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Flight Handbook

NAVY MODELS

AD-5W

AIRCRAFT



PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE
AND THE CHIEF OF THE BUREAU OF AERONAUTICS

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INTERIM REVISION SUMMARY

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Nos. 1 and 2	

INTERIM REVISIONS OUTSTANDING: (to be maintained by custodian of Flight Handbook)

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SECTION I

DESCRIPTION

THE AIRCRAFT

The Model AD-5W airplane is a three-place, carrier based landplane manufactured by the Douglas Aircraft Company, Inc., El Segundo Division. The airplane is equipped for airborne early warning and is adaptable for anti-submarine search missions. The cockpit accommodates the pilot, an observer, and conventional flight and engine controls, including an automatic pilot. No flight controls are provided for the observer. A radar operator occupies the middle compartment just aft of the cockpit during operational missions. Provisions are made for the installation of armament equipment. The airplane is equipped for catapult take-offs and arrested landings. For general arrangement of the airplane, see figure 1-2.

DIMENSIONS.

The principal three-point dimensions and the weight of the airplane are as follows:

Length	40 feet
Span (wings spread)	50 feet 1/4 inch
Span (wings folded)	23 feet 11 1/8 inch
Height (maximum propeller)	15 feet 9 5/8 inches
Height (over folded wings)	16 feet 7 5/8 inches
Height (maximum during wing folding)	19 feet 4 7/8 inches

COMPARISON WITH PRIOR MODEL AD-SERIES AIRPLANES

The AD-5W airplane is distinguished from previous AD-series airplanes by an enlarged clear plexiglas canopy enclosing a side-by-side cockpit seating arrangement. A fixed metal canopy covers the compartment just aft of the cockpit, and metal hinged enclosures cover the radar operator's compartment. These features and the radome installation aid positive identification of the airplane. In addition, it will be noted that the vertical surface area has been increased approximately 50 percent and the engine moved forward eight inches.

POWER PLANT

The engine is a Wright Cyclone R3350-26WA, 18-cylinder, twin-row, air-cooled, radial engine rated at 2700 horsepower for take-off. The engine is equipped with a single-stage, two-speed supercharger, a Stromberg PR58U1 carburetor and a spinner injection system. The lubrication system is a dry sump type wherein oil is supplied under pressure to all moving engine parts except the propeller shaft and crankshaft anti-friction bearings. Lubrication to individual pistons and cylinder walls is supplied by jets. Water injection is not installed on the airplane.

POWER PLANT CONTROLS

THROTTLE. The throttle (11, figure 1-3) is located on the pilot's left console. Take-off manifold pressure is restricted by a throttle stop incorporated in the throttle quadrant. The stop regulates manifold pressure at 57 inches plus or minus one inch, when the airplane is tied down. A gain over this value of one inch in manifold pressure can be expected for take-off. A two position microphone switch (13, figure 1-3) incorporated on the inboard end of the throttle grip is moved forward for radio transmission and aft for intercommunication. A catapult take-off handgrip located just forward of the throttle lever rotates up and against the side of the cockpit when not in use.

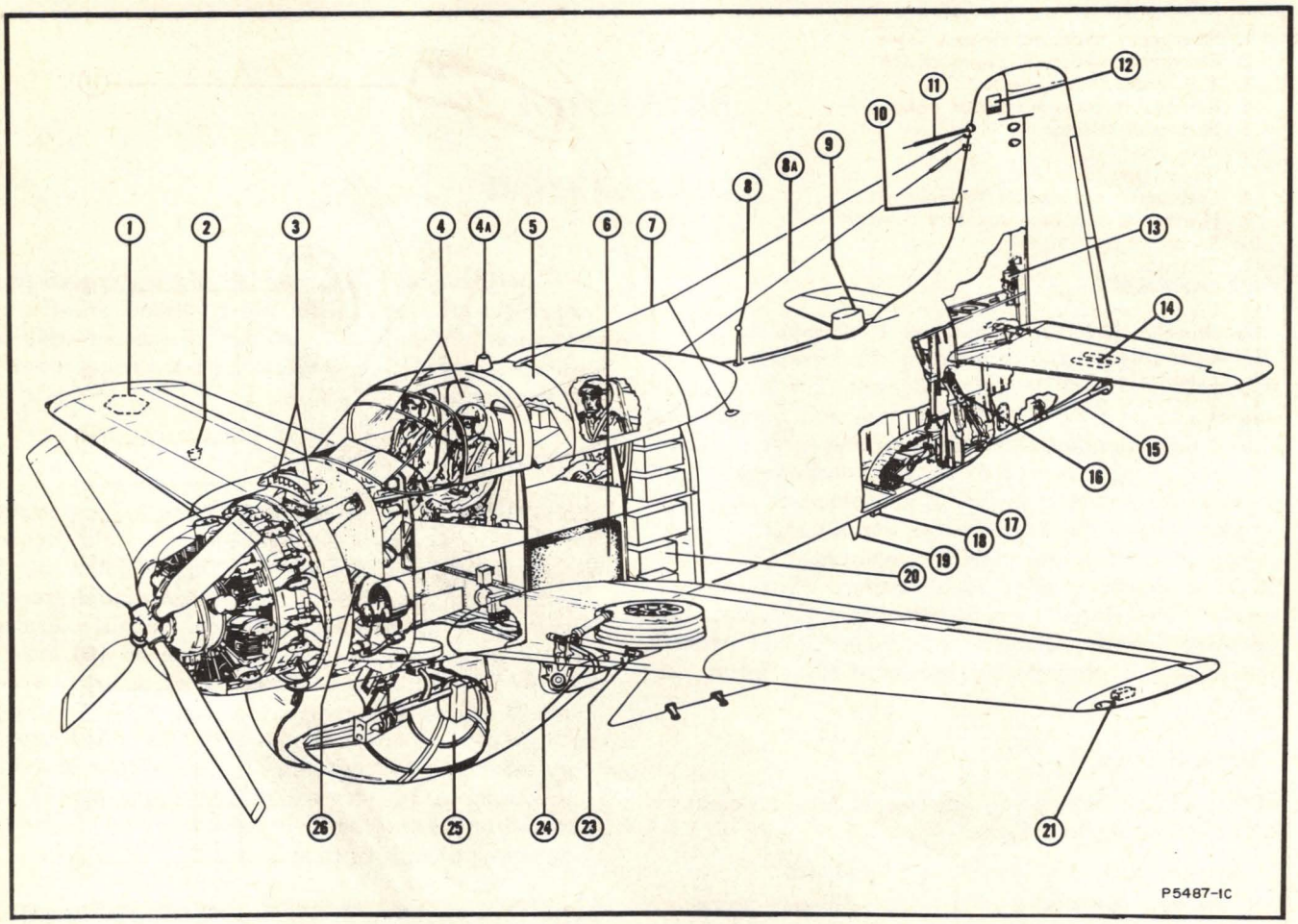
AUTOMATIC MANIFOLD PRESSURE REGULATOR. An automatic manifold pressure regulator will restrict take-off manifold pressure between 56 and 58 inches Hg, even though the throttle is pushed to its full forward position beyond the throttle stop. The regulator will maintain a selected manifold pressure under all flight conditions and will reset manifold pressure when changing supercharger speeds.

SUPERCHARGER. The supercharger control (10, figure 1-3) located on the pilot's left console just outboard of the throttle, has "LOW" and "HIGH" blower positions.

MIXTURE CONTROL. The mixture control lever (27, figure 1-3) located on the cockpit left console, has "IDLE CUTOFF," "NORMAL" and "RICH" positions. Detents at "RICH" and "NORMAL" prevent the control from being moved aft toward "IDLE CUTOFF" without first depressing a spring-loaded button installed in the handle of the mixture control lever.

FRICTION ADJUSTMENT. A friction adjustment knob (28, figure 1-3), located on the inboard side of the cockpit left console, adjusts the friction on the throttle and propeller pitch control levers.

CARBURETOR AIR. The carburetor air door is elec-



1. UHF direction finder antenna AN/ARA-25
2. UHF receiver-transmitter antenna AN/ARC-27A
3. Cockpit heating and ventilating air intake ducts
4. Windshield and sliding enclosure
4A. AS-133/APX-AN/ARN-21 antenna
5. Radar operator's compartment
6. Main fuel cell
7. HF antenna AN/ARC-2
8. Navigation receiver antenna AN/ARR-2A[1] [2]
8A. ADF sense antenna AN/ARN-6 [2]
9. ADF loop antenna AN/ARN-6 [2]
10. Radar operator's heating and ventilating air intake
11. Static boom
12. UHF antenna AN/ARC-27A
13. Horizontal stabilizer actuating unit
14. Radar altimeter antenna AN/APN-22
15. Arresting hook
16. Arresting hook hold down unit
17. Tail gear
18. IFF transponder antenna AN/APX-6
19. Radar relay antenna AN/ART-28
20. Electronics equipment compartment
21. Marker beacon antenna AN/ARN-12 [2]
22. Deleted
23. Catapult hook
24. Main landing gear
25. Antenna and radome AN/APS-20E search radar
26. Engine oil tank

Figure 1-2. General Arrangement

trically operated and controlled by a switch (8, figure 1-3) located on the left-hand console. Switch positions are "DIRECT" and "ALTERNATE."

AIR TEMPERATURE INDICATOR. The air temperature indicator (27, figure 1-5) installed on the pilot's instrument panel normally shows carburetor air temperature. Outside air temperature is obtained on the same indicator by pushing the button (34, figure 1-4) below the indicator.

IGNITION. Ignition for the R3350-26WA engine is furnished by a dual magneto (Scintilla type DF18-LN-2), providing true double ignition from a single unit. The ignition switch (20, figure 1-3) is located forward and above the cockpit left console.

PRIMER. An engine priming valve is attached to the after side of the carburetor. Fuel flows directly from the pressure side of the carburetor into the priming valve, then through three separate lines to the blower

[1] Airplanes prior to BuNo. 135139
[2] Airplanes prior to Service Change No. 511.

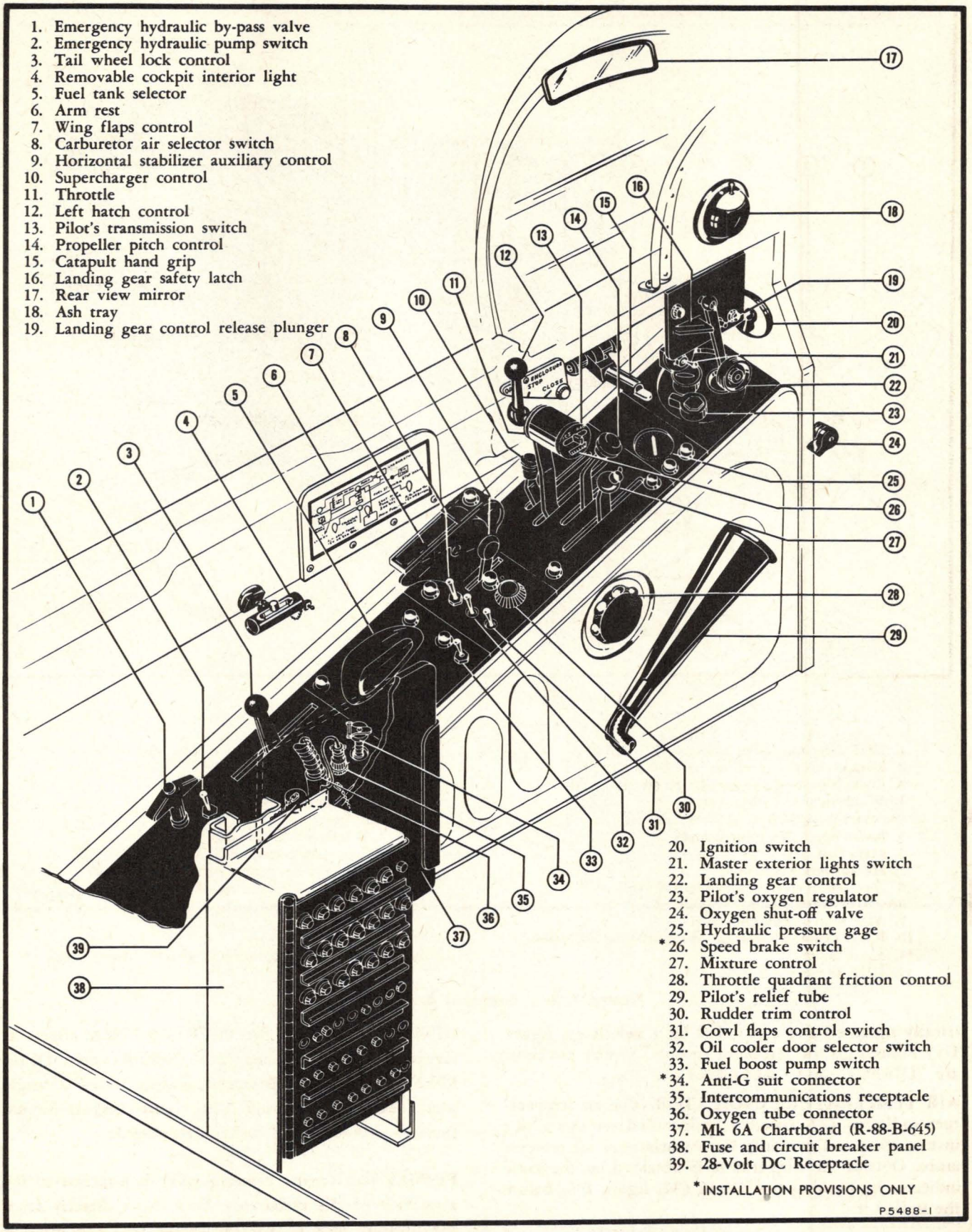
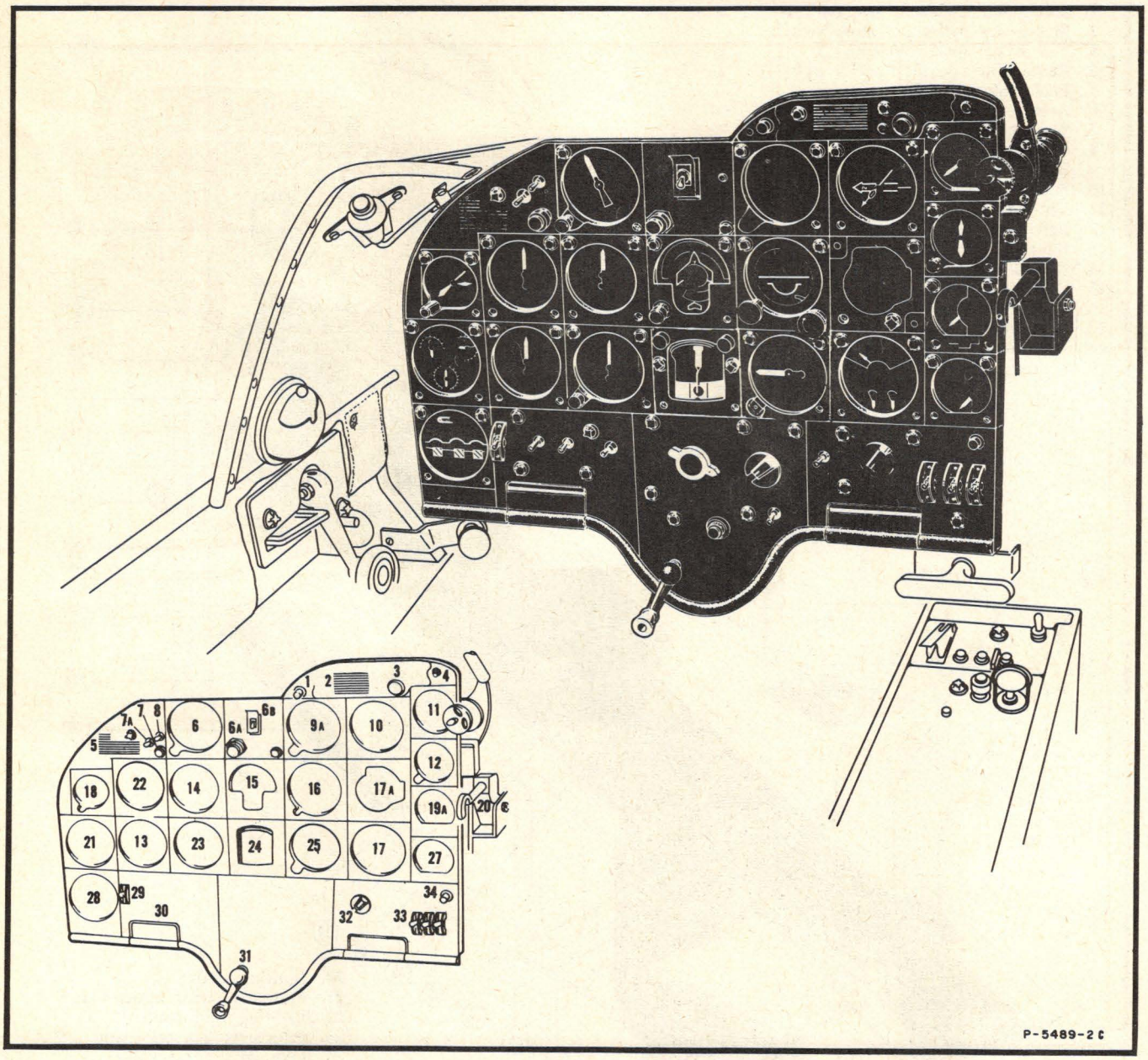


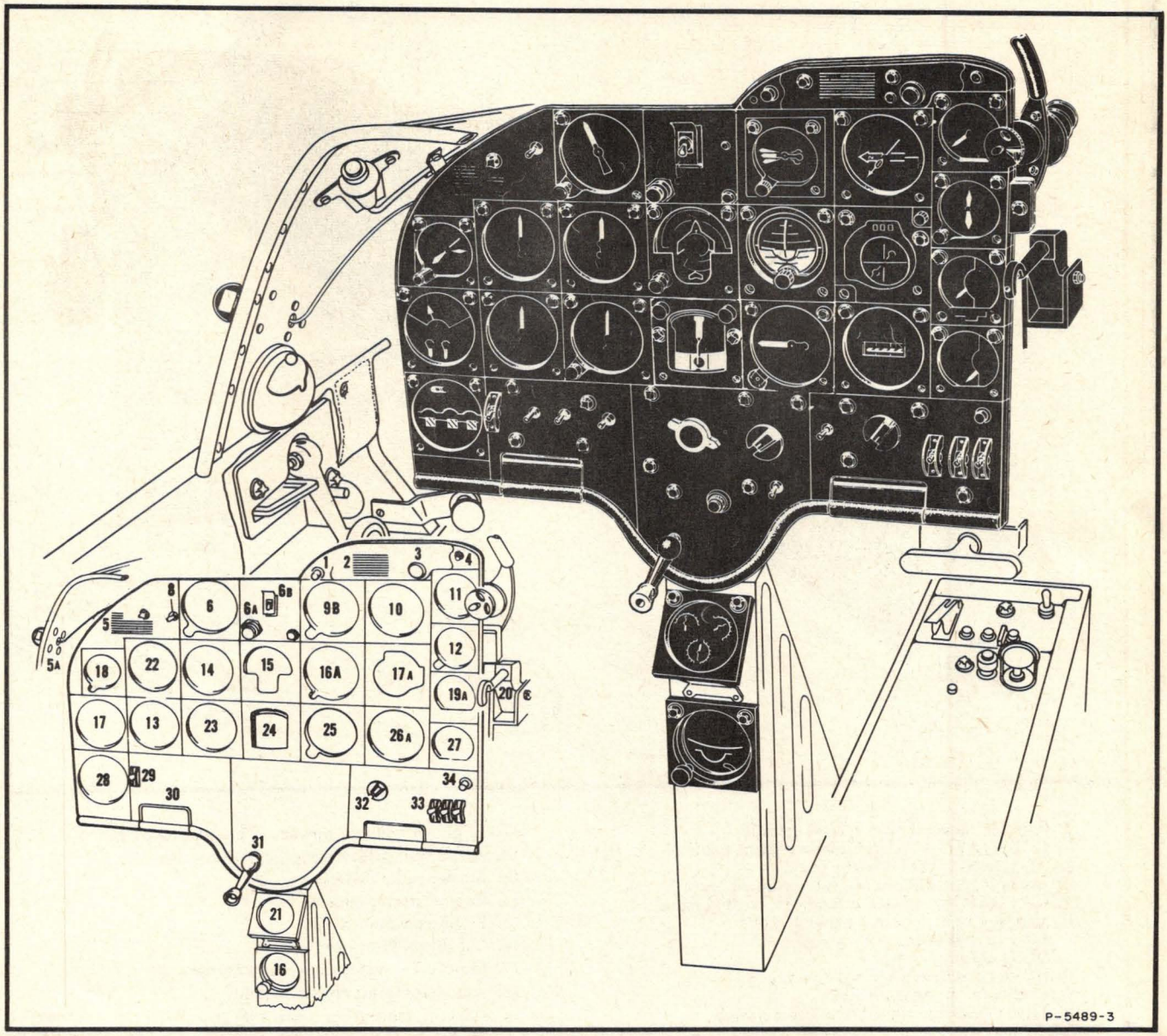
Figure 1-3. Cockpit — Left Console



1. Degrease switch
2. Take-off check list
3. Fuel pressure warning light
4. Fuel quantity indicator test switch
5. Landing check list
5A. Landing gear flashing warning light
6. ID-257/APN-22 height indicator
6A. Generator warning light
6B. Battery-generator switch
7. Marker beacon indicator light
7A. Marker beacon audio switch
8. G-2 compass control switch
9. Deleted
9A. Blank
9B. Accelerometer
10. ID-250/ARN course indicator
11. Fuel quantity indicator
12. Elapsed time clock
13. Engine tachometer
14. Airspeed indicator
15. G-2 compass indicator
16. Gyro horizon
16A. Vertical gyro indicator
17. Engine gage unit
17A. ID-249/ARN course indicator, or blank
18. Eight day clock

Airplanes Prior to Service Change No. 511, 635, and 652

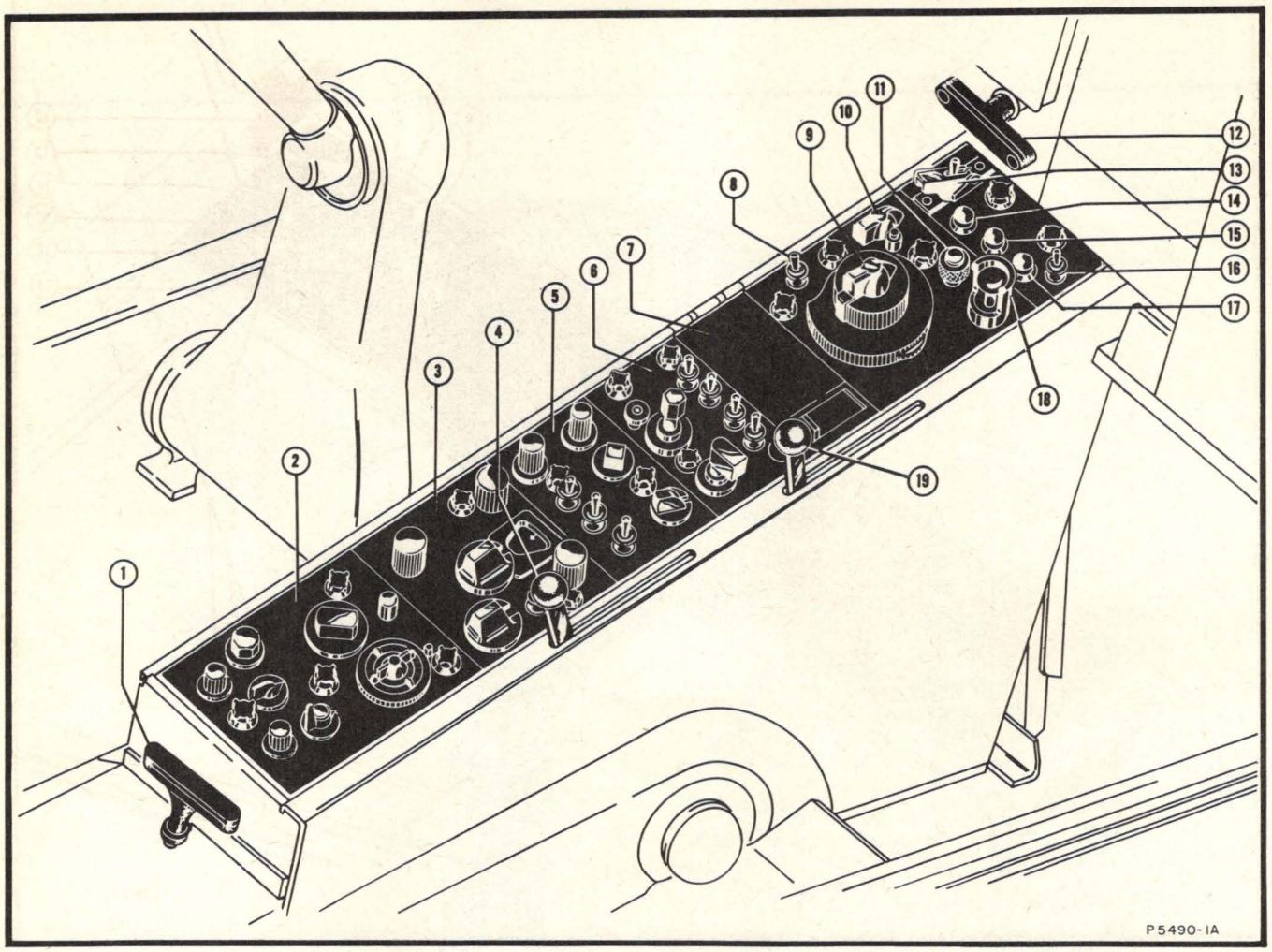
Figure 1-4. Cockpit — Pilot's Instrument Panel (Sheet 1)



19. Front bank oil pressure gage
19A. Cylinder head temperature gage
20. Arresting hook control
21. Trim position indicator
22. Manifold pressure gage
23. Altimeter
24. Turn and bank indicator
25. Rate-of-climb indicator
26. Deleted
26A. ID-310/ARN range indicator
27. Air temperature indicator
28. Wheels and flaps position indicator
29. Master armament switch
30. Center wing stations manual release handle
31. Rudder pedal adjustment crank
32. Inner stations function selector switch
33. Inner stations selector switches
34. Outside air temperature button

Airplanes After Service Change No. 511, 635, and 652

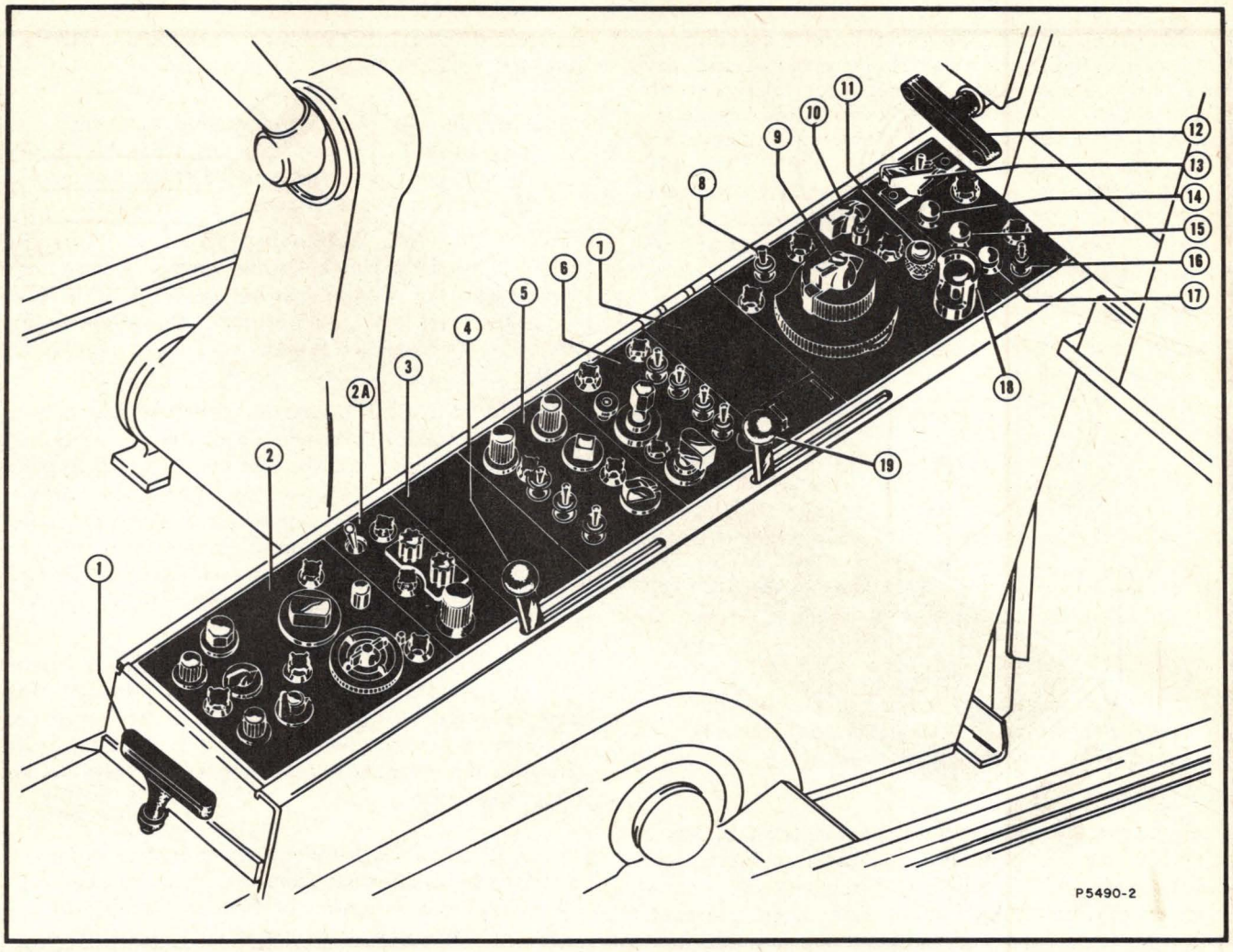
Figure 1-4. Cockpit — Pilot's Instrument Panel (Sheet 2)



1. Aileron power boost release handle
2. C-1024/ARC-27A UHF radio control panel
3. AN/ARN-6 ADF control panel
4. Cockpit heat distributor valve control lever
5. C-737/AIC-4A pilot's interphone control panel
6. Exterior lights control panel(1) (or) Interior lights control panel(2)
7. Wing folding controls
8. Rudder trim switch (inoperative)
9. Automatic pilot controller
10. Flight instrument power selector switch
11. Flight instrument power failure warning light
12. Automatic pilot emergency release handle
13. Master radio switch
14. Engine starter switch
15. Engine primer switch
16. Oil dilute-pitot heat switch
17. Observer's windshield degrease switch
18. Automatic pilot clutch switch
19. Cockpit ventilation control lever

Airplanes prior to Service Change No. 511.

Figure 1-5. Cockpit — Center Console (Sheet 1)



1. Aileron power boost release handle
2. C-1024/ARC-27A UHF radio control panel
2A. C-866/ARN-21 control panel
3. Blank
4. Cockpit heat distributor valve control lever
5. C-737/AIC-4A pilot's interphone control panel
6. Exterior lights control panel[1] (or) Interior lights control panel[2]
7. Wing folding controls
8. Rudder trim switch (inoperative)
9. Automatic pilot controller
10. Flight instrument power selector switch
11. Flight instrument power failure warning light
12. Automatic pilot emergency release handle
13. Master radio switch
14. Engine starter switch
15. Engine primer switch
16. Oil dilute-pitot heat switch
17. Observer's windshield degrease switch
18. Automatic pilot clutch switch
19. Cockpit ventilation control lever

Airplanes after Service Change No. 511.

Figure 1-5. Cockpit — Center Console (Sheet 2)

case of the engine. The engine is primed by building up pressure with the fuel booster pump then pressing the PRIMER switch (15, figure 1-5) located on the cockpit center console.

STARTER. The starting system consists primarily of a direct-cranking electric starter and an ignition booster. The system is controlled by a push-button switch (14, figure 1-5) located on the cockpit center console labeled STARTER. Pressing the STARTER switch actuates the starter and the ignition booster.

ENGINE COOLING

COWL FLAPS. The cowl flaps are electrically operated and controlled by a three position momentary-contact toggle switch (31, figure 1-3) located on the cockpit left console. The switch is moved to "OPEN" or "CLOSE" for operation of the cowl flaps and automatically returns to "OFF" when released, thus maintaining the cowl flaps in any selected position.

NOSE FLAPS. Nose flaps are installed in addition to side cowl flaps to reduce cooling air flow during cold weather operations. The nose and cowl flaps are actuated by the COWL FLAPS switch in a sequence controlled by a limit switch arrangement. The nose flaps open first and at their full open position, the cowl flaps open. Closing of the flaps is the reverse of the opening sequence. An indicator, mechanically linked to the nose flaps, extends upward through the anti-drag ring to the right of the top center line when the nose flaps are closed.

[1] Airplanes prior to BuNo. 132751.
[2] Airplanes BuNo. 132751 and subsequent.

OIL COOLER DOOR. The two oil cooler doors on the sides of the fuselage are electrically operated and may be set for either automatic or manual control by a switch (32, figure 1-3) located on the cockpit left console inboard of the cowl flap switch. Indicated positions are "AUTO," "OPEN," "CLOSE" and "OFF." The OIL COOLER DOOR switch is spring-loaded in both the "OPEN" and "CLOSE" positions, and returns to "OFF" when released. In the "AUTO" position, oil temperature is maintained at 80 ± 9°C.

PROPELLER

The airplane is equipped with either an Aeroproducts A642-G804/M20A2-162 or an A642-G805/M20A2-162 hydraulically actuated variable pitch constant speed propeller, 13 feet 6 inches in diameter. The -G804 and -G805 propellers are identical except for incorporation of a heavier torque cylinder in the -G805 for increased fatigue strength of the part. The propeller pitch control lever (14, figure 1-3), located on the cockpit left console, has the indicated positions "INCREASE" and "DECREASE." With the control lever in the full "INCREASE" position, take-off rpm should be 2900 ± 15 rpm.

Note

The performance charts for the aircraft with the -G804 propeller are applicable to the aircraft with the -G805 propeller installed.

OIL SYSTEM

The oil tank, located forward of the firewall, has a service capacity of 38.5 U.S. gallons (see figure 1-13 for oil grade and specification). The oil system is automatic in operation. Oil dilution controls are provided. Oil temperature and rear bank oil pressure are indicated on the engine gage unit (17, figure 1-4) located on the pilot's instrument panel. Front bank oil pressure is indicated on a gage (19, figure 1-4) to the right of the engine gage unit.

OIL DILUTION. Oil dilution is controlled by the OIL DILUTE—PITOT HEAT switch (16, figure 1-5) located on the cockpit center console. Moving the switch to "OIL DILUTE" energizes the fuel booster pump to supply fuel under pressure to the oil dilution system, shifts the oil tank diverter valve to the warm-up compartment, and opens the oil dilution solenoid valve.

FUEL SYSTEM

A 380 U. S. gallon (2280 pound) capacity, self-sealing fuel cell (6, figure 1-2) is installed in the fuselage. Either a standard type or high speed (Aero 1A) 150 or 300 gallon capacity external auxiliary fuel tank may be carried on each of the two inner-wing bomb racks. (Refer to ENGINE LIMITATIONS, Section V, for operating limits when using either the normal or the alternate fuel grade. Also, see figure 1-13 for fuel grades and specifications.)

FUEL TANK SELECTOR. Fuel is selected from any one of the tanks by the fuel tank selector (5, figure 1-3) on the cockpit left console. Fuel tank selector positions are labeled "OFF," "CTR EXT," "LH EXT," "MAIN," and "RH EXT."

Note

The CTR EXT position of the fuel tank selector is to be disregarded since the AN/APS-20E radome installation prevents the installation of a center external fuel tank.

FUEL PRESSURE WARNING LIGHT. A warning light (3, figure 1-4) mounted on the pilot's instrument panel warns the pilot of loss in fuel pressure in sufficient time to switch to another tank before the engine loses power from fuel starvation. The warning light, labeled FUEL WARN, is a "push-to-test" type.

BOOSTER PUMP. An electrically driven fuel booster pump is controlled by a switch (33, figure 1-3) on the cockpit left console near the fuel tank selector. In addition to supplying fuel under pressure to the engine-driven pump, the booster pump also supplies fuel under pressure to the primer and oil dilution systems. The fuel booster pump is turned on automatically by the OIL DILUTE-PITOT HEAT switch when the "OIL DILUTE" position is selected.

FUEL QUANTITY INDICATOR. A "capacitance" type fuel quantity indicating system is provided. The gage (11, figure 1-4), located on the instrument panel, indicates in pounds the quantity of fuel in the main tank. No fuel quantity indicating system is provided for the auxiliary tanks.

Note

Gasoline varies in weight depending upon the density of the fuel; therefore, when the tank is full, the indication of fuel in pounds will vary when other than standard day conditions exist.

INDICATOR TEST SWITCH. A push button switch labeled FUEL QUAN TEST (4, figure 1-4) mounted on the pilot's instrument panel is used to test the operation of the fuel quantity indicator. When the test switch is pushed in, a "fuel tank empty" impulse is fed to the fuel quantity indicator circuit. The fuel quantity indicator will drop toward a zero reading, and, when the button is released, will return to the actual fuel quantity indication.

EXTERNAL TANK RELEASE CONTROLS. The external auxiliary fuel tanks can be jettisoned electrically through the armament panel switches. (Refer to JETTISONING EXTERNAL AUXILIARY FUEL TANKS, Section III.) Jettison the external tanks manually by means of the CENTER WING BOMB REL handle (30, figure 1-4) located below the left side of the instrument panel. See figure 5-4 for operating limitations and restrictions when carrying external fuel tanks.

ELECTRICAL SYSTEMS

Electrical power is provided by two 24-volt, 24 ampere-hour batteries, a d-c generator, an a-c generator, two inverters or an external power source. Both a-c power and d-c power can be supplied by an external power source connected to the external power receptacles

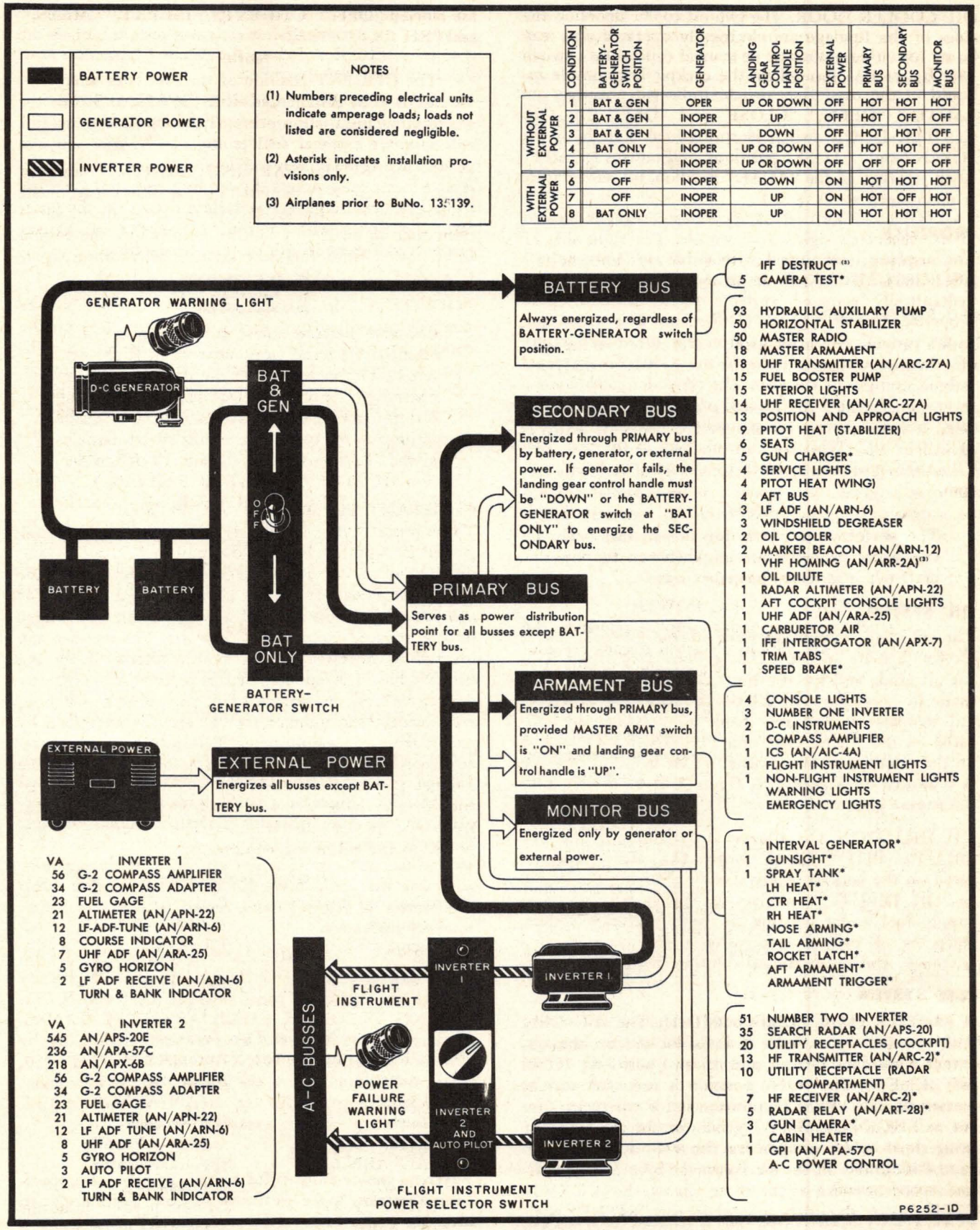


Figure 1-8. D-C Power and Constant Frequency A-C Power Distribution

D-C GENERATOR WARNING LIGHT. On early aircraft[1] a d-c generator warning light (10, figure 4-4, sheet 1) is located on the observer's right-hand console adjacent to the battery-generator switch. In later aircraft[2] the generator warning light (6A, figure 1-4, sheet 2) is located on the pilot's instrument panel adjacent to the battery-generator switch. A glowing warning light indicates that the d-c generator is not supplying power to the system.

D-C VOLT-AMMETER. A d-c volt-ammeter is located on the observer's right-hand console. The right side of the instrument indicates d-c system voltage and the left side indicates d-c system amperage.

A-C POWER SUPPLY SYSTEM

Both a variable frequency (400 to 800 cycles per second) and a constant frequency (400 cycles per second) a-c power supply system is provided. The engine-driven a-c generator provides three phases (separate sources) of variable frequency a-c power, the frequency of which is dependent upon the rpm of the generator. Two d-c powered inverters provide three phases of constant frequency a-c power. A-c power can be supplied only to the variable frequency bus from an external power source; however, constant frequency a-c power will be available from the two inverters whenever d-c power is supplied from an external power source.

VARIABLE FREQUENCY A-C POWER

The engine driven a-c generator supplies power to the circuit breakers where various electrical circuits are connected. This source of power is controlled by the A-C GEN FIELD switch and the A-C PWR switch. Failure of the d-c generator in flight will result in loss of a-c generator power on all circuits except the emergency lighting system since the monitor bus must be energized in order to utilize power from the a-c generator. The monitor bus cannot be energized by battery power.

A-C POWER SWITCH. The A-C PWR switch (12, figure 4-4) is located on the observer's right-hand console and has three positions, "OFF," "INT," and "EXT." The "INT" position is used for normal operations and will allow power to be delivered by the a-c generator as long as the monitor bus is energized. The "EXT" position is used when operation from an external power source is desired. The "OFF" position disconnects the a-c generator from the system.

A-C GENERATOR FIELD SWITCH. The A-C GEN FIELD switch (11, figure 4-4) is located on the observer's right-hand console and has two positions, "ON" and "RESET." The "ON" position is used for normal operations. The "RESET" position is for emergency use and will de-activate the a-c generator. In the event of an overload in the variable frequency a-c system, which may be indicated on the a-c voltmeter by a loss of voltage on one or more of the three phases, the A-C GEN FIELD switch should be placed in the "RESET" position for a few seconds and then returned to the "ON" position. Utilization of such a procedure may restore a-c power to the system. If power is not restored, place the A-C GEN FIELD switch in the "RESET" position until the fault has been remedied.

EMERGENCY A-C LIGHTING SYSTEM. If the d-c generator should fail during flight, the a-c generator will supply a-c power only to the FLT INSTR and the NON FLT INSTR lights. The emergency system operates automatically unless the landing gear has been extended before d-c generator failure occurs. In the latter case, the lights will continue to operate on battery power a sufficient length of time for landing.

CAUTION

Conserve battery power by turning off non-essential electrical equipment when flight cannot be terminated. With the d-c generator inoperative, only the equipment operating directly from the primary bus will be available as long as the battery-generator switch remains in the "BAT & GEN" position. (Refer to Section III, D-C GENERATOR FAILURE.)

CONSTANT FREQUENCY A-C POWER

Three phase, 115 volt, 400 cycle constant frequency a-c power is supplied by two d-c powered inverters and distributed to circuit breaker panels from which the flight instruments and other circuits receive power. For operation of certain items of a-c equipment, the voltage only is reduced from 115 to 26 volts. The number one inverter is operated by d-c power directly from the primary bus. The number two inverter also operates by d-c power from the primary bus, providing a switching relay within the number two inverter is energized by power from the monitor bus. Failure of the d-c generator in flight will result in the loss of power from the number two inverter, since the monitor bus cannot be energized by battery power. See figure 1-8 for constant frequency power distribution. The inverters supply power to the following equipment:

Number One Inverter

*Gyro horizon instrument
*G-2 compass
*Fuel gage
Voltmeter
*Turn & Bank Indicator
Radar Altimeter (AN/APN-22)
LF ADF (AN/ARN-6)
UHF ADF (AN/ARA-25)

Number Two Inverter

*Gyro horizon instrument
*G-2 compass
*Fuel gage
Voltmeter
LF ADF (AN/ARN-6)
UHF ADF (AN/ARA-25)
Search Radar (AN/APS-20E)
Automatic pilot
Radar Altimeter (AN/APN-22)
IFF Receiver (AN/APX-6B)
IFF Interrogator (AN/APX-7)
Ground position indicator (AN/APA-57C)
*Turn & Bank Indicator

*Essential equipment

[1] Airplanes BuNo. 132729-132750.
[2] Airplanes BuNo. 132751 and subsequent.

FLIGHT INSTRUMENT POWER SELECTOR SWITCH. The FLT INSTR PWR SEL switch (10, figure 1-5) is located on the cockpit center console adjacent to the auto-pilot controller. The switch has two positions, "INVERTER 1" and "INVERTER 2 & AUTO PILOT." This switch permits selection of an alternate source of power for the essential flight instruments in the event of failure of either inverter. Non-essential instruments and the automatic pilot are provided with power from the number two inverter regardless of the position of the FLT INSTR PWR SEL switch.

INVERTER WARNING LIGHT. A red warning light labeled FLT INSTR PWR FAILURE is located beside the selector switch. When illuminated, the light indicates failure of the selected inverter to provide sufficient power to the circuits. If the warning light remains illuminated on both inverter positions, no power will be available for the flight instruments and the flight should be terminated as soon as possible.

CAUTION

Do not take-off on the "INVERTER 2 & AUTO PILOT" position except in an emergency. The number two inverter cuts out at an engine speed below approximately 1200 rpm, therefore the gyros will not accelerate to a safe operating speed during normal taxi operations.

VOLTMETER PHASE SELECTOR SWITCH. The voltmeter phase selector switch (14, figure 4-4) is located on the observer's right console. This rotary type switch has five positions; "A," "B," and "C" of the 400-800 cycle source (a-c generator) on lower half of switch, and "A" and "C" of the 400 cycle source (selected inverter) on upper half of switch. This switch enables the operator to check each phase of the a-c power source on the a-c voltmeter.

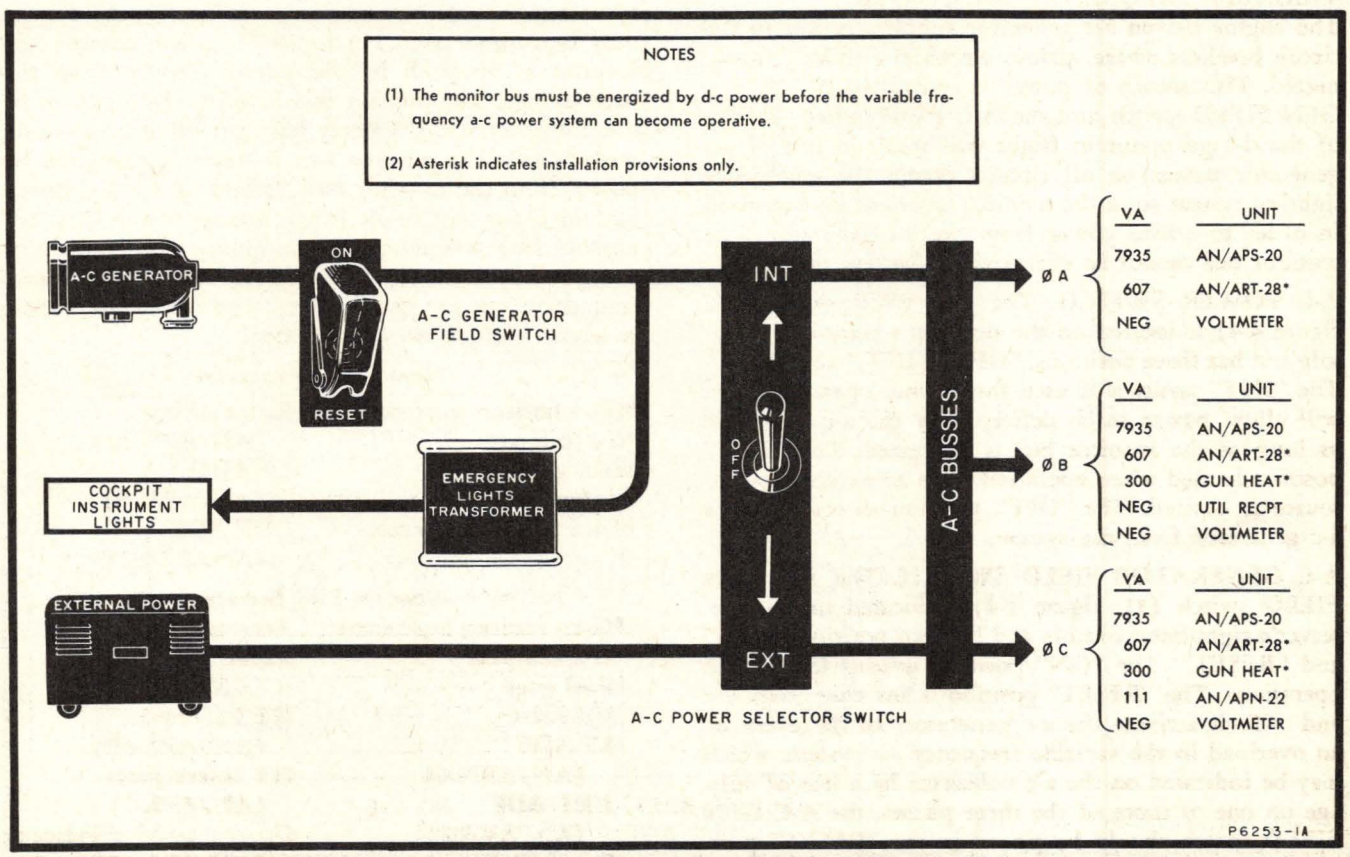


Figure 1-9. Variable Frequency A-C Power Distribution

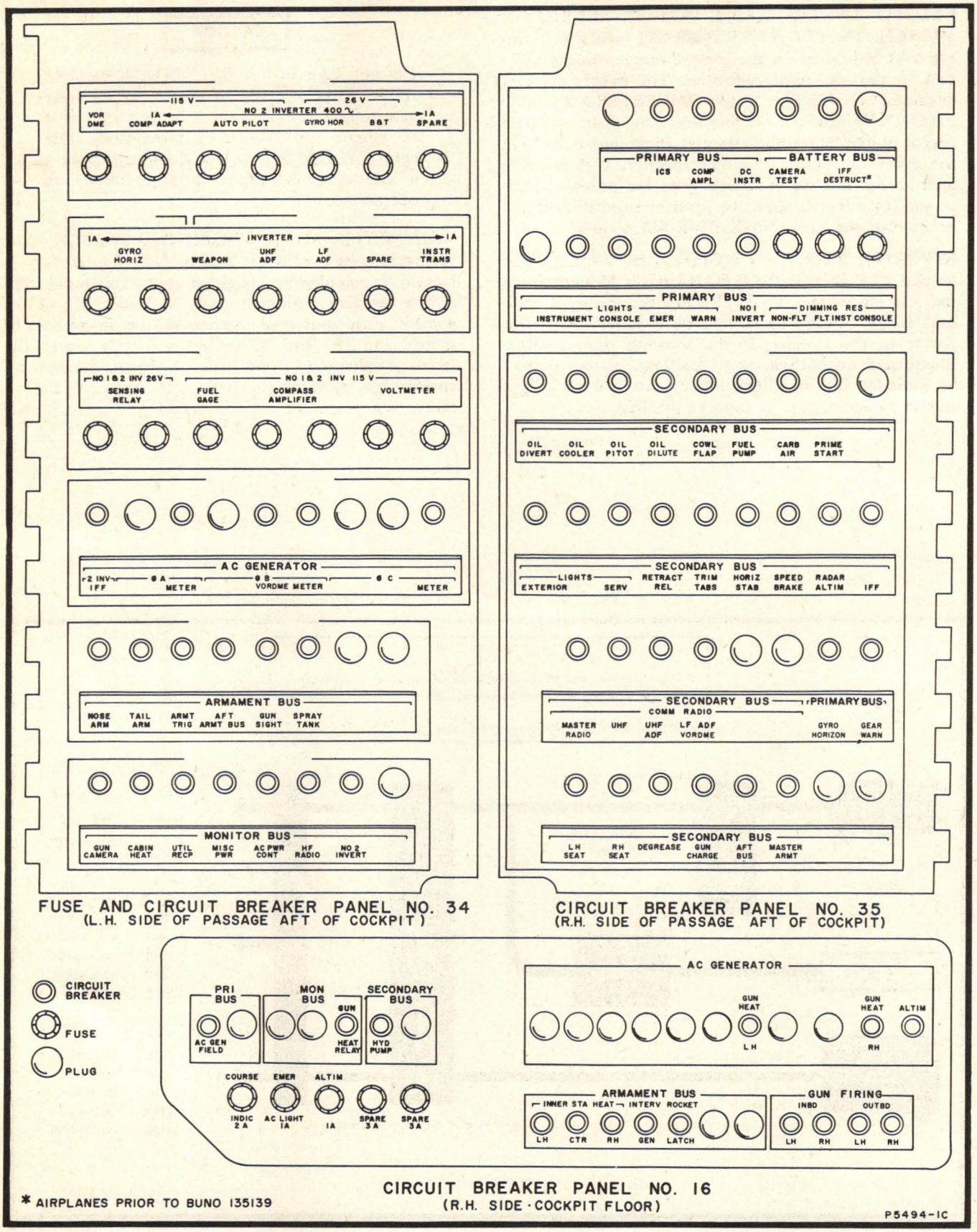


Figure 1-10. Circuit Breaker Panels

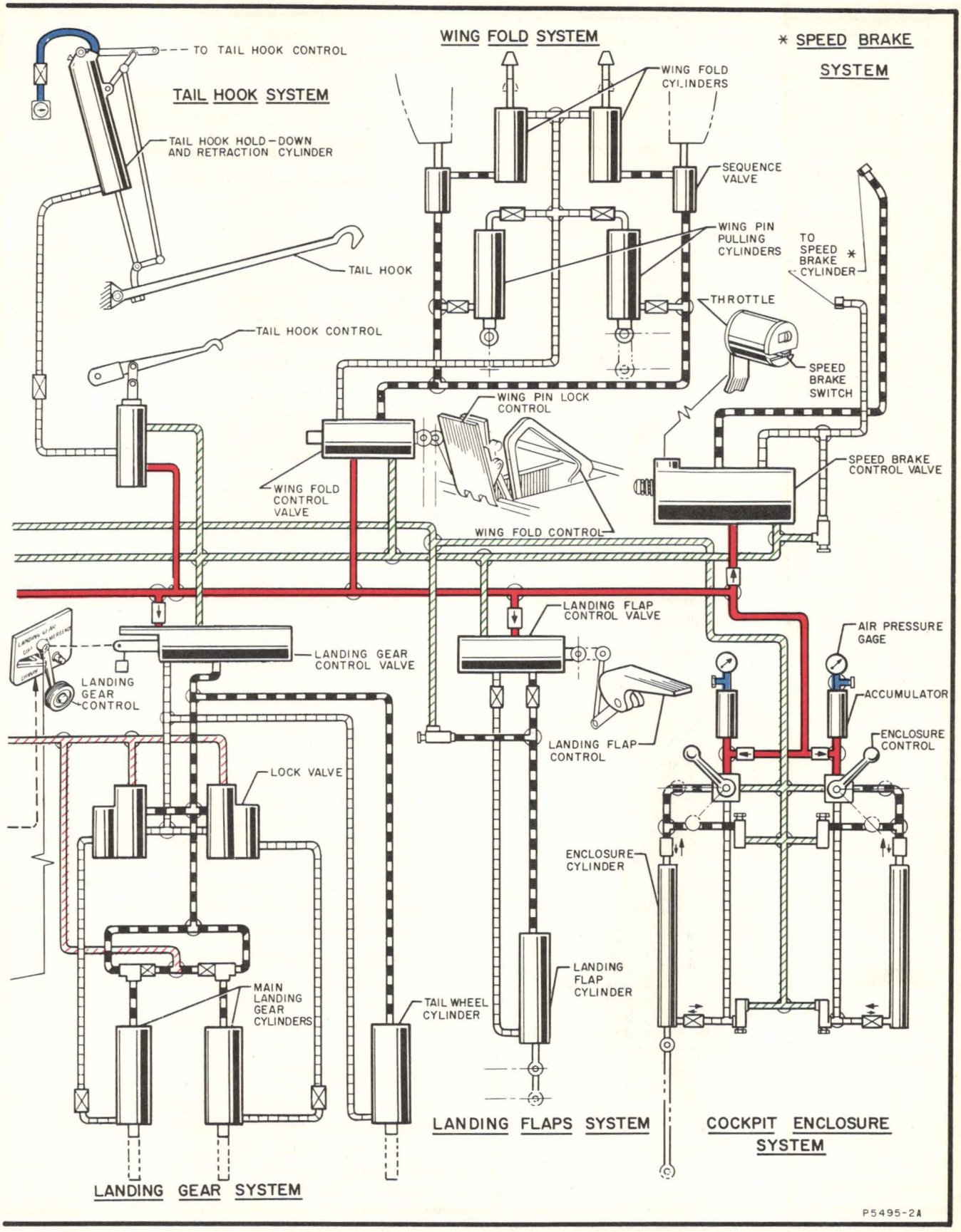


Figure 1-11. Hydraulic System (Sheet 2)

or by fore and aft movement of the horizontal stabilizer trim lever (9, figure 1-3) located on the cockpit left console.

Note

The elevators are fitted with a small sheet metal tab used to adjust trim to within prescribed limits in the cruise condition at 230 knots. The adjustment of this tab is critical. Deflection of 1/4 inch will cause a change of one degree in the trim setting of the horizontal stabilizer. It is important that the trim be checked periodically to insure that the cockpit trim settings fall within a prescribed region. At an airspeed of 230 knots at 10,000 feet, the necessary level flight trim of the airplane as indicated on the horizontal stabilizer indicator is 1 to 1½ degrees nose down.

WARNING

This check must always be made after the stabilizer, elevators or sheet metal tab have been repaired or newly installed. This is necessary because large deviations from the normal trim setting may lead to structural damage to the tail during high speed flight.

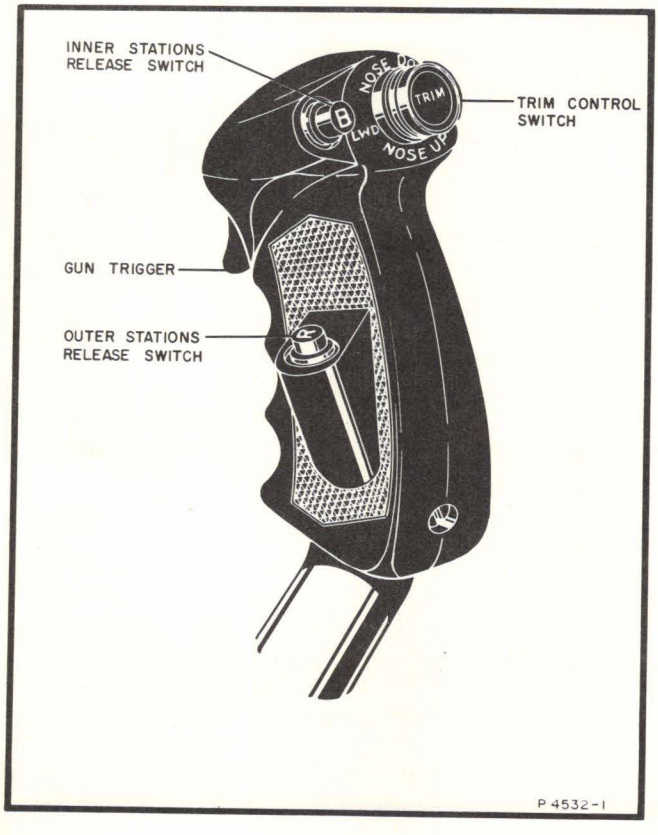


Figure 1-12. Control Stick

An indicator is provided on the pilot's instrument panel (21, figure 1-4) which shows the position of the three trimming surfaces.

WARNING

Use of horizontal stabilizer to assist recovery from dives may result in structural failure.

WING FLAPS. The wing flaps are hydraulically operated and controlled by a lever (7, figure 1-3) located on the cockpit left console. The wing flaps control lever has three positions: "UP," "STOP," and "DOWN." A position indicator (28, figure 1-4) is provided on the pilot's instrument panel.

RUDDER GUST LOCK. Flight controls are secured externally on the parked airplane. The rudder gust lock consists of a cable, a felt-padded jaw assembly, two brackets and a locking latch to take up the slack on the cables. The rudder gust lock necessitates locking ailerons and elevator by tying the control stick in the aft position with the pilot's seat belt.

SPEED BRAKE. Provisions are made for the installation of a single speed brake on the lower aft fuselage. When the speed brake is installed, the SPEED BRK switch (26, figure 1-3) on the throttle grip is moved to "OPEN" or to "CLOSE" for operation of the speed brake.

STALL WARNING SYSTEM.[1] A stall warning system is provided in the aircraft to warn the pilot of an unsafe flying speed or aircraft attitude. The system operates on a percentage of airspeed above the stall for any attitude of the aircraft. As a stall is approached, due to a dangerous attitude or low airspeed, the control stick will begin to vibrate rapidly. Vibration begins at an airspeed of approximately 8 to 9 knots above the stall speed, and continues until the angle of attack is reduced or the airspeed increased.

In icing conditions, heat may be furnished to the stall warning lift transducer located on the leading edge of the wing, by actuating the OIL DILUTE-PITOT HEAT switch to the "PITOT HEAT" position.

WING FOLDING

The wings are folded and spread by pressure from either the main or the emergency hydraulic system. A non-hydraulic latch locking mechanism safeties the hydraulically-operated locking pins. Tubular warning "flags," located in the leading edge of the wing at the fold joints, extend when the latches are not engaged with the locking pins.

[1] After Service Change No. 640.

WING FOLDING CONTROLS. The wing folding controls (7, figure 1-5) are located on the cockpit center console. A door type control marked WING PIN LOCK operates the locking pin latches. The handle controlling the folding operation is located in the recess under the WING PIN LOCK door. To fold the wings, first move the WING PIN LOCK door up to mechanically release the wing pin latches, extend the warning flags and expose the wing folding handle. Next raise the wing folding handle to hydraulically retract the wing pins and fold the wings. To spread the wings, reverse this procedure. With the wings fully spread, close the WING PIN LOCK door, making certain that it is flush with the console and that the two warning "flags" retract into the leading edge of wing.

CAUTION

Both the WING PIN LOCK door and the wing fold handle should be in the open (unlocked and folded) position at all times when the wings are folded.

LANDING GEAR

The landing gear is retracted and extended by either the main or the emergency hydraulic system. The actuating linkage which raises or lowers the gear causes the strut to pivot so that the wheel is stowed flush with, and in the same plane as, the wing lower surface. The landing gear struts telescope automatically upon retraction, permitting the wheels to fit into wells between the wing spars. A switch is actuated by compression of the left shock strut, de-energizing a safety solenoid which prevents inadvertent movement of the landing gear control handle to the "UP" position when the airplane is resting on the gear.

LANDING GEAR CONTROL. The LANDING GEAR control (22, figure 1-3) incorporates three positions: "UP," "DOWN," and "EMERGENCY." With the airplane resting on the ground, the control handle cannot be moved to "UP" unless a safety latch (16, figure 1-3) adjacent to the control handle is manually depressed. This safety latch is automatically deflected by an electrical solenoid when the airplane is airborne. A red warning light in the landing gear control handle illuminates whenever the control handle is moved to either "DOWN" or "UP," remaining on until all three wheels are locked in position. A wheels and flaps position indicator (28, figure 1-4), showing the position of all three wheels, is located on the pilot's instrument panel.

WARNING

When moving the landing gear control to any position, make sure the control handle stops in its detent by "click and feel" rather than position indication alone. In the "DOWN" position, make sure the handle is forward of the solenoid operated safety latch so that when the latch comes out into position upon landing it will not strike the landing gear control handle. If this is not observed the control handle may work its way aft, shutting off hydraulic pressure to the landing gear, causing the hydraulically operated down-lock linkage to break toward the retracted position.

The landing gear control can be moved to "EMERGENCY" by manually depressing the landing gear control release plunger (19, figure 1-3) located between the "DOWN" and "EMERGENCY" positions and moving the control full forward. Approximately three times the normal landing gear control force is required to reach "EMERGENCY" from "DOWN." Moving the landing gear control to "EMERGENCY" simultaneously starts the emergency hydraulic pump, shifting an emergency selector valve from the system position to the landing gear emergency down position. In this position the emergency hydraulic pump pressure operates the main landing gear only and not the tail wheel gear. No pressure indication is provided for emergency gear extension. For emergency tail gear extension, refer to Section III, LANDING GEAR EMERGENCY EXTENSION.

WARNING

Following in-flight emergency extension of the landing gear due to main hydraulic system failure, the landing gear control handle must remain in the "EMERGENCY" position until the control linkage is manually reset on the ground.

CAUTION

If the control handle is inadvertently moved to the "EMERGENCY" position under otherwise normal conditions, the control linkage can be reset in flight by depressing the release plunger and moving the control handle to the "UP" position. Do not move the handle directly to the "DOWN" position as this will only partially reset the linkage. To reset the linkage while the airplane is on the ground, move the control handle from the "EMERGENCY" position to the "DOWN" position and have the linkage reset at the valve. Do not move the control handle to the "UP" position when the airplane is on the ground.

LANDING GEAR FLASHING WARNING LIGHT. After incorporation of Aircraft Service Change No. 652, the airplane will be equipped with a landing gear flashing warning light (5A, figure 1-4, sheet 2) located

on top of the glareshield at the left-hand side of the cockpit. The light is identified as "WHEELS," and flashes at a rate of two cycles per second whenever the throttle is retarded past approximately 90% of full power, the flaps are down, and the landing gear is in any position other than fully down and locked. The landing gear flashing warning light is powered by the d-c primary bus.

CAUTION

In the event that a no-flaps landing is made, due to flaps failure or wind conditions, extra care should be taken to ascertain that the gear is down and locked, as the landing gear flashing warning light will continue to blink in this condition. The landing gear position indicator and landing gear handle warning light may be used for this purpose.

TAIL WHEEL LOCK. The tail wheel lock control (3, figure 1-3) is located at the aft end of the cockpit left console.

BRAKE SYSTEM

The airplane is equipped with single-disc "spot" brakes operated with power boost derived from the main or emergency hydraulic systems. Operation is direct and by toe pressure on the brake pedals. In case of hydraulic system failure, braking pressure is available by exerting approximately three times the normal force on the pedals.

Note

Braking power boost is furnished by the emergency hydraulic system if the EMER HYD switch is held "ON." However, boost will not be provided for braking if the emergency hydraulic system is actuated by placing the landing gear control handle in the "EMERGENCY" position. In this case, braking may be had by exerting approximately three times the normal force on the pedals.

ARRESTING GEAR

The arresting hook control (20, figure 1-4) is located to the right of the pilot's instrument panel. Moving the control lever to the "HOOK DOWN" position lowers the hook and, in conjunction with the landing gear, turns on the landing approach light. A red warning light in the arresting hook control illuminates when the control is moved to the "HOOK DOWN" position and remains on until the hook reaches the full down position. Normally, the light will be on only momentarily. Lifting the control lever to the "HOOK UP" position will return the hook to the up position.

INSTRUMENTS

A conventional instrument panel contains tl.e flight instruments necessary for all-weather operations. The electric gyro-horizon and G-2 compass control the auto pilot. The turn and bank indicator is air driven and the pitot-static system is connected to the altimeter, airspeed, and rate-of-climb indicators. The static boom projects forward from the leading edge of the vertical stabilizer while the pitot head is located beneath the right outboard wing panel.

G-2 COMPASS. The G-2 compass consists of a compass-controlled directional gyro indicator, an amplifier and a remote compass transmitter. Approximately three minutes are required for the gyro to reach operating speed after the battery-generator switch has been turned to "BAT & GEN" or "BAT ONLY." The compass is non-tumbling and does not require caging prior to or after maneuvers. For use, the gyro should be set to correspond with the directional indication of the miniature dial in the center of the indicator face. To correctly set the directional gyro indicator, the caging knob must be fully depressed at the new heading for at least two seconds and then released straight out, avoiding any twisting motion. A switch (8, figure 1-4) which controls the compass slaving system is located on the pilot's instrument panel. The switch must be in the "CONTROL" position for the directional gyro indicator to be subject to compass control. In this condition the directional gyro is stabilized by the compass transmitter and amplifier providing continuous magnetic heading indication of the airplane. Moving the switch to the "FREE" position disconnects the gyro torque motor from the compass circuit allowing the indicator to operate as a free directional gyro. The "FREE" position prevents directional indications from becoming erratic due to the excessive "dip" of the earth's magnetic field in the polar regions or to other magnetic field disturbances such as are created by an aircraft carrier.

WARNING

Do not under any circumstances set or reset the G-2 compass while the P-1 auto pilot is engaged. This will cause abrupt, violent rudder forces in excess of design limits of the airplane.

GYRO HORIZON. Approximately two minutes are required for the gyro horizon (16, figure 1-4) to reach operating speed after the battery-generator switch is turned to "BAT & GEN" or "BAT ONLY". The airplane attitude must not exceed 70 degrees pitch or 110 degrees bank while the gyro horizon is uncaged, since the gyro tumbles at attitudes in excess of these limits.

VERTICAL GYRO INDICATOR. The aircraft is equipped with an MM-2 vertical gyro attitude indicator (16A, figure 1-4, sheet 2) located on the instrument panel. This instrument provides the pilot with a constant visual attitude indication of the pitch and roll of the aircraft. Attitude reference signals are transmitted to the MM-2

indicator by the K-4 controller which is mounted remotely in the aircraft. Pitch and roll attitudes are indicated by a universally mounted sphere which is visible as the background for a miniature reference airplane attached to the instrument case. The horizon is represented on the sphere as a white line dividing the top and bottom halves of the sphere. The upper half, symbolizing sky, is identified by a light gray color above the horizon line labeled "CLIMB"; the lower half, symbolizing the earth, is identified by a dull black color below the horizon line labeled "DIVE." The sphere is graduated every five degrees of climb and dive. The sphere is free to move a full 360 degrees of roll at roll rates up to 275 degrees per second. Multiple rolls may be made without accumulative instrument error. Bank angles may be read on a semi-circular scale located on the perimeter of the upper half of the instrument case. The miniature reference airplane is always in the logical physical relationship to the simulated earth, horizon or sky areas of the background sphere during maneuvers, and is sufficiently realistic to enable the pilot to fly the airplane simply by flying the instrument. The indicator is capable of accurate attitude presentations in all pitch attitudes including loops and immelmans; however, the instrument will "tumble" if the aircraft is rolled in either a vertical climb or dive. The K-4 remote gyro control unit is driven by a 115 volt, 400 cycle, a-c electric motor which receives current from the number 1 or number 2 inverter. Control power is furnished by the 28 volt d-c primary bus. The MM-2 indicator receives all its power from the K-4 gyro control unit. The instrument is illuminated indirectly by the instrument lighting system. The instrument features automatic caging and is ready for use shortly after electrical power is introduced into the system. Within 2 minutes the gyro is erected, the amplifier channels are warmed up, and the "OFF" flag is retracted from the indicator face. Failure at any time of the a-c or d-c power supply or the election relay will cause the "OFF" flag to reappear. An adjusting knob sets the potentiometer controlling the sphere setting to line up the horizon line with the reference airplane to accommodate different sized pilots and trim and loading conditions of the airplane.

WARNING

- The indicator is not reliable for attitude reference if the power warning flag is visible.
- Rolling the aircraft while in a vertical attitude will cause the instrument to tumble.

In the event that a maneuver has been performed which has caused the vertical gyro to tumble, the instrument will erect itself at a "slow" slaving rate of three degrees per minute. "Fast" slaving may be obtained by turning the BAT SWITCH to "OFF," momentarily.

MISCELLANEOUS EQUIPMENT

CANOPY. The canopy covering the cockpit is of clear plexiglas while the radar operator's compartment is completely enclosed to darken the interior to ensure better radar scope illumination and signal interpretation. A tinted plexiglass window is installed in both of the hinged hatches covering the radar operator's compartment. A fabric cover on the inner side of each window may be opened by unfastening the zipper attachment. Both hinged hatches swing upward to open, and access to the radar operator's compartment is from the left side of the fuselage. Access to the cockpit is gained from either side of the fuselage through sliding hatches.

COCKPIT HATCH CONTROLS. The two sliding cockpit hatches are hydraulically operated. Levers controlling operation of the hatches are installed on either side of the fuselage both inside and outside the cockpit. The hatches move in the direction the control levers are moved, and can be stopped at any intermediate point by placing the control lever in the "STOP" position. In case of hydraulic failure the sliding hatches are provided with hydraulic pressure from two pressurized accumulators and check valves. Each hatch operates independently of the other on its own accumulator pressure.

CAUTION

Sufficient pressure is maintained in the accumulators after engine shutdown for several operations of the sliding hatches. Extreme caution should be exercised when entering or leaving the cockpit to avoid accidental movement of the controls and possible bodily injury from the pressure of a closing hatch.

Manual operation of the hatches is required if hydraulic pressure is not available and pneumatic accumulator pressure is expended. Access to the cockpit is gained by operation of levers installed on the lower forward edge of each hatch, both inside and outside. Approximately 50 pounds of force is required for manual operation.

Note

If the hatches fail to open by hydraulic pressure during in-flight emergency, manual operation of the hatches may prove difficult due to limited arm leverage and slipstream effect. Reducing airspeed will lower resistance of outside pressure.

RADAR OPERATOR'S MIDDLE COMPARTMENT HATCH CONTROLS. The middle compartment hatches are manually operated and controlled by levers (figure 3-1) located both inside and outside on the forward end of the hatches. In addition, a manually operated emergency release handle is installed on the center overhead canopy support. Pulling the emergency handle downward jettisons the hatches on both sides of the

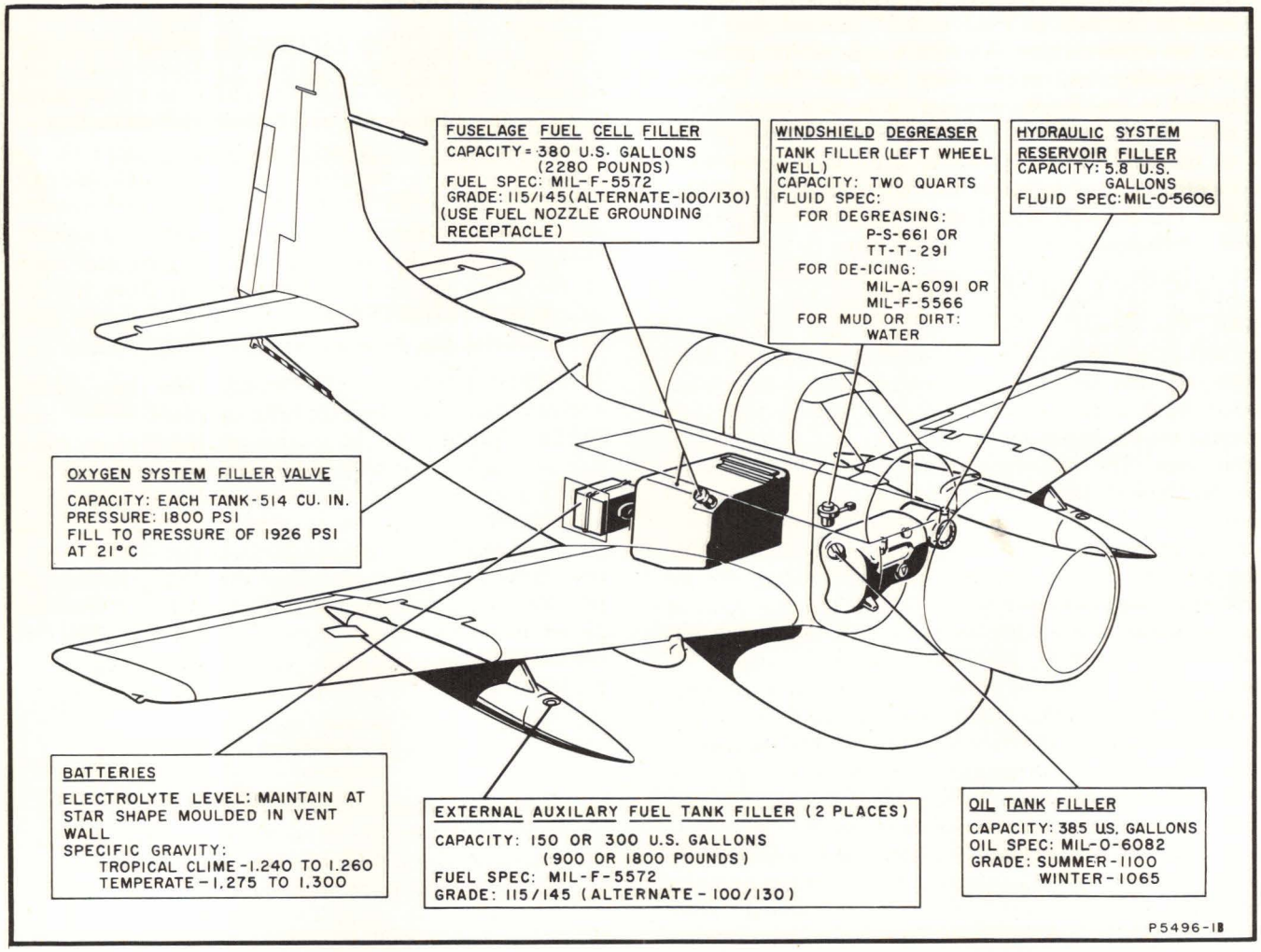


Figure 1-13. Servicing Points and Specifications

compartment. In aircraft prior to incorporation of Service Change Number 622, jettisoning is accomplished mechanically thru release of the locking pins and hatch hinges. In aircraft after incorporation of Service Change Number 622, jettisoning is accomplished by mechanically releasing the locking and hinge pins and pneumatically ejecting the hatch covers into the slipstream through the action of two pistons located under the leading edges of the hatch covers. The pneumatic jettisoning system is comprised of an air bottle charged to 3000 psi, a control valve, an ENCL EMER REL handle, mechanical linkages, and associated piping. The hatches should be kept closed during engine warm-up, take-off, and flight.

CAUTION

The middle compartment hatches must be inspected for proper latching prior to take-off. Failure to do this may result in loss of enclosure and possible damage to aircraft.

SEATS

Each seat accommodates a seat pad, a back pad, a PK-2 pararaft kit and a seat type parachute. The pilot's and the observer's seats are electrically adjusted by switches located on the right-hand front of the bucket portion of each seat. The seats move upward and forward when the switch is moved to the "UP" position and downward and aft when moved to the "DOWN" position. The radar operator's seat is not adjustable.

CAUTION

(1) Because of the location of the seat switch in some airplanes, it is possible for the pilot's hand to be caught between the seat and the center console during raising and lowering of the pilot's seat, if the hand is held in an unnatural position.

(1) Airplanes prior to BuNo. 132744.

SHOULDER HARNESS AND SAFETY BELT. The shoulder harness and safety belt on each seat are of the conventional type. An inertia reel take-up mechanism is provided for the shoulder harness. The harness is locked in position by pushing the handle located on the left side of each seat forward to the "LOCK" position. In the "UNLOCK" position, the reel is automatically locked when subjected to a deceleration along the thrust line of the airplane (as in a head-on crash) in excess of 2.5 G.

PERSONNEL GEAR ATTACHMENT. The headphones and microphone connections are incorporated with the oxygen tube adjacent to each seat.

AUXILIARY EQUIPMENT

Refer to Section IV for description and operation of the following auxiliary equipment:

Heating, Ventilating and Anti-icing Systems
Communications and Electronic Equipment
Lighting Equipment
Automatic Pilot
Oxygen System
Armament Equipment
Miscellaneous Equipment

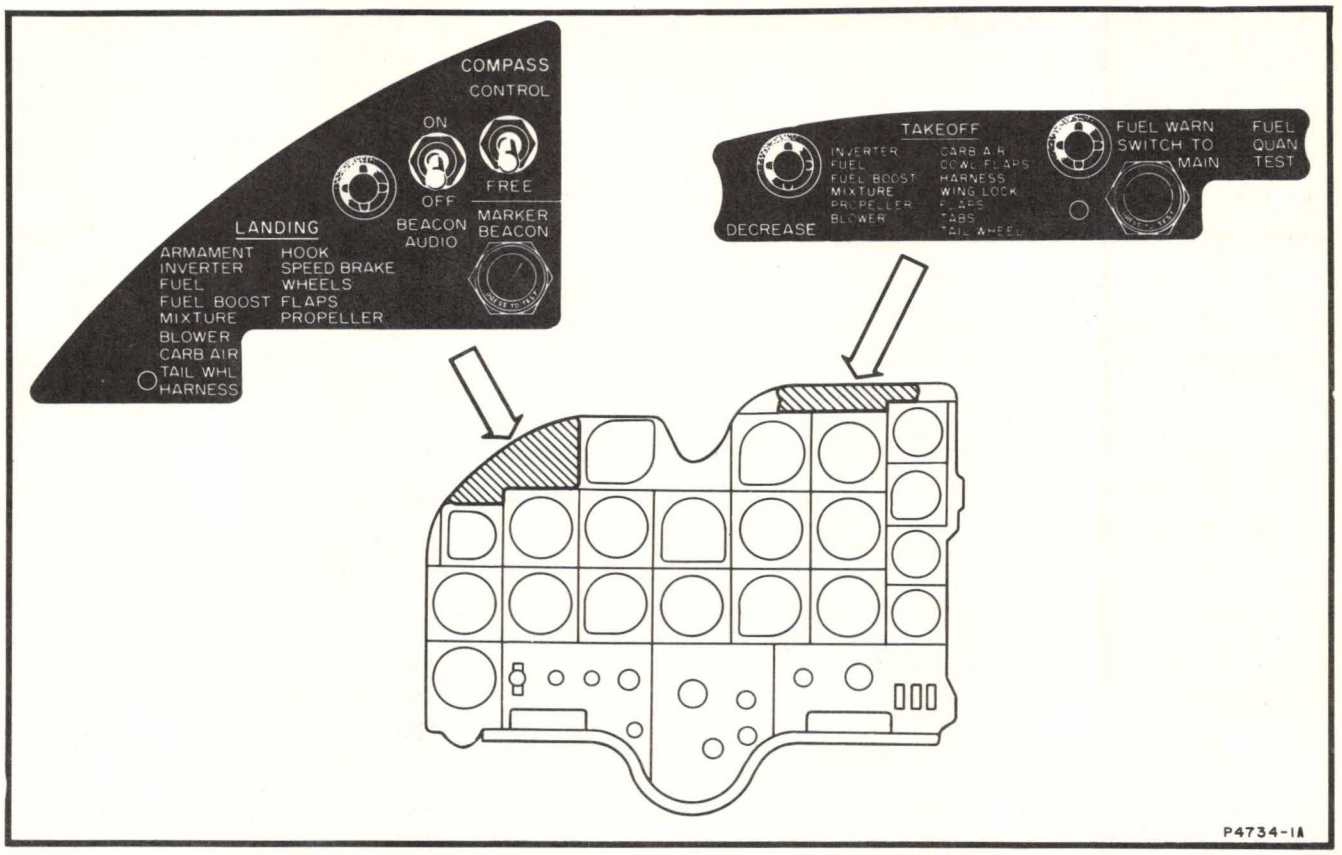


Figure 2-2. Check-off Lists

t. FLT INSTR lights switch .... "OFF"

u. Auto pilot clutch switch ..... "DISENGAGED"

v. Wing pin lock door and wing fold lever—Should be in the open position if wings are folded, or closed if wings are spread.

w. If the wings are spread, check to see that the wing lock-pin warning flags are retracted into the wings.

Note

Although pilots of tall or average height should experience no difficulty, a short pilot must raise himself slightly out of the seat to see the right-hand wing lock-pin warning flag.

x. Check control surfaces for free and correct movement.

y. Emergency hydraulic pump-switch ..... "ON"—check pressure—"OFF"

INTERIOR CHECK (NIGHT FLIGHTS). Check the operation of all interior and exterior lights.

BEFORE STARTING ENGINE

EMERGENCY HYDRAULIC PUMP CHECK

With external power applied or the battery-generator switch in either position, actuate the emergency hydraulic pump switch and check for pressure on the hydraulic pressure gage. This will indicate that the pump is in good operating condition.

CLEAR ENGINE PROCEDURE. To clear the engine, turn propeller through four revolutions (16 blades) with the engine starter.

CAUTION

Extensive damage to the engine may result from liquid lock, an accumulation of raw fuel or oil in the lower cylinders, if this procedure is not followed. Clearing the engine may be done by the ground crew immediately prior to flight. If unusually high compression is present the spark plugs must be removed from the lower cylinders and the liquid allowed to drain. The propeller should never be turned opposite to normal rotation as this may force liquid into the intake pipes from where it is likely to be drawn back into the cylinders when the engine is started.

ALTERNATE FUEL. The engine can be operated on an alternate grade of fuel (see figure 1-13); however, certain additional limitations apply in this case. Refer

to Section V, ENGINE LIMITATIONS, when an alternate grade of fuel is to be used.

STARTING ENGINE

a. Set throttle friction as desired.

b. Adjust the throttle to obtain the following recommended engine speeds during a start:

(1) 1100 to 1200 rpm for OAT of 5° to 16°C.

(2) 1300 to 1400 rpm for OAT of 18° to 32°C.

(3) 1400 to 1450 rpm for OAT of 38°C or higher.

Note

Do not allow engine speed to exceed 1450 rpm during a start.

c. Fuel boost pump ..... "ON"

Note

An external power supply should be used when starting the engine and the battery-generator switch should be "OFF" until external power is removed.

d. Energize the starter and, after the propeller has turned through two complete revolutions (8 blades), press the primer button and quickly turn the ignition switch to "BOTH" in that order.

Note

- The primer button must be held down for continuous delivery of fuel. Intermittent operation results in an exceedingly erratic fuel/air ratio during the attempt to start and increases the possibility of severe backfiring. However, excessive overpriming should also be avoided. This can cause liquid lock or difficult engine starts. After the engine starts, adjust airflow with the throttle to obtain smooth engine operation.
- A friction-disc dry clutch, pre-set to a torque of approximately 800 foot-pounds, is incorporated in the starter to prevent liquid lock damage to the engine.

e. Should the engine fail to start within 30 seconds, allow the starter to cool and repeat the starting procedure.

f. When the engine is operating smoothly on the primer alone, move the mixture control to "RICH." Release primer when a drop in rpm indicates fuel from the carburetor has reached the cylinders. Priming can be continued as needed for smooth engine operation. If the engine ceases to fire, increase priming, or if the engine runs rough and smokes, stop priming.

Note

The only use for the primer after the engine is operating on carburetor fuel (mixture "RICH") is to occasionally add the primer flow to keep the engine running smoothly until warmed-up during cold weather operation when temperatures range below freezing.

CAUTION

Do not start the engine with the mixture control out of "IDLE CUT-OFF" as this may cause "liquid lock" and result in engine damage which may not be immediately detected.

g. After the engine has started, reset the throttle for 1200 rpm. Do not pump the throttle. Operate the throttle evenly and slowly although the engine is running smoothly.

h. Check oil pressure.

CAUTION

Stop the engine if the rear oil pressure gage does not register within ten seconds, or does not reach 40 psi within 20 seconds. Advancing the throttle while the oil is cold will result in cavitation within the oil pump. A loss of oil pressure is associated with such cavitation. During cold weather starting, the throttle should be retarded to minimum idle (650 rpm) during warm-up to maintain a stabilized oil pressure. If the pressure does not stabilize, the engine should be stopped and heat applied locally to the oil lines and tank.

i. Refer to Section III, FIRE WHILE STARTING ENGINE, for instructions to be followed in case of fire while starting.

j. If the engine does not start, allow any excess fuel to drain out of the blower drain. Inspection of the exhaust stack outlets should indicate whether the engine has been overprimed or underprimed. Excessive black smoke indicates overpriming and use of the primer switch should be governed accordingly. If the engine is overprimed, turn all switches off, open the throttle, put mixture control in "IDLE CUTOFF" and turn the propeller through six revolutions with the starter.

ENGINE GROUND OPERATION

a. Warm up at approximately 1200 to 1400 rpm.

b. Head the airplane into the wind when an extended period of ground operation is anticipated.

c. For all ground operations, except as specified in GROUND TESTS and PRE-FLIGHT ENGINE CHECK, keep the propeller in full "INCREASE" rpm position, and the super-charger control in "LOW" blower.

d. Continue the warm-up until oil pressures stabilize.

e. Cylinder head temperature should not exceed 260°C.

CAUTION

During ground operations, make certain that the heating system control lever is in the "OFF" or the "WIND & CABIN" position, since use of the "WIND" position allows extremely hot air to be directed against the windshield, which might result in cracking of the glass.

GROUND TESTS

ELECTRICAL SYSTEM

D-C POWER SUPPLY CHECK

a. Disconnect the external power source, if used, and place the battery-generator switch in the "BAT & GEN" position.

b. Determine that all circuit breakers are pushed in.

c. With engine idling, place a light load on the electrical system, such as cockpit or instrument lights.

d. Increase engine speed gradually to approximately 1500 rpm until the d-c voltmeter reads approximately 27 volts. If the GEN WARN light goes off it is an indication that the reverse-current relay is functioning properly. Push the warning light in to test it.

e. Increase the engine speed and check the d-c voltmeter. The voltmeter reading should increase until it reaches approximately 28 volts and should remain at that reading regardless of any further increase in engine speed.

CAUTION

A take-off should not be made if the GEN WARN light is on or if the d-c voltmeter reading is below 26.7 volts.

A-C POWER SUPPLY CHECK

While maintaining sufficient engine speed for generator output (approximately 1500 rpm), make the following check:

a. AC PWR switch ..... "INT"

b. AC GEN FIELD switch ..... "ON"

c. Turn the a-c voltmeter phase selector switch to each of the 400-800 cycle phases. The voltmeter should indicate 110 ± 6 volts for each phase.

d. With the FLT INSTR PWR SEL switch on "INVERTER 1," turn the phase selector switch to each of the 400 cycle phases. The voltmeter should indicate 115 ± 2.5 volts for each phase.

e. Turn the FLT INSTR PWR SEL switch to "INVERTER 2 & AUTO PILOT" position and repeat the check of the 400 cycle phases. The voltmeter should indicate 115 ± 2.5 volts for each phase.

INVERTER WARNING AND SELECTION CHECK

While maintaining sufficient engine speed for d-c generator output (approximately 1500 rpm), check inverter operation by first placing the FLT INSTR PWR SEL switch on "INVERTER 2 & AUTO PILOT." The FLT INSTR PWR FAILURE warning light should be out.

a. Turn the battery-generator switch to "BAT ONLY." The warning light should illuminate.

b. Switch to "INVERTER 1." The warning light should go out.

c. Turn the battery-generator switch to "BAT & GEN." Remain on "INVERTER 1" for take-off.

CAUTION

While operating on the number one inverter, the flight instruments will be unsafe for take-off unless the a-c generator has cut in and is producing the proper output (25 volts minimum).

WARNING

The number two inverter cuts out at an engine speed below approximately 1200 rpm, therefore the gyros may not come up to a safe operating speed during normal taxi operations. Do not take-off on "INVERTER 2 & AUTO PILOT" except in an emergency.

HYDRAULIC SYSTEM CHECK

The following check should be made for normal operation of the hydraulic system:

Emergency hydraulic bypass valve . . Handle depressed

Emergency hydraulic switch ..... "OFF"

Aileron boost release handle ..... "IN"

Hydraulic pressure gage ..... 2600 to 3100 psi

Note

The hydraulic pressure gage installed in the airplane has a tolerance of ±125 psi. This should be taken into account when checking the hydraulic system. No attempt should be made to reset the regulator or the relief valves with the airplane pressure gage.

FUEL SYSTEM CHECK

FUEL PUMPS. With the engine running at 1500 to 1800 rpm turn the fuel boost pump "OFF" to check operation of the engine-driven pump. Fuel pressure should be 19 to 21 psi. With the fuel booster pump "ON," fuel pressure may increase as much as two and one-half pounds. If external auxiliary tanks are installed, the engine should be run on each tank long enough to see that all fuel lines are clear. Return the fuel tank selector valve to "MAIN" for take-off.

FUEL QUANTITY INDICATOR. Check the fuel quantity gage indication by depressing the FUEL QUAN TEST switch. The fuel quantity indicator will drop toward a zero reading and then return to an actual fuel quantity indication when the switch is released if the indicator is functioning properly. If no deflection of the indicator needle is apparent, some part of the system is malfunctioning.

OIL SYSTEM CHECK. With the engine running at 1500 to 1800 rpm, check the front and rear oil pressures and oil temperature.

Front oil pressure	35 psi ± 5
Rear oil pressure	70 psi ± 5
Oil temperature	85°C desired 95°C maximum 30°C minimum

Note

Rear oil pressure may indicate as low as 15 psi when the engine is idling.

TAXIING INSTRUCTIONS

The airplane is equipped with a conventional tail wheel type landing gear and standard taxiing procedures should be followed. The rudder becomes effective at speeds of over 10 knots. The controls should be set as follows for taxiing:

a. Oil cooler door	"AUTO"
b. Wing flaps	"UP"
c. Mixture control	"RICH"
d. Propeller control	"INCREASE"
e. Carburetor air	"DIRECT"
f. Tail wheel	"UNLOCK"

Note

Lock the tail wheel during extended cross-wind taxiing to relieve excessive braking action.

WARNING

The canopy must be closed during extended periods of cross-wind taxiing in order to prevent carbon monoxide contamination in the cockpit.

BEFORE TAKE-OFF

PRE-FLIGHT ENGINE CHECK

IDLE MIXTURE. With the engine idling at 650 ± 50 rpm and the fuel boost pump "OFF," move the mixture control slowly toward "IDLE CUT-OFF" and observe any change in engine speed. Return the mixture control to "RICH" before the engine cuts out. A rise of more than ten rpm indicates too rich an idle mixture, and no rise or a drop in engine speed indicates that the idle mixture is too lean. A rise of five to ten rpm is desirable. This will permit idling at low speed without fouling the spark plugs and also affords good accelerating characteristics. A slight momentary drop in manifold pressure may be used as an indication of a slight rise of rpm.

SUPERCHARGER CLUTCH

a. Set the engine speed at 1600 rpm with the throttle and note manifold pressure.

b. Move the supercharger control to the "HIGH" blower position and lock.

c. Open the throttle to obtain 30 inches MAP.

CAUTION

The control stick must be held back to prevent airplane from nosing over.

d. Move the supercharger control to the "LOW" position and lock. A sudden increase in rpm indicates that the two-speed mechanism is working properly.

CAUTION

Do not repeat supercharger clutch shift check at less than five minute intervals.

e. Reset engine speed at 1600 rpm and check manifold pressure obtained at the beginning of the check. The readings should be the same.

Note

The engine is equipped with a roller type clutch which requires no desludging.

PROPELLER

a. Run the engine at 1600 rpm, not exceeding 25 inches MAP during the following check.

b. Note rpm reaction as propeller control is placed in full "DECREASE" (high pitch) position. The propeller should govern engine speeds down to 1100 to 1300 rpm. Surging within these speeds is normal.

c. Return the control to full "INCREASE" (low pitch) position.

d. Check for reduction and full recovery of rpm.

MAGNETO AND POWER CHECK. Make power check using as a manifold pressure setting the field barometric pressure as noted on the manifold pressure gage prior to starting. With the propeller control in the full "INCREASE" position and the engine giving the proper power output, the rpm should read 2310 ± 50. Any deviation beyond the 50 rpm allowable drop or increase indicates a malfunctioning power plant. This power check is valid for any field elevation.

a. Advance the throttle to obtain a manifold pressure setting equal to the field barometric pressure. The rpm should be 2310 ± 50.

Fly at the lowest altitude consistent with safety and stay in the "clean" condition until landing is imminent. If more power is required, increase the throttle setting to obtain the maximum allowable of 3120 rpm. This engine speed may be maintained for a maximum of 30 seconds.

FIRE

ENGINE FIRE

FIRE WHILE STARTING ENGINE. Fire in the induction system may result from backfiring where the presence of excessive priming fuel exists. Allowing the engine to run will often cause the fire to be drawn out through the engine. If the fire continues, place the mixture control in "IDLE CUTOFF," turn the ignition switch and fuel tank selector to "OFF" and vacate the airplane. An outside portable fire extinguisher must be used to extinguish the fire.

FIRE DURING TAKE-OFF. If a fire occurs during take-off, land as quickly as possible and abandon the airplane.

FIRE DURING FLIGHT. It is left to the pilots discretion whether to attempt to extinguish the fire or to bail out. If altitude and other factors permit, the following steps should be carried out:

a. Propeller ..... "DECREASE" rpm

b. Throttle (simultaneously with step a) ..... "CLOSE"

c. Fuel selector ..... "OFF"

d. Cowl flaps ..... "OPEN"

e. Mixture control ..... "IDLE CUTOFF"

f. Ignition ..... "OFF"

g. Electrical switches ..... "OFF"

h. Ventilation system ..... "OFF"

i. Lower landing gear if the tires are in the path of the flames when retracted.

FUSELAGE FIRE

No fire fighting equipment is carried in the airplane. If a fuselage fire occurs there is the possibility that it is electrical in origin. Refer to ELECTRICAL FIRE in this section for the procedure to be followed in such a case. In any event, it is left to the discretion of the pilot whether or not to effect an immediate forced landing or to abandon the airplane.

WARNING

Opening the cockpit canopy during a fuselage fire will cause a draft which may increase the intensity of the fire and draw flames into the cockpit area. If the decision has been made to bail out, be prepared to do so immediately after the canopy is opened.

WING FIRE

a. Release external auxiliary fuel tanks.

b. If a wing fire occurs during night flight turn "OFF" the switches which control all wing lights.

c. Attempt to extinguish the fire by side-slipping the airplane away from the fire.

ELECTRICAL FIRE

If a fire in the electrical system occurs the following procedure should be used:

a. Turn battery-generator switch "OFF."

b. Turn off all but the most essential electrical equipment.

c. If the fire is extinguished, turn on the battery-generator switch and determine whether or not the fire recurs. If fire again breaks out, turn off the battery-generator switch. In any event prepare for an emergency landing and terminate the flight as rapidly as the situation demands.

SMOKE ELIMINATION

If smoke or toxic fumes should penetrate the cockpit the following procedure is recommended:

a. VENT lever ..... "ON"

b. Oxygen regulators ..... "100% OXYGEN"

c. Don oxygen masks.

CAUTION

Opening the canopy may alleviate the situation but caution should influence this action as draft may increase cockpit contamination.

LANDING EMERGENCIES (EXCEPT DITCHING)

In the event of a forced landing over land, the pilot should consider a number of variables in order to determine his best landing configuration. These include altitude, type of terrain, and characteristics of the airplane. Landings in such areas as golf courses, ploughed fields, swamps, mud or sand should be made with the wheels retracted. Most nose-overs occur as a result of landing in such terrain with landing gear down, and nearly all serious injuries and fatalities result from nosing over. A surface appearing smooth and level from the air is frequently rough, crossed with ditches, soft or full of obstructions when the landing is made. All forced landings should be made well above the stalling speed. There will be little or no control of the airplane if an attempt is made to land at, or slightly above, the stalling speed.

PROCEDURE DURING LANDING EMERGENCIES

a. Refer to LANDING WITHOUT POWER in this section for action to be taken if engine failure is the cause of the emergency landing.

b. Forewarn the crew by interphone and make sure all safety belts and shoulder straps are drawn tight and secured.

CAUTION

Secure or jettison all loose gear in the cockpit or middle compartment. The hazard of loose gear during the landing impact is obvious.

c. Jettison radar operator's hatch upon orders from the pilot before an anticipated crash landing.

EMERGENCY ENTRANCE

Entrance to the aircraft may be gained by opening the hatches as illustrated in figure 3-1, using the handles (references 3 and 6) to release the latches. If the aircraft has overturned, there is a possibility that the hatches cannot be opened. Axes or other cutting tools must be used to gain entrance in this case. Should fire prevent approach to the forward part of the aircraft, a hole chopped in the fuselage side above the aft end of the dive brake will give access to the radar operator's compartment.

DITCHING

The decision to ditch is left to the discretion of the pilot. It is recommended, however, that the airplane be abandoned during instrument flight conditions or at night when no power is available for ditching. Consideration should be given to the fact that ditching will allow the crew to obtain all survival gear stowed in the aircraft, such as canteens, drift signals, or first aid kits. Ditching will also allow the crew to remain together for mutual aid. The following Ditching Chart prescribes the duties of the various crew members in the event of a water landing:

DITCHING CHART

Crew Member	*Duty*	*Provide*	*Exit*
Pilot	Warn crew; jettison all external stores, make radio distress call and position report. After radar operator's compartment hinged enclosure has been jettisoned, open canopy.	Parachute Pararaft Charts	Left side of cockpit.
Observer	Turn on emergency IFF and stow loose gear. After radar operator's compartment hinged enclosure has been jettisoned, open canopy.	Parachute Pararaft Canteens	Right side of cockpit.
Radar Operator	Secure loose gear; jettison equipment and canopy upon orders from pilot.	Parachute Pararaft Canteen First-Aid Kit	Left side of compartment.

PREPARATION FOR DITCHING

a. Consume as much of the fuel supply as possible to lighten the airplane and reduce stalling speed. An empty fuel cell will also contribute to flotation.

b. Ditch with power still available. Power will permit the pilot to select the most favorable landing position and attitude.

c. Ditch with landing gear up and flaps down. The arresting hook can be lowered to provide an initial indication of the proximity to the surface of the water.

LANDING TECHNIQUE

a. Ditch at the lowest possible speed that allows safe control of the airplane. Because of the inherent difficulty in accurately judging height above water, the airplane should not be fully stalled.

b. Ditch at the lowest possible rate of descent. One hundred feet per minute is recommended. With power-off, a carefully controlled flare out will give this result.

c. It is recommended that the airplane be ditched along the top of, and parallel to, the swells if the wind does not exceed 20 knots. In winds of greater velocity, ditching should be accomplished upwind to take advantage of the lowered speed. It must be remembered, however, that the possibility of ramming nose-on into a wave is increased during a cross swell landing, or of the tail striking a wave crest and nosing in.

BAIL-OUT PROCEDURE

If the airplane is to be abandoned, instructions must be passed to the crew by interphone or prearranged signal. Reduce airspeed and lower landing flaps before bailing out. The technique of diving for the wing root with knees against the chest and head and with arms tucked in should be followed. The most serious error in exit is in straightening the body immediately upon leaving the airplane. This is caused by the use of improper bailout procedures or by some part of the clothing catching on the airplane.

PILOT AND OBSERVER. Normally the pilot should abandon the airplane from the left side and the observer from the right side. The following procedure will apply to both the pilot and observer and is the recommended procedure for bailout from the cockpit:

a. Open canopy.

WARNING

It is imperative that the radar operator's compartment hinged enclosures be jettisoned prior to opening the cockpit sliding canopy. This procedure is necessary due to a pressure differential which dangerously hinders break-away of the hinged enclosures.(1)

b. Release all encumbrances (safety belt, shoulder harness, oxygen system, radio cord, etc.).

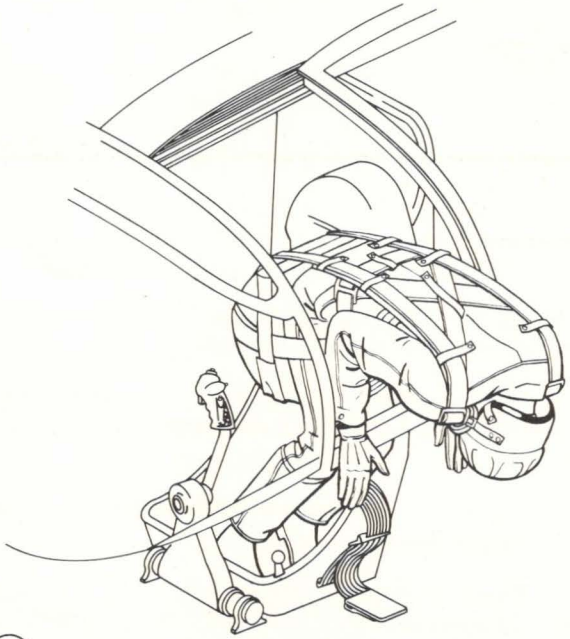
(1)Prior to Service Change No. 622.



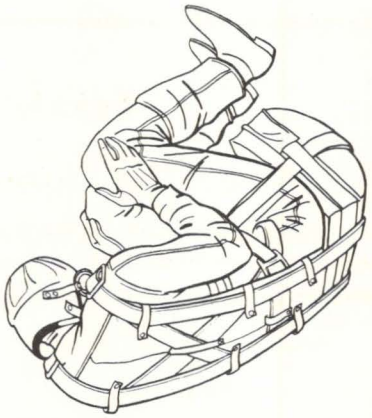
(1) PLACE RIGHT HAND ON TOP OF WINDSHIELD AND LEFT HAND ON EDGE OF AIRPLANE COCKPIT. RAISE PARACHUTE CLEAR OF SEAT AS BODY IS TURNED TOWARD SIDE OF EXIT. BRING LEFT FOOT TOWARD SEAT OF AIRCRAFT. (REVERSE PROCEDURE IF EXIT IS TO RIGHT.)



(2) PLACE BOTH FEET IN SEAT, TAKING CARE TO KEEP HEAD AND BODY WELL INSIDE AIRCRAFT. TUCK CHIN AGAINST CHEST AND BEGIN FORWARD ROLL.



(3) POSITION OF BODY AS FORWARD ROLL IS BEGUN. COORDINATE A VIGOROUS PUSH WITH THE FEET AND PULL–PUSH WITH THE HANDS AND ARMS, AND DIVE FOR THE WING ROOT.



(4) POSITION OF BODY AS IT REACHES WING LEVEL OF AIRCRAFT — CHIN DOWN AGAINST CHEST AT ALL TIMES AND KNEES PULLED UP TOWARD CHIN. HOLD POSITION UNTIL CLEAR OF AIRCRAFT.

P4982-1A

Figure 3-2. Bail-Out Procedure (Sheet 1)

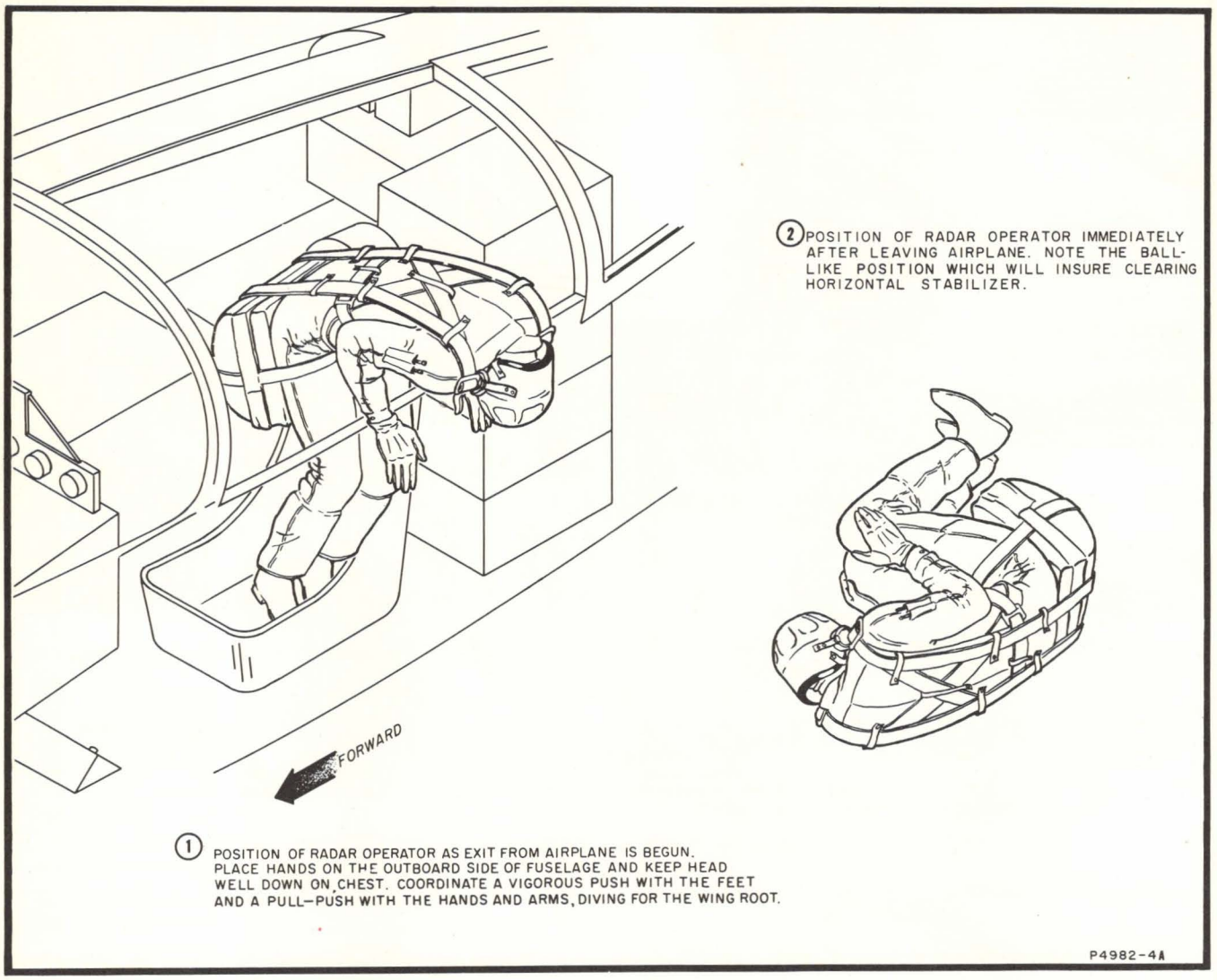


Figure 3-2. Bail-Out Procedure (Sheet 2)

c. Follow steps outlined in figure 3-2 (sheet 1).

d. Do not straighten the body immediately upon leaving the airplane. When well clear, straighten body, place both hands on chest, and with feet together, pull the ripcord.

Note

The procedures outlined in figure 3-2 (sheet 1) are for the pilot and are to be reversed for the observer, i.e., in Step 1, left hand on top of windshield in place of right hand, etc.

RADAR OPERATOR. The radar operator must abandon the airplane from the left side. It is of the utmost importance that the radar operator tuck his body into a ball-like position immediately upon leaving the airplane. The following procedure is recommended when bailing out from the radar operator's compartment:

a. When ordered by the pilot, release all encumbrances (safety belt, shoulder harness, etc.) except for the radio cord.

b. Prepare to exit without delay to give the pilot all the time possible for his exit.

c. When so ordered, jettison the canopy by pulling the red handle marked ENCL EMER REL (5, figure 3-1) ▌ located on the top center beam. This handle must be pulled through its full travel.

d. Upon receiving the order to bail-out, place hands on the outboard side of fuselage of the left-hand exit. Give a vigorous coordinated push with the feet and a pull-push with the arms. This is necessary to insure a

ELECTRONIC EQUIPMENT

TYPE	DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
COMMUNICATION					
UHF RADIO	AN/ARC-27A	SHORT RANGE-TWO WAY VOICE COMMUNICATION AND RELAY	PILOT	LINE-OF-SIGHT	COCKPIT CENTER CONSOLE
* HF RADIO	AN/ARC-2	MEDIUM RANGE-TWO WAY VOICE COMMUNICATION	OBSERVER	100 MILES	OBSERVER'S RIGHT CONSOLE
INTERPHONE	AN/AIC-4A	INTER-COMMUNICATION	PILOT AND CREW	CREW STATIONS	PILOT AND CREW MEMBER STATIONS
NAVIGATION					
VHF HOMING RECEIVER	AN/ARR-2A(1)(3)	YG HOMING	OBSERVER	LINE-OF-SIGHT	OBSERVER'S RIGHT CONSOLE
UHF/ADF	AN/ARA-25	DIRECTIONAL HOMING	PILOT	LINE-OF-SIGHT	COCKPIT CENTER CONSOLE
RADIO COMPASS	AN/ARN-6(3)	DIRECTIONAL HOMING AND RANGE RECEIVER	PILOT	20-200 MILES DEPENDING ON VARIABLE CONDITIONS	COCKPIT CENTER CONSOLE
* OMNI-RANGE RECEIVER	AN/ARN-14E(2)(3)	VOR, VAR, AND LOCALIZER SIGNALS	PILOT	LINE-OF-SIGHT	COCKPIT CENTER CONSOLE
MARKER RECEIVER	AN/ARN-12(3)	RECEIVES AND INDICATES MARKER BEACON POSITION	PILOT	WITHIN MARKER BEACON SIGNAL PATTERN	COCKPIT CENTER CONSOLE
TACAN	AN/ARN-21(4)	DIRECTIONAL HOMING AND DISTANCE MEASURING	PILOT	195 MILES	COCKPIT CENTER CONSOLE
RADAR					
SERCH RADAR	AN/APS-20E	PROVIDES RADAR SEARCH AND RADAR BEACON RECEPTION	RADAR OPERATOR	LINE-OF-SIGHT	OBSERVER'S AND RADAR OPERATOR'S EQUIPMENT PANEL
G P I	AN/APA-57C	GROUND STABILIZES RADAR INDICATOR	RADAR OPERATOR		OBSERVER'S AND RADAR OPERATOR'S EQUIPMENT PANEL
* RADAR RELAY	AN/ART-28	RELAYS RADAR VIDEO	RADAR OPERATOR	LINE-OF-SIGHT	OBSERVER'S AND RADAR OPERATOR'S EQUIPMENT PANEL
RADAR ALTIMETER	AN/APN-22	INDICATES ALTITUDE ABOVE THE SURFACE	PILOT	0 TO 10,000 FEET (OVER LAND) 0 TO 20,000 FEET (OVER WATER)	PILOT'S INSTRUMENT PANEL
IDENTIFICATION					
* SIF SET	AN/APA-89	CODER	OBSERVER	LINE-OF-SIGHT	OBSERVER'S RIGHT CONSOLE
IFF SET	AN/APX-6	IDENTIFIES AS FRIENDLY	OBSERVER	LINE-OF-SIGHT	OBSERVER'S RIGHT CONSOLE
IFF INTERROGATOR	AN/APX-7	TRANSMITS IFF INTERROGATION SIGNALS	RADAR OPERATOR	LINE-OF-SIGHT	RADAR OPERATOR'S LEFT HAND CONSOLE

* INSTALLATION PROVISIONS ONLY

(1) AIRPLANES PRIOR TO BUNO 135139

(2) AIRPLANES BUNO 135139 AND SUBSEQUENT

(3) AIRPLANES PRIOR TO SERVICE CHANGE NO. 511

(4) AIRPLANES AFTER SERVICE CHANGE NO. 511

P5501-1E

Figure 4-2. Table of Electronic Equipment

Figure 4-3. Deleted (Sheet 1)

Key to Figure 4-3. Electronic Equipment Location (Sheet 1)
Deleted

MICROPHONE FOOT SWITCHES. Two microphone foot switches, labeled MIC RADIO and MIC ICS respectively, are located at both the observer's and radar operator's position. The MIC RADIO switch (16, 23, figure 4-11) controlling radio transmissions, is located on the upper left-hand corner of the foot rests and the MIC ICS switch, (17, 24, figure 4-11), which controls interphone transmissions, is located in the upper right-hand corner of the footrests at each crew station.

AUXILIARY INTERPHONE PANELS. Two auxiliary interphone panels are located within the aircraft. One, as part of the radar operator's compartment dome light assembly, contains a MIC (microphone) jack, a PHONE headset jack and a DORSAL COMPT LIGHTS switch. The second panel, positioned aft of the radio equipment shelf on the lower right-hand side of the aft fuselage compartment includes an INTERCOM receptacle for personnel gear attachment, a MIC JACK, an extension cord with a receptacle for a microphone and headset connector assembly, a MIC SWITCH extension cord and a DORSAL FLOOD LIGHT switch. Headsets connected to these panels will receive all signals channeled through the observer's interphone control panel.

UHF RADIO EQUIPMENT

The AN/ARC-27A Dual Relay System enables the aircraft to serve as a relay point for extending the range of two way UHF radio communication with modulated signals as, for example, between aircraft or between aircraft and a surface station. By this method the equipment is capable of extending far beyond the horizon the normal UHF line-of-sight transmissions. In relay operation, a modulated radio signal received from either terminal station of the circuit is automatically retransmitted to the other terminal station. A slight reduction in communication range probability occurs at the higher frequencies due to radiation pattern peculiarities of the AT-141/ARC antennas. The two desired frequencies are selected on the C-1024/ARC-27A and C-1025/ARC-27A radio control panels, and must correspond to the frequencies being used by the terminal stations. Frequency selection on either control panel automatically tunes the respective AN/ARC-27A receiver-transmitter.

The receiver-transmitter (UHF #1 or UHF #2) through which UHF communication is conducted at any one of the three crew stations, is determined by the position of the systems operation switch on the C-1024/ARC-27A radio set control panel on the center console.

RADIO SET CONTROL C-1024/ARC-27A. The pilot's UHF radio control panel is located on the center console (2, figure 1-5). The panel contains a CHAN selector switch which permits the selection of any one of twenty preset channels, a guard channel, or a manual position. For communication on the guard frequency, the CHAN selector must be turned to the "G" position. The manual position is used when selecting with the manual frequency selector any of 1750 possible channel frequencies other than those preset on the CHAN selector. The panel also contains a VOL control and SENS-1 and SENS-2 controls to adjust the sensitivity of the receiver-transmitters, a function selector switch, and a systems operation switch. The positions of the function selector switch, and their corresponding functions, are listed as follows:

Position	*Function*
"T/R"	Connects selected system for normal transmitting and receiving.
"T/R—G REC"	Connects selected system for normal transmitting and receiving. Places the guard receiver in operation and permits monitoring of the guard frequency.
"ADF"	Places the AN/ARA-25 direction finding system in operation through the UHF #1 receiver.

The systems operation switch has six positions with which to select the type of operation as follows:

"OFF" .....Both receiver-transmitters off.

"1T/R" .....Number one receiver-transmitter on, number two off.

"1T/R 2R" .....Number one receiver-transmitter on, number two receiver on.

"RELAY" .....Both receiver-transmitters on, relay. In this position it is not possible to transmit without disrupting relay operations.

"2T/R 1R" .....Number two receiver-transmitter on, number one receiver on.

"2T/R" .....Number two receiver-transmitter on, number one off.

RADIO CONTROL PANEL C-1025/ARC-27A. The observer's UHF radio control panel is located on the right console (16, figure 4-4). The panel contains a CHAN selector switch which permits selection of any one of twenty preset channels, a guard channel, and a manual position. The manual position is used while

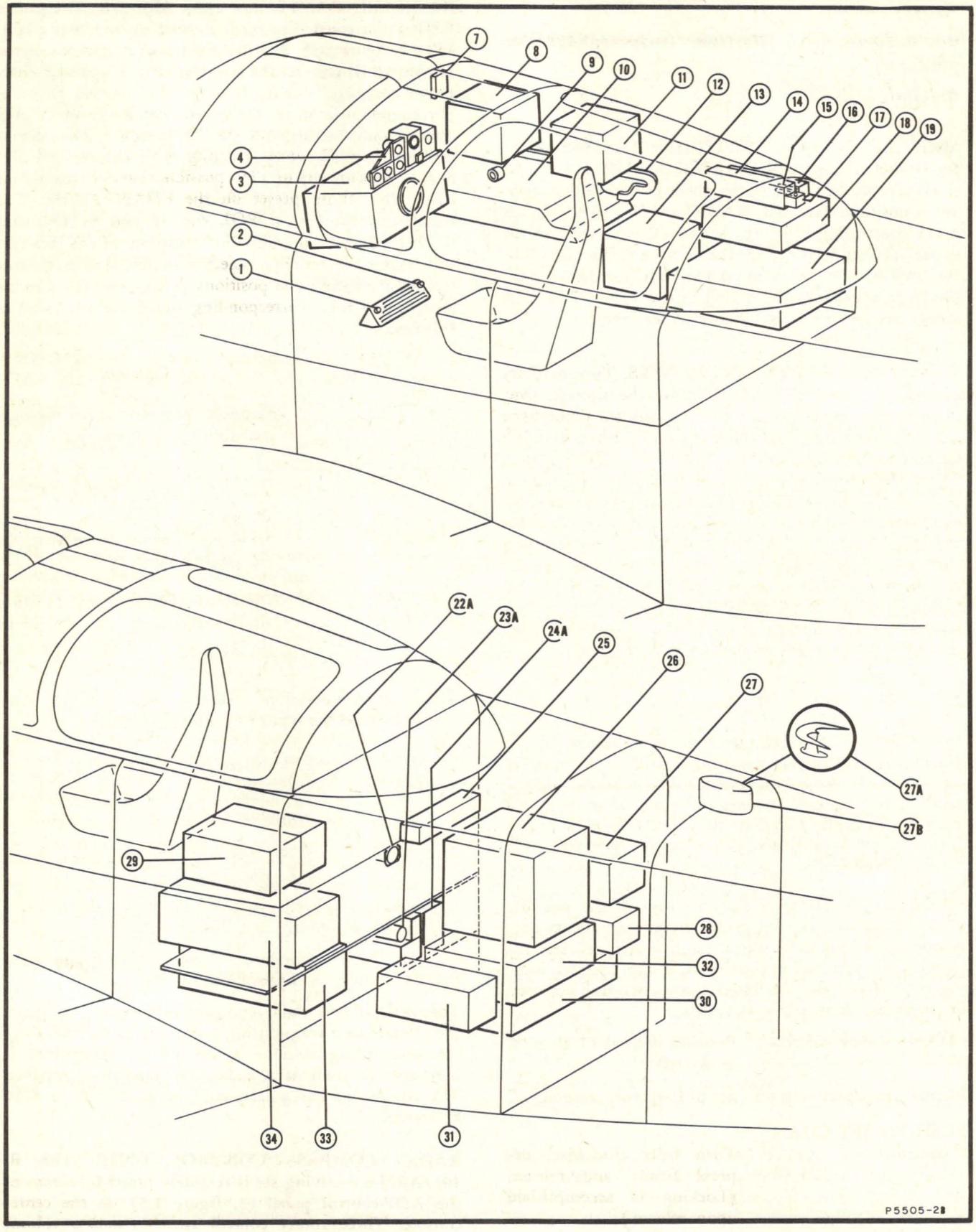


Figure 4-3. Electronic Equipment Location (Sheet 2)

Key to Figure 4-3. Electronic Equipment Location (Sheet 2)

1. MIC RADIO switch
2. MIC ICS switch
3. IP-203/APS-20B indicator
4. Radar operator's instrument panel
5. Deleted
6. Deleted
7. CU-165/APS-20B duplexer
8. R-251/APS-20B receiver
9. Search radar wave guide pressure gage
10. T-467/APS-20E transmitter
11. C-1499/APS-20E control
12. Search radar wave guide
13. C-1061/APA-57B indicator control
14. CP-132/APA-57C computer-indicator
15. HD-127/APS-20B dehydrator
16. SA-235/APA-57 inertia switch
17. HD-126/APS-20B air compressor
18. *T-271/ART-28 transmitter
19. PP-829/APS-20B power supply
20. Deleted
21. Deleted
22. Deleted

22A.*ID-251/ARN course indicator[1], or ID-307/ARN[2]

23. Deleted

23A.*DY-84/ARN dynamotor[1]

24. Deleted

24A.*R-540/ARN-14E radio receiver[1], or RT-220/ARN-21[2]

25. AM-674/APA-57B electronic control amplifier
26. PP-347/APS-20B power supply
27. *PP-615/ART-28 power supply

27A.*AT-172/ARN-14 antenna[1]

27B. AS-313A/ARN-6 loop antenna[1]

28. RT-261/APX-7 receiver-transmitter
29. SN-55/APS-20B electrical synchronizer
30. TF-158/APS-20B transformer assembly
31. HD-125/APS-20B cooling unit
32. KY-84/APX-7 coder-synchronizer
33. RT-178/ARC-27 receiver-transmitter and sensitive relay
34. RT-178/ARC-27 receiver-transmitter and sensitive relay
35. Deleted
36. Deleted
37. Deleted
38. Deleted

*Installation provisions only.

selecting with the manual frequency selector any of the 1750 possible frequencies that have not been preset on the channel selector.

PRESETTING FREQUENCIES. Any of the possible 1750 frequencies can be preset on any of the twenty positions or guard position on the channel selector switch. The channel selector switch, the channel locking control and the manual frequency selector are used in presetting frequencies as follows:

CHAN selector switch . . . . Position desired (1 thru 20 or guard)

Manual frequency selector . Set to frequency desired

PUSH TO SET CHAN control . . . . . Turn fully clockwise, depress firmly and release. (Locking is accomplished upon release.)

[1]Prior to Service Change No. 511.
[2]After Service Change No. 511.

The channel selected is now ready for operation on the frequency selected. The manual position on either channel selector switch can be used for operation on a frequency where it is not desired to preset that frequency.

CAUTION

It is important that each time a channel is reset the PUSH TO SET CHAN control be fully depressed. If the control is not fully depressed on any one channel the other channels may be improperly set.

AUTOMATIC DIRECTION FINDING EQUIPMENT

The AN/ARA-25 automatic direction finding (ADF) equipment operates in conjunction with the AN/ARC-27A UHF radio communication system to provide directional indication of the source of signals in the 225 to 400 megacycles band. Relative source indication is provided by the number 1 needle of the ID-250/ARN course indicator (10, figure 1-4) for homing purposes.

OPERATION OF THE EQUIPMENT. The AN/ARA-25 is energized whenever the MASTER RADIO switch is turned "ON," and is placed in operation when the UHF function selector switch is placed in the "ADF" position.

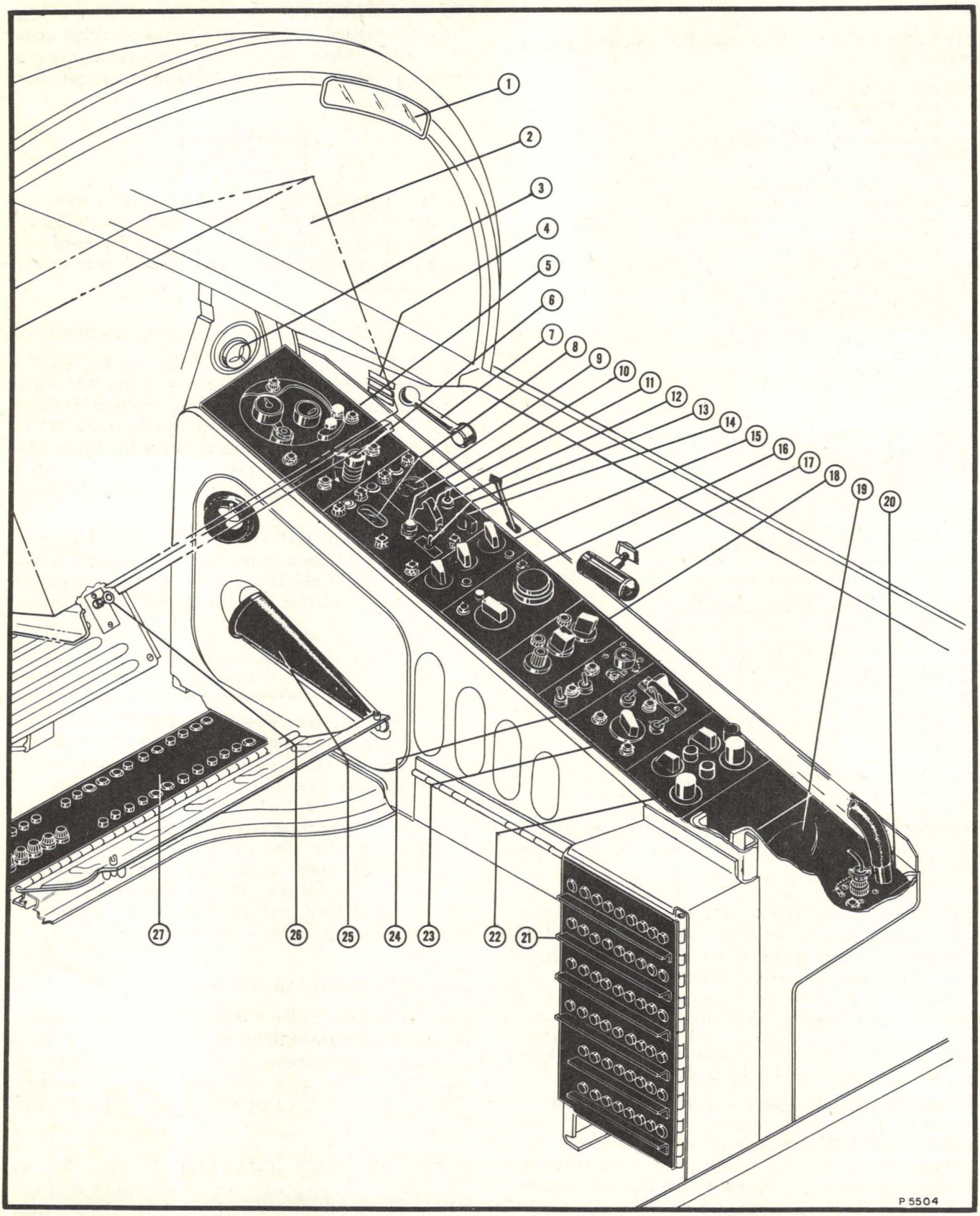
CAUTION

In this airplane, when the AN/ARA-25 is used for homing on ground signals or for air rendezvous, errors up to nine degrees may be experienced. When used as a direction finder errors may be as much as plus or minus thirty degrees. Since these errors vary with operating frequency, size, type and location of external stores and other factors, pilots should exercise caution in the use of this equipment for homing and rendezvous and should not depend on this equipment as a direction finder.

RADIO COMPASS EQUIPMENT[1]

The AN/ARN-6 radio compass is designed to guide the aircraft to a transmitting station or to take bearings on transmitting stations as an aid to navigation. It may also be used as a radio communication receiver. The equipment has a frequency range of 100 to 1750 kilocycles.

RADIO COMPASS CONTROL UNIT. The R-101/ARN-6 receiving set is remotely tuned by means of the ADF-control panel (3, figure 1-5) on the center console. Three rotary control switches and a volume control knob are located on the ADF panel. The VOL control is for adjustment of the audio signal strength.



Airplanes BuNo. 132729 through BuNo. 132750
Figure 4-4. Cockpit — Observer's Right Console (Sheet 1)

←

Key to Figure 4-4. Cockpit — Observer's Right Console (Sheet 1)

1. Mirror
2. IP-203/APS-20B indicator
3. Ventilator
4. Airspeed and compass correction cards
5. Oxygen regulator
6. Oxygen shut-off valve
7. Right-hand canopy control
8. D-c voltmeter
9. A-c voltmeter
10. D-c generator warning light(1)
11. A-c generator switch
12. A-c power switch
13. Battery-generator switch(1)
14. A-c phase selector switch
15. Interior lights control panel
16. C-1025/ARC-27A UHF radio control panel
17. Cockpit utility light
18. C-738/ARR-2A homing radio control panel(3)
19. Spare lamps container
20. Oxygen and communications outlets
21. Circuit breaker panel #35
22. C-736/AIC-4A interphone control panel
23. C-629/APX-6 IFF control panel
24. Navigation receiver switch panel
25. Observer's relief tube
26. MIC ICS switch
27. Circuit breaker panel #16

The BAND switch is used to select the desired frequency band. Tuning within the selected band is accomplished electrically and is controlled by means of the FREQ tuning switch. This switch has two indicated positions, "DEC" (decrease frequency) and "INC" (increase frequency), and returns to a neutral point when released. The rate of tuning increases as the control is turned farther toward either extreme position. The third rotary switch is identified by its three marked positions, "OFF," "ADF," and "ANT."

On later aircraft(2) the control panel is labeled RADIO COMP, and a CW-VOICE switch and a loop position control have been added. Also, the positions on the function selector switch have been revised with the addition of the loop control, the new positions being labeled "OFF," "COMP," "ANT" and "LOOP." The "LOOP" position provides for directional positioning of the loop with the LOOP L-R switch. The "COMP" position corresponds to ADF operation on the preceding panel.

RADIO COMPASS OPERATION. Turning the function switch from "OFF" to either of the remaining positions turns the receiving set on if the MASTER RADIO switch is "ON." When tuned to "ADF," the set receives through both a loop and a wire antenna. As the set is tuned for maximum signal strength, the loop antenna will automatically align itself with the direction of travel of the signal. A visual indication of the signal direction is presented by the number 2 needle of the ID-250/ARN course indicator (10, figure 1-4) on the pilot's instrument panel. When the "ANT" position is selected, the loop antenna is switched out of the circuit and the set operates as a low frequency receiver only.

Operation of the RADIO COMP panel on later aircraft(2) is the same as in the preceding instruction except for the following: With the function selector switch on "LOOP" position, the loop antenna may be set on a fixed position or rotated in either direction by turning the LOOP L-R switch to left or right. The CW-VOICE switch may be set on "CW" position for greater accuracy in tuning in a station and then placed on "VOICE" for normal operation.

ID-250/ARN COURSE INDICATOR

The ID-250/ARN course indicator (10, figure 1-4) located on the pilot's instrument panel, is used as an aid to navigation in conjunction with the AN/ARN-6 radio compass or the AN/ARN-14E omni-range (VOR) equipment and the AN/ARA-25 automatic direction finding equipment. The indicator face is a compass repeater indicator card slaved to the G-2 compass master direction indicator and repeats the directional indications given by the latter. Two needle pointers are provided. The number one needle provides a visual indication of the direction of signals received by the AN/ARA-25 equipment, and the number two needle performs an identical function for the AN/ARN-6 or the AN/ARN-14E equipment. Readings thus observed are magnetic bearings to the selected stations, provided the G-2 compass is correctly set and the G-2 COMPASS control switch is in the "CONTROL" position. To avoid confusion and erroneous readings, the two needles are interlocked to give a single indication for the AN/ARN-6, or the AN/ARN-14E, when the AN/ARA-25 equipment is not in use.

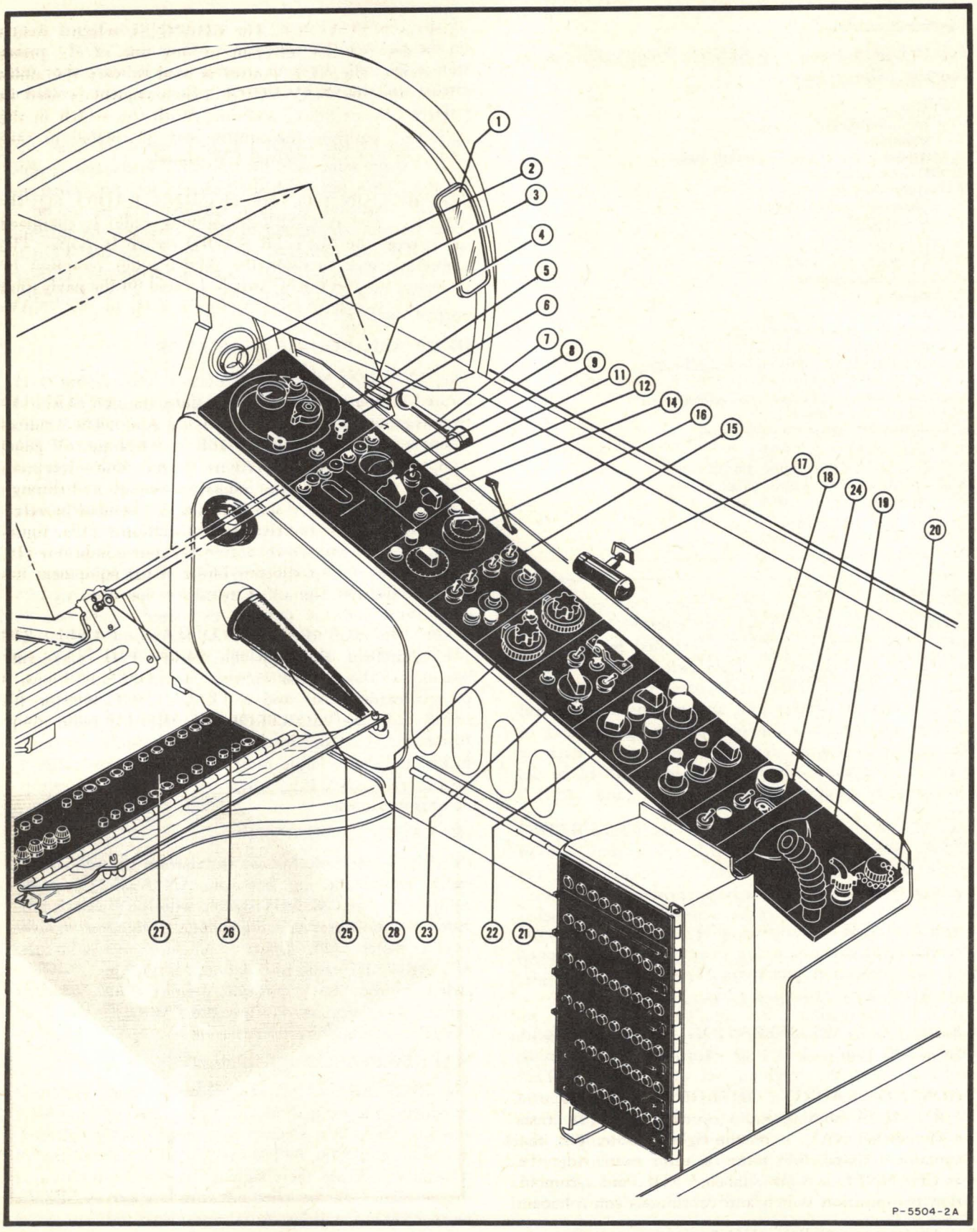
HF RADIO EQUIPMENT

Provisions are made for the installation of AN/ARC-2 radio equipment in lieu of AN/ARC-27A radio equipment. The CW-OUT switch, with KEY jack, is provided on the observer's interphone navigation receiver switch panel, (24, figure 4-4), for use with the AN/ARC-2 HF radio installation. Placing the CW-OUT switch in the "CW" position permits transmission of carrier wave signals. Placing the CW-OUT switch at "OUT" permits voice transmission.

MARKER BEACON EQUIPMENT(3)

The R-122/ARN-12 marker beacon receiving system is provided as a navigation aid. Using the AT-134/ARN antenna, the system receives a 75-megacycle signal, modulated at 400, 1300, or 3000 cycles, from marker beacon transmitters. From these signals the relative position of the airplane can be checked with respect to specific marker beacon stations. Aural and visual indications are provided by the intercommunication radio and a marker beacon indicating light respectively. The system is energized when the MASTER RADIO switch is set to "ON."

(1) Airplanes prior to BuNo. 135139 prior to Service Change No. 575.
(2) Airplanes BuNo. 132743 and subsequent.
(3) Prior to Service Change No. 511.



Airplanes BuNo. 132751 and Subsequent
Figure 4-4. Cockpit — Observer's Right Console (Sheet 2)

Key to Figure 4-4. Cockpit — Observer's Right Console (Sheet 2)

1. Mirror
2. IP-203/APS-20B indicator
3. Ventilator
4. Airspeed and compass correction cards
5. Oxygen regulator
6. Oxygen shut-off valve
7. Right-hand canopy control
8. D-c voltmeter
9. A-c voltmeter
10. Deleted
11. A-c generator switch
12. A-c power switch
13. Deleted
14. A-c phase selector switch
15. Exterior lights control panel
16. C-1025/ARC-27A UHF radio control panel
17. Cockpit utility light
18. C-738/ARR-2A homing radio control panel(1)
19. Spare lamps container
20. Oxygen and communications outlets
21. Circuit breaker panel #35
22. C-736/AIC-4A interphone control panel
23. C-629/APX-6 IFF control panel
24. Navigation receiver switch panel
25. Observer's relief tube
26. MIC ICS switch
27. Circuit breaker panel #16
28. C-1272/APA-89 control panel

MARKER BEACON VISUAL INDICATOR. The marker beacon indicator light (7, figure 1-4) is installed on the pilot's instrument panel for visual presentation of the marker beacon code. The light is a "push-to-test" type.

MARKER BEACON AUDIO SWITCH. The BEACON AUDIO switch (7A, figure 1-4, sheet 2) is located on the pilot's instrument panel adjacent to the MARKER BEACON indicator light. The switch is normally turned "ON" for reception of marker beacon signals in the headset. Setting the switch to "OFF" position shuts off aural signals to prevent interference with other radio reception, such as AN/ARC-27A.

HOMING RADIO EQUIPMENT(1)

The AN/ARR-2A homing radio provides code or voice reception on any one of six preset channels for homing or communication purposes. The preset channels may be selected by remote control. When the receiver is used for navigation a beat oscillator produces an audible beat note. When used for reception of voice modulation, the beat note oscillator is cut out.

HOMING RADIO CONTROL PANEL. The C-738/ARR-2A homing radio control panel (18, figure 4-4), labeled NAV, is on the right console. The panel contains a six-position rotary selector switch identified as CHANNEL, a control labeled VOL, and a combination two-position switch and continuous control identified as NAV-VOICE. The CHANNEL selector switch provides for the selection of any one of six preset channels. The VOL control is used to vary the audio level and the NAV-VOICE switch control is used to select CW or voice reception. With the switch in the "NAV" position, the control may be rotated to vary the pitch of the received CW signal.

OPERATION OF THE HOMING RADIO EQUIPMENT. The AN/ARR-2A homing radio is energized whenever the MASTER RADIO switch is "ON." The observer may monitor the pilot's audio reception by placing the NAV-REC switch, located on the navigation receiver switch panel (24, figure 4-4), in the "NAV-REC" position.

OMNI-RANGE (VOR) EQUIPMENT(2)

Provisions are made for installing the AN/ARN-14E omni-range (VOR) radio receiving equipment. Control is effected through the C-760B/A/ARN control panel on the center console (figure 4-4A). Voice reception and station identification signals are monitored through the radio headset; visual guidance is obtained by reference to the ID-249/ARN course indicator (17a, figure 1-4, Sheet 2) and the ID-250/ARN course indicator (10, figure 1-4). The frequency range of the equipment lies within the 108.0 to 136.0 megacycle spectrum.

OMNI-RANGE RADIO CONTROL PANEL. The C-760B/ARN control panel, marked VHF-NAV, contains a POWER switch with "ON-OFF" positions, a VOLUME control and a FREQUENCY selector for operation and control of the AN/ARN-14E radio equipment.

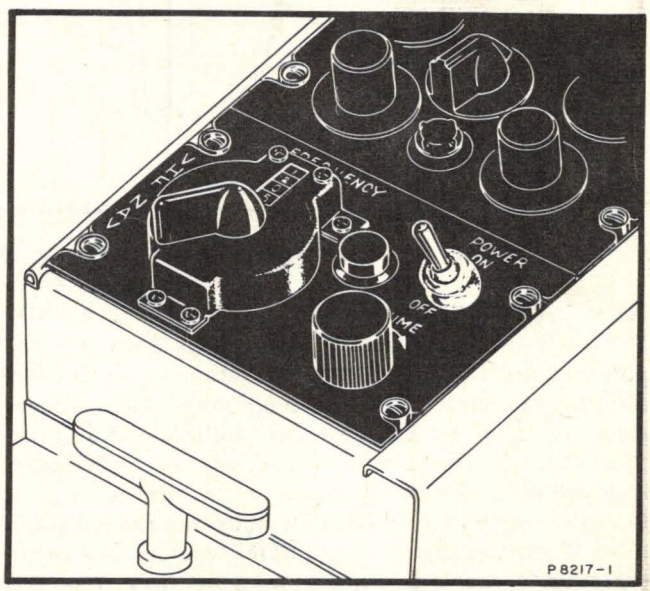


Figure 4-4A. AN/ARN-14E Omni-Range Radio Control Panel

(1) Airplanes prior to BuNo. 135139 prior to Service Change No. 511.
(2) Airplanes BuNo. 135139 and subsequent prior to Service Change No. 511.

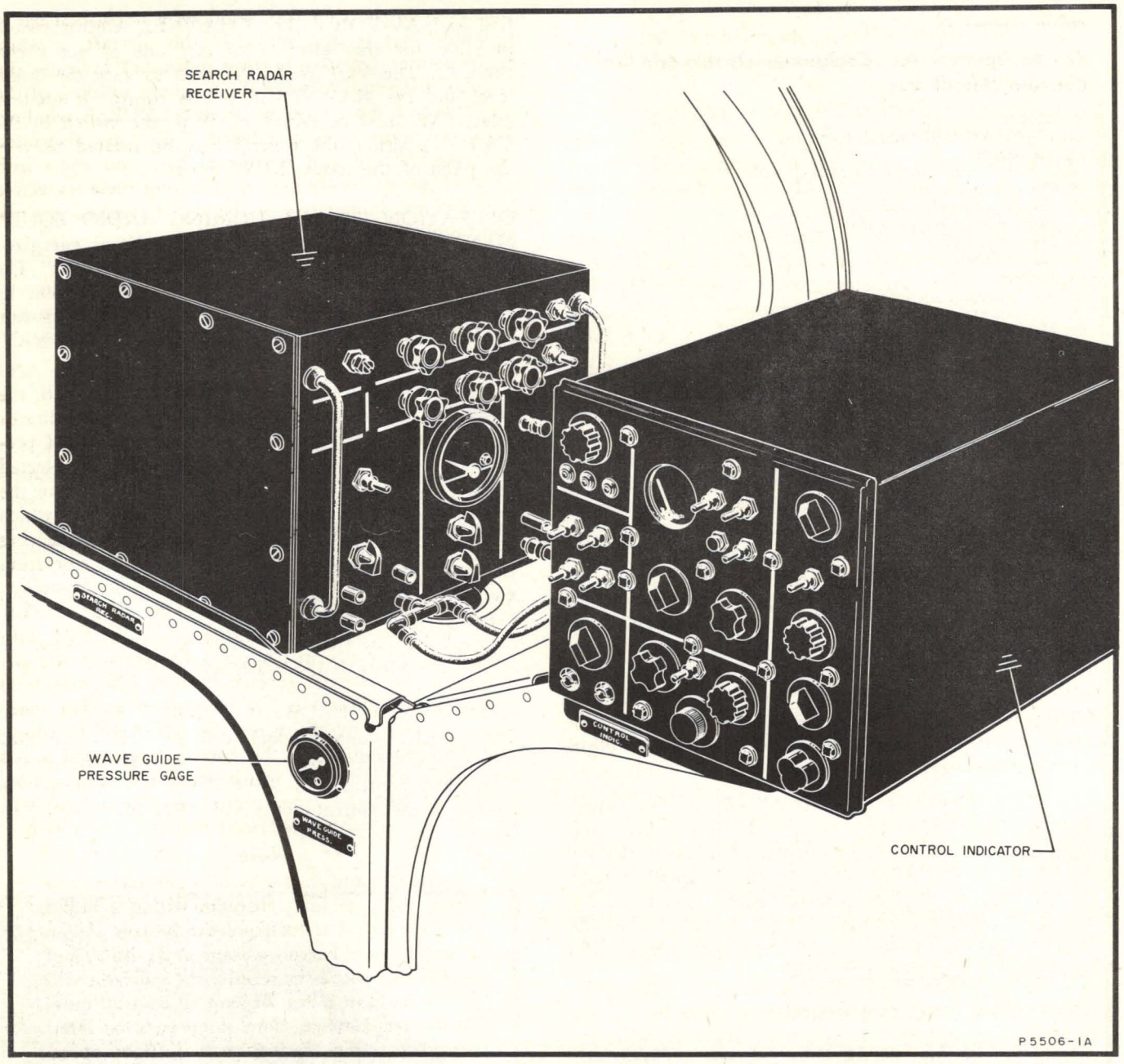


Figure 4-5. AN/APS-20E Search Radar Equipment

ID-249/ARN COURSE INDICATOR. The ID-249/ARN course indicator, through its various components, provides a visual presentation of navigation information received by the omni-range radio equipment. Components of the course indicator, and their functions, are described as follows: A SET knob, mounted on the lower left corner of the instrument case, is used to set into a COURSE window the desired track to be flown. An adjacent TO-FROM window shows that the selected course is either toward or away from the omni-range station. The course indicator also contains two bars and a pointer. The vertical bar moves from a center position to either the left or right indicating the on-course or off-course condition of the aircraft with respect to the selected course set in the COURSE window; the horizontal bar normally provides glide path information during an approach or letdown, however, with this installation glide path equipment will not be installed and the horizontal bar remains inoperative. The pointer, a relative heading indicator, presents the angular difference between the magnetic heading of the airplane and the course set in the COURSE window. Two warning flags, labeled OFF, are associated with the vertical and horizontal bars, and fall into view whenever the equipment operating their respective bars becomes inoperative, or the signals received are weak and unreliable.

Note

As the horizontal bar is always inoperative in this aircraft, the related warning flag will be visible at all times.

AN/ARN-21 (TACAN) RADIO EQUIPMENT.[1] The AN/ARN-21 radio equipment provides the pilot with a continuous indication of bearing and distance to any selected surface TACAN beacon located within a line-of-sight distance from the aircraft, up to approximately 195 nautical miles. Components of the system are the C-866/ARN-21 control panel, the RT-220/ARN-21 receiver-transmitter and mount, the ID-249/ARN and ID-250/ARN course indicators, the ID-310/ARN range indicator, the ID-307/ARN azimuth indicator, the AS-133/APX antenna, and the CV-279/ARN phase detecting network unit. Beacon identification signals are monitored through the radio headset; bearing indications are displayed on the ID-249/ARN course indicator and the No. 2 needle of the ID-250/ARN course indicator; range information is displayed on the ID-310/ARN range indicator. D-c power is supplied through the secondary and radio busses, while a-c power is supplied from either the number one or number two inverter and the variable-frequency a-c generator.

AN/ARN-21 RADIO CONTROL PANEL. The C-866/ARN control panel, marked NAV, is located on the center console. The panel contains a function switch with "OFF," "REC," and "T/R" positions, two CHAN (channel) selector knobs, and a VOL (volume) control knob. The right CHAN knob selects the single digit (or unit number) of the channel number from zero to nine, while the left CHAN knob determines the tens and hundreds figure of the channel number from zero to twelve. A total of 126 channels may be selected. While the function switch is in the "T/R" position, each selected channel utilizes two frequencies, enabling both range and bearing detection operations to be conducted simultaneously; reception is accomplished on one frequency and transmission on another.

AN/ARN-21 RECEIVER-TRANSMITTER. The RT-220/ARN-21 receiver-transmitter is located in the aft equipment compartment. The unit, together with its mount, incorporates the necessary circuits for transmitting and receiving pulses from range indications, and for receiving signals for azimuth indications.

ID-249/ARN COURSE INDICATOR. The ID-249/ARN course indicator (17A, figure 1-4, sheet 2) provides a visual presentation of navigation information received by the AN/ARN-21 equipment. Components of the course indicator and their respective functions are as follows: a SET knob mounted on the lower left corner of the instrument case is used to set into a COURSE window the desired track to be flown; an adjacent TO-FROM window shows that the selected course is either toward or away from the selected beacon; a vertical bar moves from a center position to either the left or the right, indicating any off-course condition of the aircraft in respect to the selected course set in the COURSE window; a horizontal bar is provided, but is inoperative in this aircraft; a white circle pointer (relative bearing indicator) indicates the angular difference between the magnetic heading of the airplane and the course set in the COURSE window. Two, red warning flags labeled "OFF" are associated with the vertical and horizontal bars and come into view whenever the equipment operating their respective bars becomes inoperative or the signal received is weak and unreliable.

Note

As the horizontal bar is always inoperative in this aircraft, the related warning flag will be visible at all times.

ID-250/ARN COURSE INDICATOR. When the AN/ARN-21 radio equipment is installed in the aircraft, the number 2 needle of the ID-250/ARN course indicator is connected to the AN/ARN-21 equipment and provides a visual indication of the direction of the selected navigation beacon. When the needle is searching for the correct bearing, the pointer will rotate at a rate which precludes the reading of a course. Reception of bearing signals beyond the normal 195 nautical mile operating range is possible if atmospheric conditions are favorable.

ID-310/ARN RANGE INDICATOR. The ID-310/ARN range indicator (26A, figure 1-4, sheet 2) indicates the slant range in nautical miles between the aircraft and the selected surface beacon. The maximum range of the indicator is 195 nautical miles. The numerals will rotate rapidly when the AN/ARN-21 equipment is "searching" for the correct range, and a red bar will come into view which warns the pilot against reading an incorrect range indication. The red bar will also be visible when the equipment is inoperative.

Note

The slant range factor is of significance only when flying at high altitudes within a radius of ten nautical miles from the beacon. As an example, upon beacon passage at an altitude of 24,300 feet above the terrain, the indicator will read 4 nautical miles. Beyond 10 nautical miles horizontal distance, slant range may be interpreted as range during normal flight operations.

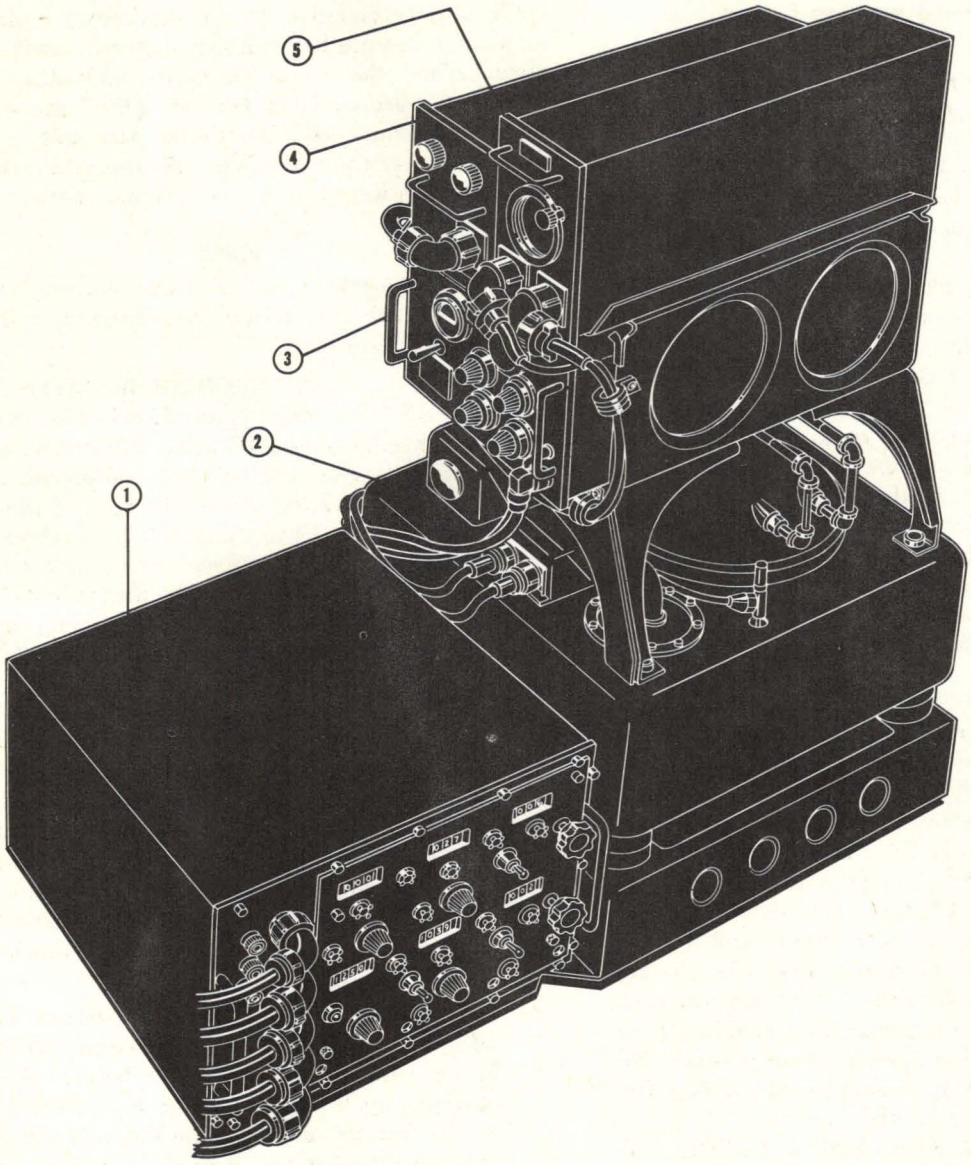
OPERATION OF AN/ARN-21 EQUIPMENT. A warm-up period of 90 seconds is required after the function switch is turned out of the "OFF" position. Observe the following procedure for operating the AN/ARN-21 radio:

a. Function switch.....“REC” or “T/R”
b. CHAN selector.....set to desired channel number
c. VOL control.....adjust as necessary
d. Identify beacon by tone signals in the headset.

RADAR ALTIMETER

The AN/APN-22 radar altimeter is designed to provide reliable indications of altitude from 0 to 10,000 feet over land and from 0 to 20,000 feet over water. The accuracy of indication is plus or minus 2 feet from

[1] After Service Change No. 511.



1. C-1061/APA-57B indicator control
2. PP-829/APS-20B power supply
3. *T-271/ART-28 transmitter
4. SA-235/APA-57 inertia switch
5. CP-132/APA-57C computer-indicator

*Installation provisions only.

Figure 4-6. Ground Position Indicator Equipment

0 to 40 feet, and plus or minus 5 percent of the indicated altitude from 40 to 20,000 feet.

CAUTION

When the AN/APS-20E is operating, it will interfere with the AN/APN-22 causing erratic movements of the height indicator needle between the altitudes of 2000 and 8000 feet. Interference varies from a needle jump of 1000 feet to disappearance of the needle behind the mask.

HEIGHT INDICATOR. The ID-257/APN-22 height indicator (6, figure 1-4) is located on the pilot's instrument panel and shows the true altitude of the aircraft above the surface. An ON-LIMIT switch, located on the indicator, is used to turn the equipment on and off and to select the limit altitude by adjustment of a bug pointer on the outside of the calibrated scale.

Note

A warning plate is installed on the pilot's instrument panel adjacent to the ID-257 height indicator which warns the pilot of the inaccuracy of the AN/APN-22 above 2000 feet when operated simultaneously with the AN/APS 20E radar set.

LIMIT INDICATOR SYSTEM. An altitude limit indicator system is included to provide a visual indication of flight at, or below, a preset altitude. When at or below a pre-set altitude, a red warning light on the height indicator is illuminated.

DROP OUT. The drop-out altitude (altitude at which the signal becomes too weak to operate the radar altimeter) is above 10,000 feet over land, and 20,000 feet over water. The drop-out altitude decreases in banks of 60° and in climbs and dives of 70° or more. When drop-out occurs, an electrical circuit disables the indicator and moves the indicator needle behind a mask to prevent the pilot from using it when the signals are too weak to give a reliable reading.

OPERATION OF THE RADAR ALTIMETER

a. Turn the ON-LIMIT control in a clockwise direction.

b. Allow approximately 3 minutes for the equipment to begin operating.

CAUTION

Allow at least 12 minutes warm-up time after starting to insure complete accuracy.

c. Set the bug pointer to the desired altitude limitation.

SEARCH RADAR EQUIPMENT

The AN/APS-20E radar set is a high powered search radar installed as part of the AEW (Aircraft Early Warning) system. Operation is conducted in conjunction with airborne, shipboard or ground equipment to extend the normal radar horizon of surface radar equipment. At an altitude of 5,000 feet the set can search an area within a 100 mile radius. At an altitude of 25,000 feet the search radius is extended to 200 miles. When the antenna is rotating at its maximum speed of 15 revolutions per minute at 25,000 feet, an area of 125,000 square miles may be searched every four seconds. Radar search information is presented on the IP-203/APS-20B indicators provided for the radar operator and the observer. With the AN/ART-28 relay system[1] installed, this information is relayed to any shipboard, airborne, or land based unit of the AEW system. IFF responses to interrogation signals transmitted by the AN/APX-7 radar recognition set are also displayed on the IP-203/APS-20B indicators.

WARNING

- Do not attempt to operate the AN/APS-20E radar set if unfamiliar with the function of all operating controls and procedures. Only authorized personnel should operate this equipment.
- Operation of the AN/APS-20E radar set on the ground should be kept to a minimum. The utmost care should be exercised not to direct the beam at congested areas, refueling airplanes, or ground personnel. When any abnormal indications are noted, immediately turn the equipment off by turning the SYSTEM switch to the "OFF" position.

STARTING THE EQUIPMENT. To place the AN/APS-20E radar in operation, turn the SYSTEM switch to "STANDBY". The AIR warning lamp will light until pressurization of the system is normal. The OL warning lamp will light when the 15 minute time delay starts and will go out when the time delay has timed out. The HEAT warning lamp should not light. Turn the SYSTEM switch to "OPERATE."

STOPPING THE EQUIPMENT. To stop the equipment, turn the SYSTEM switch to the "OFF" position and reset all controls to their pre-operation position.

CAUTION

Precautions should be taken to protect a carrier-based AN/APS-20E radar set and associated radar equipment from moisture. If no flight is made during a 24 hour period, the equipment should be operated for half an hour to dry it out.

GROUND POSITION INDICATOR EQUIPMENT

The AN/APA-57C ground position indicator equipment supplies voltages to the off-centering sweep circircuits in the IP-203/APS-20B indicators so that the radar presentation on the PPI remains stabilized, i.e., the trace origin is displaced about the face of the PPI as the aircraft flies about.

OPERATION. To place the AN/APA-57C ground position indicator in operation it is only necessary to place the GPI switch, located on the AN/APS-20B indicators, to the "GPI" position.

RADAR RELAY TRANSMITTING SET AN/ART-28.

Provisions are made for the installation of the AN/ART-28 radar relay data transmitter. This equipment, when installed, relays to another station the video signals received by the AN/APS-20E search radar set.

RADAR IDENTIFICATION EQUIPMENT

AN/APX-6 TRANSPONDER

The AN/APX-6 identification equipment provides the airplane with a means of identifying itself when correctly challenged by surface or airborne IFF equipment. The system also permits surface tracking of the airplane in which it is installed. Functionally, the AN/APX-6 system receives challenges originated by an interrogator-responser and transmits coded replies to the interrogator-responsor for display on the challenger's radar indicator.

IFF CONTROL. A C-629/APX-6 control panel (23, figure 4-4) is installed in the right-hand console and is identified as IFF. The unit contains a rotary selector

[1] After Service Change No. 511.

switch identified as MASTER with five designated positions; "OFF," "STDBY," "LOW," "NORM" and "EMERGENCY." Also included are toggle switches labeled MODE 2 and MODE 3, and a DESTRUCT switch which is guarded to prevent its being inadvertently actuated.

KY-81/APA-89 CODER.[1] Provisions are made for installation of the KY-81/APA-89 coder unit. The C-1272/APA-89 control panel is identified as SIF and located on the observer's right console (28, figure 4-4, sheet 2).

AN/APX-7 INTERROGATOR-RESPONSOR

The AN/APX-7 radar recognition set is designed to challenge the identity of targets detected by the AN/APS-20E search radar equipment, distinguishing between friendly aircraft and enemy targets.

OPERATION. The C-1040/APX-7 radar recognition control panel is located on the radar operator's left console (4, figure 4-7). The equipment is operated as follows:

a. Place the PWR-OFF switch in the "PWR" position. A three minute delay period must be allowed prior to operation.

Note

Panel illumination does not indicate the set is in operation.

b. Select one of the modes of operation to be used. Turn the desired MODE switch until the position marker on the switch skirt is under the panel mark.

c. Rotate the VIDEO switch to the video desired, either "IFF", "RADAR", or BOTH."

d. Determine whether momentary or continuous challenging is desired and place the CHALL switch in the corresponding position. For momentary or short challanges it is necessary only to hold the CHALL switch in the "MOM" position. When released, the switch will return to the center "OUT" position. For continuous challenging, place the switch in the "CONT" position.

e. To stop the equipment, turn the PWR-OFF switch to "OFF."

LIGHTING SYSTEM

INTERIOR LIGHTS

The interior lighting system includes all panel and console lights, various compartment flood and utility lights and the fuselage service lights. The interior lights receive power from the primary bus with the exception of the fuselage service lights, which are energized by the secondary bus.

INTERIOR LIGHTS CONTROL PANEL. In early aircraft[2] the INT LTS control panel (15, figure 4-4) is located on the observer's right console. In later aircraft[1] it is located on the center console (6, figure 1-5). The panel contains three rotary switches labeled FLT INSTR, NON-FLT INSTR, and CONSOLE. To turn the lights on, rotate the desired switch out of the "OFF" position in a clockwise direction. Light intensity is controlled by further rotation toward the "BRT" position. Lighting of the various instruments, panels and consoles is controlled through the INT LTS panel.

Note

A dimmer circuit which dims the warning lights on the instrument panel, is cut into the system when the FLT INSTR switch is turned on.

COCKPIT FLOOD AND UTILITY LIGHTS

A dome light on the COCKPIT LGTS panel located above the pilot's right shoulder on the cockpit canopy centerline, provides flood illumination of the cockpit with either red or white light. In addition to the dome light, there are two adjustable utility lights installed, one each above the left and right consoles. These lights can be removed from their brackets for use in other parts of the cockpit as desired.

FLOOD AND UTILITY LIGHTS CONTROL. Two switches on the COCKPIT LGTS panel operate the dome light and the utility lights. The control switch labeled WHITE-OFF-RED selects either "RED" or "WHITE" flood-lighting and the utility lights are on in either position. The other switch is labeled BRT-DIM-MED and adjusts only the intensity of the dome light when the control switch is on "RED." Since the white floodlight cannot be dimmed, the control switch should only be turned to "WHITE" in an emergency. Bright light may adversely affect the pilot's night vision.

COCKPIT EMERGENCY FLOOD LIGHTING. The dome light floods the cockpit with white light when the WHITE-OFF-RED control is on "WHITE" position.

RADAR OPERATOR'S COMPARTMENT LIGHTING

The radar operator's compartment is illuminated by two compartment lights located on either side of the centerline structure and a removable light on the left-hand side of the compartment above the radar operator's console. These lights and the radar operator's instrument lights are controlled through a LIGHTS control panel (3, figure 4-7) located on the radar operator's left console. The control panel contains two rotary-type switches marked INSTRUMENTS and COMPARTMENT. These switches vary the intensity of illumination when rotated between the "OFF" and "BRT" positions. A dome light is installed overhead at the aft end of the compartment. The switch for this light (7, figure 4-11), identified as COCKPIT LTG, is on the left side of the upper centerline structure just aft of the "eye ball" air vents. The switch can be turned from "OFF" to either "RED" or "WHITE" for compartment illumination. Associated with the dome light assembly is a panel containing jacks for a microphone and headset, and a toggle switch labeled DORSAL COMPT LIGHTS. Refer to paragraph on SERVICE LIGHTS in this section for operation of this switch.

SERVICE LIGHTS

AFT FUSELAGE. Two service lights are located in the dorsal fuselage area aft of the radar operator's com-

[1] Airplanes BuNo. 132751 and subsequent.
[2] Airplanes prior to BuNo. 132751.

SECTION VII

SYSTEMS OPERATION

POWER PLANT OPERATION

General engine smoothness and stable instrument readings are the most satisfactory indications of engine performance. If any irregularity in engine performance is noted during flight the engine should be throttled down, and if unable to correct the condition, a landing should be made for further investigation. The following information is given in the interest of maintaining optimum engine performance.

GROUND OPERATION

Prolonged ground operation should be avoided whenever possible. If it becomes necessary to operate the engine for an extended period with the aircraft motionless, head into the wind for maximum uniform cooling benefits.

USE OF THE COWL FLAPS. The cowl flaps automatically assume a full open position with the weight of the airplane resting on the wheels, thereby compressing the landing gear shock struts. This automatic opening feature can be overridden, however, by use of the COWL FLAPS switch on the cockpit left console. Closing the cowl flaps in flight will not override the automatic feature and the cowl flaps will open immediately upon landing. The cowl flaps should be open during engine warm-up but closed after the engine has been allowed to cool following shut-down, to protect the engine from existing weather conditions. If the cowl flaps have been closed during ground operation, termination of the d-c power supply will reinstate the automatic opening feature. Therefore, if closed, the cowl flaps will open automatically when d-c power is supplied to the secondary bus, as for instance, during the engine starting procedure.

USE OF ALTERNATE AIR. Use of alternate air for ground operation during extreme cold weather is beneficial as an aid to fuel vaporization. If alternate air is used for any reason during ground operation, ensure that direct air is selected prior to take-off.

CLEARING A FOULED ENGINE. Spark plugs may become fouled during extended ground operation particularly if the idle mixture is set too rich or if an excessive amount of oil is being pumped into the cylinders. The practice of running the engine at high power in an attempt to clean spark plugs has undoubtedly worked in some instances, but in a majority of cases the plugs have been fouled to a greater degree because of the deficiency of air in the rich mixture used for high power, and by a hardening of the substance already on the plugs. The already marginal firing efficiency of the spark plugs is lessened by increasing the heat and pressure in the cylinders. Partially fouled plugs often check satisfactorily at the medium manifold pressures and relatively cold head temperatures used for the magneto check but short out during the take-off run or climb out when compression pressures and temperatures have built up to a maximum. Because of these factors it is recommended that accumulated carbon deposits be burned-out and the formation of additional deposits be minimized by the following procedure:

a. During the latter part of the engine warmup and for prolonged idling (800 to 1200 rpm) at other times during ground operation, set the mixture control in the "NORMAL" position.

b. Immediately prior to the magneto check and again (if practicable) just before take-off, adjust manifold pressure to field barometric pressure with mixture control in the "NORMAL" position and operate for 15 seconds.

CAUTION

Assure that the mixture control is in the "RICH" position for take-off.

Note

The mixture control should remain in the "NORMAL" position for all ground operations except as noted. However, due to variations in the condition of the ignition system and carburetion system, and certain climatic conditions, some individual aircraft may require the "RICH" position for satisfactory acceleration while taxiing or maneuvering on the deck.

IN-FLIGHT OPERATION

When changing power settings during flight reduce manifold pressure before reducing rpm and increase rpm before increasing manifold pressure. To do otherwise may risk exceeding the operating limits of the engine.

USE OF MIXTURE CONTROL. The "RICH" position shall be used during all take-offs, approaches and landings. Rich mixture should also be used during let-downs to prevent engine backfiring. This is particularly true when the rate of descent or climatic condition tends to over-cool the engine. The "NORMAL" position may be

used during all other flight operations provided that the cylinder head temperature limit is not exceeded.

MANIFOLD PRESSURE REGULATOR. With the throttle positioned to give a desired manifold pressure, the manifold pressure regulator automatically maintains the selected manifold pressure at all altitudes below the critical altitude for the setting. If the critical altitude for the selected manifold pressure is exceeded, pushing the throttle lever further forward will have no effect as the carburetor is already at "full throttle." Power can be increased in this situation only by increasing the engine speed.

If oil pressure drops below approximately 25 psi the spring-loaded piston in the MAP regulator will drop to full low manual schedule where the actual throttle position is about one half the corresponding position of the throttle lever. The maximum MAP obtainable at Military rpm under this condition is about 1.5 times outside air pressure in low blower and about 2.3 times outside air pressure in high blower.

HIGH POWER SETTINGS. When engine detonation, roughness, or malfunction is encountered at high power settings, use "RICH" mixture control setting.

SUPERCHARGER CONTROL. High blower should be used only at altitudes where desired power is not available in low blower. When operating at normal rated power, do not shift to high blower unless not more than 36 inches of manifold pressure can be obtained at full throttle in low blower, otherwise less power will be available in high blower than could be obtained by remaining in low. If operating at military power, the shift should be made when no more than 40 inches of manifold pressure can be obtained. When operating at an engine speed lower than 2600 rpm, shifting is advisable when manifold pressure has decreased to 28 inches Hg. This will insure a power increase without the surge in manifold pressure associated with a shift to high blower exceeding the engine limitations. At low powers in low blower it is advantageous to obtain more power by increasing engine speed to 2600 rpm before shifting to high blower.

BLOWER SHIFTING. To shift from low to high blower:

a. Mixture control—"RICH" to lessen any tendency of the engine to cut out or run roughly.

b. Throttle—Reduce to 20 inches MAP to prevent exceeding the power setting desired after the shift to high blower.

c. Propeller control—When feasible, the engine speed should be reduced to 1600 rpm to reduce the danger of twisting the engine tail shaft, hence putting the engine in an out-of-time condition.

Note

When justified by emergencies or tactical requirements, blower shifts may be made at engine speeds up to 2600 rpm, *but such shifts must be kept to a minimum.*

d. Supercharger control—Shift rapidly to "HIGH" blower. Be prepared to retard the throttle to check excessive manifold pressure rise.

Note

The manifold pressure regulator is normally capable of maintaining any selected manifold pressure below critical altitude. However, it should not be expected to control manifold pressure during a blower shift as changes occur too rapidly for the regulator to follow. Manual operation of the throttle is essential to proper control of manifold pressure during blower shifting.

To shift from high to low blower:

a. Mixture control—"RICH."

b. Propeller control—Engine speed must not exceed 2600 rpm unless justified by an emergency or a tactical requirement.

c. Supercharger control—Shift rapidly from "HIGH" to "LOW."

d. Advance throttle to obtain the desired manifold pressure.

CAUTION

Do not shift to the same ratio at less than five minute intervals to prevent overheating of the clutch plates and eventual failure.

OPERATION IN HIGH BLOWER. Normal mixture settings may be used for all high blower operations while using 115/145 grade fuel, unless cylinder temperatures exceed limits or engine roughness is encountered. When these conditions occur during high blower operation, always use rich mixture.

Note

The use of military power while in high blower should be avoided in hot or humid weather when tactically feasible.

ENGINE CONTROL DURING LETDOWN. To prevent faulty oil scavenging or loading of the engine nose section with oil during a prolonged letdown, the propeller governor should be set at maximum cruise (2200 rpm), plus or minus 100 rpm, and a minimum manifold pressure of 15 inches MAP. Any manifold pressure above 15 inches MAP within engine speed limits, mixture control setting and altitude should be used. If a lower power setting is held during a prolonged letdown the engine will foul in the same manner as during extended glides with closed throttle.

ENGINE OVERSPEED. Should the engine exceed the maximum limit of 3150 rpm, immediately close the throttle, pull the propeller control toward "DECREASE" rpm position and reduce airspeed to a minimum commensurate with maintaining safe flight. This will aid in controlling engine speed, thereby reducing the danger of subsequent engine damage.

Note

Should the engine speed exceed 2990 RPM an engine inspection is required. Should the engine speed exceed 3150 RPM engine removal is required.

ENGINE SHUT-DOWN. To reduce the possibility of liquid lock, spark plug fouling and to permit optimum crankcase scavenging, the engine should be shut down from idle rpm. A period of two to five minutes engine operation at 650 rpm should precede the shut-down. This time interval should be observed whenever possible.

FUEL SYSTEM

FUEL FLOW. Fuel flow is directed from the selected tank through the selector valve to the electrical fuel booster pump, to the engine driven fuel pump, then to the carburetor. No fuel transfer between tanks is possible. A carburetor vapor vent returns excess fuel to the

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main tank. The vent line can return fuel from the carburetor at a maximum rate of 10 U.S. gallons per hour. Normally however, there is little or no return.

FUEL BOOSTER PUMP. The electrically energized fuel booster pump is normally used during starting, take-off, and landing. It may also be used to aid the engine-driven fuel pump in maintaining adequate fuel pressure at altitude, when a shift is made from one tank to another, or to serve as an emergency fuel pump in the event of failure of the engine-driven pump. Use of the fuel booster pump during ground operation under hot climatic conditions is an aid to vapor lock prevention.

FUEL TANK SELECTION. The main tank should be used for starting, warm-up, take-off, climb and landing. Selection of the main tank during flight should be made for combat, maneuvering, or when entering areas of severe turbulence.

Note

Since the main tank is used for starting, take-off and climb, sufficient fuel will be used to avoid the possibility of the tank overflowing due to fuel returning through the vapor vent line.

Fuel from the auxiliary tanks should be used for level flight only except as required to reduce the fuel level in the tanks.

Note

Fuel should be consumed from each auxiliary tank for a period of approximately five minutes soon after take-off. This procedure is recommended to minimize the possibility of fuel being siphoned overboard from full tanks.

SELECTION SEQUENCE. In flight, fuel should be used from the tanks in the following sequence: left external auxiliary, right external auxiliary, and fuselage main. The reason for selecting the tanks in this order is to maintain as favorable a loading condition as possible during any unbalance which occurs as fuel is consumed. This sequence also allows the maximum use of external fuel prior to dropping the tanks upon approaching a combat area.

SELECTION PROCEDURE. To change the selection of fuel flow from one tank to another:

a. Fly the airplane in a level attitude.
b. Fuel booster pump ..... "ON"
c. Fuel tank selector ..... Desired tank
d. Fuel booster pump ..... "OFF"

Care must be taken in the selection of the proper tank as the indicated progressive positions of the fuel selector valve handle are not in the same order as the required fuel tank selection sequence.

FUEL PRESSURE WARNING LIGHT. A pressure sensitive switch located in the fuel pressure indicator line will cause the fuel pressure warning light to glow whenever the fuel pressure drops below approximately 17 psi. An illuminated warning light indicates that the engine will operate for another 10 to 25 seconds before fuel starvation occurs. Some flickering of the warning light may occur, if the selected tank is low on fuel, when the aircraft is in a steep climb or dive or flying through extremely rough air. This characteristic is not considered objectionable.

FUELING PROCEDURE. Each tank is fueled individually and should be filled in the following sequence: fuselage main; external wing tanks.

OIL SYSTEM

The oil system is automatic in operation. Operation of the oil cooler doors, the oil tank warm-up compartment and oil dilution, however, can be controlled from the cockpit.

OIL COOLER DOORS. The oil cooler doors, one located on each side of the fuselage just above the leading edge of the wing, are thermostatically operated when the OIL COOLER DOOR switch is set at "AUTO." If some malfunction of the automatic feature occurs, the cooler doors can be opened or closed at the discretion of the pilot through use of the OIL COOLER DOOR switch. No indication of the position of the cooler doors is available to the pilot. When using manual control the pilot must position the doors, readjusting as necessary, until the desired oil temperature is maintained.

WARM-UP COMPARTMENT. As an aid to rapid warm-up after starting a cold engine, the main oil tank contains a smaller warm-up compartment from which the engine draws and returns oil whenever the oil temperature is below 55°C. The flow of oil is directed to and from the warm-up compartment by a thermostatically controlled diverter valve. The valve is positioned electrically when the battery-generator switch is energized. When the oil is cold, the resulting high viscosity causes resistance to the diverter valve, thereby creating an overload on the actuating motor. This overload can cause the motor to burn out. To eliminate this possibility, the oil diverter valve should be preset during every engine shut-down. This is accomplished by use of the oil dilution switch as outlined in Section II.

STOPPING THE ENGINE.

OIL DILUTION. Oil should be diluted during engine shut-down whenever an engine start is anticipated at temperatures approaching or below the freezing level if pre-heat is not available. This procedure should not be confused with that which outlines the positioning of the oil diverter valve. Although the oil dilution switch is used in either case, the oil diverter valve should be positioned during every engine shut-down while dilution of the oil supply need be used only for extremely cold operating conditions. Refer to Section IX, COLD WEATHER OPERATING PROCEDURES.

During oil dilution is is necessary for a ground crewman to open the oil dilution shut-off valve, located in the oil cooler section just forward of the fire wall. The pilot must then place the oil dilution switch on "OIL DILUTE" for the required period. This positioning of the oil dilution switch will cause the oil diverter valve to divert oil flow to the warm-up compartment of the oil tank and will also actuate the electrical fuel booster pump. Turning the battery-generator switch off before turning the oil dilution switch off at the completion of

the process will cause the diverter valve to remain in the correct position for the next engine start.

ELECTRICAL POWER SUPPLY SYSTEMS

Both a-c and d-c power operate the electrical equipment installed in the airplane. Two types of a-c power are utilized, variable frequency and constant frequency. Variable frequency a-c power is supplied by an engine-driven a-c generator or by an external power source. Constant frequency a-c power is supplied by two inverters which are operated from d-c power. Two batteries and an engine driven d-c generator or an external power source supply the d-c power. Emergency a-c power is supplied by the a-c generator to operate cockpit lights if the d-c generator fails.

D-C POWER SUPPLY SYSTEM

See figure 1-8 for d-c power distribution schematic and component units of the d-c power supply system. D-c voltage and amperage can be checked on the d-c volt-ammeter. An emergency warning light is provided to indicate loss of d-c generator power.

BATTERIES. Two 24-volt, 24 ampere-hour aircraft type batteries provide d-c power to the system. The batteries are parallel-connected to maintain a constant 24-volts to the system. An external source of power should be used for starting and ground checking of electrical equipment as continuous or frequent use of the batteries requires considerable battery maintenance and shortens battery life.

D-C GENERATOR. A 30-volt, 400 ampere, engine-driven d-c generator provides the normal source of d-c power for the airplane while airborne. D-c generator output voltage is regulated to 27.7 $\pm$ 0.5 volts by a voltage regulator connected to the generator field coil.

D-C POWER DISTRIBUTION

D-c power is distributed from its source to one or more of the following major busses: primary, secondary, armament, monitor, and battery busses. D-c power is further distributed from the major busses to minor busses or to the circuit breaker panels which are terminals for the electrical circuits. This power is controlled by the battery-generator switch, which has three positions: "BAT & GEN," "OFF," and "BAT ONLY."

PRIMARY BUS. While the primary bus supplies d-c power directly to some equipment, it serves as a distribution point through which d-c power flows to the secondary, armament and monitor busses. This flow is dependent upon the power source, actuation of relays and position of the battery-generator switch. When the battery-generator switch is placed in the "BAT & GEN" or "BAT ONLY" positions, battery power will flow to the primary bus. D-c generator power will flow to the primary bus when the d-c generator is in operation and the battery-generator switch is placed in the "BAT & GEN" position. External power will flow to the primary bus regardless of the position of the battery-generator switch.

SECONDARY BUS. In normal flight operation with the battery-generator switch on the "BAT & GEN" position, d-c generator power actuates a relay to allow power to flow from the primary bus to the secondary bus. When the battery-generator switch is on "BAT ONLY," battery power actuates a relay to make this connection and thus energize the secondary bus. Also, lowering the landing gear will energize the secondary bus with the battery-generator switch on either "BAT & GEN" or on "BAT ONLY" position. D-c power from an external power source will energize the secondary bus only if the battery-generator switch is on "BAT ONLY" or if the landing gear is extended.

ARMAMENT BUS. The armament bus receives power from the primary bus when a relay is actuated by moving the MASTER ARMAMENT SWITCH to the "ON" position. However, the armament bus can be energized only when the secondary bus is energized since the relay operates from secondary bus power. The MASTER ARMAMENT SWITCH (circuit breaker type) will automatically move to "OFF" and de-energize the armament bus when the landing gear is extended.

MONITOR BUS. The monitor bus can be energized only from the d-c generator or from an external d-c power source. With the battery-generator switch in the "BAT & GEN" position, and with the d-c generator operating, power will flow from the d-c primary bus to the monitor bus relay, which then allows power to flow from the primary bus to the monitor bus. External power will flow from the primary bus across the monitor control relay to the monitor bus relay, which allows power to flow from the primary bus to the monitor bus.

BATTERY BUS. With the batteries installed, the battery bus will remain energized regardless of the position of the battery-generator switch.

CIRCUIT BREAKER PANELS. All d-c electrical circuits are connected to the d-c power supply system at the circuit breakers located on the circuit breaker panels. See figure 1-10.

VARIABLE FREQUENCY A-C POWER SUPPLY SYSTEM

See figure 1-9 for variable frequency a-c power distribution schematic and component units of the system. The variable frequency a-c power supply system can only be utilized when the airplane engine is operating, since it is derived from the engine-driven a-c generator. Voltage output of the a-c generator is checked on the a-c voltmeter which is used in conjunction with the voltmeter phase selector switch. No warning light is provided to indicate a-c generator failure.

A-C GENERATOR. The engine-driven a-c generator provides 200-volts line-to-line, and 115-volts to ground. The total power delivered by the generator is nine kilovolt-amperes (KVA) at a frequency of 400 to 800 cycles per second. The frequency of the generator output is dependent upon the rpm of the generator. The generator

week if not subjected to harsh cleaning methods, deicing or de-greasing fluids, or salt sprays. Re-applications should be made whenever the compound may have been removed by any of the physical causes noted above. (See WINDSHIELD RAIN REPELLENT, this section.) Wet snow, freezing rain and ice will adhere to skin surfaces and cause hazardous loss of lift if corrective measures are not taken. Ice or snow conditions existing on the ground prior to flight will increase taxi and take-off hazards. The following precautions should be observed whenever ice, snow, or freezing rain is encountered or anticipated.

a. Before entering cockpit, check wings, wheels, radome, control surface hinge points, pitot tubes, etc. Make certain all ice and snow are removed.

WARNING

Loose snow cannot be depended upon to blow off, and only a thin layer of frost is necessary to cause a loss of lift and unusual stalling characteristics. It is extremely important that the propeller be free of ice before take-off.

WINDSHIELD RAIN REPELLENT. Normal visibility through the windshield and canopy when encountering rain is made possible by use of a rain repellent kit, stock number R83K710075. The kit contains a cleaner, bonding paste and a rain repellent stick. For every operation when using the application methods described, use only clean soft cloths. The following procedures are recommended for application of the rain repellent materials:

a. Wash surface if excessively soiled.

b. Clean surface with cleaner provided, then polish.

c. Apply bonding paste in a thin film, first making certain that surface is dry.

d. Polish the surface until all the black color disappears.

e. Apply the stick rain repellent by rubbing the side of the stick lightly over surface. Avoid excessive application of this material for best results.

f. Polish until the film is clear.

Note

If halo effect is encountered after repellent has been applied to the windshield, it may be desirable to leave a portion of the windshield untreated for night carrier landings.

After application, the windshield may frequently be cleaned and polish according to the following requirements:

a. If the film is cloudy or moderately soiled, clean and polish.

b. If surface is soiled, but will respond to water cleaning, apply mild soap or mild detergent with cloth and water only and after drying, polish. Should this procedure remove the film, it may be restored by applying the rain repellent only and then polishing.

c. When use of a harsh cleaner or detergent is required, recoating will be necessary as described in the first procedure.

CAUTION

Do not permit the rain repellent compound to remain on the sealant around the edges of the windshield and canopy.

ANTI-FOGGING COMPOUND. An anti-fogging compound, stock number R51-LAE101-1-8, is available for coating the interior surface of the windshield and canopy and will prevent fogging of these transparent surfaces. Application is as follows:

a. Wash interior surface if excessive soiled.

b. Apply anti-fogging compound, using the application unit.

c. After application, wipe surface with clean, lintless cloth until clear.

CAUTION

- Do not let anti-fogging compound come in contact with instrument panel finish, as damage to the lacquer may result.
- Avoid contact with the rubber and sealant surrounding the canopy when applying anti-fogging compound, as rubber tends to swell if treated with this preparation.

One application of the anti-fogging compound is effective for a minimum of ten fogging and drying cycles. When there is doubt as to the condition of the film, a new film should be applied.

FLIGHT IN TURBULENCE AND THUNDERSTORMS

Since the airplane is inherently stable, a pilot with proper instrument flying proficiency should anticipate no difficulty in flying through turbulent air. Refer to Section V, AN 01-40ALEB-1A, for recommended range of airspeeds for flight in severe turbulence.

COLD WEATHER OPERATING PROCEDURE

Successful cold weather operation is dependent primarily on postflight servicing and preparation of the airplane in anticipation of the requirements for subsequent operation.

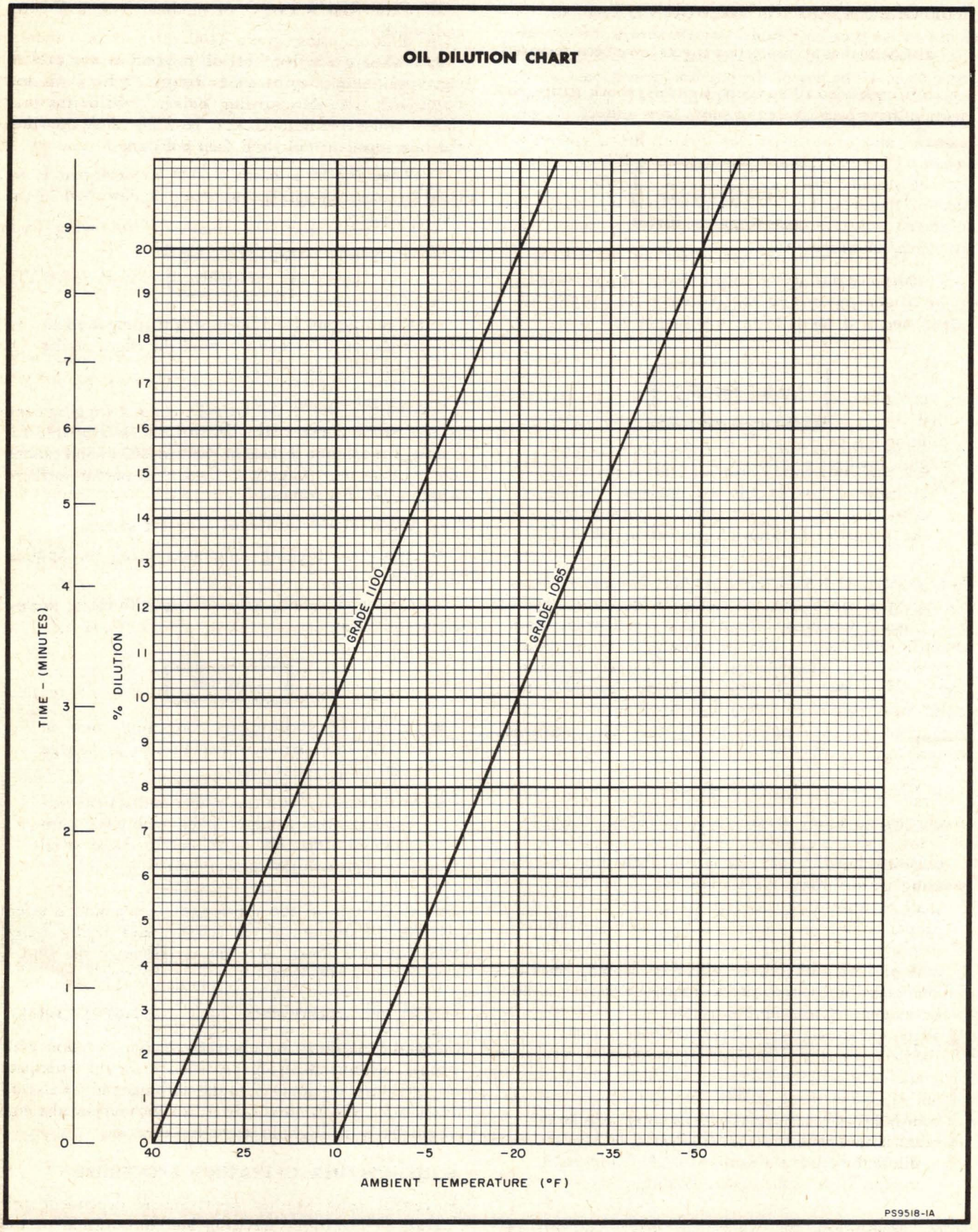


Figure 9-2. Oil Dilution Chart

BEFORE ENTERING THE AIRCRAFT

a. Check that all protective covers have been removed.

b. Check that all surfaces, controls, shock struts, and drains have been cleared of snow, frost and ice.

WARNING

The collection of snow, frost and ice on the airplane surfaces constitutes one of the major flight hazards in low temperature operation and will result in the loss of lift and unusual stalling characteristics.

c. At temperatures below −18°C it is recommended that the cockpit and engine be pre-heated, even if oil dilution has been used. If oil dilution has not been used, engine pre-heat should be used at temperatures below 2°C.

CAUTION

Apply heat until oil will flow freely from the oil drain valve and the propeller can be pulled through with comparative ease.

d. Have fuel filters and fuel drain cocks checked for ice. Apply heat if necessary to drain moisture.

ALTERNATE OIL

Grade 1100 lubricating oil shall be used at ground starting temperatures down to 1°C. When temperatures below 1°C are expected, or if it would be necessary to use oil dilution, use grade 1065 lubricating oil. When using grade 1065 lubricating oil, inlet temperatures shall be maintained between 65°C and 75°C to obtain proper engine lubrication during engine operation, and to prevent accumulation of moisture and volatile products of oxidation in the oil. If it is not possible to maintain these temperature limits, oil pressure should be maintained within the normal operating range and oil temperatures should be kept above 60° C. If grade 1065 oil is not available use pre-heat. If pre-heat is not available it will be necessary to dilute the grade 1100 oil. If, when using grade 1065, the temperature goes below 0°F (−18°C) it will be necessary to use pre-heat. If pre-heat is not available it will be necessary to dilute the grade 1065 oil.

OIL DILUTION.

Oil dilution using grade 1100 oil will be conducted only when grade 1065 oil or pre-heat is not available and continuous temperatures below 25°F (−4°C) are expected. Oil dilution using 1065 oil will be conducted only when pre-heat is not available and continuous temperatures below 10°F (−12°C) are forecasted. Refer to figure 9-2.

STARTING ENGINE

a. Set the throttle to obtain the following recommended engine speeds during a start:

(1) 700 to 800 rpm (throttle closed) for OAT of −20°C or lower.

(2) 900 to 1000 rpm for OAT of −20°C to −1°C.

b. During cold weather operations, except in cases of emergency, an external power supply must be used when starting the engine.

c. Priming the engine before the starter is engaged should be avoided. Prime continuously while cranking until the engine fires and accelerates to several hundred rpm. At this time advance the mixture control to "RICH" and cease priming.

d. The only use for the primer after the engine is operating on the carburetor fuel (mixture "RICH") is to occasionally ad the primer flow to keep the engine running for the first one or two minutes of warm-up time. This is necessary in extreme cold OAT, i.e., −1°C or below.

Note

If the engine shows a marked tendency to backfire during the start, abort the starting procedure and investigate the automatic manifold pressure regulator. Experience indicates that the manifold pressure regulator lever may not readily follow the throttle lever toward the idle range under cold weather conditions. Since the throttle should be barely "cracked" for cold weather starts, manual adjustment of the regulator lever may be necessary.

e. The throttles should be retarded to a minimum idle during the early stages of warm-up to maintain a stabilized oil pressure. Advancing the throttle while the oil is cold will result in cavitation within the oil pump and a loss of oil pressure. If the oil pressure does not stabilize, the engine should be stopped and heat applied locally. Excessive pressure should not last over 30 seconds after starting. If it does, stop the engine and ascertain the cause. When the oil pressures show stability during manipulation of the throttle, increase the engine speed to approximately 1200 rpm and continue the warm-up.

WARM-UP. Normal warm-up procedures will usually evaporate sufficient gasoline from diluted engine oil to eliminate any difficulty with scavenging. If time permits, run the engine at least thirty minutes with the oil temperature above 50°C to rid the oil of gasoline.

GROUND TESTS

Supplemental to the normal procedures for ground tests, the following should be accomplished:

a. Operate all hydraulic systems except the landing gear through several cycles.

b. Operate all flight controls from lock to lock several times and check for freedom of movement.

c. Check gyro instruments for proper operation. As much as 10 to 15 minutes may be required for gyros to erect in cold weather.

TAXIING INSTRUCTIONS

If taxiing in loose snow, hold control stick back and use sufficient power to keep momentum. Avoid sharp turns, but if they must be made, use a minimum of differential braking so a wheel will not pivot and dig in. Exercise extreme caution and use reduced engine speeds while taxiing on ice. Use alternate air while taxiing to improve fuel vaporization, prevent fouling of the spark plugs, and eliminate icing of the induction system.

Operating at reduced engine speeds will cause the generator to cut out, consequently, only essential electrical equipment should be used in order to conserve battery power. To assure a minimum drain upon the battery the following equipment should be turned off as indicated unless use prior to take-off is absolutely necessary.

a. Keep all interior and exterior lighting at a minimum.

b. Fuel booster pump ..... "OFF" until just before take-off

c. Pitot heater ..... "OFF" until initiating the take-off run

d. Nonessential communications and electronic equipment. . OFF

BEFORE TAKE-OFF

a. Turn on pitot heat just prior to take-off.

b. Switch to "DIRECT" carburetor air just prior to take-off.

Note

Take-off in alternate air is not recommended at ambient air temperatures above −20°C.

c. Place cockpit heater lever in "WIND & CABIN" position.

AFTER TAKE-OFF

Operate the landing gear, flaps, and arresting hook through several cycles to prevent them from freezing in the up position, but do not set the brakes as they may freeze in the locked position. Expect slow operation of the hydraulic system due to stiffening of all lubricants and fluids. Operate the trim tabs and control surfaces to rid them of slush or moisture which may tend to freeze.

CARBURETOR AIR CONTROL. The "ALTERNATE" air position should be used as a normal operation when flying in any condition conducive to the formation of induction system ice and when cruising under cold weather conditions, to improve fuel vaporization. The shift to alternate air should be made before carburetor icing conditions are encountered. When making the shift to or from alternate air, it is desirable to use "RICH" mixture during the shift. The manifold pressure lost in the use of alternate air will automatically be compensated for by the manifold pressure regulator. If the carburetor air temperature exceeds 38°C (low blower) or 16°C (high blower) in alternate air, reduce allowable MAP limits 1 inch for each 6°C in excess of these temperatures. Reduce standard day MAP limit 6 inches when CAT indicator needle registers 50°C. Pilots must be on the alert for atmospheric conditions that may cause carburetor icing. The normal drop in manifold pressure that occurs when the carburetor screen starts to ice is concealed because the manifold pressure regulator automatically opens the carburetor throttle to compensate for the loss of manifold pressure. The pilot therefore, may receive no warning until the screen is heavily iced. Use of "ALTERNATE" air must be based on judgment rather than on any definite indication of icing. Icing can occur in the small air metering passages of the carburetor at ambient air temperatures of 5°C and below.

ICING. If icing conditions should be encountered, the altitude should be changed immediately in an attempt to find a level free of the hazard. If a climb should be attempted, a high airspeed should be maintained during the climb. Underwing icing, particularly prevalent in an airplane with external stores under the wing, is retarded if high angle-of-attack climbs are avoided.

OIL TEMPERATURE. Cold weather operation often results in oil-in temperatures below the minimum required to evaporate blow-by water and volatile products of oxidation of the oil. Continued operation of the aircraft engine with crankcase and engine temperatures below 60°C may result in the formation of engine oil-water emulsion and sludge. Note should be taken of any periods of operation where oil-in temperatures are continuously below this minimum desired operating temperature, since under these conditions the oil should be changed every 60 hours to prevent the accumulation of water.

DESCENT

Keep cylinder head temperatue above 100°C and oil temperatures above 30°C during descent. If the engine should tend to cool below these limits during an extended let-down, lower the landing gear so that more engine power will be required.

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