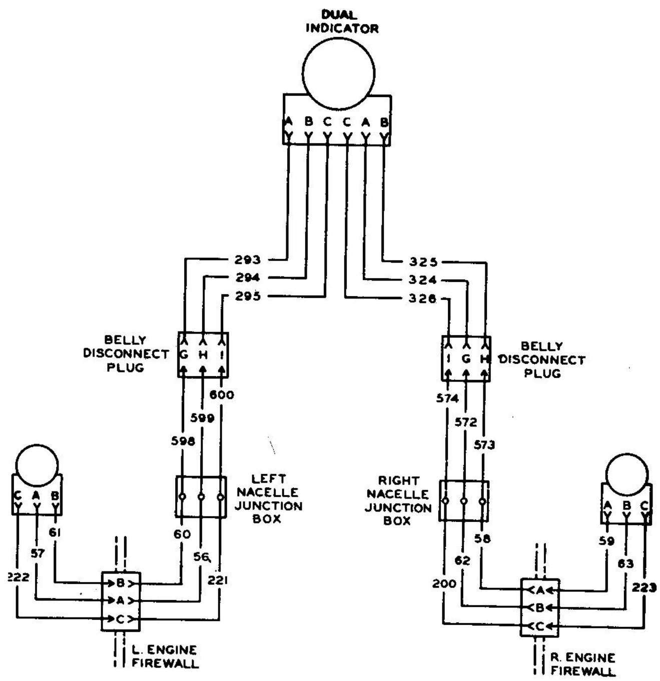
Indicator	Generator
A	B
B	A (no grounds)
C	C

Right Tachometer

Indicator	Generator
A	B
B	A (no grounds)
C	C



D18S Tachometer Circuit



D18C Tachometer Circuit

LANDING GEAR CIRCUIT

The landing gear motor, located in the belly of the airplane, is controlled by the toggle switch in the pilot's compartment. Dynamic brake relays in the belly, the 'Up' and 'Down' limit switches in the left nacelle, and the safety switch installed on the left landing gear shock strut, comprise the landing gear circuit.

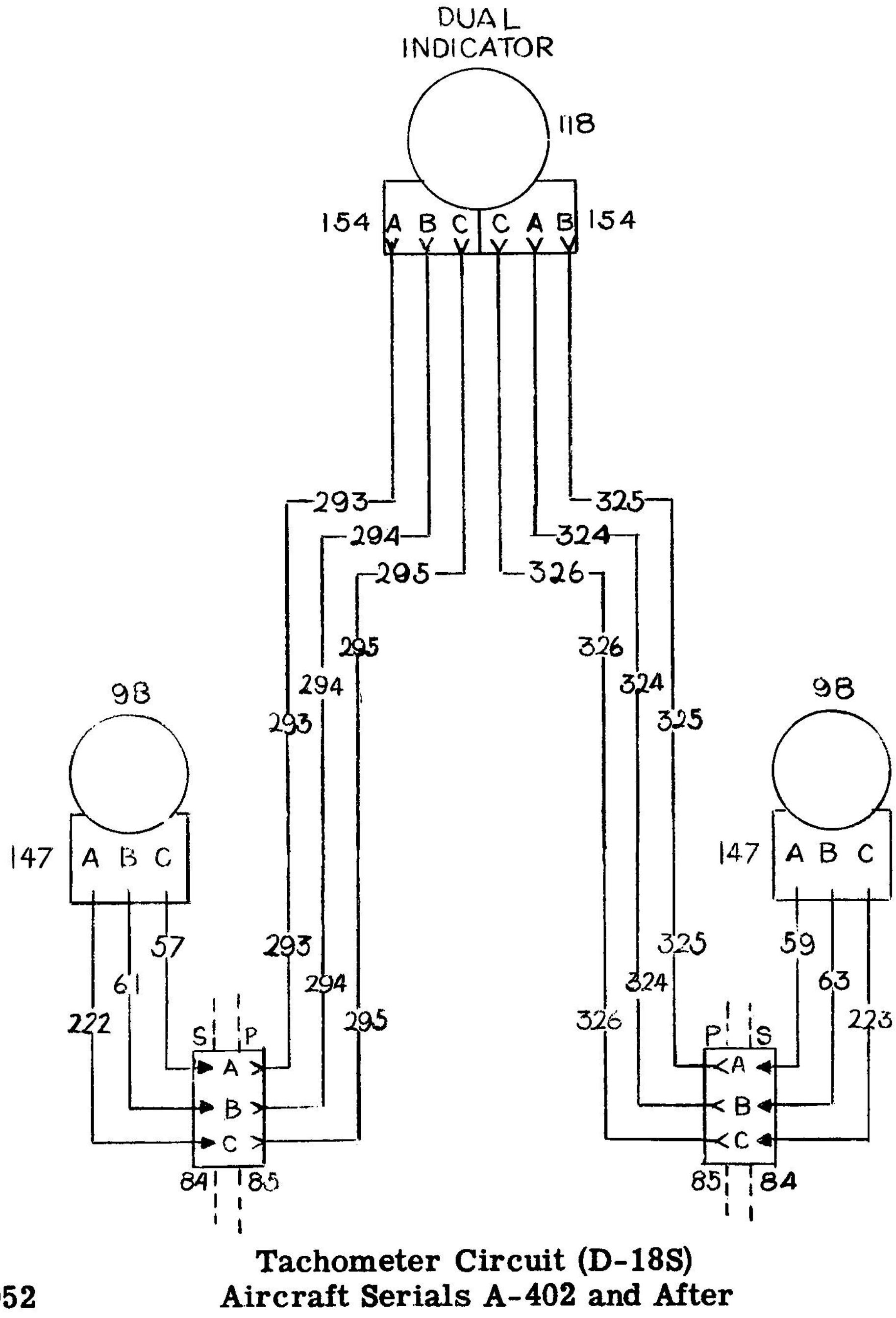
The energizing circuit, between the toggle switch and the dynamic relay, is protected with a 20 ampere fuse at the sub-panel. A 50 ampere, thermal type circuit breaker, reset at the pilot's floorboards, is installed between the operating motor and the main power source.

When the reversing switch is in the 'Up' position, energizing is completed through the safety switch and 'Up' limit switch to the dynamic up relay. This closes the power circuit to the motor, the motor operates until the landing gear has retracted to its full 'Up' position and actuates the 'Up' limit position switch. Actuation of the limit switch opens the energizing circuit to the relay and stops the motor. Simultaneously, the dynamic brake grounds to the current generated in the 'Down' winding of the motor and brings he landing gear retraction to an immediate stop. The same action is repeated when the gear is lowered with the motor controlled through the 'Down' limit switch and 'Down' relay of the dynamic brake.

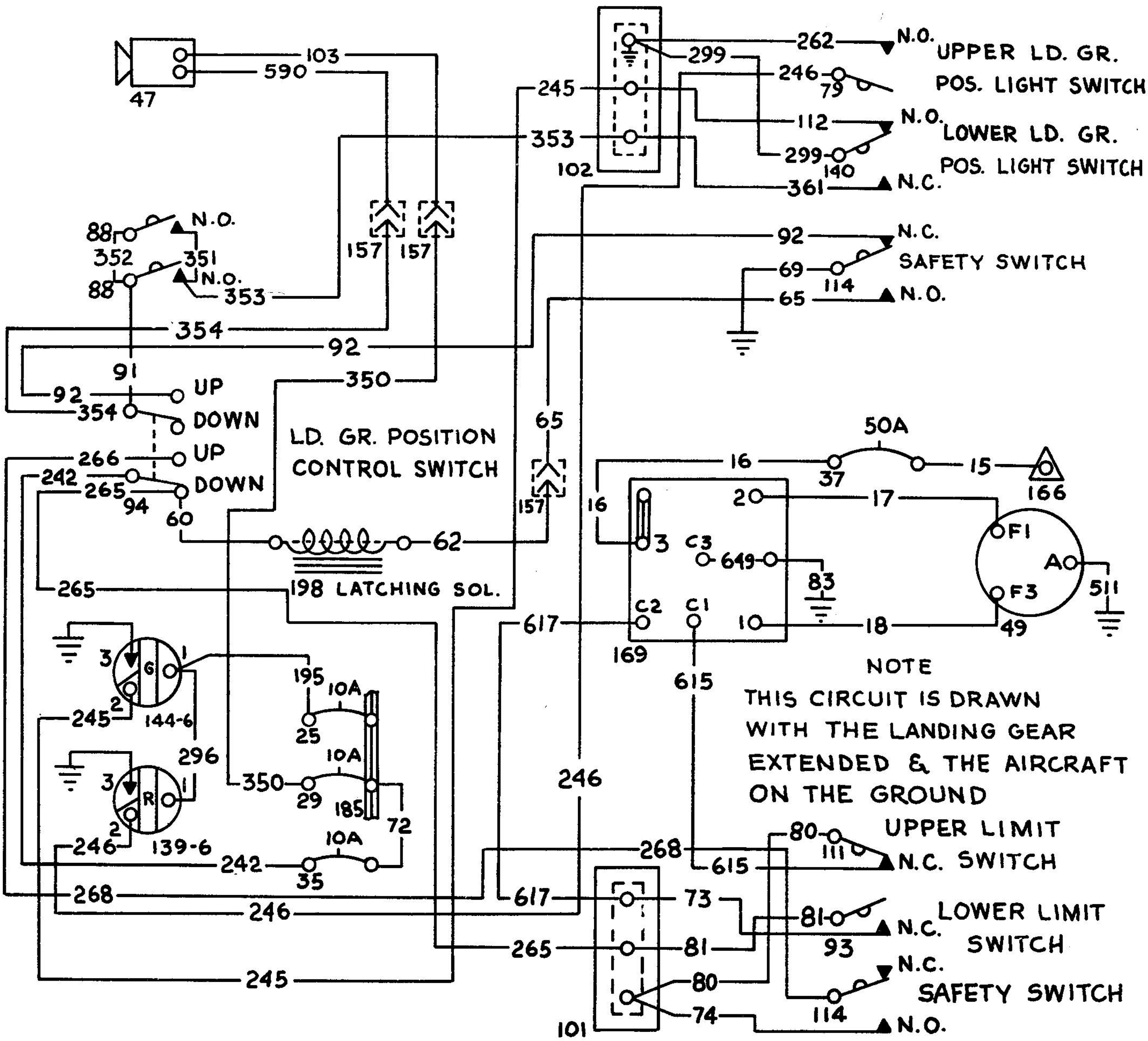
Trouble Shooting

Usually, when checking trouble in the landing gear circuit, the defect can be isolated as to the energizing circuit of the operating circuit. The 'click' of the relays will indicate that the energizing circuit is operating satisfactorily and the trouble will be found in the motor operating circuit. Place the airplane on jacks to clear main and tail wheels from the floor before operating the landing gear.

1. Landing gear will not retract or lower: check the fuse in the energizing circuit and the circuit breaker in the



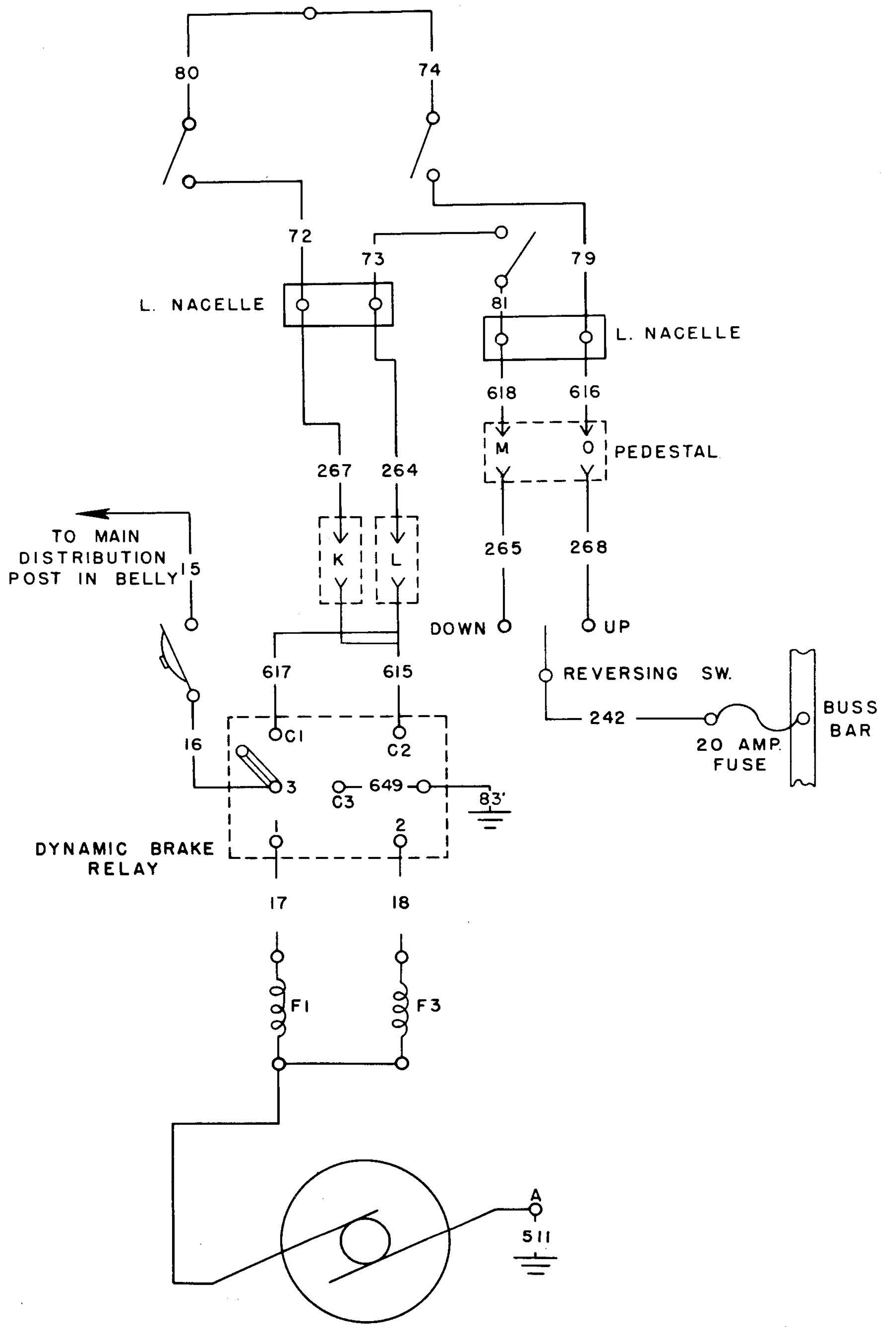
Tachometer Circuit (D-18S)
Aircraft Serials A-402 and After



Landing Gear Circuit
Aircraft Serials A-537 and After

Insert this page after Page 84B.

The diagram of the landing gear circuit on Page 85 is deleted. Use the diagram on Page 84B.



Landing Gear Circuit

motor circuit. Test continuity from subpanel fuse to the center terminal of the reversing switch.

2. Landing gear will lower but not retract: test continuity from the lower terminal of the reversing switch through the landing gear safety switch and 'Up' limit switch to the energizing wire terminal (No. C-1) on the dynamic brake relay. Test continuity from terminal '1' of dynamic brake relay to 'Up' winding of the motor. Check the dynamic brake relay by disconnecting the leads at the motor and turning on the electrical system. Test at the relay terminals with 24 volt test light.

Do not allow disconnected motor leads to ground. Manually set the landing gear so that both limit switches are clear of slide assembly actuator and place the reversing switch in 'Up' position. Test from terminal '1' of the relay assembly to the ground, if the 'up' relay is making proper contact, the test light will go on. Turning off the reversing switch or operating the 'Up' limit or safety switch should cause the test light to go off. This tests the 'up' relay for proper contact and circuit breaking operation.

Repeat the test for the 'Down' relay by placing the reversing switch in 'Down' position and testing from terminal '2' to ground. Operate the reversing switch or the 'Down' limit switch.

FUEL ANALYZER CIRCUIT

The fuel analyzer indicates the fuel air ratio by the analysis of the engine exhaust gas. The exhaust gas is picked up by a sampling tube located in the tail pipe and passes through an analysis cell where the thermal conductivity of the gas is measured. The thermal conductivity of a gas is its ability to conduct heat which, in turn, has a direct relation to fuel air ratio.

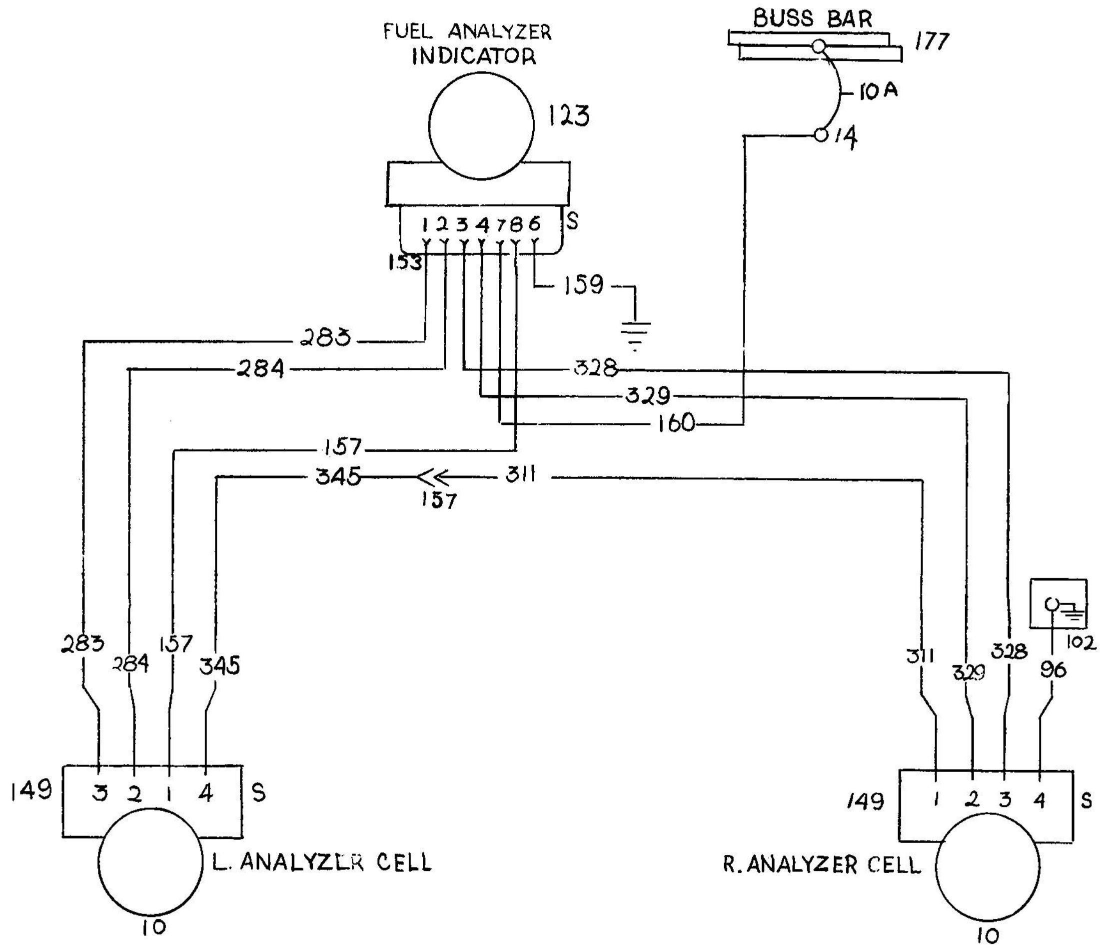
FUEL ANALYZER ADJUSTMENT

When checking the fuel analyzer, allow sufficient time (approximately one minute) to elapse, after setting the mixture control, before reading the indicator. When the mixture is changed at the carburetor, there is some delay before the change in the exhaust gases is noted on the indicator. If the indicator does register a leaner mixture or backs up the scale toward the rich side as the mixture is leaned out, detonation has undoubtedly been encountered and the mixture should be enriched.

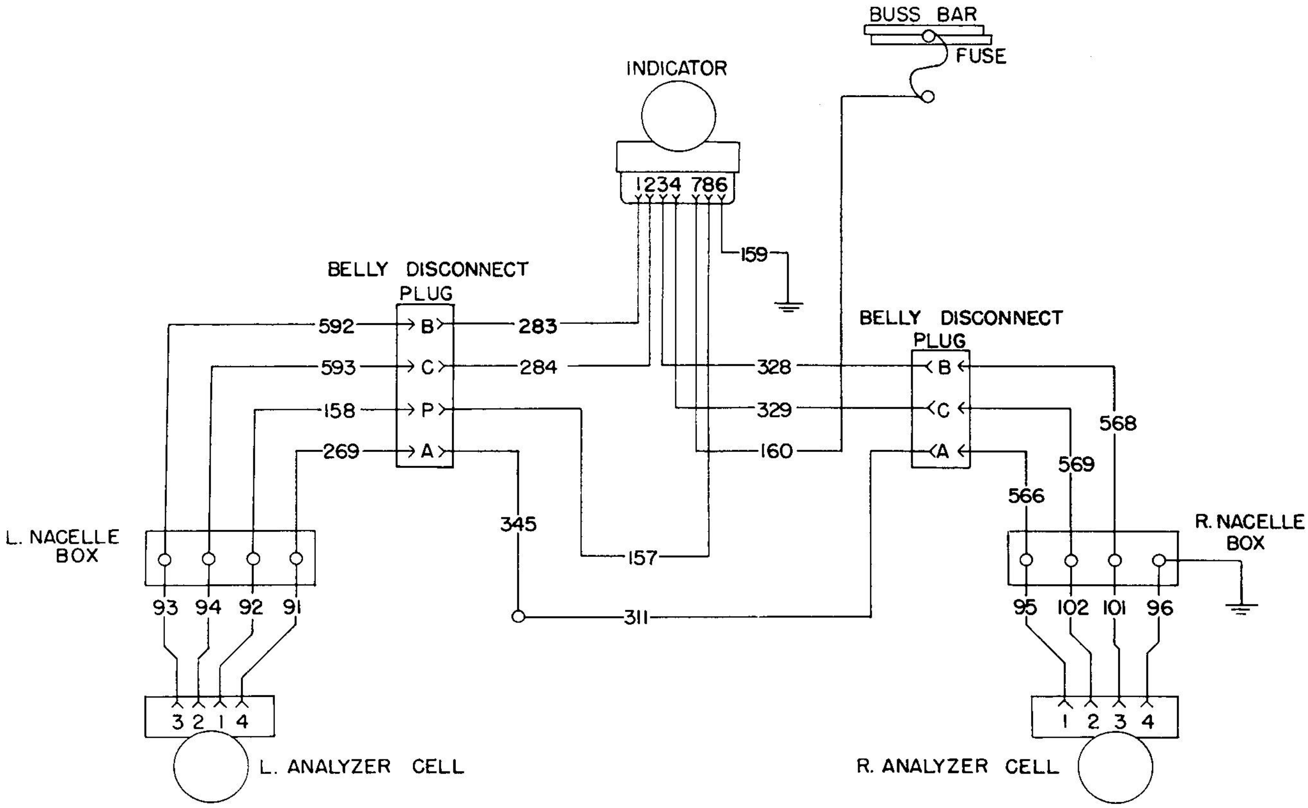
With the electrical system turned off, the indicator pointers should rest at the line marked 'A' on the scale. If they do not, they may be brought to this position by turning the small adjusting screws located on the instrument.

The electrical zero may be adjusted as follows:

1. Remove the vapor plug, containing the dampening wick from the analyzer units in each nacelle. Soak the wick in clean water and replace both the wick and the vapor plug.
2. Remove the filter cover and take out the metal wool. Install a clean cloth, dampened with clean water and replace the filter cover.
3. Turn on the electrical system, and allow the analyzer units, containing the damp cloth to 'cook' for thirty minutes. This is done to allow the ballast tube to arrive at its maximum temperature, otherwise there would be a variation in reading at the indicator.
4. At the end of thirty minutes the indicator points should be resting on the 'A' line. If they are not, they may be adjusted to the line by regulating the rheostat at the analyzer unit.
5. After the adjustment is made at each analyzer cell, remove the wet cloths



Fuel Analyzer Circuit
Aircraft Serials A-402 and After



Fuel Analyzer Circuit

from the filter chambers and replace the metal wool and covers.

Trouble Shooting

Test for continuity (Cambridge Type 8500-11) and ground with a battery powered test light. Remove the sub-panel fuse and disconnect plugs at indicator and the cell units.

1. Indicator Plug Pin 7 to Sub-Panel Fuse.
2. Indicator Plug Pin 1 to Left Cell Plug Pin 3.
3. Indicator Plug Pin 2 to Left Cell Plug Pin 2.
4. Indicator Plug Pin 8 to Left Cell Plug Pin 1.
5. Indicator Plug Pin 4 to Left Cell Plug Pin 2.
6. Indicator Plug Pin 3 to Right Cell Plug Pin 3.
7. Indicator Plug Pin 5 to Right Cell Plug Pin 4. (grounded circuit)
8. Indicator Plug Pin 4 to Right Cell Plug Pin 2.

Service Notes

Checking of the mechanical and electrical zero settings of the indicator pointers should be made at regular intervals.

The vapor plug wick must be kept saturated with water when checking or resetting electrical zero. The plug has a very small hole in the countersink near the base which must be kept open.

At 100 hour inspection periods, the metal wool should be removed and washed in unleaded gasoline. Allow to dry, then wash in water and replace in the chamber. Press the metal wool in so as to clear the inlet pipe. In time the wool becomes distorted and should be replaced. Replace only with specified non-corrosive wool cartridge; do not use ordinary wool.

Analyzer sampling tubes and lines may be cleaned by rotating an old tachometer flex shaft through them. Check for clogged or burned off sampling tubes in the exhaust stacks.

FLAP CIRCUIT

The flap system is electrically operated by a reversible motor located in the belly section of the airplane. The motor is controlled by a reversing switch in the pilot's compartment. Travel of the flaps is regulated by limit switches above the flap screw shaft at the gear housing. An actuator, traveling on this shaft, operates the switches. A dynamic brake relay provides a remote switching control of the motor, and braking action to eliminate coasting in the flap system.

Trouble Shooting

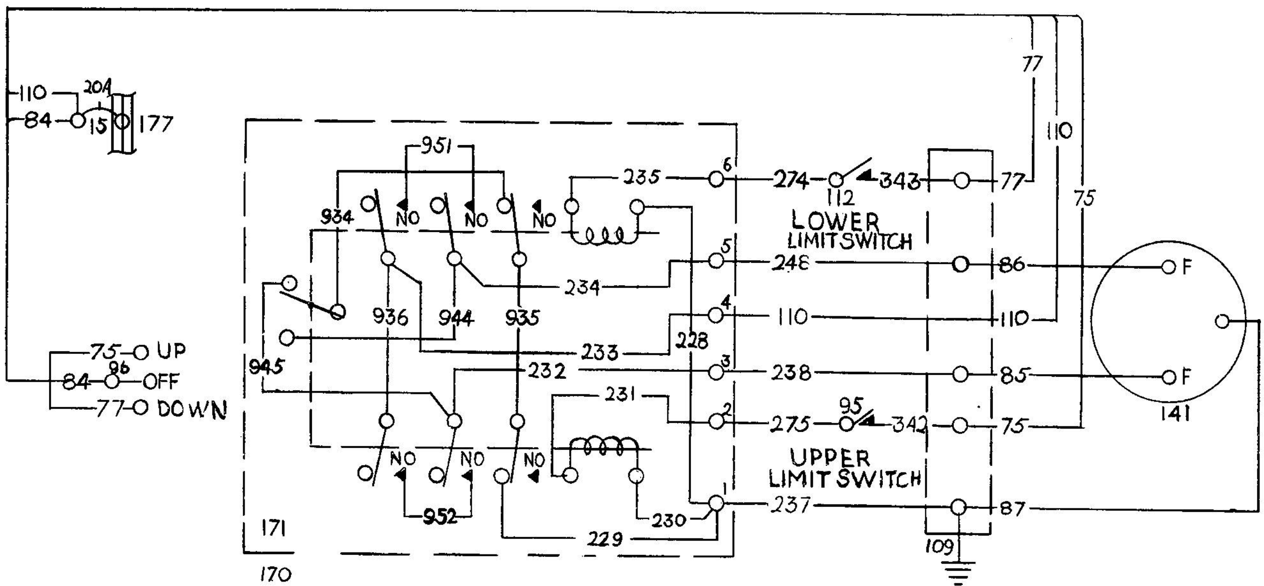
1. Flaps will not raise or lower: check the fuse. Test continuity from the center terminal of the reversing switch to the fuse. Test the ground connection of motor.

2. Flaps operate in one direction only: if flaps will raise but not lower, test continuity from top terminal of reversing switch to the 'Down' winding of motor. Check operation of the 'Down' limit switch. If flaps will lower but not raise, test continuity from the bottom terminal of the reversing switch to the 'Up' winding of the motor. Check operation of the 'Up' limit switch.

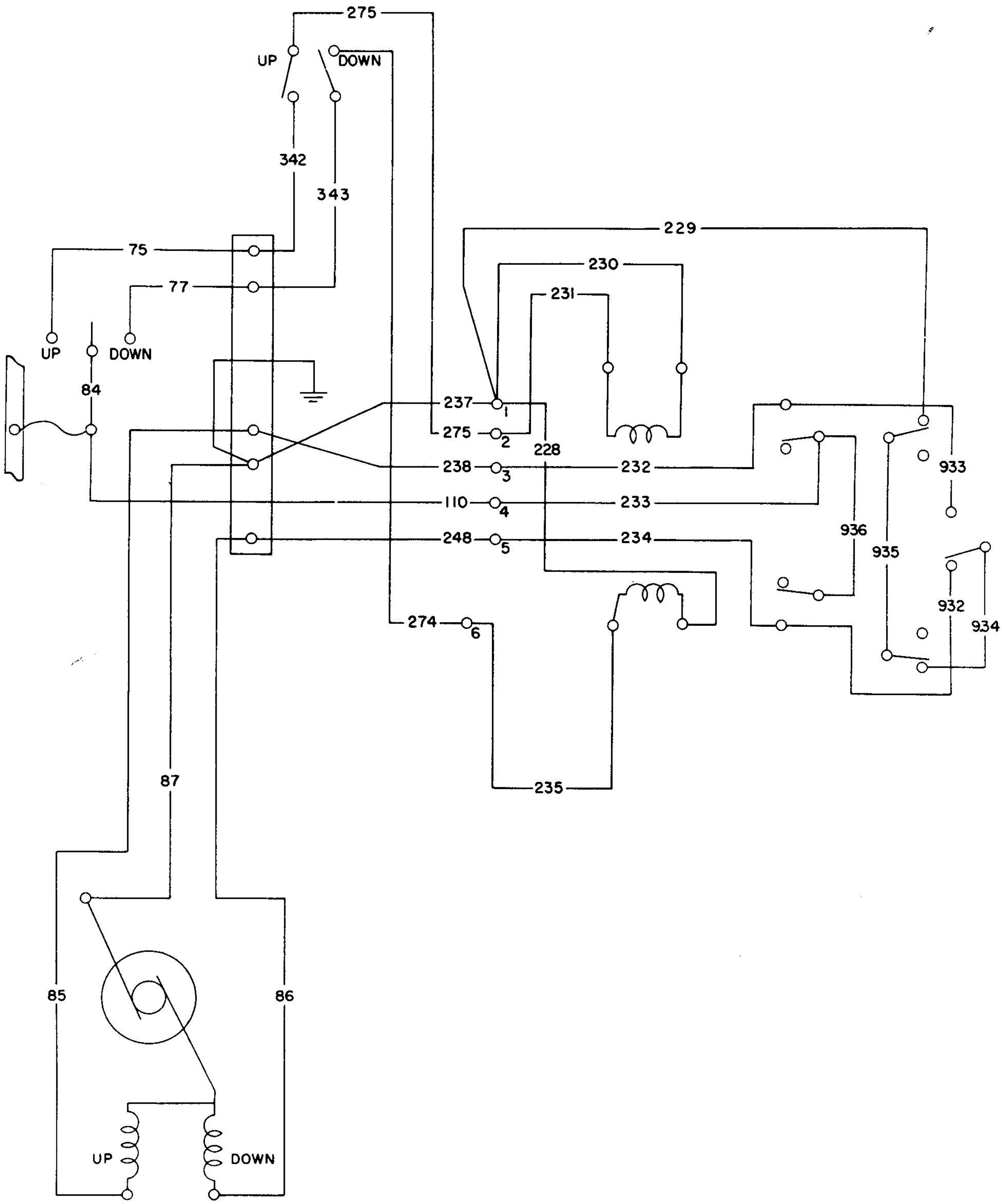
3. Circuit blowing fuses: if a fuse is blown when the reversing switch is in neutral position, test for ground between the switch and the fuse. If the fuse is blown when the reversing switch is operated to the 'Up' for 'Down' positions, test for ground on that side of the circuit causing the difficulty.

NOTE: When testing this circuit against grounds, it is best to remove the motor leads from the terminal strip, as windings of the motor are of low enough resistance to cause a grounded condition to show on the test light.

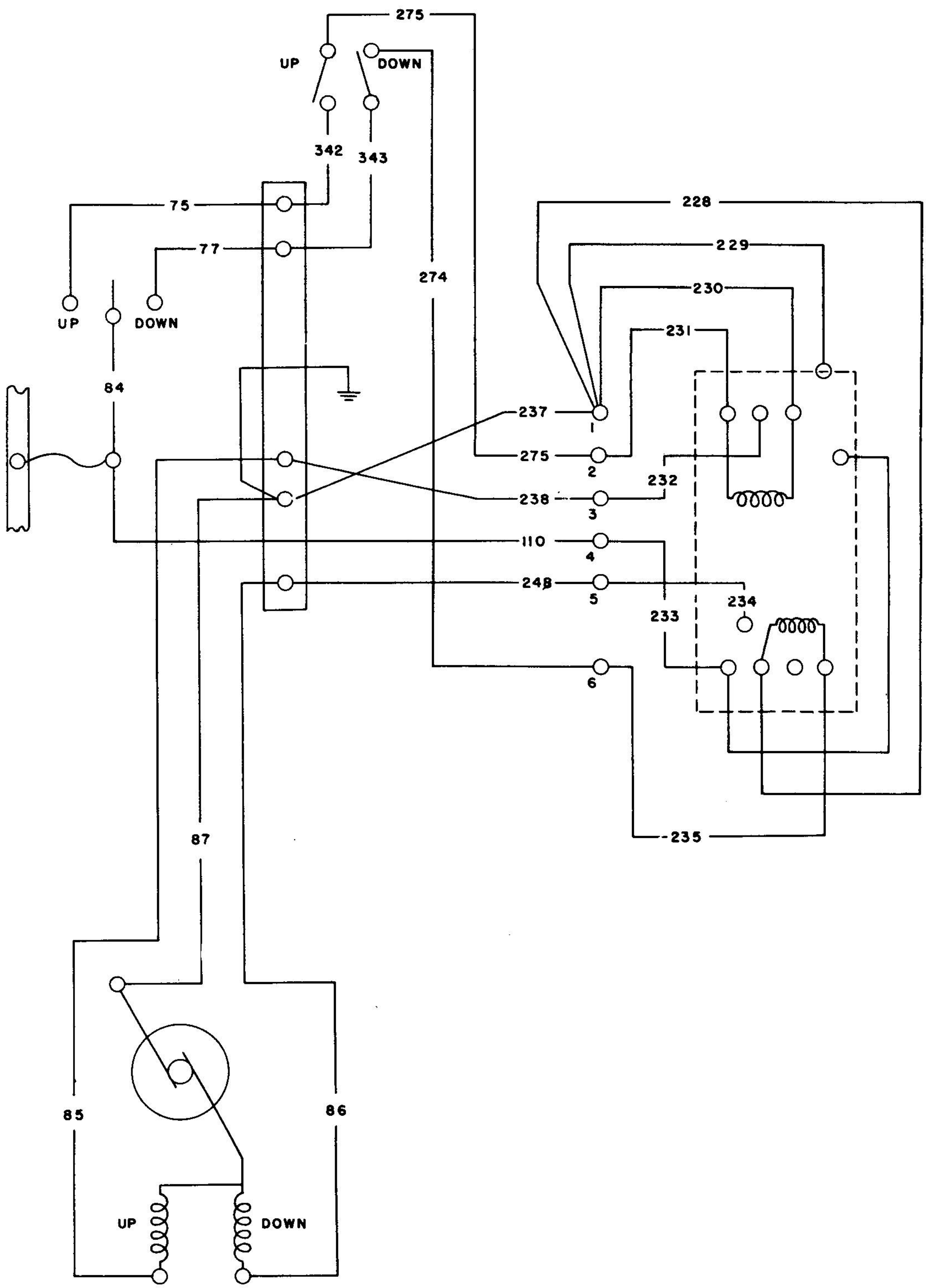
4. To check dynamic brake relay: disconnect the leads from the terminal strip and turn on the electrical system. Test at relay terminals with 24 volt test light. Manually set the flaps so that both limit switches are clear of actuator arm and place the reversing switch to 'Up' position. Test from terminal No. 3 to ground. If the relay is making proper contact, the test light will come on. Turning off the reversing switch or operating the 'Up' limit should cause the test light to go off. This tests the 'Up' relay for proper contact and circuit breaking operation. Repeat the test for the 'Down' relay by placing the reversing switch in the 'Down' position and testing from terminal No. 5 to the ground. Operate the reversing switch and 'Down' limit switch.



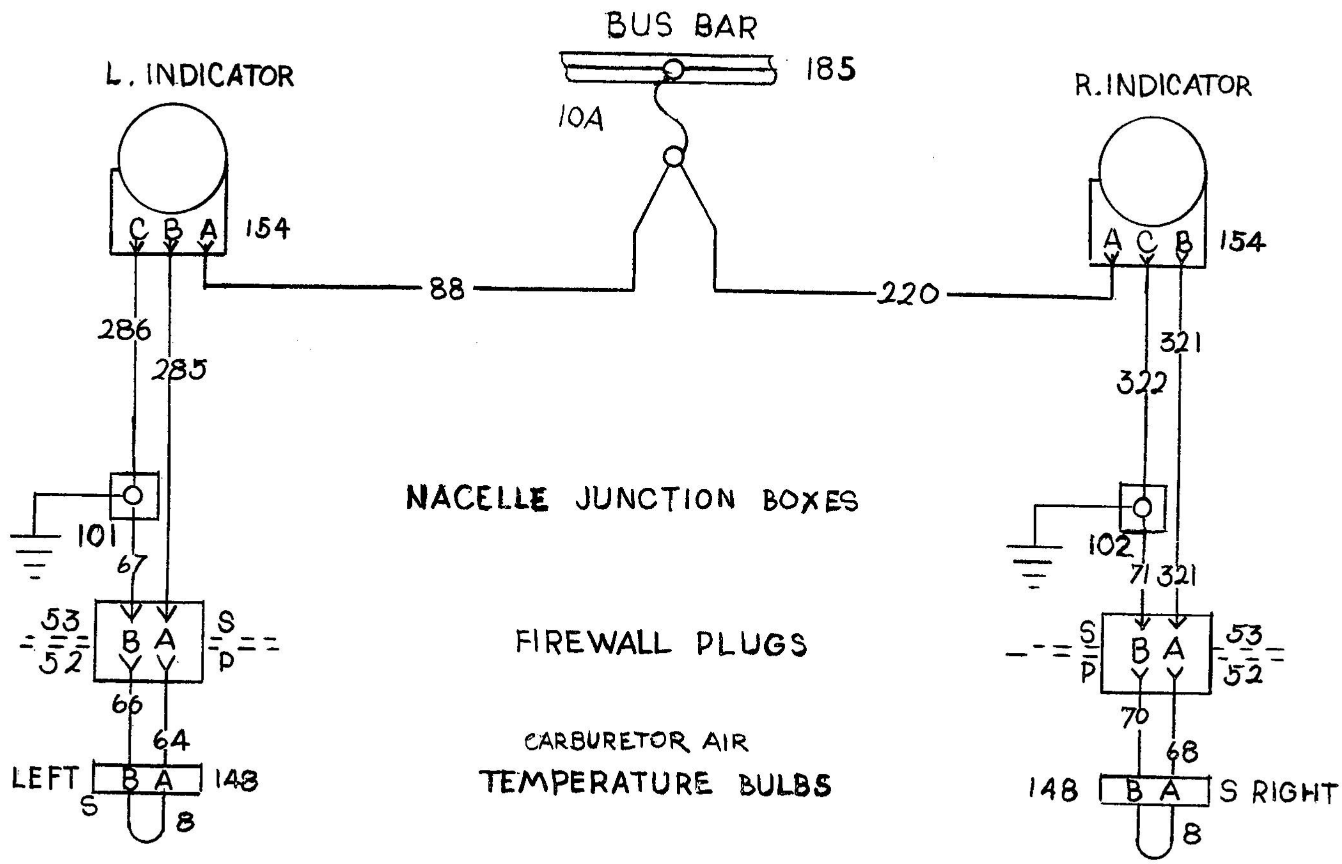
Flap Motor and Dynamic Brake (Phillips) Circuit
Aircraft Serials A-537 and After



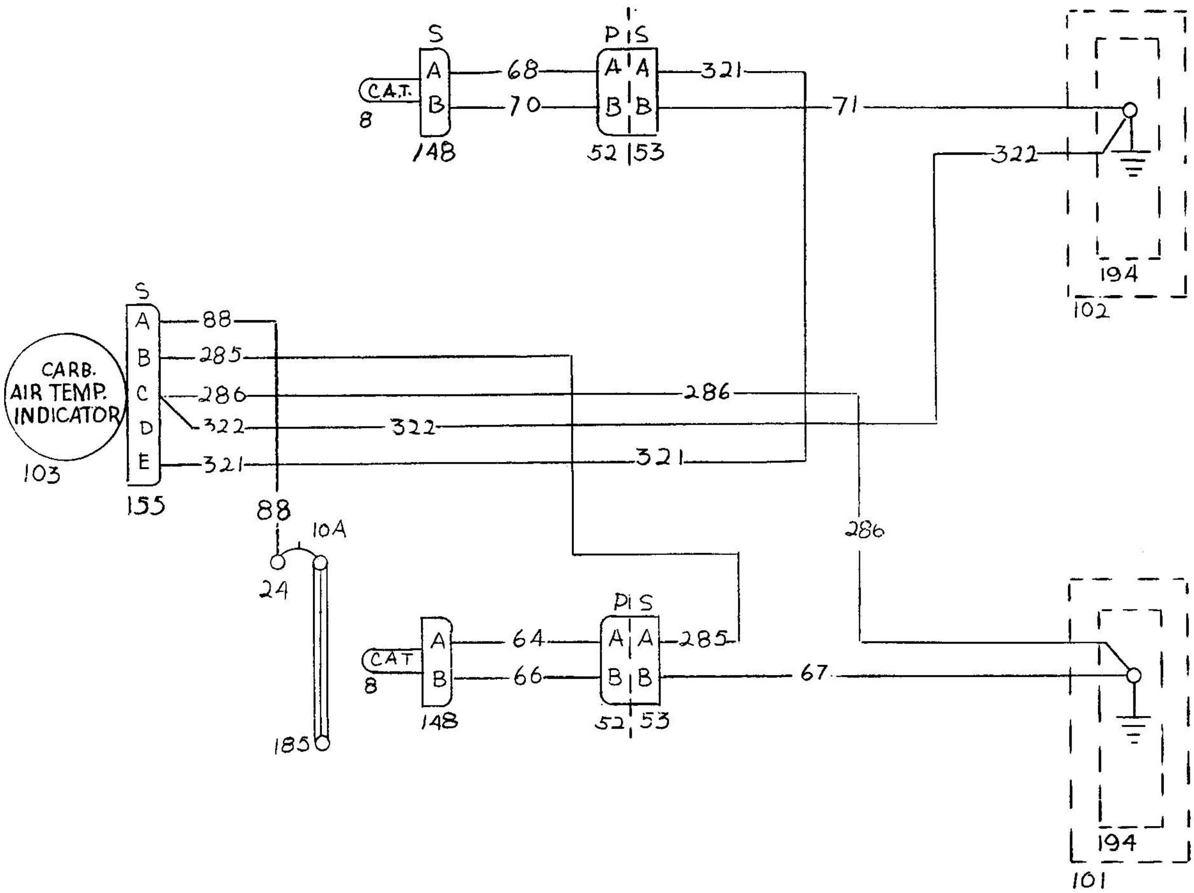
Flap Circuit with Phillips Dynamic Brake Relay



Flap Circuit with General Electric Dynamic Brake Relay

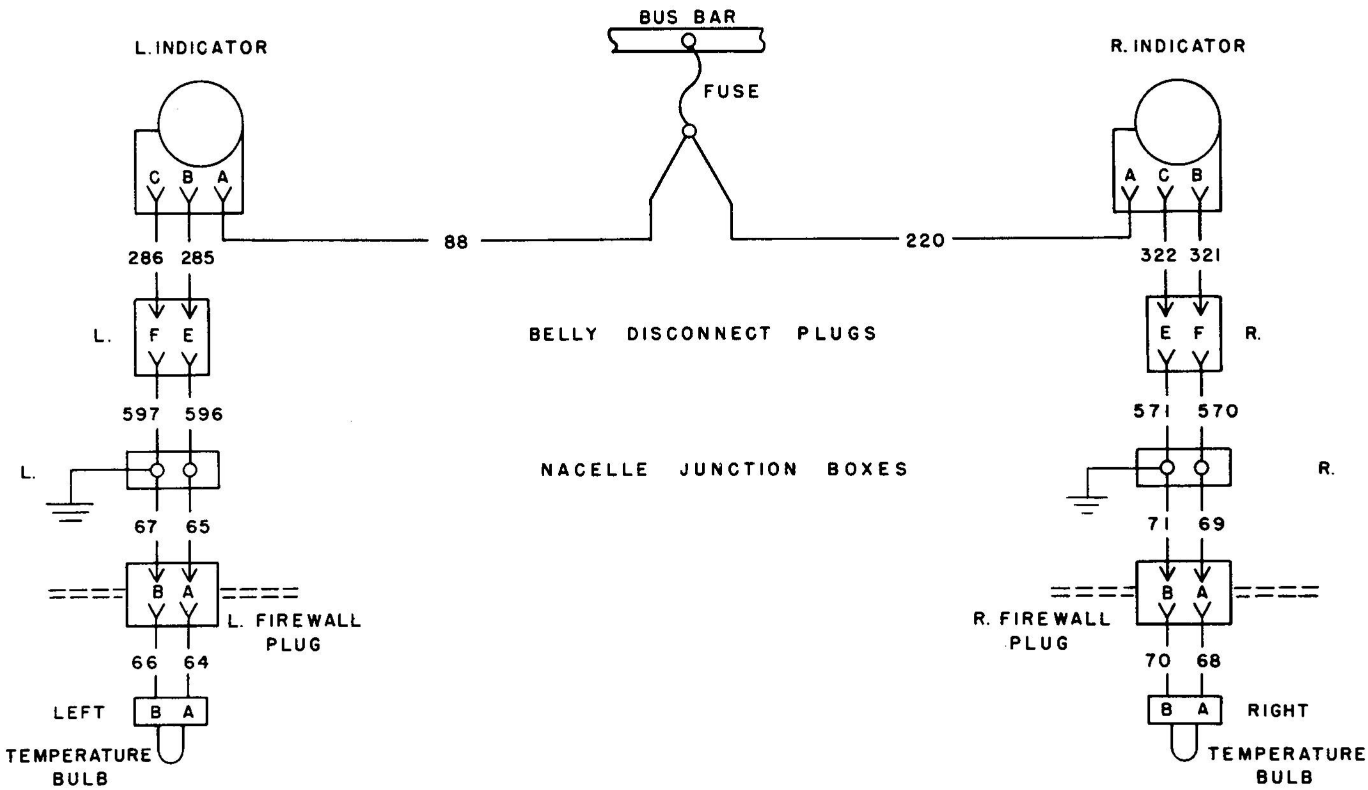


Carburetor Air Temperature Circuit
Aircraft Serials A-402 to A-537



Carburetor Air Temperature Circuit
Aircraft Serials A-537 and After

 January 1952



Carburetor Air Temperature

CARBURETOR AIR TEMPERATURE CIRCUIT

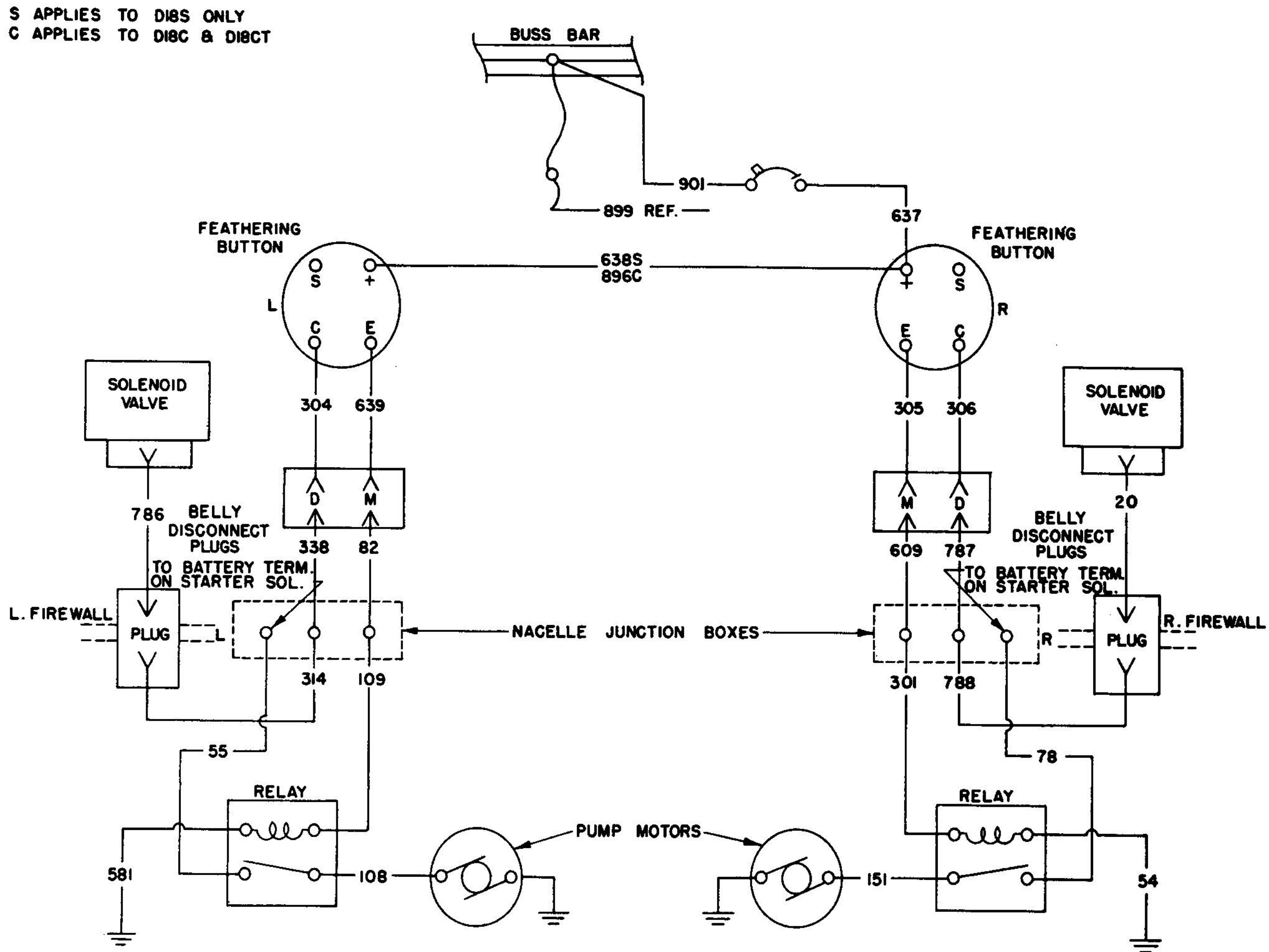
The carburetor air temperature instrument is a resistance type thermometer consisting of a sensitive element bulb located in the chamber above the carburetor, and the indicator on the pilot's instrument panel. There is a separate bulb and indicator for each engine.

Trouble Shooting

1. No reading at indicator: check the sub-panel fuse. Test the continuity from fuse to 'A' post indicator.

2. Indicator reading off scale at low temperature end: Test for ground between 'B' post of indicator and 'A' post of resistance bulb; from 'C' post of indicator to ground terminal and from 'B' post of resistance bulb to ground terminal.

3. Indicator reading high or low: check for poor connection at the fuse or between the indicator and the resistance bulb. Test for ground on pin 'B' of firewall plug and pin 'B' (or pin 1) on plug at resistance bulb, using an ohmmeter on the high resistance scale. (A very small leakage to ground on these wires will affect the reading of the indicator.)



Propeller. Feathering Circuit with One Circuit Breaker.

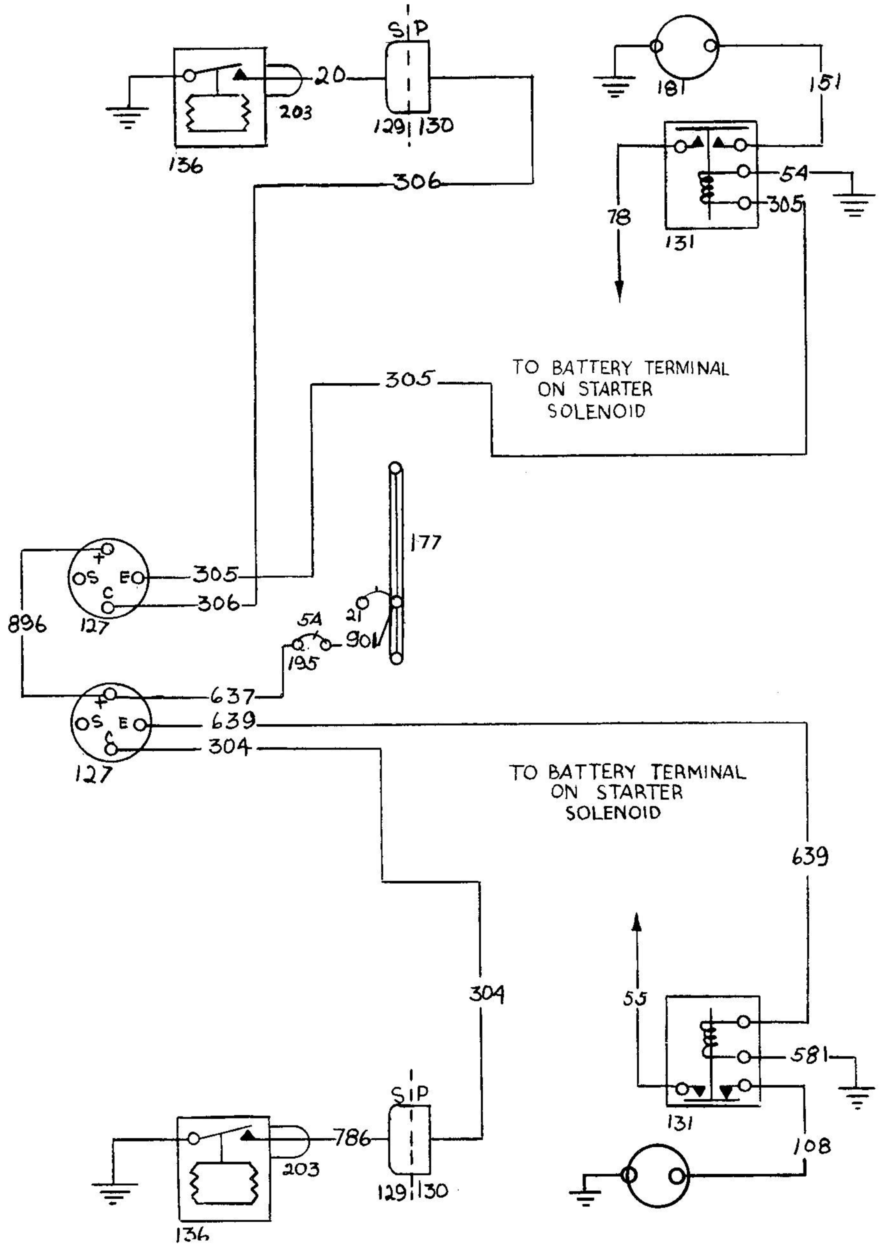
HYDROMATIC PROPELLER FEATHERING CIRCUIT

The hydromatic propeller is feathered by depressing the switch, located on the pilot's instrument panel. When the switch is operated, a solenoid in the circuit closes, energizing an electrically driven pump. The pump pressurizes the fluid in the propeller dome, feathering the propeller. When the blade reaches the full feathered position, a pressure relief switch opens the circuit.

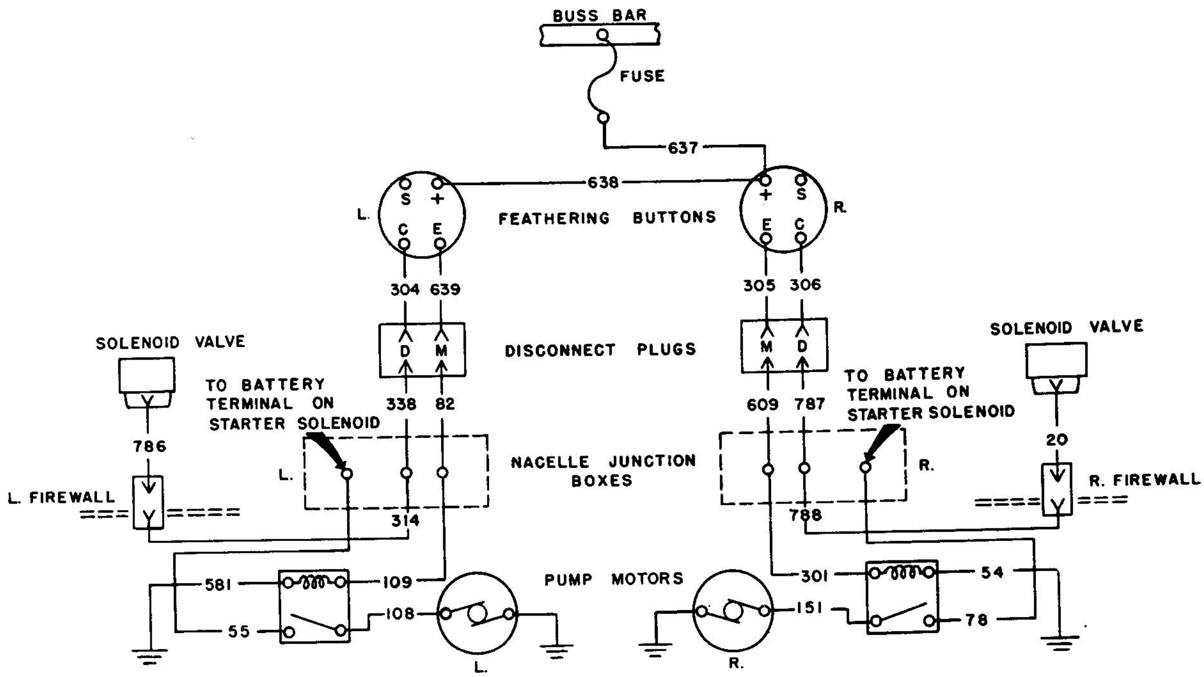
Trouble Shooting

1. Failure to feather: check for loose, dirty or improper external connections. Check the operation of the control switch, solenoid, and pump motor. Make a continuity test for grounded, shorted, or open leads.

2. Incorrect engine speed: check for broken solenoid spring. Check for shorted coils in pump motor.

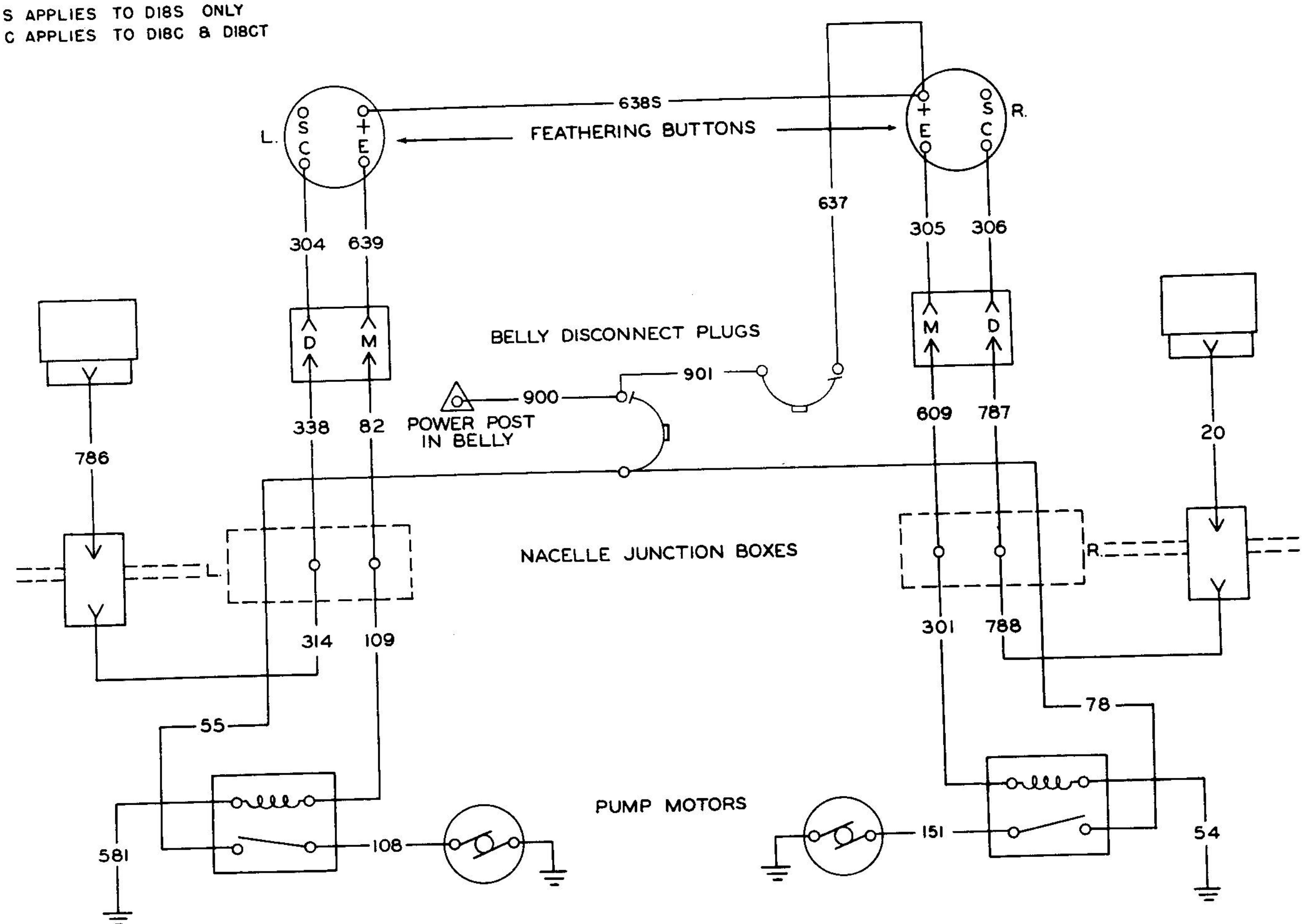


Propeller Feathering Circuit
Aircraft Serials A-402 and After

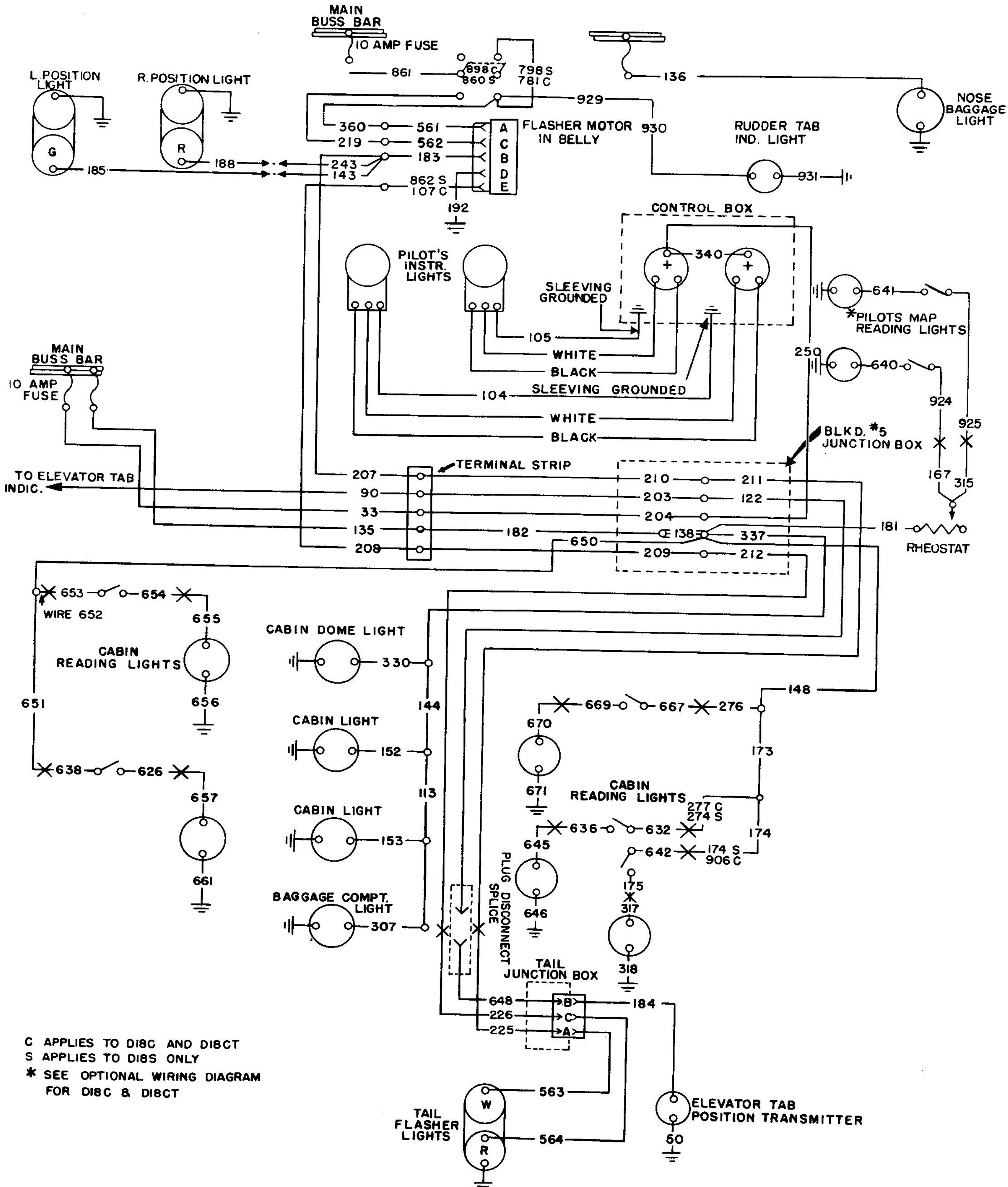


Propeller Feathering Circuit with Fuse

S APPLIES TO D18S ONLY
C APPLIES TO D18C & D18CT

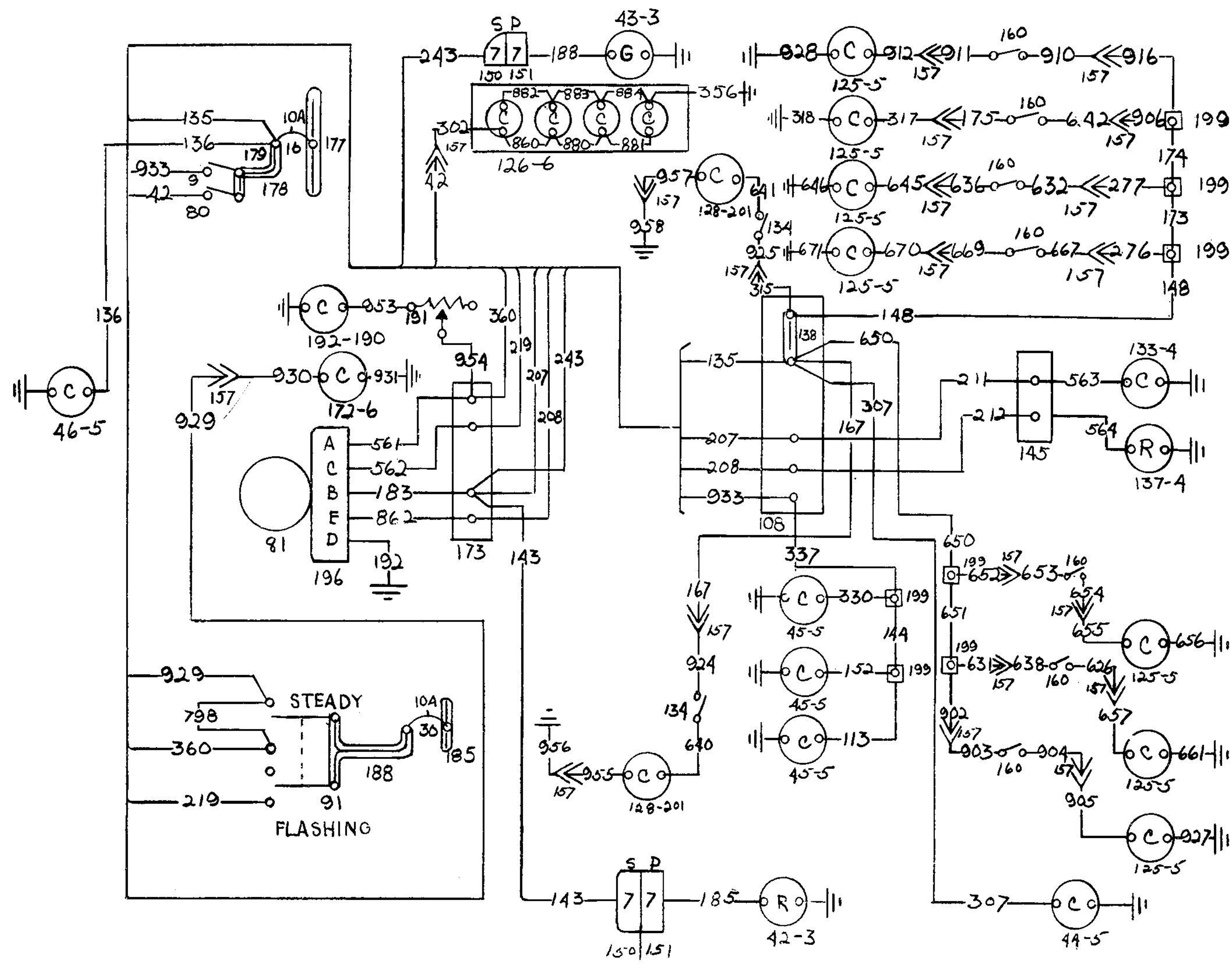


Propeller Feathering Circuit with Two Circuit Breakers



C APPLIES TO D18C AND D18CT
S APPLIES TO D18S ONLY
* SEE OPTIONAL WIRING DIAGRAM FOR D18C & D18CT

Navigation, Instrument, and Interior Lighting Circuit



Navigation, Instrument, and Interior Lighting Circuits
Aircraft Serials A-537 and After

NAVIGATION LIGHT CIRCUIT

Navigation lights consist of two wing tip lights (one on each wing) green for left, red for right; two lights attached to the trailing edge of elevator (one red, one white). A flasher located in the belly of the airplane, is wired to all of these lights and flashes alternate lights for safety purposes. A switch is provided to change from 'flash' to 'steady' as desired.

Trouble Shooting

1. Light inoperative: check the sub-panel fuse. Check bulb. Make point by point continuity test of the circuit.
2. Circuit blowing fuse: make point by point test for ground to the light causing the fuse to blow out.
3. Flasher inoperative: check fuse. Make continuity check from the fuse to the switch and from the switch to the flasher. Check the flasher for loose connections on the terminal board and the switch.

INSTRUMENT LIGHT CIRCUIT

The instrument panels are lighted by fluorescent spot lamps. Each fluorescent light is controlled by a knob in the control box located just aft of the co-pilot's chair and at the top of bulkhead No. 5 in the pilot's compartment. When the control knob is turned to 'start' position, the starting circuit (black wire) is completed through the heater filament in the lamp bulb to the ground. After the gases in the bulb are ignited, the control knob is turned to the operating circuit (white wire which is completed through the bulb to the ground.

Trouble Shooting

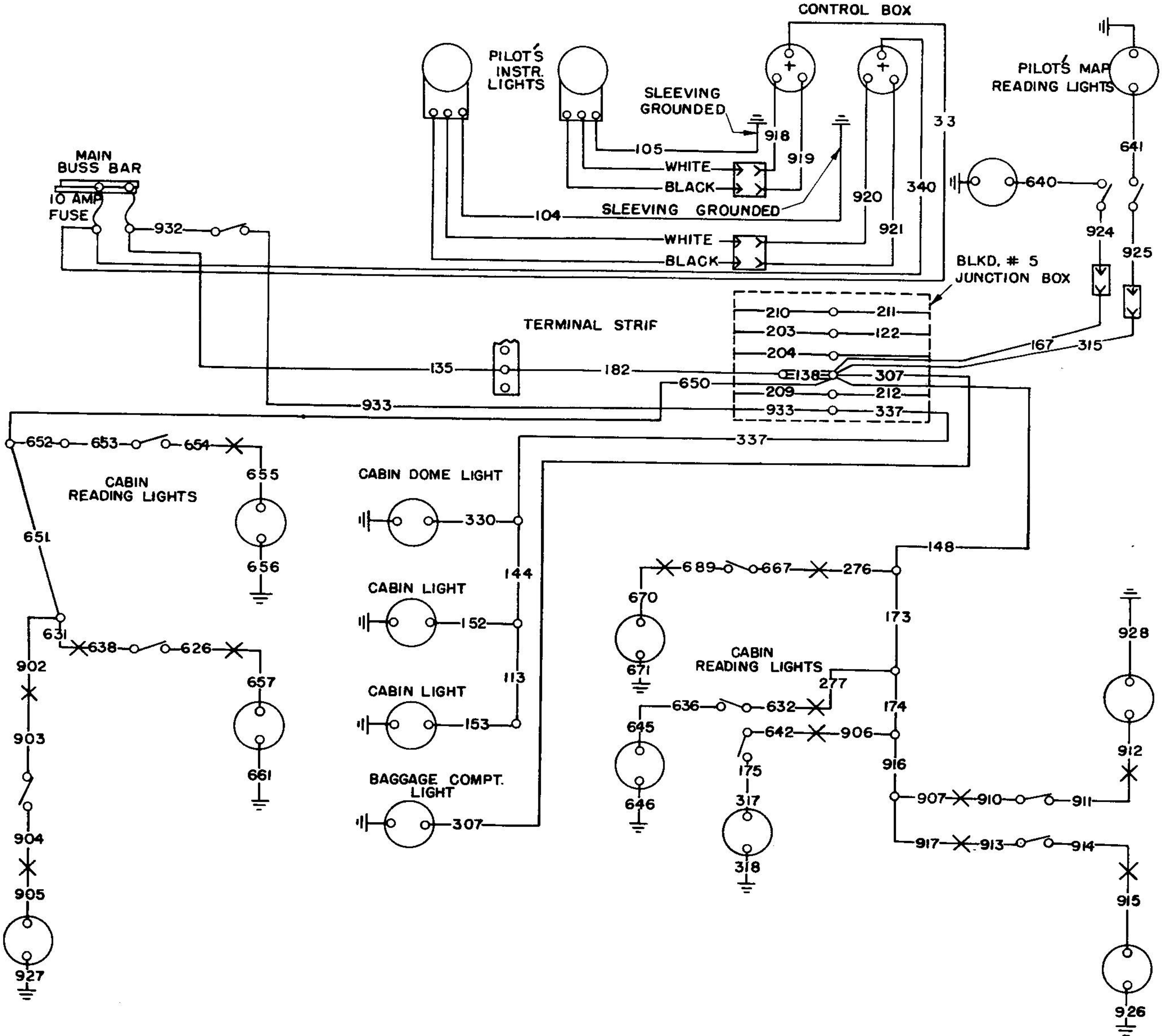
1. Check fuse with fluorescent light knobs turned to 'Off' position.
2. Test continuity from the fuse to the terminal '3' at the light control.

INTERIOR LIGHTING CIRCUIT

The interior lights consist of dome and reading lights. There are five dome lights in the airplane; one in the nose baggage compartment, three in the cabin, and one in the rear baggage compartment. Reading lights are provided for the pilot and co-pilot, one for each, and a separate reading light for each seat in the cabin. All lights, both dome and reading, have individual switches. All of the dome and reading lights are on the same electrical circuit.

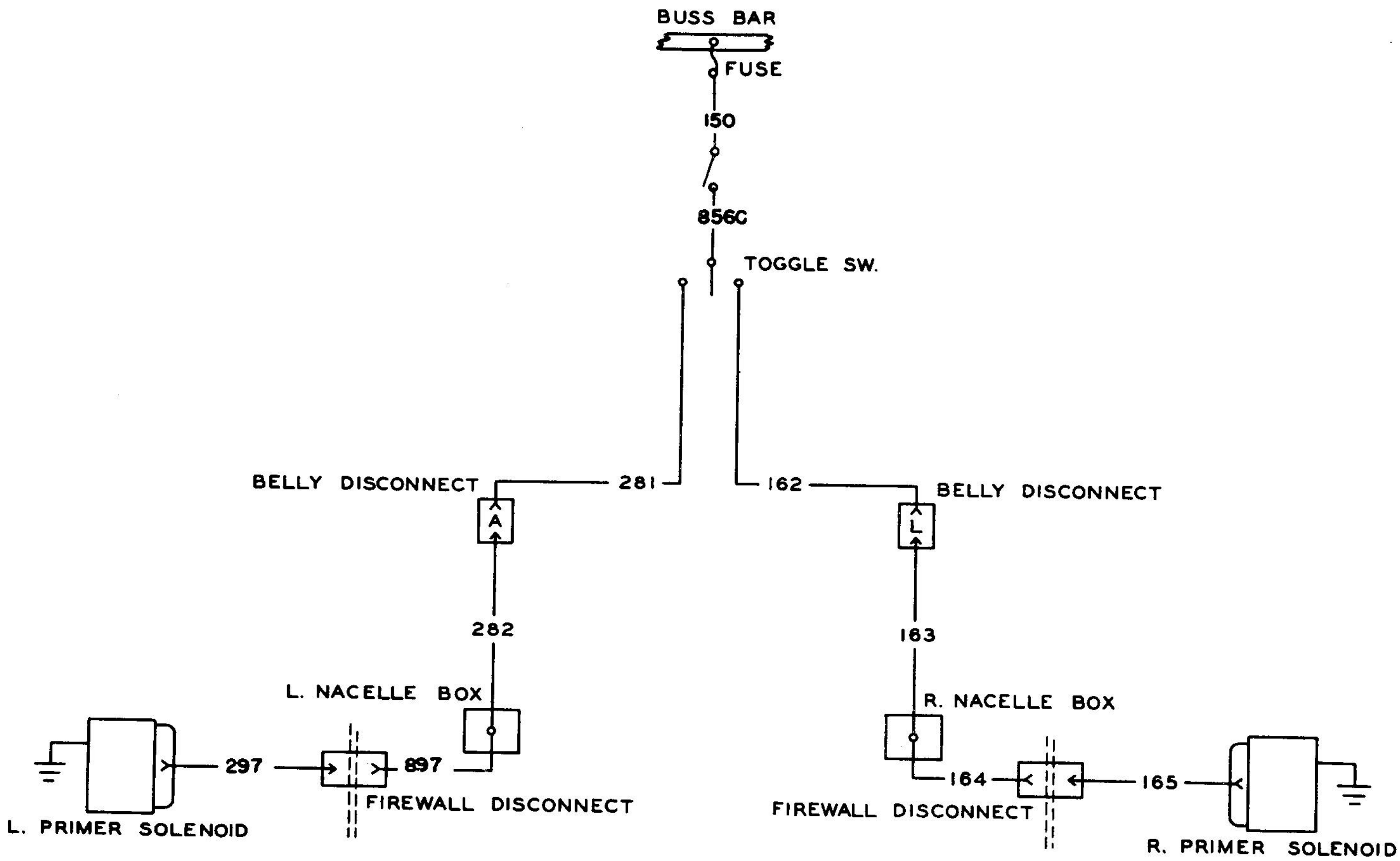
Trouble Shooting

1. Continuity of the circuit may be checked by point to point testing and by operation.
2. Check for burned out bulbs and poor ground connections at the light mounting screws.



OPTIONAL WIRING FOR D18S, D18C, & D18CT

Optional Interior Lighting



D18C Primer Circuit

ELECTRIC PRIMER CIRCUIT
D18C Only

The electric primers are controlled by a toggle switch located on the right sub-panel in the pilot's compartment. The primer units are located, one on each engine and consist of an electric solenoid that actuates a normally closed fuel valve.

Fuel pressure to the primer valves is obtained by means of the wobble pumps in the pilot's compartment.

Trouble Shooting

1. Primer solenoid valve inoperative: check the fuse at the sub-panel. Check the toggle switch operation. Test the continuity from the switch to the primer solenoid valve. Check the ground at the solenoid mounting.

2. Solenoid sticks in open position: check the toggle switch operation. Check the return spring in the solenoid valve.

3. If circuit is blowing fuse, check for ground between the fuse and the solenoid valve.

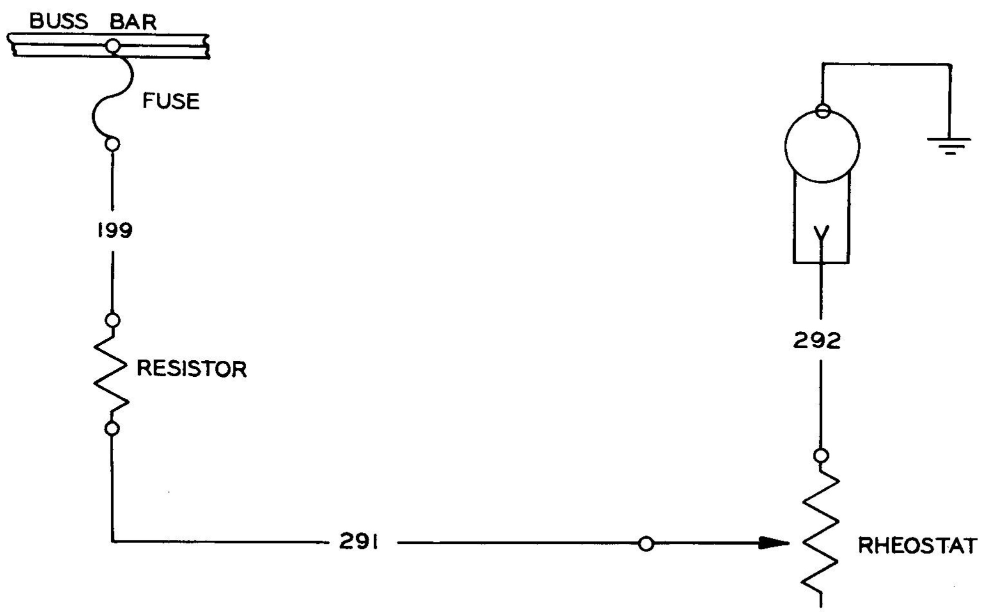
NO SMOKING & FASTEN SEAT BELT CIRCUIT

Two passenger instruction units operated electrically, are mounted on the aft side of bulkhead No. 5. The 'No Smoking' unit is installed to the left and the 'Fasten Seat Belt' unit is installed to the right of the pilot's compartment. Toggle switches located on the right sub-panel in the pilot's compartment control these units.

NOTE: On later airplanes, the two instruction units are combined in a single dual unit and is mounted aft of bulkhead No. 5 on the left side. The wiring numbers are the same as formerly used on the "No Smoking" circuit.

1. Instruction units inoperative: check the fuse in the sub-panel. Check the contacts at the switches. Check the switch operation.

2. Instruction unit dim when lighted up: check for one or more burned out bulbs. Check the connections at the lampholders. Test the continuity from the switch through the units to the ground using a 24 volt test light.



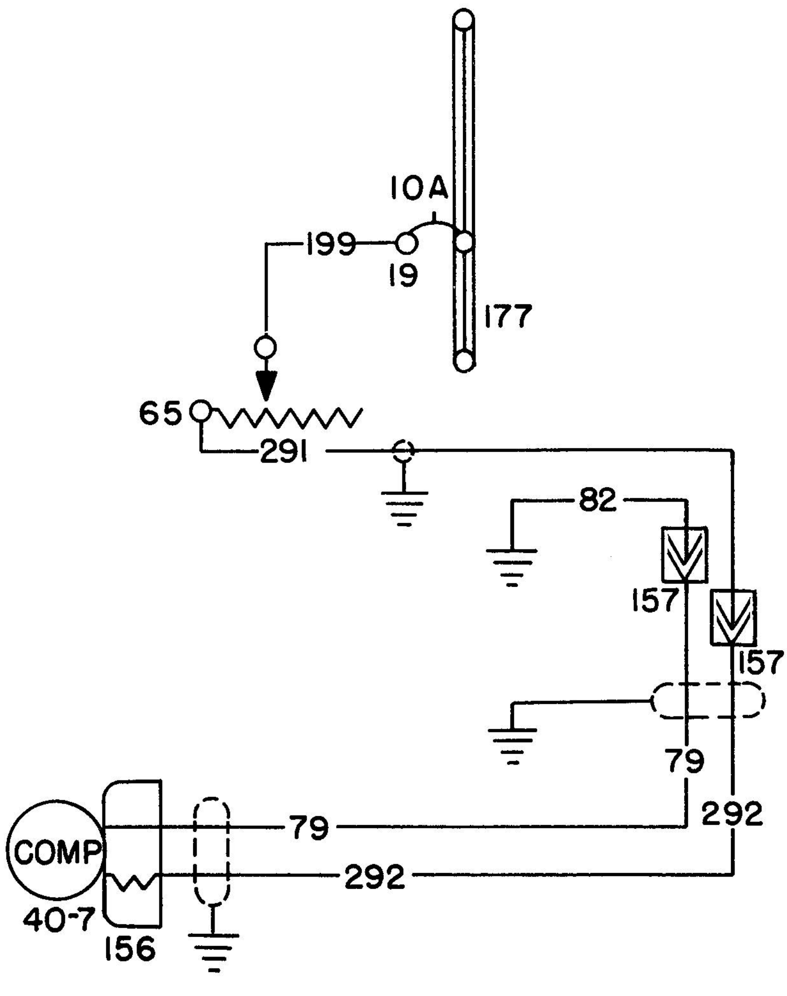
Compass Light Circuit

COMPASS LIGHT CIRCUIT

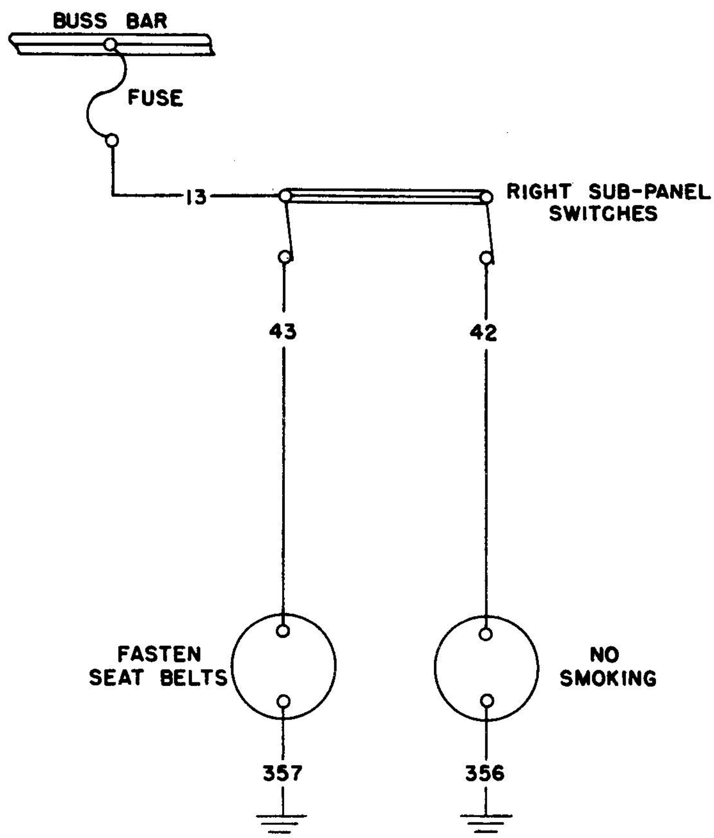
The compass light is controlled by a variable rheostat located on the left fixed instrument panel in the pilot's compartment. The fuse is located in the sub-panel. A fixed resistor is located in the circuit to lower the voltage to the amount required for the built-in 3 volt lamp in the compass.

Trouble Shooting

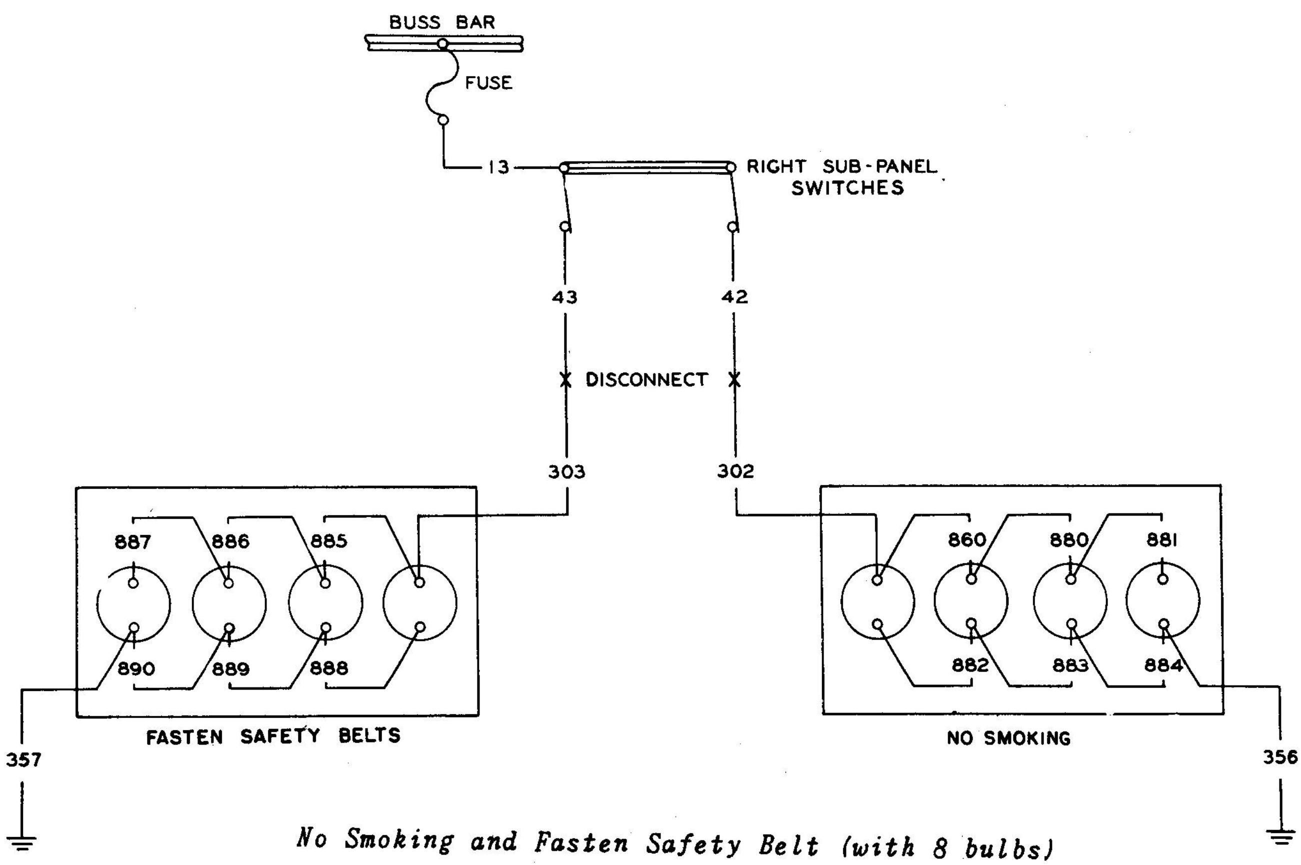
1. Compass light inoperative: check the fuse in the sub-panel. Check the compass light bulb. Test the continuity from the fuse through the resistor and the rheostat to the compass plug, using an ohmmeter. Check for secure ground between the compass and the instrument panel.



Compass Light Circuit
Aircraft Serials A-537 and After



No Smoking and Fasten Safety Belt (with 2 bulbs)



No Smoking and Fasten Safety Belt (with 8 bulbs)

FUEL LEVEL INDICATOR CIRCUIT

The fuel level indicator circuit consists of a transmitting unit in each tank, connected through a tank selector switch to an indicator. The transmitter unit is a variable rheostat with a movable arm actuated by a float in the tank. As the arm moves with the fuel level, the voltage output to the indicator is varied to give the indicator readings. Voltage at the rheostat arm in the transmitter varies from 0 to 4 or 5 volts. This is provided for by a resistor built into the indicator.

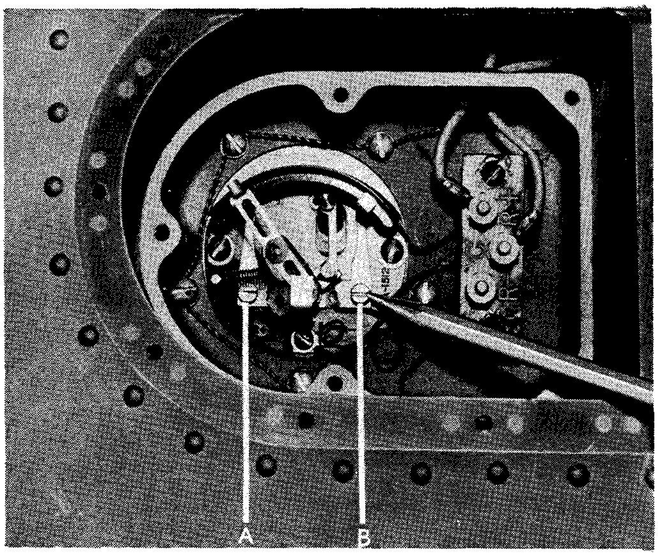


Fig. 82 Fuel Transmitter Unit Adjustment

FUEL INDICATOR ADJUSTMENT

Two men are required to make the fuel level indicator adjustments; one stationed in the pilot's compartment to check the indicator readings and one at the transmitter unit to adjust the rheostat. Read the indicator from directly in front, not from an angle. Adjustments may be made with the airplane in a three point position.

D18S TANK CALIBRATION

The fuel tank transmitter units are calibrated at 'Empty' and 'Full' positions. To calibrate for the 'Empty' positions: turn the selector switch to the desired tank. With the transmitter unit float resting flat on the bottom of the tank, (See D18CT Operating Limitations) turn 'Empty' adjustment screw 'A' (See Fig. 82) until the indicator reads '0'. To calibrate the front wing tank transmitter units (and nose tank, if installed) at 'Full' positions:

1. Raise the transmitter unit float until it rests lightly against the top of the tank. (The float can be reached through the tank filler neck.)
2. Turn the 'Full' adjustment screw 'B' until the fuel indicator pointer rests above the '10' mark by a distance equal to the width of the mark. The pointer is not set directly on the '10' mark. This compensates for the difference between holding the float at a 'Full' position and a normal full tank position.

To calibrate the two wing rear tank transmitting units:

1. Raise the float until its centerline is $1\frac{1}{2}$ inches from the top of the tank. (A jig may be used to advantage for this measurement.)
2. Turn the 'Full' adjustment screw 'B' (See Fig. 66) until the indicator pointer rests on the '10' mark.

D18C TANK CALIBRATION

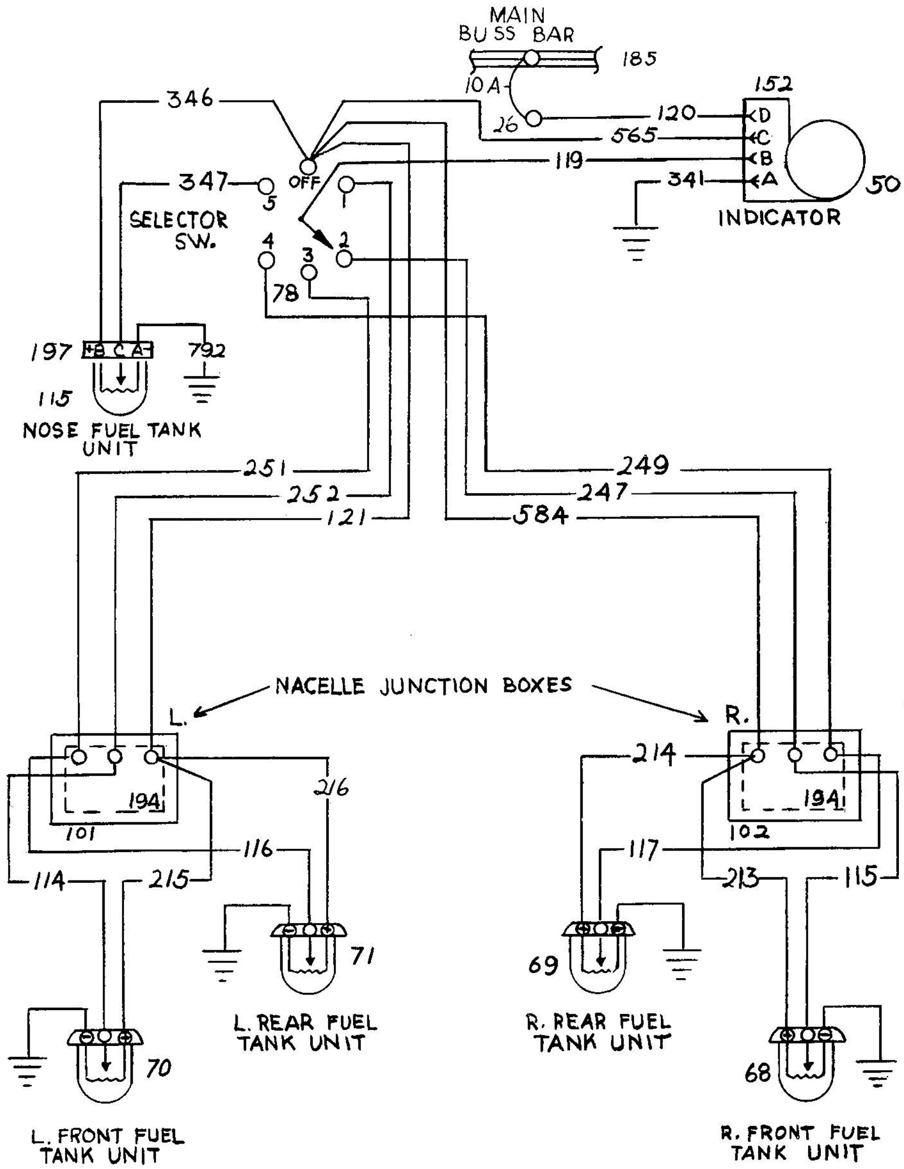
The fuel tank transmitter units are calibrated to 'Empty' position with three gallons of fuel in the tank and the float resting normally at this level. For full position use the same procedure as outlined for the D18S.

Service Note

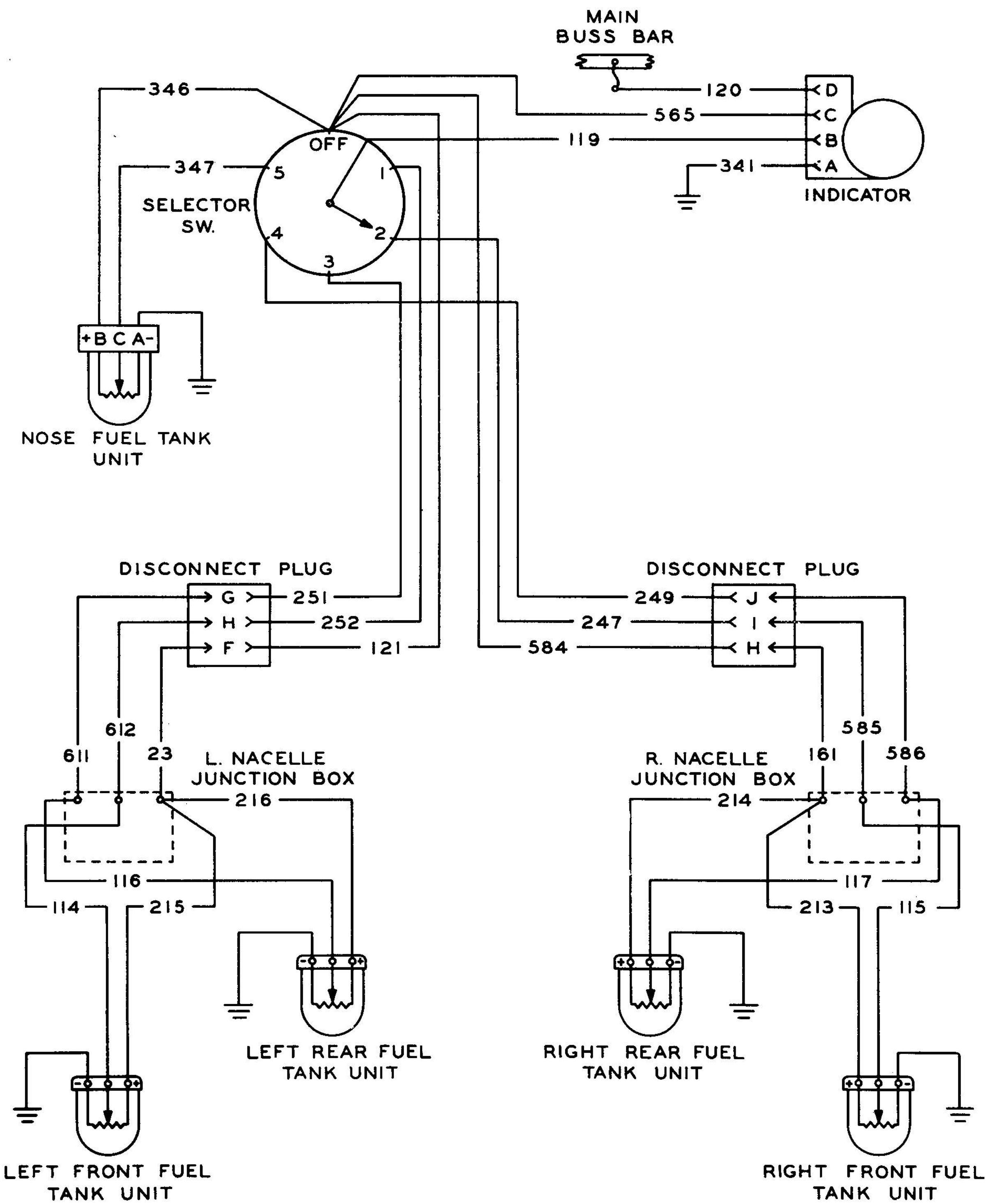
Do not attempt to make adjustments by bending the pointer or float pivot arm.

FUEL PRESSURE WARNING CIRCUIT

Warning of low fuel pressure is given by two red indicator lights, located on the



Fuel Level Indicator Circuit
Aircraft Serials A-402 and After



Fuel Line Indicator Circuit

pilot's instrument panel. Each light is operated by a pressure unit connected to the fuel pressure fitting on the carburetor. The pressure unit consists of two separate bellows-like chambers, one for fuel pressure and the other for atmospheric pressure. The chambers are divided by a diaphragm to which the electrical contacts are attached. A set of stationary grounded contacts are mounted opposite to the movable contacts on the diaphragm. When the fuel pressure in the unit drops below (3 to 5 pounds for the D18S and 11 to 13 pounds for the D18C), the contacts close, completing the circuit through the indicator light on the instrument panel. The circuit is connected to power at the sub-panel fuse and completed through the indicator light to the ground connections at each pressure unit.

FUEL PRESSURE INDICATOR ADJUSTMENT

Remove the cover from the pressure unit. Turn on the master battery switches and fuel tank selector valves. With the wobble pump, build up a pressure of 11 to 12 pounds on the indicator instrument. Stop pumping and allow the pressure to decrease, noting the pressure reading on the instrument at the instant the warning light comes on. Turn the adjustment screw on the pressure unit (See Fig. 83) until the indicator light burns at between 3 to 5 pounds for D18S, and 11 to 13 pounds for D18C.

Trouble Shooting

1. Both indicator lights inoperative:

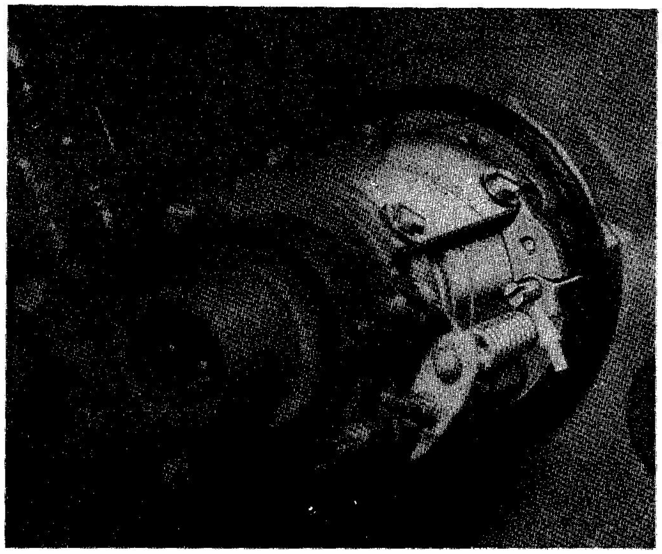


Fig. 83 Fuel Pressure Indicator.

check the fuse at the sub-panel. Test continuity between the fuse and the indicator light terminal.

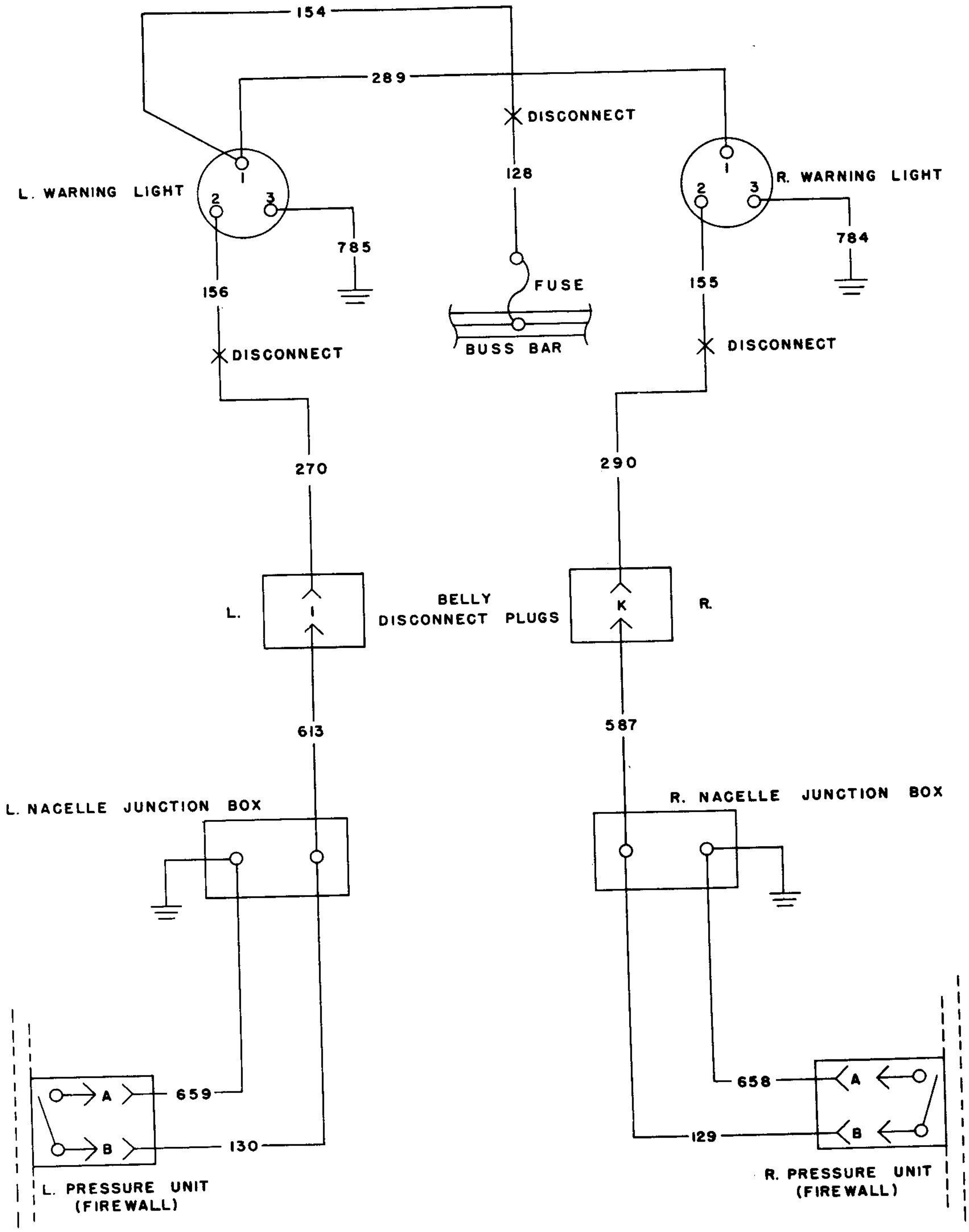
2. One indicator light inoperative: check the indicator light bulb. Test continuity from the indicator light terminal to the pressure unit. Check the pressure unit contacts. Check the ground connection at the pressure unit.

3. Indicator light does not go out: test for ground at the lampholder. Test the ground between the indicator light and the pressure unit. Check the pressure unit contacts.

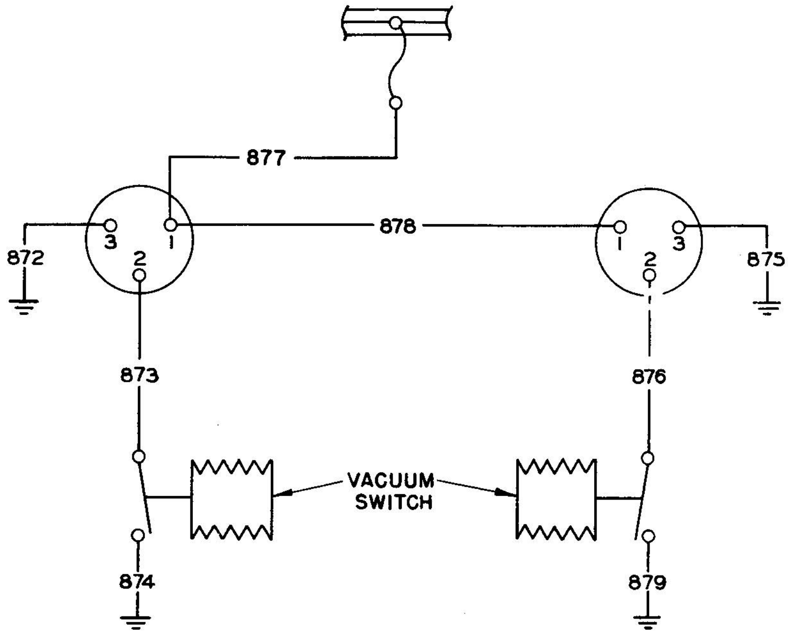
4. Fuse blowing: test for ground between the fuse and the indicator lights.

Service Note

Do not allow the pressure unit cover to ride against the contact assembly when reinstalling.



Fuel Pressure Warning Circuit



Vacuum Light Circuit

VACUUM WARNING LIGHT CIRCUIT

The two vacuum warning lights on the panel in the pilot's compartment are controlled by the two vacuum switches mounted on the fore side of bulkhead 3A.

VACUUM SWITCH ADJUSTMENT

These switches are set to close on a vacuum of 3 in. Hg. Remove the back cover and connect the unit to a vacuum test system. Move the adjusting screw slowly until the contacts close on 3 in. Hg. as indicated by the test system.

Trouble Shooting

1. Warning lights inoperative: check the fuse at the sub-panel.
2. Check the lamps.
3. Test the continuity from the fuse to vacuum switches.
4. Test the continuity from the vacuum switches through the ground. Check the ground connection at lampholder.

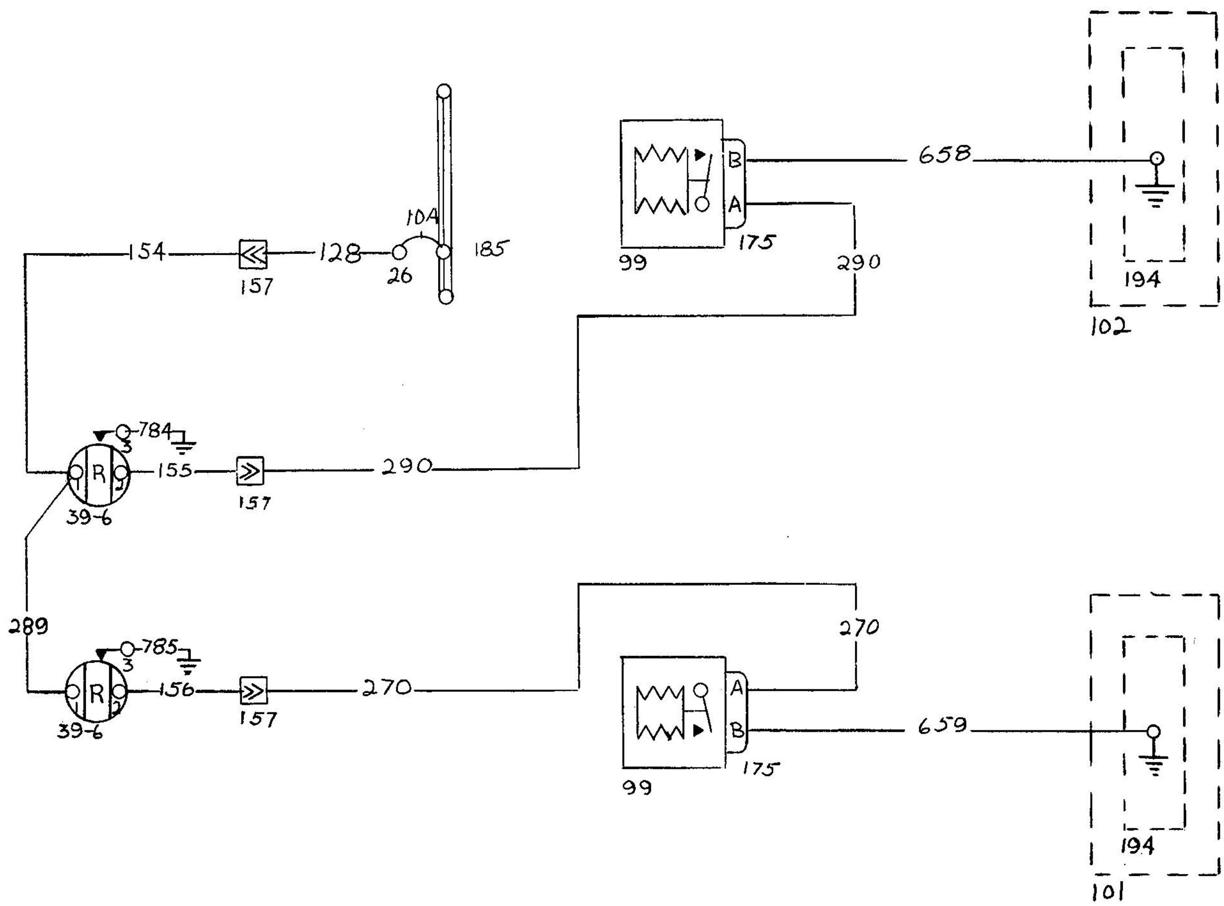
FIRE DETECTOR CIRCUIT D18C-T

The fire detector circuit consists of sixteen dual fuse units; eight for each engine and two indicator warning lights, mounted on the pilot's right sub-panel. Provision is made to test the lights by pressing the cap of the lampholders.

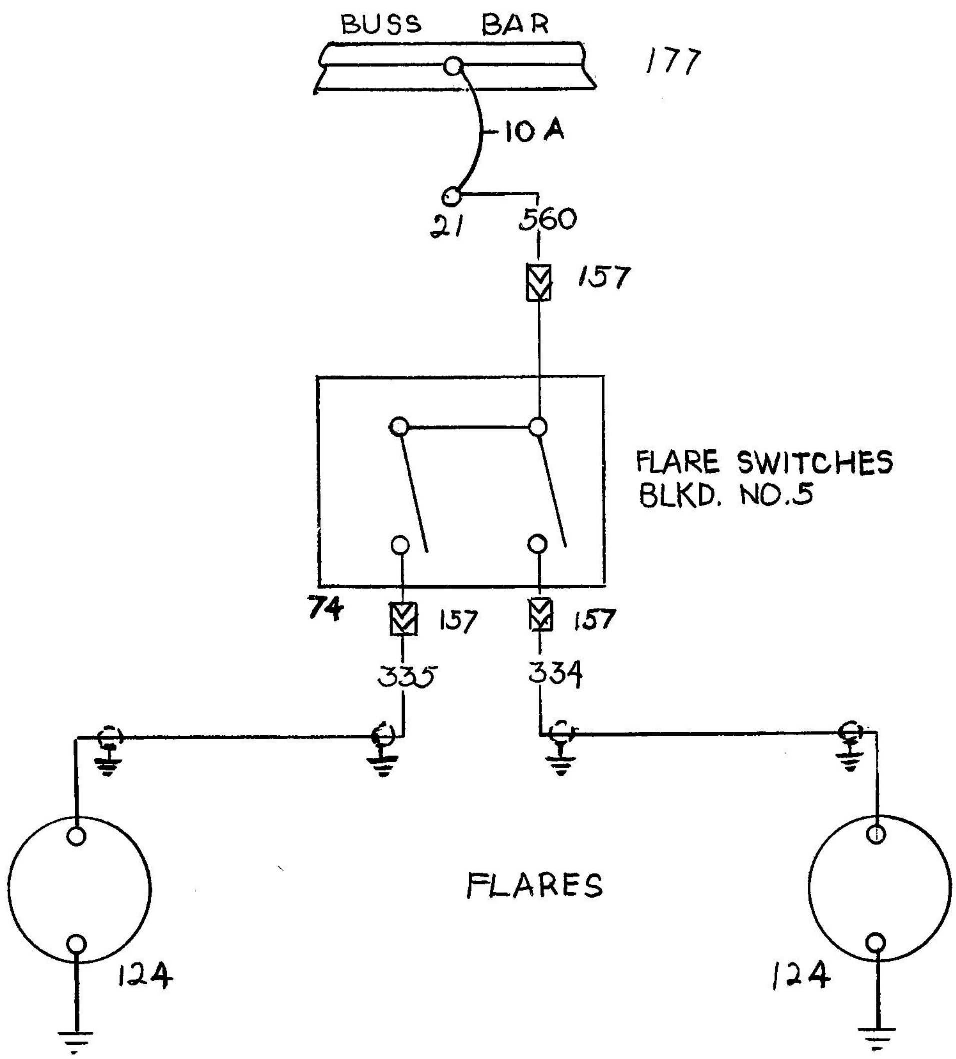
The two warning lights remain 'Off' until high temperatures melt one or more of the fire fuses in the units. These fuses melt at a temperature of approximately 380° F.

Trouble Shooting

1. Indicator warning lights inoperative: check the fuse at the sub-panel. Test continuity from the lampholder terminal No. 3. Using an ohmmeter, test



Vacuum Light Circuit
Aircraft Serial A-537 and After



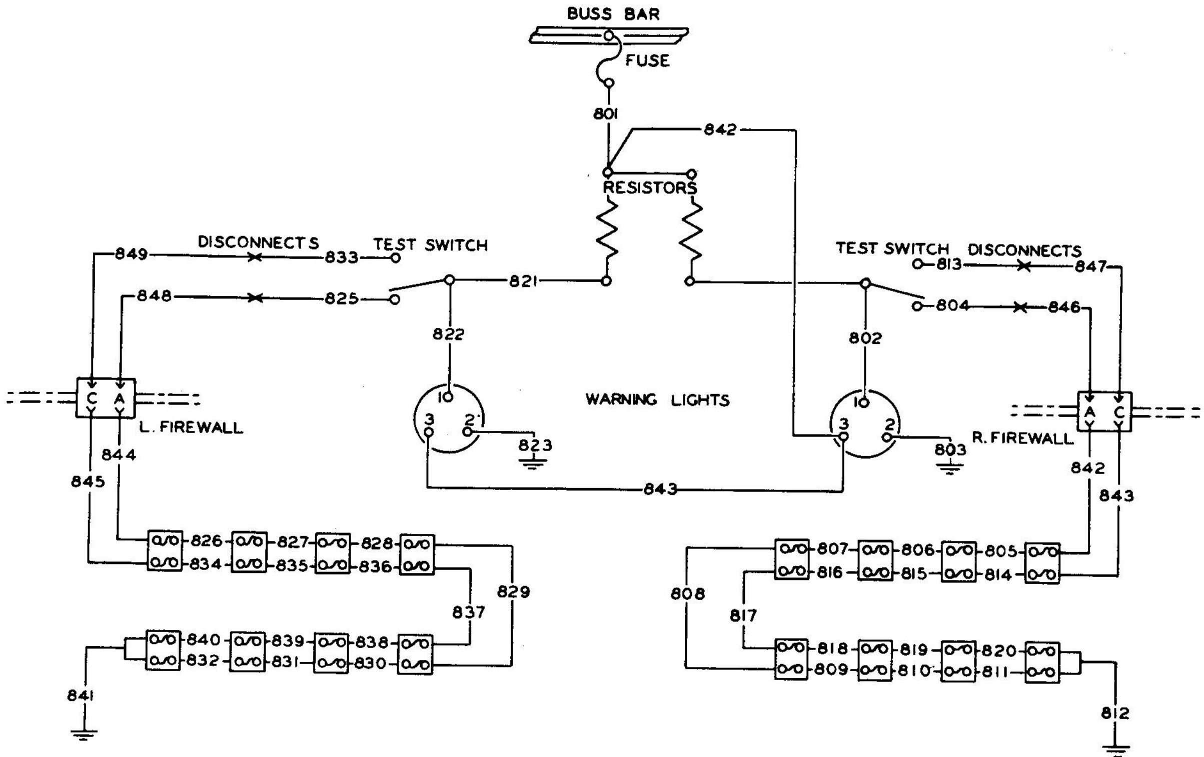
Flare Circuit
Aircraft Serials A-537 and After

Insert this page after Page 104B.

The correct description of the "FLARE CIRCUIT" follows:

FLARE CIRCUIT

Two parachute-type flares, located between No.10 and 11 bulkheads are provided with the airplane. A master and two flare switches are mounted on No. 5 bulkhead above and directly behind the pilot. The master switch is locked in the "OFF" position by the hinged switch cover which is safetied with very light copper safety wire. The safety wire is easily broken, allowing the cover to be raised, permitting the master switch to be turned on, energizing the flare circuit, and uncovering the individual flare switches.

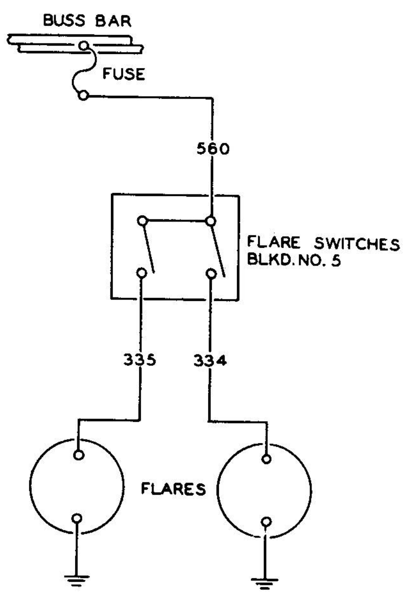


D18CT Fire Detector Circuit

from the fuse through the 125 ohm resistor to terminal No. 1 at the lampholder. Test from the ground to the terminal No. 2 at the lampholder.

2. One warning light stays on: test for open circuit from the toggle switch through the fire units to ground using a battery powered test light.

3. Circuit blowing fuses: test for ground with an ohmmeter, from fuse through the resistor to the lampholder.



Flare Circuit

FLARE CIRCUIT

Two parachute type flares, located between No. 10 and 11 bulkheads are provided with the airplane. A double switch to release one or both flares is located on No. 5 bulkhead above and directly behind the pilot. The flares are wired to a common fuse with the landing light switch.

Trouble Shooting

1. Flares will not release: check fuse. Check the connections at the fuse. Test for open circuit.

CAUTION: Do not close flare switches

when the master switches are "On".

LANDING LIGHT CIRCUIT

A retractable landing light is installed in each outboard wing section of the airplane. Each light assembly contains a retractable motor and switch contacts. A small solenoid provides a braking action by operating against the armature of the retracting motor. Toggle switches in the pilot's compartment provide separate control for each landing light.

When the toggle switch is placed in 'Down' position, the circuit is completed to the motor, energizing and lifting the solenoid brake, and lowering the landing light. The light comes on and the motor continues to operate until the pre-set travel is opened. The light remains on until retracted. When the toggle switch is placed is 'retract' position, the circuit is completed to the opposite winding, the solenoid brake releases, and the light assembly is retracted. Upon reaching the fully retracted position, the circuit is opened to the light and to the motor. The light assembly stops in a position flush with the wing, the solenoid brake is against the motor armature and the light is off.

LANDING LIGHT ADJUSTMENT

The extended position of the light may be regulated by adjusting the limit switch contact. (See Fig. 84) The light should extend a distance of $11\frac{1}{2}$ inches, measured from the lower aft side of the lens rim to the aft edge of the light housing in the wing.

Trouble Shooting

1. Landing light inoperative: check the fuse at the sub-panel. Disconnect the wiring at the center section disconnect plug. With switch in 'Down' position and using a 24 volt test light, test pin 5 at the disconnect plug to the ground. If the test light comes on it will indicate that the inboard wiring is all right. Test continuity from pin '5' at the outboard wing plug terminal 'B' at the landing light. Check the landing light switch contacts. Check the ground connection at the landing light.

2. Landing light will not retract: check the sub-panel fuse. With switch in retracted position and using a 24 volt test light, test from pin '4' at center section plug to the ground. Test from pin '4' at the outboard wing plug to terminal 'A' at the landing light. Check contacts at the landing light. Check the ground connection at the landing light.

Service Note

The switch contact points in the landing light must be kept clean to avoid arcing, pitting, and subsequent trouble.

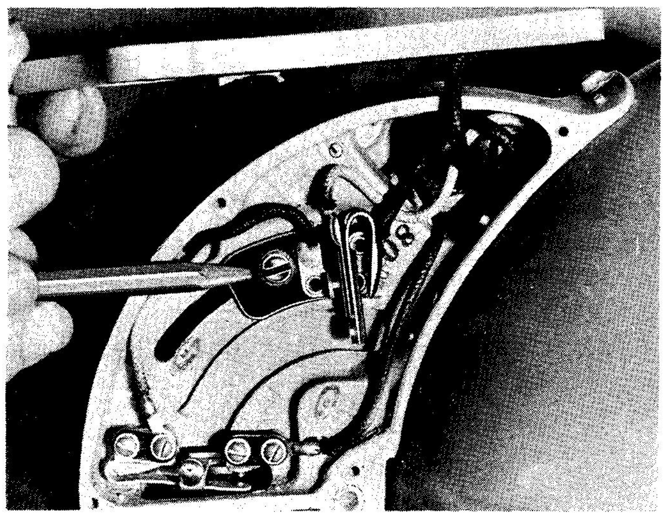
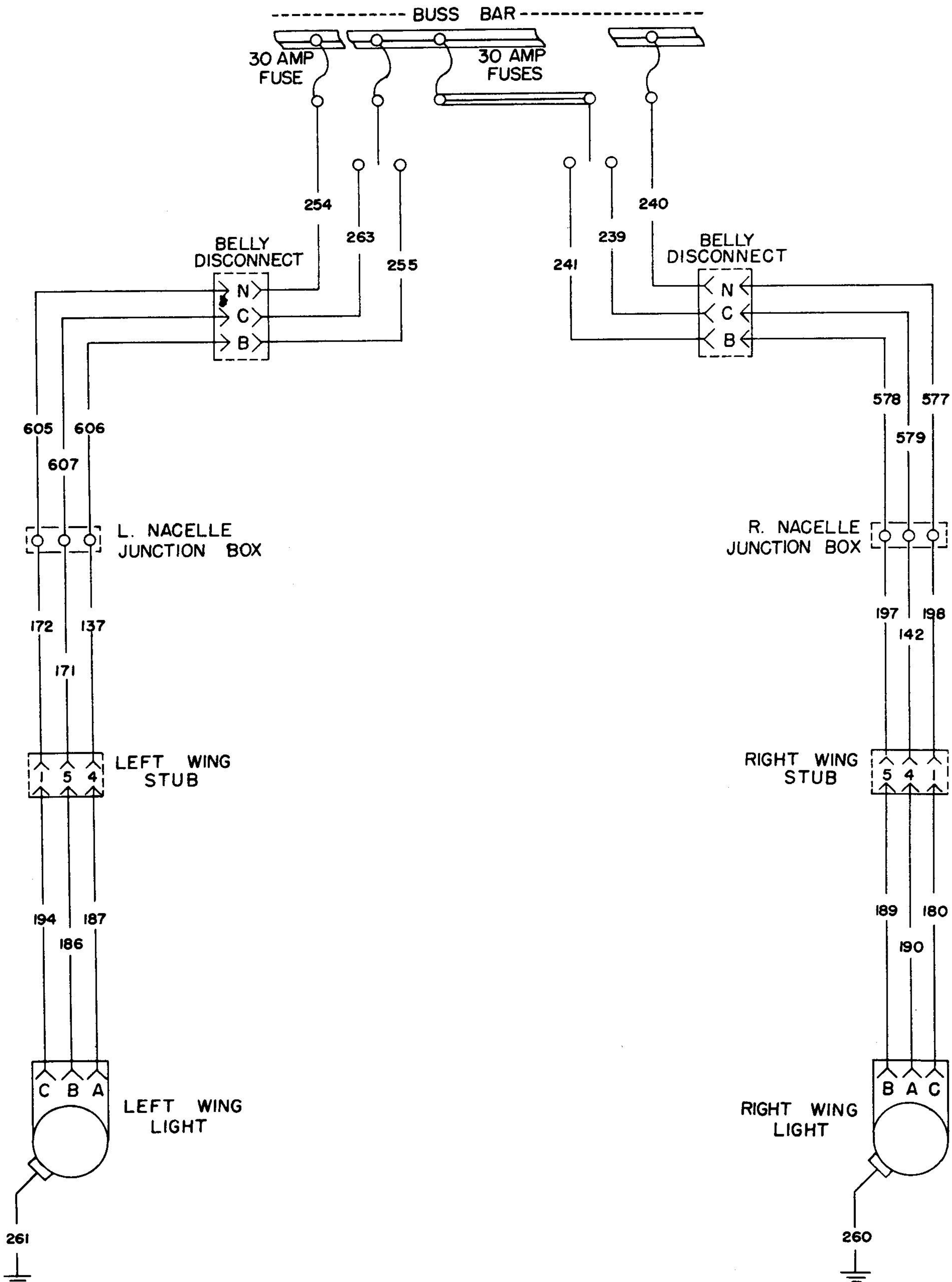


Fig. 84 Landing Light Adjustment

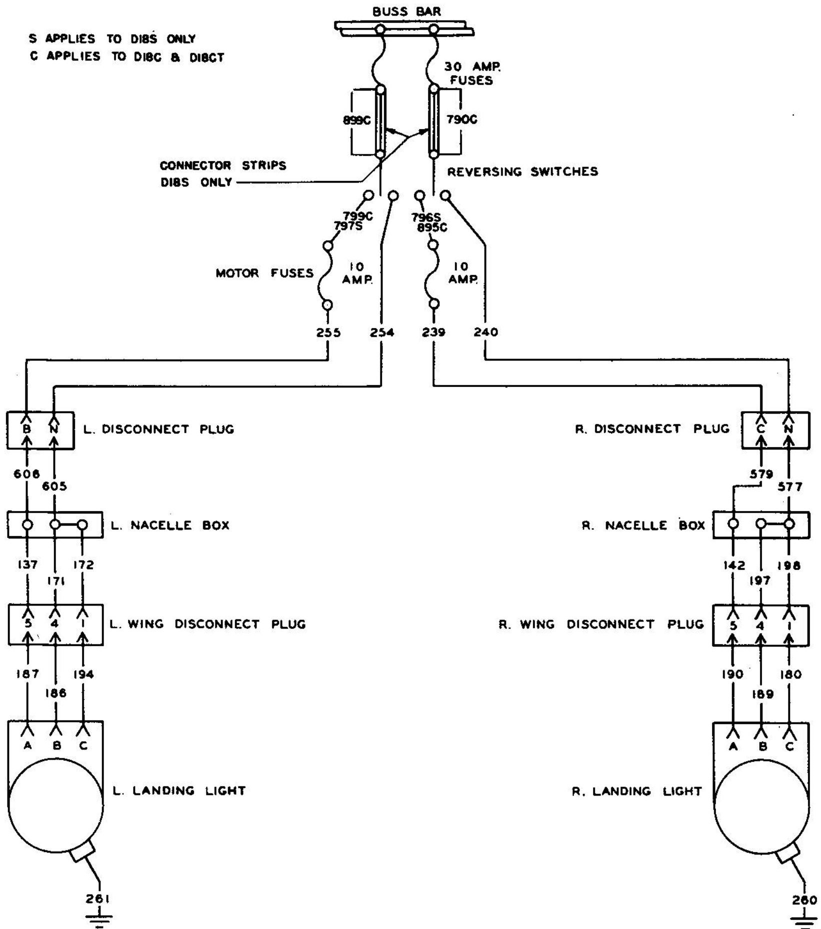
ALTERNATE LANDING LIGHT CIRCUIT

An alternate landing light circuit is included in this section to provide for turning off the lamp assembly while it is in an extended position.

Operation of the landing light units is the same as given in the above circuit with the exception of control of the lamps from the toggle switch in the pilot's compartment.



Landing Light Circuit (without light cut off in down position)



Alternate Landing Light Circuit

Trouble Shooting

1. Landing light inoperative: check both the 10 and 30 ampere fuses at the sub-panel. Disconnect the wiring at the center section plug. With switch in 'Down' position and using a 24 volt test light, test pin 4 at the disconnect plug to ground. If test light comes on, it will indicate that the inboard wiring is all right. Test the continuity from pin 4 at the outboard wing plug to terminal 'B' at the landing light. Check the landing light switch contacts. Check operation of the switch. Check the ground connection at the landing light.

2. Landing light will not retract: check the sub-panel fuses. With switch in retract position and using a 24 volt test light, test from pin 5 at the outboard wing plug to terminal 'A' at the landing light. Check the contacts at the landing light. Check the ground connection at the landing light.

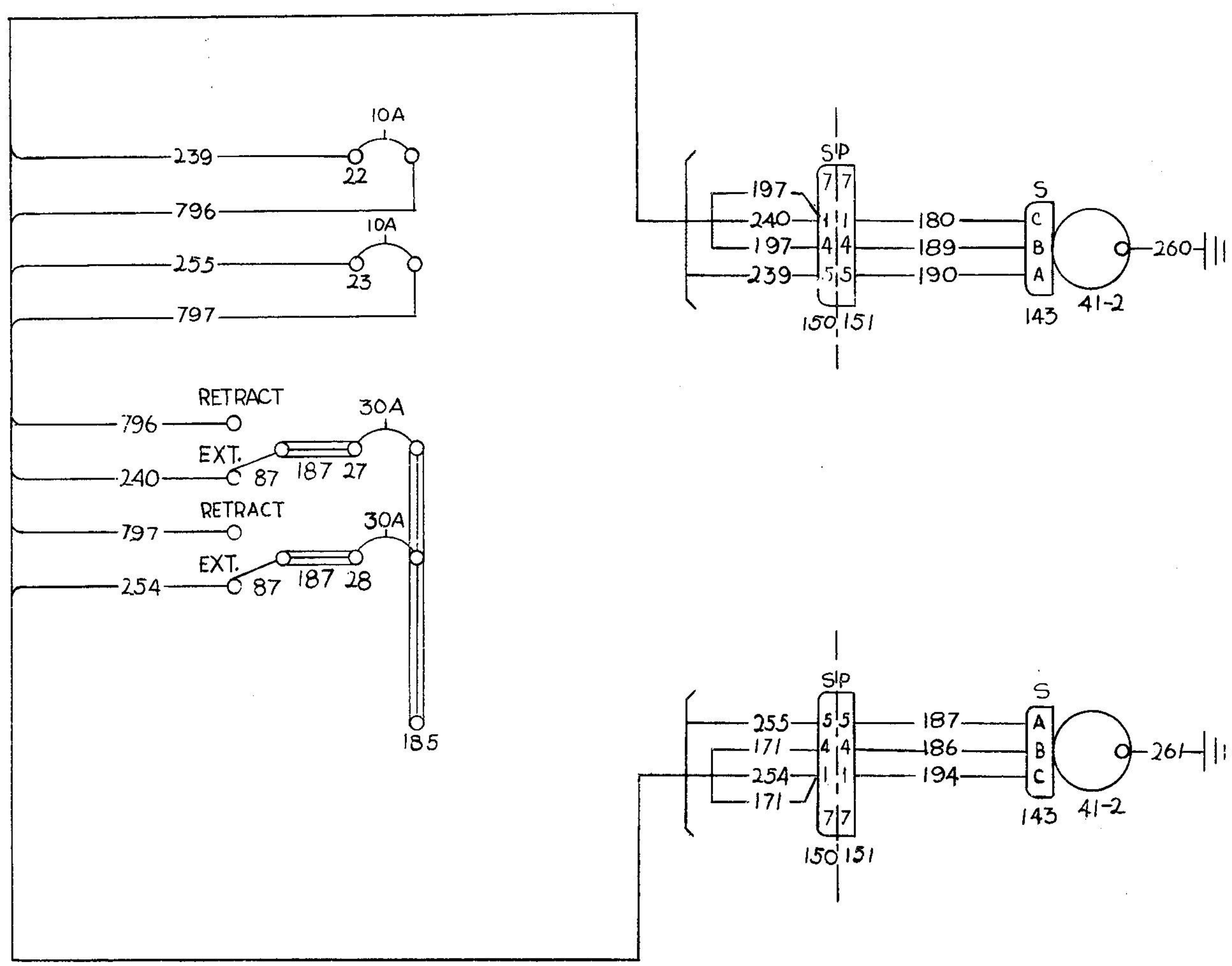
3. Landing light does not come on: check the continuity between the fuse and terminal 'C' at the landing light. Check the landing light bulb. Check the ground at the landing light.

Service Note

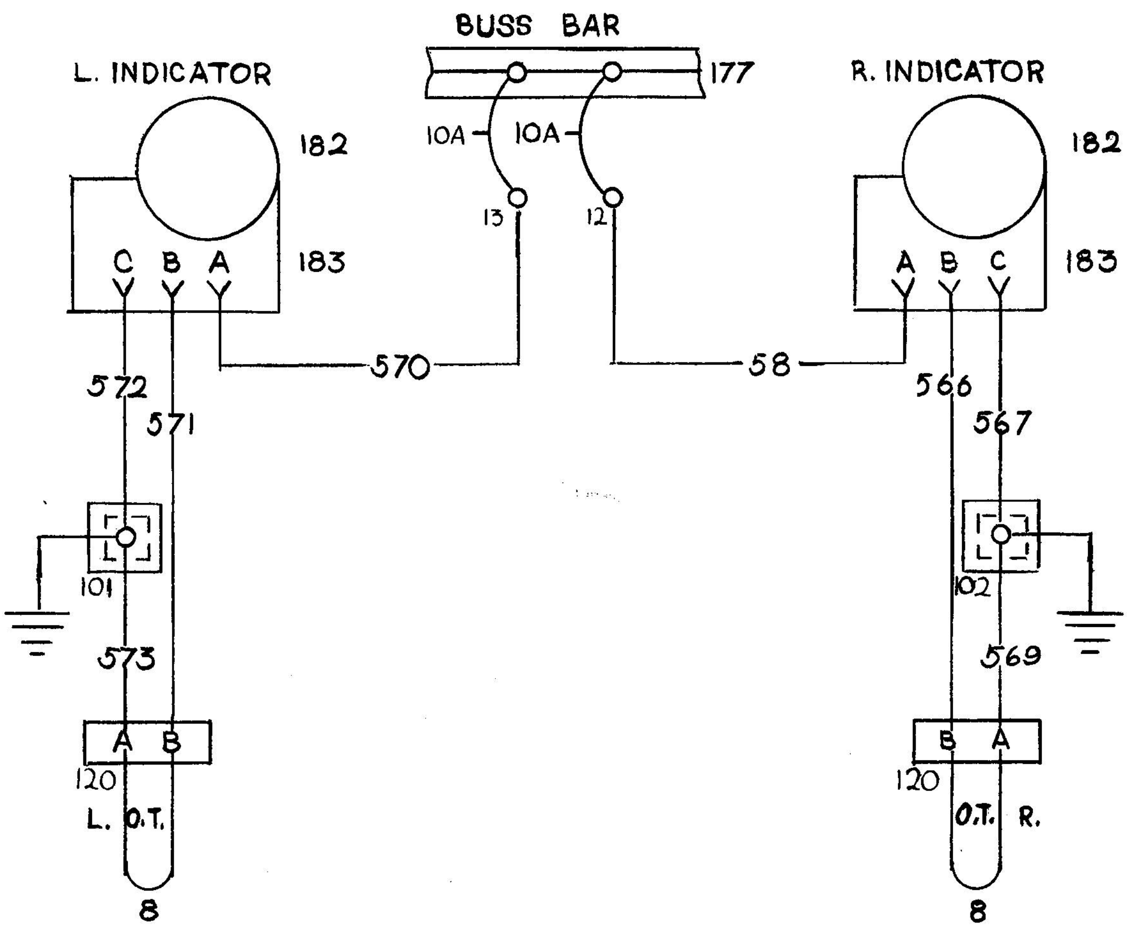
The switch contact points in the landing light must be kept clean to avoid arcing, pitting, and subsequent trouble.

OIL TEMPERATURE CIRCUIT

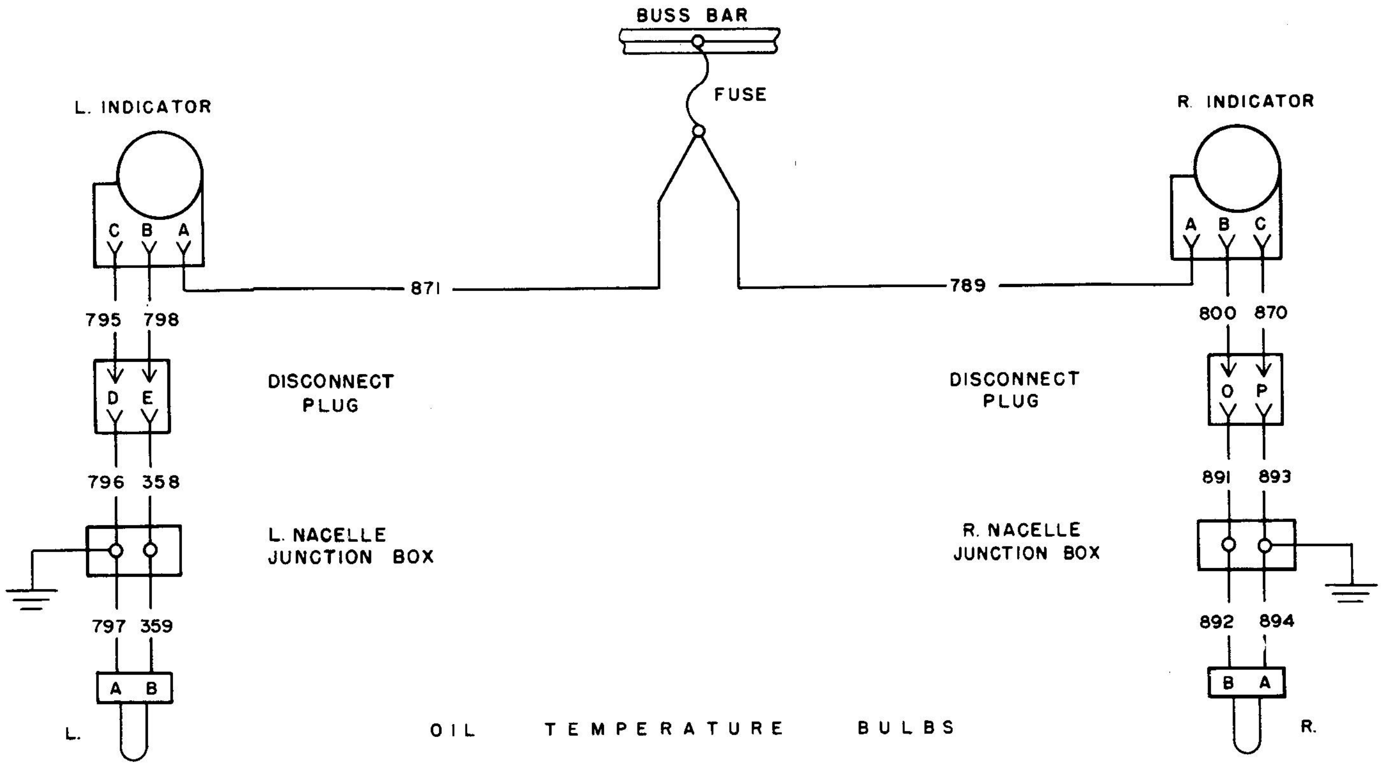
The oil temperature instrument is a resistance type thermometer consisting of



Landing Light Circuit
Aircraft Serials A-402 and After



Oil Temperature Circuit
Aircraft Serials A-537 and After



Oil Temperature Circuit

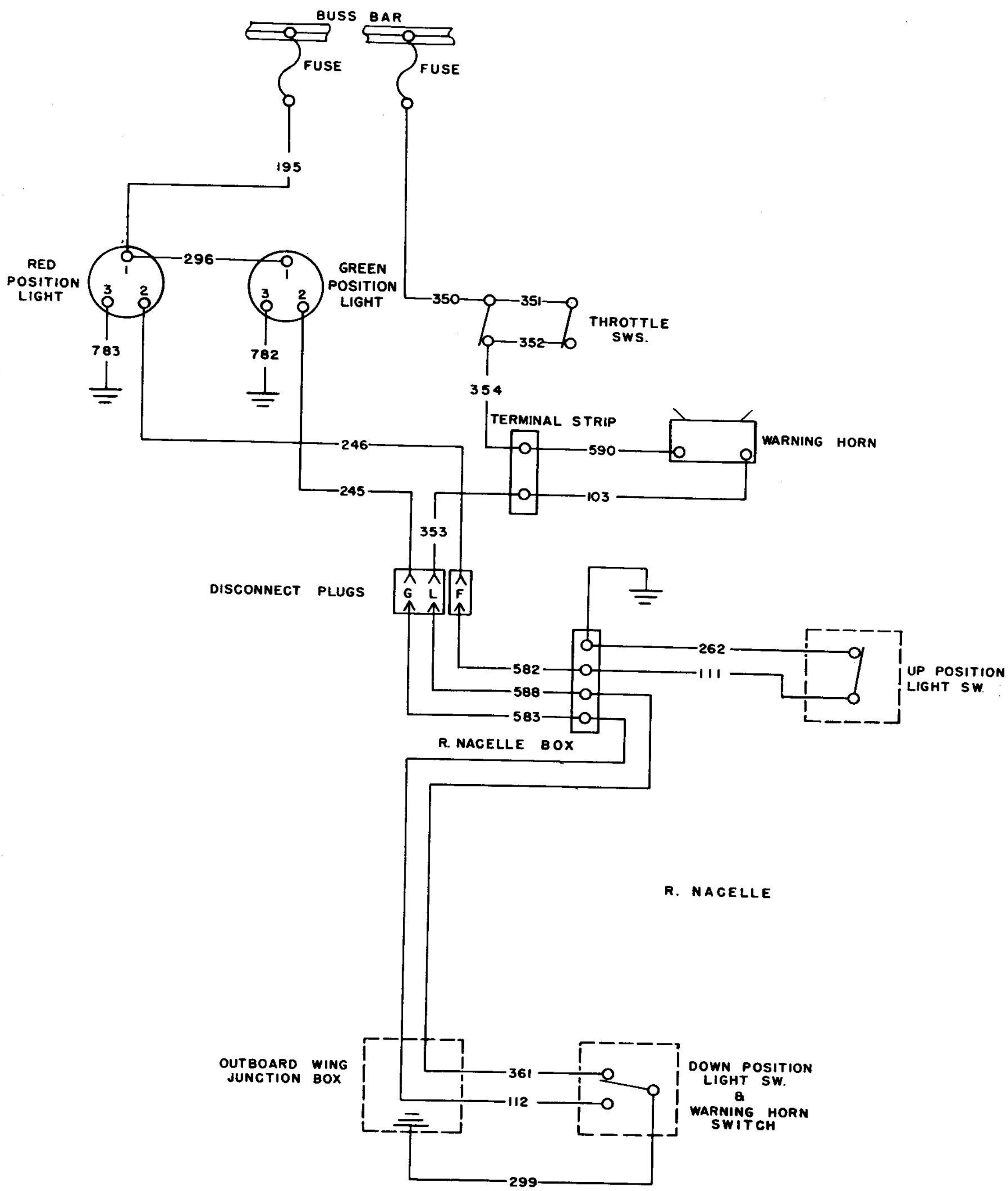
a sensitive element bulb inserted in the chamber provided on the main oil line in each landing gear nacelle.

Trouble Shooting

1. No reading at indicator: check the sub-panel fuse. Test the continuity from the fuse to 'A' terminal of the indicator. Check the indicator.

2. Indicator off scale at low temperature end: test for ground between 'B' terminal of indicator and 'B' terminal of resistance bulb; from 'C' post of indicator to the ground terminal and from 'B' terminal of the resistance bulb to the ground terminal. Test the ground connection of the terminal. Make an ohmmeter test for open circuit in the temperature bulb.

3. Indicator reading high or low: check for poor connection at the fuse or between the indicator and the temperature bulb. Test for ground on terminal 'B' indicator and terminal 'B' at temperature bulb, using an ohmmeter on the high resistance scale. (A very small leakage to the ground on these wires will affect the indicator reading.)



Warning Horn and Position Light Circuit

LANDING GEAR WARNING HORN CIRCUIT

A warning horn, located under the co-pilot's seat, sounds a warning if the engine throttles are closed with the landing gear in the retracted position. Three micro switches control this circuit. Each engine throttle actuates one normally open switch located in the control pedestal. The other switch, actuated by the landing gear slide assembly, is installed in the right nacelle; this double-throw switch which also operates in the landing gear green position light circuit, connects to the warning horn at the 'C' (normally closed) terminal. The warning horn connects through the throttle switches to the fuse in the sub-panel, then through the nacelle switch to the ground.

THROTTLE SWITCH ADJUSTMENT

The throttle warning switch is set so the warning horn will sound when the manifold pressure reads 12 inches of HG, or less when flying at 1000 feet above the ground, with the propeller in low pitch. To make this adjustment the airplane should be flown at approximately 1000 feet above the ground area. Slowly close the throttle until the manifold pressure reads 12 in. Hg. Mark a line on the control pedestal, even with the forward edge of the throttle arms. Land the airplane and raise on jacks until the main and tail wheels clear the floor. Manually retract the landing gear until the green warning light ceases to burn. Align the throttles with the marks placed on the pedestal and adjust the throttle switches by loosening the screws securing the throttle switches (located directly beneath the throttles) to the pedestal bracket, and with the electrical system turned on, move the switches until the warning horn sounds. Open the throttle approximately 1/32 inch past the mark, to see if the horn stops sounding. If the horn ceases to sound, the switches are correctly set.

NOTE: If a test light is available, the airplane need not be raised on jacks. Connect the test light through the switch and adjust the switch so the light turns on instead of the horn sounding.

Trouble Shooting

1. Horn inoperative: check the fuse in the sub-panel. Remove the fuse and test continuity to the horn. Check the operation of the throttle switches. Test from the nacelle switch to the ground.
2. Circuit blowing fuse: test for ground between the fuse and the warning horn.

LANDING GEAR POSITION LIGHT CIRCUIT

Two indicator lights, one red and one green, located in the pilot's left sub-panel, register the full up or down position of the landing gear. The lights are controlled by micro switches at the slide tube in the right nacelle. When the landing gear is in its up position, the normally open switch is operated, and closes the circuit to the red indicating light. As the gear is lowered, the switch opens the circuit leaving both lights off until at the down position the lower switch is actuated and the circuit is closed to the green indicating light. Both lights are connected to power at the sub-panel fuse with a single wire. The red light is connected through the upper switch to ground; the green light through the lower switch to the ground. The lower switch, a double throw type, also operates in the warning horn circuit and the terminals are marked 'O' and 'C'. The green light wire connects to the 'O' (normally open) terminal.

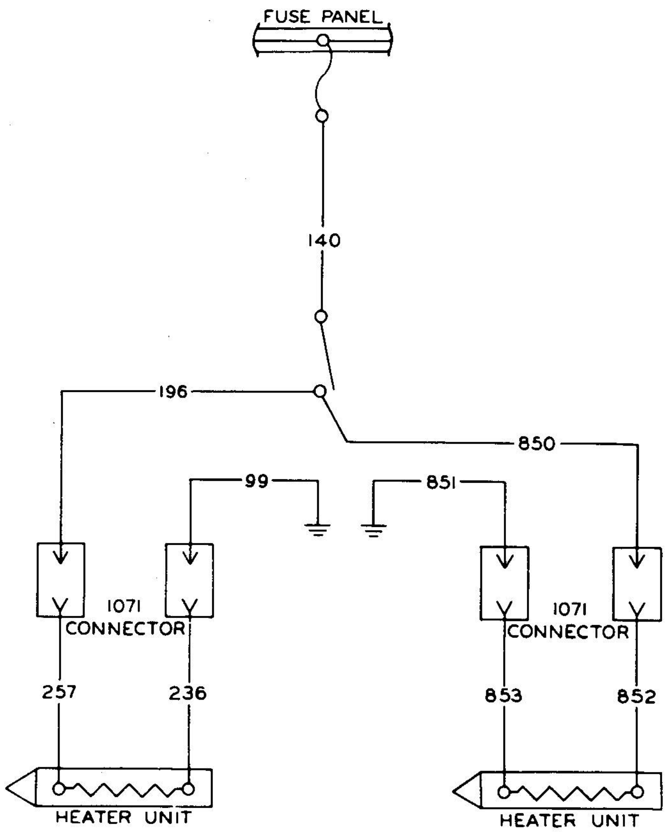
Trouble Shooting

1. Both lights inoperative: check fuse. Test the continuity from the fuse to the lampholders.
2. One light inoperative: check the lamp and the lampholder. Check the operation of the switch. Test the continuity from the lampholder to the switch and from switch to the ground. Test for ground between the light and the switch.
3. Circuit fuse blows: test for ground between the fuse and the lights.

PITOT HEAT CIRCUIT

The pitot mast heads are equipped with an electrical resistance heater for the purpose of ice elimination.

Operation of the toggle switch in the pilot's compartment completes the circuit from the sub-panel fuse, through the heater elements to ground.



Pitot Heat Circuit

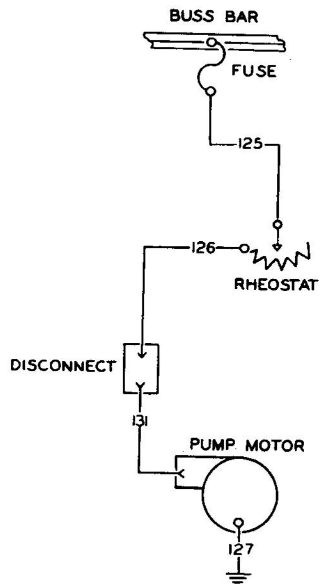
Trouble Shooting

1. Heater inoperative: check the sub-panel fuse. Check the toggle switch operation. Test the continuity of the circuit with an ohmmeter. Check the ground connection.

2. Circuit blowing fuse: test the circuit for ground. Test the heater element for ground. (Element should have 2 or 3 ohms resistance.)

ANTI-ICER CIRCUIT

A motor driven pump is controlled by a variable rheostat located on the right side of the instrument panel. The rheostat has been painted with a red line, indicating the rheostat position for slow speed operation of the anti-icer system. Sufficient current will flow through the rheostat when the indicator is placed on the red line to operate the pump motor. Whenever the rheostat is set past the red line, current flow is diminished to such an extent that the motor will not operate. If this condition occurs, the motor will heat and may eventually burn out.



Anti-Icer Circuit

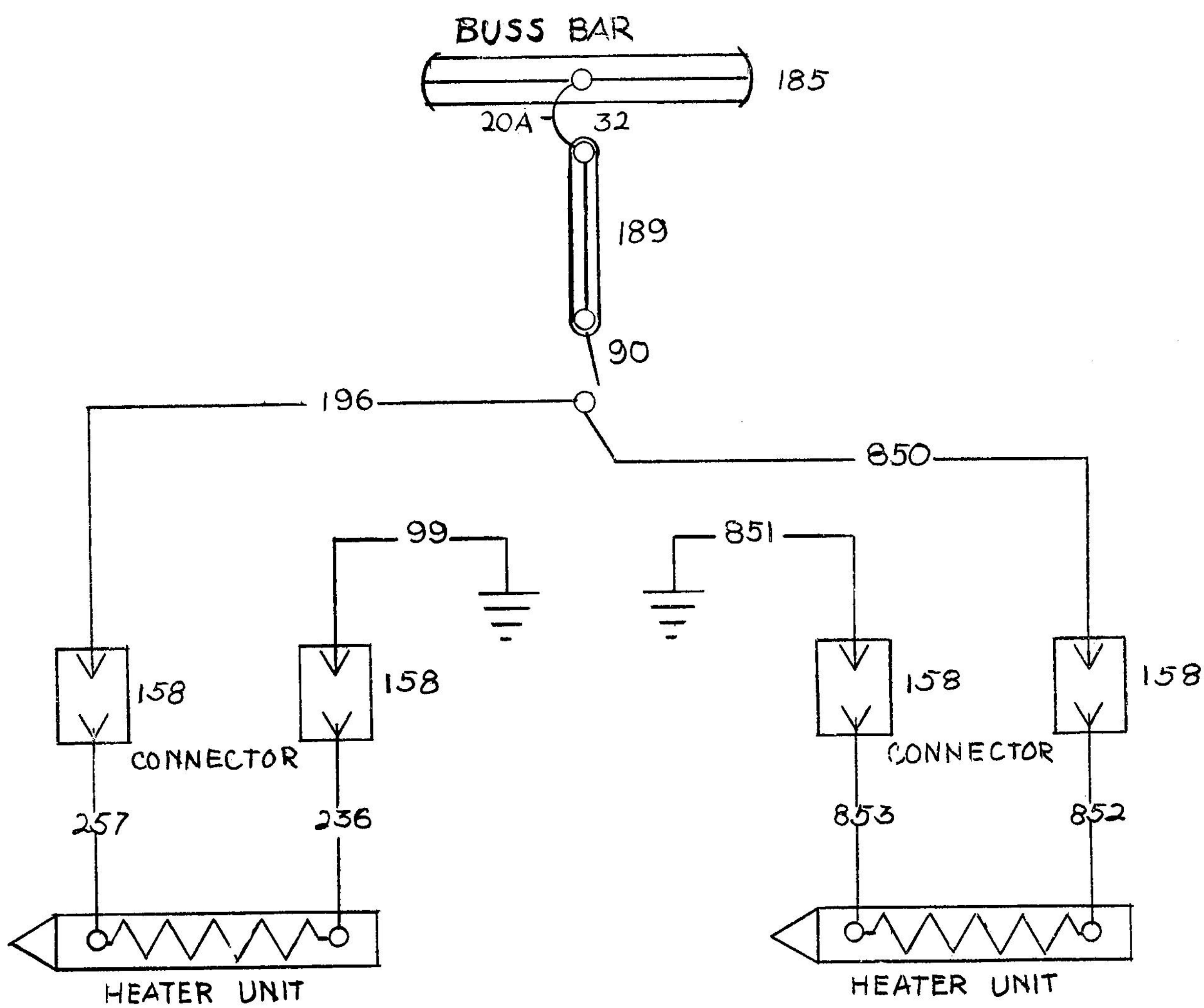
Trouble Shooting

1. Motor inoperative: check the fuse in the sub-panel. Test the continuity from the fuse through the rheostat to the pump motor using an ohmmeter. Check the ground at the motor.

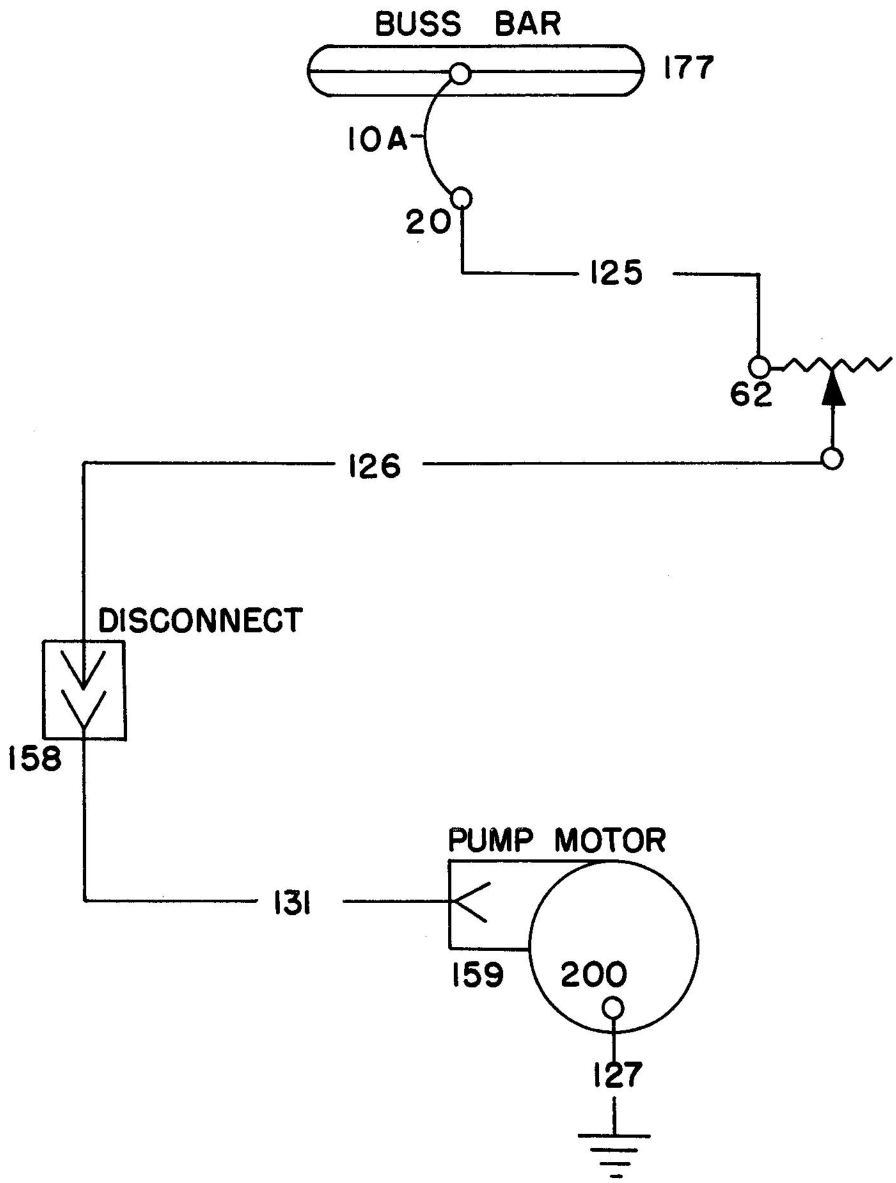
OIL DILUTION CIRCUIT

The engine oil is diluted by connecting a small fuel line into the oil system. The flow of fuel from this line is controlled by an electric solenoid valve operated by a toggle switch in the pilot's compartment.

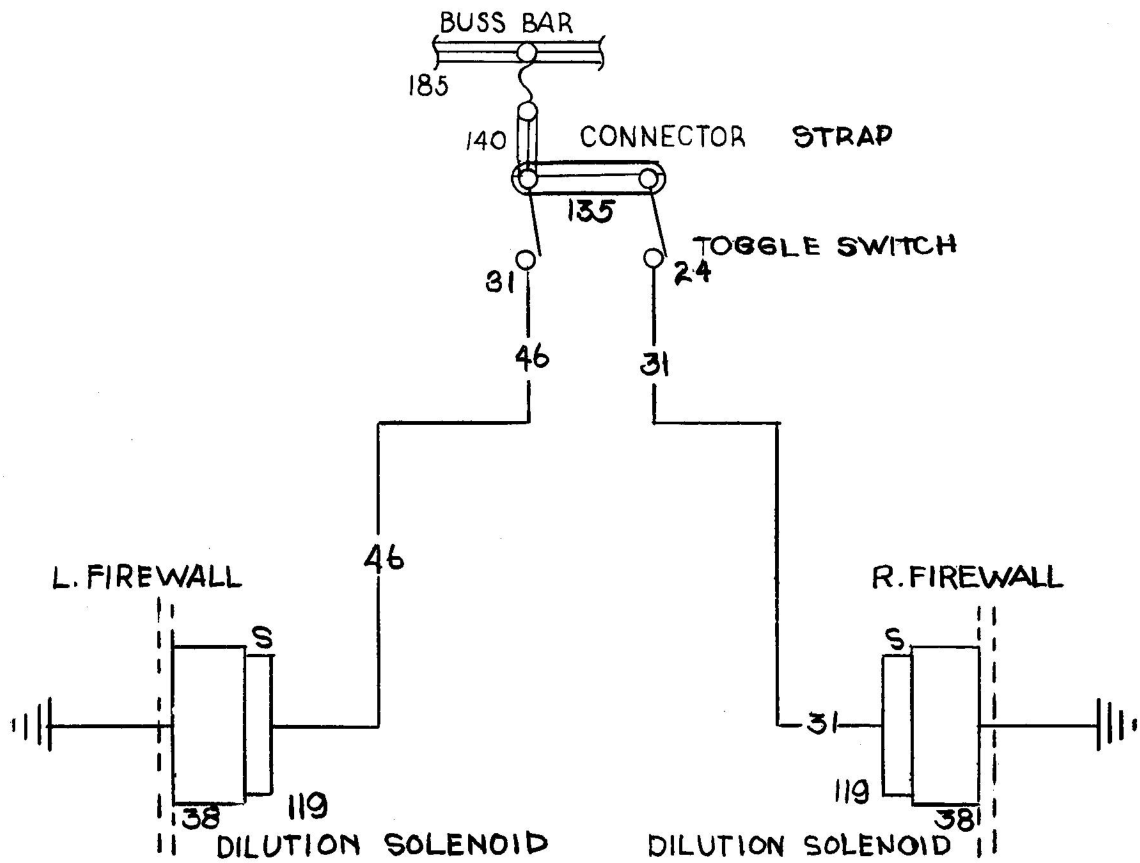
When the toggle switch is held to the 'On' position, the circuit is completed from



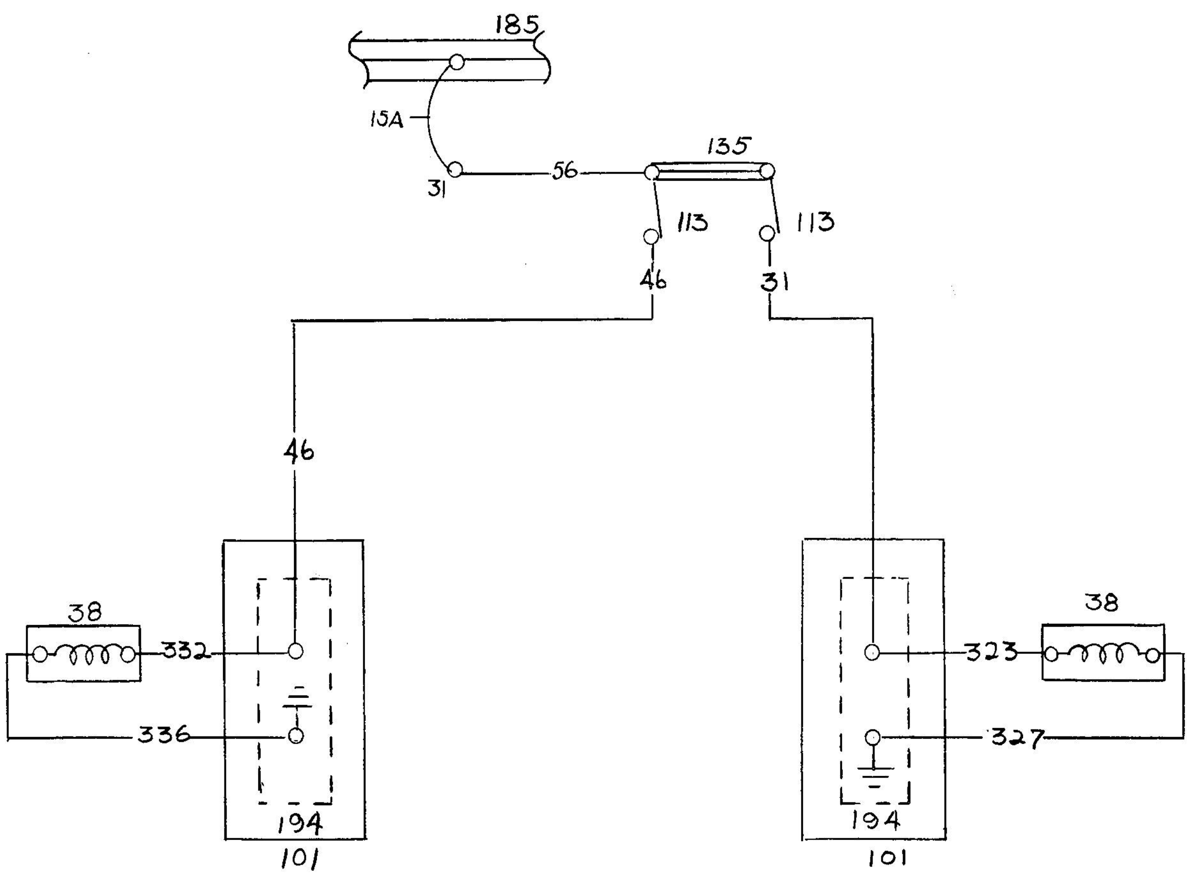
Pitot Heat Circuit
Aircraft Serials A-537 and After



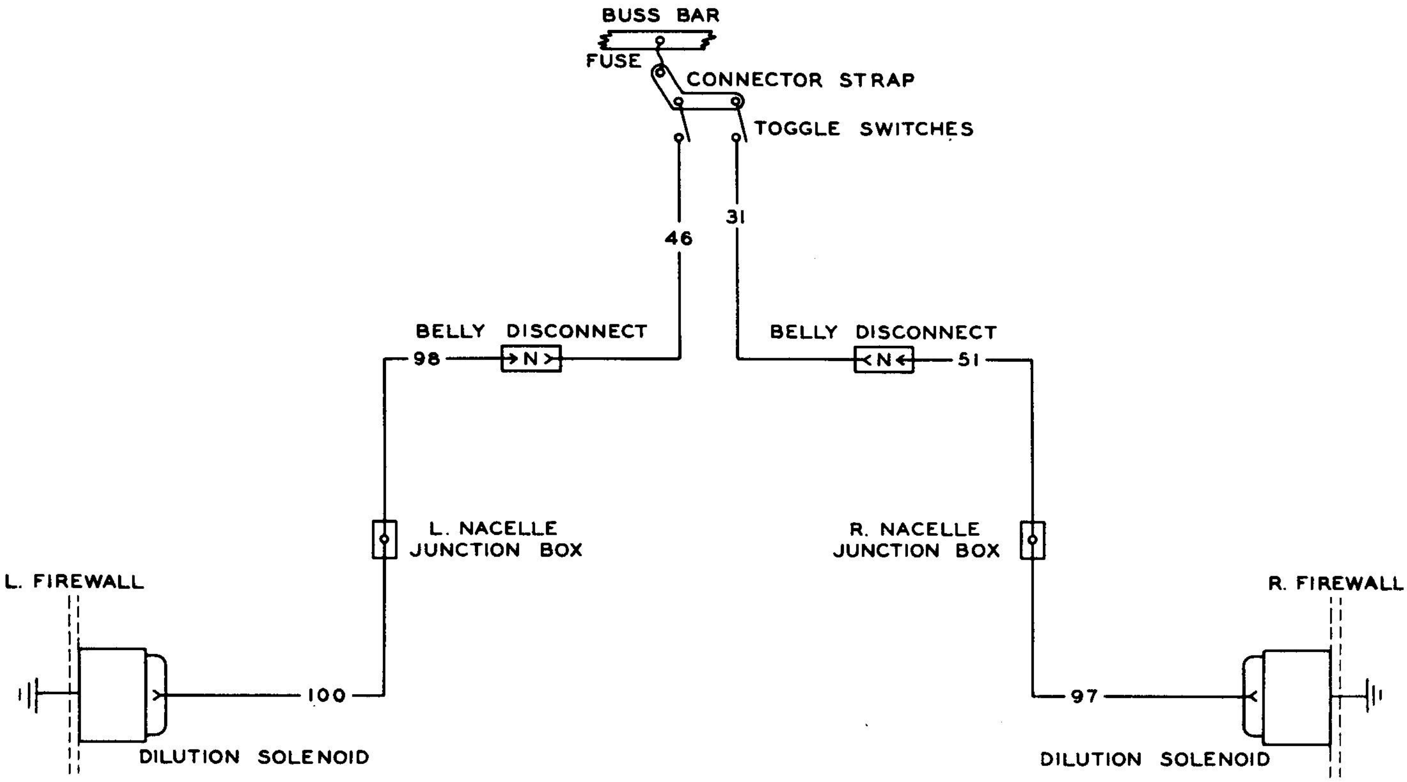
Anti-Icer Pump Circuit
Aircraft Serials A-537 and After



Oil Dilution System
Aircraft Serials A-402 to A-537



Oil Dilution System
Aircraft Serials A-537 and After



Oil Dilution Circuit

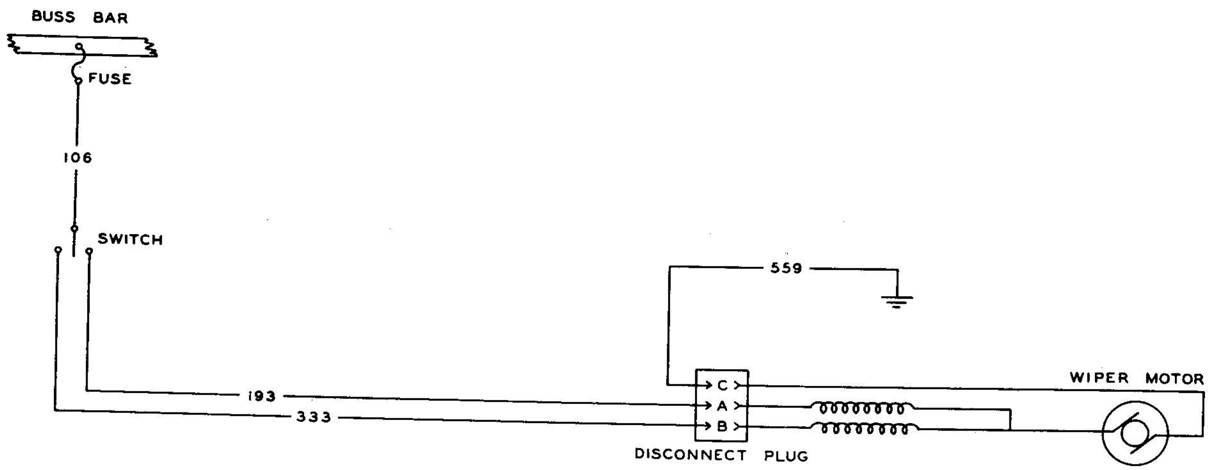
the sub-panel fuse to the ground of the solenoid energizing coil. The operation of the solenoid opens the valve and allows the fuel to enter the oil system. Releasing the toggle switch, opens the circuit to the solenoid and allows the valve to close by spring tension.

Trouble Shooting

1. Solenoid valve inoperative: check the sub-panel fuse. Check the toggle switch operation. Test the continuity from the switch to the solenoid valve. Check the ground at the solenoid mounting.

2. Solenoid sticks in open position: check the toggle switch operation. Check the return spring in the solenoid valve.

3. If circuit is blowing fuse: check for ground between the fuse, and the solenoid valve.



Windshield Wiper Circuit

WINDSHIELD WIPER CIRCUIT

The pilot's windshield wiper is controlled by a toggle switch located on the sub-panel. The fuse is located at the buss bar.

Trouble Shooting

1. Wiper inoperative: check the fuse at the sub-panel. Check the operation of the switch. Disconnect the plug at the motor and test continuity from the switch to the plug. Check the ground connection at the terminal 'C'.

ELEVATOR TAB AND FLAP POSITION INDICATOR CIRCUITS

The elevator tab and flap position indicators are variable resistance units, each consisting of a dial indicator and rheostat transmitter. The elevator tab transmitter is mounted on an elevator rib and is connected to the left tab drive by a spring loaded bronze cable. The flap position transmitter is connected to the flap shaft at the gear box in the right nacelle.

The elevator tab and flap position indicator circuits have a common power connection at the sub-panel fuse. A 120 ohm resistor is installed in the power lead at each indicator which operates the circuits at 12 volts. Each indicator and each transmitter is grounded.

Adjustments

To calibrate the elevator tabs with the trailing edge of the elevator, slip the bronze drive cable on the rheostat drive shaft until the indicator reads '0', then operate the tab through full travel several times to check the setting of the indicator.

To calibrate the flap position indicator, set the flaps at the neutral position. (Neutral position of the flaps is 1/6 turn of the handcrank from the full up position.) Remove the transmitter unit from the flap shaft (located in the right nacelle) and rotate the rheostat until the indicator reads '0'. (The electrical system must be on and the transmitter unit grounded, to obtain a reading at the indicator.) Replace the transmitter unit and operate the flap several times to check the setting of the indicator.

NOTE: Since flap position transmitters will not always give a full travel indication, calibrate the unit at "0".

Insert this page after Page 114.

The description of the elevator tab position indicator should read as follows:

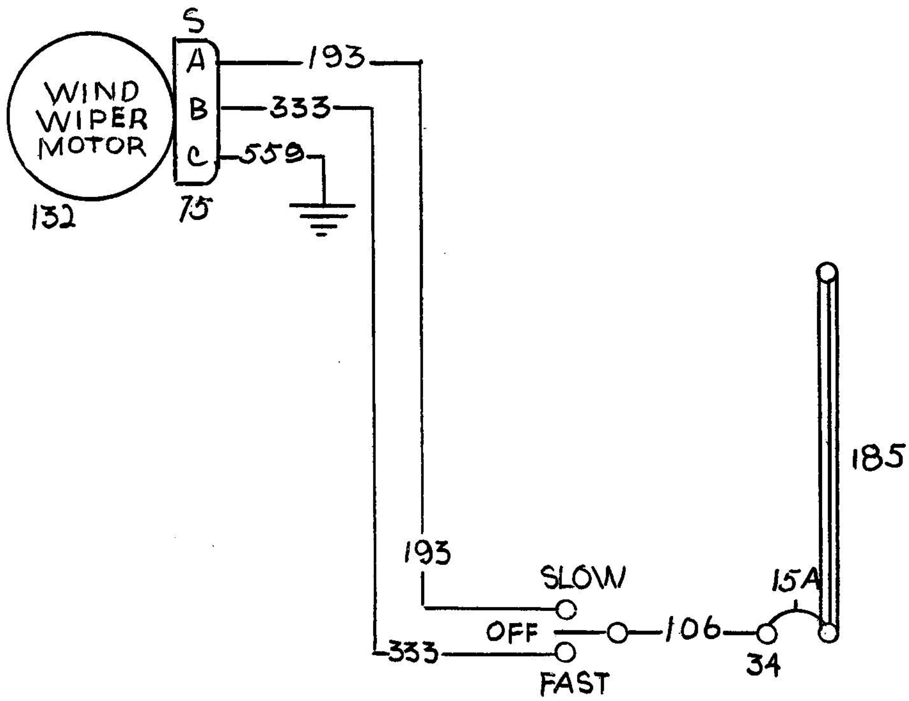
POSITION INDICATOR CIRCUITS

The elevator tab and flap position indicators are variable resistance units, each consisting of a dial indicator and rheostat transmitter. The elevator tab transmitter is mounted on an elevator rib and is connected to the left tab drive by a spring-loaded ratchet.

The paragraph on elevator tab adjustment should read as follows:

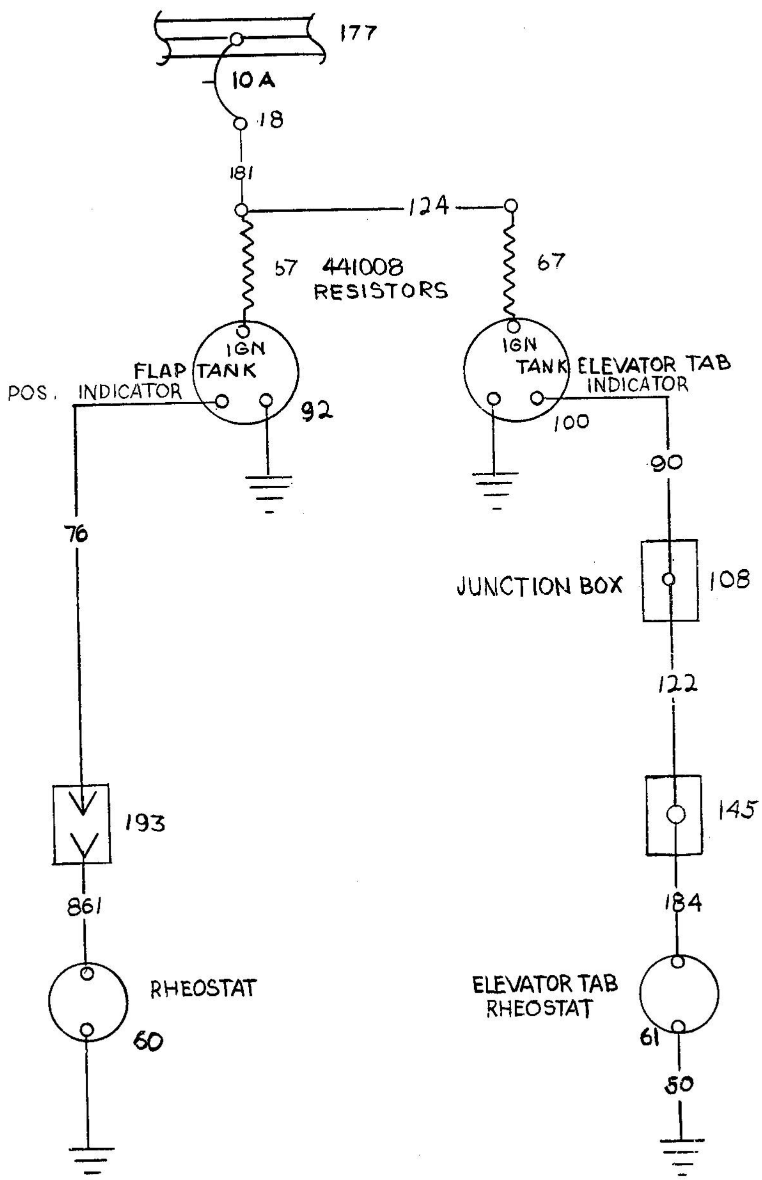
Adjustments

To calibrate the elevator tab with the trailing edge of the elevator, first place the elevator tab in the neutral position, then with a finger, raise the ratchet off the rheostat drive gear and rotate gear until dial indicator reads '0'. Release ratchet and adjust gear to mesh with ratchet teeth. Operate tab through full travel several times to ascertain if indicator is operating properly.

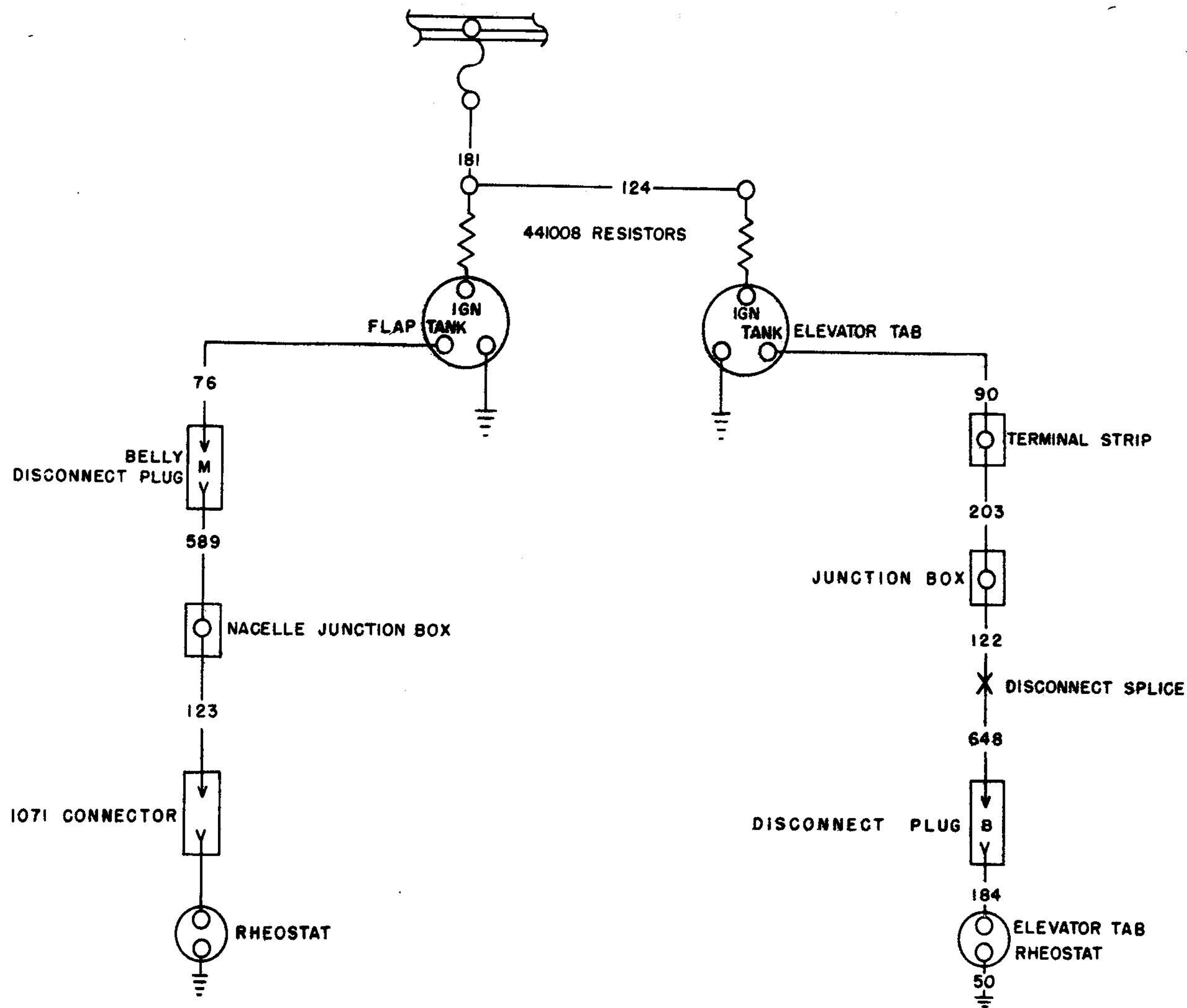


Windshield Wiper Circuit
Aircraft Serials A-537 and After

 January, 1952



Elevator Tab and Flap Position Indicator Circuits
Aircraft Serials A-402 and After



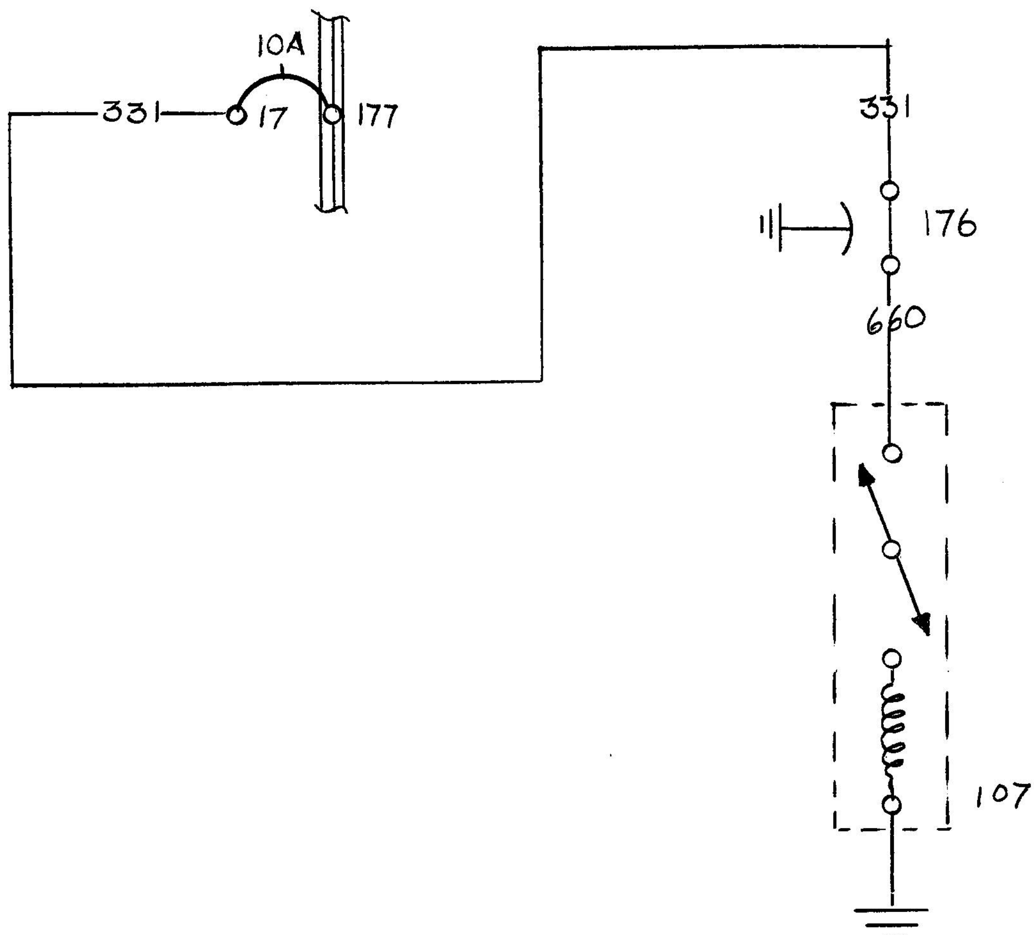
Elevator Tab and Flap Position Indicator Circuits

Trouble Shooting

1. Both indicators inoperative: check the fuse. Test the continuity from the fuse to the terminal at the indicators. (Because of the high resistance in these circuits, continuity tests should be run with an ohmmeter.)

2. One indicator inoperative: test 120 ohm resistor at the inoperative indicator. Check the ground connection at the inoperative indicator. Test the continuity from the 'tank-post' of the indicator to the transmitter terminal of the inoperative circuit. Check the contacts in the inoperative transmitter.

3. Full scale reading on one indicator: test for ground between the 'tank-post' and the transmitter.



Deicer System
Aircraft Serials A-402 and After

SECTION V
Inspection Guide

D18S AND D18C

This Inspection Guide is furnished in an effort to supply the mechanic conducting periodic inspections, with a general outline which will aid in maintaining the Models D18S and D18C Beechcraft. This guide should be used in conjunction with the Civil Aeronautics Administration Form 319 and this manual.

PRE-FLIGHT

The airplane should be visually inspected to determine any obvious defects or damage to the following:

- Wings
- Fuselage
- Empennage
- Control Surfaces
- Landing Gear
- Check Fuel Tanks and surrounding structure for evidence of leaks.
- De-Icer Boots
- Propellers
- Engine Cowling
- Fuel Tank Filler Caps and Covers

Check the operation of the following for full travel, free smooth and directional operation:

- Ailerons
- Aileron Tabs
- Elevators
- Elevator Tabs
- Rudders
- Rudder Tabs

Check the following electrical and radio equipment for proper operation:

- Transmitter and Receiver
- Position Lights
- Landing Lights
- Wing Flaps
- Fuel Quantity Gauges
- Fuel Pressure Warning Lights (with wobble pump)

ENGINE RUN UP INSPECTION

D18S - PRATT AND WHITNEY WASP JR. ENGINES

NOTE: Start and warm up engine in accordance with C.A.A. Operating Limitations.

Check the magnetos for RPM drop with approximately 30 in. hg. and propellers in low pitch (normal drop; from both magnetos to a single magneto is 50 to 75 RPM, not to exceed 100 RPM).
Check oil pressure (minimum 50 lbs. with normal operating pressure 70 to 90 lbs.)
Check fuel pressure (3 to 5 lbs.)
Check cylinder head temperature (do not exceed 450° F (232° C) during ground run up).
Check engines for proper run up (2300 RPM) at 30 in. hg.

D18C - CONTINENTAL ENGINES (R-9A)

NOTE: Start and warm up engine in accordance with C.A.A. Operating Limitations.

Check magnetos for RPM drop at 30 in. hg. for a maximum period of 30 seconds with propellers in low pitch (normal drop on a single magneto is 75 to 100 RPM).
Check oil pressure (minimum 50 lbs.)
Check fuel pressure (11-13 lbs.)
Check cylinder head temperature (do not exceed 550° F).
Check engines for proper run-up (2300 RPM) at 30 in. hg.

100 HOUR INSPECTION

POWER PLANT - D18S and D18C

Remove cowling and clean engines.
Check spark plugs and replace if necessary.

NOTE: Apply anti-seize on threads before installing spark plugs.

Check magnetos for burned points and replace if necessary.
Check engine mount for cracks at welded joints and fittings, and general condition of structure.
Check engine accessory mounting bolts for security.
Check engine mount bolts and engine lord mount bushings for condition, damage, and security.

NOTE: Lordmount bushings should be replaced at engine overhaul.

Check ignition harness for condition and security.
Check intensifier tubes and cabin heater valve for breaks and leakage.
Check exhaust collector rings and tail pipes for security, cracks, or leaks.
Check carburetor for leaks. Remove the fuel strainer and clean.
Check carburetor heat system for security, leaks, or damage.
Check firewalls for cracks or damage.
Start and warm up engines in accordance with C.A.A. Limitations.
With engines turning 1900 RPM, check generator voltage (28.5). Adjust voltage regulator if necessary. Place generators under load to check paralleling system.
Check generator brushes and replace if worn.
Check reverse current relay. This should cut in and cut out at approximately 26 volts.
Check all engine controls with engine running for smoothness of operation, excessive play and alignment.
Check propeller operation throughout speed range.
Check feathering and unfeathering operation.
Stop engines and inspect for oil and fuel leaks.
Inspect propellers for oil leaks, dents and scratches.
Inspect cowling, cowling supports, and cowl flaps for general condition and proper fit. Check cowl flaps for operation. Reinstall cowling and check bonding.

COCKPIT

Check seats for operation, security and damage.
Check safety belts for condition and security.
Check service tags on fire extinguishers.
Check windows for security and operation. Replace if defective.
Check windshield for damage.
Check instruments for correct operation and proper markings as listed in approved operating limitations.
Check instrument lights for operation.
Check fuse amperage in accordance with placards.
Remove pressure fire extinguisher and weigh in accordance with cylinder placard.
Visually inspect flares.

ENGINE CONTROLS

Check propeller controls for synchronization, excessive play, ease and smoothness of operation, adjustment of friction control, and placards.
Check oil shutter controls for synchronization, excessive play, ease and smoothness of operation, adjustment of friction control, and placards.
Check manifold heat controls for synchronization, excessive play, ease

and smoothness of operation, adjustment of friction control, and placards.

Check oil by-pass control for excessive play, ease and smoothness of operation, and placards.

Check cabin heat control for excessive play, ease and smoothness of operation, and placards.

FLIGHT CONTROLS

Check flight controls for ease, smoothness, and direction of operation.

Check cables for fraying throughout system, and especially at pulleys and fairleads.

Check cable tensions as follows:

Aileron - Balance System	35 lbs. ± 5 lbs.
Aileron	50 lbs. ± 10 lbs.
Elevator	120 lbs. ± 10 lbs.
Rudder Front Balance	60 lbs. ± 10 lbs.
Rudder Rear Balance	30 lbs. ± 10 lbs.
Rudder - Aft of Reduction Pulleys	30 lbs. ± 10 lbs.

Adjust tab cables to remove all slack and for smooth operation.

Visually check aileron, elevator, and rudder bellcranks including bellcrank bearings.

Clean pulleys and check for damage, free action, alignment, and security.

Inspect the following sprockets for alignment, freeness, and security:

Aileron Tab Sprocket at No. 3 Rib of Left Wing.

Elevator Tab Sprocket at Bulkhead No. 15.

Rudder Control Chain Sprockets inside pilot's and co-pilot's control column.

NOTE: No lubrication required.

Check control surface travels as follows:

		D18S	D18-C-CT
Aileron	Up	$38\frac{1}{2} \pm 1$	$37\frac{1}{2} \pm \frac{1}{4}$
Aileron	Down	21 ± 1	20 ± 2
Flap	Down	45 ± 1	* 25 ± 2
Elevator	Up	35 ± 1	35 ± 2
	Down	25 ± 1	25 ± 2
Rudder	Right	25 ± 1	25 ± 2
	Left	25 ± 1	25 ± 2
Aileron Tab	Up	22 ± 1	20 ± 2
	Down	19 ± 1	20 ± 2
Elevator Trim Tab	Up	18 + 1	20 + 2
	Down	13 ∓ 1	14 ∓ 2
Rudder Trim Tab	Right	31 ± 1	30 ± 2
	Left	32 ± 1	30 ± 2

* D18C is also licensed with 45° flap.

FUEL SYSTEM

Remove wing tank covers and visually inspect fuel tanks.

NOTE: To be checked at first inspection, and periodically at every 500 hours thereafter.

Drain the Sumps.

Check all lines, hoses and hose clamps for security, signs of chafing, leakage, and proper clearance.

Inspect all firewall fittings.

Drain fuel strainers and clean screens.

Check fuel gauge for full and empty position.

NOTE: Calibrate liquidometer in accordance with this manual if recalibration is necessary.

OIL TANKS

Check oil tanks for leaks and security of mounting.

Check oil lines, hoses and hose clamps for security and leaks.

Drain and flush oil tanks and system.

PASSENGER COMPARTMENT

Check seats and safety belts for wear and security of attachment.

Check ventilators for operation.

Release emergency exit, apply talc to rubber seal to prevent sticking before reinstalling.

Oil cabin door hinges and graphite the lock.

Check emergency release on cabin door.

UNDERCARRIAGE

NOTE: Airplane must be on jacks (front and rear).

Check struts, lift legs and retracting mechanism for damage or obvious defects.

Clean slide tubes and slide assembly and check for damage, defects and excessive wear.

NOTE: Do not grease slide tubes, powdered graphite should be used as a lubricant.

Check landing gear motor and shafts, universal attaching taper pins, and universals for tightness, wear and elongation of holes.

Check landing gear retract chains, repair links, and sprockets for condition and security.

Inspect slide chain for proper tension and wear, (adjust if necessary in accordance with this manual).

Check all bolts for safety and excessive wear.

Check the landing gear doors for freeness of operation, looseness of door hinges, and correct adjustment.

Check D18C landing gear mechanism for excessive wear at the latching fingers and cam catch.

NOTE: Replacement should be made where excessive wear is indicated on all functioning parts.

Check handcrank box for security of mounting and marking, and chain for wear, tension, and clearance.

Check mechanism both electrically and manually for smooth operation.

Check oil level in landing gear motor gear box. If required refill with Gargoyle No. 6 or equivalent.

Check the limit switches, position light switches, and safety switch for security, and proper function. (If necessary reset in accordance with this manual).

Check landing gear overload clutch in accordance with this manual.

Deflate shock struts and check oil level.

Refill with AAF 3580D, or AN-VV-0-366b. (Refer to manual for refilling procedure).

Check all welds for cracks.

Check air oil shock struts for leakage and proper inflation ($2\frac{1}{2}$ inches).

Check tires for general condition and proper inflation (13 in. from ground to centerline of axle).

Check bungee cords for condition and replace, if necessary.

Check entire brake system for signs of leakage and condition and security of lines.

Check brake fluid level in reservoir and refill as per manual, if necessary.

Check individual brake segments for excessive wear in accordance with this manual.

FUSELAGE

Check surface for damage, wrinkles, distortion, loose rivets and corrosion.

Check drain holes; open if necessary.
Clean tail section aft of bulkhead #10.
Check all bulkheads for security and damage.
Check radio and radio racks for security.

TAIL WHEEL

Check tail wheel gear for obvious defects and damage.
Clean slide tube. (Do not grease) Lubribate with powdered graphite.
Check retraction cables and pulleys for fraying alignment, and condition.
Check tail wheel doors for condition, clearance, operation, and security.
Check tail wheel lock for security and free operation.
Check oil level in tail wheel strut (deflate fully and fill to plug level).
Inflate strut (3 in.) and check for leaks.
Check top tail wheel retract cable for 70 lbs. $\pm$ 10 lbs. tension and lower cable to 50 lbs. $\pm$ 10 lbs. with landing gear fully extended.
Check tire for wear and inflation. (6 in. from ground to centerline of axle.)

WING AND CENTER SECTION

Check surface for obvious damage, dents, loose rivets, and wrinkles.
Check gap strips for security. (Screw should be approximately one quarter turn from tight.)
Check wing attaching bolts for security and safety.
Check all inspection plates and doors for security and fit.
Check de-icer boots for security, condition, and operation, if used.
Check all drain holes and remove all obstructions.
Check position lights and landing lights for security, operation, and cracked lenses.
Check fabric lightening hole covers on rear spars and in the wheel wells, replace if necessary.

Check all welds in nacelle truss for cracks and corrosion.

AILERON AND FLAPS

Check fabric and rib stitching for condition and damage.
Check aileron and flap hinges for excessive play, freeness of operation, and security.
Check drain holes and remove all obstructions.
Check flap scuff-plate for condition and security.
Check bonding on flaps and ailerons.
Check aileron tab for security and smooth operation.
Check flap actuating mechanism, and screws, lubricate flap gear boxes with ANG-3 grease.
Check flap clutch tension as per this manual.
Operate flaps electrically and manually.

STABILIZER AND VERTICAL FINS

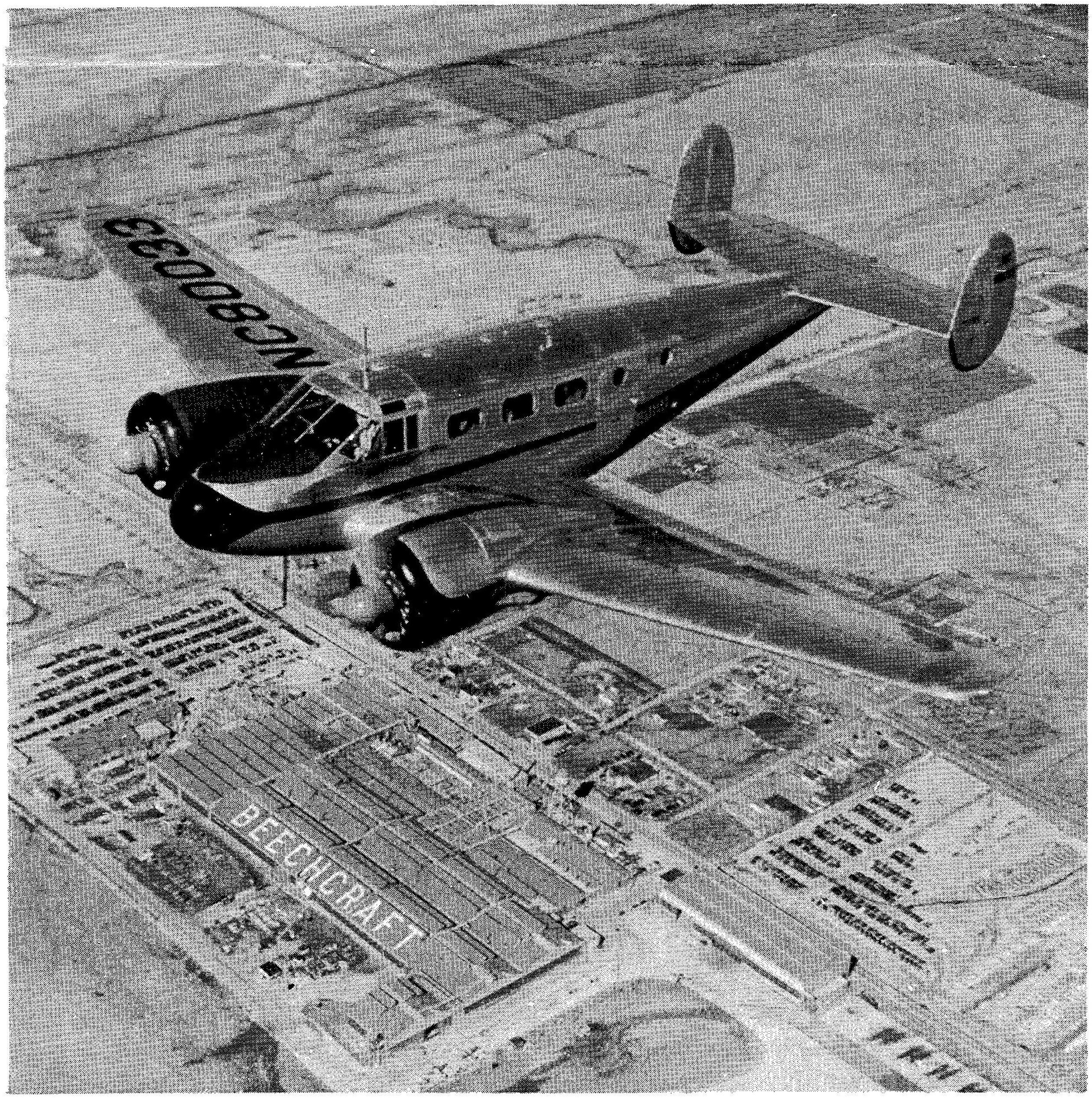
Check stabilizer and vertical fins for damage, loose rivets, security of attachment and corrosion.
Check de-icer boot for security, condition, and operation, if used.
Check abrasion shoe for condition and security, and replace if necessary.
Inspect fairing for security, dents and cracks.
Check all drain holes and remove all obstruction.
Check all inspection doors for fit and security.

ELEVATOR AND RUDDERS

Check fabric and rib stitching for condition and defects.
Check elevator and rudder hinges for excessive play, security and freeness of operation.
Check elevator and rudder tabs for security and smooth operation.

MISCELLANEOUS

Check hydrometer reading and fluid level of battery.
Check battery box for corrosion and repaint with acid resistant paint if necessary.
Check vent and drain system, clean jar and felt, and add one tablespoon full of soda to each felt disc. (Two felt discs in each jar.)
Check wobble pump for operation and fuel leaks. Fuel pressure by-pass is set at 6 lbs. for Pratt and Whitney engines, and 15 lbs. for Continental engines.
Check operation of windshield wiper, if installed.



SECTION VI
Appendix

SPECIAL EQUIPMENT

AILERON CONTOUR JIG

The neutral position of the aileron may be determined by the use of an aileron contour jig. (See Fig. 85) The jig is installed over the aileron and wing at No. 5 rib of the outboard wing panel.

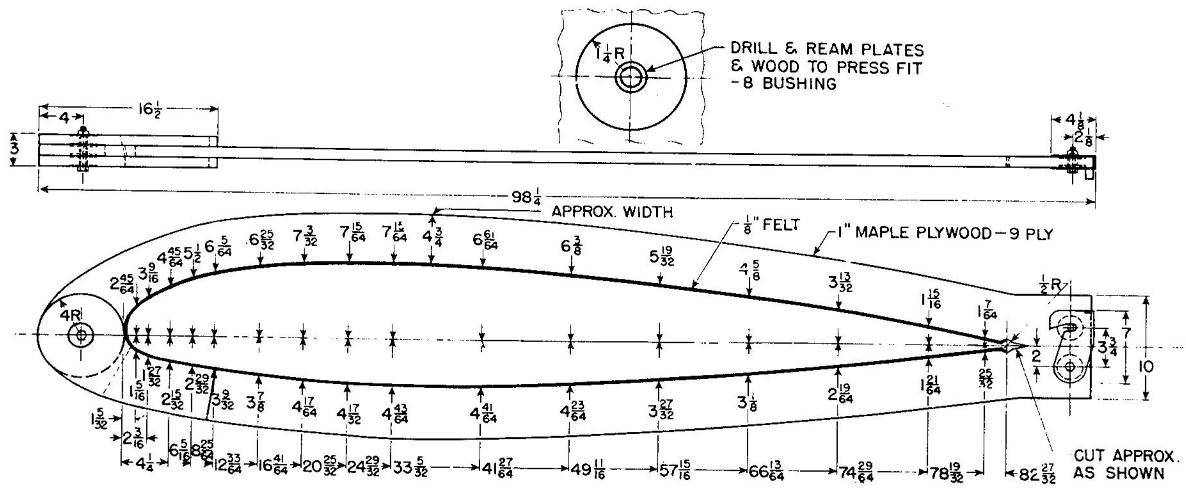


Fig. 85 Aileron Contour Jig

RUDDER RIGGING BLOCKS

Rudder rigging blocks (See Fig. 86) are used to hold the rudder reduction pulleys in the proper location while adjusting the cable tension. Two blocks are used, one for each slide assembly. They are inserted in the slots of the reduction pulley bracket, located in the belly of the airplane.

The block is fabricated from a steel plate with a welded half round steel projecting lug.

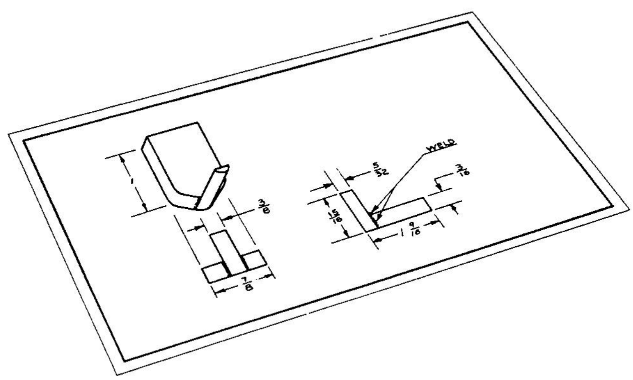


Fig. 86 Rudder Rigging Blocks

ELEVATOR CONTOUR JIG

The elevator jig (See Fig. 87) is used to hold the elevator in neutral position while the cable tensions are adjusted and the control column is located in neutral position. The jig is installed around the stabilizer and elevator over the fourth rib from the center of the stabilizer.

RUDDER ALIGNING JIG

The rudder aligning jig (See Fig. 88) is designed to hold the rudder firmly in neutral position while the cable tensions are adjusted and the rudders aligned. The jig is lowered to rest snugly approximately the second rib from the top of the rudder and fin.

FLAP CONTOUR JIG

The flap contour jig (See Fig. 89) is used

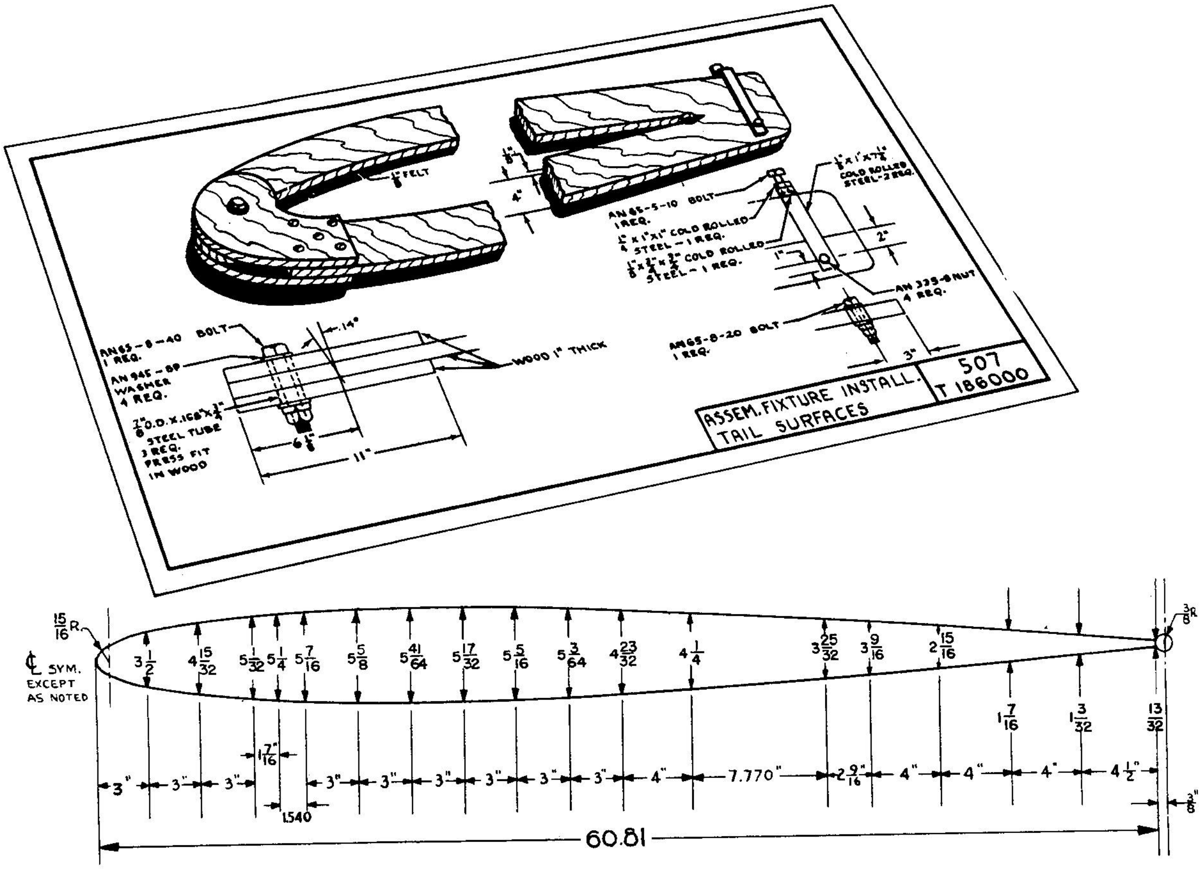


Fig. 87 Elevator. Contour. Jig

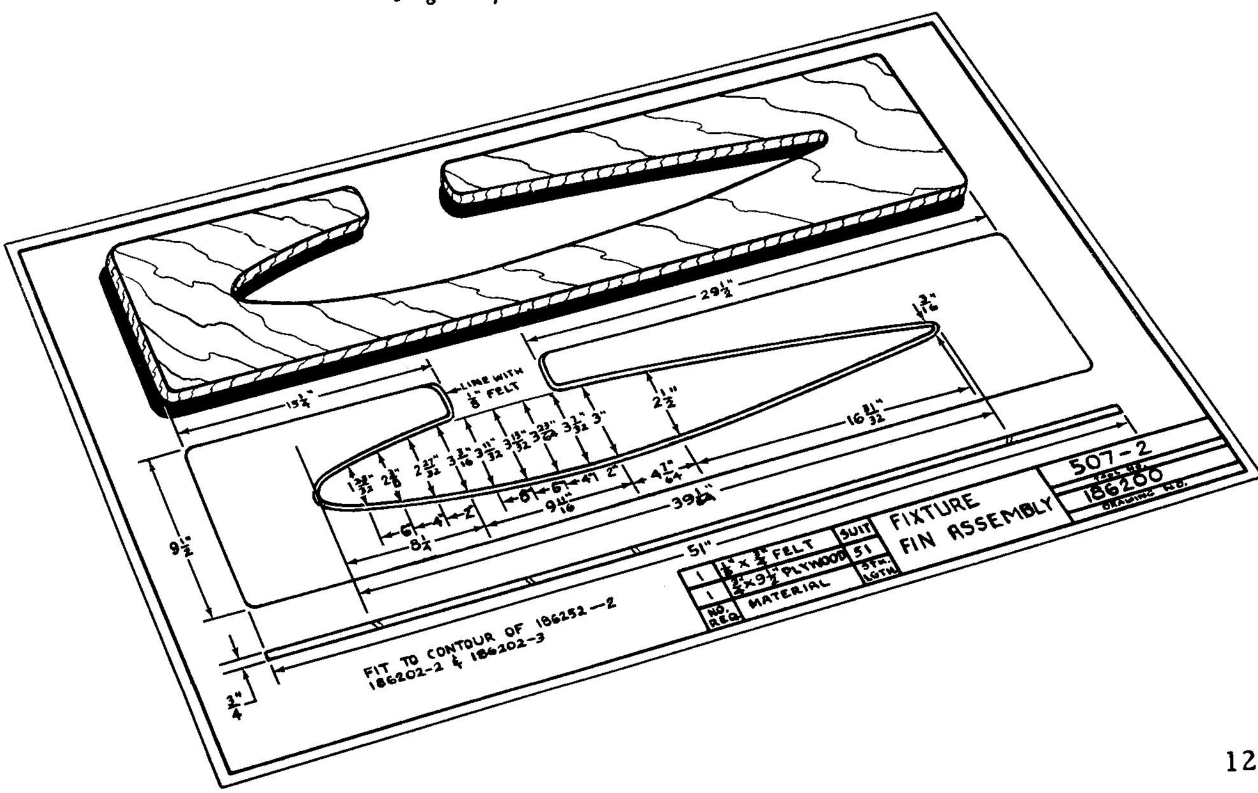


Fig. 88 Rudder. Aligning Jig

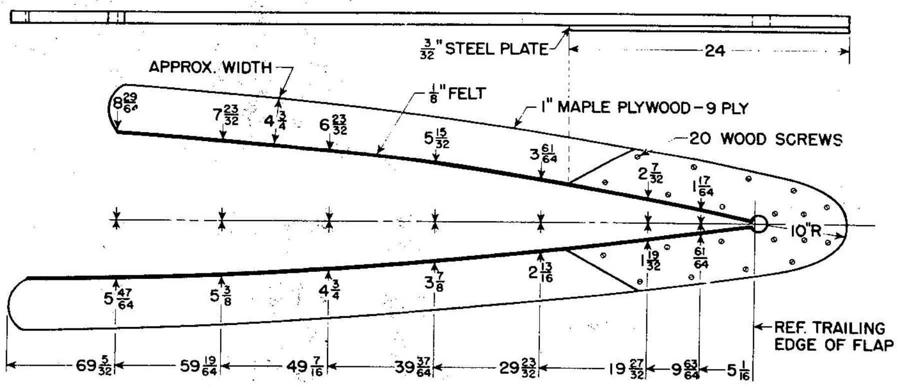


Fig. 89 Flap Contour Jig

to determine the streamline position of the flap in relation to the wing. The jig is installed over the flap and wing at the No. 3 rib of the outboard panel.

D18S TIMING TEMPLATE

The timing template (See Fig. 90) is designed to aid in timing the magnetos to the engine. The timing template is installed on the front case of the engine.

D18C TIMING TEMPLATE

This timing template (See Fig. 91) is similarly designed except the magnetos settings are staggered as shown on the template. Installation is also made on the front case of the engine.

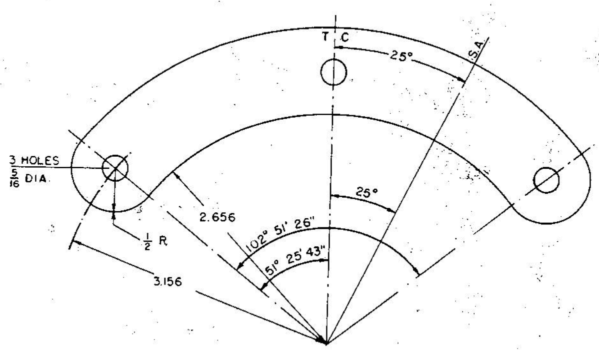


Fig. 90 D18S Timing Template

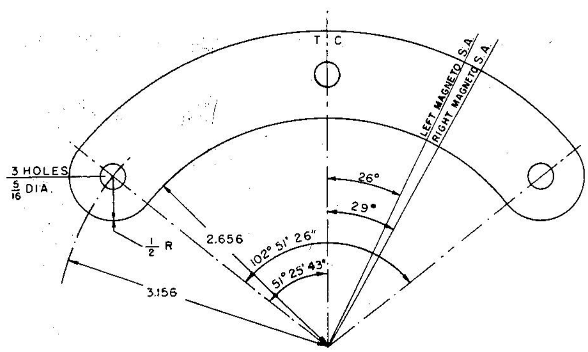


Fig. 91 D18C Timing Template

100 HOUR INSPECTION

POWER PLANT - D18S and D18C

Remove cowling and clean engines.
Check spark plugs and replace if necessary.

NOTE: Apply anti-seize on threads before installing spark plugs.

Check magnetos for burned points and replace if necessary.
Check engine mount for cracks at welded joints and fittings, and general condition of structure.
Check engine accessory mounting bolts for security.
Check engine mount bolts and engine lord mount bushings for condition, damage, and security.

NOTE: Lordmount bushings should be replaced at engine overhaul.

Check ignition harness for condition and security.
Check intensifier tubes and cabin heater valve for breaks and leakage.
Check exhaust collector rings and tail pipes for security, cracks, or leaks.
Check carburetor for leaks. Remove the fuel strainer and clean.
Check carburetor heat system for security, leaks, or damage.
Check firewalls for cracks or damage.
Start and warm up engines in accordance with C.A.A. Limitations.
With engines turning 1900 RPM, check generator voltage (28.5). Adjust voltage regulator if necessary. Place generators under load to check paralleling system.
Check generator brushes and replace if worn.
Check reverse current relay. This should cut in and cut out at approximately 26 volts.
Check all engine controls with engine running for smoothness of operation, excessive play and alignment.
Check propeller operation throughout speed range.
Check feathering and unfeathering operation.
Stop engines and inspect for oil and fuel leaks.
Inspect propellers for oil leaks, dents and scratches.
Inspect cowling, cowling supports, and cowl flaps for general condition and proper fit. Check cowl flaps for operation. Reinstall cowling and check bonding.

COCKPIT

Check seats for operation, security and damage.
Check safety belts for condition and security.
Check service tags on fire extinguishers.
Check windows for security and operation. Replace if defective.
Check windshield for damage.
Check instruments for correct operation and proper markings as listed in approved operating limitations.
Check instrument lights for operation.
Check fuse amperage in accordance with placards.
Remove pressure fire extinguisher and weigh in accordance with cylinder placard.
Visually inspect flares.

ENGINE CONTROLS

Check propeller controls for synchronization, excessive play, ease and smoothness of operation, adjustment of friction control, and placards.
Check oil shutter controls for synchronization, excessive play, ease and smoothness of operation, adjustment of friction control, and placards.
Check manifold heat controls for synchronization, excessive play, ease

and smoothness of operation, adjustment of friction control, and placards.
Check oil by-pass control for excessive play, ease and smoothness of operation, and placards.
Check cabin heat control for excessive play, ease and smoothness of operation, and placards.

FLIGHT CONTROLS

Check flight controls for ease, smoothness, and direction of operation.
Check cables for fraying throughout system, and especially at pulleys and fairleads.
Check cable tensions as follows:

Aileron - Balance System	35 lbs. ± 5 lbs.
Aileron	50 lbs. ± 10 lbs.
Elevator	120 lbs. ± 10 lbs.
Rudder Front Balance	60 lbs. ± 10 lbs.
Rudder Rear Balance	30 lbs. ± 10 lbs.
Rudder - Aft of Reduction Pulleys	30 lbs. ± 10 lbs.

Adjust tab cables to remove all slack and for smooth operation.
Visually check aileron, elevator, and rudder bellcranks including bellcrank bearings.
Clean pulleys and check for damage, free action, alignment, and security.
Inspect the following sprockets for alignment, freeness, and security:

Aileron Tab Sprocket at No. 3 Rib of Left Wing.
Elevator Tab Sprocket at Bulkhead No. 15.
Rudder Control Chain Sprockets inside pilot's and co-pilot's control column.

NOTE: No lubrication required.

Check control surface travels as follows:

		D18S	D18-C-CT
Aileron	Up	$38\frac{1}{2} \pm 1$	$37\frac{1}{2} \pm 1\frac{}{4}$
Aileron	Down	21 ± 1	20 ± 2
Flap	Down	45 ± 1	* 25 ± 2
Elevator	Up	35 ± 1	35 ± 2
	Down	25 ± 1	25 ± 2
Rudder	Right	25 ± 1	25 ± 2
	Left	25 ± 1	25 ± 2
Aileron Tab	Up	22 ± 1	20 ± 2
	Down	19 ± 1	20 ± 2
Elevator Trim Tab	Up	18 ± 1	20 ± 2
	Down	13 ∓ 1	14 ∓ 2
Rudder Trim Tab	Right	31 ± 1	30 ± 2
	Left	32 ± 1	30 ± 2

* D18C is also licensed with 45° flap.

FUEL SYSTEM

Remove wing tank covers and visually inspect fuel tanks.

NOTE: To be checked at first inspection, and periodically at every 500 hours thereafter.

Drain the Sumps.

Check all lines, hoses and hose clamps for security, signs of chafing, leakage, and proper clearance.
Inspect all firewall fittings.
Drain fuel strainers and clean screens.
Check fuel gauge for full and empty position.
NOTE: Calibrate liquidometer in accordance with this manual if recalibration is necessary.

OIL TANKS

Check oil tanks for leaks and security of mounting.

Check oil lines, hoses and hose clamps for security and leaks.

Drain and flush oil tanks and system.

PASSENGER COMPARTMENT

Check seats and safety belts for wear and security of attachment.

Check ventilators for operation.

Release emergency exit, apply talc to rubber seal to prevent sticking before reinstalling.

Oil cabin door hinges and graphite the lock.

Check emergency release on cabin door.

UNDERCARRIAGE

NOTE: Airplane must be on jacks (front and rear).

Check struts, lift legs and retracting mechanism for damage or obvious defects.

Clean slide tubes and slide assembly and check for damage, defects and excessive wear.

NOTE: Do not grease slide tubes, powdered graphite should be used as a lubricant.

Check landing gear motor and shafts, universal attaching taper pins, and universals for tightness, wear and elongation of holes.

Check landing gear retract chains, repair links, and sprockets for condition and security.

Inspect slide chain for proper tension and wear, (adjust if necessary in accordance with this manual).

Check all bolts for safety and excessive wear.

Check the landing gear doors for freeness of operation, looseness of door hinges, and correct adjustment.

Check D18C landing gear mechanism for excessive wear at the latching fingers and cam catch.

NOTE: Replacement should be made where excessive wear is indicated on all functioning parts.

Check handcrank box for security of mounting and marking, and chain for wear, tension, and clearance.

Check mechanism both electrically and manually for smooth operation.

Check oil level in landing gear motor gear box. If required refill with Gargoyle No. 6 or equivalent.

Check the limit switches, position light switches, and safety switch for security, and proper function. (If necessary reset in accordance with this manual).

Check landing gear overload clutch in accordance with this manual.

Deflate shock struts and check oil level.

Refill with ~~AAF 3580D, or AN-VV-0-366b~~. (Refer to manual for refilling procedure). MIL-0-5606 .543

Check all welds for cracks.

Check air oil shock struts for leakage and proper inflation ($2\frac{1}{2}$ inches).

Check tires for general condition and proper inflation (13 in. from ground to centerline of axle). Pcc 14"

Check bungee cords for condition and replace, if necessary.

Check entire brake system for signs of leakage and condition and security of lines.

Check brake fluid level in reservoir and refill as per manual, if necessary.

Check individual brake segments for excessive wear in accordance with this manual.

FUSELAGE

Check surface for damage, wrinkles, distortion, loose rivets and corrosion.

Check drain holes; open if necessary.
Clean tail section aft of bulkhead #10.
Check all bulkheads for security and damage.
Check radio and radio racks for security.

TAIL WHEEL

Check tail wheel gear for obvious defects and damage.
Clean slide tube. (Do not grease) Lubribate with powdered graphite.
Check retraction cables and pulleys for fraying alignment, and condition.
Check tail wheel doors for condition, clearance, operation, and security.
Check tail wheel lock for security and free operation.
Check oil level in tail wheel strut (deflate fully and fill to plug level).
Inflate strut (3 in.) and check for leaks.
Check top tail wheel retract cable for 70 lbs. ± 10 lbs. tension and lower cable to 50 lbs. ± 10 lbs. with landing gear fully extended.
Check tire for wear and inflation. (6 in. from ground to centerline of axle.)

WING AND CENTER SECTION

Check surface for obvious damage, dents, loose rivets, and wrinkles.
Check gap strips for security. (Screw should be approximately one quarter turn from tight.)
Check wing attaching bolts for security and safety.
Check all inspection plates and doors for security and fit.
Check de-icer boots for security, condition, and operation, if used.
Check all drain holes and remove all obstructions.
Check position lights and landing lights for security, operation, and cracked lenses.
Check fabric lightening hole covers on rear spars and in the wheel wells, replace if necessary.

Check all welds in nacelle truss for cracks and corrosion.

AILERON AND FLAPS

Check fabric and rib stitching for condition and damage.
Check aileron and flap hinges for excessive play, freeness of operation, and security.
Check drain holes and remove all obstructions.
Check flap scuff-plate for condition and security.
Check bonding on flaps and ailerons.
Check aileron tab for security and smooth operation.
Check flap actuating mechanism, and screws, lubricate flap gear boxes with ANG-3 grease.
Check flap clutch tension as per this manual.
Operate flaps electrically and manually.

STABILIZER AND VERTICAL FINS

Check stabilizer and vertical fins for damage, loose rivets, security of attachment and corrosion.
Check de-icer boot for security, condition, and operation, if used.
Check abrasion shoe for condition and security, and replace if necessary.
Inspect fairing for security, dents and cracks.
Check all drain holes and remove all obstruction.
Check all inspection doors for fit and security.

ELEVATOR AND RUDDERS

Check fabric and rib stitching for condition and defects.
Check elevator and rudder hinges for excessive play, security and freeness of operation.
Check elevator and rudder tabs for security and smooth operation.

MISCELLANEOUS

Check hydrometer reading and fluid level of battery.

Check battery box for corrosion and repaint with acid resistant paint if necessary.

Check vent and drain system, clean jar and felt, and add one tablespoon full of soda to each felt disc. (Two felt discs in each jar.)

Check wobble pump for operation and fuel leaks. Fuel pressure by-pass is set at 6 lbs. for Pratt and Whitney engines, and 15 lbs. for Continental engines.

Check operation of windshield wiper, if installed.