AN 01-40ALEA-1

Flight Handbook

NAVY MODEL

A-1G AIRCRAFT

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IMPORTANT

In order that you will gain the maximum benefits from this handbook, it is imperative that you read this page carefully.

FOREWORD

This handbook is written as a text for the pilot for immediate study and later reference in order that he may gain complete familiarity with the airplane he is assigned to fly. Thus, as complete a picture as practicable of the basic structure and installations of the airplane along with the fundamental operating procedures involved are included. It is not the function of the handbook to teach the pilot how to fly the airplane, as it is assumed he is competent in this matter. However, the handbook contains information regarding behavior peculiar to the aircraft in various conditions of flight and ground operation.

The handbook is divided into nine sections and an appendix. Sections I, II and III are closely interrelated and contain complete information relative to the physical act of flying the airplane. Section I provides a complete description of the aircraft and its systems, instruments and controls. Emergency equipment that is not a part of an auxiliary system is also described. Section II contains information for the normal operation of the airplane and describes all procedures to be accomplished by the pilot from the time the aircraft is approached until it is left parked on the ramp after completing one non-tactical flight under ordinary conditions. Section III describes the procedures to be followed in meeting any emergency, except those in connection with auxiliary equipment, that could reasonably be expected to be encountered.

Section IV contains the description and operation of all auxiliary equipment which does not actually contribute to flight but enables the aircraft to perform specialized functions. All limitations and restrictions that must be observed during normal operation are discussed in Section V, while Section VI attempts to evaluate any unusual flight characteristics, both favorable and unfavorable, that the aircraft may possess. These two sections are currently classified Confidential, and are published in the supplemental handbook, NavAer 01-40ALEA-501A. A discussion relative to the operation of the various systems in the airplane is contained in Section VII. Section VIII describes the duties of each crew member which are considered necessary for the accomplishment of a normal non-tactical flight. Section IX consists of instructions for operating the aircraft under all weather conditions including instrument flight. A Confidential Supplement, which is published under a separate cover, contains all flight operating data charts for the airplane and other applicable Confidential material. Refer to NavAer 01-40ALEA-501A, Supplement to Flight Handbook for Navy Model AD-5N Aircraft.

It should be noted that the information in this handbook will be kept current by frequent revisions. Since, however, a slight delay in the dissemination of revision material is to be expected, *it is imperative that flight crews stay abreast of pertinent technical directives which frequently cover critical flight restrictions or new techniques involved in operation of the aircraft.* To offset these delays and to assure that all vital information is placed in the hands of the pilot as soon as possible, Interim Revisions, issued by BuAer as necessary, will be sent to each activity that includes this Flight Handbook on its Aeronautical Publications Requirement Request. Interim Revisions received at the squadron level will be placed between the cover and the title page and will be listed on the flyleaf under Interim Revisions Outstanding. During the next regular revision of the Flight Handbook, each outstanding Interim Revision will be incorporated into the book. This action will be noted on the flyleaf by revision number and pages affected.

In order to make the text as specific as possible, the nomenclature used to identify controls and other equipment is identical wherever possible to that used in the airplane itself. Such nomenclature is capitalized. Also capitalized, and enclosed in quotation marks, are the control positions as they are identified in the aircraft. For example: The OIL COOLER DOOR switch is spring-loaded in the "OPEN" or "CLOSE" position and returns to "OFF" when released.

An alphabetical index is included at the end of the book to facilitate reference to the text.

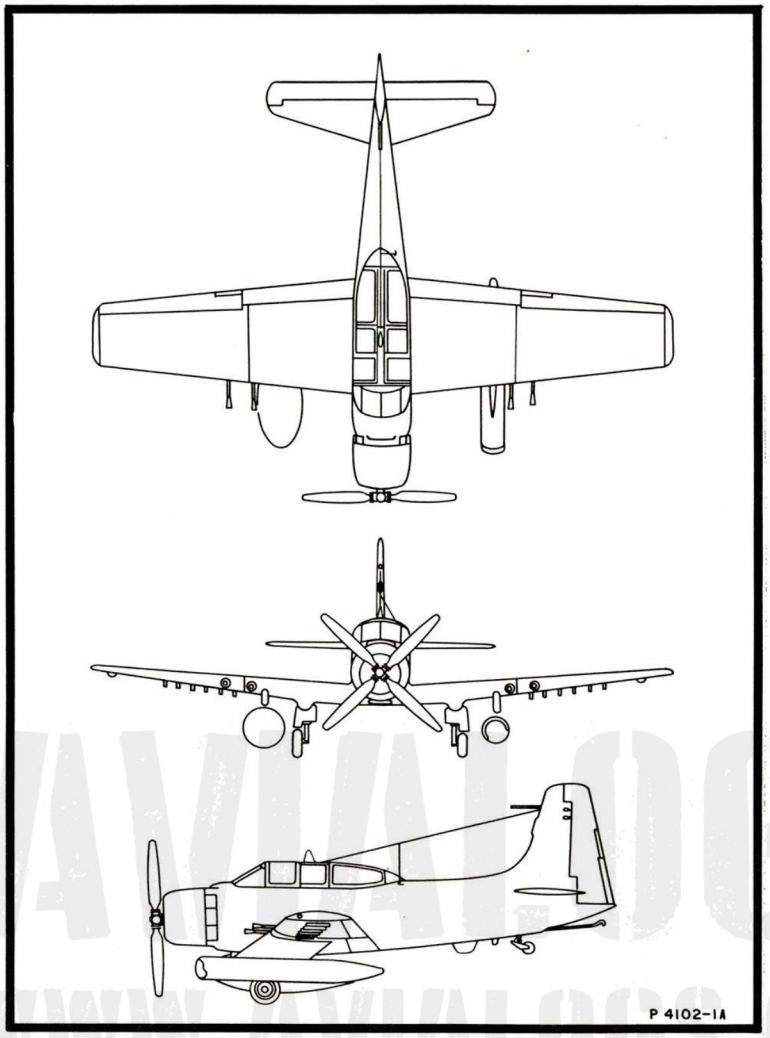


Figure 1-1. Model AD-5N Airplane

SECTION I

DESCRIPTION

THE AIRCRAFT

The Model AD-5N airplane is a three-place, carrier based landplane, manufactured by the Douglas Aircraft Co., Inc., El Segundo Division. The airplane is primarily designed to operate as a night attack airplane and may be employed for night bombing, intercept, strafing, anti-submarine, and radar countermeasure missions. The cockpit houses a pilot, an ECM operator or observer, conventional flight and engine controls, and an automatic pilot. No flight controls are provided for the ECM operator. Provisions are made for a radar operator to be seated in the middle compartment just aft of the cockpit. The airplane is equipped for catapult take-offs and arrested landings. Four 20-mm guns are installed in the wings with space provisions for approximately 200 rounds of ammunition for each gun. Six rocket launchers may be installed under each outer wing panel. The inner wing and the centerline bomb racks are capable of carrying bombs or torpedoes. The airplane normally carries an AN/APS-31 radar nacelle on the right inner wing bomb station and may carry a searchlight-sonobuoy-flare dispenser, or a chaff dispenser installation on the left inner wing bomb rack. Special armament stores may be carried on the centerline bomb rack. A single speed brake is installed on the bottom of the fuselage. For general arrangement see figure 1-2.

DIMENSIONS

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

Length	40 feet
Span (wings spread)	50 feet ¼ inch
Span (wings folded)	23 feet 11⅛ inches
Height (maximum propeller)	15 feet 9⅝ inches
Height (over folded wings)	16 feet 7⅝ inches
Height (maximum during wing folding)	19 feet 4⅞ inches

COMPARISON WITH PRIOR MODEL AD-SERIES AIRPLANES

The most apparent difference between the Model AD-5N and previous AD-series airplanes is the enlarged canopy installation. In addition, the vertical surface area has been increased approximately 50 percent; the engine has been moved forward about eight inches; the inner wing bomb fairings have considerable rake, and only one dive brake is installed on the airplane.

POWER PLANT

The engine is a Wright Cyclone R3350-26WA with a single-stage, two-speed supercharger. It is an 18-cylinder, two-row, air-cooled, radial engine, rated at 2700 horsepower at take-off. The engine is equipped with a Stromberg PR58U1 carburetor and a spinner injection system. The lubrication system is a dry sump type in which the oil is supplied under pressure to almost all moving engine parts except the propeller shaft and crank-shaft anti-friction bearings. Lubrication to each individual piston and cylinder wall is supplied by jets. Water injection provisions are not installed on the airplane; however, water injection equipment will be available in a combat power kit and can be installed at squadron level.

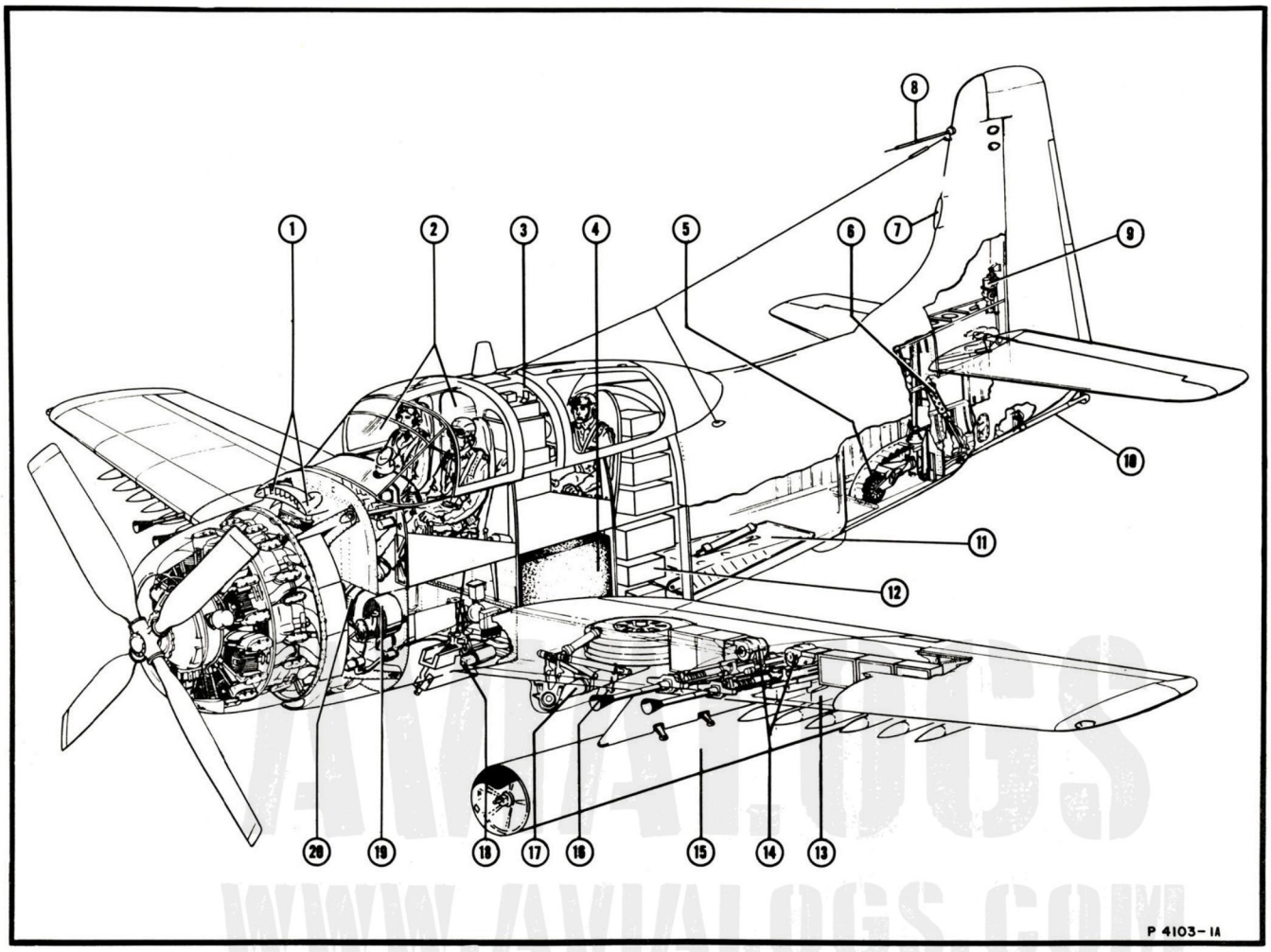
POWER PLANT CONTROLS

THROTTLE. The throttle lever (12, figure 1-3) is located on the cockpit left console. A throttle stop, adjusted to indicate to the pilot the throttle position for take-off manifold pressure, is incorporated in the throttle quadrant. The throttle stop is set to give between 56 and 58 inches Hg in manifold pressure during take-offs. A two-position microphone switch and a two-position speed brake control switch are incorporated on the inboard end of the throttle lever grip. The microphone switch, the upper of the two switches, is moved forward for radio transmission and aft for intercommunication. The speed brake control switch (10, figure 1-3) has "OPEN" (aft) and "CLOSE" (forward) positions. A hand grip (3, figure 1-3) used for catapult take-off, is located just forward of the throttle lever and is rotated up against the side of the cockpit when not in use.

AUTOMATIC MANIFOLD PRESSURE REGULATOR. An automatic manifold pressure regulator on the engine 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 also maintain a selected manifold pressure under all flight conditions, and will reset manifold pressure when changing supercharger speeds.

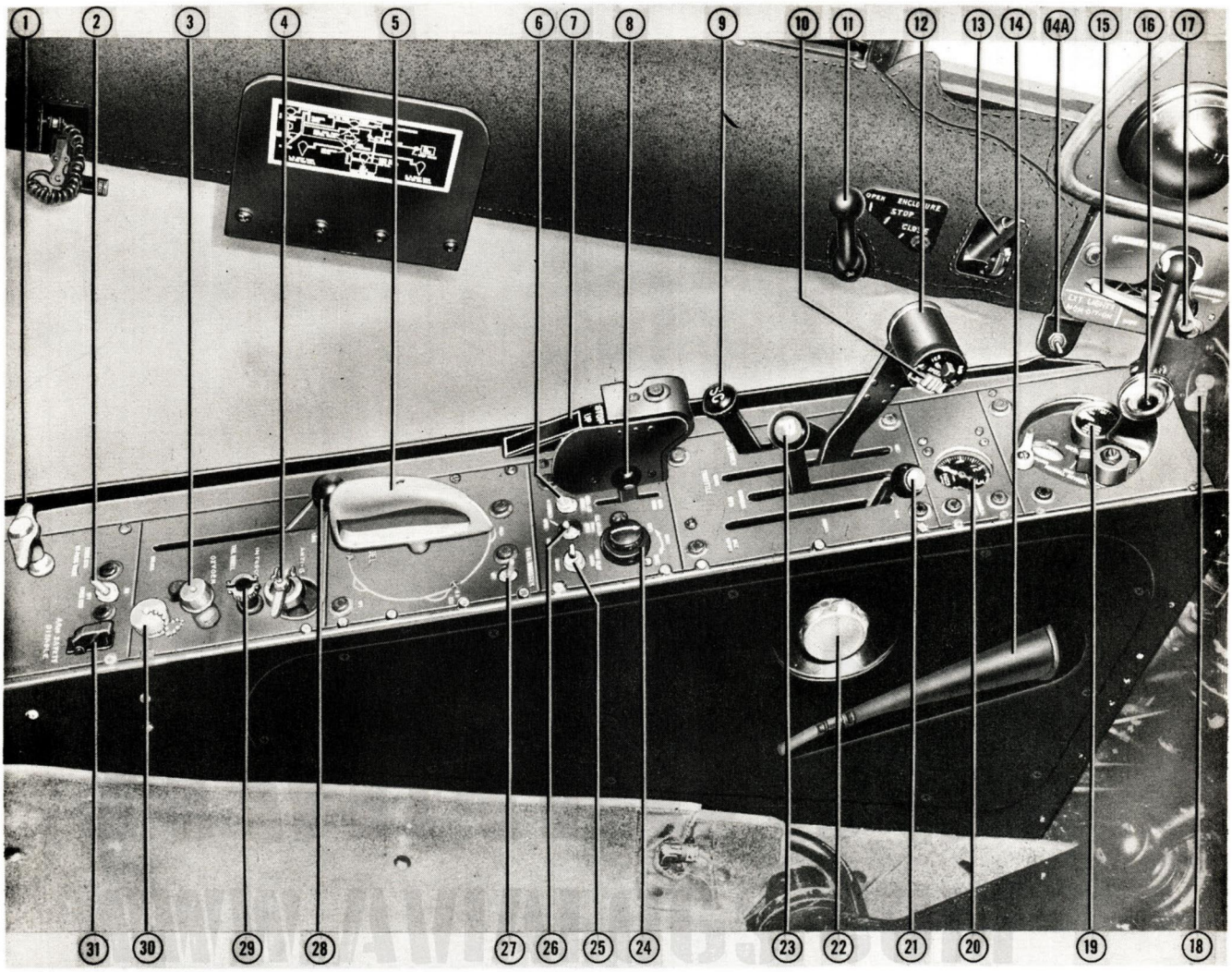
SUPERCHARGER. The supercharger control (9, figure 1-3), located on the cockpit left console just outboard of the throttle, has "LOW" and "HIGH" blower positions.

MIXTURE CONTROL. The mixture control lever (21, figure 1-3), located on the cockpit left console has "IDLE CUTOFF," "NORMAL" and "RICH" positions.



1. Cockpit heating and ventilating air intake ducts
2. Windshield and sliding enclosure
3. Radar operator's compartment
4. Main fuel cell
5. Tail gear
6. Arresting hook hold-down unit
7. Radar operator's compartment heating and ventilating air intake
8. Static boom
9. Horizontal stabilizer actuating unit
10. Arresting hook
11. Speed brake
12. Electronic equipment compartment
13. Outer station stores racks
14. Gun installation and ammunition storage
15. Searchlight-sonobuoy/flare dispenser
16. Catapult hook
17. Landing gear
18. Centerline stores rack
19. Hydraulic reservoir
20. Oil tank

Figure 1-2. General Arrangement

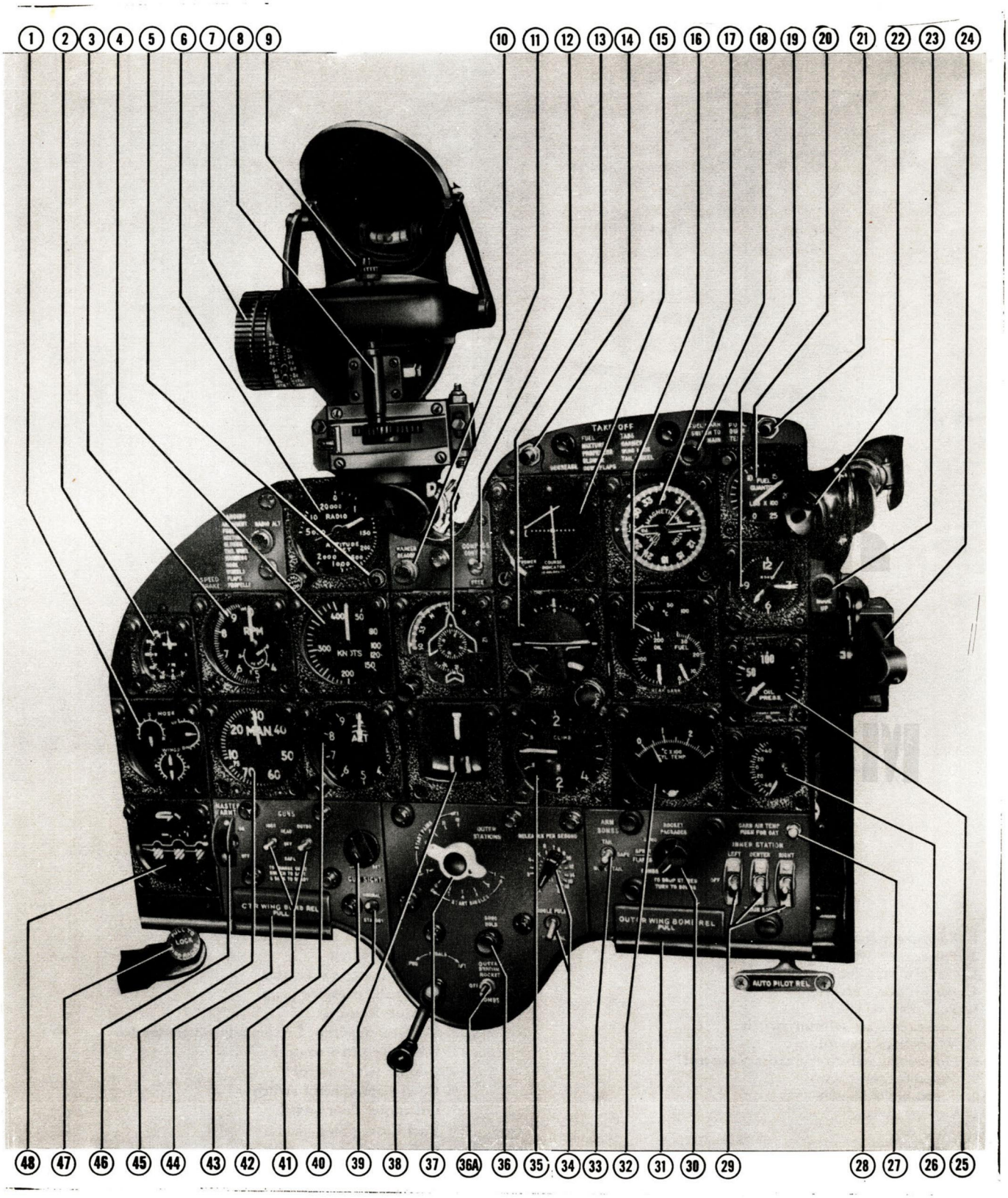


1. Emergency hydraulic by-pass valve
2. Emergency hydraulic pump switch
3. Oxygen tube connector
4. Anti-g suit connector
5. Fuel tank selector
6. Carburetor air selector switch
7. Wing flaps control
8. Horizontal stabilizer auxiliary control
9. Supercharger control
10. Speed brake switch
11. Canopy control
12. Throttle
13. Catapult grip
14. Pilot's relief tube

14A. Exterior lights switch

15. Landing gear safety latch
16. Landing gear control
17. Landing gear control release plunger
18. Ignition switch
19. Pilot's oxygen regulator
20. Hydraulic pressure gage
21. Mixture control
22. Throttle quadrant friction adjustment knob
23. Propeller pitch control
24. Rudder trim control
25. Cowl flaps control switch
26. Oil cooler door switch
27. Fuel boost pump switch
28. Tail wheel lock control
29. Intercommunications system receptacle
30. 28-volt d-c receptacle
31. Armament safety disable switch

Figure 1-3. Cockpit — Left Console



Airplanes prior to BuNo 132486
(prior to Service Change Nos. 505 and 511)
Figure 1-4. Cockpit — Pilot's Instrument Panel (Sheet 1)

←

Key to Figure 1-4 (Sheet 1)

1. Trim position indicator
2. Elapsed time clock
3. Tachometer
4. Airspeed indicator
5. Low limit altitude warning light
6. AN/APN-1 height indicator
7. Mil adjustment knob
8. MK 20 MOD 4 gunsight
9. Reticle control knob
10. Marker beacon indicating light
11. G-2 compass indicator
12. Compass control switch
13. Gyro horizon
14. Degreasing switch
15. ID-304/APA-70C course indicator
16. Engine gage unit
17. ID-250/ARN course indicator
18. Fuel pressure warning light
19. Eight day clock
20. Fuel quantity indicator
21. Fuel quantity indicator test button
22. Air vent
23. Arresting hook warning light
24. Arresting hook control
25. Front bank oil pressure indicator
26. Air temperature indicator
27. Outside air temperature button
28. Automatic pilot manual release handle
29. Inner stations selector switches
30. Inner stations function selector switch
31. Outer wing stations manual release handle
32. Cylinder head temperature indicator
33. Bomb arming switch
34. Intervalometer switches
35. Rate-of-climb indicator
36. Sonobuoy circuit warning light
36A. Outer stations function selector switch(1)
37. Outer stations selector switch
38. Rudder pedal adjustment crank
39. Turn and bank indicator
40. Gunsight lamp selector switch
41. Gunsight reticle brilliance control
42. Altimeter
43. Gun switches
44. Center wing stations manual release handle
45. Manifold pressure gage
46. Master armament switch
47. Center wing racks manual lock handle
48. Wing flaps and landing gear position indicator

(1) Airplanes BuNo 132515 and subsequent

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 (22, figure 1-3), located on the inboard side of the cockpit left console, adjusts the friction on the throttle and propeller pitch control levers only.

CARBURETOR AIR. The carburetor air door is electrically operated and is controlled by a switch (6, figure 1-3) located on the lefthand console. Switch positions are "DIRECT" and "ALTERNATE."

AIR TEMPERATURE INDICATOR. The air temperature indicator (26, figure 1-4) is on the pilot's instrument panel. The indicator normally shows carburetor air temperature. Outside air temperature reading on the same indicator is obtained by depressing the momentary contact switch (27, figure 1-4) adjacent to 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 (18, 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, and then through three lines to the blower case of the engine. The engine is primed by building up pressure with the fuel booster pump and then pressing the PRIMER switch (14, 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 (13, figure 1-5) located on the cockpit center console labeled STARTER. Pressing the STARTER switch actuates the starter and the ignition booster.

ENGINE COOLING

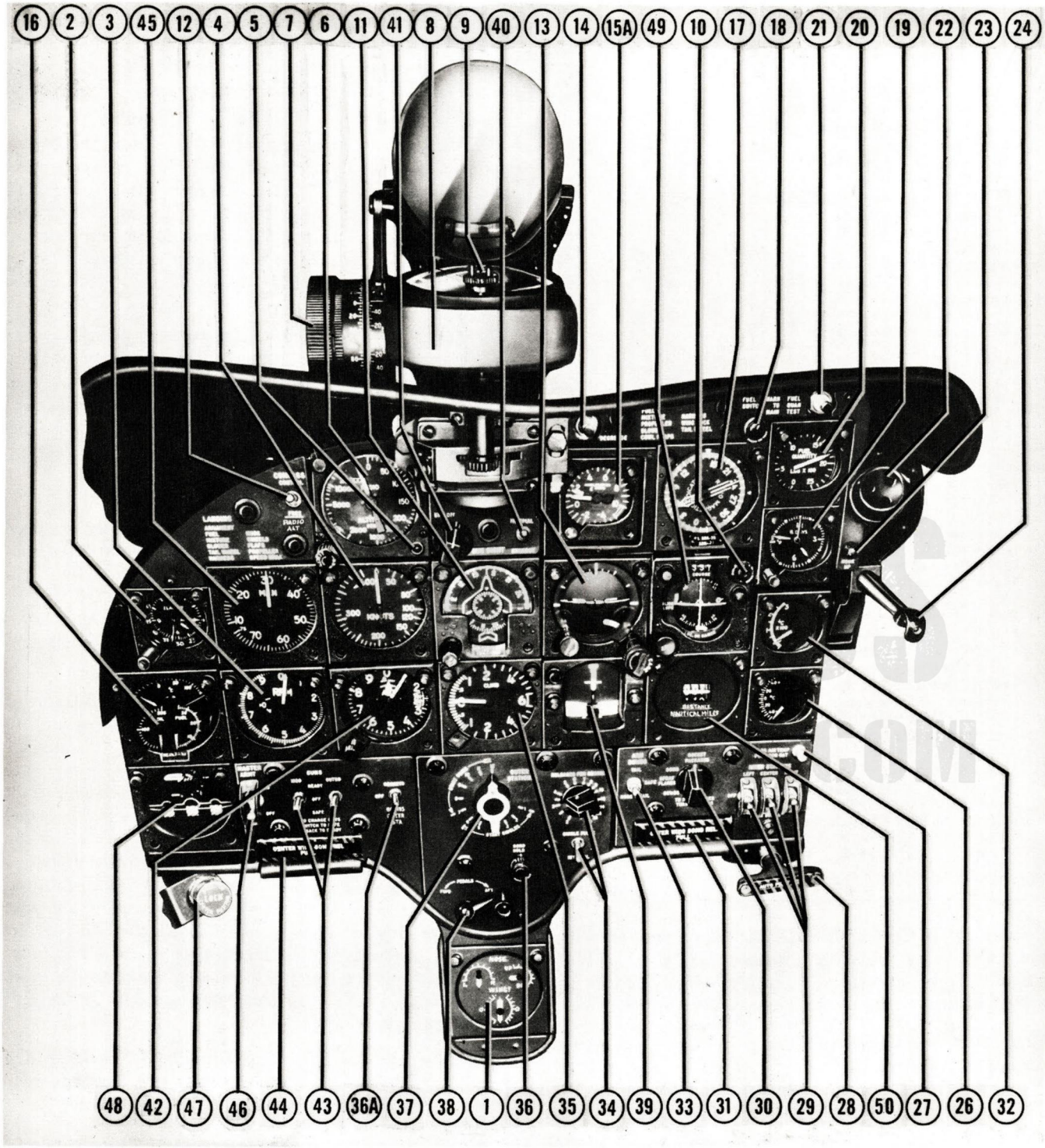
COWL FLAPS. The cowl flaps are electrically operated and are controlled by a three position momentary contact toggle switch (25, figure 1-3) located on the cockpit left console. The switch is moved to "OPEN" or "CLOSE" for operation of the cowl flaps and automatically returns to "OFF" when released, thus maintaining the cowl flaps in any selected position.

NOSE FLAPS. Nose flaps are installed in addition to side cowl flaps to reduce the 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 antidrag ring to the right of the top centerline when the nose flaps are closed. A microswitch is attached to the left landing gear telescoping mechanism in such a manner that whenever the weight of the airplane is on the landing gear, the nose and cowl flaps extend to the full open position.

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 (26, 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 springloaded in the "OPEN" position and returns to "OFF" when released.

PROPELLER

The airplane is equipped with either an Aeroproducts A642-G804/M20A2-162-0 or an A642-G805/M20A2-162



Airplanes prior to BuNo 132486
(after Service Change Nos. 505 and 511)
Figure 1-4. Cockpit — Pilot's Instrument Panel (Sheet 2)

Key to Figure 1-4 (Sheet 2)

1. Trim position indicator
2. Elapsed time clock
3. Tachometer
4. Airspeed indicator
5. Low limit altitude warning light
6. AN/APN-1 height indicator
7. Mil adjustment knob
8. MK 20 MOD 4 gunsight
9. Reticle control knob
10. Marker beacon indicating light (inoperative)
11. G-2 compass indicator
12. Compass control switch
13. Gyro horizon
14. Degreasing switch
15. Deleted
15A. Accelerometer
16. Engine gage unit
17. ID-250/ARN course indicator
18. Fuel pressure warning light
19. Eight day clock
20. Fuel quantity indicator
21. Fuel quantity indicator test button
22. Air vent
23. Arresting hook warning light
24. Arresting hook control
25. Deleted
26. Air temperature indicator
27. Outside air temperature button
28. Automatic pilot manual release handle
29. Inner stations selector switches
30. Inner stations function selector switch
31. Outer wing stations manual release handle
32. Cylinder head temperature indicator
33. Bomb arming switch
34. Intervalometer switches
35. Rate-of-climb indicator
36. Sonobuoy circuit warning light
36A. Outer stations function selector switch[1]
37. Outer stations selector switch
38. Rudder pedal adjustment crank
39. Turn and bank indicator
40. Gunsight lamp selector switch
41. Gunsight reticle brilliance control
42. Altimeter
43. Gun switches
44. Center wing stations manual release handle
45. Manifold pressure gage
46. Master armament switch
47. Center wing racks manual lock handle
48. Wing flaps and landing gear position indicator
49. ID-249/ARN course indicator
50. ID-310 range indicator

constant speed, hydraulically actuated variable pitch 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 (23, 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, the take-off rpm should be 2900 ± 15.

Note

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

[1] Airplanes BuNo 132515 and subsequent

OIL SYSTEM

The oil tank is located forward of the firewall and 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 oil pressure are indicated on the engine gage unit (16, figure 1-4) located on the pilot's instrument panel.

OIL DILUTION. Oil dilution is controlled by a combination OIL DILUTE–PITOT HEAT switch (16, figure 1-5) located on the cockpit center console. Moving the switch to "OIL DILUTE" turns on 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

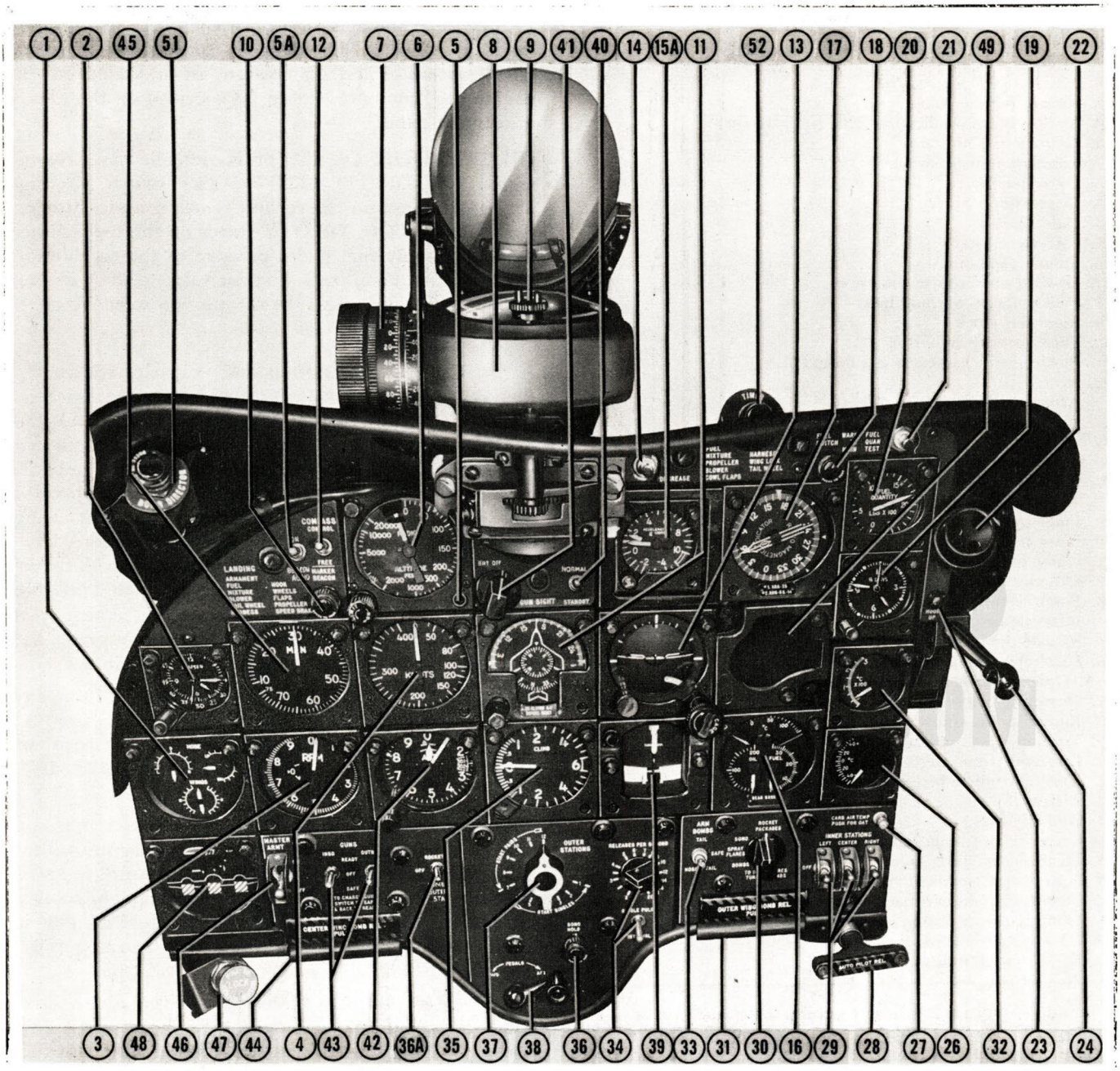
A 380 U.S. gallon (2280 pound) capacity self-sealing fuel cell (4, figure 1-2) is provided in the fuselage. Either a standard type or high speed (Aero 1A) 150 or 300 gallon (900 or 1800 pound) capacity external auxiliary fuel tank may be carried on the fuselage bomb rack and on each of the inner wing bomb racks provided tanks of equal capacity are installed on the inner wing racks. Because of required fuel-oil ratio limitations, however, no more than two 300 gallon external auxiliary fuel tanks may be carried at one time. Refer to ENGINE LIMITATIONS, Section V, for operating limits when using either the normal or the alternate fuel grade. See also, 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."

FUEL PRESSURE WARNING LIGHT. A warning light (18, figure 1-4) mounted on the pilot's instrument panel warns the pilot of loss in fuel pressure in sufficient time for him to switch from a drop tank to another external tank or to the main fuel cell 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 provided and is controlled by a switch (27, 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 dilution switch.

QUANTITY INDICATOR. A capacitance type fuel quantity indicating system is provided. The gage (20, figure 1-4) is located on the instrument panel and indicates in pounds the quantity of fuel in the main tank. A fuel quantity indicating system is not provided for the auxiliary tanks.



Airplanes BuNo 132486 and subsequent
(prior to Service Change No. 511)
Figure 1-4. Cockpit — Pilot's Instrument Panel (Sheet 3)

Key to Figure 1-4 (Sheet 3)

1. Trim position indicator
2. Elapsed time clock
3. Tachometer
4. Airspeed indicator
5. Low limit altitude warning light
5A. Marker beacon audio switch
6. ID-257/APN-22 height indicator
7. Mil adjustment knob
8. MK 20 MOD 4 gunsight
9. Reticle control knob
10. Marker beacon indicating light
11. G-2 compass indicator
12. Compass control switch
13. Gyro horizon
14. Degreasing switch
15. Deleted
15A. Accelerometer
16. Engine gage unit
17. ID-250/ARN course indicator
18. Fuel pressure warning light
19. Eight day clock
20. Fuel quantity indicator
21. Fuel quantity indicator test button
22. Air vent
23. Arresting hook warning light
24. Arresting hook control
25. Deleted
26. Air temperature indicator
27. Outside air temperature button
28. Automatic pilot manual release handle
29. Inner stations selector switches
30. Inner stations function selector switch
31. Outer wing stations manual release handle
32. Cylinder head temperature indicator
33. Bomb arming switch
34. Intervalometer switches
35. Rate-of-climb indicator
36. Sonobuoy circuit warning light
36A. Outer stations function selector switch[1]
37. Outer stations selector switch
38. Rudder pedal adjustment crank
39. Turn and bank indicator
40. Gunsight lamp selector switch
41. Gunsight reticle brilliance control
42. Altimeter
43. Gun switches
44. Center wing stations manual release handle
45. Manifold pressure gage
46. Master armament switch
47. Center wing racks manual lock handle
48. Wing flaps and landing gear position indicator
49. ID-249 course indicator[1]
50. Deleted
51. Bomb director indicating light
52. LABS timer indicating light

Note

Gasoline varies in weight dependent on the density of the fuel, therefore the indication of fuel in pounds will vary when the tank is full and standard day conditions do not prevail.

INDICATOR TEST SWITCH. A push button switch labeled FUEL QUAN TEST (21, figure 1-4) mounted on the pilot's instrument panel, is used in testing 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 will then return to an actual fuel quantity indication when the button is released if the indicator is functioning properly.

EXTERNAL TANK RELEASE CONTROLS. The external auxiliary fuel tanks can be jettisoned electrically through the armament panel switches (refer to RELEASING BOMBS, Section IV). The tanks also can be released manually (refer to INNER STATIONS—MANUAL JETTISON, Section IV).

ELECTRICAL SYSTEMS

Electrical power is provided by two 24-volt, 24-ampere-hour batteries, a d-c generator, an a-c generator, and two inverters, or by an external power source. D-c power is supplied by the batteries and the d-c generator. A-c power is supplied from the a-c generator and two inverters. Both a-c and d-c power can be supplied by an external power source connected to the external power receptacle which is located in an access compartment in the lower surface of the wing just inboard and forward of the right wheel well. Refer to Section III for emergency operation, and to Section VII for system operation of the electrical system. An emergency source of d-c power is made available from the a-c generator through a transformer and a power rectifier. On later aircraft,[2] the emergency d-c system has been replaced by an emergency a-c lighting system to provide power for the instrument lights only when the d-c generator fails.

D-C POWER SUPPLY SYSTEM

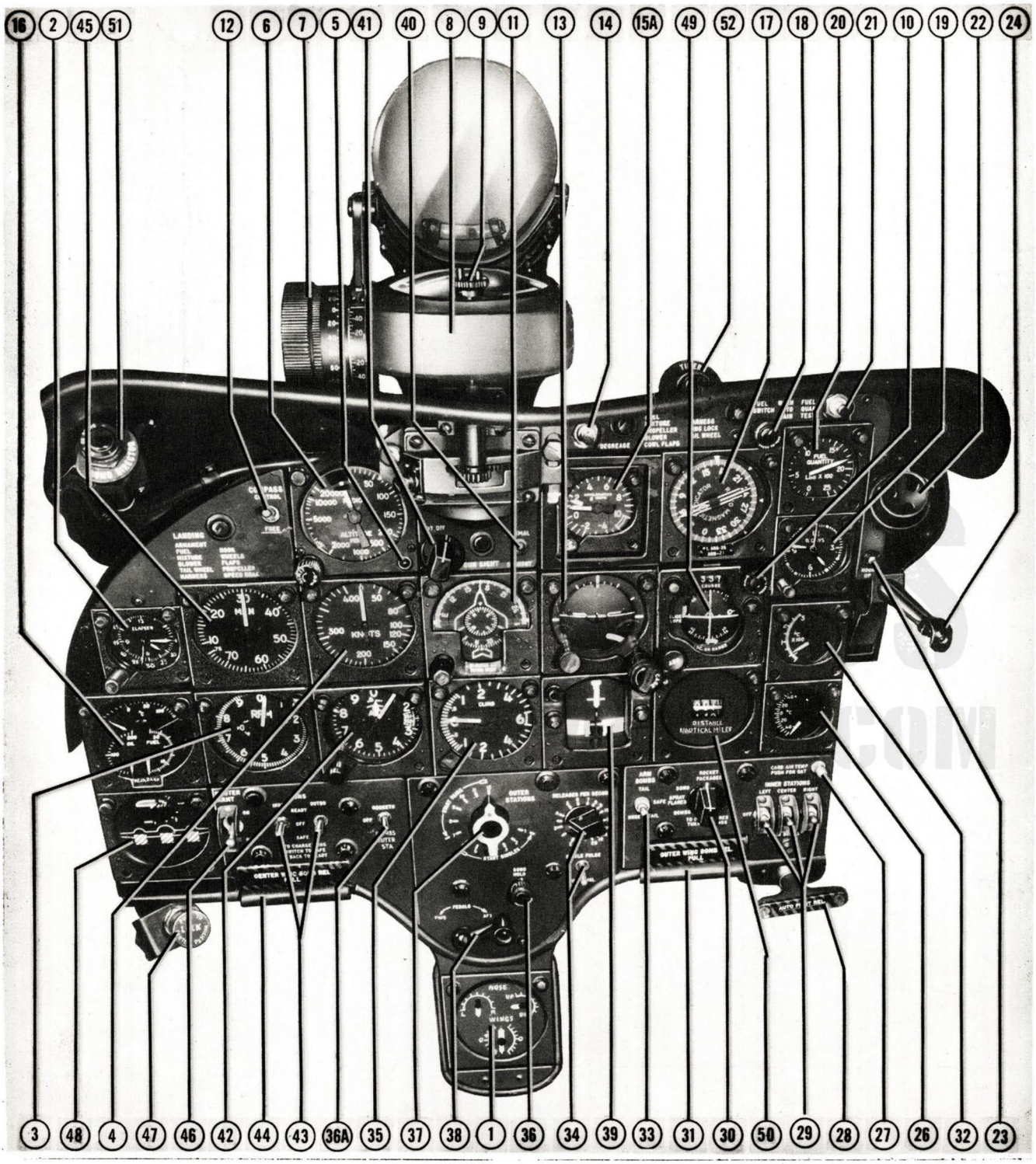
D-c power is distributed from its source to one or more of the six major busses; the d-c tie, primary, secondary, armament, monitor, and battery busses. From these busses, the current is further distributed to minor busses and to circuit breakers where the various d-c circuits are connected. D-c power is controlled by the battery-generator switch. See figure 1-8.

BATTERY-GENERATOR SWITCH. The battery-generator switch (1, figure 4-2) is located on the ECM operator's forward console and has three positions, "OFF," "BAT & GEN," and "BAT ONLY." The "BAT & GEN" position is used for normal operations and provides d-c power from the batteries and the d-c generator. The "BAT ONLY" position is for emergency use and provides power from the batteries only.[3] The "BAT ONLY" position will also provide emergency d-c power from the a-c generator through a transformer and a power rectifier. This emergency d-c power is provided in case the d-c generator should fail during flight and will energize only the primary bus, however, the batteries will concurrently supply power to the secondary bus while in the "BAT ONLY" position.

[1] Installation provisions only

[2] Airplanes BuNo 132528 and subsequent

[3] Airplanes prior to BuNo 132528



Airplanes BuNo 132486 and subsequent
(after Service Change No. 511)
Figure 1-4. Cockpit — Pilot's Instrument Panel (Sheet 4)

Key to Figure 1-4 (Sheet 4)

1. Trim position indicator
2. Elapsed time clock
3. Tachometer
4. Airspeed indicator
5. Low limit altitude warning light
6. ID-257/APN-22 height indicator
7. Mil adjustment knob
8. MK 20 MOD 4 gunsight
9. Reticle control knob
10. Marker beacon indicating light[1] (inoperative)
11. G-2 compass indicator
12. Compass control switch
13. Gyro horizon
14. Degreasing switch
15. Deleted

15A. Accelerometer

16. Engine gage unit
17. ID-250/ARN course indicator
18. Fuel pressure warning light
19. Eight day clock
20. Fuel quantity indicator
21. Fuel quantity indicator test button
22. Air vent
23. Arresting hook warning light
24. Arresting hook control
25. Deleted
26. Air temperature indicator
27. Outside air temperature button
28. Automatic pilot manual release handle
29. Inner stations selector switches
30. Inner stations function selector switch
31. Outer wing stations manual release handle
32. Cylinder head temperature indicator
33. Bomb arming switch
34. Intervalometer switches
35. Rate-of-climb indicator
36. Sonobuoy circuit warning light

36A. Outer stations function selector switch[1]

37. Outer stations selector switch
38. Rudder pedal adjustment crank
39. Turn and bank indicator
40. Gunsight lamp selector switch
41. Gunsight reticle brilliance control
42. Altimeter
43. Gun switches
44. Center wing stations manual release handle
45. Manifold pressure gage
46. Master armament switch
47. Center wing racks manual lock handle
48. Wing flaps and landing gear position indicator
49. ID-249 course indicator
50. ID-310 range indicator
51. Bomb director indicating light
52. LABS timer indicating light

CAUTION

All non-essential electrical equipment should be turned off when the "BAT ONLY" position is selected in order to conserve battery power.

D-C EXTERNAL STARTING SWITCH. An external starting switch is located in the right wheel well just above the external power receptacle access compartment. This momentary contact switch provides for emergency starting of other aircraft by use of a jumper cable. At least 1850 rpm must be maintained while the external starting switch is momentarily depressed on the assisting airplane in order to provide d-c power to the airplane being started.

DISABLING SWITCH FOR ARMAMENT SAFETY CIRCUIT. A disabling switch (figure 4-12), located in the left-hand wheel well, is used to deactivate the armament safety circuit so that ground tests of the armament circuits may be made.

Note

The armament safety circuit serves to deenergize the armament circuits whenever the landing gear handle is placed in the "DOWN" position.

D-C GENERATOR WARNING LIGHT. A d-c generator warning light (3, figure 4-2) is located on the ECM operator's forward console. A glowing warning light indicates that the d-c generator is not supplying power to the system.

D-C VOLTAMMETER. A d-c voltammeter (2, figure 4-2) is located on the ECM operator's forward 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

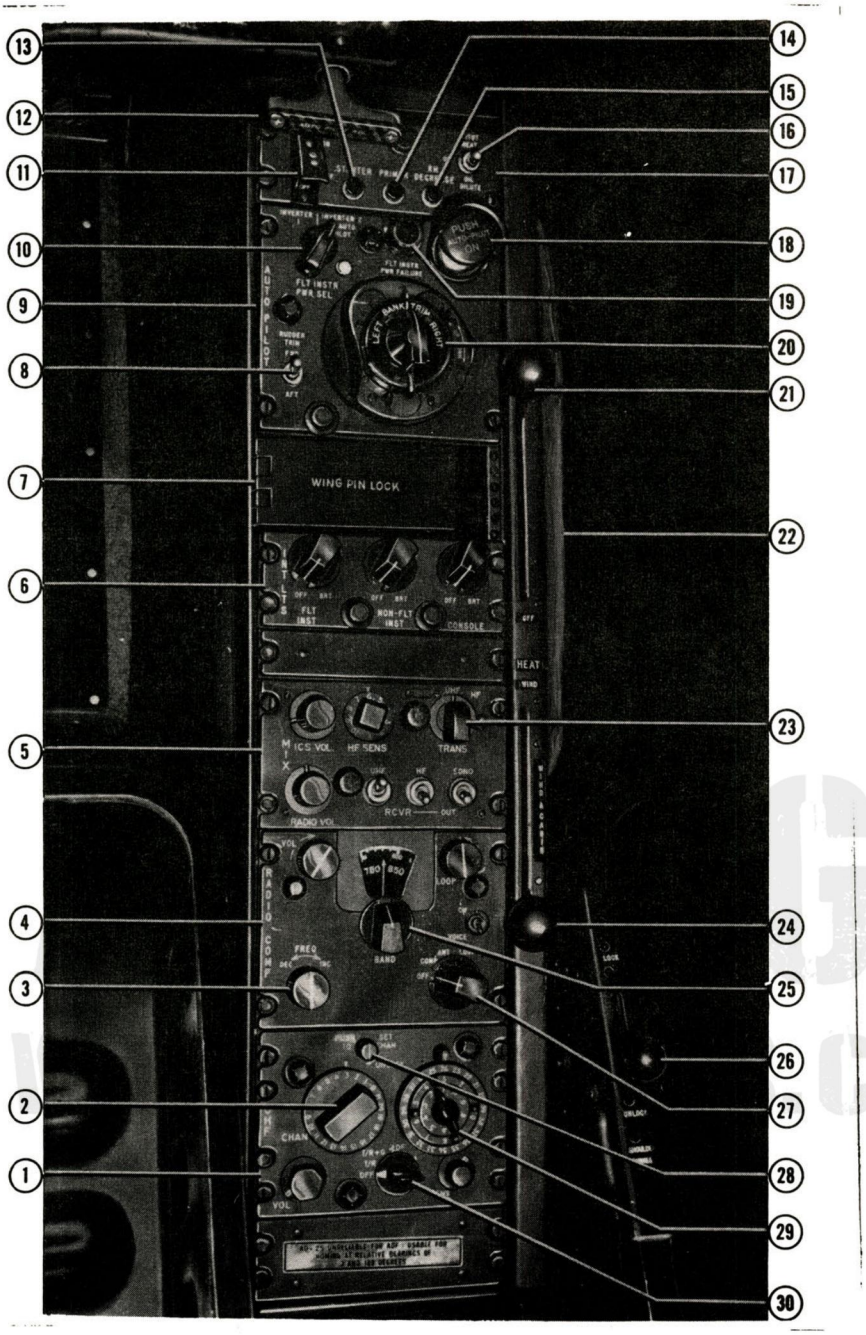
Both a variable frequency (400 to 800 cycles per second) and a constant frequency (400 cycles per second) a-c power supply system is provided. The engine driven a-c generator provides three phases (or separate sources) of variable frequency a-c power, the frequency of which is dependent upon the rpm of the generator. The two inverters provide three phases of constant frequency a-c power. Only variable frequency a-c power can be supplied 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. The inverters are operated on d-c power.

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 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. On later aircraft,[2] failure of the d-c generator will result in a loss of a-c generator power to all units except the cockpit lights which automatically will be supplied with 26 volts a-c power through an emergency a-c trans-

[1] Installation provisions only

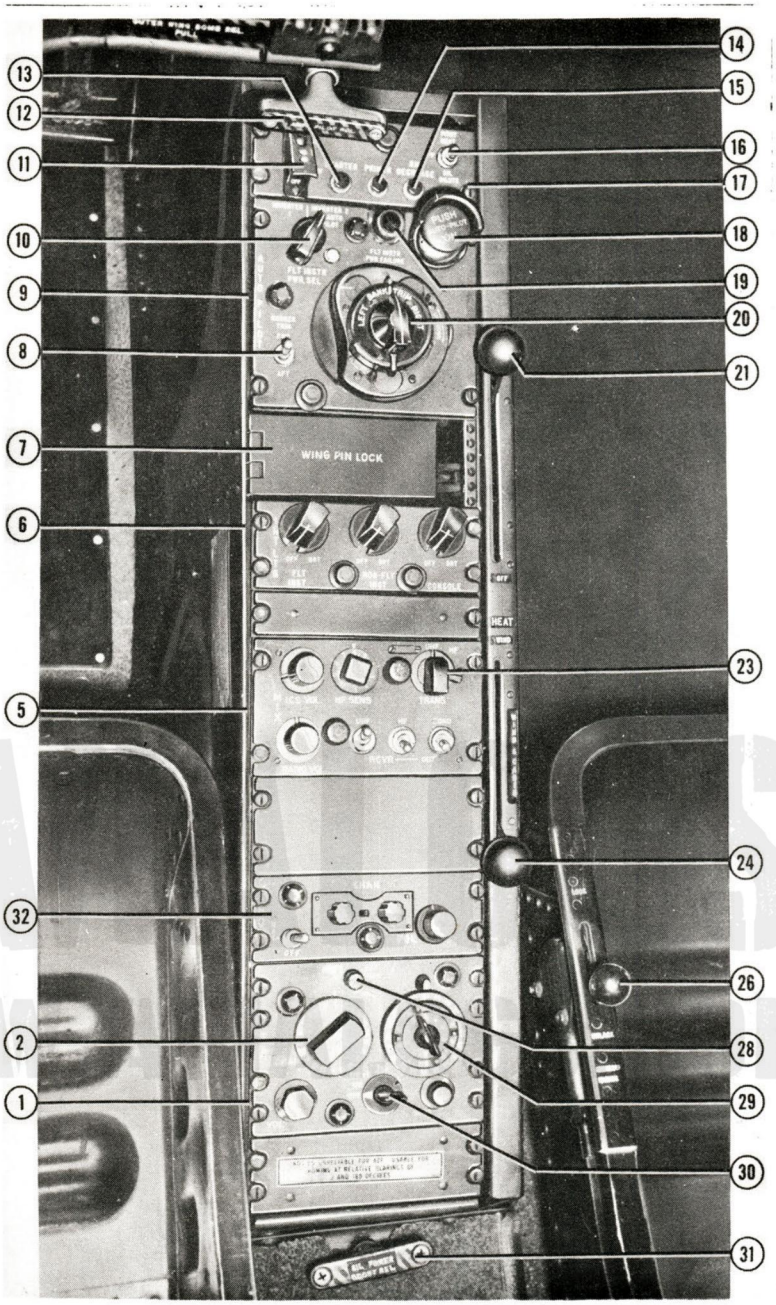
[2] Airplanes BuNo 132528 and subsequent



1. C-1015/ARC-27A UHF radio control panel
2. UHF channel selector switch
3. ADF frequency selector control
4. AN/ARN-6 ADF control panel
5. C-737/AIC-4A pilot's interphone control panel
6. Exterior lights control panel[1]
   Interior lights control panel[2]
7. Wing folding control panel
8. Automatic pilot control switch
9. Automatic pilot control panel
10. Flight instrument power selector switch
11. Master radio switch
12. Automatic pilot emergency release handle
13. Engine starter switch
14. Engine primer switch
15. ECM operator's windshield degrease switch
16. Pitot heat—oil dilute switch
17. Engine switches control panel
18. Automatic pilot clutch control
19. Flight instrument power failure warning light
20. Automatic pilot controller
21. Cockpit ventilation control
22. Map case
23. Transmitter selector switch
24. Cockpit heat and defroster control
25. AN/ARN-6 ADF band selector control
26. ECM operator's shoulder harness lock control
27. AN/ARN-6 ADF function selector switch
28. UHF channel locking control
29. UHF manual tuning control
30. UHF function selector switch

[1] Airplanes prior to BuNo 132950
[2] Airplanes BuNo 132950 and subsequent, prior airplanes by service change

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



1. C-1015/ARC-27A UHF control panel
2. UHF channel selector switch
3. Deleted
4. Deleted
5. C-737/AIC pilot's ICS panel
6. Interior lights control panel
7. Wing folding control panel
8. Automatic pilot control switch
9. Automatic pilot control panel
10. Flight instrument power selector
11. Master radio switch
12. Autopilot emergency release handle
13. Engine starter switch
14. Engine primer switch
15. ECM operator's windshield degrease switch
16. Pitot heat—oil dilute switch
17. Engine switches control panel
18. Autopilot clutch control
19. Flight instrument power failure warning light
20. Automatic pilot controller
21. Cockpit ventilation control
22. Map case (not shown)
23. Transmitter selector switch
24. Cockpit heat and defroster control
25. Deleted
26. ECM operator's shoulder harness lock
27. Deleted
28. UHF channel locking control
29. UHF manual tuning control
30. UHF function selector switch
31. Aileron power boost release handle
32. AN/ARN-21 radio control panel

(After Service Change Nos. 511 and 514)

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

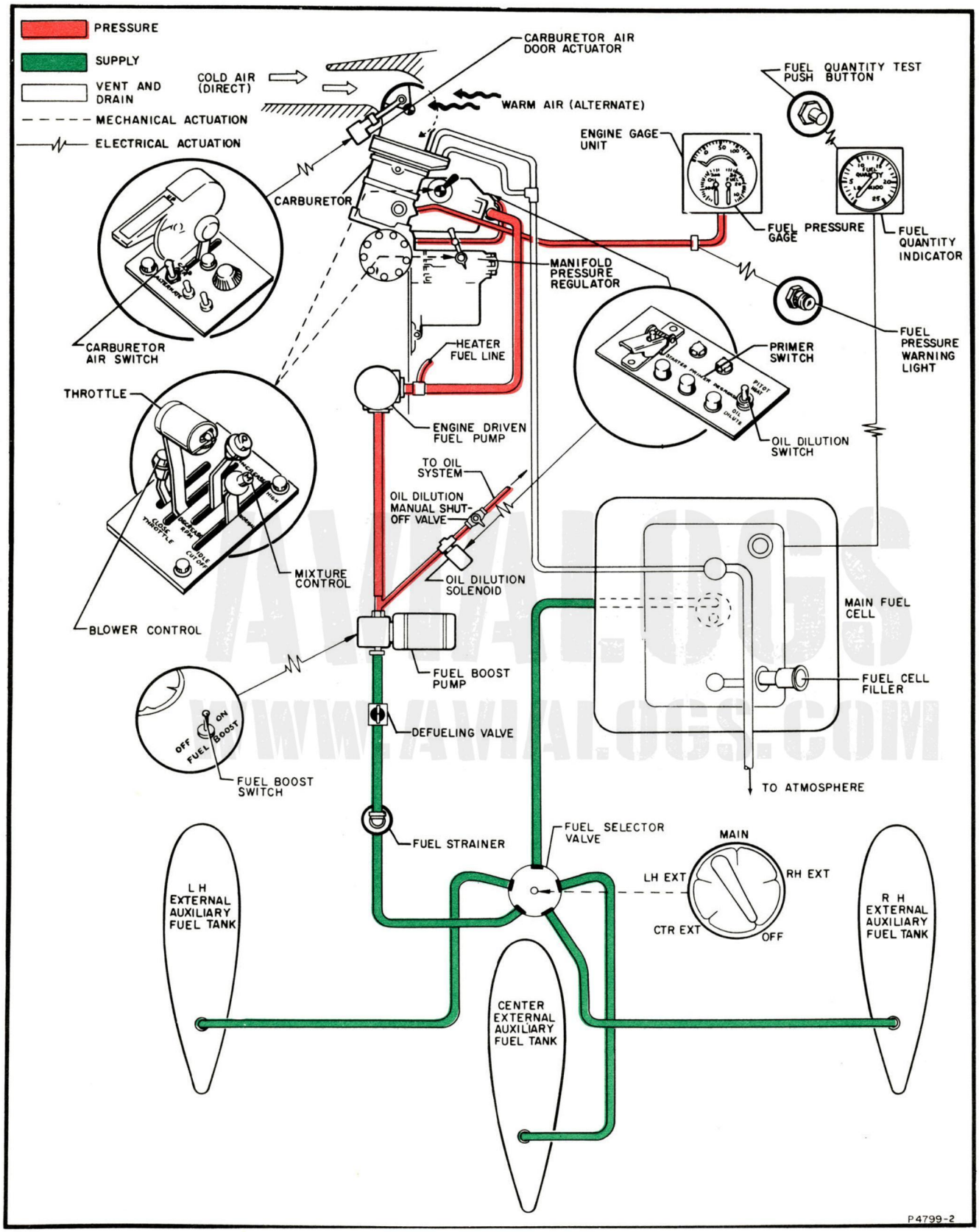


Figure 1-6. Fuel System

FUEL QUANTITY DATA

TANKS	USABLE FUEL	UNUSABLE FUEL– LEVEL FLIGHT	EXPANSION SPACE	TOTAL VOLUME GALLONS
MAIN (FUSELAGE CELL)	378	2	0	380
CTR EXT (CENTER EXTERNAL)				
AERO 1A	150	*	*	150
AERO 1A OR MK 8 MOD 1	300	*	*	300
LH EXT				
MK 12, OR AERO 1A	150	*	*	150
AERO 1A OR MK 8 MOD 1	300	*	*	300
RH EXT				
MK 12, OR AERO 1A	150	*	*	150
AERO 1A OR MK 8 MOD 1	300	*	*	300
* INFORMATION TO BE ADDED WHEN AVAILABLE				

REMARKS:

USABLE FUEL TOTALS	GALLONS
(1) Main and three small external tanks	828
(2) Main and two large external tanks	978

P4986-1

Figure 1-7. Fuel Quantity Data Table

former if the landing gear is retracted. If the landing gear has been extended prior to d-c generator failure, battery power should be sufficient to operate the instrument lights until a landing can be effected. See figure 1-9.

A-C POWER SWITCH. The A-C PWR switch (6, figure 4-2) is located on the ECM operator's forward console and has three positions, "OFF," "INT," and "EXT." The "INT" position is used for normal operations and will provide power from 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 (4, figure 4-2) is located on the ECM operator's forward 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 overloaded condition in the variable frequency a-c system which may be manifested by a loss of voltage on one or more of the three phases as indicated on the a-c voltmeter, 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 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.

CONSTANT FREQUENCY A-C POWER

The number one and number two inverters provide constant frequency a-c power to circuit breakers where flight instrument and other circuits are connected. This source of power is controlled by the FLT INSTR PWR SEL switch. The number one inverter is operated by d-c power from the primary bus and the number two inverter is operated by d-c power from the d-c tie bus, provided a switching relay within the number two inverter has been 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 and a list of equipment which is supplied power by the inverters.

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 provides an alternate

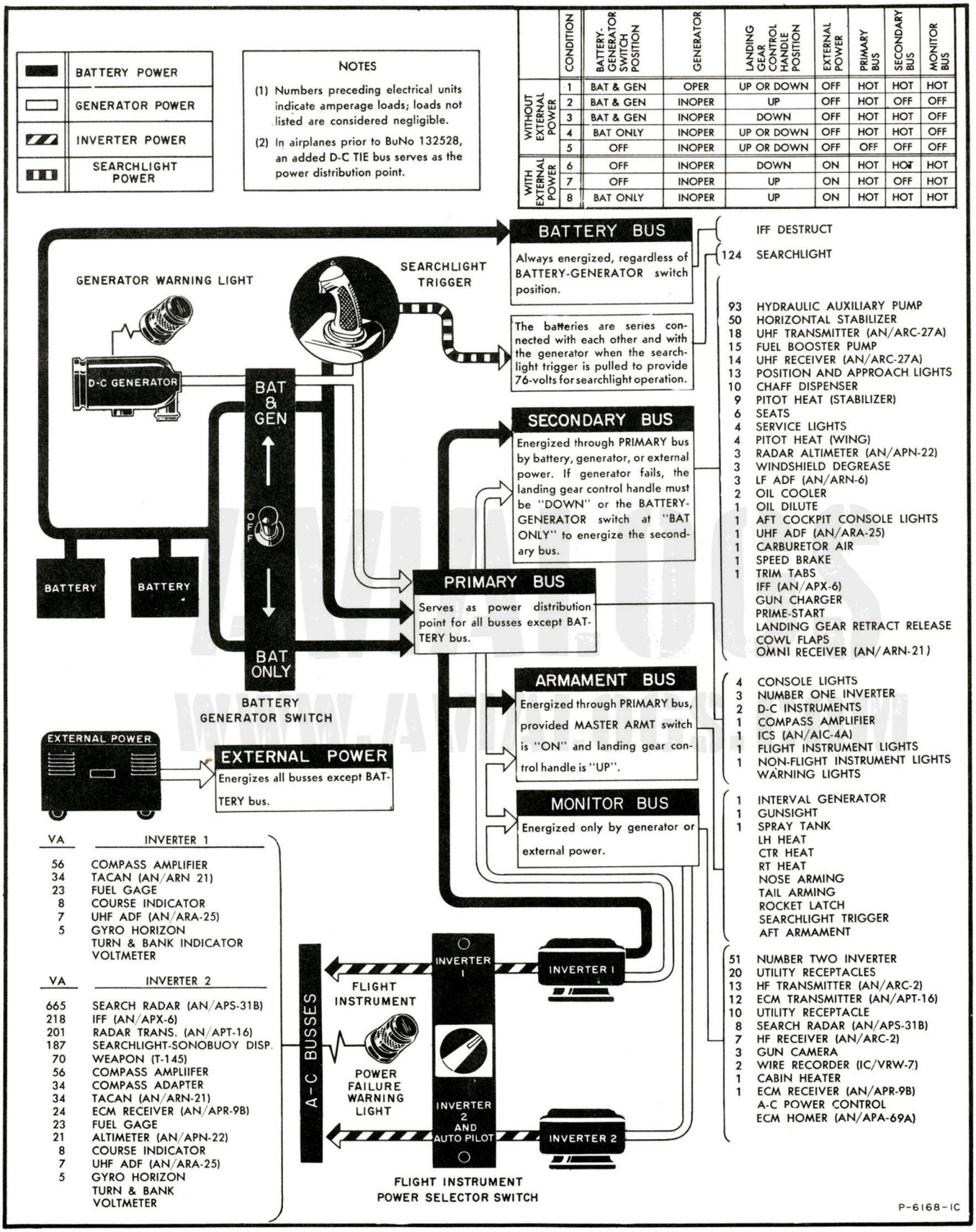


Figure 1-8. D-C Power and Constant Frequency A-C Power Distribution

source of power to the essential flight instruments in the event of failure of either inverter. A red warning light adjacent to the switch will glow to indicate failure of the selected inverter. When the FLT INSTR PWR SEL switch is in the "INVERTER 1" position, the number one inverter is supplying power to the fuel quantity indicator and flight instruments. The number two inverter is supplying power to electronic equipment. When the FLIGHT INSTR PWR SEL switch is in the "INVERTER 2 & AUTO PILOT" position, the number two inverter supplies power to the fuel quantity indicator, flight instruments, and auto pilot, in addition to the electronic equipment.

INVERTER WARNING LIGHT. A warning light labeled FLT INSTR PWR FAILURE (19, figure 1-5) is located on the cockpit center console. An illuminated warning 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 operation of the flight instruments and the flight should be terminated as soon as is practicable.

CAUTION

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. Do not take-off on the "INVERTER 2 & AUTO PILOT" position except in an emergency.

VOLTMETER PHASE SELECTOR SWITCH. The voltmeter phase selector switch (7, figure 4-2) is located on the ECM operator's forward 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.

A-C VOLTMETER. The a-c voltmeter (5, figure 4-2) is located on the ECM operator's forward console and indicates voltage output of each phase of the a-c power source.

CHECKING A-C VOLTAGE OUTPUT

Each phase of the variable frequency and constant frequency a-c power sources can be checked by selecting the respective phase on the voltmeter phase selector switch and reading the voltage output on the a-c voltmeter. Each phase of the a-c generator should read approximately 115 volts and each phase of the inverters should read approximately 117 volts.

HYDRAULIC SYSTEM

Two hydraulic systems with three separate hydraulic pumps are provided. These are the main system and the aileron boost system. One pressurized hydraulic fluid reservoir supplies all three pumps. A difference in standpipe heights in the reservoir automatically reserves enough fluid for emergency extension of the landing gear by means of the emergency pump if fluid loss occurs through line failure upstream from the landing gear selector valve.

MAIN HYDRAULIC SYSTEM. The main hydraulic system receives its pressure from an engine-driven hydraulic pump or from an electrically driven emergency hydraulic pump. This hydraulic system, which incorporates an accumulator, supplies pressure for operating the power boost wheel brakes, actuating the forward cockpit hatches, opening and closing the speed brake, extending and retracting the landing gear and landing flaps, retracting the tail hook, folding and spreading the wings, and charging the guns. A single hydraulic system pressure gage (20, figure 1-3) is provided to indicate main system pressure. The hydraulic gage should indicate 2600 to 3100 psi when the engine-driven pump is in operation. When the engine-driven pump is not in operation, and the emergency hydraulic pump is turned on, the hydraulic gage should indicate 2900 to 3050 psi, except that when the landing gear lever is placed in the "EMERGENCY DOWN" position the hydraulic gage will not indicate emergency pump pressure.

ACCUMULATOR. The main hydraulic system accumulator and attached air pressure gage are located at the center and forward of the firewall. With all hydraulic system pressure exhausted, the accumulator air pressure should be 1500 to 1900 psi. The accumulator serves to absorb surges and should not be relied upon as an added source of reserve power. After engine pump and emergency pump failure, the accumulator hydraulic pressure will dissipate within a few minutes.

EMERGENCY HYDRAULIC BYPASS VALVE. An emergency bypass valve is installed in the main hydraulic system to provide a means of depressurizing the system when surging of the regulator or failure of the system is evident. The valve is for emergency use only and is not to be used to depressurize the hydraulic system during normal flight conditions. The control handle (1, figure 1-3) which is located on the cockpit left console, is pulled up to depressurize the system. If subsequent operation of the system is desired, the button on top of the handle must be depressed in order to return the handle to its original position.

EMERGENCY HYDRAULIC PUMP. An electrically driven emergency hydraulic pump can be turned on by a spring-loaded switch labeled EMER HYD (2, figure 1-3) to provide pressure to the main hydraulic system in case of main system pump failure. The emergency pump can also be used to check out the main hydraulic system when the engine is not running.

Note

Speed of operation of equipment when using emergency pump pressure alone is considerably reduced.

When the landing gear control is moved to the "EMER" position, the emergency hydraulic pump is automatically turned on, supplying fluid from the reserve supply in the fluid reservoir to the main landing gear only.

AILERON POWER BOOST HYDRAULIC SYSTEM. The aileron power boost hydraulic system operates on pressure from a separate engine-driven hydraulic pump. No pressure indication is provided. An emergency release handle located beneath the pilot's instrument panel (on later aircraft,[1] located on the aft end of the center console) is provided to release the aileron control system from the boost system in the event of failure of the aileron boost system. The required force to operate the ailerons will be increased approximately four times after aileron boost has been disconnected.

FLIGHT CONTROLS

SURFACE CONTROLS. Conventional control stick and rudder pedals are provided. The position of both rudder pedals may be adjusted simultaneously by means of a crank (38, figure 1-4) located just below the instrument panel.

RUDDER GUST LOCK. The rudder gust lock is externally installed and consists of a cable, a felt-padded jaw assembly, two brackets, and a locking latch which is used to take up slack on the cables. Use of the rudder gust lock will necessitate locking the ailerons and elevator by tying the control stick in the aft position with the pilot's seat belt.

AILERON POWER BOOST SYSTEM. An aileron power boost hydraulic system is provided to reduce stick control forces. If the boost system should fail, it can be mechanically disconnected from the aileron control system by pulling out the emergency release handle. When the boost system is disconnected, control stick forces for aileron operation will increase approximately four times but will still permit adequate aileron control at lower speeds for approach and landing. Once disconnected, the boost system cannot be re-engaged during flight.

TRIM CONTROL. Electrically operated trim tabs, controllable from the cockpit, are located on the rudder

[1] Airplanes BuNo 132500 and subsequent

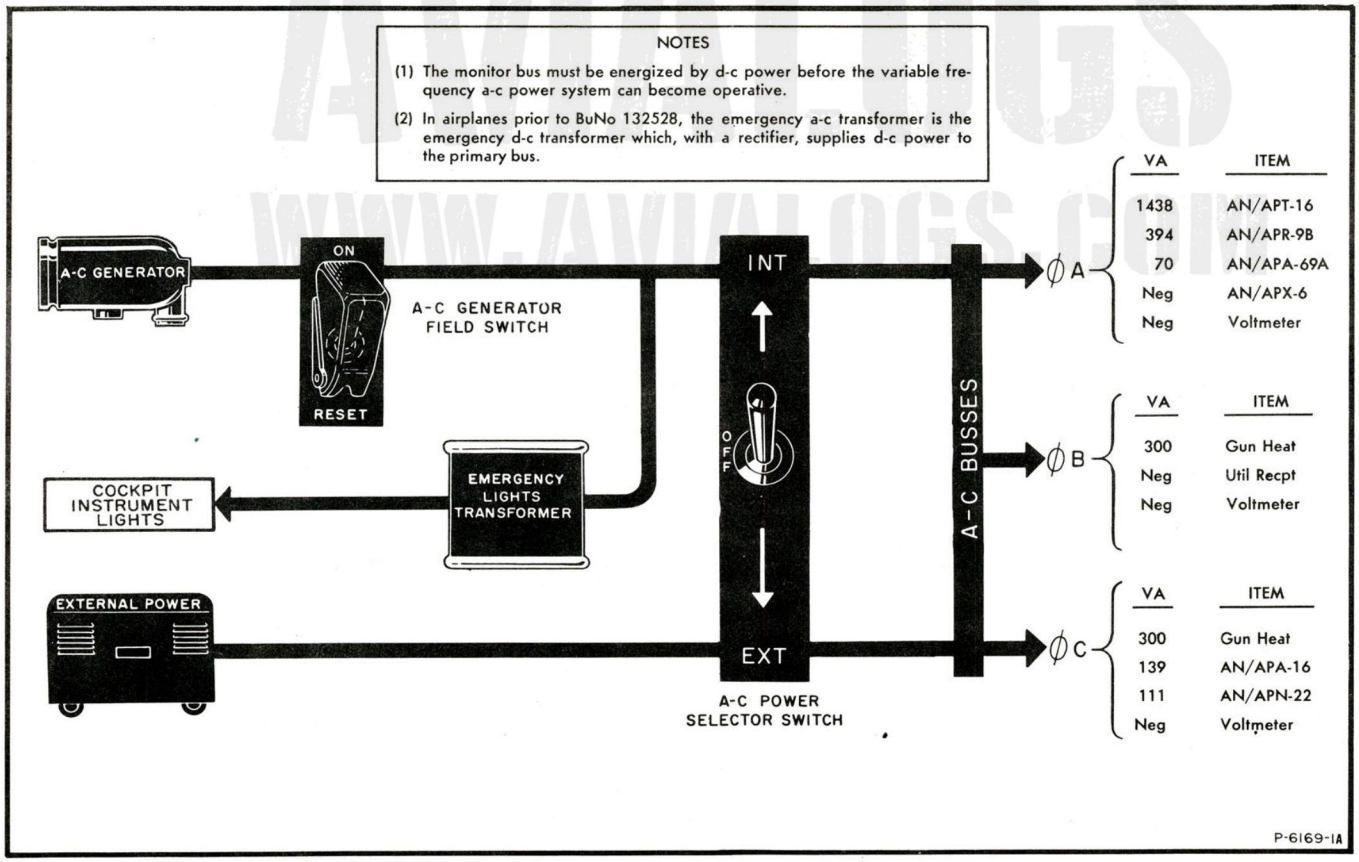


Figure 1-9. Variable Frequency A-C Power Distribution

Figure 1-10. Deleted

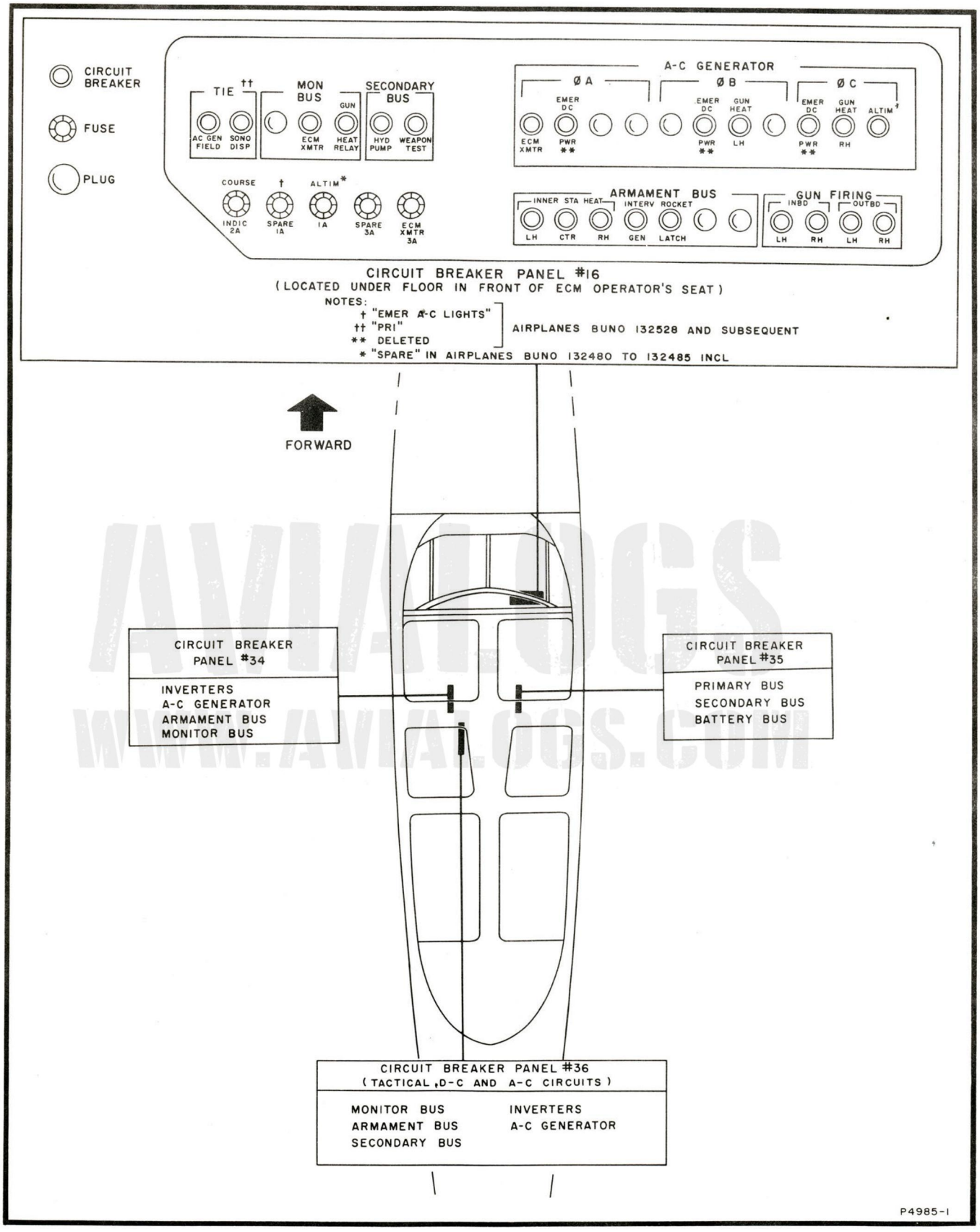


Figure 1-11. Circuit Breaker Panels

and left-hand aileron. Rudder trim is controlled by rotation of the rudder trim knob (24, figure 1-3) located on the cockpit left console. Aileron trim is controlled by lateral movement of the thumbswitch control located on top of the pilot's control stick (see figure 4-10). The entire surface of the horizontal stabilizer is used to produce controllable longitudinal trim which ranges from 0° to 3° nose down to 0° to 6° nose up. The horizontal stabilizer is controlled by fore and aft movement of the thumbswitch control on the control stick or by fore and aft movement of the horizontal stabilizer trim lever (8, figure 1-3) located on the cockpit left console. An indicator is provided on the pilot's instrument panel (1, figure 1-4) which shows the position of the three trimming surfaces.

WARNING

Except in an emergency never use horizontal stabilizer to assist recovery from dives as such 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. When the control lever is placed in the "DOWN" position, the flaps can be extended to a maximum of 40 degrees. To place the wing flaps at intermediate degrees of extension, the control lever must be moved to "DOWN" and then to "STOP" when the flaps reach the desired position, as indicated on the wing flaps position indicator (48, figure 1-4) located on the pilot's instrument panel. A safety feature causes the flaps to blow back at speeds in excess of 110 knots, however they should not be extended above 130 knots to prevent possible damage.

SPEED BRAKE. The hydraulically operated fuselage-bottom speed brake is actuated electrically by the SPEED BRK switch on the throttle grip (10, figure 1-3). The switch is pressed to "OPEN" (aft) or to "CLOSE" (forward) for operation of the speed brake. There is no neutral position provided; therefore, the speed brake can be actuated to the fully opened or fully closed positions only. A blow-back feature operates on the speed brake at speeds above 348 knots. A safety feature interrupts the speed brake circuit when the weight of the airplane is on the landing gear, thus preventing inadvertent extension of the speed brake when the aircraft is on the ground. This safety feature, furthermore, will prevent the speed brake from extending immediately following a take-off if the SPEED BRK switch has been inadvertently left in the "OPEN" position. In this case, the speed brake can be extended only by first pressing the switch to the "CLOSE" position and then returning it to "OPEN." For safe and correct use of the speed brake, refer to paragraph entitled USE OF THE SPEED BRAKE, Section VI.

CAUTION

Check the speed brake switch for "CLOSE" position prior to landing. The speed brake will be severely damaged if left in the "OPEN" position during a landing.

WING FOLDING

The wings are folded and spread by pressure from either the main or the emergency hydraulic system. A non-hydraulic locking mechanism operates latches to safety 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.

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 unlatch the wing locking pins and expose the wing folding handle. Next, raise the wing folding handle to fold the wings. To spread the wings, reverse this process. After the wings are fully spread, close the WING PIN LOCK door, making certain that it is flush with the console and that the two warning "flags" are retracted into the leading edge of wing.

CAUTION

Both the WING PIN LOCK door and the wing fold handle should be kept in the open (unlocked and folded) positions 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 and 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 also telescope automatically upon retraction in order that the wheels may fit into the wells between the wing spars. A switch is actuated by compression of the left shock strut to de-energize 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 (15, figure 1-3) incorporates three positions:

"UP," "DOWN," and "EMERGENCY." When the airplane is resting on the ground, the control handle cannot be moved to "UP" unless a safety latch (15, figure 1-3) adjacent to the control handle is manually depressed. This safety latch is automatically pulled out of the way by an electrical solenoid when the airplane is airborne. A red warning light in the landing gear control handle will come on whenever the control handle is moved to either "DOWN" or "UP," and will remain on until all three wheels are locked in the selected positions. A wheels and flaps position indicator (48, figure 1-4), showing the position of all three wheels, is on the pilot's instrument panel.

WARNING

When moving the landing gear control to any position, make sure that the control handle stops in its detent by "click and feel" rather than position indication alone. In the "DOWN" position, make sure that 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 far enough to shut off hydraulic pressure to the landing gear, in which case the hydraulically operated down-lock linkage may break toward the retracted position.

The landing gear control can be moved to "EMERGENCY" by manually depressing the landing gear control release plunger (17, figure 1-3) located between the "DOWN" and "EMERGENCY" positions. 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 electrically driven hydraulic pump and shifts 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, and engine-driven hydraulic pump pressure is completely cut off from the landing gear system. No pressure indication is provided for emergency gear extension. The landing gear control handle can be returned from "EMERGENCY" by first depressing the release plunger. To extend the tail gear in an emergency, refer to Section III, LANDING GEAR EMERGENCY EXTENSION.

WARNING

During flight do not return landing gear handle directly to the "DOWN" position after it has been placed in the "EMERGENCY" position. The handle should either be left in "EMERGENCY" or returned to "UP" and then to "DOWN." When the control handle is pulled back from "EMERGENCY" into "DOWN," the landing gear control linkage is only partially reset.

CAUTION

If the control handle is moved inadvertently to the "EMERGENCY" position, under otherwise normal conditions, the control linkage can be reset in flight by moving the control handle to the "UP" position. To reset the linkage while the airplane is on the ground and after the engine is shut down, have the ground crew move the control handle from the "EMERGENCY" position to the "DOWN" position, and reset the linkage at the valve. When the airplane is on the ground, do not move the control handle to the "UP" position.

TAIL WHEEL LOCK. The tail wheel lock control (28, figure 1-3) is located at the after end of the cockpit left console.

BRAKE SYSTEM

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

Note

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

ARRESTING GEAR. The arresting hook control (24, 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 will come on when the control is moved to the "HOOK DOWN" position. The light will remain on until the hook reaches the full down position. Normally, the light will come on as the handle is moved to the "HOOK DOWN" position and will go off almost immediately. Lifting the control lever to the "HOOK UP" position

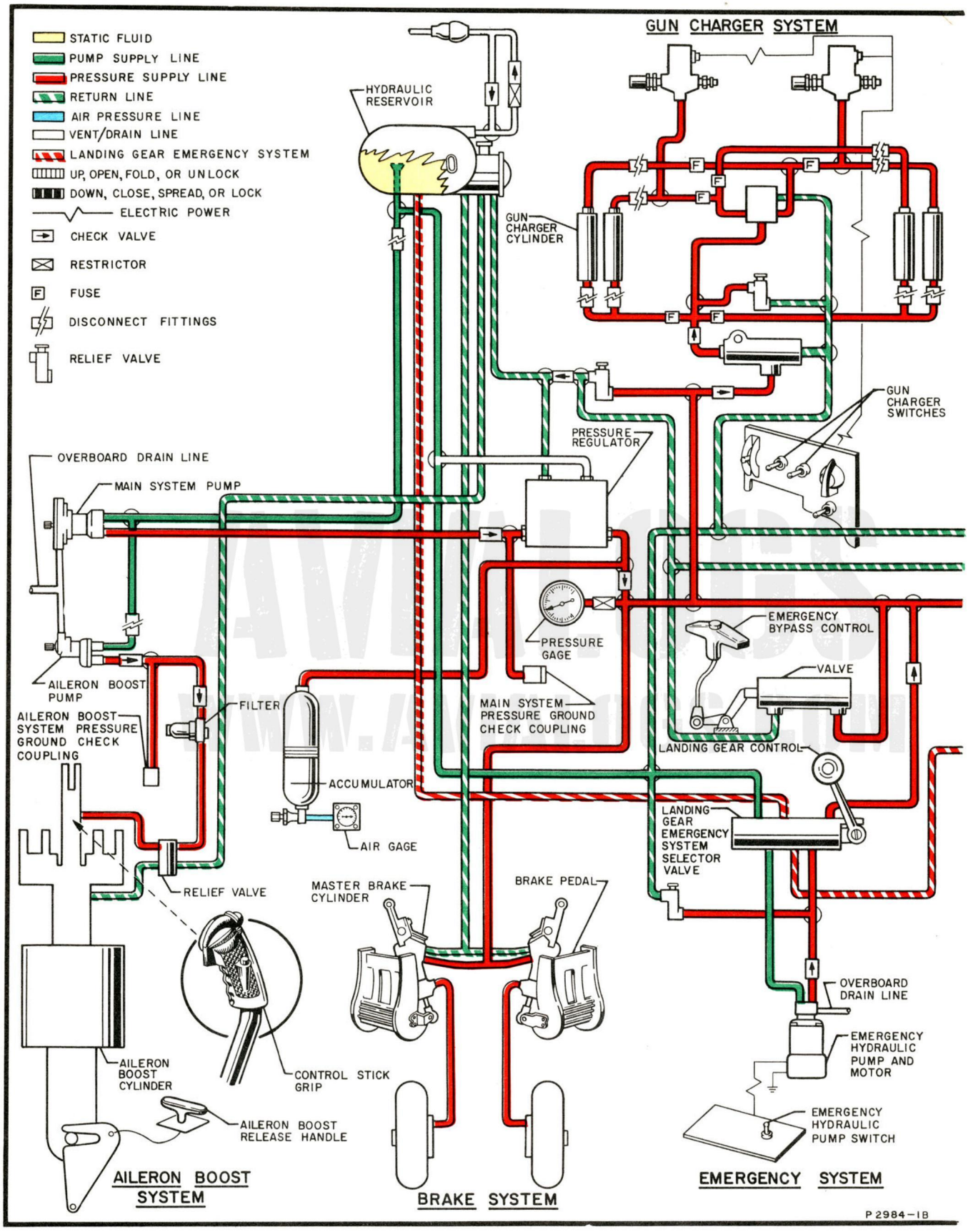


Figure 1-12. Hydraulic System (Sheet 1)

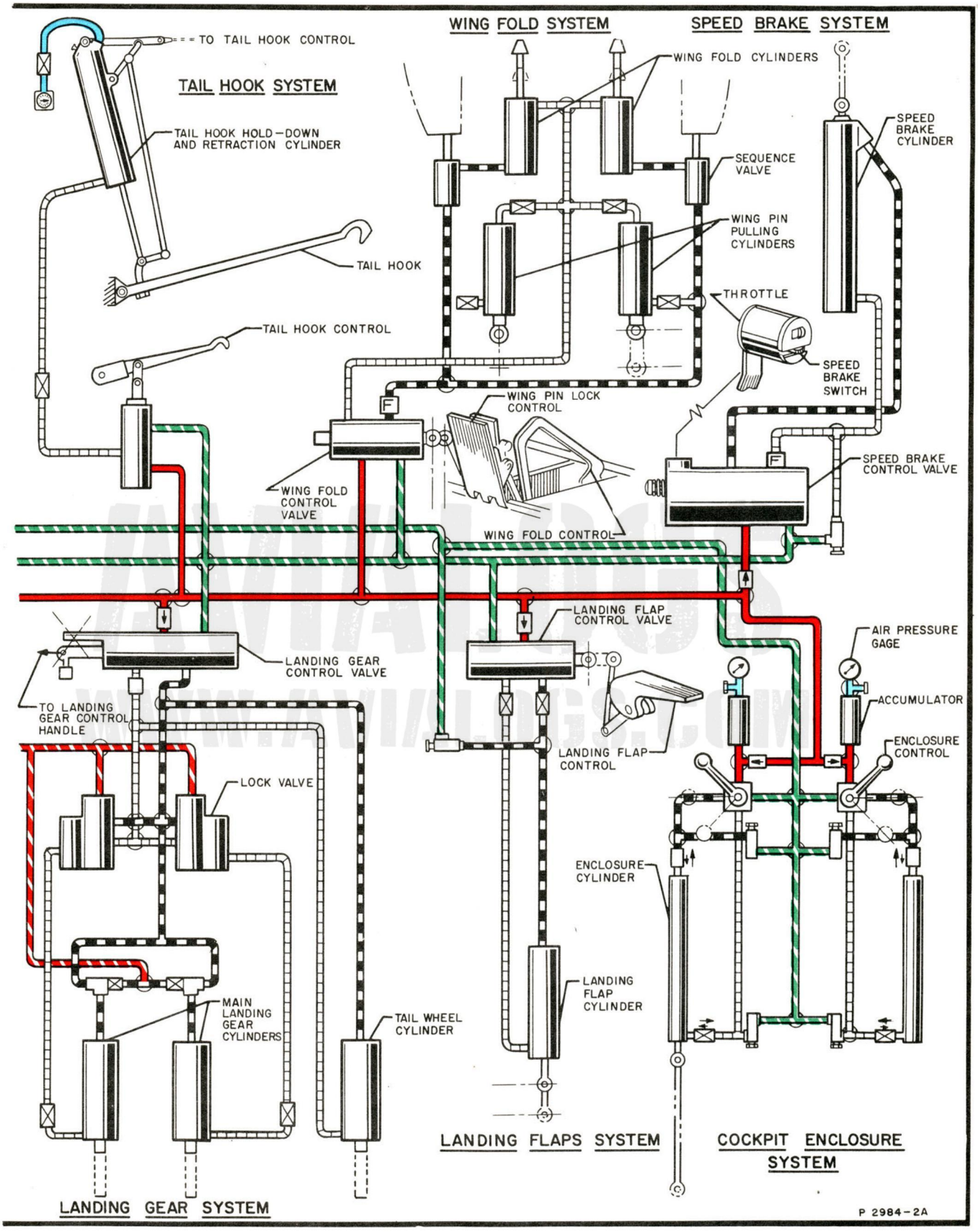


Figure 1-12. Hydraulic System (Sheet 2)

hydraulically returns the hook to the "UP" position. In the event the arresting hook control cable system fails, the arresting hook will automatically extend.

INSTRUMENTS

A conventional instrument panel contains all the flight instruments necessary for all-weather operations. The gyro-horizon and G-2 compass, both electrically operated, further serve to control the auto pilot. Refer to paragraph entitled FLIGHT INSTRUMENT POWER SELECTOR SWITCH, this section, for information on selection of alternate power sources for the essential flight instruments. An accelerometer located on the pilot's instrument panel (15A, figure 1-4) is provided to indicate the accelerations imposed upon the aircraft. The accelerometer is operated by an internal mechanical system and indicates from minus 5 to plus 10 "g" units. The turn and bank indicator consists of a ball-type inclinometer and a vacuum driven gyro rate of turn indicator. Vacuum to drive the gyroscope of the indicator is maintained by a vacuum (pressure) pump which is installed on the engine supercharger rear cover. A pitot-static system is connected to the airspeed and rate-of-climb indicators and the altimeter. The static boom projects forward from the leading edge of the vertical stabilizer while the pitot head is located beneath the outer starboard wing panel.

G-2 COMPASS. The G-2 compass consists of a compass controlled directional gyro indicator (11, figure 1-4), an amplifier and a remote compass transmitter. Approximately three minutes are required for the gyro to reach operating speed after either the No. 1 or No. 2 inverters are energized. The compass is non-tumbling and does not require caging before 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 kept fully depressed at the new heading for at least two seconds, and then must be released straight out, avoiding any twisting motion. A switch (12, 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 will be stabilized by the compass transmitter and amplifier and will provide a continuous indication of the magnetic heading 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 free directional gyro. The "FREE" position is used to prevent the directional indications from becoming erratic due to the excessive "dip" of the earth's magnetic field in the polar regions, or to other magnetic 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 may cause abrupt, violent rudder forces exceeding the design limits of the airplane.

GYRO HORIZON INDICATOR. The aircraft is equipped with a C-1 type gyro horizon indicator (13, figure 1-4) located on the pilot's instrument panel. 26-volt, 400 cycle, three-phase electrical power is supplied by the No. 1 and/or No. 2 inverters to operate the gyro. The function of the indicator is to present visual indications of the amount of pitch and roll of the aircraft and to develop autosyn signals to control the auto pilot. Manual caging is provided by a cage knob control. When the gyro is caged, a signal flag marked "CAGED" is raised behind the glass and on the face of the indicator. An adjustable reference bar and control knob is provided with the indicator. Approximately two minutes are required for the gyro to reach a normal operating speed after electrical power is supplied. Caution must be exercised not to exceed 70 degrees pitch or 110 degrees bank while the gyro horizon is uncaged as it will tumble at attitudes in excess of these limits. Refer to paragraph entitled AUTOMATIC PILOT, Section IV, for operation of the gyro horizon indicator in conjunction with the auto pilot.

STANDBY COMPASS. A magnetic standby compass is mounted on the cockpit windshield crossbar. The directional indication given by this compass must be corrected for deviation which is supplied by a compass correction card located on the right hand cockpit rail.

MISCELLANEOUS EQUIPMENT

CANOPY

A canopy covers the cockpit and extends aft a sufficient distance to enclose the radar operator's compartment. The canopy covering the cockpit is of clear plexiglas while the radar operator's compartment is enclosed with blue plexiglas to darken the interior for better instrument illumination and also to prevent the emanation of light from within. In conjunction with the blue plexiglas, amber goggles are used by the operator to further enhance the contrast between the darkened compartment and the illuminated instruments. The radar operator's compartment can be entered from either side of the fuselage through hinged hatches that swing upward when opened. Access to the cockpit is gained from either side of the fuselage through sliding hatches.

Note

Check position of rear-view mirrors before closing cockpit canopy hatches. If improperly positioned the mirrors may be damaged when the hatch is closed.

COCKPIT HATCH CONTROLS. The two sliding hatches are hydraulically operated. Levers or knobs[1] controlling operation of the hatches are installed on either side of the fuselage both inside and outside of the cockpit. The hatches move in the direction of the control levers and can be stopped at any intermediate point by placing the control lever in the "STOP" position. Operation of the hatches in case of hydraulic failure is assured by means of an accumulator and check valve which will supply pressure for emergency actuation of the hatches.

WARNING

- The accumulator supplies pressure to the sliding enclosures even when the engine is not operating. In entering or leaving the cockpit, extreme caution is urged to prevent inadvertent actuation of the enclosure controls and possible bodily injury from the pressure of the closing hatches.

[1] Airplanes BuNo 132572 and subsequent

If no hydraulic pressure is available, the hatches can be opened manually by means of levers installed on the lower forward edge of each hatch, both inside and outside. See figure 3-1.

Note

Approximately 50 pounds of pressure are required to manually open the canopy without the aid of hydraulic pressure. Because of poor arm leverage and the effects of slipstream, difficulty may be experienced in attempting to manually open the canopy in flight, therefore, the airplane should be slowed down as much as possible during such attempt.

RADAR OPERATOR'S MIDDLE COMPARTMENT HATCH CONTROLS. The hatches for the middle compartment are manually operated and are controlled by levers (figure 3-1) located on the forward end of the hatches, both inside and outside. 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

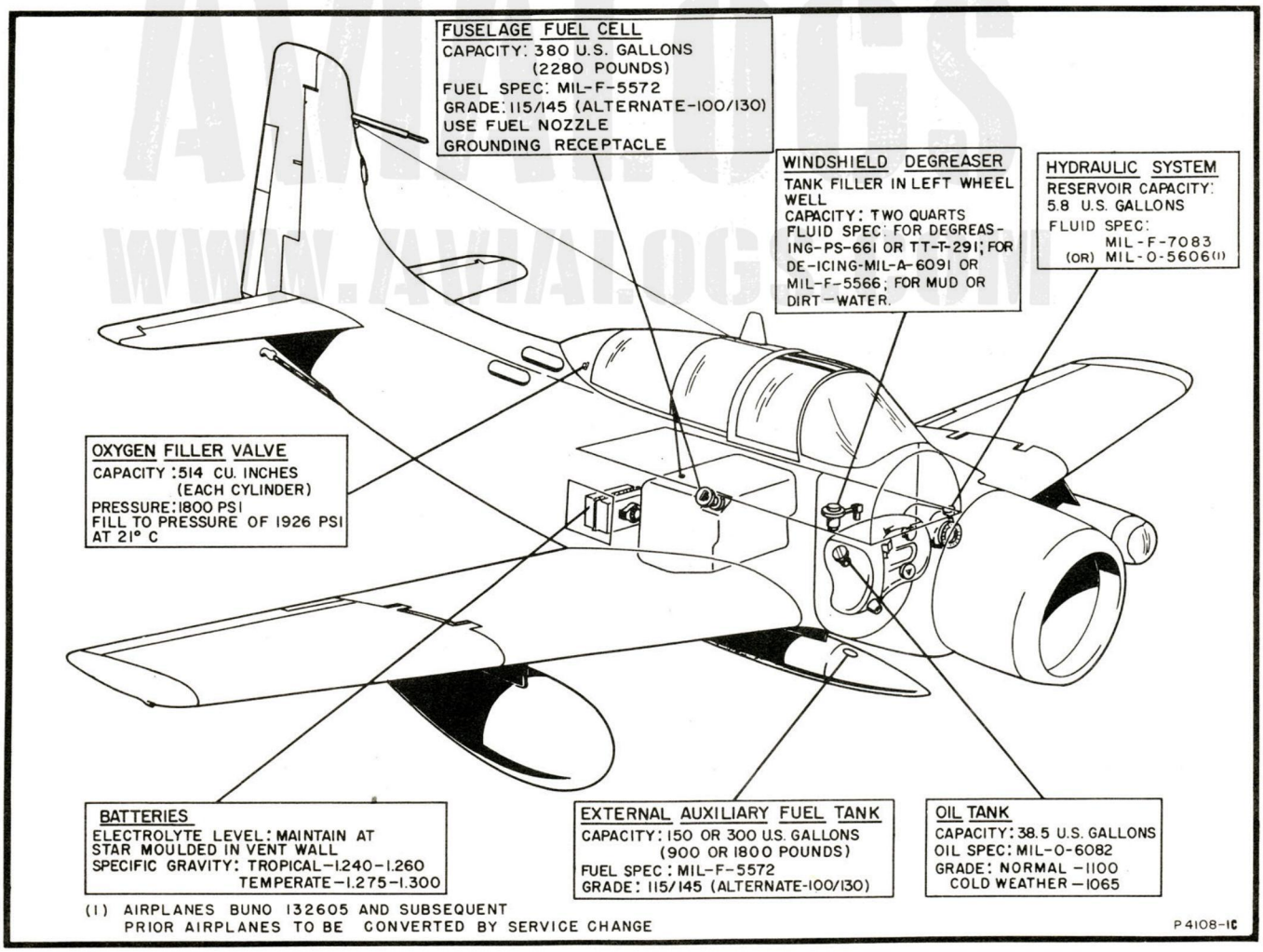


Figure 1-13. Servicing Points and Specifications

both sides of the compartment. The hatches should be kept closed during engine warm-up, take-off, and flight. Refer to the warning on jettisoning the aft enclosure in paragraph entitled BAIL-OUT PROCEDURE, Section III.

CAUTION

All latches on the hinged enclosures should be locked prior to take-off. Failure to do this may result in loss of hinged enclosure and possible damage to aircraft.

SEATS

Each seat is designed to accommodate a seat pad, a back pad, a PK2 pararaft kit, and a seat type parachute. The pilot's seat and the ECM operator's seat 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 fastened to the deck and is not adjustable.

CAUTION

Because of the location of the seat switch, 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. To correct this difficulty, the switch has been reversed in later aircraft.(1)

SHOULDER HARNESS AND SAFETY BELT. The shoulder harness and safety belt are of the conventional type. An inertia reel take-up mechanism is provided for the shoulder harness. The harness may be 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. The oxygen tubes are located 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

(1) Airplanes BuNo 132607 and subsequent

SECTION II

NORMAL PROCEDURES

BEFORE ENTERING THE AIRCRAFT

FLIGHT RESTRICTIONS. Refer to Section V for discussion and tabulation of limitations imposed on the aircraft.

CRUISE CONTROL. Preflight planning must include a determination of power settings versus fuel available, desired airspeed, required range, etc., as necessary to complete the proposed mission. Cruise control information for the complete flight regime is presented in Appendix II. It is recommended that operational charts be prepared from this basic information. The recommended power schedule (RPM-MAP), power limits (RPM-MAP), and long range cruising speeds are presented on the Specific Range charts in the Appendix. Adherence to these procedures is mandatory. In the interest of prolonging engine life, the following is recommended:

a. Long range power schedule be used, reducing power for every 500 pounds reduction in airplane gross weight whenever practical.

b. Favor lower altitudes in flight planning.

WEIGHT AND BALANCE. Determine weights of ammunition, bombs or other stores which have been loaded. Check gross weight and center of gravity for take-off, and determine the anticipated loading for landing. Refer to Section V for weight limitations and center of gravity limitations involved. Care must be taken to assure that additions of equipment affecting weight and balance fall within center of gravity fore and aft limits as defined in the AN 01-1B-40 Handbook of Weight and Balance Data. It is necessary to complete Weight and Balance Clearance Form F prior to flight whenever an airplane is loaded in a manner for which no previous valid Form F has been filed.

EXTERIOR INSPECTION. Prior to entering the airplane, the Naval Aircraft Flight Record form ("yellow sheet") must be consulted to determine the status of the assigned aircraft. Certification by the plane captain of fuel, oil, and ordnance loaded should be checked, and the pilot must sign for acceptance of the aircraft. Following this, the exterior of the airplane must be checked for general condition and cleanliness, noting the specific details as called out in figure 2-1.

CAUTION

Rudder stops may be damaged by heavy gust loads. Damage of this type can be prevented by having the rudder pedals manned at all times while the rudder battens are removed.

UPON ENTERING THE AIRCRAFT

INTERIOR CHECK (ALL FLIGHTS). An inspection of the interior of the cockpit and of the middle and aft compartments must be made to check the general condition of the airplane and to determine that all gear is properly stowed and secure. After fastening safety belt and shoulder harness, the following check is to be made:

a. Make oxygen, anti-g, and radio connection as required.

b. Battery-generator switch ..... "BAT & GEN"

Note

If available, an external d-c power supply should be plugged into the aircraft system. In this event, leave the battery-generator switch "OFF" until the external power supply has been disconnected.

c. Adjust the seat and rudder pedals as necessary.

d. Fuel tanks selector ..... "MAIN"

e. Cowl flaps ..... "OPEN"

f. Oil cooler door ..... "AUTO"

g. Carburetor air switch ..... "DIRECT"

h. Mixture control ..... "IDLE CUTOFF"

i. Propeller control ..... "INCREASE"

j. Throttle ..... "CLOSED"

k. Dive brake ..... "CLOSE"

l. Supercharger ..... "LOW" blower

m. Check oxygen regulator and shut-off valve.

n. Landing gear control ..... "DOWN"

o. Ignition switch ..... "OFF"

p. Set pressure altimeter and clock

q. Note manifold pressure reading

r. Uncage gyro instruments

s. Tail hook control ..... "UP"

t. FLT INSTR PWR SEL switch .. "INVERTER 1"

u. FLT INSTR lights switch ..... "OFF"

v. Auto pilot clutch switch ..... "DISENGAGED"

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

x. If the wings are spread, check to see that the wing lock-pins are retracted into the wings, and check the control surfaces for free and correct movement.

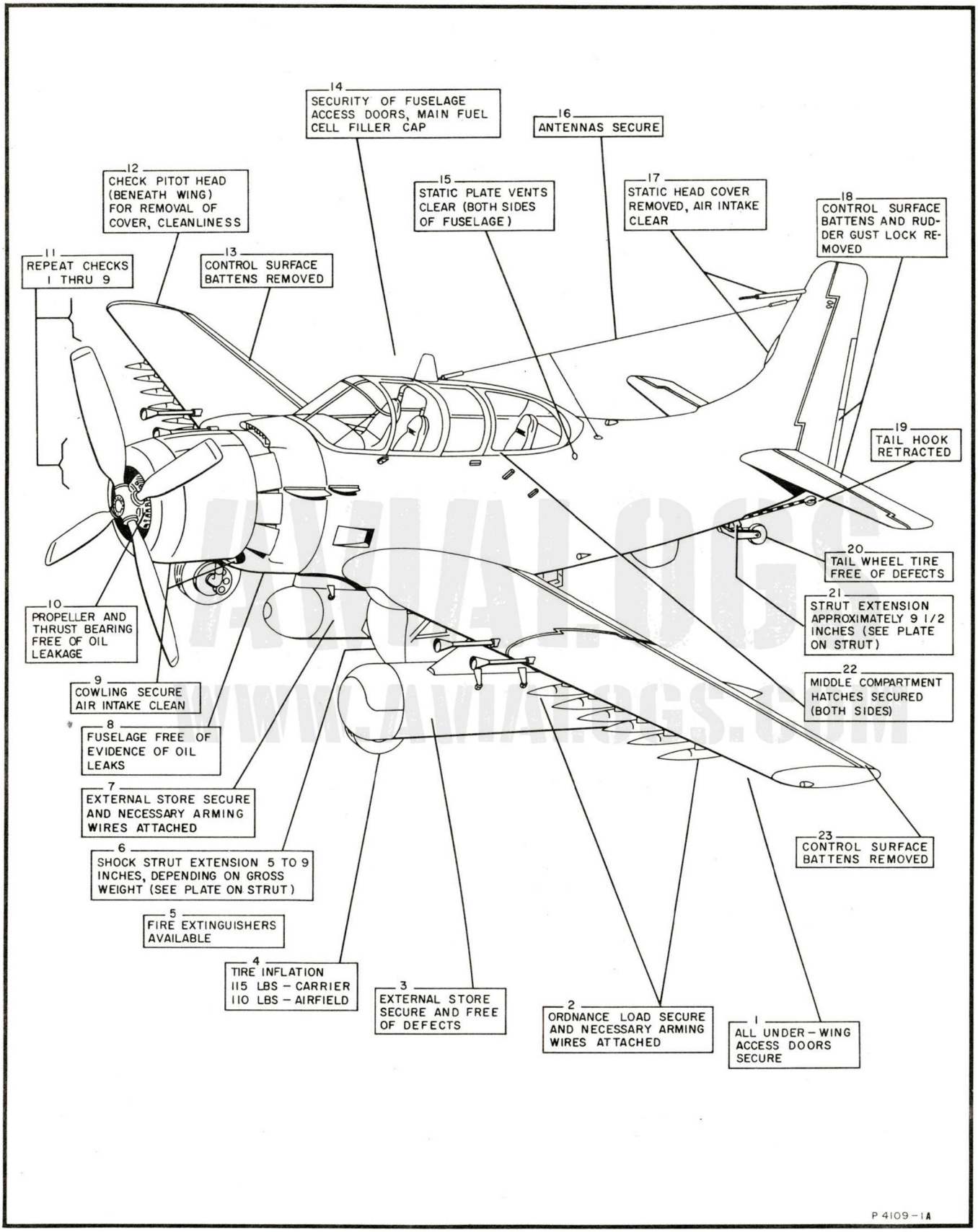


Figure 2-1. Exterior Inspection

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.

y. HEAT control lever ..... "WIND&CABIN" or "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.

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

CAUTION

The above procedure is necessary to prevent liquid lock, an accumulation of raw fuel or oil in the lower cylinders, which may cause extensive damage to the engine. 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 apt to be drawn back into the cylinders when the engine is started.

Note

A clutch safety feature incorporated in the starter protects the starter and engine mechanism against overload such as might be caused by liquid lock. When the torque load on the starter exceeds the clutch setting (750-950 foot pounds), the clutch will slip.

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 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 (40° to 60°F).

(2) 1300 to 1400 rpm for OAT of 18° to 32°C (65° to 90°F)

(3) 1400 to 1450 rpm for OAT of 38° C (100°F) or higher.

Note

Do not allow the 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.
- [1]When an external power source is used for engine starting, and with the battery-generator switch in the "OFF" position, the battery circuit breaker may pop open if the battery charge is low. This is caused by current flow exceeding the five ampere capacity of the circuit breaker; however, no damage will result from this condition and it is only necessary to reset the circuit breaker after the engine is started and the generator has cut in.

CAUTION

During cold weather operations, except in cases of emergency, an external power supply must be used when starting the engine. The cowl flaps should be open when starting the engine even under cold weather conditions. No attempt should be made to accelerate the warming-up period by closing the cowl flaps.

d. Energize the starter, and after the propeller has turned through two complete revolutions (8 blades), press the primer button and turn the ignition switch to "BOTH" in that order in rapid succession. After the engine starts, adjust the airflow with the throttle to obtain a smoothly running engine.

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.

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

f. When the engine is operating smoothly on the primer alone, move the mixture control to "RICH." Release the primer when a drop in rpm indicates that fuel from the carburetor has reached the cylinders.

[1]Airplanes prior to BuNo 132517

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 the 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 the temperatures range below freezing.

CAUTION

Do not start the engine with the mixture control out of "IDLE CUTOFF" as the engine may "liquid lock" and cause engine damage which may not be immediately detected.

g. After the engine is running smoothly on the carburetor, reset the throttle for 1200 rpm. Do not pump the throttle. Operate the throttle smoothly and slowly even after the engine is running smoothly. Do not allow engine speed to exceed 1450 rpm during start.

h. Check the 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 a minimum idle during warm-up to maintain a stabilized oil pressure. If the oil pressure does not stabilize, the engine should be stopped and heat applied locally to the oil lines and tank.

i. Refer to Section III for instructions to be followed in case of fire while starting.

j. If the engine does not start, wait a few minutes to 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. The 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" position, and turn the propeller through with the starter six revolutions.

k. Fuel boost pump ..... "OFF"

ALTERNATE/EMERGENCY STARTING PROCEDURE. When no other external power source is available, an aircraft that has already been started may be used to start another through use of a jumper cable engaged to both external d-c power receptacles. The aircraft supplying the power must maintain approximately 1850 rpm in order to bring its electrical output up to that required for an engine start. After the engine has been run up to this speed, in order to transfer power to the other aircraft, it is necessary to depress the momentary contact switch adjoining the external power receptacle. When the start has been completed, it is only necessary to disconnect the jumper cable from both aircraft.

ENGINE GROUND OPERATION

a. Warm up at approximately 1200 to 1400 rpm.

b. Head the airplane into the wind where ground operation for an extended period of time 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, the supercharger control in "LOW" blower, and the mixture control in "NORMAL."

d. Continue the warm-up until the oil pressure shows stability during manipulation of the throttle.

e. Cylinder head temperatures should never exceed 260°C.

CAUTION

During ground operations, make certain that the HEAT 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 the engine idling, place a light load on the electrical system, such as cockpit or instrument lights.

d. Increase the 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 in the warning light 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.

f. A take-off should not be made if the GEN WARN light is on or if the d-c voltmeter reading is too low (below 26.7 volts) or too high (above 28.7 volts).

*D-C EMERGENCY POWER SUPPLY CHECK. While maintaining sufficient engine rpm for generator output (approximately 1500 rpm) make the following check:

a. Battery-generator switch.....“BAT ONLY”

b. Decrease engine speed to 800 rpm. The wheel and flap position indicators and the air temperature indicator will “sag.”

Note

Too long a period at this condition will cause the flight instrument gyros to slow down and tumble as inverter power is lost during the check.

*Airplanes prior to BuNo 132528

c. Maintain 800 rpm and switch the battery-generator switch to “OFF” and then back to “BAT ONLY.” The indicators should now show the correct readings.

d. Battery-generator switch.....Return to “BAT & GEN”

A-C POWER SUPPLY CHECK. While maintaining sufficient engine rpm 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 approximately 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 approximately 110 ± 6 volts for each phase.

e. Turn the FLT INSTR PWR SEL switch to the “INVERTER 2 & AUTO PILOT” position and repeat the check of the 400 cycle phases. The voltmeter should indicate approximately 110 ± 6 volts for each phase.

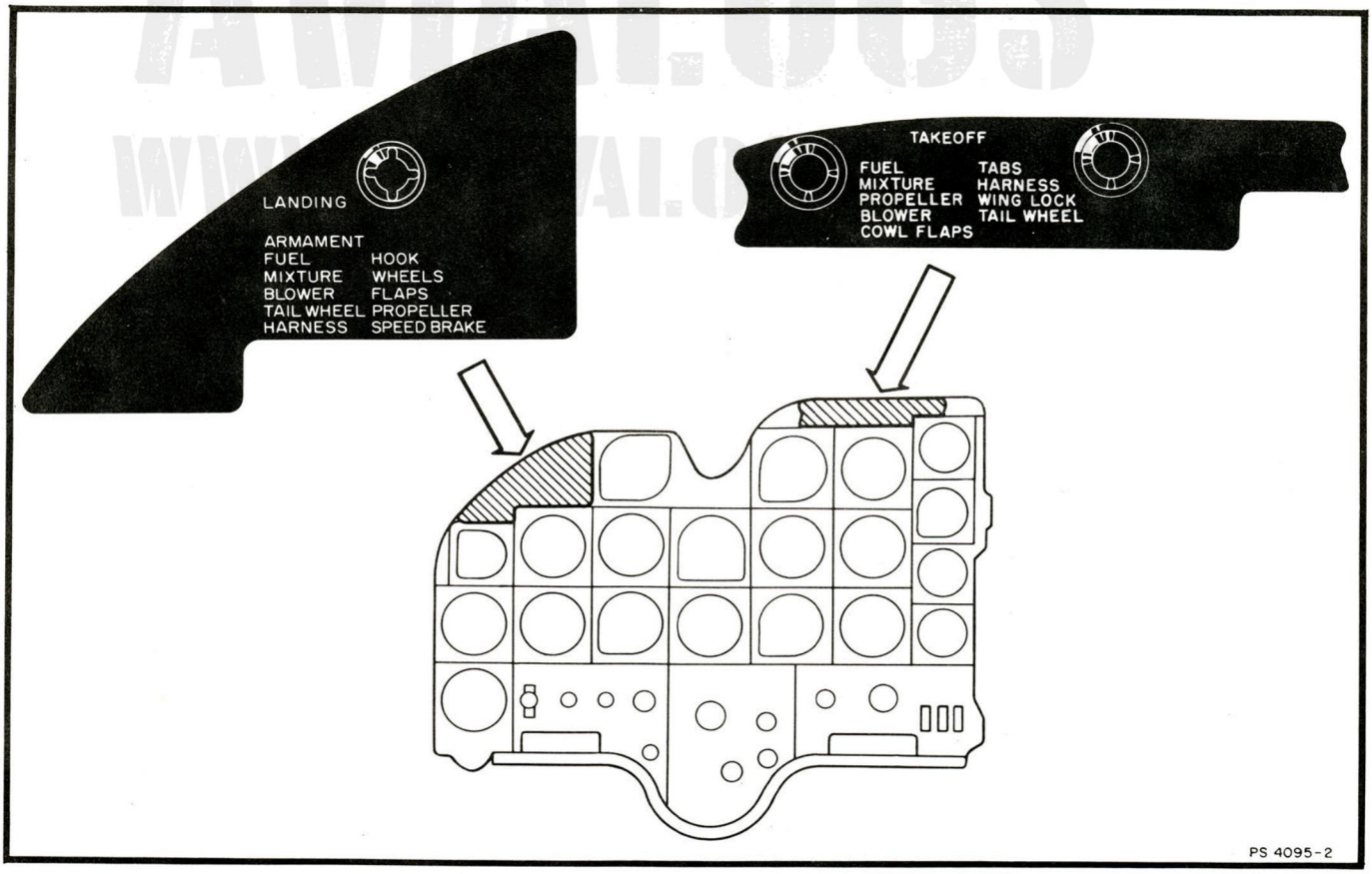


Figure 2-2. Check-off Lists

INVERTER WARNING AND SELECTION CHECK. While maintaining sufficient engine rpm for d-c generator output, 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. 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

FUEL PUMPS. With the engine running at 1500 to 1800 rpm turn the fuel boost pump "OFF" to check the 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. Press the FUEL QUAN TEST switch on the instrument panel. The fuel quantity indicator will drop toward a zero reading, and then will 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. With the engine running at 1500 to 1800 rpm, check the oil pressure and oil temperature.

Rear oil pressure..... 70 psi ± 5

Oil temperature ..... 85°C desired
95°C maximum
30°C minimum

Note

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

TAXIING INSTRUCTIONS

The airplane is equipped with 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 crosswind taxiing to relieve excessive braking action.

WARNING

During extended period of crosswind taxiing, it is recommended that the canopy be closed 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 pump "OFF," move the mixture control slowly toward "IDLE CUTOFF" 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 plugs and also affords good accelerating characteristics. A momentary slight drop in manifold pressure may be used as an indication of a slight rise in 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.

c. Open the throttle to obtain 30 inches Hg manifold pressure.

CAUTION

Make sure stick is 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 and stationary oil-operated disc-type clutch which does not need to be desludged.

PROPELLER

a. Run the engine at 1600 rpm but do not exceed 25 inches Hg during the following check.

b. Note rpm reaction as 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 the 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.

WARNING

In order to preclude the possibility of the airplane nosing over, do not use a manifold pressure setting that exceeds field barometric pressure unless the tail of the airplane is adequately tied down.

b. Place the ignition switch in the "LEFT" position for a minimum of 15 seconds to allow the rpm to stabilize and note rpm dropoff.

Note

Thirty seconds is the maximum time the ignition switch should remain in any position other than "BOTH."

c. Return the switch to "BOTH" and allow the engine speed to stabilize.

d. Repeat this procedure for the "RIGHT" position.

e. Atmospheric conditions will influence the readings obtained. A drop of 75 rpm or less when operating on one magneto is considered satisfactory providing no engine roughness is encountered.

Note

If magneto check is unsatisfactory, clean spark plugs out by reducing rpm to idle range (approximately 800 rpm), lean toward "IDLE CUTOFF" to establish a mixture leaner than best power (indicated by a decrease on the tachometer of 25 to 50 rpm) and run for two minutes. Return mixture control to "RICH" and repeat magneto check.

IGNITION SWITCH CHECK. At the start of the day's flying, the "OFF" position of the ignition switch should be checked to assure proper connection of the ground wires.

a. Run the engine at idle rpm.

b. Turn the ignition switch "OFF" momentarily to see if the engine stops firing.

c. Return the switch to "BOTH."

ENGINE IDLE RPM CHECK

a. Retard the throttle to the full aft "CLOSE" position.

b. Engine idle should be 650 ± 50 rpm.

PRE-FLIGHT AIRCRAFT CHECK

AIRFIELD AND CARRIER CHECK

a. Cockpit canopy ..... "OPEN"

Note

Both sides of the pilot's canopy should be open during take-off.

WARNING

The middle compartment canopy must be closed during engine turn-up, take-off, or in flight, otherwise it may be carried away by the propwash or slip-stream.

b. Shoulder harness and safety belt ..... Adjusted and locked

c. Tail Wheel: Airfield ..... "LOCK"
Carrier ..... "UNLOCK"

d. Fuel booster pump ..... "ON"

e. Fuel tank selector ..... "MAIN"

f. Cowl flaps ..... "OPEN"

g. Oil cooler door ..... "AUTO"

h. Carburetor air ..... "DIRECT"

i. Wing flaps: Airfield ..... As desired
Carrier ..... "DOWN" (40°)

j. Rudder tab ..... 2 units nose right

k. Horizontal stabilizer ..... ¾ unit nose up

l. Aileron tab ..... Neutral

m. Throttle friction control ..... Adjust as needed

n. Mixture ..... "RICH"

o. Propeller control ..... "INCREASE"

p. Speed brake ..... "CLOSE"

q. Supercharger ..... "LOW" blower

r. Wings ..... Spread and locked

s. Check controls for free and correct movement.

t. Run up engine.

WARNING

In order to prevent the airplane from nosing over, do not exceed 2400 rpm or 30 inches Hg manifold pressure on the ground unless the tail of the airplane is adequately tied down.

u. Check all instruments for indications within the required limits.

v. FLT INSTR PWR SEL switch ..... "INVERTER 1"

w. Gyro horizon ..... Cage and uncage to erect

CATAPULT CHECK. In addition to the preceding check, the following should be accomplished:

a. Trim settings for catapulting with symmetric loadings are:

- Horizontal stabilizer ..... 3 units nose up
- Aileron ..... "0"
- Rudder ..... 2 units nose right

Note

Asymmetric loadings require 4 units aileron tab to reduce wing heaviness after the catapult launch.

b. Tail wheel ..... "UNLOCK"

c. Catapult grip ..... Down

d. Throttle friction control .... Tighten

e. Place feet against rudder pedals with legs stiff.

f. Place head firmly against headrest.

g. Brace right arm, locking elbow against abdomen. Hold control stick in neutral or slightly aft of neutral position.

h. Push throttle forward to obtain take-off setting and grasp catapult handgrip.

TAKE-OFF

The airplane is inherently stable and has no unusual take-off characteristics except that full power should not be applied before beginning the take-off run. Rudder control is almost immediately effective; the tail will begin to rise at approximately 45 knots. Typical take-off speeds with flaps "UP" are 95 to 100 knots IAS at 19,000 pounds gross weight and 100 to 105 knots at 21,000 pounds. Use of flaps during a take-off from a smooth paved runway is unnecessary. If an absolute minimum run take-off is to be made, such as from a carrier deck, the flaps must be full "DOWN" (40 degrees) to obtain the take-off performance as presented in Appendix 1. Note, however, that if an obstacle is to be cleared after a minimum run take-off, the flaps should be lowered only 25 degrees for better initial climb performance.

MINIMUM RUN TAKE-OFF. A minimum run take-off may be accomplished by exercising the following procedure: Lower landing flaps; hold brakes and advance throttle to obtain 30 inches of manifold pressure, taking care to keep the tail on the ground; release brakes and advance throttle to full take-off power; raise tail to approximately a level flight attitude in order to reduce drag; and assume a three-point attitude upon approaching flying speed. The airplane can be expected to become airborne at an IAS varying from 80 knots at 19,000 pounds to 85 knots at 21,000 pounds.

ENGINE FAILURE DURING TAKE-OFF. Refer to Section III for a discussion on procedures to follow in case of engine failure during a take-off.

AFTER TAKE-OFF

a. Retract the landing gear as soon as a point is reached beyond which a safe landing cannot be made on the runway or in any level space available immediately beyond the runway.

Note

The landing gear will retract in a maximum time of nine seconds.

b. The flaps, if used, will begin to blow back at air speeds above 110 knots, however the wing flaps shall be retracted before the maximum permissible indicated airspeed for wing flaps extended, given in Section V, is exceeded. This blow back feature allows the flaps to be retracted after take-off with little or no settling of the airplane and with a minimum change in trim.

c. The fuel boost pump should be turned off after the climb out is established; however, selection of the droppable wing tank should be made before the boost pump is turned off. Refer to Section VII for additional information on fuel system management.

CLIMB. The characteristics of the airplane in a climb are normal. Although the best climbing speed at sea level is approximately 140 knots IAS while using a power setting of 2600 rpm and 48 inches of manifold pressure, this power setting must be reduced as altitude is increased to prevent exceeding the engine operating limits. A power setting of 2600 rpm and 45.5 inches of manifold pressure will permit the climb to be maintained to full throttle altitude without reducing power and without exceeding the limiting BMEP. Refer to Appendix II for additional data on climbing speeds and power settings.

Note

It will be noted that the Engine Operating Limits Chart in Appendix II indicates that 2600 rpm and 46.5 inches of manifold pressure would permit a climb from sea level to full throttle altitude without exceeding the limiting BMEP, but since the chart is constructed without ram effect, a realistic full throttle altitude would be approximately 1000 feet higher, and consequently a power setting of one inch less manifold pressure would be necessary to prevent exceeding the limits.

a. Adjust cowl flaps as necessary to maintain the cylinder head temperature below 245°C when climbing at normal rated power. When operating at military power do not exceed 260°C. A material reduction in cylinder head and oil temperatures can be obtained by climbing at an IAS from 15 to 20 knots faster than best climbing speed. A tendency for the oil to overheat can be checked more quickly by reducing engine speed than by throttling alone.

b. After the climb has been established, and during the climb, it may be necessary to use the fuel booster pump at higher altitudes, if the engine pump alone does not maintain sufficient pressure (19 psi minimum).

c. A possibility of carbon monoxide concentrations in the cockpit exists if the sealing is not meticulously maintained. The highest CO concentrations are most likely under high power versus low airspeed climb conditions.

WARNING

Remedial action in case of suspected or indicated CO concentration should consist of opening the enclosure and breathing 100 percent oxygen. Increased power should be avoided and a landing should be made as soon as possible.

Note

Tests for the presence of carbon monoxide contamination should be conducted for all operating conditions at every 120 hour check. If contamination is indicated, the airplane should be subjected to a preventative maintenance program for effective resealing.

DURING FLIGHT

FLIGHT CHARACTERISTICS AND SYSTEMS OPERATIONS. For complete information regarding in-flight characteristics of the aircraft, refer to Section VI. Operation of the various systems of the airplane during flight is discussed in Section VII.

APPROACH AND LANDING

PRE-TRAFFIC PATTERN CHECK LIST

a. For landing gross weights allowed and center of gravity limitations, refer to Section V.

b. Shoulder harness and safety belt . . . "LOCKED"

c. Exterior lights: Carrier . . . . . "DIM"
Airfield . . . . . "BRIGHT"

d. Master armament switch . . . . . "OFF"

e. Gun charger switch . . . . . "OFF"

f. Tail wheel: Airfield . . . . . "LOCK"
Carrier . . . . . "UNLOCK"

g. Fuel booster pump . . . . . "ON"

h. Fuel tank selector . . . . . "MAIN"

i. Oil cooler door . . . . . "AUTO"

j. Carburetor air . . . . . "DIRECT"

k. Horizontal stabilizer . . . . . "NOSE UP" as required

l. Trim tabs . . . . . As desired

m. Speed brake . . . . . "CLOSE"

CAUTION

Failure to close the speed brake before landing will result in damage to the speed brake and possible structural damage to the aircraft, since the extended speed brake will not clear the deck with the aircraft in a landing attitude.

n. Mixture . . . . . "RICH"

o. Supercharger . . . . . "LOW" blower

p. FLT INST PWR SEL . . . . . "Inverter 1"

q. Cockpit canopy . . . . . "OPEN"

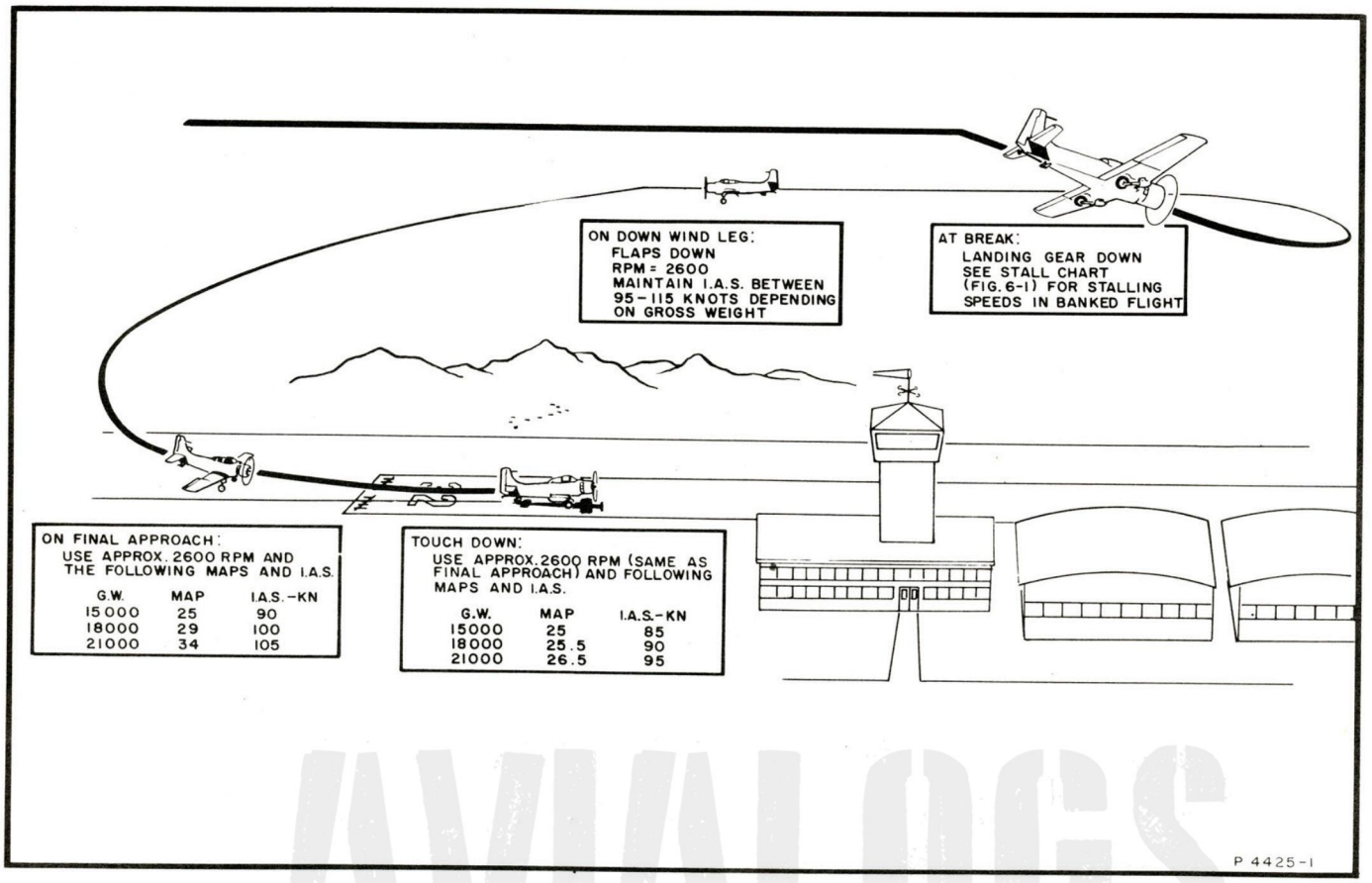


Figure 2-3. Landing Pattern Diagram

TRAFFIC PATTERN CHECK LIST

a. Arresting hook ..... "DOWN" for carrier landing

b. Landing gear control ..... "DOWN"

c. Landing flaps control ..... "DOWN"

Note

Full flaps are normally used during a landing on an airfield, however, lesser flap settings are desirable during high wind conditions. Full flaps should be used for all carrier landings.

d. Propeller control ..... 2600 rpm

CAUTION

Note position of the landing gear and flaps on the wheels and flaps indicator.

e. Trim tabs ..... As desired

APPROACH

Recommended approach speeds in the landing configuration at various gross weights and bank angles can be found in example 2 of figure 6-1A, STALL SPEEDS AND RECOMMENDED APPROACH SPEEDS. The region of recommended approach speeds is based on a minimum speed of 1.10% of power off stall speed and a maximum speed of 1.15% of power off stall speed. As can be seen in figure 6-1A, the recommended approach speeds for various gross weights and bank angles increase proportionately with the stall speed predictions. Therefore, an approach speed within the region of those recommended should be used to insure that the minimum margin above stalling speed with approach power will be maintained. For turbulent air, all approach speeds should be increased by 5 knots indicated.

CAUTION

If sufficient altitude is not available for stall recovery, an ample margin of speed above the stall should be maintained. In the approach and landing, the aerodynamic stall warning may not occur enough above the stalling speed to denote a dangerously slow attitude. Any abrupt application of power at a speed just above the stall may result in a torque roll which cannot be controlled with the ailerons and rudder. (Refer to WAVE-OFF, Section II.)

LANDINGS

AIRFIELD. Maintain an approach speed at least 10 to 15 per cent above the predetermined power-off stalling speed (see figure 6-1). Control at this speed is excellent.

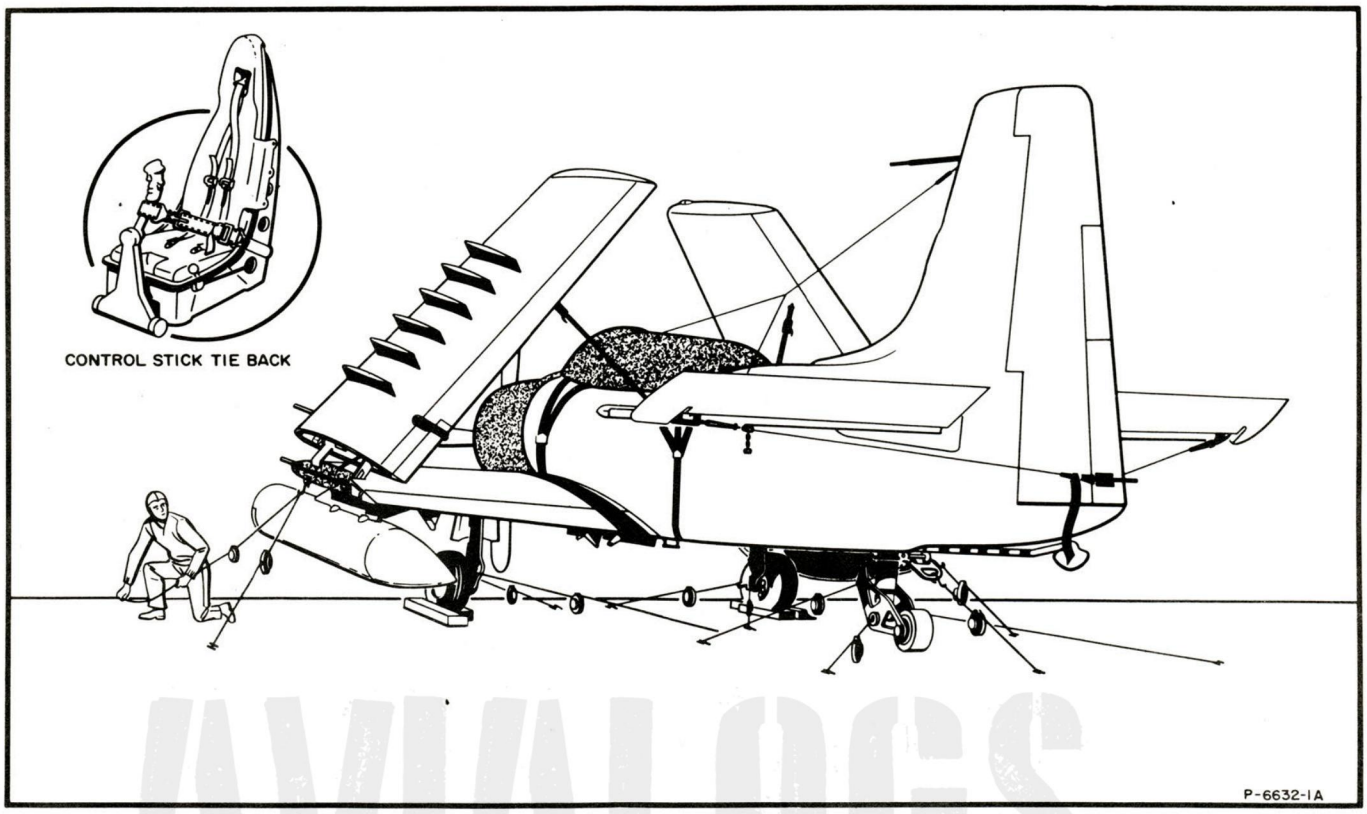


Figure 2-4. Mooring

Stall warning is apparent only at airspeeds close to the stall, and the airspeed must be closely controlled during the approach. Rudder control during the roll-out is effective down to approximately 20 knots.

CARRIER. The most critical factor in making a successful carrier approach and landing is airspeed, and for tail wheel type landing gear airplanes the range of airspeed at the cut points for a satisfactory carrier landing is small. If the cut airspeed is below the recommended range, the airplane most likely will be stalled before touchdown, thus resulting in an extremely hard landing that may exceed the landing strength of the airplane. Although the airplane may seem to fly well at an approach airspeed slower than the recommended range, under this condition when the throttle is retarded at the cut, the airspeed may be such that it is below the power-off stall airspeed or it may quickly reach that point as a result of the airplane decelerating from the loss of thrust. On the other hand, if the airspeed at the cut is above the recommended range, it will become difficult to prevent bounce landings or floating with the possibility of a barrier crash. Bounce landings at high airspeeds occur in main-landing-gear-first landings, tail-wheel-first landings, and three-point landings. In the case of the main wheels touching first, a nose-up moment results at impact because the center-of-gravity is aft of the wheels, causing the angle of attack to increase beyond that required to sustain level flight at that airspeed. The resulting lift is then sufficient to overcome the weight of the airplane, causing the airplane to become airborne again. In the case of a tail-wheel-first landing, even though the airplane noses down, the angle of attack is still sufficient to have excess lift and the airplane bounces. In a like manner, a bounce can be produced in a three-point landing. Under these circumstances if the arresting hook catches a wire before the airplane contacts the barrier, the resulting arrestment can be somewhat erratic and may cause high loads to be applied to the structure.

The recommended cut airspeed range is from 10 to 15 per cent above *the power-off stall speed* of the airplane for its configuration and weight (refer to Section VI for the proper method of obtaining this airspeed for each individual airplane). The airspeed on the downwind and crosswind legs can be slightly higher to permit maneuvering; however, in no normal approach should the airspeed be so great that the throttle has to be retarded radically in order to reduce the airspeed. As can be seen by the stall airspeed chart in Section VI, large reductions in thrust will cause a substantial increase in stall speed thus reducing the margin of airspeed available for maneuvering.

CAUTION

- Carrier landings on angled deck ships should be made with particular attention to achieving a good lineup and avoiding landings with right to left drift which, when associated with the increased runout of angled deck arresting gears, can result in the aircraft coming to rest in the port catwalk even though a pendant is engaged.
- A burble effect, present under all wind conditions, produces a definite tendency for the right wing to drop as the airplane approaches and passes the round-down at the forward end of the landing area on angled deck ships.

WARNING

Do not use full "INCREASE" rpm during an approach and landing. (Refer to WAVE-OFF, Section II.)

HEAVY LOAD. Any approach and landing made in a heavily loaded aircraft must be made at a proportionally higher airspeed. For example, the power off stalling speed of this airplane at 21,000 pounds gross weight and with wheels and flaps down is approximately 87 knots IAS.

CROSS WIND. Cross wind landings can best be made by landing with the tail slightly up and using somewhat less than full-down flaps. Crab into the wind to correct for drift, and just prior to contact with the ground use some downwind rudder to line the airplane up with the runway. During the roll-out after landing there will be the normal tendency for the upwind wing to rise or for the airplane to turn into the wind. Use a little rudder or brake as needed for counteraction.

CAUTION

Use brake cautiously until the tail wheel is on the ground.

MINIMUM RUN. Use flaps full down, the propeller in low pitch (2600 rpm) and the throttle as required to make an approach similar to a carrier landing. Come in over the end of the runway at about ten feet, close the throttle and make a normal flared-out landing. Use the brakes as necessary. Leave the flaps down until the end of the roll-out to assure maximum drag.

LANDING EMERGENCIES. Refer to Section III for a discussion of emergencies which may occur during landings.

WAVE-OFF. See paragraph on slow flight characteristics contained in Section VI. With a propeller control setting of 2600 rpm, 48 inches of manifold pressure can be used during a wave-off without exceeding the limiting BMEP of the engine. Furthermore, a rapid opening of the throttle at this governing rpm can be accomplished without a dangerous overspeeding of the engine. This is sufficient power to make a smooth wave-off if any situation arises which should demand it. It should be recognized, furthermore, that the use of a higher rpm and more manifold pressure can cause torque forces which may be difficult to control at speeds close to the stall. A trim setting of two to three units right wing down will be of some value in overcoming this tendency.

WARNING

Do not use full "INCREASE" rpm during an approach and landing.

AFTER LANDING

Raise landing flaps upon completion of landing roll. Excessive taxiing with the flaps down may allow the flaps to be damaged by gravel thrown back by the propeller blast.

a. Check the cowl flaps. They should be open for proper engine cooling.

b. Propeller control ..... "INCREASE"

POST FLIGHT ENGINE OPERATION. A post flight check should be made if any phase of engine operation has been questionable. Before stopping engine, manually lean at idle rpm to a mixture leaner than best power, which will be indicated by a decrease on the tachometer of approximately 25 to 50 rpm. Allow the engine to idle until the cylinder head temperature drops below 150°C. In addition to properly cooling the engine, this will permit better scavenging of engine oil and, because of the high percentage of air in the fuel-air mixture, serves to clear any fouled spark plugs. Manual leaning of the carburetor may be performed while taxiing with the engine running at approximately 800 rpm.

STOPPING THE ENGINE

a. Propeller control ..... "INCREASE"

b. Booster pump ..... "OFF"

c. Mixture control ..... "IDLE CUTOFF"

d. Ignition switch ..... "OFF" after propeller stops rotating

e. Cowl flaps ..... Check to see that they are fully open.

f. With engine oil still warm following engine shutdown and with the battery-generator switch still at "BAT & GEN," accomplish the following steps to properly position the oil diverter valve for a cold start. Refer to OIL SYSTEM, Section VII, for further information concerning this procedure.

g. Oil dilution switch—"OIL DILUTION" for five seconds.

Note

The oil dilution shut-off cock is kept closed when not diluting oil.

h. Battery-generator switch ..... "OFF"

i. Oil dilution switch ..... "OFF"

Note

Steps g, h, and i may be accomplished following step a providing that the engine is idling below generator cut-in rpm.

OIL DILUTION. Refer to COLD WEATHER ENGINE OPERATION, Section IX, for complete information on oil dilution.

BEFORE LEAVING THE AIRPLANE

a. Fuel tank selector ..... "OFF"

b. All electrical switches ..... Off

c. Wing flaps ..... "UP"

d. Throttle ..... "CLOSE"

Note

If throttle is opened or left in the open position while the engine is not running, sludge or congealed oil may cause the pilot valve and/or servo piston of the manifold pressure regulator to stick in the "increase throttle" position, resulting in a "run away" condition during the next start. This condition is more likely to occur in cold weather.

MOORING

a. Tail wheel ..... "LOCK"

b. Chock wheels.

c. If gusty wind conditions prevail, tie airplane down, install jury struts, rig rudder gust locks on rudder, and tie control stick in aft position with seat belt. See figure 2-4.

CAUTION

After securing control column with the seat belt, do not apply tension by lowering seat. Applying tension to the belt in this manner will place undue strain upon the control column and may cause damaged to the control column yoke.

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SECTION III

EMERGENCY PROCEDURES

ENGINE FAILURE

If engine failure occurs, the primary rule of flight governs the immediate action to be taken—maintain flying speed. Quickly set up a safe gliding attitude, and then if altitude permits, attempt to remedy the cause of the engine failure through the procedure as outlined in the following paragraph.

PROCEDURE ON ENCOUNTERING ENGINE FAILURE.

a. In rapid succession:
Switch to a full fuel tank.

Mixture control ..... "RICH"
Fuel boost pump ..... "ON"
Throttle ..... ¼ open

CAUTION

The engine should never be started at full throttle, since a momentary but serious overspeeding of the engine would result.

b. If engine failure has been caused by fuel starvation, the foregoing steps may be sufficient to re-establish engine operation. If not, continue as follows.

c. To prevent premature start and backfiring, move mixture control to "IDLE CUTOFF" until adequate fuel pressure is built up.

d. Use primer as necessary until engine is firing smoothly.

e. Move mixture control to "RICH."

ENGINE FAILURE UNDER SPECIFIC CONDITIONS

ENGINE FAILURE DURING TAKE-OFF. In the event of engine failure during take-off, LAND STRAIGHT AHEAD. As many as possible of the operations listed below should be performed in the order given.

a. Release external auxiliary tanks or bombs.

b. Landing gear—"UP" unless sufficient runway is available STRAIGHT AHEAD for a landing in the normal ("DOWN") position.

c. Wing flaps ..... full "DOWN"
d. Lower the seat.
e. Battery-generator and ignition switch... "OFF"
f. Fuel selector ..... "OFF"
g. Cockpit hatch ..... "OPEN"

ENGINE ROUGHNESS. If engine is popping and losing power during take-off, the trouble may be fouled plugs. The engine will often run normally, at a reduced manifold pressure. This reduced manifold pressure, however, is generally sufficient to maintain level flight.

ENGINE FAILURE DURING FLIGHT. The maximum gliding ratio is 12.6 to 1 at approximately 120 knots IAS with the wheels and flaps up and the propeller in full high pitch. Do not lower wheels or flaps until the need for either has been positively determined. If engine failure should occur during daylight visual flight conditions, it is up to the discretion of the pilot whether to attempt a landing or to bail out. At night or during instrument conditions, the aircraft should be abandoned in flight.

LANDING WITH NO POWER. Certain actions must be taken to insure the successful completion of a forced landing. The following steps are organized in order of importance; however, the complete check should be accomplished if possible.

a. Jettison external fuel tanks, bombs or other stores.

WARNING

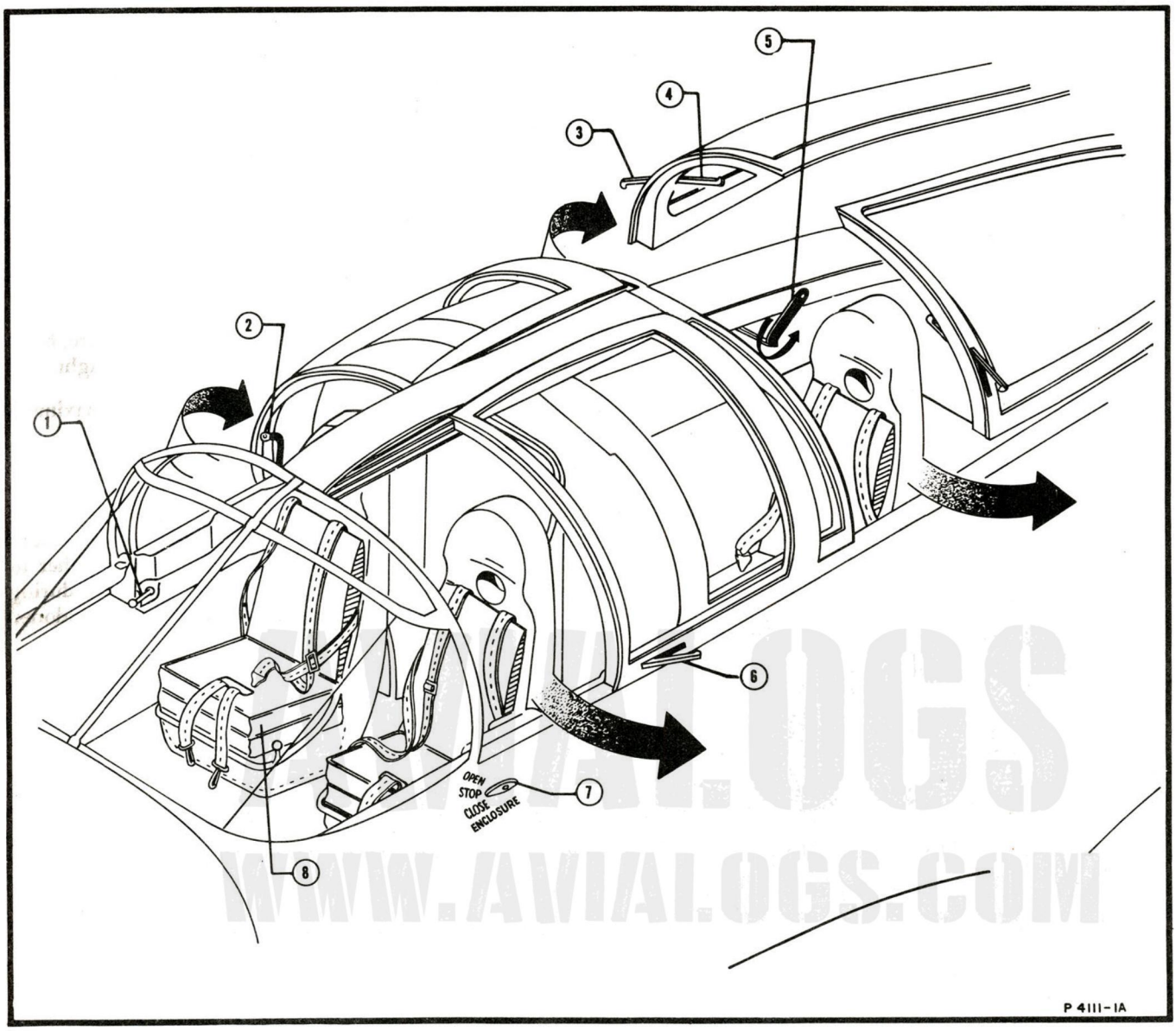
Jettison bombs in an unarmed condition.

b. Tighten and lock shoulder harness and safety belt.
c. Canopy ..... "OPEN"
d. Pilot's seat ..... Lower
e. Battery-generator and ignition switches ..... "OFF"

Note

If the radar altimeter is to be utilized during an emergency landing, the battery-generator switch must be left on; however, the battery-generator switch should be turned off before the actual landing.

f. Place goggles down over the eyes.
g. Mixture control ..... "IDLE CUTOFF"
h. Fuel tank selector ..... "OFF"
i. Landing gear ..... "DOWN" or "UP" as warranted by the situation
j. Wing flaps ..... full "DOWN" when landing is imminent.



1. Hatch actuating control*
2. Hatch manual opening lever*
3. Middle compartment hatch external opening lever
4. Middle compartment hatch internal opening lever
5. Middle compartment hatches jettisoning handle
6. Hatch manual opening lever*
7. Hatch actuating control*
8. Parachute and pararaft*

*Typical both sides.

Figure 3-1. Emergency Equipment and Exits

LANDING WITH SEIZED ENGINE. If a landing with gear down is considered feasible with the engine seized, use the following procedure for lowering the gear:

a. Battery-generator switch . . . . . "BAT ONLY"
b. Landing gear control . . . . . "EMER"

MANIFOLD PRESSURE REGULATOR FAILURE. Loss of engine oil pressure may result in a failure of the automatic function of the manifold pressure regulator. When the oil pressure drops below approximately 25 psi, the spring-loaded piston in the manifold pressure regulator moves into the full-low manual schedule, wherein the actual throttle position is only one-half the corresponding position of the cockpit lever. Under these conditions, the maximum attainable manifold pressure at military rpm will be approximately 1.5 times the outside air pressure in low blower, and 2.3 in high blower. Movement of the throttle control to the full open position will, in most cases, provide up to 40 inches manifold pressure at sea level. Utilization of this procedure may provide sufficient power for the pilot to reach a suitable landing area before the engine fails completely from lack of oil.

PROPELLER FAILURE

Failure of the governor to operate properly may result

in a run-away propeller. A run-away propeller goes in to full low pitch and may result in an engine speed as high as 3600 rpm or more. When such a failure occurs, the only method of reducing the engine speed is to throttle back and decrease the airspeed. In doing this, it is desirable to throttle back to 2900 rpm and reduce the indicated airspeed to the approximate values shown in the table below:

Weight (pounds)	*Altitude (feet)*	*Indicated Airspeed (knots) Flaps down Gear down*	*Flaps up Gear up*
16,000	S. L.	117	138
16,000	5,000	105	124
16,000	10,000	91	108
18,000	S. L.	114	135
18,000	5,000	101	120

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

FIRE

ENGINE FIRE

FIRE WHILE STARTING ENGINE. Backfiring sometimes causes fire in the induction system as a result of the presence of excessive fuel after priming. 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 quench the fire.

FIRE DURING TAKE-OFF. If a fire occurs during take-off, a landing should be made as quickly as possible.

FIRE DURING FLIGHT. The best means of preventing engine fire is through a rigid ground inspection and maintenance of those items which might fail and cause a fire. It is left to the pilot's 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 item 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 practicable (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, however, there is the possibility that it is electrical in origin. Refer to ELECTRICAL FIRE 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 in flight.

WARNING

Opening the cockpit canopy during a fuselage fire will cause a draft which may increase the intensity of the fire and even draw flames up 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 and bombs.

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

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

ELECTRICAL FIRE. In the event of a fire in the electrical system, 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 case, prepare for an emergency landing and terminate the flight as rapidly as the situation demands.

SMOKE ELIMINATION. If smoke or toxic fumes should enter the cockpit, the first course of action is for the pilot and crew to assure themselves a supply of uncontaminated air. Use oxygen masks with the regulators set for "100% OXYGEN." Ventilate the cockpit by throwing the VENT lever to full "ON." Opening the canopy may alleviate the situation, but this move should be made with caution as there is danger that additional smoke may be drawn into the cockpit by the draft caused by an open canopy.

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 the characteristics of the airplane. Landings in areas such as golf courses, ploughed fields, swamps, mud or sand should be made with the wheels up. Most nose-overs occur as a result

of landing in such territory with the landing gear down, and nearly all serious injuries and fatalities result from nosing over. Pilots should remember that ground which appears smooth and level from the air frequently turns out to be rough, crossed with ditches, soft, or full of obstructions when the actual 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 the listed action to be taken under the paragraph LANDING WITH NO POWER if engine failure is the cause of the emergency landing.

b. The crew must be forewarned by interphone and a check should be made, if time permits, that all safety belts and shoulder straps are locked.

CAUTION

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

c. The radar operator's hatch should be jettisoned upon receipt of orders from the pilot before an anticipated crash landing.

EMERGENCY ENTRANCE

Entrance into 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. If fire should prohibit an 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

Experience with airplanes of a similar type indicates that this aircraft has good ditching characteristics. The decision to ditch in any case is left to the discretion of the pilot, however, it is recommended that the aircraft be abandoned in flight during instrument conditions or at night, particularly if no power is available for the landing. Consideration in any decision should be given to the fact that ditching the airplane will allow the crew to obtain all survival gear that is stowed in the aircraft itself, such as canteens, drift signals, or first aid kits. Ditching will also allow the crew to remain together for mutual aid. As actual ditchings have shown that the aircraft will remain afloat for approximately 20 seconds or less, it is imperative that the crew be prepared to abandon the ship at once. In order to do this, the aft enclosures should be jettisoned and the cockpit sliding enclosures opened before impact with the water.

WARNING

It is imperative that the radar operator's hinged enclosures be jettisoned prior to opening the pilot's or ECM operator's sliding enclosures. This procedure is necessary due to a pressure differential which will be created if either of the cockpit sliding enclosures are opened prior to jettisoning the hinged enclosures. Above 250 knots, this pressure differential can cause inward shattering of the enclosure plexiglas, endangering the occupants of the compartment.

The following DITCHING CHART tabulates the functions of the various crew members in case of a water landing:

DITCHING CHART

Crew Member	*Duty*	*Provide*	*Position*	*Exit*
Pilot	Warn crew: jettison all external stores, make radio distress call and position report and, after the radar operator's hinged enclosures are jettisoned, open canopy.	Parachute Pararaft Charts	Pilot's seat, safety belt and shoulder harness tight.	Left side of cockpit.
ECM Operator	Turn on emergency IFF; stow loose gear, and after the radar operator's hinged enclosures are jettisoned, open canopy.	Parachute Pararaft Canteens	ECM operator's seat, safety belt and shoulder harness tight.	Right side of cockpit.
Radar Operator	Secure loose gear; jettison equipment and hinged enclosure upon orders from pilot.	Parachute Pararaft Canteen First-Aid Kit	Radar operator's seat, safety belt and shoulder harness tight.	Right side of compartment.

PREPARATION FOR DITCHING

a. If possible, use up most of the fuel supply to lighten the airplane and reduce stalling speed. An empty fuel cell will also contribute to flotation.

b. Ditch while power is still available. Power will allow the pilot to obtain the most favorable landing position and attitude.

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

d. Jettison the hinged enclosures and open the cockpit sliding enclosures in that sequence before impact with the water.

Note

In the event the hinged enclosures will not jettison, check to ascertain that the pilot's and ECM operator's sliding enclosures are both closed. If either of the cockpit sliding enclosures are open, the hinged enclosures will be difficult if not impossible to jettison due to a pressure differential. As a last resort, the hinged enclosures may be pushed or kicked loose after pulling the emergency release handle marked EMER RELEASE located on the top center beam.

LANDING TECHNIQUE

a. Ditch at the lowest possible forward speed commensurate with 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. During a power-off landing, 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 higher winds, it is recommended that ditching be accomplished upwind to take advantage of the lowered forward speed. It must be remembered, however, that the possibility of ramming nose-on into a wave is increased during a cross swell landing, as is the possibility of striking the tail on a wave crest and nosing in.

BAIL-OUT PROCEDURE

If the airplane is to be abandoned in flight, instructions must be passed to the crew and passengers over the interphone system or by prearranged signals. If possible, slow the airplane to an airspeed of 120 knots or less and lower flaps before bailing out. The technique of coordinating a vigorous push with the feet and pull-push with the hands and arms, and diving for the wing root, with knees pulled up against the chest and head and arms tucked in, should be followed. The most grave error in exit is in straightening the body immediately upon leaving the airplane. This is caused by the use of improper bail-out procedures or by some part of the person or clothing catching on the airplane.

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

a. Open canopy.

WARNING

It is imperative that the radar operator's hinged enclosures be jettisoned prior to opening the cockpit canopy. This procedure is necessary since opening the cockpit canopy before jettisoning the hinged enclosures creates a pressure differential which dangerously hinders break-away of the latter. Above 250 knots, this pressure differential can cause inward shattering of the enclosure plexiglas, endangering the occupants of the compartment.

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

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 ECM operator.

RADAR OPERATOR. It is considered that abandoning the airplane from the radar operator's compartment can be readily accomplished. It is suggested that the radar operator abandon the airplane from the right side since the seat may interfere with escape from the left side. Also, with the engine running, the directional rotation of the propeller has a tendency to force the body downward when leaving from the right 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 for bailing out from the radar operator's compartment:

a. Upon receipt of orders from the pilot release all encumbrances (safety belt, shoulder harness, etc.) except the radio cord.

b. Be prepared to exit without delay in order to give the pilot all the time possible for his exit.

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

Note

In the event the hinged enclosures will not jettison, check to ascertain that the pilot's and ECM operator's sliding enclosures are both closed. If either of the cockpit sliding enclosures are open, the hinged enclosures will be difficult if not impossible to jettison due to a pressure differential. As a last resort, the hinged enclosures may be pushed or kicked loose after pulling the emergency release handle.

d. Upon receiving the order to bail-out, place hands on the outboard side of fuselage of the right hand exit, coordinate a vigorous push with the feet and pull-push with the hands, and roll and fall into slipstream. As soon as body hits the slipstream, draw knees up to chest and keep in this ball-like position until well clear of the airplane. (See figure 3-2, sheet 2.)

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

AIRCRAFT SYSTEMS EMERGENCY OPERATION

FUEL SYSTEM. If fuel pressure is lost, the fault may lie in the engine fuel pump or fuel exhaustion of the selected tank. Proceed as follows:

a. Check position of fuel tank selector and set to tank containing fuel.

b. Turn fuel booster pump "ON."

CAUTION

If booster pump is turned "ON" before a fuel tank has been selected, an air lock may occur in the fuel line and prevent regaining fuel pressure.

c. Follow the steps outlined under PROCEDURE ON ENCOUNTERING ENGINE FAILURE, if an air start must be made.

JETTISONING EXTERNAL AUXILIARY FUEL TANKS. The external fuel tanks can be jettisoned in an emergency either electrically or manually. If time permits, it is preferable to jettison the tanks electrically as this will cause the centerline tank to be displaced by the bomb ejector. It has been found that a centerline tank, particularly when empty, will strike the fuselage when released without the use of the ejector. If possible, the airplane should be slowed down before the tanks are jettisoned. See External Fuel Tanks chart, figure 5-5, for the jettisoning capabilities of the aircraft. Jettison the tanks electrically as follows:

a. MASTER ARMT switch . "ON"

b. Function selector switch . "BOMBS"

c. INNER STATIONS selector switch . . . . . "LEFT," "CENTER" and "RIGHT"

d. Pickle switch B . . . . . Depress

In an emergency demanding immediate action, regardless of possible slight damage to the airplane, jettison all external tanks simultaneously by pulling out the [1]CENTER WING BOMB REL handle located below the left side of the instrument panel.

ELECTRICAL POWER SYSTEM

D-C GENERATOR FAILURE. Failure of the d-c generator will be indicated by a glowing warning light. After such failure occurs, d-c power from the battery will energize only the primary bus when the battery-generator switch is in the "BAT & GEN" position, however, the secondary bus can be energized by lowering the landing gear. Placing the battery-generator switch in the "BAT ONLY" position will energize both the primary and secondary bus from battery power. To conserve battery power it is recommended that the battery-generator switch be left in the "BAT & GEN" position as long as possible and that all non-essential equipment powered from the primary bus be turned off. Should it become necessary to use equipment powered from the secondary or armament bus, place the battery-generator switch in the "BAT ONLY" position and turn off all non-essential equipment.

Failure of the d-c generator will also cause a loss of variable frequency a-c power from the a-c generator since the a-c power relay is activated by power from the monitor bus. The monitor bus can only be energized by power from the d-c generator or from an external power source. Also all circuits powered by the number two inverter will be de-energized after failure of the d-c generator since power from the monitor bus is required to energize a relay which allows power to flow from the d-c tie bus to operate the number two inverter. In such event, the FLT INSTR PWR FAILURE warning light will be illuminated when the number two inverter is selected. A-c power can be supplied to the essential flight instruments by turning the FLT INSTR PWR SEL switch to the "INVERTER 1" position.

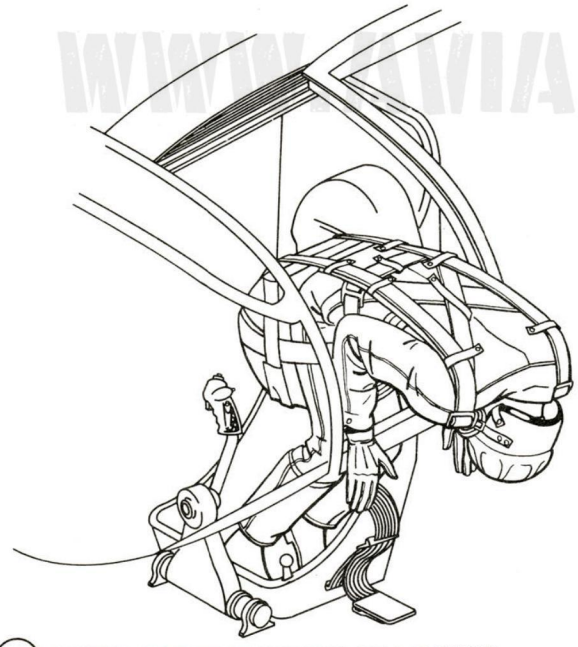
[2]In earlier airplanes, an emergency power supply system which includes a transformer that transforms 115-volt a-c generator power to 26-volt a-c and a rectifier, supplies 28-volt d-c power to the primary bus. When the battery-generator switch is placed in the "BAT ONLY" position, a ground is provided through the

[1]Labeled EMER BOMB SALVO REL on airplanes prior to BuNo 132500

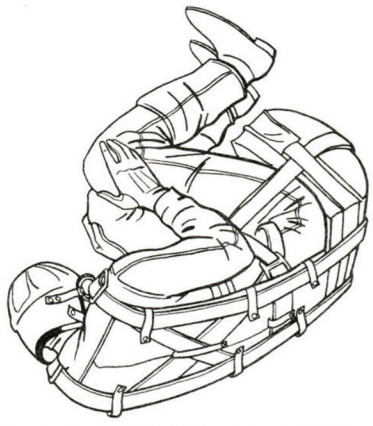
[2]Airplanes prior to BuNo 132528

(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.

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

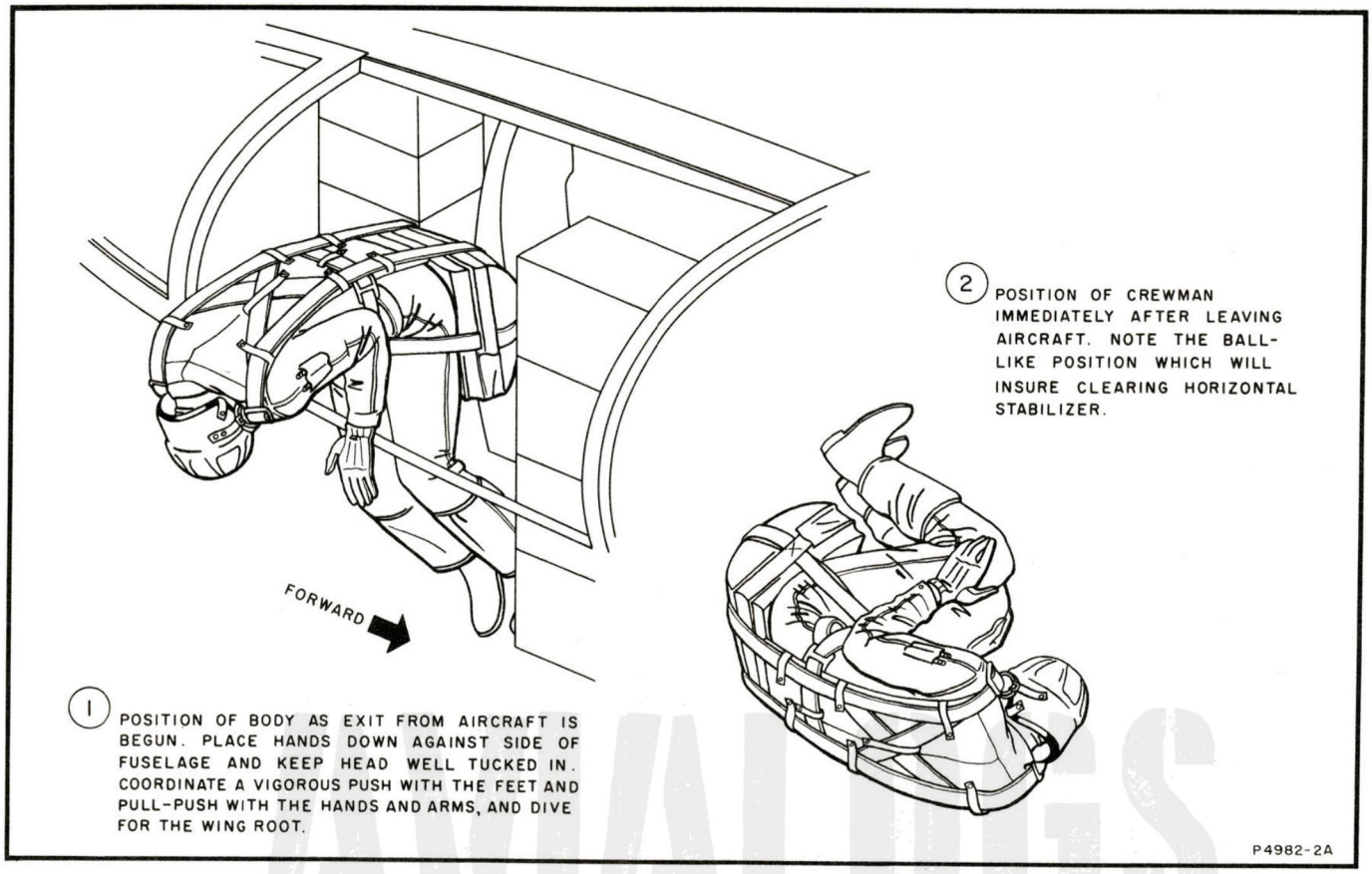

Figure 3-2. Bail-Out Procedure (Sheet 2)

switches-closed contacts to the coil of the emergency d-c power relay. The relay coil is then energized by d-c power from the rectifier. Rectified d-c power is then delivered to the primary bus. Should the emergency system fail, the primary bus in automatically supplied by the batteries. Switching to "BAT ONLY" will always put voltage on the primary bus.

Note

In the event of d-c generator failure on airplanes incorporating an emergency d-c system, the battery-generator switch should be placed in the "BAT ONLY" position in order to energize the primary bus from the a-c generator through the power rectifier. The secondary bus will then be energized from the battery, therefore, all non-essential equipment powered from the secondary bus must be turned off in order to conserve battery power.

A-C GENERATOR FAILURE. Failure of one or more phases of the a-c generator will result in the loss of operation of one or more units dependent upon a-c generator power (see figure 1-9). A-c generator output can be checked by phase by use of the a-c voltmeter and the associated phase selector switch. If complete loss of power is indicated, turning the AC GEN FIELD switch momentarily to "RESET" and then turning it to "ON" may restore the lost power. If power cannot be regained by this action, turn the AC GEN FIELD switch off ("RESET" position).

INVERTER FAILURE. If failure of the selected inverter is indicated by the FLT INSTR PWR FAILURE warning light, turn the FLT INSTR PWR SEL switch to the remaining inverter. If the warning light fails to go out, the selected inverter is not functioning properly, and no a-c power, therefore, will be available for the gyro horizon, the G-2 compass, the fuel gage or any of the equipment dependent upon the number two inverter.

HYDRAULIC POWER SYSTEM

EMERGENCY HYDRAULIC BYPASS VALVE. If surging of the pressure regulator or failure within the hydraulic system (other than main pump failure) is evident, pull up the EMER HYD BYPASS VALVE control to depressurize the main hydraulic system.

HYDRAULIC FAILURE WITHIN COCKPIT. Failure within the cockpit of some section of the high pressure hydraulic system can produce a fog resembling smoke. This fog can easily be misinterpreted as caused by fire. Evidence that the airplane is not on fire can be detected by the odor and moisture of the fog. If such a failure occurs, immediately depressurize the main system by use

of the EMER HYD BYPASS VALVE control. With the system so depressurized, the landing gear can be lowered with the emergency hydraulic pump only (refer to LANDING GEAR SYSTEM).

EMERGENCY HYDRAULIC PUMP. In case of failure of the engine-driven hydraulic pump, system pressure can be regained by pressing the EMER HYD switch to "ON." The switch must be held "ON" throughout operation of any equipment, except when the LANDING GEAR control is moved to the "EMERGENCY" position. See EMERGENCY HYDRAULIC PUMP, Section I. All devices normally operated by the hydraulic system can be actuated with emergency pump pressure, however speed of operation of such equipment is considerably reduced.

LANDING GEAR SYSTEM

LANDING GEAR SAFETY SOLENOID. A safety circuit operates a solenoid which prevents the LANDING GEAR control lever from being moved to the "UP" position when the landing gear is extended and the weight of the airplane is on the shock struts (struts compressed). If the circuit fails so that the safety lever prevents LANDING GEAR control operation during flight, manually depress the solenoid release lever adjacent to the LANDING GEAR control.

EMERGENCY EXTENSION OF LANDING GEAR. If the engine-driven hydraulic pump has failed, the landing gear may be lowered by placing the LANDING GEAR control in the "DOWN" position and operating the emergency hydraulic pump. If the landing gear should fail to extend because of the loss of hydraulic fluid, an emergency supply of fluid is provided in the reservoir below the main supply line standpipe which is utilized by moving the LANDING GEAR control to "EMERGENCY" after first depressing the release plunger located between the "DOWN" and "EMERGENCY" positions. This procedure will extend the main wheels only. The tail wheel may remain retracted or may extend by the force of gravity and air loads. It may be possible to fully extend the tail wheel by applying a minimum load factor of approximately 4 g's.

Note

If the LANDING GEAR control has been moved to the "EMERGENCY" position, manually reset the emergency control valve when the airplane is on the ground by moving the LANDING GEAR control from the "EMERGENCY" to the "DOWN" position, and have the ground crew reset the control linkage at the valve. The emergency hydraulic pump will remain energized in this condition until the control linkage is reset.

CAUTION

When the airplane is on the ground, do not attempt to reset the emergency control valve by moving the LANDING GEAR control to "UP."

Note

If procedures given fail to get the wheels down, it is recommended pursuant to current Navy directives, that the aircraft be landed in that condition without resorting to hazardous, nonstandard maneuvers in an attempt to lower the gear.

EMERGENCY BRAKE OPERATION. The brakes are operated by a power boost system from the main hydraulic system. In case of loss of hydraulic system pressure, the brakes can be operated by depressing the rudder brake pedals, however, approximately three times the normal foot pressure will be required.

FLIGHT CONTROL SYSTEM

AILERON POWER BOOST EMERGENCY RELEASE. If the aileron boost hydraulic system fails causing high control forces, the aileron power boost system may be disconnected by pulling the emergency release handle. The required force to operate the ailerons will be increased approximately four times after aileron boost has been disconnected. For flight characteristics of the aircraft with the aileron boost system disconnected, refer to the paragraph on FLIGHT CONTROLS, Section VI.

DAMAGED CONTROL SURFACES. If damage has occurred to the control surfaces from hazards such as gunfire or collision, check the slow flight characteristics of the aircraft at an altitude above 5,000 feet. Approach the stalling speed with caution, and determine the minimum safe airspeed that can be maintained during a landing.

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SECTION IV

DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT

HEATING SYSTEM

PILOT'S COMPARTMENT

Air is taken in through an intake duct on top of the fuselage just forward of the cockpit, circulated through a heater muff around the exhaust stacks and then carried to a distributor valve (see figure 4-1). The distributor valve control lever (24, figure 1-5) is located to the right of the pilot on the center console. Indicated control lever positions are "OFF," "WIND," and "WIND & CABIN." Selection of the "WIND" position causes hot air to be directed against the windshield for defrosting purposes. Intermediate heat can be obtained by placing the control lever in any desired intermediate position.

CAUTION

Use of the "WIND" position is limited to emergency use only. If it is absolutely necessary to operate the defroster, apply heated air gradually to prevent cracking of the windshield.

RADAR OPERATOR'S COMPARTMENT

The radar operator's compartment is provided with a separate gasoline-fueled heating system. Fuel for the heater is supplied by the engine-driven fuel pump. The HEATER control panel (see figure 4-1) is located on the left-hand side of the centerline structure of the canopy. An ON-OFF switch and a thermostat control are provided. Use of the thermostat control permits regulation of the hot air at temperatures between 100°F and 250°F. Adjustable outlets for the hot air ducts, three on each side of the compartment, are located in the cable guards at the floor level. Another outlet is located at the aft end of the compartment on the overhead structure. With the heater control in the "OFF" position, cooling air is supplied through the heater ducts. To prevent operation of the heater when no air is being supplied through the intake duct, a safety switch on the left-hand landing gear renders the heater circuits inoperative when the weight of the aircraft causes compression of the shock strut. Furthermore, a thermoswitch will cause a break in the heater circuit if the hot air duct overheats to a temperature of approximately 325°F.

HEATER IGNITION SELECTOR SWITCH. Selection of alternate sets of ignition points for the heater is controlled by the heater ignition selector switch on the heater ignition unit labeled SOUTH WIND IGNITION UNIT, located in the aft compartment on the right-hand side above the oxygen bottle. The heater ignition selector switch has two positions, "1" and "2." Position "1" selects ignition points for normal operation. In position "2," an alternate set of ignition points is used when the other fails.

VENTILATING SYSTEM

PILOT'S COMPARTMENT

Ventilating air is received through an intake on top of the fuselage forward of the windshield (see figure 4-1). The main flow of ventilating air, routed to a diffuser outlet at the firewall, can be controlled by a VENT lever (21, figure 1-5) on the center console. The lever can be moved from full "OFF" to any position up to full "ON." In addition to the main ventilating air, two adjustable "eyeball" outlets, located one above the right-hand console and one above the forward end of the center console, receive a separate supply of air from the air intake.

RADAR OPERATOR'S COMPARTMENT

Ventilating air from the air scoop in the vertical stabilizer flows to a diffuser to cool the electronic equipment and the middle compartment. Two "eye-ball" outlets at the forward end of the overhead centerline structure can be adjusted to direct a portion of the air flow. Ventilating air also enters the compartment from two slotted ducts affixed to the canopy structure forward of the hatches. A VENT lever, located on the canopy centerline structure has two indicated positions, "ON" and "OFF," and can be turned to any intermediate position for control of the air flow through the slotted ducts to the compartment. Flow of vent air to the two "eye-balls" and the electronic gear is continuous.

DEFROSTING SYSTEM

Refer to HEATING SYSTEM, PILOT'S COMPARTMENT.

ANTI-ICING AND DE-ICING SYSTEMS

CARBURETOR ALTERNATE AIR. Icing of the carburetor air induction system can be prevented by use of the alternate air system. Select alternate air as follows:

a. Mixture control ..... "RICH"

b. Carburetor air switch ..... "ALTERNATE"

c. Mixture control ..... "NORMAL"

PITOT HEAT. Icing of the pitot and static boom heads is prevented by the use of electrical heaters. Turn the

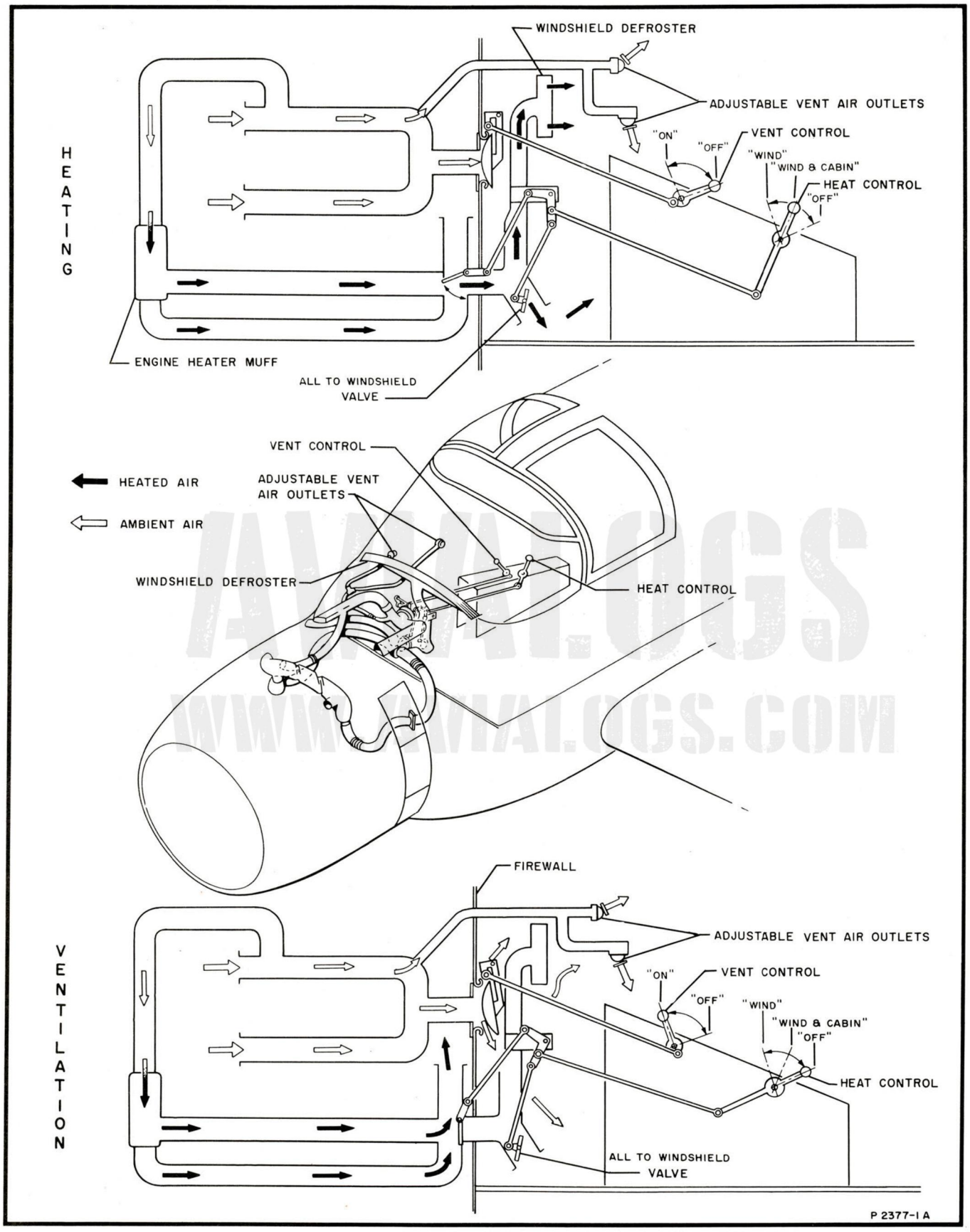


Figure 4-1. Heating and Ventilating System (Sheet 1)

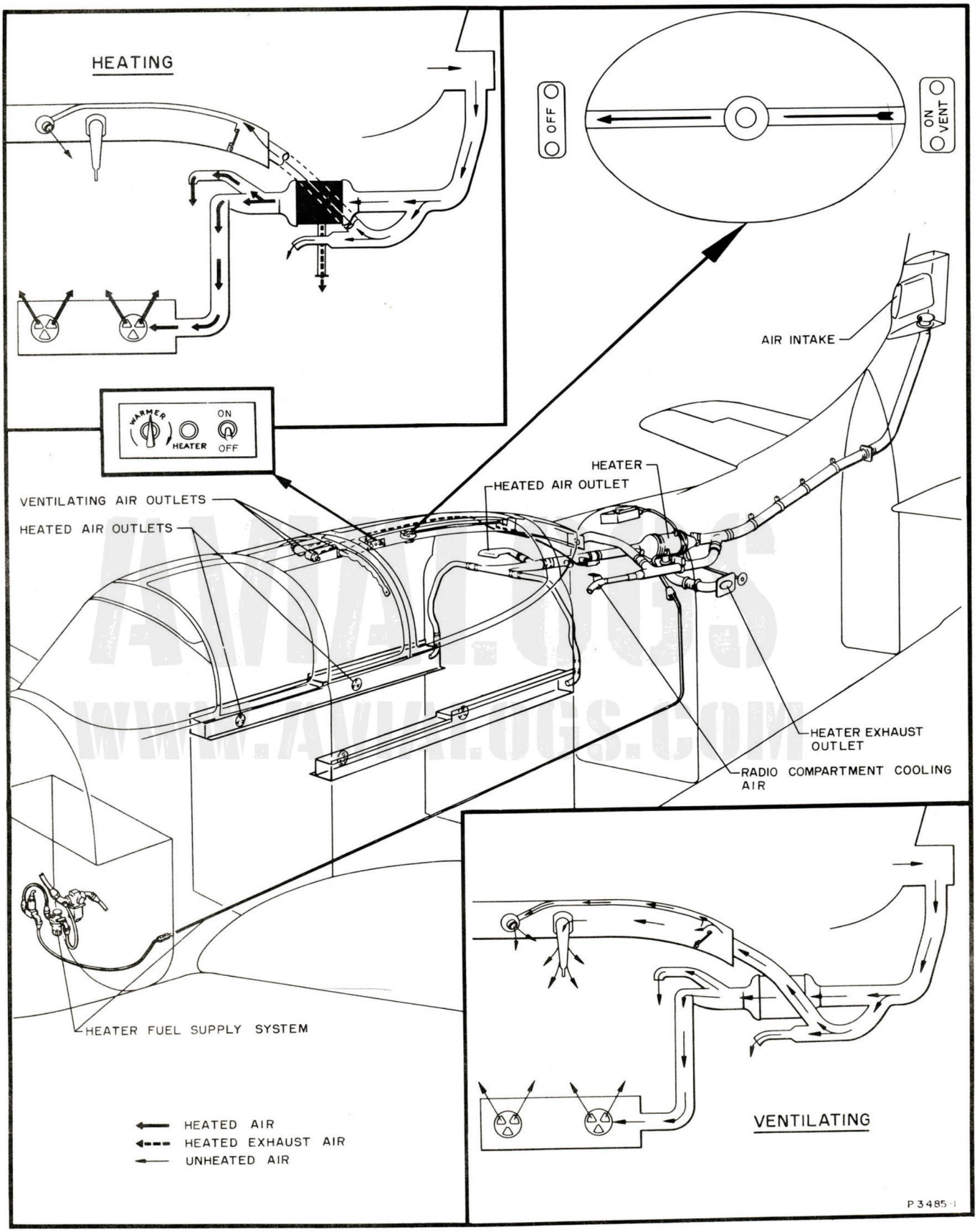
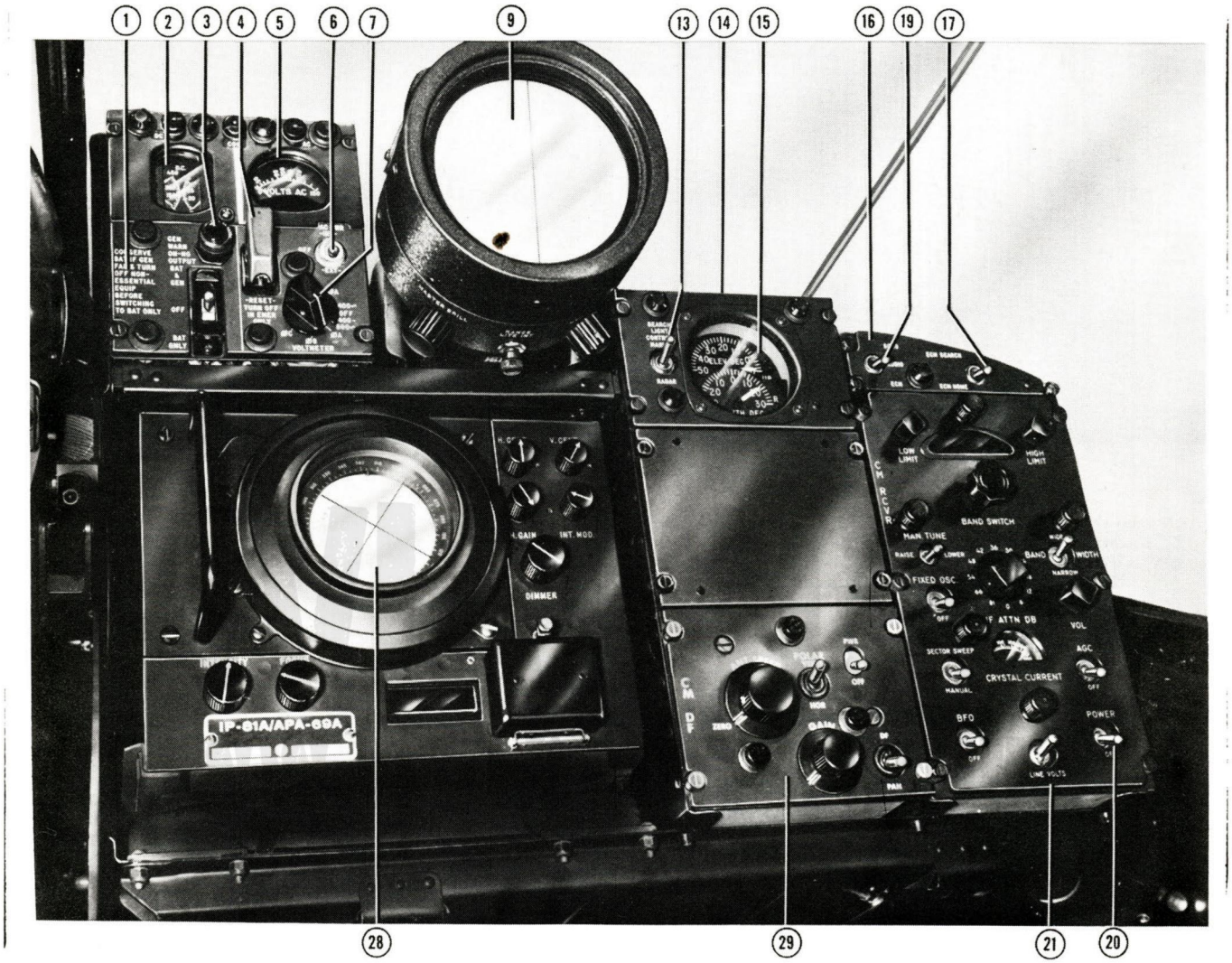


Figure 4-1. Heating and Ventilating System (Sheet 2)

1. Battery-generator switch
2. D-c voltmeter
3. D-c generator warning light
4. A-c generator switch
5. A-c voltmeter
6. A-c power switch
7. A-c phase selector switch
8. Bomb director control panel
9. ID-162A/APS-31 indicator
10. Target altitude indicator
11. Barometric pressure dial
12. Null test meter
13. Searchlight control manual-radar switch
14. AN/AVQ-2A searchlight control panel
15. Searchlight position indicator
16. ECM control panel
17. ECM Search-ECM Home switch
18. Accelerometer
19. Audio switch
20. AN/APR-9B power switch
21. C-654/APR-9B control panel
22. ID-226A/APR-9 control panel and indicator
23. Space provisions for C-817/APT-16 control panel and indicator
24. Bomb director power switch
25. Interior lights control panel
26. Non-flight instrument switches
27. Flight instrument switches
28. Azimuth indicator IP-81A/APA-69
29. Direction finder control

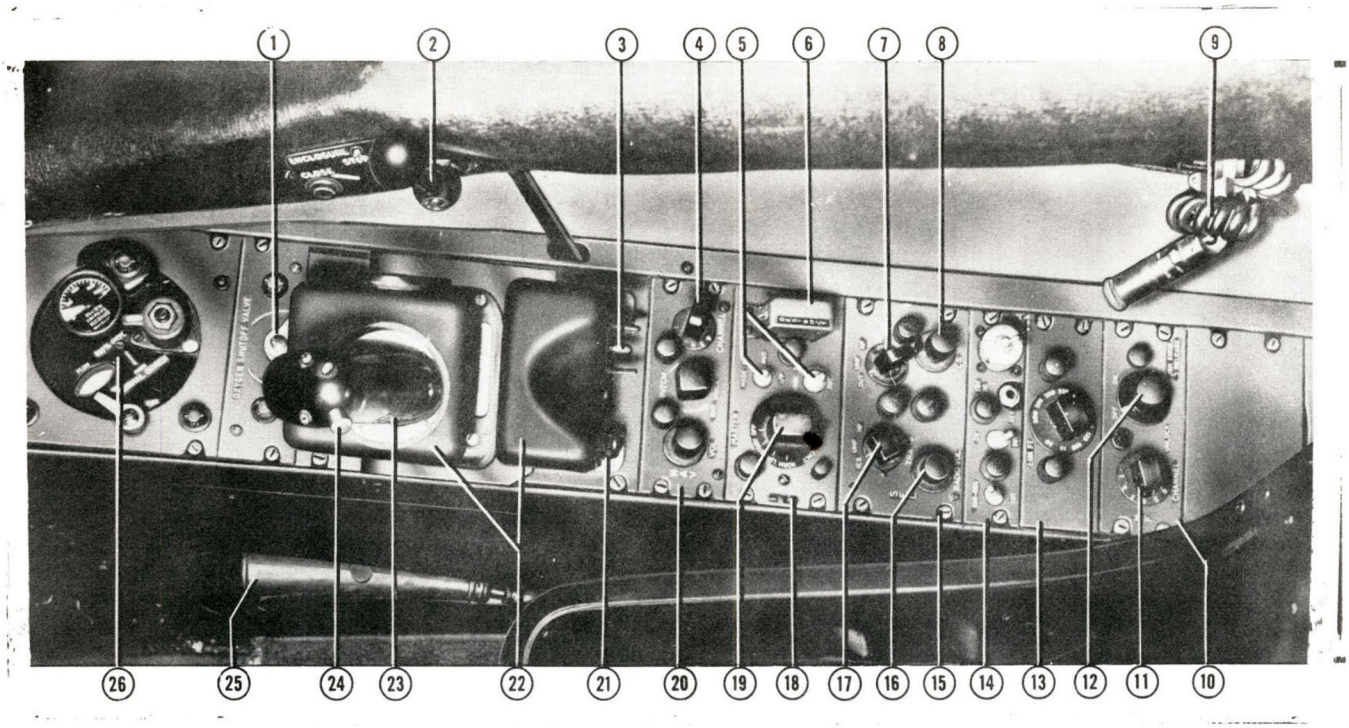
Airplanes prior to BuNo 134974 before service change

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



1. Battery-generator switch
2. D-c voltmeter
3. D-c generator warning light
4. A-c generator switch
5. A-c voltmeter
6. A-c power switch
7. A-c phase selector switch
8. Deleted
9. ID-162A/APS-31 indicator
10. Deleted
11. Deleted
12. Deleted
13. Searchlight control manual-radar switch
14. AN/AVQ-2A searchlight control panel
15. Searchlight position indicator
16. ECM control panel
17. ECM Search-ECM Home switch
18. Deleted
19. Audio switch
20. AN/APR-9B power switch
21. C-654/APR-9B control panel
22. Deleted
23. Deleted
24. Deleted
25. Deleted
26. Deleted
27. Deleted
28. Azimuth indicator IP-81A/APA-69
29. Direction finder control

BuNo 134974 and subsequent; prior aircraft by service change
Figure 4-2. Cockpit — ECM Operator's Instrument Panel (Sheet 2)



1. Oxygen shut-off valve
2. ECM operator's canopy control
3. AN/AVQ-2A start switch
4. AN/ARR-2A homing radio channel selector switch
5. AN/APX-6 IFF mode selector switches
6. AN/APX-6 IFF destructor switch
7. ECM operator's receiver-out switch
8. ECM operator's ICS volume control
9. Removable cockpit utility light
10. C-732/ARC-2 HF radio control panel
11. HF radio channel selector switch
12. HF radio power switch
13. AN/APN-1 radar altimeter control panel(1)
14. Navigation receiver switch panel

Airplanes prior to BuNo 132590

Figure 4-3. Cockpit — ECM Operator's Right Console (Sheet 1)

PITOT HEAT-OIL DILUTE switch (16, figure 1-5) to "PITOT HEAT" whenever there is the possibility of ice formation.

CAUTION

Pitot-static heat should not be used for more than a limited period of time while the aircraft is on the ground, as overheating will occur if there is no cooling airflow over the heated units.

COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT

All communications and electronics equipment installed in the aircraft are listed in the Table of Communications and Associated Electronics Equipment (see figure 4-4). A MASTER RADIO switch (11, figure 1-5) is located on the center console and controls power from the secondary bus to the AN/ARA-25 UHF ADF equipment, the AN/ARN-6 radio compass, the AN/ARR-2A navigation receiver, the AN/ARC-27A UHF communications equipment, and the AN/ARN-12 marker beacon equipment. The MASTER RADIO switch also controls power from the monitor bus to the AN/ARC-2 HF communications equipment. Other communications and electronic equipment is turned on at the associated control panels only. After service change No. 511 the AN/ARR-2A navigation equipment and the AN/ARN-12 marker beacon equipment will be removed from the aircraft. The AN/ARN-6 radio compass equipment will be replaced by the AN/ARN-21 (TACAN) equipment.

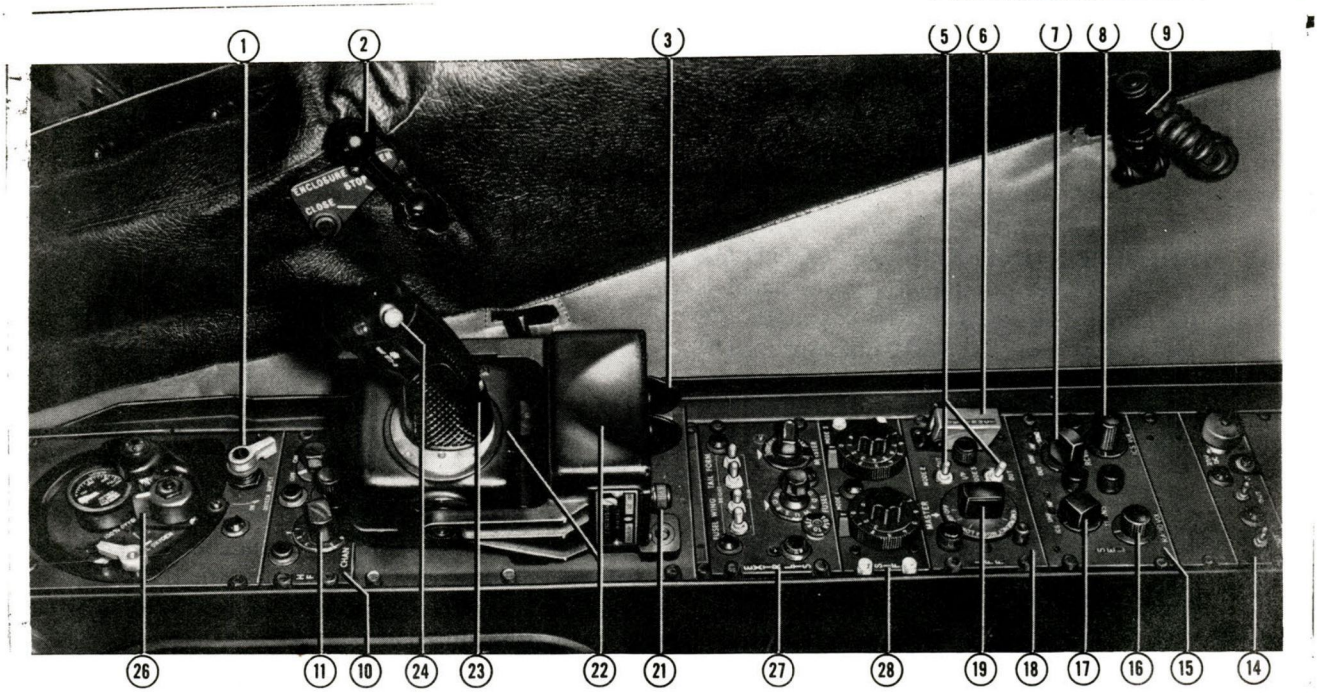
Note

During ground operations, the secondary bus will be energized by battery power if the engine is operated at an rpm which is below the d-c generator cut-in speed. During such operations, turn on only those units of the communications equipment as are necessary, in order to prevent excessive drain of the battery.

INTERPHONE EQUIPMENT

The AN/AIC-4A interphone provides communication between the pilot and crew members. The interphone equipment is not controlled by the MASTER RADIO switch and will begin operation following a one minute warm-up period when the battery-generator switch is switched to either the "BAT & GEN" or "BAT ONLY"

(1) Airplanes prior to BuNo 132486



15. C-736/AIC-4A ECM operator's interphone control panel
16. ECM operator's radio volume control
17. ECM operator's transmitter selector switch
18. C-629/APX-6 IFF control panel
19. AN/APX-6 master selector switch
20. C-738/ARR-2A homing radio control panel
21. Searchlight control panel light
22. AN/AVQ-2A searchlight control assembly
23. C-742/AVQ-2A searchlight handgrip control
24. ECM operator's bomb release switch
25. ECM operator's relief tube
26. ECM operator's oxygen regulator
27. Exterior lights
28. C-1272/APA-89 control panel(1)

BuNo 132590 and subsequent

Figure 4-3. Cockpit — ECM Operator's Right Console (Sheet 2)

position. Since the interphone equipment is connected directly to the primary bus, it will operate from battery power (or emergency d-c power(2)) in the event of d-c generator failure.

PILOT'S INTERPHONE CONTROL PANEL. A C-737/AIC-4A interphone control panel (5, figure 1-5) is located on the center console. This control panel contains the following controls: RADIO VOL control, ICS VOL control, HF SENS control, three RCVR-OUT switches with "UHF," "HF," and "SONO" positions (the "SONO" circuit is not presently connected to the control panel), and a TRANS switch with "UHF" and "HF" positions. The RADIO VOL control regulates the audio levels of all radio receiving sets other than the AN/ARN-12 marker beacon, the AN/ARN-6 radio compass, and the AN/ARR-2A homing receiver, which are regulated at their respective control panels. The pilot's ICS VOL control is used to adjust the audio level of the pilot's ICS reception.

The UHF and HF RCVR-OUT switches allow the pilot to select either or both the UHF or HF receivers. The TRANS switch is used to select either the UHF or HF transmitter for broadcast.

(1) Airplanes BuNo 134974 and subsequent; prior airplanes by service change

(2) Airplanes prior to BuNo 132528

Note

The audio level of the pilot's reception ICS can be adjusted by placing the throttle microphone switch in the "ICS" position and adjusting the volume of the side-tone to a comfortable level with the ICS VOL control. The crew may adjust their ICS audio reception with the ICS VOL control located on their respective interphone control panels.

ECM OPERATOR'S INTERPHONE CONTROL PANEL. A C-736/AIC-4A interphone control panel is located on the ECM operator's right-hand console (15, figure 4-3) and contains a RADIO VOL control, an ICS VOL control, a RCVR selector switch with "OUT," "UHF," "HF," and "SONO" positions, and a TRANS selector switch with "ICS," "UHF," and "HF" positions. The RADIO VOL control serves the same purpose as does the pilot's RADIO VOL control. The ICS VOL control adjusts the audio level of the ECM operator's ICS reception. The RCVR-OUT selector switch allows the ECM operator to select UHF, HF, and ECM receivers (the "SONO" circuit is not presently connected to the control panel, however, the ECM operator can receive audio signals from the AN/APR-9 ECM receiver in the "SONO" position if the "SONO-ECM" switch

(19, figure 4-2) is placed in the "ECM" position). The RCVR-OUT selector switch also incorporates an "OUT" position which enables all reception except ICS to be discontinued, if desired. The TRANS selector switch is used to select either ICS, UHF or HF transmitters for broadcast.

RADAR OPERATOR'S INTERPHONE CONTROL PANEL. A C-736/AIC-4A interphone control panel is located on the radar operator's left-hand console (7, figure 4-8) and differs from the ECM operator's interphone console panel only to the extent that the radar operator may not transmit on UHF or HF frequencies nor can he receive signals from the AN/APR-9B ECM receiver.

MICROPHONE AND HEADSET JACKS. The pilot's and crew members' microphones and headsets are connected to the oxygen supply tubes located to the left of each seat.

THROTTLE MICROPHONE SWITCH. The pilot's microphone switch is located on the throttle control lever. The two-position switch is pressed forward for "RAD" and aft for "ICS" transmission.

MICROPHONE FOOT SWITCHES. A microphone foot switch, labeled MIC SWITCH, is located on both the ECM operator's and radar operator's foot rests. The radar operator's foot rest also includes an ICS OUT switch which enables the operator to discontinue reception of ICS transmissions when desirable for tactical purposes.

UHF RADIO EQUIPMENT

The AN/ARC-27A radio equipment provides two-way voice communications with other aircraft or surface stations. The equipment can transmit or receive on any one of 1750 frequencies within a range of 225 to 400 megacycles. Transmission and reception are on the same frequency and through the same antenna.

UHF RADIO CONTROL PANEL. The C-1015/ARC-27A control panel (1, figure 1-5) is located on the cockpit center console panel and provides for remote tuning of the RT-178/ARC-27A transmitter-receiver. The control panel contains a VOL control, SENS control, function selector switch, CHAN selector switch, and a manual tuning control composed of three concentric dials. The VOL control is inoperative since the volume of the UHF receiver is controlled from the interphone control panels. The SENS control replaces the TONE-VOICE switch on earlier control panels and controls the pitch of the receptions. The function selector switch is used to place the set into operation and has four positions which provide for the following:

Position	*Function*
"OFF"	Set inoperative
"T/R"	Places transmitter in standby and main receiver in operation
"T/R + G REC"	Places transmitter in standby and main receiver in operation and permits monitoring of guard frequency
"ADF"	Places transmitter in standby and main receiver in operation and also places AN/ARA-25 direction finder system in operation through main receiver

The CHAN selector switch (2, figure 1-5) has 20 channel positions numbered 1 through 20, a guard channel marked "G" and a manual position labeled "M." The guard channel and the 20 channel positions can be preset to any desired frequency within the operating limits of the equipment. The manual position "M" is used in conjunction with the manual tuning control (29, figure 1-5) which allows the operator to manually select the desired frequency and to lock it into the guard channel or into any one of the 20 available positions. The manual tuning control consists of three concentric dials. The outer dial is used to select the first two digits of the desired frequency, the center dial is used to select the third digit of the frequency, and the inner dial is used to select the digit to the right of the decimal point.

OPERATION OF THE UHF RADIO

a. Turn the function selector switch to the operation desired.

b. Turn CHAN selector to channel number desired. If monitoring of guard frequency is desired the function selector switch must be placed in the "T/R + G REC" position. If transmission on guard frequency is desired, the CHAN selector switch must be placed in the "G" position.

c. If transmission and reception is desired on any frequency other than the preset frequencies and guard frequency, place the CHAN selector switch in the "M" position and select the desired frequency by use of the manual tuning control.

d. For operation on "ADF" refer to AUTOMATIC DIRECTION FINDING EQUIPMENT.

AUTOMATIC DIRECTION FINDING EQUIPMENT

The AN/ARA-25 automatic direction finding equipment operates in conjunction with the AN/ARC-27A UHF radio communication system to provide rough directional indication of the source of signals in the 225 to 400 megacycles band. Source indication in degrees of relative magnetic direction is provided by the number 1 needle of the ID-250/ARN course indicator (17, figure 1-4) for homing purposes when the UHF function selector switch is placed in the "ADF" position.

TABLE OF ELECTRONIC EQUIPMENT

TYPE	DESIGNATION	FUNCTION	PRIMARY OPERATOR	RANGE	LOCATION OF CONTROLS
COMMUNICATION					
UHF RADIO	AN/ARC-27A	SHORT RANGE-TWO WAY VOICE COMMUNICATION	PILOT	LINE-OF-SIGHT	COCKPIT CENTER CONSOLE
HF RADIO	AN/ARC-2	MEDIUM RANGE-TWO WAY VOICE COMMUNICATION	ECM OPERATOR PILOT AND	100 MILES	ECM OPERATOR'S RIGHT CONSOLE
INTERPHONE	AN/AIC-4A	INTER-COMMUNICATION	CREW	CREW STATIONS	PILOT AND CREW MEMBER STATIONS
NAVIGATION					
UHF-ADF	AN/ARA-25	DIRECTIONAL HOMING	PILOT	LINE-OF-SIGHT	COCKPIT CENTER CONSOLE
RADIO COMPASS	AN/ARN-6	DIRECTIONAL HOMING AND RANGE RECEIVING	PILOT	0-200 MILES	COCKPIT CENTER CONSOLE
TACAN	AN/ARN-21(3)	DIRECTIONAL HOMING AND DISTANCE MEASURING	PILOT	195 MILES	COCKPIT CENTER CONSOLE(5)
RADAR ALTIMETER	AN/APN-1(1)	INDICATES ALTITUDE ABOVE THE SURFACE	PILOT	4000 FEET	PILOT'S INSTRUMENT PANEL AND ECM OPERATOR'S RIGHT CONSOLE
RADAR ALTIMETER	AN/APN-22(2)	INDICATES ALTITUDE ABOVE THE SURFACE	PILOT	20,000 FEET OVER WATER 0-10,000FEET OVER LAND	PILOT'S INSTRUMENT PANEL
VOR-LOC-VAR	AN/ARN-14E	TONE LOCALIZER, OMNI DIRECTIONAL RANGE, VHF VISUAL AURAL RANGE, GENERAL COMMUNICATIONS	PILOT	LINE-OF-SIGHT	COCKPIT CENTER CONSOLE
MARKER RECEIVER	AN/ARN-12	RECEIVES AND INDICATES MARKER BEACON POSITION	PILOT	WITHIN MARKER BEACON SIGNAL PATTERN	
SONOBUOY RECEIVER	AN/ARR-26(3)	RECEIVES SIGNALS FROM SONOBUOYS	RADAR OPERATOR	20 MILES	RADAR OPERATOR'S COMPARTMENT
WIRE RECORDER	IC/VRW-7(3)	RECORDS COMMUNICATION AND SONOBUOY SIGNALS	RADAR OPERATOR		RADAR OPERATOR'S LEFT CONSOLE
RADAR					
SEARCH RADAR	AN/APS-31B	PROVIDES RADAR SEARCH AND RADAR BEACON RECEPTION	RADAR OPERATOR	LINE-OF-SIGHT	RADAR OPERATOR'S EQUIPMENT PANEL
RADAR COUNTER-MEASURES					
ECM RECEIVER	AN/APR-9B	DETECTS RADIO AND RADAR SIGNALS	ECM OPERATOR	LINE-OF-SIGHT	ECM OPERATOR'S INSTRUMENT PANEL
ECM DIRECTION FINDING	AN/APA-69A(3)	PROVIDES HOMING ON RADAR SIGNALS	ECM OPERATOR	LINE-OF-SIGHT	ECM OPERATOR'S INSTRUMENT PANEL
ECM JAMMING ATTACHMENT	AN/APT-16(3)	PROVIDES MEANS TO JAM RECEIVED RADAR FREQUENCIES	ECM OPERATOR	LINE-OF-SIGHT	ECM OPERATOR'S INSTRUMENT PANEL
CHAFF DISPENSPER	MX-900/A(3)	PROVIDES MEANS TO JAM AND DECEIVE ENEMY RADAR EQUIPMENT	RADAR OPERATOR	LINE-OF-SIGHT	RADAR OPERATOR'S LEFT CONSOLE
IDENTIFICATION					
IFF SET	AN/APX-6,-6B(4)	IDENTIFIES AS FRIENDLY	ECM OPERATOR	LINE-OF-SIGHT	ECM OPERATOR'S RIGHT CONSOLE
SIF	AN/APA-89(3)(4)		ECM OPERATOR	LINE-OF-SIGHT	ECM OPERATOR'S RIGHT CONSOLE
ARMAMENT					
RADAR BOMBSIGHT	AN/APA-16	LOW ALTITUDE BOMBING	RADAR OPERATOR	0-800 FEET	RADAR OPERATOR'S EQUIPMENT PANEL
SEARCHLIGHT	AN/APQ-2A	ILLUMINATES SURFACE TARGETS	ECM OPERATOR		ECM OPERATOR'S INSTRUMENT PANEL AND RIGHT CONSOLE

(1) BUNOS PRIOR TO 132486

(2) BUNO 132486 AND SUBSEQUENT

(3) PROVISIONS ONLY

(4) BUNO 134974 AND SUBSEQUENT

(5) AFTER SERVICE CHANGE

DATA AS OF: 1 August 1956 P-5000-1F

Figure 4-4. Table of Electronic Equipment

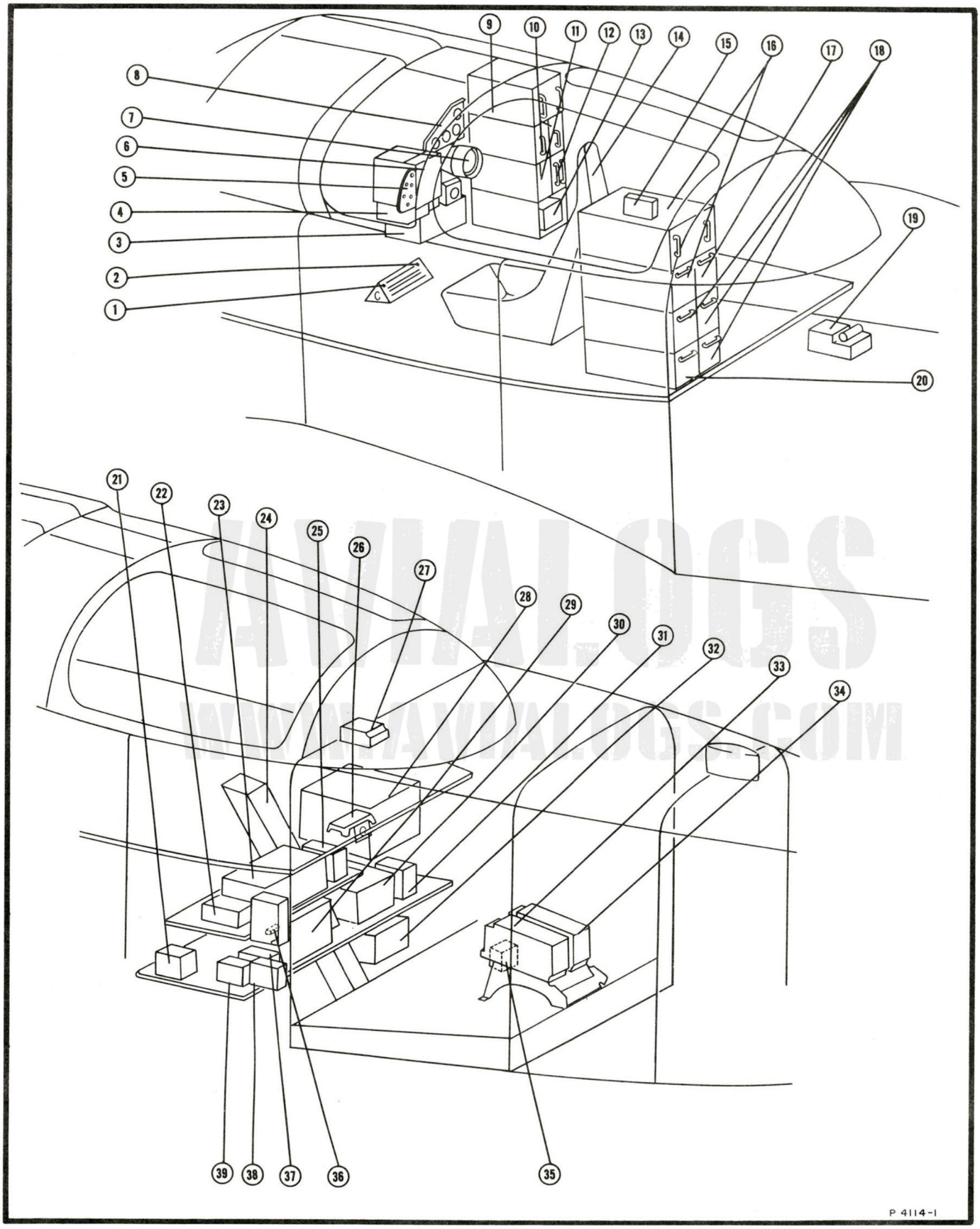


Figure 4-5. Electronic Equipment Location

Key to Figure 4-5.

1. ICS-OUT switch
2. Microphone foot switch
3. C-106/APA-16 Control unit
4. MX-139/APA-16 Capacitor unit
5. Armament panel
6. C-729/APS-31A Control panel
7. ID-162A/APS-31 indicator
8. Instrument panel
9. SN-36B/APS-31 Synchronizer unit
10. R-316/ARR-26 Receivers
11. C-610/ARR-26 Control unit
12. PP-468/ARR-26 Power supply unit
13. IC-VRW-7 Wire recorder
14. Radar operator's seat
15. TD-6/APA-16 Rocket adapter unit
16. PP-336/337/APR-9 Power supply units
17. CV-43/APR-9 Mixer amplifier unit
18. AN/APR-9B Tuner units
19. R-4A/ARR-2A Receiver unit(1)
20. SA-240/APA-70C Switch assembly
21. G-2 compass adapter
22. R-122/ARN-12 Marker beacon receiver
23. RT-9/ARC-2 Receiver-transmitter unit
24. Flare chute
25. AM-40A/AIC-4 Interphone amplifier
26. Automatic pilot turn and bank indicator
27. ECM Tuner switch assembly
28. RT-82/APX-6 Receiver-transmitter unit
29. RT-178/ARC-27A Receiver-transmitter unit
30. R-101/ARN-6 Radio compass unit or RT-220/ARN-21 Receiver-transmitter unit(3)
31. AM-608/ARA-25 Electronic control amplifier
32. RT-160/APN-22 Transmitter-receiver unit
33. Deleted
34. Deleted
35. Deleted
36. RE-120/ARA-25 Solenoid relay
37. TN-131/APR-9 Tuner unit
38. Automatic pilot amplifier adapter
39. P-1 Servo amplifier

CAUTION

The AN/ARA-25 is unreliable for general use as automatic direction finding equipment. 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.

OPERATION OF THE AUTOMATIC DIRECTION FINDING 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 (30, figure 1-6) is placed in the "ADF" position.

RADIO COMPASS EQUIPMENT

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 (4, 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. 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 position, "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."

(2)On later aircraft the control panel is labeled RADIO COMP, and a CW-VOICE switch and loop position control are added. A "LOOP" position on the function selector switch provides for directional positioning of the loop with the LOOP L-R switch.

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 loop and a long 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 radio compass indicator (17, 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.

(2)Operation of the RADIO COMP panel on later aircraft is the same as in the preceding instructions except for the following procedure: With the function selector switch on the "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 the 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 (17, figure 1-4), located on the pilot's instrument panel, is used in conjunction with the AN/ARN-6 radio compass, the AN/ARN-21 radio equipment (when installed), and the AN/ARA-25 automatic direction finding equipment as

(1)Airplanes prior to BuNo 134974

(2)Airplanes BuNo 132606 and subsequent

(3)After service change

an aid to navigation. The indicator face is a compass card which is slaved to the G-2 compass, and repeats the directional indications given by the latter. Two needle pointers are provided. The number 1 needle provides a visual indication of the direction of signals received by the AN/ARA-25 equipment, and the number 2 needle performs an identical function for the AN/ARN-6 or -21 radio compass.[1] To avoid confusion and erroneous readings, the two needle are interlocked to give a single indication when the AN/ARA-25 equipment is not in use. After service change the AN/ARN-6 radio compass equipment will be replaced by the AN/ARN-21 (TACAN) radio equipment.

CAUTION

When the AN/ARN-6 radio compass is receiving in a frequency range of 850 to 1750 kilocycles, the directional indication given by the number 2 needle of the ID-250/ARN course indicator will be 180 degrees in error if the AN/ARC-2 radio equipment is tuned to a channel frequency of 4000 kilocycles or higher, regardless of whether the AN/ARC-2 is "ON" or "OFF."

HF RADIO EQUIPMENT

The AN/ARC-2 HF radio equipment provides radio telephone communication between aircraft or between aircraft and surface stations in the frequency range of 2000 to 9050 kilocycles on any of eight preset frequencies.

HF RADIO EQUIPMENT CONTROL PANEL. The C-732/ARC-2 Control Panel (10, figure 4-3) is located on the ECM operator's right-hand console. It contains an OFF-ON switch to start and stop the equipment and a CHANNEL selector switch for the selection of any one of eight preset frequencies.[2]

OPERATION OF THE HF RADIO EQUIPMENT. Crew members are provided with control of the equipment as follows:

ECM Operator: Only the ECM operator can start and stop the equipment and select the preset frequencies:

a. Rotate the OFF-ON switch to "ON."

a. Turn the CHANNEL selector switch to the desired preset frequency.

c. Place the TRANS and RCVR switches to "HF" on the ECM operator's ICS control panel in order to transmit and receive on the HF radio system.

Pilot: To transmit and receive on the HF radio system, the TRANS and RCVR-OUT switches on the pilot's ICS control panel must be placed in the "HF" position.

Radar Operator: To receive on the HF radio system the RCVR switch on the radar operator's ICS control panel must be placed on "HF." No provision is made for the radar operator to transmit over the system.

CW OPERATION. A KEY jack and a CW-OUT switch are located on the ECM operator's right-hand console and a KEY jack is located on the radar operator's left-hand console. They provide for CW operation when the OFF-ON switch is "ON," and the desired frequency has been selected.

a. Insert key cord plug into the KEY jack.

b. Move the CW-OUT switch to "CW."

c. Equipment now ready for "CW" transmission.

MARKER BEACON EQUIPMENT

The R-122/ARN-12 marker beacon receiver is provided as a radio 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. A BEACON AUDIO switch[3] located on the pilot's instrument panel (5A, figure 1-4, sheet 3) enables the pilot to turn the aural signal off while retaining the visual. The system is energized when the MASTER RADIO switch is set to "ON." After service change when the AN/ARN-21 (TACAN) radio equipment is installed in the aircraft, the ARN-12 marker beacon equipment will be removed.

MARKER BEACON VISUAL INDICATOR. The marker beacon indicating light (10, figure 1-4) is installed on the pilot's instrument panel for visual presentation of the marker beacon code. The light is a "press-to-test" type.

HOMING RADIO EQUIPMENT[4]

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 (20, figure 4-3), labeled NAVIG, is on the right-hand 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 chan-

[1] Airplanes BuNo 132484 and subsequent
[2] In later aircraft a SENS (volume) control has been added
[3] Airplanes BuNo 135042 and subsequent
[4] Airplanes prior to BuNo 134975

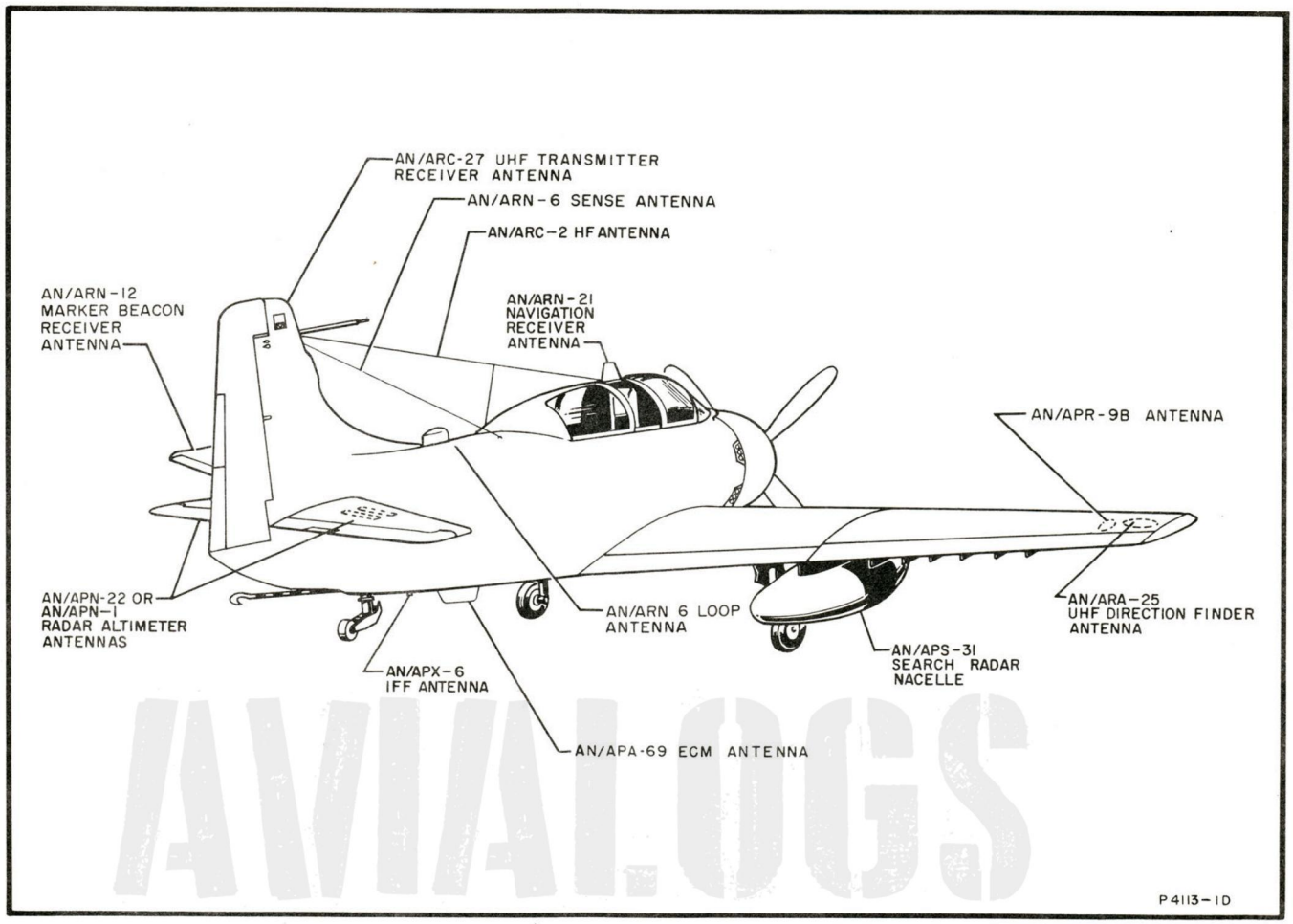


Figure 4-6. Antenna Location

nels. 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 ECM operator may monitor the pilot's audio reception by placing the NAV-REC switch in the "NAV-REC" position. After service change when the AN/ARN-21 (TACAN) radio equipment is installed in the aircraft, the AN/ARR-2A homing radio equipment will be removed.

AN/ARN-14E VHF RADIO[1]

Installation provisions are provided for the AN/ARN-14E radio. This omni range receiver is capable of receiving all transmissions in the 108.0 to 136.0 megacycle spectrum. It provides VOR, VAR and localizer signals. The ID-249 indicator provides VOR information and the number two needle of the ID-250 magnetic indicator gives visual indications of signal directions. After service change when the AN/ARN-21 (TACAN) radio equipment is installed in the aircraft, the AN/ARN-14E provisions will be removed.

AN/ARN-14E CONTROL PANEL. Controls for operation of the AN/ARN-14E radio are located on the C-760A marked VHF-NAV. The control panel contains a POWER ON TONE—OFF switch, VOLUME control, and a frequency selector.

AN/ARN-21 (TACAN) RADIO EQUIPMENT[1]

The AN/ARN-21 radio equipment provides to the aircraft a continuous indication of its bearing and range to any selected surface beacon which may be located within a line-of-sight distance from the aircraft up to 195 nautical miles. Components of the system include 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 AS-133/APX antenna, and a CV-279/ARN phase detecting network unit. Beacon identification signals are monitored through the radio headset; bearing indications are displayed on the ID-249ARN course

[1] Airplanes BuNo 134974 and subsequent

indicator and the #2 needle of the ID-250/ARN course indicator; range indications are displayed on the ID-310/ARN range indicator. D-c power is supplied through the radio bus and a-c power is supplied from either number one or number two inverter and the a-c generator.

AN/ARN-21 RADIO CONTROL PANEL. A C-866/ARN control panel marked NAV (32, figure 1-5) is located on the center console. The panel contains a power control switch with OFF, REC and T/R positions, two CHAN (channel) selector knobs and a VOL (volume) control knob. The right CHAN knob determines the single digit (or unit figure) of the channel number from zero to nine while the left 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 power switch is in the T/R position, each 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 the interrogation pulses and receiving the responsor pulses for range indications, and for receiving radial signals for azimuth indications.

ID-249/ARN COURSE INDICATOR. The ID-249/ARN course indicator (49, figure 1-4, sheet 4) provides a visual presentation of navigation information received by the AN/ARN-21 radio equipment. Components of the course indicator and their respective 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 selected beacon. 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 is inoperative in this aircraft. The white-circle pointer (a relative bearing indicator) presents the angular difference between the magnetic heading of the airplane and the course set into 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 provides a visual indication of the direction of signals received by the AN/ARN-21 equipment. When the needle is searching for the correct bearing, the pointer will rotate at a rate which prevents course readings. Reception for bearing indications beyond the normal 195 nautical mile operating range of the equipment is possible if atmospheric conditions are favorable.

ID-310/ARN RANGE INDICATOR. The ID-310/ARN range indicator (50, figure 1-4, sheet 4), associated with the AN/ARN-21 radio equipment, 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 indicator is "searching" for the correct range and a red bar will come into view which warns the operator against reading an incorrect distance indication. The red bar will also be visible when the indicator is inoperative.

Note

The slant range factor described herein is of significance only when flying at high altitudes and within a radius of ten nautical miles from the beacon. As an example: upon beacon passage at an absolute altitude of 24,320 feet, the indicator will read four nautical miles. Beyond 10 nautical miles, "slant range" need only be expressed as "range" during normal flight operations.

OPERATION OF AN/ARN-21 RADIO EQUIPMENT. Operation of the AN/ARN-21 radio equipment is controlled through the C-866/ARN control panel. When the master radio switch is "ON" and the AN/ARN-21 power switch is in the REC position, bearing information alone will be displayed. When the power switch is in the T/R position, both bearing and distance information is displayed. Channel selection is accomplished by turning the two CHAN knobs to the desired channel number. The volume of the identification signal is adjusted through the VOL control knob.

RADAR ALTIMETER (AN/APN-1)[1]

The AN/APN-1 radar altimeter gives an indication of the altitude of the plane above the surface to a height of 4000 ft. It is used to establish the correct altitude for dropping depth charges, bombs, mines and torpedoes, for low flying attacks at night or in adverse weather, and for instrument let-downs and approaches.

CAUTION

Radar altimeter readings are unreliable while the AN/ARC-27 transmitter is being operated.

[1] Airplanes prior to BuNo 132486

AN/APN-1 CONTROLS. Controls for operation of the AN/APN-1 radar altimeter are located on the indicator and on the altimeter control panel (13, figure 4-3) located on the ECM operator's right-hand console. The indicator contains an ON-OFF switch and a range switch which is used to select either low range (0-400 feet) or high range (0-4000 feet). The altimeter control panel contains a limit switch which works in conjunction with the indicator light or the indicator. The setting of the switch determines the altitude below which the indicator light will function. The limit switch is calibrated in increments of 25 feet on the low range and 250 feet on the high range.

CAUTION

Do not use high scale below 600 feet.

AN/APN-1 INDICATORS. Two AN/APN-1 indicators are installed; one on the pilot's instrument panel (6, figure 1-4, sheet 1) and one on the radar operator's panel (19, figure 4-7). The numerals 1, 2, 3, and 4 on the low range, and the numerals 10, 20, 30, and 40 on the high range are read as hundreds of feet.

AN/APN-1 ALTIMETER LIMIT INDICATING LIGHT. A red press-to-test light, labeled "RADIO ALT" (5, figure 1-4, sheet 2), is located on the pilot's instrument panel. The function of this light is to illuminate when the airplane is at a lower altitude than that preset on the altitude limit switch.

RADAR ALTIMETER (AN/APN-22)[1]

The AN/APN-22 Radar Altimeter is designed to provide reliable indications of altitude from 0 to 10,000 feet over land and from 0-20,000 feet over water. The accuracy of indication is plus or minus 2 feet from 0-40 feet, and plus or minus 5 percent of the indicated altitude from 40 to 20,000 feet.

HEIGHT INDICATOR. The ID-257/APN-22 height indicator (6, figure 1-4, sheet 3) 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 off and on and to select the limit altitude by adjustment of a bug pointer on the outside of the calibrated scale.

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 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, climbs and dives of 50° 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 (AN/APN-22)

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

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

c. Set the bug pointer to the desired altitude limitation with the ON-LIMIT switch.

d. To stop the equipment, turn the ON-LIMIT switch in a counterclockwise direction to its fullest extent.

SEARCH RADAR EQUIPMENT

The AN/APS-31B search radar equipment is designed for search and beacon operations and for low-altitude bombing operations when used in conjunction with the AN/APA-16 radar bombsight equipment. For search operation, signals from objects up to a distance of 200 miles are displayed on the radar scopes which are calibrated to provide correct range of targets. For beacon operation, signals from beacon stations are shown on the scopes for navigational purposes. Two ID-162A/APS-31 radar scopes are provided, one for the ECM operator or the pilot, and one for the radar operator. Controls necessary for the operation of this equipment are located on a C-729/APS-31A control unit (8, figure 4-7) located in the radar operator's compartment.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. Operating personnel must at all times observe safety precautions. Do not depend on interlock relays for protection, but always shutdown motor generators or other power equipment. Under certain conditions, dangerous potentials may exist in circuits with power controls in the "OFF" positions as the result of charges retained by capacitors, etc. To avoid casualties, always discharge and ground circuits prior to touching them.

PRE-START PROCEDURE. Before starting the equipment, the POWER control should be in the "OFF" position in order that certain controls may be preset. Adjust the controls on the C-729/APS-31A control panel as follows:

a. MASTER BRILL	Three-quarter turn clockwise
b. MKR BRILL	One-quarter turn clockwise
c. GAIN CONTRAST	"0"
d. TUNING	"5"

[1] Airplanes BuNo 132486 and subsequent

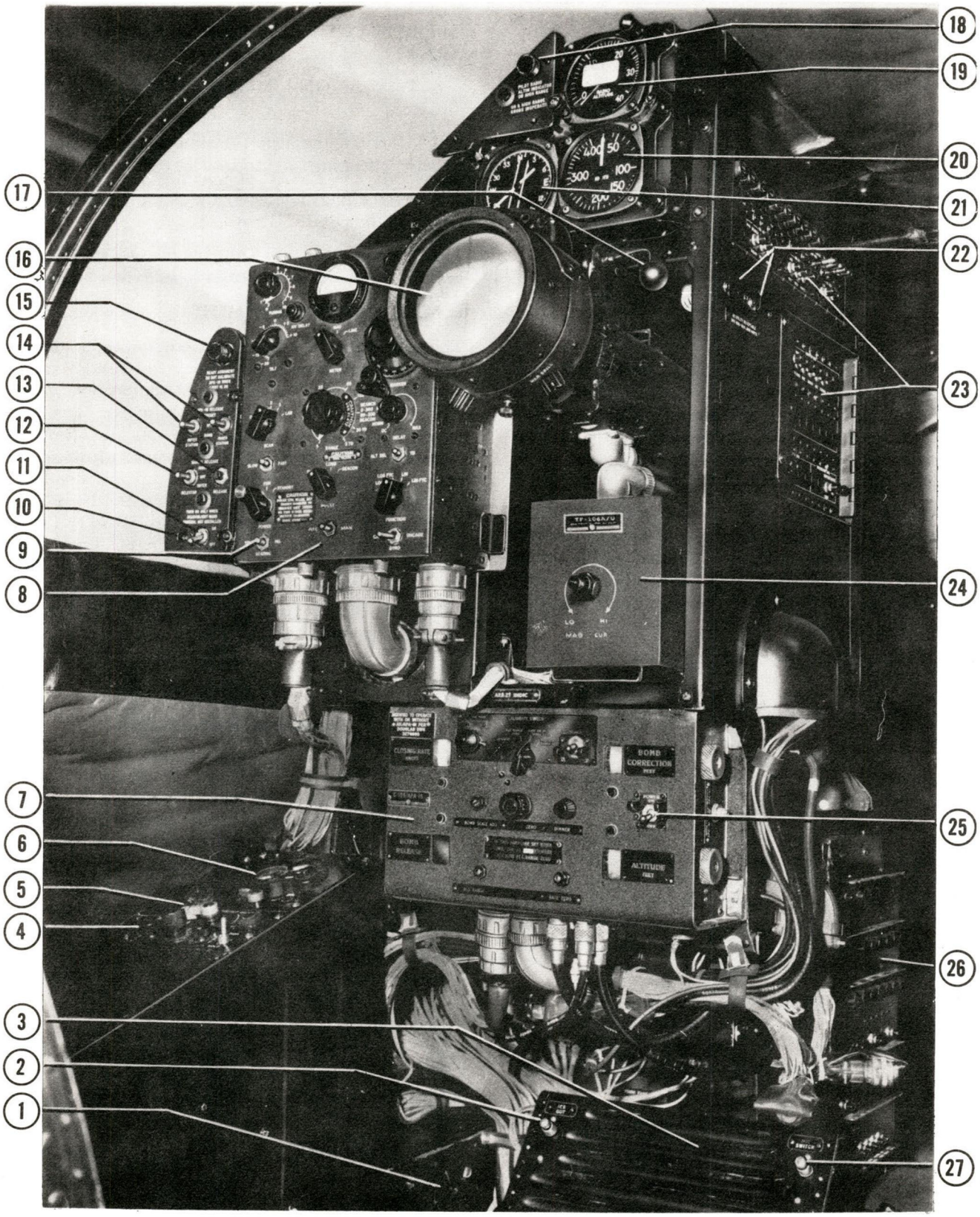


Figure 4-7. Radar Operator's Equipment Panel

Key to Figure 4-7

1. Ventilation outlet duct
2. ICS OUT switch
3. Radar operator's foot rest
4. C-907/A Chaff dispenser control panel
5. Oxygen shut-off valve
6. Oxygen quantity indicator
7. C-106/APA-16 control panel
8. C-729/APS-31A control unit
9. AN/APS-31B power control switch
10. Radar operator's armament control panel
11. Armament switch
12. Manual release selector switch
13. Manual release button
14. APA-16 release switches
15. Ready Armament warning light
16. ID-162A/APS-31 radar scope
17. Radar scope position locking lever
18. Radio altimeter high range warning light
19. AN/APN-1 Radio altimeter
20. Airspeed indicator
21. Radio magnetic compass indicator
22. A-c utility receptacles
23. Aft circuit breaker panels
24. TF-106A/U auto transformer
25. AN/APA-16 power switch
26. Terminal panel #34
27. Microphone foot switch

e. GYRO ..... "CAGE"
f. METER ..... "LINE"
g. MARKER ..... "0"
h. DELAY ..... "NORM"
i. TILT ..... "0"
j. SLOW-FAST ..... "SLOW"
k. PULSE ..... "SHORT"
l. AFC-MAN ..... "MAN"
m. RANGE ..... "25"
n. SCAN ..... "OFF"
o. ANTI-CLUTTER ..... "OFF"
p. MAG-CUR ..... "LO"
q. ALT DEL-TD ..... "TD"
r. FUNCTION ..... "LIN"

STARTING THE EQUIPMENT. Start the equipment according to the following procedure:

a. POWER CONTROL ..... "STANDBY"
b. MKR BRILL ..... VISIBLE POINTS
c. SCAN ..... "2"
d. METER ..... "MAG"
e. H V DELAY light ..... "OUT"
f. POWER CONTROL ..... "RUN"
g. MAG CUR ..... "6 MA"

STOPPING THE EQUIPMENT. To stop the equipment place the POWER CONTROL in the "OFF" position after caging the gyro.

EMERGENCY OPERATION OF THE EQUIPMENT. The equipment may be operated for short periods, even if the magnetron current should fall below, or rise above, its normal value, by adjusting the MAG CUR control to maintain normal current.

CAUTION

The PULSE switch must be placed in the "SHORT" position and the range control below "60" for three minutes after magnetron current is indicated on meter. The POWER switch should be temporarily placed in the "STANDBY" position when changing positions of the PULSE switch. The pilot should inform the radar operator when maneuvers are to be performed which exceed 60 degrees of pitch or roll, in which event the radar operator should place the GYRO switch in the "CAGE" position.

RADAR IFF EQUIPMENT

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

IFF CONTROL. A C-629/APX-6 control panel (18, figure 4-3) is installed in the right-hand console and is identified as IFF. The unit contains a rotary selector switch identified as MASTER with five designated positions: "OFF," "STDBY," "LOW," "NORM" and "EMERGENCY." Also included are two mode switches and a DESTRUCT switch which is guarded to prevent its being inadvertently actuated. The system is energized when the MASTER switch on the IFF control panel is set to any position other than "OFF."

DESTRUCTOR CIRCUIT. A destructor circuit is incorporated into the system for the purpose of destroying the RT-82/APX-6 receiver-transmitter to prevent its falling intact into enemy hands. Power for the destructor circuit is obtained from the battery bus through a 10-ampere circuit breaker installed in the right-hand circuit breaker panel and identified as IFF DESTR. On later aircraft,[1] the destructor circuit has been removed and the IFF equipment replaced by AN/APX-6B, a later high altitude version of the AN/APX-6.

CAUTION

Closing the DESTRUCT switch when the destructor circuit is energized by the battery bus will detonate the destructors in the RT-82/APX-6 receiver transmitter regardless of the MASTER switch setting.

AN/APA-89 EQUIPMENT.[1] Provisions are made for installation of the AN/APA-89 equipment.

ECM RECEIVING EQUIPMENT

An AN/APR-9B ECM receiver is used to detect radar

[1] Airplanes BuNo 134974 and subsequent

transmissions. An IP-81A/APA-69A indicator is provided to afford visual indication of the received signals and also serves to indicate the frequency to which the ECM receiver is tuned by means of a counter. All controls necessary to operate the equipment are located on the C-654/APR-9B control panel (21, figure 4-2), the IP-81A/APA-69A indicator (28, figure 4-2), and the ECM control panel (16, figure 4-2), all of which are located on the ECM operator's forward console.

STARTING AND STOPPING THE EQUIPMENT. The POWER-OFF switch (20, figure 4-2) located on the C-654/APR-9B control panel is used to start and stop the equipment.

WARNING

Application of power to the ECM receivers results in voltages that are dangerous to life. Adjustments and repairs which necessitate removal of the dust covers should be made only by qualified personnel who must observe applicable safety precautions.

ECM TRANSMITTING EQUIPMENT

The AN/APT-16 ECM transmitter, when used in conjunction with the ECM receiver, is designed to electronically jam radar and radio transmissions. The ECM transmitter is controlled by switches and controls located on a C-315/APT-16 control panel, which may be installed on the ECM operator's right-hand console in lieu of the C-742/AVQ-2A searchlight control, and on a C-817/APT-16 control panel which may be installed on the ECM operator's forward console to the left of the AN/APR-9B equipment.

STARTING AND STOPPING THE EQUIPMENT. The equipment may be started and stopped by the POWER-OFF switch located on the C-315/APT-16 control panel, however, the equipment should be started as follows:

a. C-315/APT-16 control panel—POWER switch in "OFF" position and TRANS A–STANDBY–TRANS B switch in "STANDBY" position.

b. C-817/APT-16 control panel — METER SELECTOR control in "MOD CUR" position; MOD LEVEL control in position "10"; and MOD CUR control in position "0."

c. C-315/APT-16 control panel—POWER switch in "ON" position.

WARNING

The application of power to the transmitter circuits results in very high voltages which are dangerous to life. Do not open equipment cases unnecessarily, and never disconnect high-voltage interlocks.

ECM HOMING EQUIPMENT[1]

The AN/APA-70C ECM homing equipment operates in conjunction with the ECM receivers to provide a directional visual indication of sources of radar and radio signals. Visual indication is provided by the ID-304/APA-70C indicator located on the pilot's instrument panel. This indicator contains a vertical needle that indicates direction of signal source and a horizontal needle that indicates signal strength. A weak signal will cause the horizontal needle to fall below the indicator horizon and a strong signal will cause the needle to rise above the indicator horizon. The horizontal needle will also indicate whether the airplane is flying to or from the signal source, as a strong signal is received when heading toward the source due to the forward location of the antennas.

STARTING AND STOPPING THE EQUIPMENT. The ECM homing equipment may be started and stopped as follows:

a. C-654/APR-9B control panel—Turn POWER-OFF switch to "POWER" position; adjust for maximum volume with VOL control; and place AGC-OFF switch in "AGC" position.

b. APA-70C control panel—Place ECM SEARCH-ECM HOME switch in "ECM HOME" position and place AUDIO switch in "ECM" position.

c. ID-304/APA-70C indicator—Turn ON-OFF switch to the "ON" position.

d. C-654/APR-9B control panel — Adjust the IF ATTN DB control to maintain the horizontal needle on the ID-304/APA-70C indicator as near to the indicator horizon as possible.

e. Alter heading of airplane until steady signal strength and direction of signals are obtained.

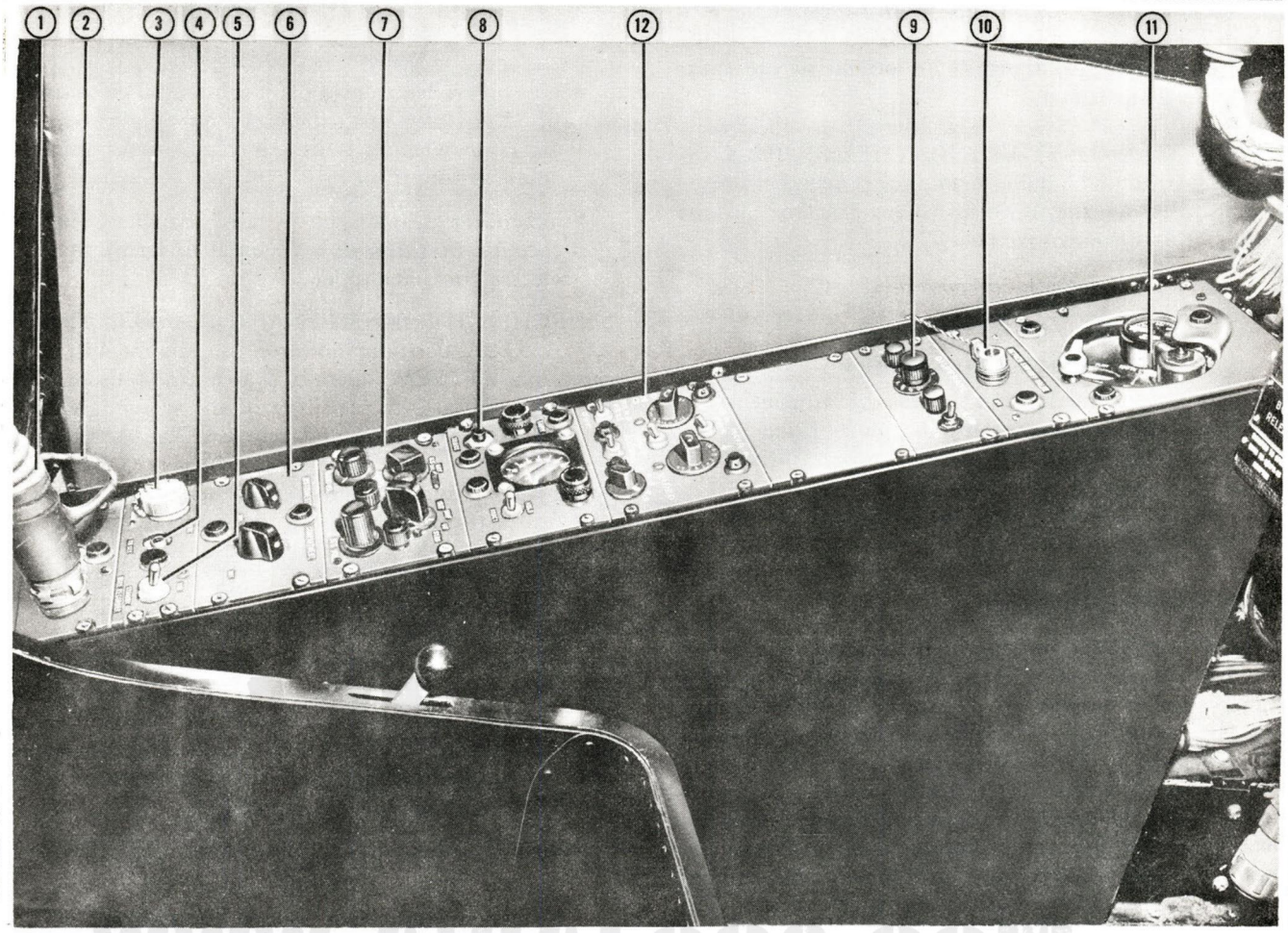
f. Stop the equipment by placing the POWER-OFF the "OFF" position, and the ON-OFF switch on the switch located on the C-654/APR-9B control panel in ID-304/APA-70C indicator to the "OFF" position. After service change when the AN/APA-69A equipment is installed in the aircraft, the AN/APA-70C equipment will be removed.

ECM DIRECTION FINDING EQUIPMENT[2]

The AN/APA-69 direction finder group when used with AN/APR-9B radar receiving set provides visual indications on its cathode-ray screen of the magnetic bearing of received radio and radar signals within the range of 1000 to 10,750 megacycles. The directional indication is converted to magnetic bearing by an azimuth scale rotating around the outer rim of the cathode-ray tube.

Control panel C-527/APA-69 includes the POWER switch which controls the primary power supply to the equipment; the ANT SPEED control, which adjusts the speed of antenna rotation; the POLAR switch, which selects antenna polarization (horizontal-vertical) when

[1] Airplanes BuNo 132636 and prior airplanes
[2] Airplanes BuNo 134974 and subsequent; prior airplanes by service change



1. Oxygen tube connector
2. Head phone cord
3. Anti-g suit connector
4. CW key plug
5. Wire recorder RUN-STANDBY switch
6. Instrument and compartment lights control panel
7. C-736/AIC-4A interphone control panel
8. Sonobuoy/flare dispenser control panel
9. C-907/A chaff dispenser control panel
10. Oxygen shut-off valve
11. Oxygen regulator
12. C-1414/ARR-26 control panel(1)

Figure 4-8. Radar Operator's Left Console

the lower frequency antenna is used; the GAIN control, which varies the sweep on the cathode-ray tube; and a PAN-DF selector. There are additional controls on the front of azimuth indicator IP-81A/APA-69 which may require adjustment from time to time. These are V CENT and H CENT, which shift the location of the display on the scope face; INT. MOD., which raises or lowers the level of the signal to produce a trace; INTENSITY and FOCUS which control the brilliance and focus of the trace.

STARTING AND STOPPING THE EQUIPMENT.
As soon as the craft is airborne, perform the following operations: Turn on the equipment by throwing the POWER switch on the direction finder control panel to "POWER." The ANT. SPEED control should be on "ZERO." Rotate the ANT. SPEED control until the rotator begins to spin, then advance to full speed. Be sure the intercept receiver is turned on. As a signal is received, adjust the GAIN control for a trace about one inch long. Set the POLAR control to the desired position, "HOR" or "VERT" as needed. The equipment is now ready for analysis of a desired signal. To secure the equipment, turn the ANT. SPEED control on the direction finder control panel to extreme counterclockwise position, or "ZERO." Turn the POWER switch to "OFF."

LOW ALTITUDE RADAR BOMBSIGHT EQUIPMENT

The AN/APA-16 low-altitude radar bombsight attachment is used in conjunction with the AN/APS-31B search radar to provide for low-altitude bombing of

(1) Installation provisions only

targets visible to radar equipment. The equipment can also be used for firing rockets from a level flight attitude. This equipment is controlled from a C-106/APA-16 control panel (7, figure 4-7) located in the radar operator's compartment.

STARTING AND STOPPING THE EQUIPMENT. The low-altitude bombing equipment may be started and stopped by the POWER switch located on the C-106/APA-16 control panel.

WARNING

To prevent inadvertent release of armament stores, adjustments should be made prior to turning the MASTER ARMT switch "ON." A red warning light (15, figure 4-7), is provided to indicate when the armament circuit is energized.

SEARCHLIGHT EQUIPMENT

An AN/AVQ-2A searchlight is installed in the nose of either the Aero 3A or Aero 3B searchlight/sonobuoy flare dispenser nacelles which can be mounted on the left inner wing bomb rack. The searchlight can be manually operated by the ECM operator and, when used in conjunction with the AN/APS-31B search radar equipment and the AN/APA-16 low-altitude bombing equipment, the searchlight can be automatically positioned by means of a radar adapter unit located in the tail cone of the searchlight/sonobuoy flare dispenser nacelle. The searchlight is controlled by a handgrip control unit located on the ECM operator's right console and an indicator is mounted on the ECM operator's forward console to indicate the position of the beam by degrees in azimuth and elevation.

SEARCHLIGHT CONTROL UNIT. Provisions have been made for the installation of a C-742/AVQ-2A handgrip control unit (23, figure 4-3) located on the ECM operator's right console. This control unit consists of the following controls:

a. HANDGRIP—The handgrip is used to manually control the vertical and horizontal movement of the searchlight. Moving the handgrip fore and aft controls the elevation of the searchlight. Rotation of the handgrip controls the azimuth of the searchlight. The handgrip contains a trigger switch and a bomb release switch. The trigger switch, when depressed, causes the batteries to be switched to series and turns on the searchlight. The bomb release switch energizes the AN/APA-16 low altitude bombing release system.

b. START SWITCH—The START switch has two indicated positions, "OFF" and "ON." In the "ON" position, the searchlight is placed in a standby condition until the trigger switch is depressed to operate the carbon arc lamp.

WARNING

- Carbon arc lamps give off a substantial amount of ultra-violet rays; therefore do not look at arc lamp when it is illuminated without suitable eye protection.
- Whenever searchlight is used, frequent inspection of batteries is essential to insure that electrolyte is at proper level.

SEARCHLIGHT POSITION INDICATOR. The ID-227/AVQ-2A position indicator (15, figure 4-2) is located on the ECM operator's forward console. This indicator indicates the position of the searchlight beam in degrees of elevation and azimuth. Mechanical stops restrict the elevation of the searchlight to 5 degrees above neutral and 45 degrees below neutral. Another set of stops restricts the azimuth of the searchlight to 27½ degrees either side of neutral. Adjacent to the indicator is the SEARCHLIGHT CONTROL switch (13, figure 4-2) which has two positions, "MANUAL" AND "RADAR." Selection of the "MANUAL" position allows the ECM operator to manually position the searchlight with the handgrip control unit. Selection of the "RADAR" position allows the AN/APS-31B search radar and the AN/APA-16 low-altitude bombing equipment to automatically position the searchlight on a target indicated on the radar equipment.

STARTING AND STOPPING THE EQUIPMENT.

Note

A manual reset type circuit breaker switch, identified as SEARCHLIGHT POWER, is installed in the aft fuselage area on the right side of the fuselage frame just below the insulating curtain. This circuit beaker protects the 76 volt d-c circuit which supplies the power to the searchlight carbon arc lamp and must be in the "SEARCHLIGHT POWER" position before the arc lamp will operate.

Start and stop the searchlight equipment in the following manner:

a. Engine speed at least 2000 rpm.

WARNING

Never operate the searchlight equipment unless the d-c generator is operating.

b. Battery-generator switch in "BAT & GEN" position.

c. MASTER ARMT switch turned "ON."

d. SEARCHLIGHT START switch turned "ON."

Note

Allow at least one minute for equipment to warm up prior to depressing trigger switch.

e. Depress trigger switch to illuminate carbon arc lamp.

f. SEARCHLIGHT CONTROL switch as desired, "MANUAL" or "RADAR."

g. To stop the equipment, make certain the SEARCHLIGHT CONTROL switch is in the "MANUAL" position, then place the SEARCHLIGHT START switch in the "OFF" position.

CAUTION

- Maximum continuous operation of the carbon arc lamp should be limited to 30 seconds, followed by a four and one-half minute delay before placing in operation again.
- Release trigger switch immediately if searchlight goes off during operation—wait several seconds and depress trigger switch again. If operation still remains intermittent, turn the equipment off.

SONOBUOY RECEIVING EQUIPMENT

Provisions are made for the installation of the AN/ARR-26 sonobuoy receiving equipment. The sonobuoy receiver system receives information from directional and non-directional sonobuoys for visual presentation on the ECM operator's and radar operator's AN/APS-31 radar indicators and aural presentation in the AN/AIC-4A interphone system. The AN/ARR-26 system consists of the following equipment: C-1414/ARR-26A control panel, R-316/ARR-26 or R-316A/ARR-26 receivers, MT-685/ARR-26 or MT-685A/ARR-26 receiver rack, AM-1007/ARR-26A amplifier, ECM-SONO audio switch, PP-468/ARR-26 power supply, and two vertically polarized, one-quarter wave length long antennas supported from the lower plating of the rear compartment.

SONOBUOY RECEIVING CONTROL PANEL. The C-1414/ARR-26A control panel (12, figure 4-8) is located on the radar operator's left-hand console. The control unit, identified as SONO, contains power control and controls for operation of the equipment.

ECM-SONO AUDIO SWITCH. The ECM-SONO audio switch (19, figure 4-2) located on the ECM operator's instrument panel connects the audio output of the AM-1007/ARR-26A amplifier to the ECM operator's AN/AIC-4A audio control circuit when in the "SONO" position. The amplifier audio output is connected at all times to the pilot's and radar operator's AN/AIC-4A audio control circuit.

OPERATION OF THE ARR-26 EQUIPMENT. Operation of the ARR-26 sonobuoy receiving equipment is achieved as follows: when the d-c and a-c power supply systems are energized, the AN/APS-31 search radar system is operating, and the AN/AIC-4A interphone system is operating, the ARR-26 equipment may be readied for operation by depressing two SONO REC circuit breakers (located on the aft circuit breaker panel) and placing the power switch of the C-1414/ARR-26A control panel in the "PWR" position.

SONOBUOY/FLARE DISPENSER

Provisions have been made for either the Aero 2A or Aero 3B sonobuoy/flare dispenser to be carried on the left inner wing bomb rack. The Aero 3B dispenser includes an AN/AVQ-2 searchlight within the nacelle. Both dispensers have a capacity of 18 AN/SSQ-2 sonobuoys and 16 Mk 5 drift signals or 18 Mk 5 parachute flares. (Before service change, the Aero 3B dispenser was designated Aero 3A and had provisions for sonobuoy and drift signal stores only.) The dispensers are designed to release both a sonobuoy and a drift signal simultaneously, except that drift signals can only be loaded in 16 of the 18 available stations. Combinations of sonobuoys, drift signals and parachute flares may be loaded if desired. A reel mechanism within the dispenser contains 18 stations, each of which may be selected by the radar operator through operation of a pickle-type SELECT switch located on the dispenser control panel in the radar operator's compartment. Stores carried in the sonobuoy/flare dispensers can be released by the pilot, however, the radar operator must first select the particular station on the dispenser and place the equipment in a ready condition before the pilot can release the store. The radar operator may also release stores carried in the dispenser by means of the aft armament panel, provided the pilot's armament switches are correctly positioned.

SONOBUOY/FLARE DISPENSER CONTROL UNIT. The sonobuoy/flare dispenser control panel (8, figure 4-8) is located on the radar operator's left console and contains the following controls and indicators:

a. Reel position indicator showing 1 to 18 stations. The 18 stations on this indicator correspond with the 18 reel stations in the sonobuoy/flare dispenser.

b. SELECT switch is a pickle-type switch and is used to select any of the 18 reel stations on the dispenser unit. Depressing this switch causes the dispenser reel to rotate to the next position. In this manner any reel station may be selected as desired for checking or for releasing. This switch will not release the sonobuoys or other stores loaded in the dispenser.

c. Reel capacity indicating light is labeled EMPTY and is used to indicate whether a particular reel station contains a store. If the reel station is empty the indicating light will be illuminated.

d. HOLD-OFF-READY switch is used to de-energize the release circuits during the time that a particular reel station is being selected and checked. In the "OFF" position, all dispenser circuits are de-energized. In the "HOLD" position, the SELECT switch can be pulsed to select a given reel station without allowing the pilot to inadvertently release stores contained in the dispenser. In the "READY" position, the pilot may release the particular store that has been selected.

e. A ready warning light is provided (15, figure 4-7) and is used to indicate that the release circuit is energized and that the pilot may now release the selected store. A similar warning light (36, figure 1-4) is provided for the pilot to indicate that the radar operator has completed his functions and that the sonobuoy and drift signal or parachute flare is ready to be dropped.

OPERATION OF THE SONOBUOY/FLARE DISPENSER.

a. PILOT. Place MASTER ARMT switch in "ON" position and inner station function selector switch (30, figure 1-4) in "SONO" position.

CAUTION

Be sure the LEFT INNER STATIONS selector switch is in the "OFF" position before operating the equipment.

b. RADAR OPERATOR. Place HOLD-OFF-READY switch in the "HOLD" position. Select the desired reel stations by use of the SELECT switch. If the EMPTY warning light is illuminated when a given reel station is selected, it indicates that the particular station is empty. When the desired station is selected, place HOLD-OFF-READY switch in "READY" position.

Note

In the "READY" position a warning light on both the pilot's and radar operator's panels will be illuminated to indicate that a store has been selected and is ready for release.

c. PILOT. When SONO-HOLD warning light (36, figure 1-4) is illuminated the sonobuoy or parachute flare may be released by depressing the bomb release button on the pilot's control stick grip.

Note

Depressing the bomb release button will release the selected sonobuoy or parachute flare and cause the dispenser reel to rotate to bring the next store into drop position. The next store can be dropped only by releasing the bomb release button and again depressing it. Only the MASTER ARMT switch and the inner station function selector switch are necessary to release stores carried in the sonobuoy/flare dispenser since the circuit is not connected to any other armament controls on the pilot's armament panel.

WIRE RECORDING EQUIPMENT

An IC-VRW-7 wire recorder (13, figure 4-5) may be installed on the lower shelf of the electronic equipment rack located on the right-hand side of the radar operator. Operating in conjunction with the interphone communications system, the wire recorder can be used to record signals received through the radar operator's ICS mixer control box. A WIRE RECORDER STANDBY-RUN switch (5, figure 4-8) on the radar operator's left console is used to place the wire recorder in operation when moved to the "RUN" position. When in the "STANDBY" position, the ICS mixer control box is cut out of the recording system, however the wire recorder may then be operated independently from the ICS system by inserting a push to talk-type carbon microphone into the face of the recorder. Depressing the microphone button will then start the recorder motor for independent operation.

Note

The equipment normally operates at a speed of 400 rpm which provides approximately 33 minutes recording time. Through a worm gear attachment, the reel speed may be preset to 200 rpm allowing twice the normal recording time.

LIGHTING EQUIPMENT

INTERIOR LIGHTS

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

INTERIOR LIGHTS CONTROL PANEL. A panel identified as INT LTS (6, figure 1-5) is located on the center console. This panel contains three rotary switches labeled FLT INST, NON-FLT INST, and CONSOLE. The switches are rotated clockwise out of the "OFF" position to turn on their respective lights. Brightness is controlled by further rotating the switches toward the extreme "BRT" position. The INT LTS switches control the lighting of the various instruments, panels and consoles.

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, making the warning lights difficult or impossible to see during daylight hours. Before daylight flights, determine that the FLT INSTR switch is "OFF."

COCKPIT FLOOD AND UTILITY LIGHTS

A dome light is installed on the cockpit canopy centerline structure above the pilot's right shoulder for 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-hand consoles. These lights can be removed from their brackets for use in other parts of the cockpit as desired. A rotating lens in each utility light allows selection of either red or white illumination.

FLOOD AND UTILITY LIGHTS CONTROL. The cockpit dome light and the two utility lights are turned

on by rotating out of the "OFF" position the FLT INST switch on the INT LTS panel. Only red illumination is gained from the dome light in this manner. The small utility lights will give red or white illumination depending upon the setting of the rotating lenses. Intensity of these three lights is not controlled through the INT LTS rheostat but by means of a toggle switch on the COCKPIT LTG panel associated with the dome light assembly. This switch can be placed on "BRT," "DIM" or "MED" to obtain the desired brilliance. In later aircraft,[1] control of both the dome light and the utility lights is effected through two switches located on COCKPIT LGT panel associated with the domelight assembly. A WHITE-OFF-RED switch selects either red or white light for the dome light, and at the same time turns on the two utility lights. When in the "RED" position the intensity of the dome light and utility lights is controlled by the BRT-MED-DIM switch. In the "WHITE" position the intensity of only the utility lights may be controlled. The "WHITE" position should be reserved for emergency use since the bright dome light may adversely affect the pilot's night vision.

Note

Care should be taken to set the rotating lenses of the two utility lights for red illumination before use of the FLT INST lights, to assure that the pilot's night adaption will not be destroyed.

COCKPIT EMERGENCY FLOOD LIGHTING. The cockpit can be flooded with white light from the dome light by turning the OFF-WHITE toggle switch on the COCKPIT LTG panel to "WHITE." Power for this light comes directly from the primary bus.

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 panel lights are controlled through a LIGHTS CONTROL panel (6, figure 4-8) located on the radar operator's left-hand console. The control panel contains two rotary type switches marked INSTRUMENTS and COMPARTMENT. These switches govern the intensity of illumination when rotated between the "OFF" and "BRT" positions. A dome light is installed overhead at the aft end of the radar operator's compartment. The switch for this dome light, identified as COCKPIT LTG, is on the left side of the 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 in either light. Associated with the dome light assembly is a panel containing jacks for a microphone and a headset, and a toggle switch labeled DORSAL COMPT LIGHTS. Refer to paragraph on SERVICE LIGHTS for effect of operation of this switch.

SERVICE LIGHTS

AFT FUSELAGE. Two service lights are located in the dorsal fuselage area aft of the radar operator's compartment. These lights are controlled through two three-way switches, one located on the radar operator's compartment dome light assembly and labeled DORSAL COMPT LIGHTS, and the other, labeled DORSAL FLOOD LIGHTS, on the aft fuselage light switch panel. The lights can be turned on or off from either location.

FORWARD FUSELAGE. A light is installed in the forward equipment and accessories compartment for use during non-flight servicing of the aircraft. The associated switch is on the light assembly.

EXTERIOR LIGHTS

The exterior lights system includes position, formation, and fuselage lights, and the approach light. Standard wing tip position lights are installed on the airplane, while the tail lights consist of one yellow and one white light mounted on each side and near the top of the vertical stabilizer. The formation lights consist of flush-mounted rectangular windows illuminated from within the airplane structure. These lights are situated one on each side of the fuselage just aft of and above the trailing edge of the wing, and one on the top and bottom of each wing tip trailing edge. The fuselage formation lights are yellow, while the wing tip formation lights are red and green similar to the position lights. The three fuselage lights are white and are located one on top of the fuselage aft of the canopy and one on each side of the fuselage aft of the trailing edge of the wing. The approach light is situated in the leading edge of the port wing. These lights all receive power from the secondary bus and are controlled through an exterior lights panel on the center console and a switch on the landing gear control panel.

EXTERIOR LIGHTS CONTROL. An EXT LIGHTS switch (14A, figure 1-3) on the landing gear control panel is used to turn the exterior lights off and on, and, when held in the "MOM" position, to give momentary operation. Functional operation of the lights is controlled through the EXTR LTS panel (27, figure 4-3) located on the right hand console. This panel contains four toggle switches labeled FUSEL (fuselage lights), FORM (formation lights), WING and TAIL (position lights). Each of these switches has three positions: "BRIGHT," "OFF," and "DIM." A rotary MASTER switch selects the function of the lights with the following positions: "MAN," "CODE," "FLSH" and "STDY." A lettered rotary switch, labeled FUSEL, is used for letter selection during automatic coding of the lights. A PUSH TO KEY switch and an associated monitor light are used for manual coding.

OPERATION OF EXTERIOR LIGHTS

The following chart lists, exclusive of approach light

[1] Airplanes BuNo 132537 and subsequent

operation, various combinations of exterior lights switch settings and the results thus obtained. It is necessary to turn the exterior lights switch located on the landing gear control panel, to the "ON" position prior to operating the exterior lights.

Switch	*Position*	*Results*
MASTER switch	"MAN"	Fuselage lights and monitor light flash with manual keying. Position and formation lights burn steadily.
FUSEL, WING, TAIL, FORM switches	"BRIGHT"	
Keying switch	Depress momentarily	
MASTER switch	"CODE"	Fuselage lights flash selected code letter. Position and formation lights burn steadily.
FUSEL code letter selector	Any letter	
FUSEL, WING, TAIL, FORM switches	"BRIGHT"	
MASTER switch	"FLSH"	Fuselage and yellow tail lights flash alternately with wing position and white tail lights. Formation lights burn steadily.
FUSEL, WING, TAIL, FORM switches	"BRIGHT"	
MASTER switch	"STDY"	All exterior lights burn steadily.
FUSEL, WING, TAIL, FORM switches	"BRIGHT"	

Note

- When FUSEL, WING, TAIL and FORM switches are on "DIM," all lights perform as above but with less brilliance.
- The formation lights are designed to emit an extremely dim lighting even in the "BRIGHT" position. During daylight they require careful checking to determine whether or not they are working.

APPROACH LIGHT OPERATION. The approach light circuit is energized from the secondary bus through the EXT LIGHTS switch, a tail hook micro-switch, a landing gear micro-switch and through a manually operated tail hook by-pass switch. During normal operations the approach light will function automatically whenever the EXT LIGHTS switch is in any position other than "OFF." The following chart lists approach light indications for such operations:

Wheels	*Hook*	*Approach Light*
Locked down	Down	Steady
Locked down	Not down	Flash
Not locked down	Any position	Off

TAIL HOOK BY-PASS. An APPROACH LIGHT switch located in the left wheel well can be used to by-pass the tail hook micro-switch to allow use of the approach light during night field carrier landing practice. Pressing the switch momentarily to the "TAIL HOOK BY-PASS" position will cause the approach light to be illuminated steadily whenever the landing gear is down and locked, even though the tail hook is up. Normal operation of the system is regained whenever the tail hook control handle is put in the "DOWN" position or the battery-generator switch is turned "OFF."

Note

When the TAIL HOOK BY-PASS switch is in use or the tail hook control is down, the yellow light will not flash.

SPARE LAMPS. A receptacle for the stowage of spare lamps is located in the right-hand console.

AUTOMATIC PILOT

A P-1 Automatic Pilot, electrically powered by the monitor bus and the number two inverter, is installed in the aircraft. Directional flight reference for the automatic pilot is established by the G-2 compass gyro; the roll and pitch flight references are established by the gyroscope in the gyro-horizon. In addition, an electrically driven turn and bank indicator (26, figure 4-5) located in the electronic equipment compartment, provides the references needed to produce co-ordinated turns when the airplane is maneuvered through the automatic pilot. All controls for the normal operation of the automatic pilot are on a single control panel on the center console. In addition, an emergency handle for mechanically disconnecting the auto-pilot from the control system is provided.

AUTOMATIC PILOT CONTROL PANEL. Selection of power, engagement of the auto-pilot and subsequent trimming and control of the aircraft is accomplished through the AUTO PILOT control panel (9, figure 1-5). The FLT INSTR PWR SEL switch is turned to "INVERTER 2 & AUTO PILOT" to energize various components of the auto-pilot system. A clutch switch, labeled PUSH AUTO-PILOT ON is used to engage the AUTO PILOT after it has been warmed up. The controller, located in the center of the AUTO PILOT PANEL, provides controls for bank and pitch trim and for maneuvering the aircraft through the auto-pilot. A control switch (8, figure 1-6) labeled RUDDER TRIM is located on the pilot's automatic pilot control panel and has two positions, "FWD" and "AFT." In the "AFT" position the radar operator is able to control the directional trim of the aircraft through the auto-pilot during bombing runs by means of DIRECTIONAL TRIM LEFT-RIGHT control located on the radar operator's instrument panel. The "FWD" position permits control of the auto-pilot from the front cockpit only.

AUTOMATIC PILOT PRE-FLIGHT CHECK

a. With the battery-generator switch at "BAT & GEN," the generators charging, and the FLT INSTR PWR SEL switch on "INVERTER 2 & AUTO PILOT," allow at least two minutes for the gyros to come up to speed and for other components of the system to warm up. Erect the gyro-horizon by first caging and then uncaging.

Note

The automatic pilot clutch switch is interlocked with the caging mechanism of the gyro horizon so that the auto-pilot cannot be engaged whenever the gyro is caged. Also, should the gyro be accidentally caged while the auto-pilot is in operation, the clutches will be automatically disengaged, returning the airplane to manual operation.

b. Center the surface controls and engage the auto-pilot by depressing the clutch switch.

c. Operate the surface controls manually. Resistance to movement will indicate an operative auto-pilot.

d. Move the turn control, pitch trim control and bank trim control and observe corresponding surface controls to see that their movement is in proportion to adjustment at the controller.

e. Pull out on the clutch switch. The auto-pilot should release, as indicated by normal manual operation of controls.

f. Turn the FLT INSTR PWR SEL switch to "INVERTER 1" for taxi and take-off.

IN-FLIGHT OPERATION

TO ENGAGE

a. Erect the gyro-horizon as needed.

b. With the G-2 compass switch in the "CONTROL" position, cage the directional gyro and set indicator (outer dial) to agree with the magnetic indicator reading (inner dial). Hold the indicator in this position for at least two seconds and then release straight out.

WARNING

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

c. Turn the FLT INSTR PWR SEL switch to "INVERTER 2 & AUTO PILOT."

d. Allow two minutes for the amplifier to warm up.

e. Center the turn-control knob in its detent position; also center the pitch-trim control and the bank-trim adjustment on the controller.

f. Trim the airplane in the desired attitude of flight.

g. Engage the automatic pilot by pressing the clutch switch in.

CAUTION

Do not engage the automatic pilot while in a turn, or in climbs, dives or banks of more than 10 degrees.

OPERATION DURING FLIGHT

a. To climb, turn the pitch-trim control counterclockwise "UP."

b. To dive, turn the pitch-trim control clockwise "DOWN."

c. To trim bank, turn the BANK-TRIM adjustment clockwise to raise the left wing; counterclockwise to raise the right wing.

d. To turn or to trim course, displace the turn-control knob out of its central detent position until the desired heading is obtained. To return to straight flight, the turn-control knob should be centered.

Note

Generally, when flying the automatic pilot, it is well to retrim the airplane in manual flight every hour.

WARNING

Do not adjust trim tabs while the automatic pilot is engaged.

TO DISENGAGE. The return to manually controlled flight is achieved by pulling out the clutch switch.

EMERGENCY RELEASE. If the auto-pilot malfunctions to the point where it jams the controls, complete mechanical disengagement can be accomplished by pulling out the emergency release handle (12, figure 1-5) which is located above the forward end of the center console.

Note

After the emergency release has been pulled, the automatic pilot cannot be used until the mechanical servo disconnects have been re-engaged.

As a last resort, the auto-pilot can be overpowered by strong application of the manual surface controls.

OXYGEN SYSTEM

Provisions are made for the installation of three oxygen cylinders of 514 cubic inch capacity each, located aft in the fuselage. Composite diluter-demand type oxygen regulators are installed for the pilot, ECM operator and the radar operator and are located on their respective consoles. All oxygen cylinders can be refilled through a single filler valve located on the upper right fuselage bulkhead at the aft end of the radar operator's compartment.

DURATION OF OXYGEN SUPPLY. The number of man-hours of oxygen available for various combinations of oxygen pressure and altitude may be obtained from the oxygen duration chart. (See figure 4-9.) The chart is based on the installation of one cylinder only used by one crew member. To obtain the total number of hours available per man, multiply the figure given in

OXYGEN DURATION

MAN-HOURS PER CYLINDER

ALTITUDE FEET	AIR VALVE	GAGE PRESSURE P.S.I.								
		1800	1600	1400	1200	1000	800	600	400	BELOW 300
30,000	NORMAL	3.9	3.4	2.9	2.3	1.8	1.3	0.8	0.2	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	100% OXYGEN	3.9	3.4	2.8	2.3	1.8	1.3	0.8	0.2	
25,000	NORMAL	4.5	3.8	3.3	2.7	2.1	1.5	0.8	0.3	
	100% OXYGEN	2.7	2.3	1.9	1.6	1.2	0.9	0.5	0.2	
20,000	NORMAL	5.5	4.8	4.0	3.3	2.6	1.8	1.1	0.3	
	100% OXYGEN	1.9	1.7	1.4	1.1	0.9	0.6	0.4	0.1	
15,000	NORMAL	6.2	5.4	4.5	3.7	2.9	2.1	1.2	0.4	
	100% OXYGEN	1.4	1.2	1.0	0.8	0.6	0.5	0.3	0.1	
10,000	NORMAL	6.1	5.2	4.4	3.6	2.8	2.0	1.2	0.4	
	100% OXYGEN	1.1	0.9	0.8	0.6	0.5	0.3	0.2	0.1	
5000	NORMAL	4.5	3.9	3.3	2.7	2.1	1.5	0.9	0.3	
	100% OXYGEN	0.7	0.6	0.5	0.4	0.3	0.2	0.1	0.1	

REMARKS:

(1) Do not exhaust supply below 300 psi except in an emergency.
(2) Figures given are based on the assumption that the oxygen cylinders are operationally empty at 300 psi.
(3) To compute hours of oxygen available per man, multiply the figures given in the chart by the number of cylinders installed in the aircraft, and divide by the number of crew members using oxygen.

EXAMPLE:

(1) Given: Normal Oxygen
Oxygen pressure . . . 1400 psi
Altitude . . . . . 20,000 feet
Crew of three
Two oxygen cylinders

(2) Result:

$$\frac{4.0 \times 2}{3} = 2.67 \text{ hours per man}$$

P5028-1

Figure 4-9. Oxygen Duration Chart

the chart by the number of cylinders installed, and divide by the number of crew members being supplied from the system.

OXYGEN SYSTEM CONTROLS

OXYGEN SHUT-OFF VALVES. Oxygen shut-off valves are installed adjacent to the pilot's, ECM operator's, and radar operator's regulators for positive shut-off of the flow of oxygen to the regulators when the system is not in use.

OXYGEN REGULATOR. Each regulator incorporates a pressure gage, a diluter valve for selection of either "NORMAL OXYGEN" or "100% OXYGEN," a flow indicator, and a lever marked SAFETY PRESSURE for selection of emergency flow of oxygen under pressure.

OXYGEN EQUIPMENT OPERATION

OXYGEN PRESSURE GAGE. Whenever the cylinders are fully charged, the pressure reading will be 1800 to 1850 psi. The cylinders are operationally empty at 300 psi.

DILUTER VALVE. In the "NORMAL OXYGEN" position of the diluter valve, diluted oxygen is supplied upon demand. The amount of dilution decreases as the altitude of the airplane is increased up to 30,000 feet. Above 30,000 feet, 100 percent oxygen is supplied automatically. Turning the valve to "100% OXYGEN" causes undiluted oxygen to be supplied upon demand, regardless of the altitude.

SAFETY PRESSURE LEVER. By turning the SAFETY PRESSURE lever "ON," oxygen is delivered under pres-

sure through the diluter valve to the mask. Safety pressure shall be used at all times above 35,000 feet. Routine use of safety pressure at lower altitudes is not recommended since such use reduces the effectiveness of the air diluter and causes increased oxygen consumption.

CAUTION

In order to utilize the safety pressure feature of this type oxygen regulator, it is necessary to use the type A-13 or A-13A Pressure Breathing Oxygen Mask.

WARNING

The SAFETY PRESSURE lever must be turned "OFF" whenever the oxygen mask is not in use, otherwise there will be a continuous flow of oxygen from the regulator which will exhaust the supply and in the presence of oil or grease will cause a violent explosion.

PRE-FLIGHT CHECK. The following items should be checked before flights in which oxygen is likely to be used, to assure proper functioning of the oxygen system.

a. SAFETY PRESSURE ..... "OFF"

b. OXYGEN SHUTOFF VALVE ... "ON"

c. Oxygen pressure gage ..... Maximum 1800 to 1850 psi

Note

If cylinder pressure has decreased more than 50 pounds in 24 hours, the leakage is excessive and the system should be repaired.

d. Check leak tightness of the oxygen connections, breathing tube, regulator diaphragm and diluter check valve as follows:

1. Blow into the open end of the oxygen tube until the flow indicator face opens.
2. Seal the open end of the oxygen tube with the tongue.
3. If the flow indicator does not close within five seconds, the leakage is within acceptable limits.

Note

If leakage is indicated, check the oxygen tube and breathing tube hose clamps for tightness. If leakage still persists, the regulator must be replaced.

e. Put on the mask. Check the mask fit by placing the thumb over the end of the mask tube and inhale lightly. If there is no leakage the mask should adhere tightly to the face and a definite resistance to inhalation should be encountered. If the mask leaks, tighten the mask suspension straps. DO NOT USE A MASK THAT LEAKS. The characteristics of the A-13A mask exhalation valve are such that with the breathing tube sealed by the thumb after the first inhalation, the exhalation valve may remain open. In testing, release the thumb after each inhalation.

f. Fully engage the mating portions of the disconnect coupling to connect the mask to the oxygen tube.

g. Use the alligator-jaw clamp to fasten the breathing tube to the shoulder harness. It is particularly important that the clip be high on the chest, otherwise movement of the head would cause the breathing tube to stretch or compress.

h. Breathe several times with the regulator air valve in both "NORMAL OXYGEN" and "100% OXYGEN" positions to check regulator operation and observe the flow indicator for "blink," verifying the positive flow of oxygen.

IN-FLIGHT CHECK. The following should be checked frequently while oxygen is being used:

a. Oxygen pressure gage for supply remaining.

b. Oxygen flow indicator for proper functioning of system.

c. Breathing tube connection for security.

Note

In the event of a loss of radio communication, check to see that the breathing tube is properly connected to the console receptacle. Headset and microphone connections are tied-in with this attachment.

EMERGENCY CONDITIONS

a. Should symptoms occur which suggest the onset of anoxia, immediately turn the SAFETY PRESSURE lever on the regulator to "ON," the diluter valve to "100% OXYGEN," and descend to below 10,000 feet. If for any reason the regulator should become inoperative and a constant flow of oxygen is not obtainable by the use of safety pressure, activate the oxygen bailout equipment, if available, and descend as rapidly as possible to below 10,000 feet.

b. Whenever excessive carbon monoxide or other noxious or irritating gas is present or suspected, regardless of altitude, the diluter valve should be turned to "100% OXYGEN" and undiluted oxygen used until the danger is past or the flight is completed.

CAUTION

Use of safety pressure does not give undiluted oxygen except when above 30,000 feet or when the diluter valve is on "100% OXYGEN."

Note

Do not exhaust supply cylinders below 300 psi except in an emergency.

ARMAMENT EQUIPMENT

All rockets, bombs, and other droppable stores are

carried externally. Twelve Aero 14D-2 or Aero 14E racks are hung beneath the outboard wing panels for mounting rockets and/or bombs, while three bomb racks, one on each inboard wing panel and one on the centerline of the fuselage, are used for mounting bombs, rockets, torpedoes, mines or other stores. In addition to the external armament, four M-3 20-mm guns are installed in the wings. Control of all armament is effected through the pilot's armament panel and, when special stores are carried, through additional control panels necessary to operate and release the type of store carried. The radar operator has limited control of the releasing of external stores through the radar operator's armament control panel (10, figure 4-7), however, the radar operator may not release stores unless the pilot has turned the MASTER ARMT switch to the "ON" position and selected the store to be released. External stores can be jettisoned manually or electrically.

MASTER ARMAMENT SWITCH. A MASTER ARMT switch (46, figure 1-4) controls the operation of all armament equipment. Unless this switch is in the "ON" position, no armament circuits can be energized. A safety feature in the armament circuit causes the MASTER ARMT switch, which is a circuit breaker type, to open whenever the landing gear is extended. When the airplane is on the ground this safety circuit can be bypassed for checking of the armament system by momentarily closing a DISABLING SWITCH (see figure 4-12) located in the left-hand wheel well. Raising the landing gear or turning the battery-generator switch "OFF" will restore the armament safety circuit for normal operations.

Note[1]

Because of the armament safety circuit, the landing gear cannot be used as a speed brake during any maneuver entailing the use of armament equipment.

The armament DISABLING SWITCH will be removed from the wheel well location and installed on the hydraulic by-pass panel (31, figure 1-3) on the aft end of the left hand console by service change. This change allows pilot operation of the switch, and permits the armament bus to be energized while the landing gear is down for use as a dive brake. Operation of the switch is the same as explained previously in this paragraph.

GUNNERY EQUIPMENT

Four forward firing 20-mm guns are mounted in the wing panels, one on each side of each wing fold joint. A gun sight is provided which may also be used as a bomb and torpedo sight. Provisions have been made for mounting a gun camera in the leading edge of the wing, inboard of the inboard right-hand gun.

GUN SIGHT

A Mk-20 Mod-4 illuminated gunsight (8, figure 1-4) is installed above the pilot's instrument panel. The sight is bore-sighted parallel to the armament datum line of the aircraft.

MIL ADJUSTMENT CONTROL. A mil adjustment knob (7, figure 1-4) provides the pilot with a positive lead adjustment of 340 mils and a negative lead adjustment of 65 mils. An adjustable pointer is provided as a further aid in sight setting. Incorporated into the sight are adjustable detents which permit easy selection of mil settings required by specific tactical maneuvers. These detents should be set on the basis of sighting data given in applicable armament tables. To adjust the sight, turn the "0" on the adjustment knob up for a positive setting, down for a negative setting.

Note

Any adjustment in excess of 200 mils should be avoided as such may result in contact between the windshield and the sight reflector plate.

RETICLE CONTROLS. Reticle selection is accomplished by rotating the reticle control knob (9, figure 1-4) located directly above the crash pad on the gunsight. Three different reticles are available: the night reticle, for use when target visibility is reduced; the day reticle, used for better image visibility against a light background; and, the combination reticle, used under conditions of reduced visibility which exist at dawn, twilight, or overcast periods. The night reticle consists of a pip, partially enclosed by two 90 degree arcs located on a 50 mil radius, and is illuminated through an orange-red filter to protect the pilot's night vision. The day reticle illuminates circles of 50 and 100 mils for air-to-air gunnery, and incorporates a "ladder" reference scale

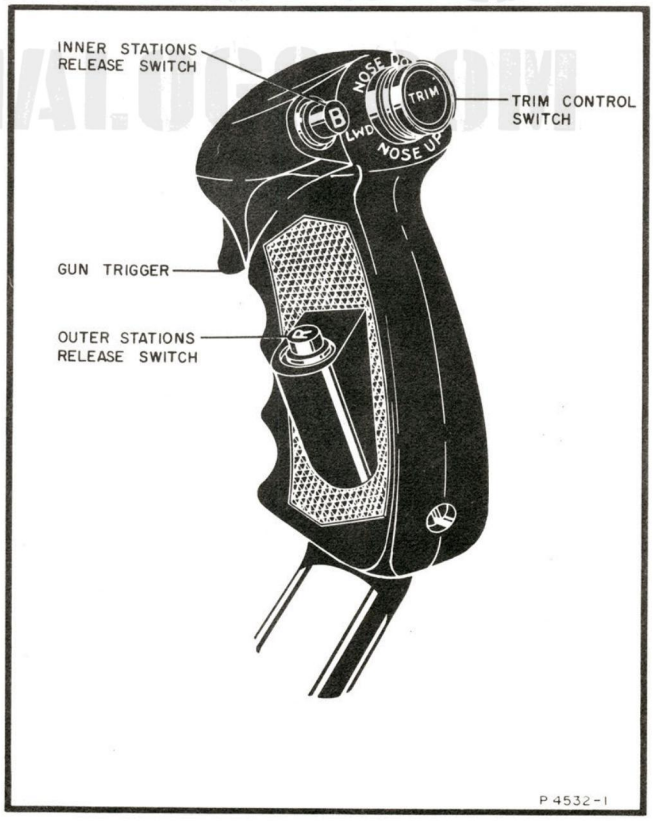


Figure 4-10. Control Stick Switches

[1] Before service change

in 10 mil graduations for rocket firing, strafing, and bombing operations.

GUNSIGHT SWITCHES. A GUNSIGHT light selector switch and rheostat (40, 41, figure 1-4) are located on the pilot's instrument panel. Rotating the rheostat clockwise from the "OFF" position turns the light on and increases the intensity of the light in the gunsight. The selector switch is primarily left in the "NORMAL" position. If this light burns out or is inoperative, another filament can be turned on by moving the selector switch to "STANDBY." The gunsight will be ready for operation when the MASTER ARMT switch is placed in the "ON" position.

Note

The gunsight cannot be ground checked unless the armament disabling switch in the left-hand wheel well is depressed to de-activate the armament safety switch on the landing gear lever.

GUN CAMERA

AN AN-N6A gun camera can be installed in the right inboard wing and operates when the gun firing switch (see figure 4-10) or the outer station release switch (see figure 4-10) is depressed. An adjustable overrun stop within the camera case automatically allows the camera to operate up to five seconds after actuation. The gun camera may be tested by means of the momentary GUN CAMERA TEST SWITCH located in the right wing in the gun camera access compartment.

GUN FIRING CONTROLS

GUN FIRING SWITCH. The trigger-type gun firing switch is located on the pilot's control stick grip.

GUN CHARGING SWITCHES. Two GUNS switches (43, figure 1-4) are used to charge the guns or to place them on safe. The left-hand switch controls the two inboard guns and the right-hand switch the outboard guns. A safety circuit will override the operation of these switches and cause the breech blocks to be retracted to the safe position if the tail hook is lowered.

TO FIRE THE GUNS:

a. MASTER ARMT switch ..... "ON"

b. GUN SWITCHES ..... "OFF" to "SAFE" to "READY"

c. GUN FIRING SWITCH ..... Squeeze trigger

WARNING

In the event a stoppage occurs during the firing of the guns, the gun charger shall not be operated in an attempt to clear the stoppage. Charging shall be accomplished only for the purpose of readying or safetying the guns.

BOMBING AND ROCKET FIRING EQUIPMENT

A bomb ejector rack is installed on the fuselage center-line station. In addition, the three inner stations are designed for the installation of either Mk 51 or Aero 61A bomb racks. When utilizing the Mk 51 bomb rack, the 14-inch suspension may be used for a load under 2000 pounds; the 30-inch suspension, requiring the use of Aero 1A adapters, shall be used for an external load of 2000 to 3500 pounds. The two inner wing racks are each capable of carrying one 2000-pound store or one torpedo, while the center line rack has a maximum capacity of 3500 pounds. Bombs weighing up to 500 pounds can also be carried on the Aero 14D-2 or Aero 14E racks of the outer wing panels. Rockets can be carried on the outer wing racks or on the two inner wing bomb racks. In addition to suspension of rockets directly on the racks, rocket packages can be hung on any of these stations for increasing the fire-power of the airplane.

BOMB EJECTOR. The bomb ejector rack, which is installed on the fuselage center line station, is designed to displace the bomb from the airplane to clear the propeller sufficiently during steep dive bombing. The bomb ejector circuit should be tested prior to each flight where use of the bomb ejector is anticipated. This test may be accomplished in the following manner:

a. MASTER ARMT switch ..... "OFF"

b. Battery-generator switch ..... "BAT & GEN" or "BAT ONLY"

c. BOMB EJECTOR TEST SWITCH ..... "CARTRIDGE TEST"

Note

If test lamp on the BOMB EJECTOR TEST PANEL lights, the circuit is complete. If it does not light, continue with the check.

d. BOMB EJECTOR TEST SWITCH ..... "LAMP TEST"

Note

If the test lamp now lights, the bomb ejector cartridge circuit is open and cartridge should be replaced. If the lamp does not light, the lamp is probably defective and should be replaced.

e. If it has been necessary to replace the lamp, repeat bomb ejector system check. If the lamp now fails to light in the "CARTRIDGE TEST" position, the cartridge circuit is open and should be checked.

BOMB AND ROCKET RELEASE SWITCHES. There are five separate switches that are used to release bombs and to fire rockets from the airplane. These switches are as follows:

a. Two pickle-type switches (see figure 4-10), one labeled B and one labeled R are located on the pilot's control stick grip. Switch B is used to release stores loaded on the inner stations and switch R is used to release stores loaded on the outer stations.

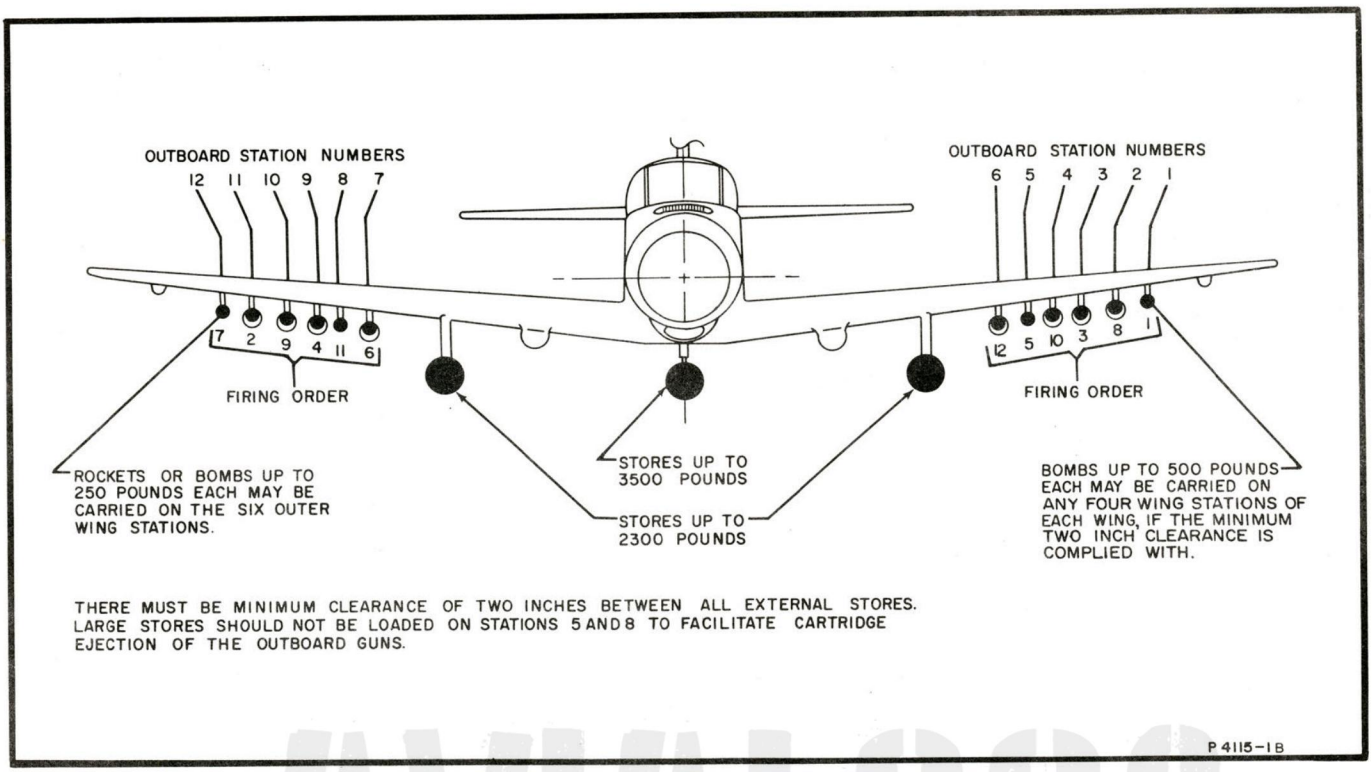


Figure 4-11. External Stores

b. A pickle-type switch (24, figure 4-3) is located on the ECM operator's searchlight control grip and is used to energize the AN/APA low-altitude bombing equipment from the cockpit.

c. A toggle-type armament switch (11, figure 4-7) is located on the radar operator's armament panel and is used to energize the AN/APA low-altitude bombing equipment from the radar operator's compartment.

d. A MANUAL RELEASE switch (12, figure 4-7) is located on the radar operator's armament panel and is used to manually release stores from the radar operator's compartment.

Note

Although the crew members are provided with a means of releasing stores, the pilot must have first placed the MASTER ARMT switch "ON" and selected the other necessary armament switches located on the pilot's armament panel before the crew members can actually effect release of certain stores.

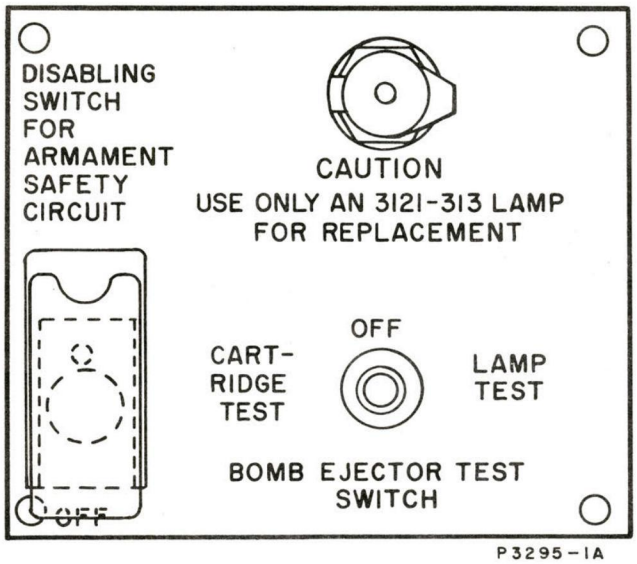


Figure 4-12. Bomb Ejector Test Panel

INNER STATION FUNCTION SELECTOR SWITCH. A function selector switch (30, figure 1-4) is located on the pilot's armament panel. Four positions are provided in order to operate or release stores carried on the inner station racks. To drop any type store loaded on the inner station racks, the switch must be rotated to the "BOMBS" position. If spray tanks are to be operated or flares are to be released, the selector switch must be rotated to the "SPRAY-FLARES" position, except that when parachute flares are to be released from the Aero 2A or Aero 3B sonobuoy/flare dispenser, the inner station function selector switch must be placed on the "SONO" position. Rotating the switch to "ROCKET PACKAGES" will allow ripple fire of rockets from packages installed on the inner wing racks.

INNER STATION SELECTOR SWITCHES. Three INNER STATION selector switches (29, figure 1-4) are located on the pilot's armament panel and are used to individually select any of the three inner station racks.

If the INNER STATION switches are positioned in the "LEFT," "CENTER," and "RIGHT" positions, all stores on the inboard stations will be salvoed when the pickle switch labeled B on the control stick is depressed, regardless of the setting of the intervalometer switches. If the three switches are placed in the "TRAIN BOMBS" and the intervalometer switch (34, figure 1-4) is placed in the "SINGLE PULSE" position, the stores will be released singly in the sequence left, right, and center, one each time the bomb pickle switch is depressed. If, however, the intervalometer switch is placed in the "INTERVAL" position, the release sequence will be at the rate selected on the RELEASES PER SECOND selector switch. Each of the INNER STATIONS selector switches may be placed in the "OFF" position to hold the store on the bomb rack while other bombs are being released.

CAUTION

Whenever a sonobuoy/flare dispenser is installed, be sure the LEFT INNER STATIONS switch is placed in the "OFF" position before turning "ON" the MASTER ARMT switch.

BOMB ARMING SWITCH. Bombs on all stations are armed by means of the ARM BOMBS switch (33, figure 1-4) located on the pilot's armament panel. Selection of "TAIL" or "NOSE & TAIL" arming is possible. The switch can be centered on "SAFE" for releasing stores unarmed.

EMERGENCY RELEASE HANDLES. Handles located beneath the armament control panel are for emergency jettisoning of stores, except rockets, on all bomb racks. The CENTER WING BOMB REL handle (44, figure 1-4) is used to jettison stores on the three inner stations. (In earlier aircraft,[1] this control is labeled EMERG BOMB SALVO REL.) Associated with this handle is another control labeled WING RACKS—PULL TO LOCK (47, figure 1-4). Use of this control locks the inner wing racks so that the centerline store only may be jettisoned. On later aircraft,[2] this control is labeled CENTER STATION—PULL TO LOCK and has the reverse function of locking the centerline rack and allowing stores on the other two inner wing racks to be jettisoned by pulling the CENTER WING BOMB REL handle. A third handle, labeled OUTER WING BOMB REL (31, figure 1-4) is used to jettison all stores on the outer wing racks, except rockets.

WARNING

Emergency and station release cable shall be periodically inspected for sufficient slack at bomb ejector emergency release lever to prevent inadvertent release of store.

[1] Airplanes prior to BuNo 132500
[2] Airplanes BuNo 132504 and subsequent
[3] Airplanes BuNo 132515 and subsequent

[3] OUTER STATIONS FUNCTION SELECTOR SWITCH. The outer stations function selector switch is located on the pilot's armament panel (36A, figure 1-4). This switch has three positions, "BOMBS," "OFF," and "ROCKETS." It must be placed in either "BOMBS" or "ROCKETS" before stores can be released from the outer wing stations. The "OFF" position provides a safety feature in the event that the outer stations release switch R is inadvertently depressed.

OUTER STATIONS SELECTOR SWITCH. An OUTER STATION selector switch (37, figure 1-4) is located on the pilot's armament panel and is used to select the release sequence of the outer wing racks. Release of rockets or bombs either singly or in pairs from the outer stations is also selected through this switch. To release stores singly, the switch is set on station "1." To release in pairs, the switch is set on station "7."

INTERVALOMETER SWITCHES. An intervalometer selector switch (34, figure 1-14) labeled RELEASES PER SECOND is used to set the number of bombs to be dropped or number of rockets to be fired per second. An associated selector switch with the two indicated positions "SINGLE PULSE" and "INTERVAL" must be placed on "INTERVAL" for use of the intervalometer.

RADAR OPERATOR'S BOMB AND ROCKET CONTROLS. An armament control panel (10, figure 4-7) is provided in the radar operator's compartment and contains controls necessary to release bombs and fire rockets by means of the AN/APA-16 low-altitude bombing equipment. This control panel contains the following controls and indicators:

a. READY ARMAMENT warning light (15, figure 4-7) which is used to indicate that the pilot has turned the MASTER ARMT switch "ON."

b. Armament switch (11, figure 4-7) is an ON-OFF switch used to energize the AN/APA-16.

c. APA-16 RELEASE switches (14, figure 4-7). The left-hand switch labeled OUTER STATIONS has three positions, "ROCKET," "OFF," and "BOMB," and is used to select either rockets or bombs for release from the outer stations by means of the AN/APA-16 equipment. The right-hand switch labeled INNER STATIONS serves the same purpose for inner stations.

d. MANUAL RELEASE SWITCHES. The left-hand switch (12, figure 4-7) labeled SELECTOR has three positions, "OFF," "INNER," and "OUTER." This switch is used to select stores from either the inner or outer stations for manual release by the radar operator. Stores are then manually released by depressing the RELEASE button (13, figure 4-7) located to the right of the SELECTOR switch.

Note

The AN/APA-16 can also be energized by depressing the pickle switch located on the ECM operator's searchlight control grip.

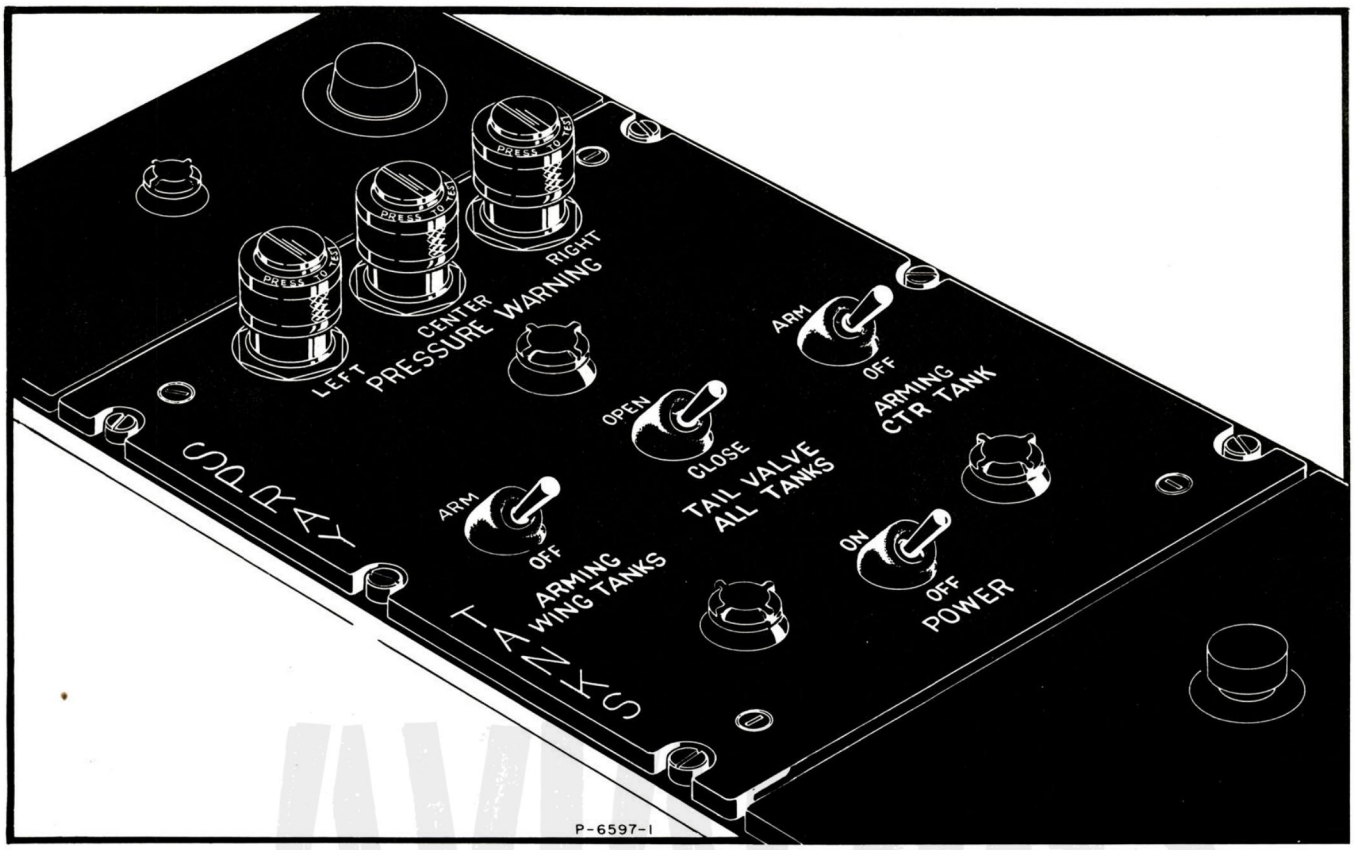


Figure 4-12A. Spray Tanks Control Panel

BOMB DIRECTOR EQUIPMENT

Provisions are provided for a Mk 3 Mod 5 Bomb Director[1] which is an electronic control unit designed to release bombs, rockets, or other stores automatically at the proper instant during the pull-out phase of a toss-bombing attack.

TORPEDO EQUIPMENT

A Mk 13 Mod 3 torpedo can be carried on each rack of the three inner stations. Torpedoes are released in the same manner as the bombs. No provisions are made for depth setting from the cockpit.

SPRAY TANK EQUIPMENT

Spray tanks can be carried on each tank of the two inner stations. The control and operation of the spray tanks is through the pilot's instrument panel, a special SPRAY TANKS panel (figure 4-12A) installed as needed on the ECM operator's right console, and pickle switch B. Armament panel controls are set as follows for operation of the spray tanks:

a. MASTER ARMT switch ..... "ON"

b. INNER STATION function selector switch ..... "SPRAY-FLARE"

c. SPRAY TANKS panel
POWER switch ..... "ON"
ARMING WING TANKS, or ARMING CTR TANK switch ..... "ARM"
TAIL VALVE ALL TANKS switch ..... "OPEN"

d. Pickle switch B ..... Depress

Secure spraying operations by:

a. TAIL VALVE ALL TANKS switch ..... "CLOSE"

b. ARMING WING TANKS, or ARMING CTR TANK switch ..... "OFF"

c. POWER switch ..... "OFF"

d. MASTER ARMT switch ..... "OFF"

Spray tanks can be jettisoned either electrically or manually as outlined under RELEASING BOMBS in this section of the manual. Refer to Bureau of Aeronautics Handbooks CO 39C-10-501, 39C-10-502 and NavAer 11-4S-600 for additional operating instructions.

[1] Airplanes BuNo 132590 and subsequent; prior airplanes through service change

RELEASING BOMBS

Turn MASTER ARMT switch to "ON" position, arm bombs as desired with ARM BOMBS switch, and place the following switches as indicated:

INNER STATIONS—SINGLE RELEASE

a. Intervalometer switch ..... "SINGLE PULSE"
b. Function selector switch ..... "BOMBS"
c. INNER STATIONS selector switches ..... "TRAIN BOMBS"
d. Pickle switch B ..... Depress

Note

Bombs will be released singly, one each time the pickle is depressed. Sequence of release is left, right, and center.

INNER STATIONS—MULTIPLE RELEASE

a. Intervalometer switch ..... "SINGLE PULSE"
b. Function selector switch ..... "BOMBS"
c. INNER STATIONS selector switches ..... "LEFT," "CENTER," or "RIGHT" or any combinations thereof
d. Pickle switch B ..... Depress

INNER STATIONS—TRAIN RELEASE

a. RELEASES PER SECOND switch ..... As required
b. Intervalometer switch ..... "INTERVAL"
c. Function selector switch ..... "BOMBS"
d. INNER STATIONS selector switches ..... "TRAIN BOMBS"
e. Pickle switch B ..... Depress

INNER STATIONS—SALVO RELEASE

a. Intervalometer switch ..... Either position
b. Function selector switch ..... "BOMBS"
c. INNER STATIONS selector switch ..... "LEFT," "CENTER," and "RIGHT"
d. Pickle switch B ..... Depress

INNER STATIONS—MANUAL JETTISON

a. CENTER LINE RACK ONLY ..... Pull WING RACKS LOCK Control and pull CENTER WING BOMB REL control
b. ALL INNER STATIONS .... Pull CENTER WING BOMB REL control

OUTER STATIONS—SINGLE RELEASE

a. OUTER STATIONS selector switch ..... As required
b. Intervalometer switch ..... "SINGLE PULSE"
(1)c. Outer stations function selector switch ..... "BOMBS"
d. Pickle switch R ..... Depress

OUTER STATIONS—TRAIN RELEASE

a. OUTER STATIONS selector switch ..... As required
b. RELEASES PER SECOND switch ..... As required
c. Intervalometer switch ..... "INTERVAL"
(1)d. Outer stations function selector switch ..... "BOMBS"
e. Pickle switch R ..... Depress

OUTER STATIONS—MULTIPLE RELEASE

a. OUTER STATIONS selector switch ..... Set on positions 7, 8, 9, 10, 11, or 12

Note

Stations 1 and 7, 2 and 8, 3 and 9, 4 and 10, 5 and 11, and 6 and 12, can be released in pairs if positions 7, 8, 9, 10, 11, and 12 are selected.

b. Intervalometer switch ..... "SINGLE PULSE"
(1)c. Outer stations function selector switch ..... "BOMBS"
d. Pickle switch R ..... Depress

OUTER STATIONS—SALVO RELEASE

a. OUTER STATIONS selector switch ..... "1" or "7"
b. RELEASES PER SECOND switch ..... "20"
c. Intervalometer switch ..... "INTERVAL"
(1)d. Outer stations function selector switch ..... "BOMBS"
e. Pickle switch R ..... Depress

OUTER STATIONS—MANUAL JETTISON

a. OUTER WING BOMB REL control ..... Pull

(1) Airplanes BuNo 132515 and subsequent

FIRING ROCKETS

Rockets may be fired from any of the 12 outer wing racks or from the left and right inner wing racks. The firing order of the outer wing racks is from one through 12. Rockets may be fired in pairs by selection of stations 7 through 12, which will cause stations 1, and 7, 2 and 8, 3 and 9, 4 and 10, 5 and 11, and 6 and 12 to be released in pairs. The firing order of the inner wing racks is the left-hand rack followed by the right-hand rack. To fire rockets from any station turn MASTER ARMT switch "ON," and place the following switches in the positions indicated:

INNER STATIONS—ROCKET FIRING

Rockets which are hung directly on the inner wing bomb racks (e.g., 11.75 HVAR rockets) are fired by following the procedures outlined for BOMB RELEASE —INNER STATIONS.

OUTER STATIONS—SINGLE FIRE

a. OUTER STATIONS selector switch ..... "1, 2, 3, 4, 5, or 6"

b. Intervalometer switch ..... "SINGLE PULSE"

(1)c. Outer stations function selector switch ..... "ROCKETS"

d. Pickle switch R ..... Depress

Note

The single fire procedure for outer stations will cause ripple fire of all rockets within a package hung on the selected station.

OUTER STATIONS—TRAIN FIRE

a. OUTER STATIONS selector switch ..... "1" or "7"

b. RELEASES PER SECOND switch ..... As required

c. Intervalometer switch ..... "INTERVAL"

(1)d. Outer stations function selector switch ..... "ROCKETS"

e. Pickle switch R ..... Depress

OUTER STATIONS—SALVO RELEASE

a. OUTER STATIONS selector switch ..... "7"

b. RELEASES PER SECOND switch ..... "20"

c. Intervalometer switch ..... "INTERVAL"

(1)d. Outer stations function selector switch ..... "ROCKETS"

e. Pickle switch R ..... Depress

(1)Airplanes BuNo 132515 and subsequent

CHAFF DISPENSING EQUIPMENT

See Supplement to Flight Handbook, NavAer 01-40-ALEA-501A.

SONOBUOY/FLARE DISPENSER EQUIPMENT. Refer to SONOBUOY/FLARE DISPENSER for discussion and operation of the sonobuoy/flare dispenser equipment.

FLARE DISPENSER EQUIPMENT

Flare dispensers can be carried on the three inner station racks. The operation of flare dispensers is controlled through the pilot's armament panel, a special FLARES panel (see figure 4-13) which is installed on the ECM operator's right console when needed, and pickle switch B. No provisions are made for the train release of flares, thus they can be released singly only. Flares can be released in the following manner:

a. MASTER ARMT switch ..... "ON"

b. Inner stations function selector switch ..... "SPRAY-FLARES"

c. LEFT flare dispenser switch .. "READY"

d. CENTER and RIGHT dispenser switches ..... "SAFE"

e. Pickle switch B ..... Depress

Note

As each flare is released, the red indicator light associated with the flare dispenser switch will be illuminated until another flare moves into the release position. The light will remain illuminated when its respective dispenser is empty.

f. When the left dispenser has been emptied, set RIGHT flare dispenser switch to "READY" and continue releases.

g. Repeat with CENTER switch on "READY" position.

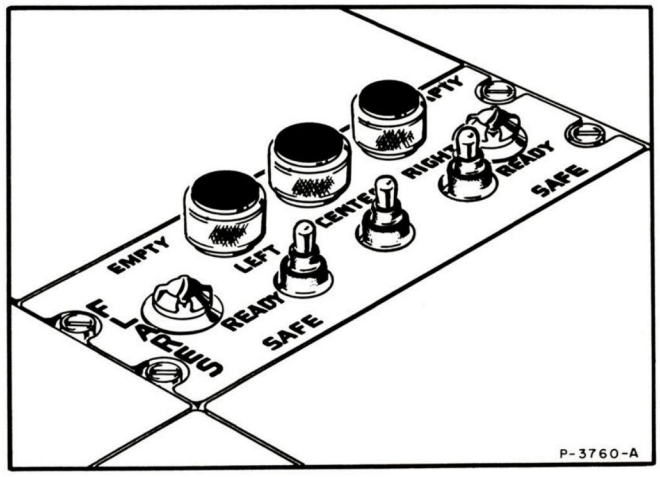


Figure 4-13. Flare Dispenser Panel

Note

If flares are dropped at any other sequence than that outlined above, each flare dispenser switch must be returned to the "SAFE" position before the next switch is placed in the "READY" position.

h. The flare dispensers themselves may be jettisoned either manually or electrically as outlined under RELEASING BOMBS in this section of the manual.

MISCELLANEOUS EQUIPMENT

WINDSHIELD DEGREASING EQUIPMENT

A windshield degreasing system is installed as an aid to improve visibility. A two quart capacity degreasing tank is installed which will permit approximately two minutes of continuous degreasing operations, however, only a few seconds of operation are normally required. For removal of dirt or mud, water may be carried in the degreasing tank. Two momentary contact DEGREASE switches are provided. One switch (14, figure 1-4) is used by the pilot to clean the left side of the windshield and another switch (15, figure 1-5) is used by the ECM operator to clean the right side of the windshield. A standpipe arrangement is provided to prevent the ECM operator from using all the degreasing fluid.

Note

Close the canopy before degreasing windshield as fluid may enter cockpit area with canopy open.

ANTI-G EQUIPMENT

Provisions for the use of an anti-g suit by the pilot are installed in the airplane. Connection of the suit to the anti-g system is made through a receptacle labeled ANTI-G (4, figure 1-3) located on the pilot's left console. A control valve within the system automatically controls the flow of pressurized air to and from the anti-g suit. Inflation of the suit begins when a minimum of 1.8 G is attained and is increased as the load factor increases until a maximum pressure of 6 psi at 5 G is reached.

Note

In order to prevent accidental actuation of the horizontal stabilizer trim switch by the anti-g suit disconnect, it is recommended that a belt loop be installed on the lower left parachute leg harness or on the lower parachute shoulder harness to secure the slack of the anti-g suit trunk tube.

WARNING

The limiting load factor given in figure 5-2 must be observed during all maneuvers even though anti-g equipment is used.

FIRST AID KIT

A first aid kit (8, figure 4-14) is located on the shelf formed by the bulkhead at the after end of the radar operator's compartment.

WATER CONTAINERS

Two canteens are located on the bulkhead directly behind the ECM operator, and one additional canteen is located on the right-hand side of radar operator's compartment.

MAP CASE

A map case is installed on the right-hand side of the cockpit center console. A map case is also installed on the inboard side of the radar operator's left console.

PLOTTING BOARDS

Two Mk 6A plotting boards are provided for the pilot and the radar operator. One is located at the left of the pilot's seat and the other is located aft of the radar operator's seat.

DRIFT SIGNALS

Two Mk 5 drift signals are located aft of the radar operator's seat. To drop the drift signals, lift the door marked FLARE CHUTE-RELIEF TUBE on the floor of the radar operator's compartment, and release the signals through the opening.

CAUTION

- Flare chute cannot be used for releasing drift signals when any center line external store extending under the opening of the flare chute is installed on the center line bomb rack.
- Do not attempt to release the drift signals by opening the hinged enclosures of the compartment. Such action will result in loss of the enclosure and probable damage to the aircraft tail structure; however, it is permissible to throw smoke lights from the pilot's or assistant pilot's compartment, providing the airspeed is reasonably reduced below maximum permissible speed for canopy opening and providing the smoke light is thrown toward the wing root.
- Do not dispense chaff through the drift signal chute as chaff may accumulate in the tail wheel well with the resultant danger of shorting terminal panels or jamming the control system.

REAR VIEW MIRRORS

Two adjustable rear view mirrors are installed on the windshield frame in the cockpit.

ASH TRAYS

Each crew position is furnished with an ash tray.

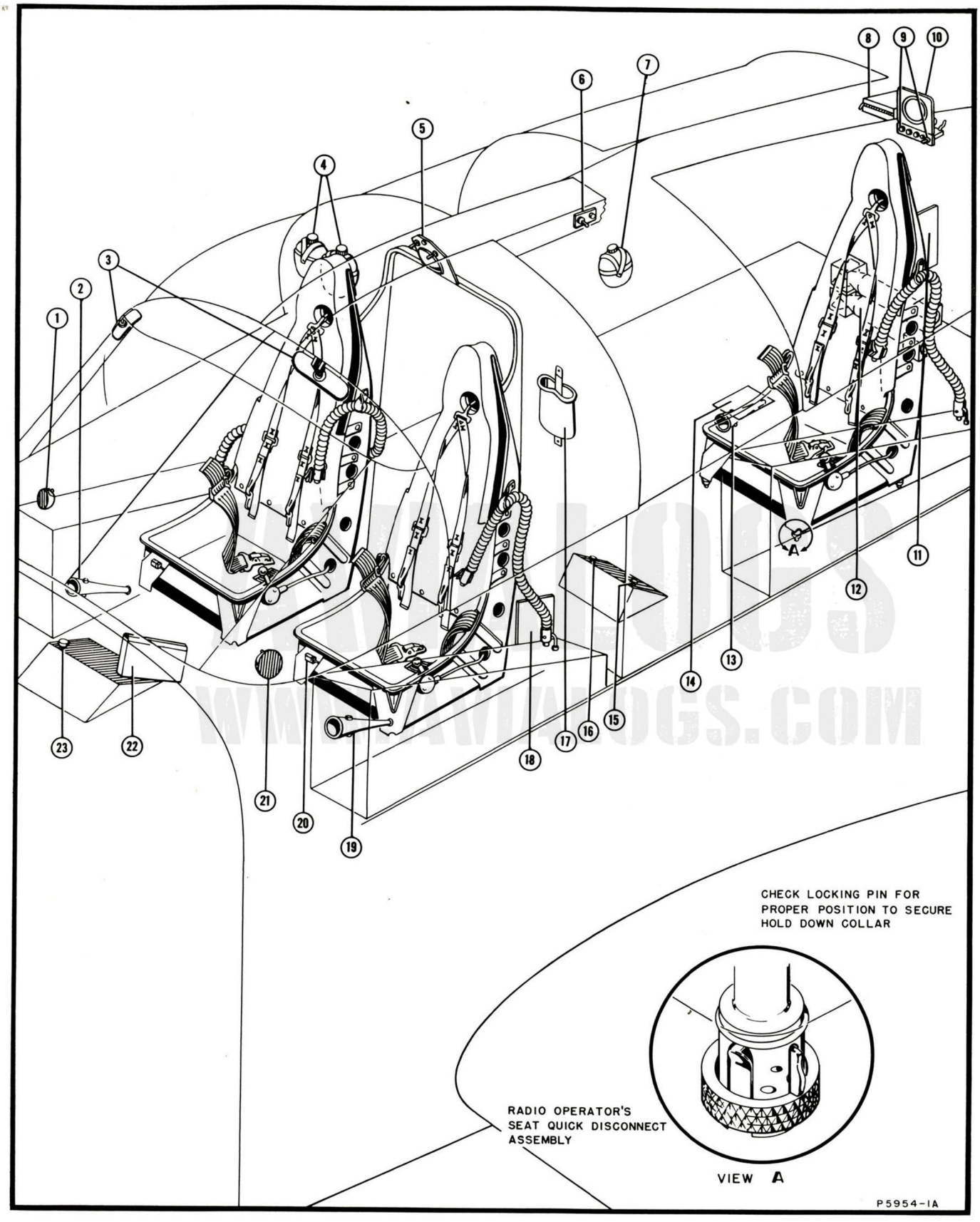


Figure 4-14. Miscellaneous Equipment

Key to Figure 4-14

1. Ash tray
2. ECM operator's relief tube
3. Rear view mirrors
4. Canteens
5. Cockpit dome light assembly
6. After cockpit dome light switch
7. Canteen
8. First aid kit
9. Microphone and headset jacks
10. After cockpit dome light assembly
11. Chartboard
12. Drift signals
13. Radar operator's relief tube
14. Flare chute-relief tube cover
15. ICS OUT switch
16. Microphone foot switch
17. Radar scope visor
18. Chartboard
19. Pilot's relief tube
20. Seat adjustment switches
21. Ash tray
22. Map case
23. Microphone foot switch

WARNING

Smoking should be curtailed on landings, take-offs, during fueling and at any other time when fuel fumes are detected.

RELIEF TUBES

Relief tubes for the pilot and ECM operator are installed on either side of the cockpit. A relief tube for the radar operator (13, figure 4-14) is installed beneath the floor of the radar operator's compartment in the drift signal chute.

INSULATING CURTAIN

An insulating curtain is provided to close off the aft fuselage area from the radar operator's compartment. The curtain is installed to insulate against cold outside air which is ducted into the aft fuselage area for the cooling of electronic equipment. A zippered flap in the curtain permits passage to the aft compartment.

BLACKOUT CURTAIN

A blackout curtain is provided to close off the radar operator's compartment from the cockpit.

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SECTION V

OPERATING LIMITATIONS

See NAVAER 01-40ALEA-501A, Confidential Supplement to Flight Handbook

SECTION VI

FLIGHT CHARACTERISTICS

See NAVAER 01-40ALEA-501A, Confidential Supplement to Flight Handbook

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SECTION VII

SYSTEMS OPERATION

POWER PLANT OPERATION

General engine smoothness coupled with stable instrument readings give the most satisfactory indications of engine performance. If any irregularity becomes apparent, the engine should be throttled down, and if the trouble cannot be remedied in flight, a landing should be made for further investigation. The following information on operation of the engine is given in the interest of maintaining optimum engine performance.

GROUND OPERATION

Extended ground operation should be avoided whenever possible. If it is necessary to operate the engine for any considerable period of time while the aircraft is motionless, head the airplane into the wind for adequate cooling.

USE OF THE COWL FLAPS. It is not generally necessary to position the cowl flaps during ground operation, as they are automatically opened fully whenever the weight of the airplane causes compression of 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. The cowl flaps should not be closed during ground operation but may be closed after shut-down when the engine has cooled, to protect the engine from existing weather conditions. Closing the cowl flaps in the air will not override the automatic feature and the cowl flaps will open immediately after the airplane has landed. If the cowl flaps have been closed during ground operation of the engine, any interruption of the d-c power supply will reinstate the automatic opening feature. Therefore the cowl flaps, if closed, should automatically open immediately after 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 is of value as an aid to fuel vaporization. If alternate air is used for any reason during ground operation caution must be observed that direct air is again selected prior to take-off.

CLEARING A FOULED ENGINE. The spark plugs may sometimes become fouled during a period of extensive ground operation, particularly if the idle mixture is too rich or if the engine is allowing an excessive amount of oil to enter the cylinders. The much used procedure of running the engine at high power in an attempt to unfoul spark plugs has probably worked in a number of cases, but in more instances the plugs have been fouled to a greater degree because of the deficiency of air in the rich mixtures used for high power settings, and by a hardening of the substance already on the plugs. Plugs that are marginal in firing ability have their ability to fire 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" positon.

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 the engine for 15 seconds.

CAUTION

Assure that the mixture control is returned to the "RICH" position prior to 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, care must be taken to reduce manifold pressure before reducing rpm and to increase rpm before increasing manifold pressure. To do otherwise would be to risk exceeding the limiting BMEP of the engine. A study of the Engine Operating Limits Curve, figure A-6, Appendix 1, will reveal that when cruising at 2300 rpm and 35 inches manifold pressure, advancing the throttle without first increasing the engine speed can cause a dangerous exceeding of the indicated BMEP limit.

USE OF MIXTURE CONTROL. The "RICH" position

shall be used during all take-off, approach, and landing operations. It is also advisable to use a rich mixture during let-downs to prevent engine back-firing. 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 does not become excessive.

MANIFOLD PRESSURE REGULATOR. When the throttle is positioned to give a desired manifold pressure, the manifold pressure regulator, which is located in the linkage between the cockpit throttle lever and the carburetor throttle lever, 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 manifold pressure regulator will drop to full-low manual schedule wherein the actual throttle position is about one-half of the corresponding position of the cockpit lever. The maximum attainable manifold pressure at Military power under this condition is approximately 1.5 times outside air pressure in low blower, and approximately 2.3 times outside air pressure in high blower. Refer to Section III for MANIFOLD PRESSURE REGULATOR FAILURE.

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

SUPERCHARGER CONTROL. High blower should be used only at altitudes where the 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, it is advisable to shift when the manifold pressure has decreased to 28 inches Hg. This is to insure that the greater power might be available without the manifold pressure rise associated with a shift to high blower exceeding the engine limitations. At low powers in low blower, it is usually advantageous to obtain more power by increasing engine speed up to 2600 rpm before the decision is made to shift to high.

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 manifold pressure to 20 inches Hg to prevent exceeding the manifold pressure desired after the shift to high blower.

c. Propeller control—When tactically feasible, the engine speed should be reduced to 1600 rpm in order to reduce the possibility 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 of up to 2600 rpm, but such shifts must be kept to a minimum.

d. Supercharger control—Shift rapidly to "HIGH." Be prepared to retard the throttle to check any tendency of the manifold pressure to rise excessively.

Note

While the manifold pressure regulator is normally capable of maintaining any selected manifold pressure below critical altitude, it should not be expected to control manifold pressure during a blower shift, because 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 should not be over 2600 rpm unless justified by emergency or 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 consequent 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, then use rich mixture. It is recommended that the use of military power while in high blower be avoided in hot or humid weather, when tactically feasible.

ENGINE CONTROL DURING A DIVE. To avoid faulty oil scavenging or to prevent the engine nose section from loading up with oil during prolonged dives, it is recommended that the propeller governor be set for the maximum cruising rpm (2200), plus or minus 100 rpm, during dives. In addition, a minimum manifold pressure of 15 inches Hg is recommended during prolonged dives. Any manifold pressure above 15 inches Hg that is within engine limits for the engine speed, mix-

ture control position, and altitude may be used. If a manifold pressure below 15 inches Hg is held during a prolonged dive, the engine will foul up in the same manner as it does when the throttle is closed during extended glides. Of further importance is the fact that the engine, which was not dive tested at a manifold pressure of less than 15 inches Hg, may be subject to master rod bearing failure if less than 15 inches of manifold pressure is used. Caution should be observed during extended dives from high altitudes to prevent the manifold pressure from building up rapidly during altitude changes which are beyond the range within which the manifold pressure regulator can function.

ENGINE OVERSPEED. If the engine should exceed the maximum limit of 3120 rpm, immediately close the throttle, pull the propeller control back toward the "DECREASE" rpm position and reduce the airspeed to a minimum commensurate with maintaining safe flight. This action will help to reduce engine speed and will thereby effectively reduce the centrifugal forces which would otherwise act to the detriment of the bearings.

Note

Should the engine speed exceed 2990 rpm an engine inspection is required. Should the engine speed exceed 3120 rpm engine removal is required.

ENGINE SHUT-DOWN. To reduce the possibility of liquid lock and plug fouling, it is recommended that the engine be shut-down from idle rpm. It is desirable that a period of two to five minutes at idle rpm precede the shut-down, and it is recommended that this time interval be provided wherever possible.

UNSTABLE ENGINE OPERATION

An unstable, or "rough running," engine can be caused by many different discrepancies in the various engine systems. Few of these malfunctions can be controlled or remedied in the air by the pilot, however under certain conditions, if the difficulty can be diagnosed, remedial action may be taken to improve the operation of the engine. Unstable engine conditions can be recognized by the following symptoms: fluctuating rpm and manifold pressure, excessive cylinder head temperature and carburetor air temperature, vibration, backfiring and afterfiring. Sources of engine instability can be divided into three groups: Ignition, Carburetion, and Mechanical.

IGNITION. A malfunctioning ignition system is not only difficult to recognize as such, usually being misinterpreted as carburetion trouble, but there is little that can be done to correct the abnormality in flight. The best procedure is to operate at some power setting (usually reduced values) which will result in the smoothest running condition.

CARBURETION. Generally, carburetion difficulties which can be controlled by the pilot originate with the introduction of ice and water into the impact tubes and suction passages of the carburetor. This ice and water reduces fuel flow and causes lean mixtures, sometimes reaching a point at which some cylinders cease firing, causing engine roughness, surging, or complete engine stoppage if no corrective action is taken. On rare occasions when ice and water enter the mixture control bleed passages, extreme richness may result with accompanying instability.

LEAN MIXTURES. Fuel-air mixtures which are too lean can result in backfiring (flame propagation from the cylinders or intake manifold back through the induction system). Damage caused by backfiring can be extensive; it can blow out intake pipe seals, deform bellows and diaphragms in the carburetor, and blow off the carburetor air scoop. Subsequent engine malfunctions resulting from backfiring can be improper fuel metering and intake pipe leaks, causing engine roughness and possibly detonation. Preventive or remedial action consists of moving the mixture control to "RICH" and applying alternate air.

RICH MIXTURE. Excessively rich mixtures can cause afterfiring (flame passage from the cylinders out through the exhaust system). Afterfiring can loosen, crack, and sometimes blow off the exhaust pipes, leading to a fire in the engine section. While applying alternate air to remove the ice and water causing the rich mixture, it may be necessary to manually control the mixture until power is regained. After stability returns, reset cruising mixture and remove alternate air when icing conditions no longer exist.

CAUTION

Do not constantly change from alternate to direct air to keep the carburetor air temperature within the prescribed limits, as this procedure may cause any accumulated ice to change positions, possibly jamming the air control door.

MECHANICAL. Failure of the internal mechanical parts of the engine obviously cannot be corrected in flight. When some mechanical failure occurs, operate at the lowest practicable power settings to reduce further damage, and land as soon as possible.

FUEL SYSTEM

FUEL FLOW. Flow of fuel is directed from the selected tank through the selector valve to the electrical fuel booster pump, to the engine driven fuel pump, and then to the carburetor. No fuel transfer between tanks is possible. A carburetor vapor vent returns excess fuel to the main tank. The vapor vent line can return fuel from the carburetor at a maximum rate of 10 U. S. gallons per hour: however, normally 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 that the engine-driven pump fails. Use of the fuel booster pump during ground operations under hot climatic conditions is an aid to the prevention of vapor lock.

FUEL TANK SELECTION. The main tank should be used for starting, warm-up, take-off, climb and landing. Fuel from the auxiliary tanks should be used for level flight only. Selection of the main tank during flight should be made for combat, maneuvers, 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.

SELECTION SEQUENCE. In flight, the fuel should be used from the installed tanks in the following sequence: left external auxiliary, right external auxiliary, fuselage 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 practice also allows the maximum use of the external fuel loading 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 will occur. Some flickering of the warning light may occur if the selected tank is low on fuel, and when the aircraft is in a steep climb or dive, or flying through extremely rough air, but this characteristic is not considered objectionable.

FUELING PROCEDURE. Each tank is filled individually. The tanks should be filled in the following sequence: fuselage main, external centerline auxiliary, and external wing tanks.

OIL SYSTEM

The oil system, although normally automatic in operation, has several features over which the pilot has a degree of control. Operation or use of the oil cooler doors, the oil warm-up compartment of the oil tank, and oil dilution 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 whenever the OIL COOLER DOOR switch is in "AUTO." If some malfunction of the automatic feature occurs, the cooler doors can be opened or closed at the discretion of the pilot by means of the OIL COOLER DOOR switch. No indication of the position of the cooler doors is available to the pilot other than the resulting oil temperature change. When using manual control, the pilot must open or close the doors, readjusting as necessary, until the desired oil temperature indication is maintained.

WARM-UP COMPARTMENT. For an aid in 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. This valve is positioned electrically whenever the battery-generator switch is energized. Whenever the oil is cold, the resulting high viscosity causes a great deal of resistance to the diverter valve which presents the possibility of creating an overload on the actuating motor. This overload can cause the motor to burn out. To prevent such trouble from occurring, it is recommended that the oil diverter valve be preset during every shut-down of the engine. This is accomplished, through use of the oil dilution switch, by following the procedure outlined in Section II under STOPPING THE ENGINE.

OIL DILUTION. Oil dilution should be used during engine shut-down whenever an anticipated engine start is to be made at temperatures approaching or below the freezing level. 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.

A feature of the oil dilution system requires that a ground crewman must turn on an oil dilution shut-off valve, located in the oil cooler section just forward of the fire wall, whenever oil dilution is to be accomplished. 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 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 are used to operate the electrical equipment installed in the airplane. Two types of a-c power are utilized, variable frequency and constant frequency a-c power. D-c power is supplied by two batteries and an engine driven d-c generator or by an external power source. 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. An emergency source of d-c power is supplied from the a-c generator through a transformer and a power rectifier.

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 voltammeter. 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 a source of d-c power to the system. These batteries are normally parallel-connected to maintain a constant 24-volts to the system, however, during searchlight operations, the batteries are series-connected by means of a series switching relay which is automatically energized when the searchlight is turned on. This serves to double the voltage output from the batteries to assist in the operation of the searchlight equipment. 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. This voltage regulator is essentially a generator field coil rheostat that governs the amount of field current required to maintain a constant generator voltage output.

D-C EXTERNAL POWER CIRCUIT. An external power rectifier is provided to protect the system from being energized by an external power source of incorrect polarity. The system can be energized from an external power source only when power of correct polarity is connected.

[1]EMERGENCY D-C POWER. An emergency source of d-c power is made available from the a-c generator through a transformer and a power rectifier. This emergency power is provided in case the d-c generator should fail in flight. Placing the battery-generator switch in the "BAT ONLY" position will allow d-c power to flow from the emergency source to the primary bus only. In this case the secondary bus will be energized by battery power, therefore, all non-essential equipment operated from the secondary bus should be turned off to conserve battery power.

[1]Airplanes prior to BuNo 132528

D-C POWER DISTRIBUTION

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

D-C TIE BUS. The d-c tie bus serves as a distribution point through which d-c power flows to the remaining major busses, depending upon the power source, actuation of relays, and the 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 through the switch across the battery relay to the d-c tie bus. D-c generator power will flow through a reverse current relay to the d-c tie 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 through the external power receptacle across the external power relay to the d-c tie bus regardless of the position of the battery-generator switch.

PRIMARY BUS. D-c power from all sources is distributed directly from the d-c tie bus to the primary bus, [1]except that if the a-c generator is in operation and the battery-generator switch is in the "BAT ONLY" position, the emergency d-c relay disconnects the primary bus from the d-c tie bus and allows emergency d-c power to energize the primary bus.

SECONDARY BUS. Battery power will energize the secondary bus relay to allow power to flow from the d-c tie bus to the secondary bus whenever the battery-generator switch is placed in the "BAT ONLY" position or whenever the switch is placed in the "BAT & GEN" position with the landing gear handle in the "DOWN" position. With the d-c generator in operation and with the battery-generator switch in the "BAT & GEN" position, the bus control relay will be actuated causing power to flow from the d-c tie bus to the secondary bus. D-c power from an external power source will energize the secondary bus only if the landing gear handle is in the "DOWN" position or if the battery-generator switch is placed in the "BAT ONLY" position.

ARMAMENT BUS. The armament bus is energized when both the d-c tie bus and the secondary bus are

energized, provided the MASTER ARMT switch is in the "ON" position and the landing gear handle is in the 'UP" position. D-c power from the secondary bus flows through the MASTER ARMT switch (circuit breaker type) when in the "ON" position, across an armament safety switch (actuated by the landing gear lever), and thereafter actuates the armament bus relay which allows power to flow from the d-c tie bus to the armament bus. The armament safety switch is provided to preclude inadvertent release of external stores during landing and ground maneuvers. If the landing gear lever is in the "DOWN" position when the MASTER ARMT switch is turned "ON," the armament safety switch will cause the MASTER ARMT switch (circuit breaker type) to return to the "OFF" position, thereby de-energizing the armament bus. An armament safety disabling switch is provided to allow for ground testing of the armament circuits. This switch de-activates the armament safety switch and enables the armament circuit to be tested while the landing gear lever is in the "DOWN" position.

MONITOR BUS. The monitor bus can be energized only from the d-c generator or from an external 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 tie bus across the bus control relay to the monitor bus relay which then allows power to flow from the d-c tie bus to the monitor bus. External power will flow from the d-c tie bus across the monitor control relay to the monitor bus relay which allows power to flow from the d-c tie bus to the monitor bus. Battery power ([1]or emergency d-c power) cannot energize 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 1-11.

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 208-volts to line and 120-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 delivers three phases (or separate sources) of variable frequency a-c power to the system. These phases are identified as "ϕA," "ϕB," and "ϕC."

VARIABLE FREQUENCY A-C POWER DISTRIBUTION. Variable frequency a-c power is delivered from the a-c generator to circuit breakers where the various electrical circuits are connected. This power is governed, controlled, or checked by the following equipment:

A-c exciter control
A-c voltage regulator
A-c generator field relay
Circuit protector switch
A-c generator field switch
A-c power switch
A-c power relay
A-c voltmeter
A-c voltmeter phase selector switch
[2]Emergency a-c lights transformer

A-C EXCITER CONTROL. The exciter control unit stabilizes the voltage output of the a-c generator when the generator is operating at high rpm. At normal generator rpm (cruising speed), the exciter control resistance is not included in the circuit.

A-C VOLTAGE REGULATOR. The a-c voltage regulator maintains a constant a-c generator output voltage by varying the generator field excitation current. The amount of current in the exciter field governs the voltage output of the a-c generator.

CIRCUIT PROTECTOR SWITCH. The circuit protector switch (circuit breaker type) is a safety device which prevents damage to the a-c generator if a short circuit should develop in the a-c generator load. Refer to A-C GENERATOR FIELD RELAY.

A-C GENERATOR FIELD SWITCH. The A-C GEN FIELD switch is controlled by the pilot or ECM operator and serves two purposes: the "ON" position completes the a-c generator field circuit allowing the a-c generator to function; and the "RESET" position is used to break the "holding circuit" which allows the a-c generator field relay to be repositioned for normal operation. It is also used to manually break the exciter field circuit to de-energize the a-c generator. Refer to A-C GENERATOR FIELD RELAY.

A-C GENERATOR FIELD RELAY. The a-c generator field relay, in conjunction with the circuit protector switch, functions as a safety device which disrupts the exciter field circuit of the a-c generator when an excessive current is drawn on any phase of the a-c generator. The exciter field circuit must be closed in order for the a-c generator to deliver power to the system. An overloaded circuit will cause the circuit protector switch to heat up and "pop" open allowing d-c control current to flow from the d-c tie bus through the coils of the a-c field relay to ground. At this point the a-c generator

[1]Airplanes prior to BuNo 132528

[2]Airplanes BuNo 132528 and subsequent

field relay is held open by a "holding circuit" between the d-c tie bus and a "ground" in the A-C GEN FIELD switch. This "holding circuit" is necessary because when the circuit protector switch has cooled it will return to the normal position and break the initial circuit between the d-c tie bus and the circuit protector switch. The "holding circuit" causes the a-c generator field relay to open the field exciter circuit which de-energizes the a-c generator. The "holding circuit" may be broken to again energize the exciter field circuit by placing the A-C GEN FIELD switch in the "RESET" position. The a-c generator should now function normally unless the overloaded condition still exists, in which case, the circuit protector switch will again heat up and "pop" open. If the circuit is still overloaded the A-C GEN FIELD switch should be placed in the "RESET" position for the remainder of the flight as this manually opens the exciter field circuit and de-energizes the a-c generator.

A-C POWER SWITCH. The A-C PWR switch is controlled by the pilot or the ECM operator and is used to select a-c power from the a-c generator or from an external power source. The three switch positions, "OFF," "INT," and "EXT," are self-explanatory.

A-C POWER RELAY. The a-c power relay is activated by d-c power from the monitor bus through the A-C PWR switch and allows variable frequency a-c power to flow from the a-c generator or from an external power source to the system, depending upon the position of the A-C PWR switch. In flight, the a-c power relay may not be activated if the d-c generator should fail since the monitor bus cannot be energized by battery power.

A-C VOLTMETER. Refer to CHECKING A-C VOLTAGE OUTPUT in Section I of this manual.

A-C VOLTMETER PHASE SELECTOR SWITCH. Refer to VOLTMETER PHASE SELECTOR SWITCH in Section I of this manual.

EMERGENCY A-C LIGHTS TRANSFORMER[1]. The emergency a-c lights transformer is activated automatically whenever the d-c generator fails. Failure of the d-c generator allows an emergency a-c lights cut-out relay to close, causing 115/200-volts phase A generator power to pass through the emergency transformer where it is reduced to 26-volts. This power is supplied to the cockpit instrument lights to provide emergency lighting.

CONSTANT FREQUENCY A-C POWER SUPPLY SYSTEM

See figure 1-8 for constant frequency a-c power distribution schematic and for component units of the system. Constant frequency a-c power is supplied by two inverters. Voltage output of the inverters may be checked by the a-c voltmeter when used in conjunction with the voltmeter phase selector switch. A FLT INSTR PWR FAILURE warning light is provided to indicate the failure of either inverter.

[1] Airplanes BuNo 132528 and subsequent
[2] Airplanes BuNo 132503 and subsequent

NUMBER ONE INVERTER. The number one inverter is a 115-volt, three-phase, 400 cycle type, and is operated from d-c power supplied by the primary bus through a 15-ampere circuit breaker. The number one inverter provides both 26-volt and 115-volt constant frequency a-c power in two phases (ϕA and ϕC) to the system. ϕB is grounded and cannot be checked on the a-c voltmeter. The number one inverter is manually switched into operation by placing the FLT INSTR PWR SEL switch in the "INVERTER 1" position. Failure of any phase of the inverter will cause the FLT INSTR PWR FAILURE warning light to be illuminated when the "INVERTER 1" position is selected. The following equipment operates from constant frequency a-c power provided by the number one inverter:

Equipment	*Voltage*	*Phase*
Gyro horizon instrument	26-volts	ϕA and ϕC
G-2 Compass amplifier	115-volts	ϕA and ϕC
Fuel gage	115-volts	ϕC
Voltmeter	115-volts	ϕA and ϕC
LF ADF tuning (AN/ARN-6)	115-volts	ϕA
[2]LF ADF (AN/ARN-6)	26-volts	ϕC
[2]UHF ADF (AN/ARA-25)	26-volts	ϕC
[5]TACAN (AN/ARN-21)	26-volts	ϕC

NUMBER TWO INVERTER. The number two inverter is a 115-volt, three-phase, 400 cycle type, and is operated from d-c power supplied by the d-c tie bus through a 150-ampere current limiter, provided a switching relay within the inverter has been energized by power from the monitor bus. The number two inverter provides both 26-volt and 115-volt constant frequency a-c power in two phases (ϕA and ϕC) to the system. ϕB is grounded and cannot be checked on the a-c voltmeter. The number two inverter is manually switched into operation by placing the FLT INSTR PWR SEL switch in the "INVERTER 2 AND AUTO PILOT" position. Failure of any phase of the inverter will cause the FLT INSTR PWR FAILURE warning light to be illuminated when the "INVERTER 2 AND AUTO PILOT" position is selected. The following equipment operates from constant frequency a-c power provided by the number two inverter:

Equipment	*Voltage*	*Phase*
[3]Gyro horizon instrument	26-volts	ϕA and ϕC
[3]G-2 compass amplifier	115-volts	ϕA and ϕC
[3]Fuel gage	115-volts	ϕC
Voltmeter	115-volts	ϕA and ϕC
[4]Spray tank	115-volts	ϕC
Searchlight control	115-volts	ϕC
Search Radar (AN/APS-31B)	115-volts	ϕA and ϕC
ECM Receiver (AN/APR-9)	115-volts	ϕC
ECM Transmitter (AN/APT-16)	115-volts	ϕC
Weapon (T-145)	115-volts	ϕA
G-2 compass adapter	115-volts	ϕA

[3] Essential flight instruments
[4] Airplanes prior to BuNo 132548
[5] After service change

Equipment	*Voltage*	*Phase*
Automatic pilot	115-volts	ϕA and ϕC
Bank and Turn indicator	26-volts	ϕA and ϕC
UHF ADF (AN/ARA-25)	26-volts	ϕC
LF ADF (AN/ARN-6)	26-volts	ϕC
TACAN (AN/ARN-21)[2]	26-volts	ϕC
Searchlight-sonobuoy dispenser	26-volts	ϕC

CONSTANT FREQUENCY A-C POWER DISTRIBUTION. Constant frequency a-c power is delivered from the two inverters to circuit breakers where the various circuits are connected. This power is governed, controlled, or checked by the following:

Instrument transformer
P-1 power junction box
Standby transformer
Flight instrument power select switch
A-c voltage sensing relay
Flight instrument power failure warning light
A-c voltmeter
A-c voltmeter phase selector switch
[1] AN/ARN-6 relay or
[2] AN/ARN-21 relay

INSTRUMENT TRANSFORMER. The instrument transformer is a 115-volt to 26-volt, single phase, step-down transformer, and is used to reduce the voltage from the number two inverter from 115-volts to 26-volts as required for certain communications radio equipment.

P-1 POWER JUNCTION BOX. The P-1 power junction box serves as a power distribution source for both a-c and d-c power, and contains a 115-volt to 26-volt step-down transformer and a relay which is energized by monitor bus power. The step-down transformer supplies 26-volt a-c power directly to the bank and turn indicator and the gyro horizon instrument through the "INVERTER 2 AND AUTO PILOT" position of the FLT INSTR PWR SEL switch.

STANDBY TRANSFORMER. The standby transformer is a 115-volt to 26-volt, three-phase, step-down transformer, and is used to reduce the voltage from the number one inverter from 115-volts to 26-volts as required by the gyro horizon instrument. The standby transformer supplies 26-volt a-c power directly to the gyro horizon instrument through the "INVERTER 1" position of the FLT INSTR PWR SEL switch.

FLIGHT INSTRUMENT POWER SELECT SWITCH. The FLT INSTR PWR SEL switch is used to select a desired inverter. When the FLT INSTR PWR SEL switch is in the "INVERTER 1" position, the 115-volt essential loads receive power directly from the number one inverter, and the 26-volt essential loads receive power from the inverter through the standby transformer. When the FLT INSTR PWR SEL switch is in the "INVERTER 2 AND AUTO PILOT" position, the 115-volt essential loads receive power directly from the number two inverter, and the 26-volt essential loads receive power from the number two inverter through the P-1 power junction box. The 115-volt non-essential loads receive power directly from the number two inverter, and the 26-volt non-essential loads receive power from the number two inverter through the instrument transformer. Only essential loads are supplied through either position of the FLT INSTR PWR SEL switch. Non-essential loads are supplied by the number two inverter as long as the inverter has an output, regardless of the position of the FLT INSTR PWR SEL switch; however, the auto-pilot cannot be engaged unless the FLT INSTR PWR SEL switch is in the "INVERTER 2 & AUTO PILOT" position.

AN/ARN-6 RELAY[1]. In order to provide 26-volts a-c power to the LF ADF and UHF ADF direction finding equipment from either inverter, a switching relay is de-energized when the FLT INSTR PWR SEL switch is moved to "INVERTER 1". Power then flows from the standby transformer to the direction finding equipment. In the "INVERTER 2 & AUTO PILOT" position, the switching relay is energized, allowing power to flow from the instrument transformer to the equipment.

[1] Airplanes BuNo 132503 and subsequent
[2] After service change

SECTION VIII

CREW DUTIES

CREW MEMBER DUTIES

In addition to his specialized duties, each crew member shall be responsible for the performing of certain functions and checks to ensure proper and efficient operation of the airplane. This section of the manual will be devoted solely to these checks that must be made before, during, and after flight by each crew member. A crew member's responsibility to his organization and fellow air-crewmen should not end by his merely being technically competent and able to recite the duties as enumerated in this section of the manual. The more familiar each crew member can be with the aircraft in which he is to fly the more able he will be to perform the duties so necessary to the accomplishment of a successful mission. It is therefore recommended that each crew member familiarize himself with Section I, III, IV, and VII of this manual. The duties of the pilot are not included in this section since they are described in Section II.

ECM OPERATOR. In addition to the normal duties as an ECM operator, perform the following functions:

BEFORE ENTERING THE AIRPLANE. Perform such external checks as may be prescribed by the pilot or by squadron instructions.

ON ENTERING THE AIRPLANE

a. Inspect station for cleanliness and for proper stowage of gear.

b. Check landing gear handle down and locked.

c. Insure that electronic equipment and searchlight power switches are turned "OFF."

d. Adjust seat for proper height.

e. Check for stowage of emergency equipment and note location of emergency controls.

f. Make oxygen, anti-g and radio connections as required.

g. Turn on oxygen by rotating the oxygen shut-off valve (18, figure 4-3) to the "ON" position.

h. Check oxygen supply and mask.

i. After turn-up, and when directed by the pilot, perform operational check of electronic, radio and ICS equipment.

j. Check for proper compartment heat and ventilation.

k. Assist pilot as directed in the performing of ground tests and completing of check-off lists.

l. Shoulder harness and safety belt secure.

m. Close canopy when directed by the pilot.

n. CATAPULT LAUNCH. Head against headrest and hands off all equipment and controls.

IN FLIGHT

a. Remain alert at all times and act as observer when not operating equipment. Continually scan the area and report to the pilot the location of all approaching aircraft that may endanger safety of flight.

b. Inform pilot of any equipment malfunctions or of any other unusual occurences.

c. In event of emergency, carry out duties and procedures as prescribed in Section III of this manual. Refer to DITCHING AND BAIL-OUT PROCEDURES in Section III.

BEFORE LANDING

a. Shoulder harness and safety belt secure.

b. Secure all unnecessary electronic equipment.

c. Assist pilot in the performing of landing checks.

d. Open canopy when directed by the pilot.

UPON LEAVING THE AIRPLANE

a. Secure all electronic and radio equipment.

b. Report all discrepancies to the pilot so that entry of such will be made on the flight record form (yellow sheet).

RADAR OPERATOR. In addition to the normal duties as a radar operator, perform the following functions:

BEFORE ENTERING THE AIRPLANE. Perform such external check as may be prescribed by the pilot or by squadron instructions.

ON ENTERING THE AIRPLANE

a. Inspect station for cleanliness and for proper stowage of gear.

b. Insure that electronic and radio power switches are in the "OFF" position.

c. Check for proper stowage of emergency equipment and note location of emergency controls.

d. Push in all circuit breakers on Circuit Breaker Panel #36.

e. Check searchlight power circuit breaker switch for "SEARCHLIGHT POWER" position.

f. Make oxygen, anti-g, and radio connections as required.

g. Turn on oxygen by rotating the oxygen shut-off valve (10, figure 4-8) to the "ON" position.

h. Check oxygen supply and mask.

i. Close hatches and make certain that they are properly latched. Hatches must not be left open during turn-up, take-off, or in flight, as they may be carried away by the slip-stream and damage the airplane.

j. Make certain that the radar operator's seat is properly secured to the deck. Check each locking pin. See figure 4-14.

Note

In earlier aircraft,[1] the hold down collar is secured by cotter key type pins; in later aircraft they are held in place by a spring-loaded locking pin.

[1] Airplanes prior to BuNo 132632

k. After turn-up, and when directed by the pilot, perform operational check of electronic, radio and ICS equipment.

l. Check for proper compartment heat and ventilation.

m. Shoulder harness and safety belt secure.

n. CATAPULT LAUNCH. Head against headrest and hands off all equipment and controls.

IN FLIGHT

a. Remain alert at all times and act as observer when not operating equipment. Continually scan area and report to the pilot the location of all approaching aircraft that may endanger safety of flight.

b. Inform pilot of any equipment malfunctions or of any other unusual occurences.

SECTION IX

ALL WEATHER OPERATION

INTRODUCTION

This section contains only those procedures that differ from, or are in addition to, normal operating instructions contained in Section II. Any discussion relative to operation of the various systems is covered in Section VII. Where repetition occurs, it is only as needed for emphasis, clarity, or continuity.

NIGHT FLYING

Night flying procedures are conventional in this airplane. Night lighting provisions are excellent, and no objectionable glare is caused by the canopy. Exhaust shields on the fuselage forward of the cockpit serve to protect the pilot's eyes from the exhaust glare.

OPERATION UNDER INSTRUMENT FLIGHT CONDITIONS

The airplane is inherently stable and has no unusual instrument flight characteristics. No difficulties other than those normally associated with instrument flight will be encountered.

AFTER STARTING THE ENGINE. The following check should be carefully made before take-off:

a. Radar altimeter ..... "ON"

b. G-2 compass control switch..... "CONTROL"

Note

It may be desirable to set the G-2 compass control switch to "FREE" for an instrument take-off from a carrier deck, as shipboard magnetic disturbances may have considerable influence on the controlling magnetic compass.

c. Gyro horizon ..... Uncage

d. FLT INST PWR SEL switch.... "INVERTER 1"

TAXIING. During turns while taxiing, the turn and bank indicator should be checked for proper operation, the G-2 compass for changes in heading, and the standby compass for freedom of operation. Check the gyro horizon for proper erection.

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).

INSTRUMENT TAKE-OFF. Prior to take-off the engine must be checked thoroughly and the check-off list reviewed. Line up in take-off position. Hold the brakes and run up the engine to approximately 1500 rpm for a minimum of 3 minutes before applying take-off power to ascertain that the a-c generator has cut-in and is producing the proper output for safe operation of the flight instruments. Take-off power should be applied smoothly and evenly while directional control is maintained by reference to the directional gyro. The rudder will become effective almost immediately and use of the brakes will not be required. No attempt should be made to raise the landing gear until the altimeter has indicated a positive reading above the field elevation. Cross reference should be made with the radar altimeter. Take-off power should be maintained until an altitude of 500 feet over the field elevation has been reached.

HOLDING. To conserve fuel, all holding should be conducted at a speed and power for maximum endurance. Refer to Maximum Endurance Charts in Appendix II. See also figure 9-1.

INSTRUMENT APPROACHES

No problems peculiar to this airplane are anticipated during instrument approaches. Equipped as it is with radio compass, UHF direction finder, marker beacon receiver and auto-pilot, radio range let-downs or GCA approaches can be made readily.

RADIO RANGE LET-DOWN. Reference should be made to figure 9-1, Instrument Approach and Landing Power Requirements, for concise information on approximate power settings which are necessary during the various stages of an instrument let-down.

GROUND CONTROL APPROACH. See figure 9-1 for approximate power settings to be used for best economy during GCA landings. During the final let-down, it is recommended that the flaps be placed half down and the airspeed be maintained at 105 knots for the most "comfortable" approach conditions. The flaps should be lowered to full down when visual contact with the runway is made.

ICE, SNOW AND RAIN

Dry snow and rain will have little effect on airplane characteristics other than restricting vision. 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 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.

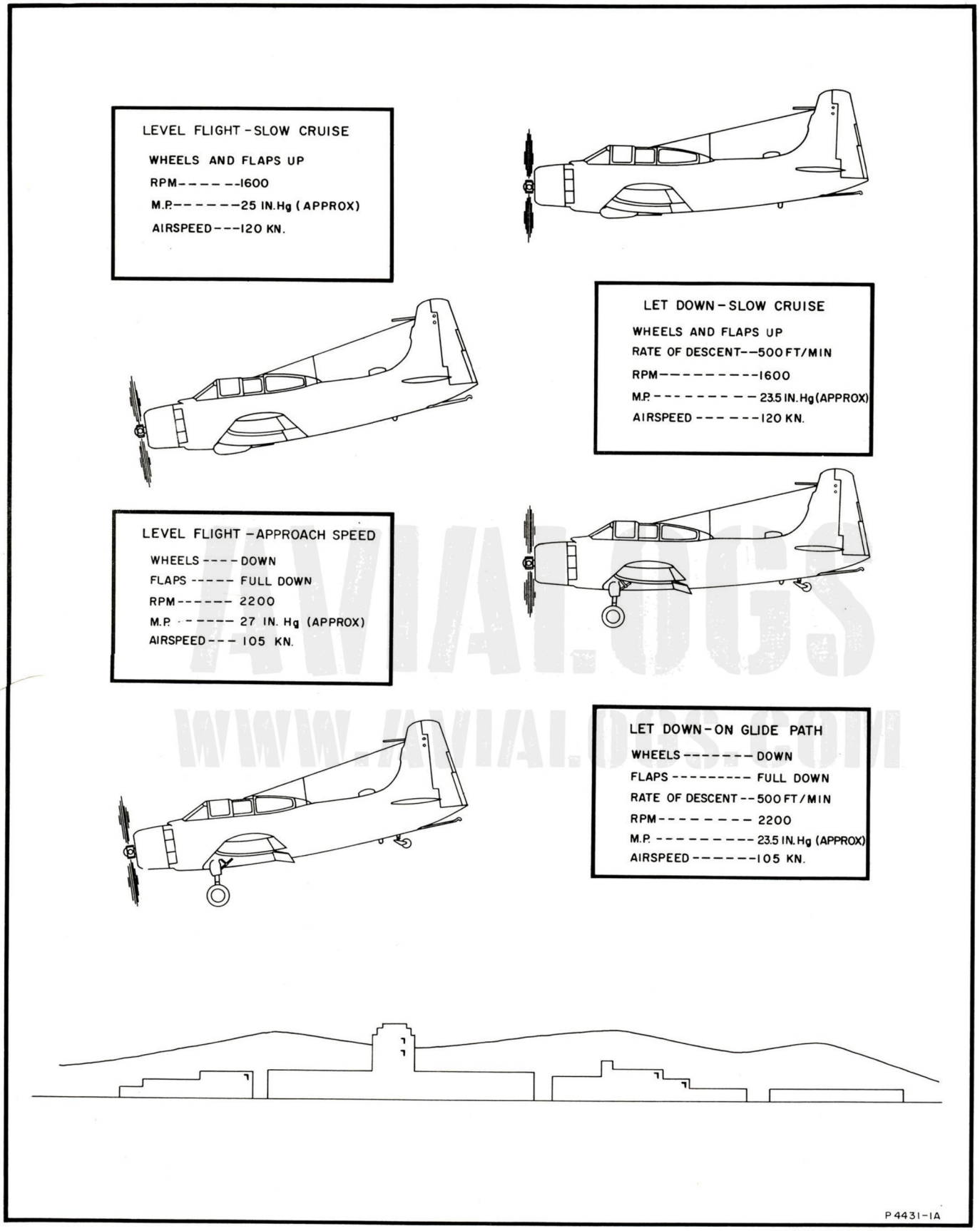


Figure 9-1. Instrument Approach and Landing Power Requirements

a. Before entering cockpit, check wings, wheels, 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 treacherous stalling characteristics. It is extremely important that the propeller be free of ice before take-off.

RAIN REPELLENT. A rain repellent kit, stock number R83K710075, is available for coating the external surface of the windshield and canopy and will permit normal visibility upon encountering rain. The method of applying the rain repellent is as follows:

a. Wash surface if excessively soiled.

b. Clean surface with the cleaner that is provided, using a soft cloth; then polish.

c. Apply the bonding paste with a clean soft cloth. Use the bonding paste sparingly, since only a thin film is required.

Note

Do not apply the bonding paste to a wet surface since a satisfactory bond will not be obtained.

d. Polish the surface with a clean soft cloth until all the black color disappears.

e. Apply the stick rain repellent by rubbing the side of the stick lightly over the surface. Do not apply rain repellent stick endwise, since too heavy a film will be deposited.

f. Polish with a soft cloth until the film is clear.

To recoat, repeat the foregoing procedure. After application, the windshield may frequently be cleaned and polished without adversely diminishing the rain repellent quanlities. Use the following procedure as a guide:

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

b. If the soiled area is heavier and of a nature that responds to mild soap or mild detergent and water, clean with a soft cloth and after drying, polish with a soft cloth. Should this procedure remove the film, it may be restored by applying the rain stick repellent only and polishing.

c. If the soiled area required the use of a cleaner, or harsh detergent, the procedure for recoating the surface should be followed to restore the rain repellent qualities.

Note

The rain repellent coating will be removed by windshield de-icing fluid.

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-XAE101-1-8, is available for coating the interior surface of the windshield and canopy and will prevent fogging of these transparent surfaces.

The method of applying the anti-fogging compound is as follows:

a. Wash interior surface if excessively soiled.

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

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

CAUTION

- The anti-fogging compound has a detrimental softening effect on cellulose nitrate instrument lacquer when in contact over one hour. Care should be taken to prevent contact of the compound with the instrument panel finish.
- The anti-fogging compound has a severe swelling effect on rubber. Care should be taken to minimize contact of the compound with the rubber and sealant surrounding the windshield and canopy.

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.

COLD WEATHER OPERATING CONDITIONS

Successful cold weather operation is dependent primarily on post-flight servicing and preparation of the airplane in anticipation of the requirements for operation on the following day.

Note

Lubricating oil of grade 1100 shall be used in all reciprocating engines at ground starting temperatures above −4°C (+250°F). When temperatures below that level are expected, use grade 1065 lubrication oil; if grade 1065 is not available use preheat; if preheat is not available, use oil dilution (follow grade 1100

dilution curves in figure 9-2). When using grade 1065 oil, inlet temperatures should be maintained between 65°C and 75°C during engine operation to obtain proper lubrication, and to prevent an accumulation of moisture and volatile products of oxidation in the oil. If it is not possible to maintain these temperature limits, the oil pressure should be kept within the normal operating range and the temperature should be maintained above 60°C. Grade 1065 lubricating oil will generally require preheat for starting at temperatures below −18°C (0°F). If preheat is not available, use oil dilution curves (see figure 9-2).

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 treacherous stalling characteristics.

c. At temperatures of −18°C (0°F) 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 (35°F).

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.

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 (0°F) or lower.

(2) 900 to 1000 rpm for OAT of −20°C to −1°C (30°F).

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."

d. The only use for the primer after the engine is operating on the carburetor fuel (mixture "RICH) is to occasionally add 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 (30°F) 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 throttle 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 tempeature 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 landing gear and speed brake, several times.

b. Operate all flight controls 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 to 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 essential.

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. Non-essential 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 (−4°F).

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. Guns should be charged as soon after take-off as practical as hydraulic action becomes sluggish due to cold. Do not fire a trial burst after take-off as plastic covers or tampions are used in the muzzles to prevent cold air from blowing down the bores.

CARBURETOR AIR CONTROL. The “ALTERNATE” air position should be used as a normal operation when flying in any conditions 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 in low blower or 15°C in high blower, while using alternate air, reduce manifold pressure limits 1 inch Hg for each 6°C above these limits. Reduce standard day MAP limit 6 inches when CAT indicator needle registers 50°C.

CAUTION

Do not shift constantly between direct air and alternate air in order to remain within the carburetor air temperature limits. When alternate air is necessary, use it until icing conditions no longer exist, remaining within manifold pressure limits as prescribed.

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 in manifold pressure. Throttle or refrigerative ice is not encountered in engines equipped with spinner injection system. “Carburetor ice” in these engines consists of ice or moisture in the air metering passages of the boost venturi hanger. Blockage of these passages causes loss of metering suction and eventual fuel starvation without affecting manifold pressure. The pilot, therefore, may receive no warning until the carburetor is heavily iced. Use of “ALTERNATE” air must be based on judgment rather than on any definite indication of icing. Carburetor icing can occur at ambient air temperatures of 15°C and below.

ICING. If icing conditions should be inadvertently 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 temperature 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 speed brake or landing gear so that more engine power will be required.

APPROACH

a. Landing gear and landing flaps require more time to operate in extremely low temperatures. Actuate brake pedals when lowering landing gear and on downwind leg to insure circulation of the sluggish fluid.

b. If icing conditions prevail, use alternate air.

LANDING

Use brakes sparingly and with caution. All unnecessary electrical loads should be reduced as soon as possible.

STOPPING ENGINE

OIL DILUTION. If temperatures below −4°C (+25°F) are anticipated prior to the next start when using grade 1100 oil, or below −18°C (0°F) when using grade 1065 oil and equipment is not available for preheating, the oil must be diluted as follows:

a. Request ground crew member to open the oil dilution manual shut-off valve.

Note

The oil dilution shut-off valve must be closed and safety-wired prior to flight.

b. Operate engine at 1000 to 1200 rpm.

c. Maintain the oil pressure above 15 psi.

d. Hold oil dilution switch in "OIL DILUTION" position for required period of time (see figure 9-2).

e. Throttle ..... "CLOSED"

CAUTION

If throttle is opened or left in the open position while the engine is shut down, sludge or congealed oil may cause the pilot valve or servo piston of the manifold pressure regulator to stick in the "increase throttle" position, resulting in a "runaway" condition during the next start.

f. Mixture control ..... "IDLE CUTOFF"

g. Ignition switch ..... "OFF"

h. Battery-generator switch ... "OFF" (after propeller stops turning)

i. Oil dilution switch ..... "OFF"

j. Have ground crew member close oil dilution manual shut-off valve.

Note

Battery-generator switch must be turned "OFF" before oil dilution switch is turned "OFF" in order to properly position the oil diverter valve for a cold start.

CAUTION

Use of oil dilution reduces the maximum amount of oil that can be carried. This should be considered in planning flights of long duration.

BEFORE LEAVING THE AIRCRAFT.

a. Have dirt and ice cleaned from shock struts.

b. Leave canopy slightly open for air circulation to prevent cracking of canopy due to differential contraction. Air circulation also retards formation of frost.

c. Check that protective engine coverings are installed.

d. Have fuel strainer pitot static drains, and fuel tank sump condensate drained within 30 minutes after stopping engines.

e. Whenever possible leave airplane parked with full fuel tanks as this prevents moisture from entering the fuel system.

f. If temperatures below −4°C (20°F) are anticipated and airplane is to remain idle for more than four hours, have batteries removed and stored in a heated room.

HOT WEATHER OPERATING PROCEDURES

Hot weather demands changes in the normal operating procedures for two reasons: first, air becomes less dense as temperature increases; and second, rubber and plastic components of the airplane are subject to damage by excessive heat. Take-off and landing rolls are longer, and stalls occur at a higher airspeed because of the rarefied air. Excessive heat makes additional precautions necessary to protect tires and canopy from damage.

BEFORE TAKE-OFF

a. Check tires for blisters.

b. Keep engine operation and taxi time to a minimum.

c. Use of the fuel boost pump during ground operation will help prevent vapor lock.

TAKE-OFF. Anticipate a longer take-off distance.

BEFORE LEAVING AIRPLANE

a. Leave canopy slightly open to permit air circulation within cockpit.

b. Make sure that protective covers are installed on pitot head, canopy, and intake ducts.

DESERT OPERATION

Desert operation is distinct from normal hot weather operation because of the presence of dust and sand. When operating under desert conditions, the normal hot weather procedure must be used, and in addition, it is extremely important to prevent external abrasion, and to prevent dust and sand from entering the aircraft systems. No single procedure can be given to cover all possible conditions of desert operation. The follow-

ing recommended procedure should be augmented whenever unique situations are encountered.

BEFORE ENTERING THE AIRPLANE

a. Check that exposed portions of shock struts and actuating cylinders are free from dust and sand. Clean with a cloth moistened with hydraulic fluid if necessary.

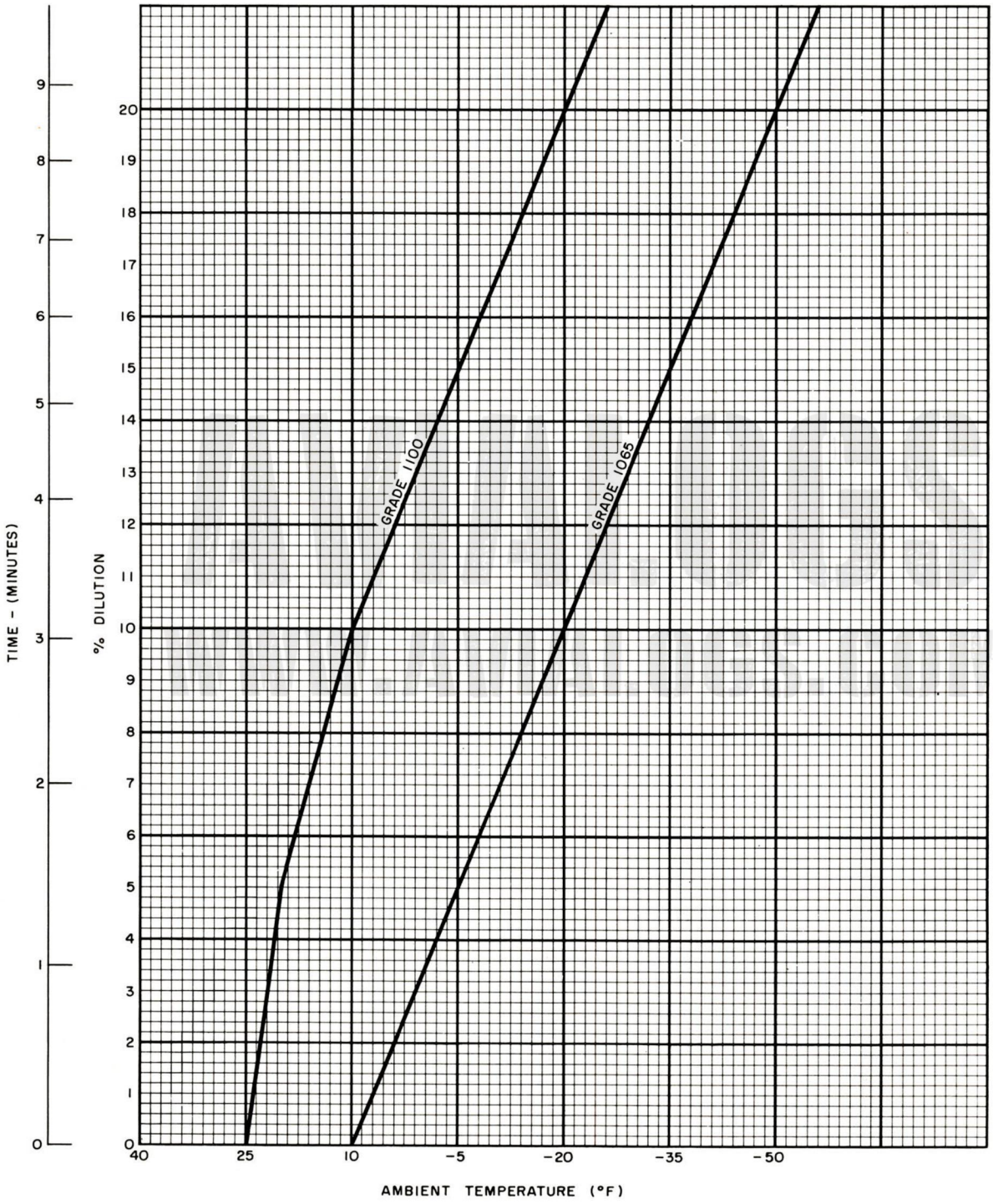
b. Check all air intakes (pitot tubes, carburetor air scoop, etc.) for accumulation of sand and dust.

c. Make sure that air, oil, and instrument filters are clean.

WARNING

Do not attempt to take-off in a sandstorm or dust storm. Park airplane down wind and shut off engine.

OIL DILUTION CHART



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