AN 01-40ALE-1

Flight Handbook

NAVY MODEL

AD-5

AIRPLANES

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

1 October 1955

Revised 1 February 1956

LIST OF REVISED PAGES ISSUED

INSERT LATEST REVISED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the current revision is indicated by a vertical line in the outer margins of the page.

Page No.	*Date of Latest Revision*
Flyleaf	1 February 1956
iii	1 February 1956
3	1 February 1956
7	1 February 1956
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92A	1 February 1956
93	1 February 1956
99	1 February 1956
100	1 February 1956
101	1 February 1956
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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 01-40ALE-501A. A discussion relative to the operation of the various systems in the airplane is contained in Section VII. Section VIII is not applicable to this airplane. Section IX consists of instructions for operating the aircraft under all weather conditions including instrument flight.

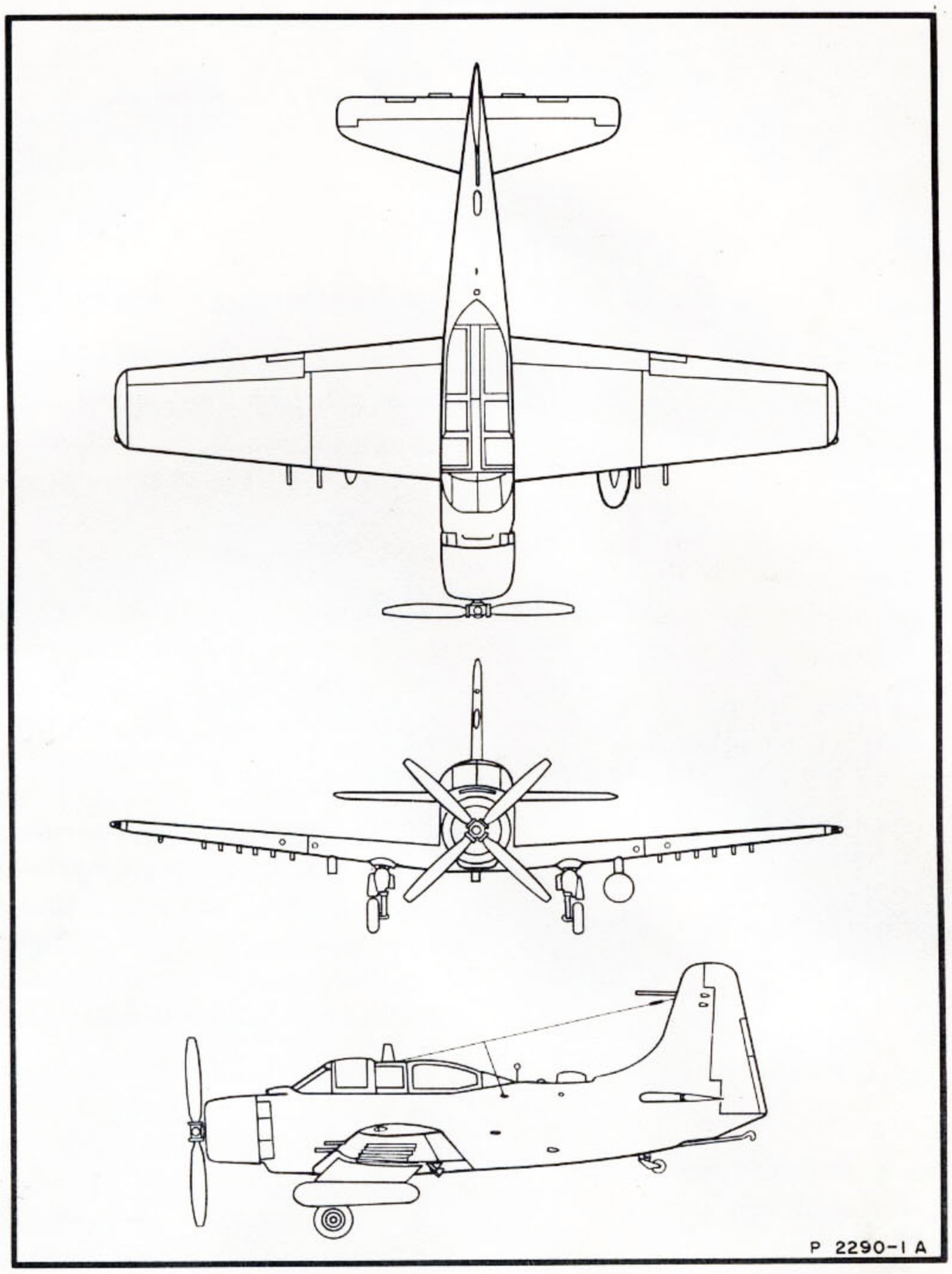
A Confidential Supplement, which is published under a separate cover, contains all flight operating data charts for the airplane and other Confidential material which is supplementary to this Flight Handbook. Refer to NavAer 01-40ALE-501A, Supplement to Flight Handbook, Navy Model AD-5 Aircraft.

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.



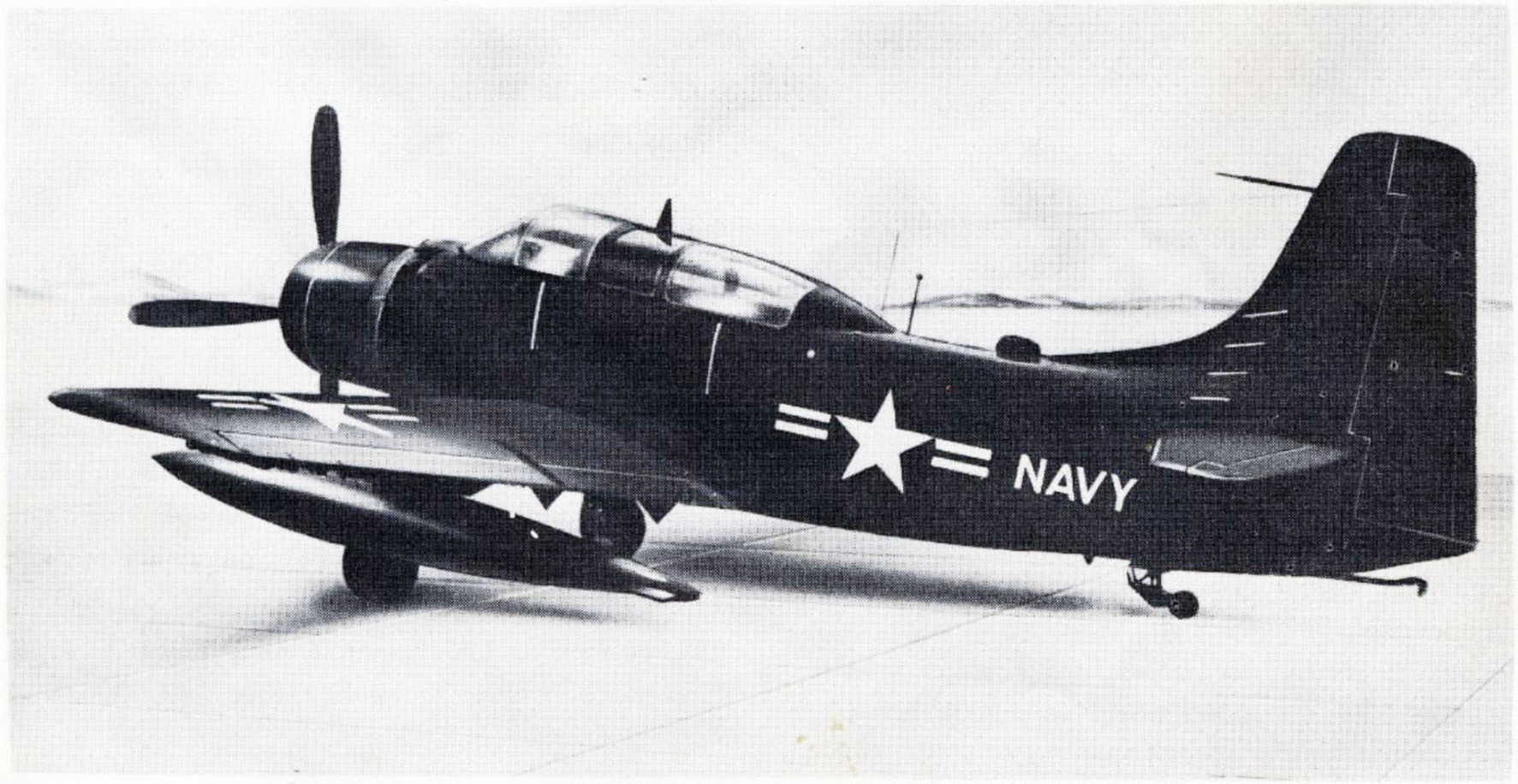


Figure 1-1. Model AD-5 Airplane

SECTION I
DESCRIPTION

THE AIRCRAFT

The Navy Model AD-5 airplane is a single-engine shore or carrier based aircraft manufactured by the Douglas Aircraft Company, Inc., El Segundo Division. Adapted from the basic AD series design, the AD-5 is a multi-purpose airplane developed to permit great versatility as an attack bomber or a utility aircraft. Provisions are made for an assistant pilot to be seated to the right of the pilot. For tactical use, the airplane is fully equipped to carry bombs, rockets, torpedoes, mines and other stores on external racks. Four 20 mm guns are installed in the wings. The airplane can be equipped with auxiliary tanks internally as well as externally for long range bombing operations. For utility purposes, the airplane can readily be equipped with passenger seats, facilities for carrying litters, or provisions which will permit the hauling of heavy cargoes. For general arrangement of the airplane, see figure 1-2.

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

Length	40 feet
Span (wings spread)	50 feet ¼ inch
Span (wings folded)	23 feet 11⅛ inches
Height (maximum over propeller)	15 feet 9⅝ inches
Height (over folded wings)	16 feet 7⅝ inches
Height (maximum during wing folding)	19 feet 4⅞ inches
Weight empty (approximate)	12,368 pounds
Useful load	6,471 pounds

COMPARISON WITH PRIOR MODEL AD-SERIES AIRPLANES. The most apparent difference between the Model AD-5 and previous Model AD-series airplanes is the enlarged cockpit canopy. Instead of the blister-type enclosure of the Model AD-4 airplane, the Model AD-5 has a canopy housing the pilot and assistant pilot side by side and extending aft a sufficient distance to cover space for cargo stowage or passenger facilities. Another outstanding difference is that the vertical surface area has been increased approximately 50 percent on the Model AD-5 airplanes. A further aid to recognition is that the previously used wing bomb rack fairings have been replaced with pylons which are designed with considerable forward "rake." In addition, the engine has been moved forward eight inches. To provide the Model AD-5 aircraft with special bombing capabilities, service changes will incorporate a water injection system, a revised instrument panel and the Mk 3 Mod 5 Bomb Director System.

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.

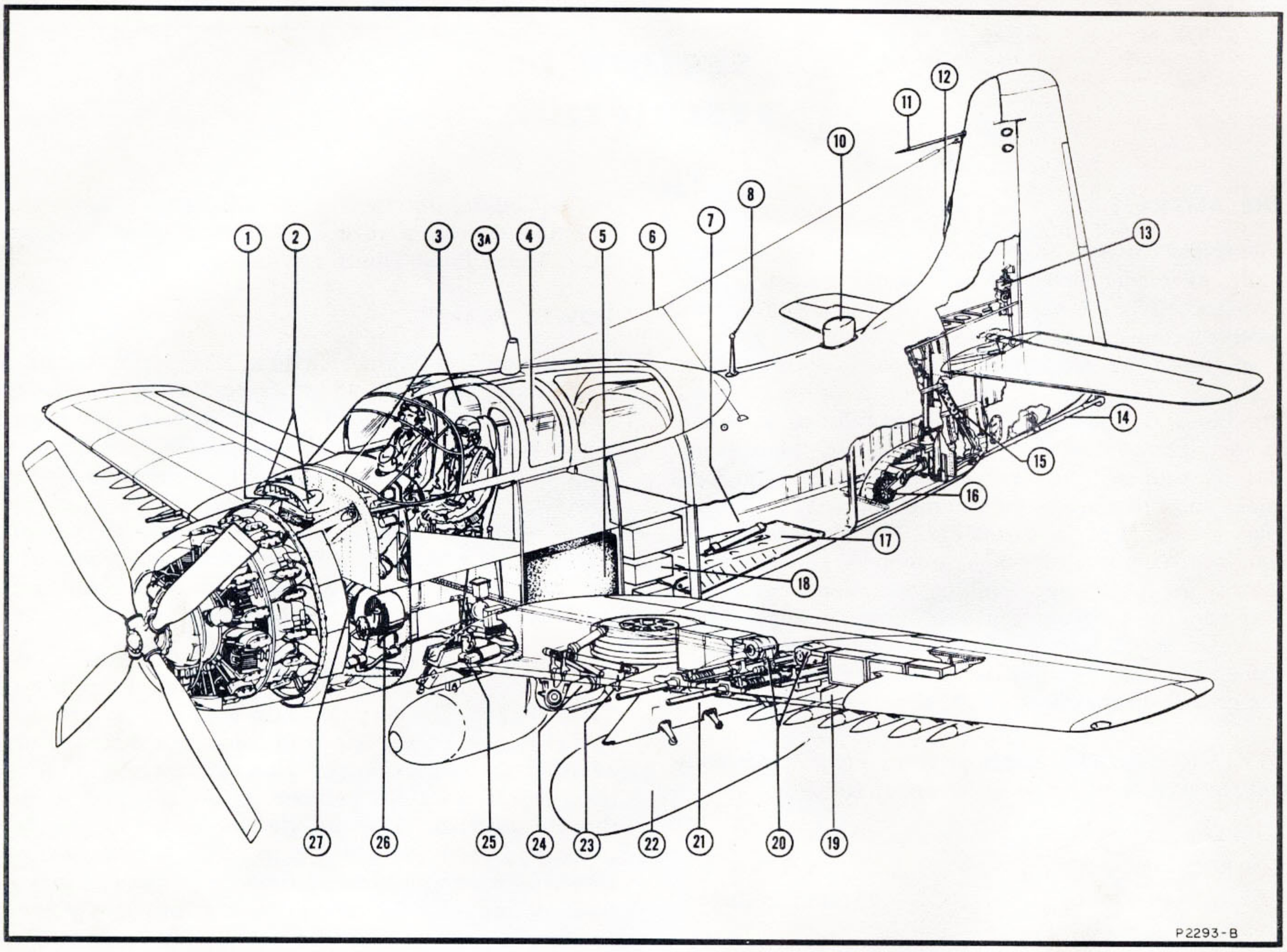
POWER PLANT CONTROLS

THROTTLE. The throttle lever (figure 1-3, reference 11), is located on the left-hand 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 has "OPEN" (aft) and "CLOSE" (forward) positions. A hand grip (figure 1-3, reference 15) 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.

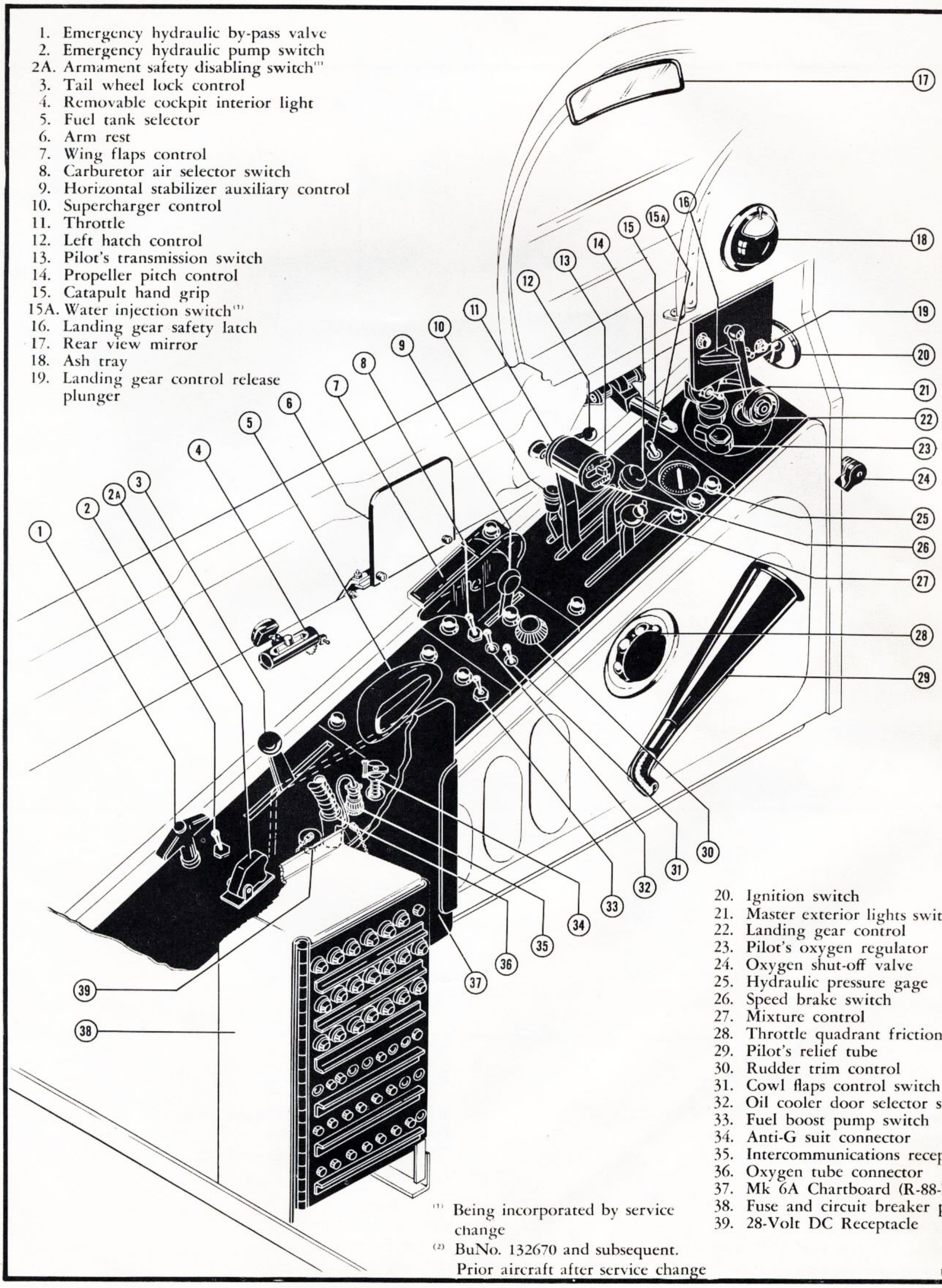
SUPERCHARGER. The supercharger control (figure 1-3, reference 10), located on the left-hand console just outboard of the throttle, has "LOW" and "HIGH" blower positions.

MIXTURE CONTROL. The mixture control lever (figure 1-3, reference 27), located on the left-hand con-



1. Carburetor air scoop
2. Cockpit heating and ventilating air intake ducts
3. Windshield and sliding enclosure
3A. UHF/VHF antenna for AN/ARC-27 or AN/ARC-1
4. Middle compartment
5. Main fuel cell
6. Sensing antenna for radio set AN/ARN-6
7. Aft compartment
8. Antenna for radio set AN/ARR-2A
9. Deleted
10. Radio compass antenna for radio set AN/ARN-6
11. Static boom
12. Middle compartment heating and ventilating air intake
13. Horizontal stabilizer actuating unit
14. Arresting hook
15. Arresting hook hold-down unit
16. Tail gear
17. Speed brake
18. Electronic equipment compartment
19. Outer station stores rack
20. Gun installation and ammunition storage
21. Inner stations stores rack
22. AN/APS-19C radar unit
23. Catapult hook
24. Landing gear
25. Centerline stores rack
26. Hydraulic reservoir
27. Oil tank

Figure 1-2. General Arrangement



1. Emergency hydraulic by-pass valve
2. Emergency hydraulic pump switch
2A. Armament safety disabling switch(1)
3. Tail wheel lock control
4. Removable cockpit interior light
5. Fuel tank selector
6. Arm rest
7. Wing flaps control
8. Carburetor air selector switch
9. Horizontal stabilizer auxiliary control
10. Supercharger control
11. Throttle
12. Left hatch control
13. Pilot's transmission switch
14. Propeller pitch control
15. Catapult hand grip
15A. Water injection switch(1)
16. Landing gear safety latch
17. Rear view mirror
18. Ash tray
19. Landing gear control release plunger
20. Ignition switch
21. Master exterior lights switch(2)
22. Landing gear control
23. Pilot's oxygen regulator
24. Oxygen shut-off valve
25. Hydraulic pressure gage
26. Speed brake switch
27. Mixture control
28. Throttle quadrant friction control
29. Pilot's relief tube
30. Rudder trim control
31. Cowl flaps control switch
32. Oil cooler door selector switch
33. Fuel boost pump switch
34. Anti-G suit connector
35. Intercommunications receptacle
36. Oxygen tube connector
37. Mk 6A Chartboard (R-88-B-645)
38. Fuse and circuit breaker panel
39. 28-Volt DC Receptacle

(1) Being incorporated by service change

(2) BuNo. 132670 and subsequent. Prior aircraft after service change

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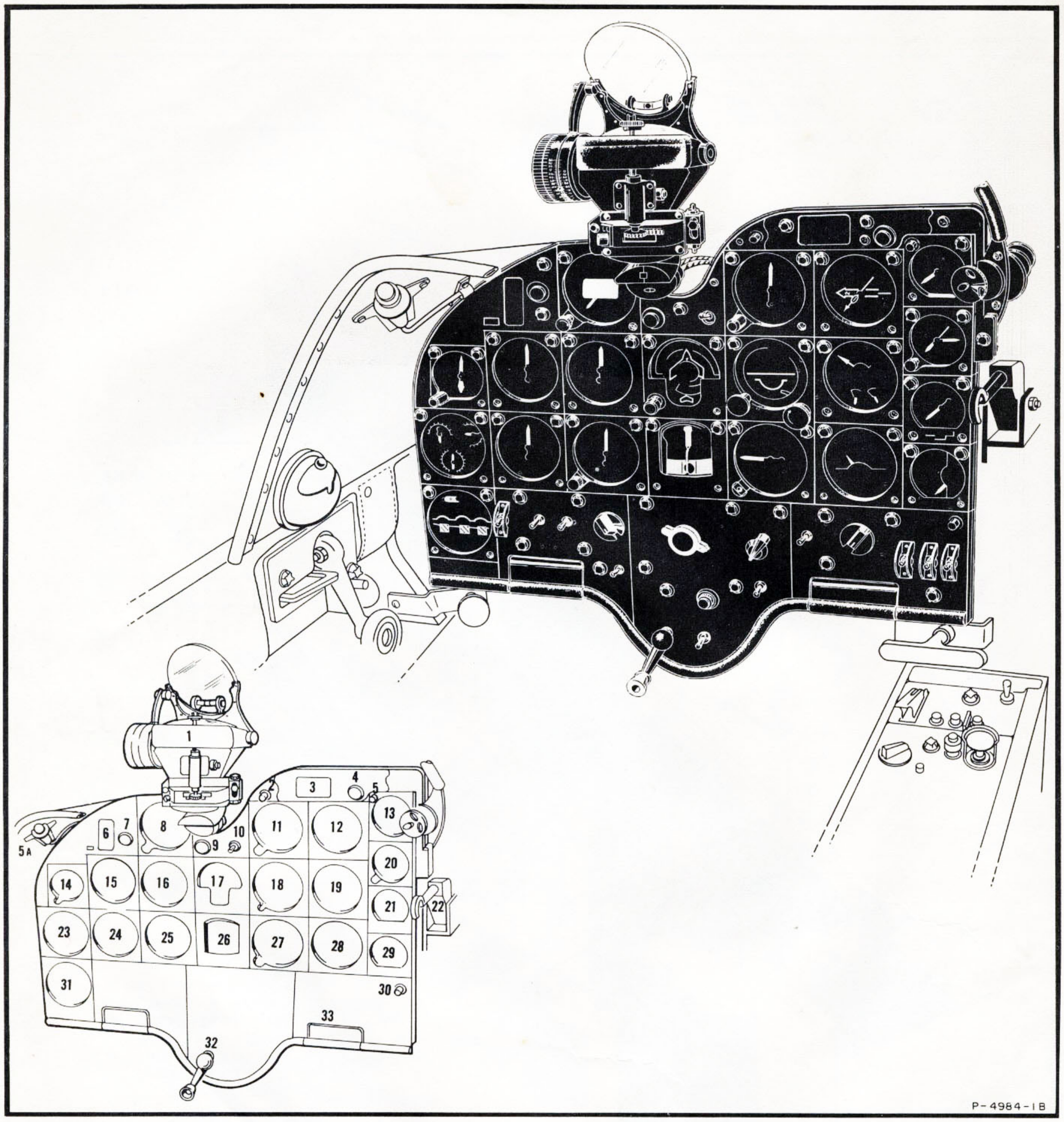
Figure 1-3. Cockpit—Left Side



1. Mk 20 Mod 4 gunsight
2. Pilot's windshield degrease control
3. Take-off check list
4. Fuel pressure warning light
5. Fuel quantity indicator test switch

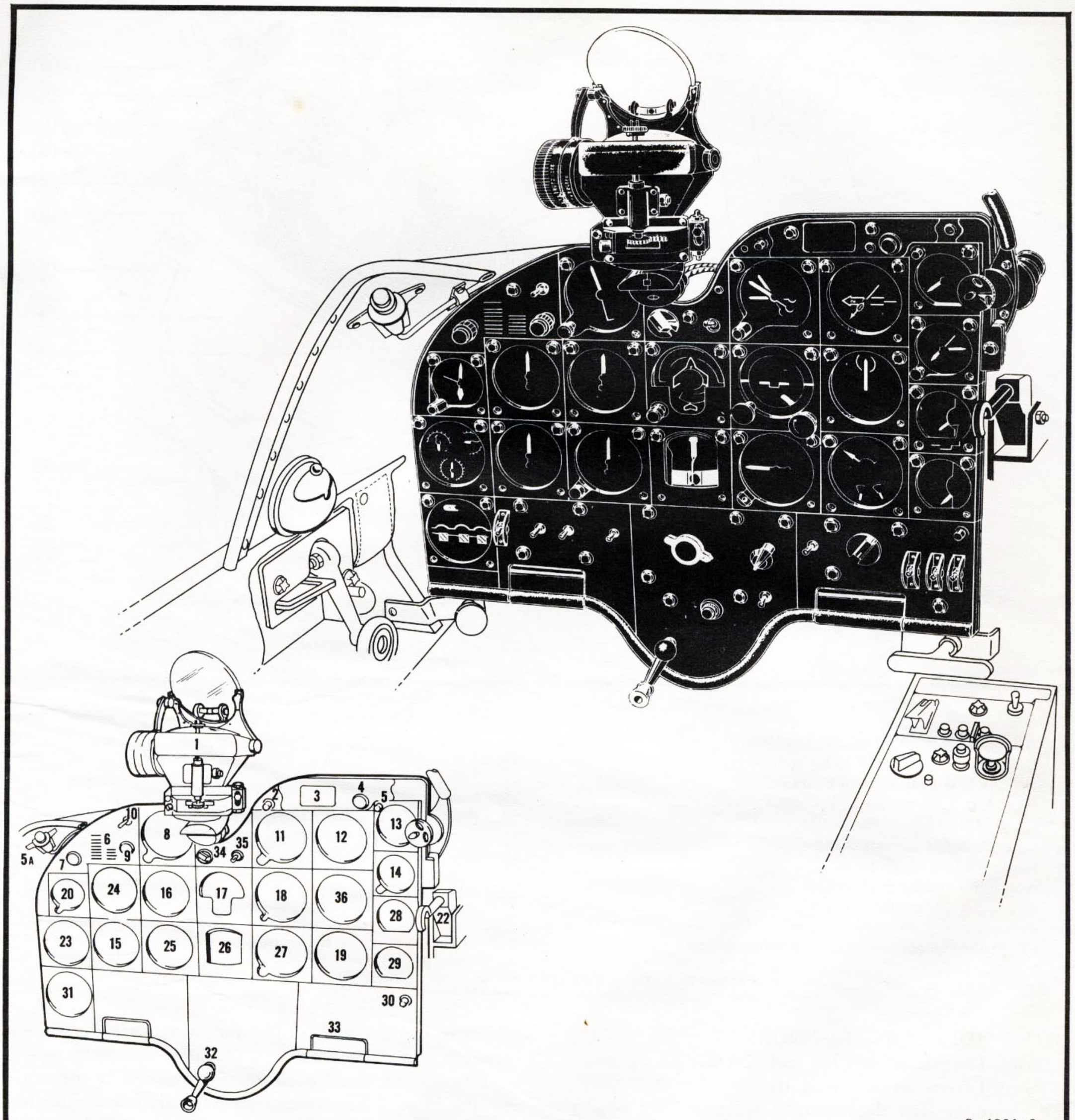
5A. Mk 3 Mod 4/5 bomb director light

6. Landing check list
7. Altitude limit indicating light(1)
8. AN/APN-1 radar altimeter(1)
   AN/APN-22 radar altimeter(2)
9. Marker beacon light
10. G-2 compass control switch
11. Accelerometer
12. ID-250/ARN course indicator
13. Fuel quantity indicator
14. Elapsed time clock
15. Tachometer
16. Airspeed indicator
17. G-2 compass indicator
18. Gyro horizon
19. Engine gages unit

(1) BuNo. 132392 through 132440.
(2) BuNo. 132441 and subsequent.

Before Service Change

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



20. Eight-day clock
21. Front bank oil pressure gage
22. Tail hook control
23. Trim position indicator
24. Manifold pressure gage
25. Pressure altimeter
26. Turn and bank indicator
27. Rate of climb indicator
28. Cylinder head temperature indicator
29. Carburetor-outside air temperature indicator
30. Outside air temperature selector switch
31. Landing gear and flaps position indicator
32. Rudder pedals adjustment crank
33. Aileron power boost release control (or) Outer stations jettison handle[1]
34. Gunsight light rheostat
35. Gunsight light filament switch
36. Torque indicator

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[1] BuNo. 132471 and subsequent.

After Service Change

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

the PRIMER switch (figure 1-5, reference 15) on the 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 (figure 1-5, reference 14) on the 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 (figure 1-3, reference 31) on the left-hand 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 anti-drag ring to the right of the top center line when the nose flaps are closed. This indicator must be observed from the assistant pilot's seat. On later aircraft(1) the indicator has been lengthened so that its position may be seen from the pilot's seat.

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 (figure 1-3, reference 32) on the left-hand console inboard of the cowl flap switch. Indicated positions are "AUTO," "OPEN," "CLOSE," and "OFF." The OIL COOLER DOOR switch is spring-loaded in the "OPEN" and "CLOSE" position and returns to "OFF" when released.

WATER INJECTION

Water injection equipment will be incorporated in these airplanes by service change. Aircraft having the water injection equipment installed may be identified by the presence of a WATER INJECTION master switch on the left-hand console. A 12½-gallon tank, located in the aft compartment, supplies fluid for approximately 5 minutes of operation. The tank filler is located in a well in the fuselage side aft of the port wing. The water injection system is actuated when the throttle is moved beyond 50 inches manifold pressure whenever the WATER INJECTION master switch is "ON."

PROPELLER

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

Note

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

OIL SYSTEM

The oil tank is located forward of the firewall and has a service capacity of 38.5 U.S. gallons. (See figure 1-11 for oil grade and specification.) The oil system is automatic in operation. Oil dilution controls are provided. The oil temperature and rear oil pressure are indicated on the engine gage unit (figure 1-4, reference 19). A separate gage (figure 1-4, reference 21) is provided for front oil pressure. (The front bank oil pressure gage is not installed in those airplanes which have been equipped by service change with the new instrument panel.)

OIL DILUTION. Oil dilution is controlled by a combination OIL DILUTE-PITOT HEAT switch (figure 1-5, reference 16) located on the 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 (figure 1-2, reference 5) is provided in the fuselage under the middle compartment deck. 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 or 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 Section V for operating limits when using either the normal or the alternate fuel grade. See also figure 1-11 for fuel grades and specifications.

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

FUEL PRESSURE WARNING LIGHT. A warning light (figure 1-4, reference 4) mounted on the instrument panel, warns the pilot of loss in fuel pressure in time for him to switch from a drop tank to another

(1) BuNo. 132645 and subsequent. Prior aircraft after service change.

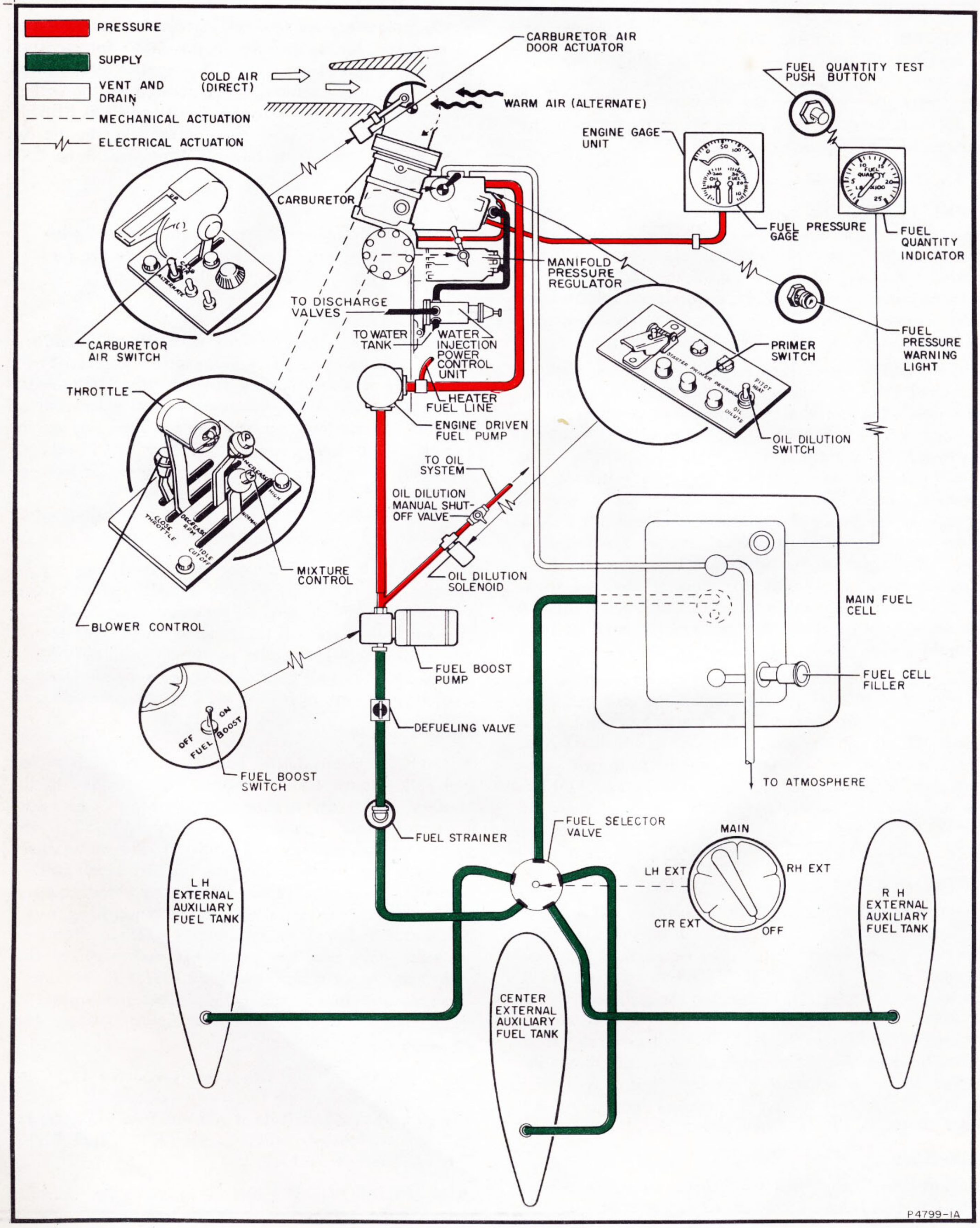

Figure 1-6. Fuel System

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 MK8 - MOD 1	300	*	*	300
RH EXT				
MK 12, OR AERO 1A	150	*	*	150
AERO 1A OR MK8 - MOD 1	300	*	*	300
INTERNAL AUXILIARY				
LEFT	155	0	2	157
RIGHT	155	0	2	157

* 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
(3) Main and two internal auxiliary tanks	688
(4) Main, two small external tanks and two internal auxiliary tanks	988

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Figure 1-7. Fuel Quantity Data Table

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 (figure 1-3, reference 33) on the left-hand 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 (figure 1-4, reference 13) 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.

Note

Gasoline varies in weight per gallon dependent upon the specific gravity of the fuel; therefore, the pilot should anticipate variations in the fuel quantity indication when the tank is full.

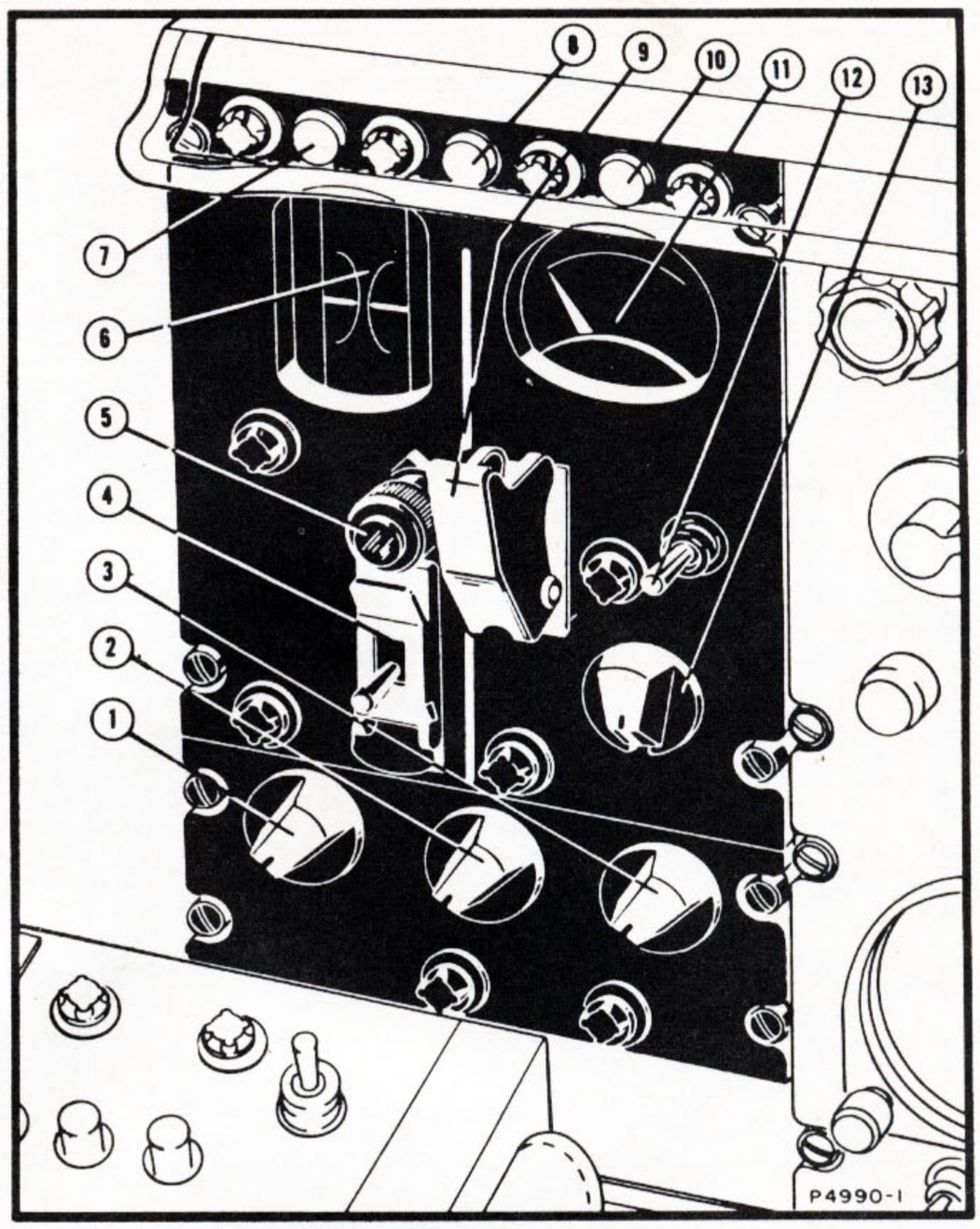
INDICATOR TEST SWITCH. A push button switch labeled FUEL QUAN TEST (figure 1-4, reference 5), mounted on the instrument panel, is used in testing the operation of the fuel quantity indicator. When the test switch is pushed in, a fuel-tank-empty impulse is fed to the fuel quantity indicator circuit. The 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 SALVO RELEASE, INNER STATIONS, Section IV). The tanks also can be released manually by means of the CTR WING BOMB RELEASE handle (figure 4-6A, reference 15).

ELECTRICAL POWER SUPPLY SYSTEM

The electrical system of the airplane is supplied d-c power by an engine-driven generator and two 24-volt, 24 ampere-hour batteries. A-c power is supplied by another engine-driven generator and two d-c powered inverters. The d-c generator will deliver a full load of 400 amperes at 28 volts. The a-c generator delivers a full load of 9 KVA and, in case of d-c generator failure (in earlier aircraft), will supply d-c power through a rectifier. Following d-c generator failure in later aircraft,[1] the a-c generator is utilized to supply 26-volt a-c power for cockpit lighting only. For ground check or for starting operation, an a-c and a d-c external power receptacle are recessed together in the lower

[1]BuNo. 133862 and subsequent.



1. Flight instrument lights rheostat
2. Non-flight instrument lights rheostat
3. Console lights rheostat
4. Battery-generator switch
5. D-C generator warning light
6. D-C voltammeter
7. D-C voltmeter test jack
8. Common ground test jack
9. A-C generator field switch
10. A-C voltmeter test jack
11. A-C voltmeter
12. A-C power selector switch
13. A-C voltmeter phase selector switch

Figure 1-7A. Electrical Power and Interior Lights Panels

surface of the wing just inboard of the right wheel well. The external power receptacle and circuit are designed to allow the use of one airplane to supply power for starting another through use of an electrical jumper cable, and external power starting switch in the right wheel well.[2]

CONTROLS AND INDICATORS

BATTERY-GENERATOR SWITCH. The battery-generator switch on the assistant pilot's forward panel (figure 1-7A, reference 4) has "BAT ONLY," "BAT & GEN," and "OFF" positions. The switch is normally placed in "BAT & GEN." This action connects battery and d-c generator power to the d-c tie bus. The "BAT ONLY" position is for emergency use.

[2]BuNo. 132425 and subsequent. Prior aircraft after service change.

BATTERY POWER

GENERATOR POWER

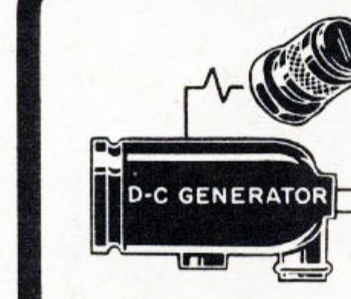
INVERTER POWER

NOTES

(A) NUMBERS PRECEDING ELECTRICAL UNITS INDICATE LOAD AMPERAGE.

(B) LOADS NOT GIVEN ARE CONSIDERED NEGLIGIBLE.

	CONDITION	BATTERY-GENERATOR SWITCH POSITION	GENERATOR	LANDING GEAR CONTROL HANDLE POSITION	EXTERNAL POWER	PRIMARY BUS	SECONDARY BUS	MONITOR BUS
WITHOUT EXTERNAL POWER	1	BAT & GEN	OPER	UP OR DOWN	OFF	HOT	HOT	HOT
	2	BAT & GEN	INOPER	UP	OFF	HOT	OFF	OFF
	3	BAT & GEN	INOPER	DOWN	OFF	HOT	HOT	OFF
	4	BAT ONLY	INOPER	UP OR DOWN	OFF	HOT	HOT	OFF
	5	OFF	INOPER	UP OR DOWN	OFF	OFF	OFF	OFF
WITH EXTERNAL POWER	6	OFF	INOPER	DOWN	ON	HOT	HOT	HOT
	7	OFF	INOPER	UP	ON	HOT	OFF	HOT
	8	BAT ONLY	INOPER	UP	ON	HOT	HOT	HOT



GENERATOR WARNING LIGHT

BAT & GEN

OFF

BAT ONLY

BATTERY

BATTERY

BATTERY-GENERATOR SWITCH

EXTERNAL POWER

BATTERY BUS

ALWAYS ENERGIZED REGARDLESS OF BATTERY-GENERATOR SWITCH POSITION.

IFF DESTRUCT

SECONDARY BUS

ENERGIZED THROUGH PRIMARY BUS BY BATTERY, GENERATOR OR EXTERNAL POWER. IF GENERATOR FAILS, THE LANDING GEAR CONTROL HANDLE MUST BE "DOWN" OR THE BATTERY - GENERATOR SWITCH AT "BAT ONLY" TO ENERGIZE SECONDARY BUS.

PRIMARY BUS (1)

SERVES AS POWER DISTRIBUTING POINT FOR ALL BUSSES EXCEPT BATTERY BUS.

ARMAMENT BUS

ENERGIZED THROUGH PRIMARY BUS PROVIDED MASTER ARMT SWITCH IS "ON" AND LANDING GEAR CONTROL HANDLE IS "UP"

MONITOR BUS

ENERGIZED ONLY BY GENERATOR OR EXTERNAL POWER

EXTERNAL POWER

ENERGIZES ALL BUSSES EXCEPT BATTERY BUS.

- 93 HYDRAULIC AUXILIARY PUMP
- 50 HORIZONTAL STABILIZER
- 18 UHF TRANSMITTER (AN/ARC-27A)
- 15 FUEL BOOSTER PUMP
- 14 UHF RECEIVER (AN/ARC-27A)
- 13 POSITION & APPROACH LIGHTS
- 10 FLARE DISPENSER
- 9 PITOT HEAT (STABILIZER)
- 8 BOMB DIRECTOR
- 6 SEATS
- 4 SERVICE LIGHTS
- 4 PITOT HEAT (WING)
- 3 RADAR ALTIMETER (AN/APN-1 OR -22)
- 3 WINDSHIELD DEGREASE
- 3 LF ADF (AN/ARN-6)
- 2 OIL COOLER
- 2 MARKER BEACON (AN/ARN-12)
- 1 VHF HOMING (AN/ARR-2A)
- 1 OIL DILUTE
- 1 UHF ADF (AN/ARA-25)
- 1 CARBURETOR AIR
- 1 SPEED BRAKE
- 1 TRIM TABS
- IFF (AN/APX-6)
- GUN CHARGER
- PRIME-START
- LANDING GEAR RETRACT RELEASE
- COWL FLAPS
- WATER INJECTION

- 4 CONSOLE LIGHTS
- 3 NUMBER ONE INVERTER
- 2 D-C INSTRUMENTS
- 1 COMPASS AMPLIFIER
- 1 ICS AN/AIC-4A)
- 1 FLIGHT INSTRUMENT LIGHTS
- 1 NON-FLIGHT INSTRUMENT LIGHTS
- WARNING LIGHTS

- 1 INTERVAL GENERATOR
- 1 GUNSIGHT
- 1 SPRAY TANK
- LH HEAT
- CTR HEAT
- RH HEAT
- NOSE ARMING
- TAIL ARMING
- ROCKET LATCH
- ARMAMENT TRIGGER

- 51 NUMBER TWO INVERTER
- 20 UTILITY RECEPTACLES
- 3 SEARCH RADAR (AN/APS-19C)
- 3 GUN CAMERA
- 1 CABIN HEATER
- A-C POWER CONTROL

VA	INVERTER 1
56	COMPASS AMPLIFIER
23	FUEL GAGE
12	LF ADF TUNE (AN/ARN-6)
8	COURSE INDICATOR
7	UHF ADF (AN/ARA-25)
5	GYRO HORIZON
2	LF ADF RECEIVE (AN/ARN-6)
	VOLTMETER

VA	INVERTER 2
218	IFF (AN/APX-6)(2)
151	AUTO PILOT
70	WEAPON (T-145)
56	COMPASS AMPLIFIER
34	COMPASS ADAPTER
23	FUEL GAGE
21	ALTIMETER (AN/APN-22)
12	LF ADF TUNE (AN/ARN-6)
8	COURSE INDICATOR
7	UHF ADF (AN/ARA-25)
5	GYRO HORIZON
2	LF ADF RECEIVE (AN/ARN-6)
	TORQUE INDICATOR
	VOLTMETER

A-C BUSSES

INVERTER 1

INVERTER 1

FLIGHT INSTRUMENT

POWER FAILURE WARNING LIGHT

INVERTER 2 AND AUTO PILOT

INVERTER 2

FLIGHT INSTRUMENT POWER SELECTOR SWITCH

(1) THE PRIMARY BUS, BUNO 133862 AND SUBSEQUENT, IS CALLED D-C TIE BUS ON PRIOR AIRCRAFT.

(2) BUNO 133902 AND SUBSEQUENT

P-6204-1B

D-C Power and Constant Frequency A-C Power Distribution

Figure 1-8. Electrical System (Sheet 1)

WARNING

Should it become necessary to move the battery-generator switch to "BAT ONLY," FIRST TURN OFF ALL NONESSENTIAL EQUIPMENT to prevent rapid depletion of 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 1600 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.(1)

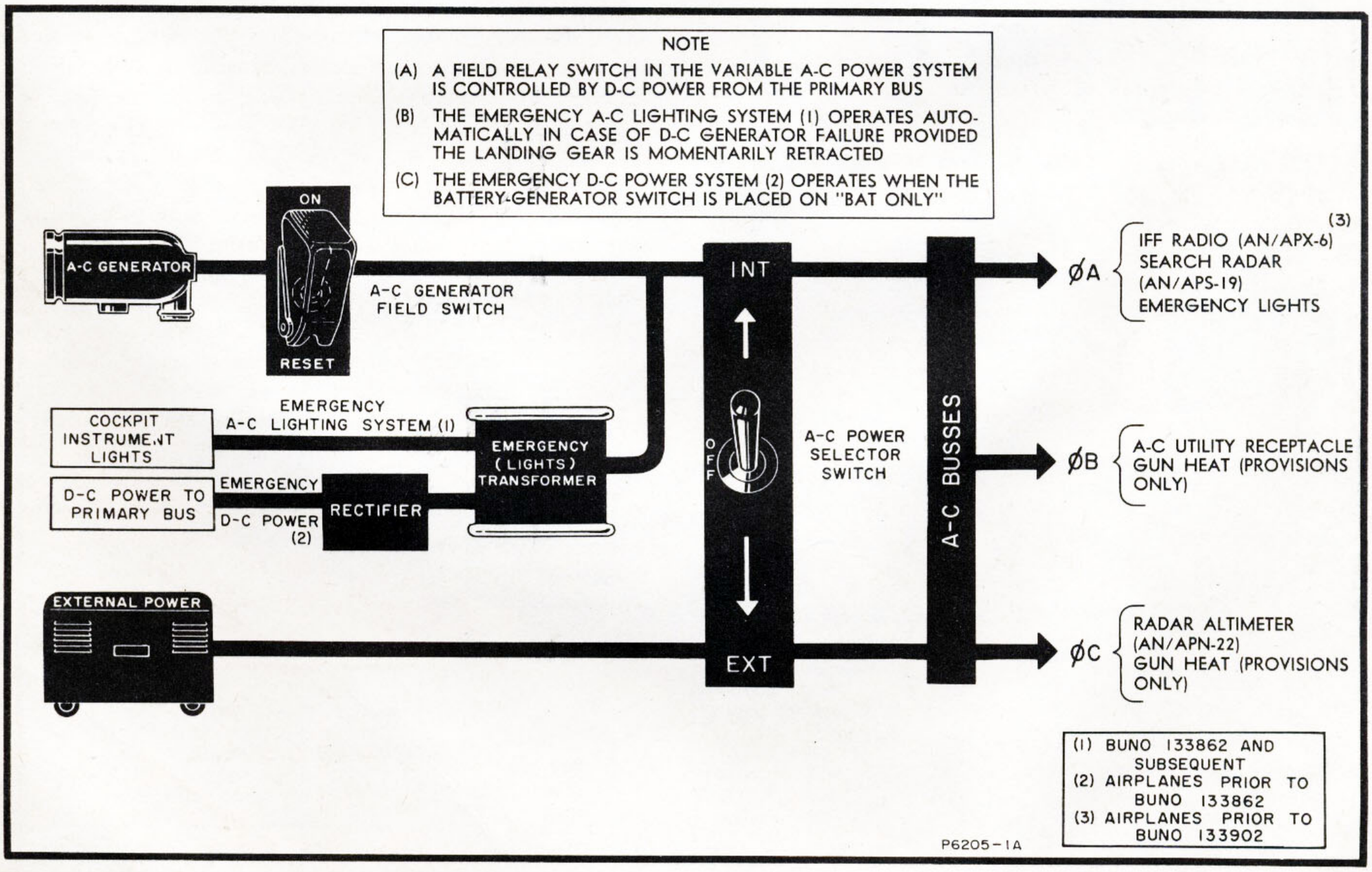
A-C GENERATOR SWITCH. The A-C GEN FIELD switch is located on the assistant pilot's forward panel (figure 1-7A, reference 9). The purpose of the a-c generator field switch is to disconnect the a-c generator from the a-c bus system in the event of generator failure and should be used only in an emergency or to reset the fault protection system after a fault has been corrected. The A-C GEN FIELD switch should be "ON" at all times during normal operations.

GENERATOR WARNING LIGHT. A generator warning light (figure 1-7A, reference 5) for the d-c generator is installed on the assistant pilot's forward panel. An illuminated warning light indicates that the reverse current relay is open and the d-c generator is not supplying power to the system. The warning light is of the push-to-test type.

A-C VOLTMETER AND D-C VOLTAMMETERS. One d-c voltammeter and one a-c voltmeter are located on the assistant pilot's forward panel (figure 1-7A, references 6, 11). The a-c voltmeter indicates the voltage of the phase to which the phase selector switch is turned. Either phase of the a-c generator or the inverter supplying the power can be selected.

A-C EXTERNAL POWER SWITCH. The A-C PWR switch located on the assistant pilot's forward panel

(1) BuNo. 132425 and subsequent.



Variable Frequency A-C Power Distribution

Figure 1-8. Electrical System (Sheet 2)

Figure 1-8 (Sheet 3). Deleted

Figure 1-8 (Sheet 4). Deleted

must be moved to the "EXT" position to utilize an external source of a-c power. When this switch is so positioned, the a-c generator is disconnected from the a-c busses. The A-C PWR switch must be returned to the "INT" position for normal a-c operation.

D-C POWER DISTRIBUTION

Five electrical busses distribute d-c power throughout the airplane. The circuit breaker panels are located on either side of the passageway between the cockpit and the middle compartment, and on the floor just forward of the assistant pilot's seat. The latter panel is reached through an access door labeled CIRCUIT BREAKER PANEL 16. Circuit breakers operated off the various busses are shown in figure 1-8. The fuse and circuit breaker panels are shown in figure 1-9.

PRIMARY BUS. The primary bus is energized when the battery-generator switch is moved to either the "BAT ONLY" or the "BAT & GEN" position or if an external d-c power supply is connected to the airplane. With d-c generator failure, the a-c generator supplies d-c power through a rectifier to the primary bus only if the battery-generator switch is in "BAT ONLY." With failure of both generators the battery supplies the primary bus with power.

MONITOR BUS. The monitor bus is energized if d-c power is being supplied by the d-c generator or if an external d-c power supply is connected to the airplane.

SECONDARY BUS. With the battery-generator switch at the "BAT & GEN" position and the d-c generator charging, the secondary bus is energized. In case the d-c generator fails, all loads operating from the secondary bus will be without power if the landing gear control handle is "UP." Under this condition, the secondary bus can be re-energized with d-c power from the battery either by moving the battery-generator switch to "BAT ONLY" or by moving the landing gear control handle to "DOWN."

ARMAMENT BUS. The armament bus is energized whenever the secondary bus is energized, provided the master armament switch is "ON."

BATTERY BUS. The battery bus is always energized when the battery is connected in the airplane.

A-C POWER DISTRIBUTION

The a-c electrical system is provided with power from the a-c generator and from two inverters. With failure of the a-c generator, circuits connected to the a-c bus (figure 1-8, sheet 2) are inoperative and should be turned off. The inverters get power from the d-c generator and will continue to supply power to their circuits regardless of the condition of the a-c generator. With failure of both generators, the battery will supply power to the number one inverter to operate essential a-c equipment. When operating a-c equipment with power from an outside source, the A-C PWR switch must be in the "EXT" position.

EMERGENCY A-C LIGHTING SYSTEM.[1] In later aircraft, the a-c generator will supply power only to the FLT INSTR and the NON-FLT INSTR lights if the d-c generator should fail. A-c power for the lights is reduced to 26 volts through a transformer in the emergency system. All equipment that normally operates on a-c generator power will be inoperative since loss of the d-c generator power de-energizes the monitor bus and thereby shuts off d-c current required to actuate the a-c power circuit.

INVERTERS. Two inverters supply the constant frequency a-c power required. The number one inverter receives its power from the primary bus while the number two inverter obtains its power from the d-c tie bus (or primary bus[1]) and is controlled by the monitor bus. Refer to figure 1-8 (sheet 1) for list of equipment using inverter power.

INVERTER SELECTOR SWITCH. Although both inverters are normally in constant operation, manual selection of inverter power for certain functions is possible by means of the FLT INSTR PWR SEL switch which incorporates two positions—"INVERTER 1" and "INVERTER 2 & AUTO PILOT." 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 and the number two inverter is supplying power to electronic equipment. When the FLT 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, besides the other equipment already indicated.

INVERTER WARNING LIGHT. A warning light labeled FLT INSTR PWR FAILURE is located on the auto pilot control panel. Illumination of the warning light indicates failure of the selected inverter to provide sufficient power to operate the flight instruments properly. In this case, the FLT INSTR PWR SEL switch must be placed in the alternate inverter position. If the light does not go out within a few seconds, the alternate inverter is not operating. There will be, therefore, no power for flight instruments, and the flight should be terminated as rapidly as conditions permit.

WARNING

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

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(1) BuNo. 133862 and subsequent.
(2) BuNo. 132639 and subsequent. Prior aircraft after service change.

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, operating at a pressure of 2600 to 3000 psi, receives its pressure from one engine-driven hydraulic pump. The hydraulic system pressure gage (figure 1-3, reference 25) indicates the pressure of the main system only. This system, which incorporates an accumulator, supplies pressure for operating the power boost wheel brakes, actuating the forward hatches, opening and closing the dive brake, extending and retracting the landing gear and landing flaps, retracting the tail hook, folding and unfolding the wings, and charging the guns.

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 in 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 (figure 1-3, reference 1), which is located on the left-hand 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 (figure 1-3, reference 2) 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 BOOST HYDRAULIC SYSTEM. The aileron boost hydraulic system operates on pressure from a separate engine-driven hydraulic pump. No pressure indication is provided. A manual disconnect (figure 1-4, reference 33 and figure 1-5, reference 1) is provided to release the aileron control system from the boost system in the event of failure of the aileron boost system.

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 (figure 1-4, reference 32) located just below the instrument panel.

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. Controllable trim tabs are located on the rudder and left-hand aileron. The entire surface of the horizontal stabilizer is used to produce trim. Aileron and elevator trim is controlled by an electrical thumbswitch (figure 4-5) on top of the pilot's control stick. Movement of the switch left or right controls lateral trim; fore and aft, longitudinal trim. Rudder trim is controlled by rotation of the rudder trim knob, labeled NOSE LEFT-RIGHT, on the left-hand console (figure 1-3, reference 30). A horizontal stabilizer trim control (figure 1-3, reference 9) on the left-hand console is provided as an override for the stick control. The movement of the override control, labeled NOSE DOWN-UP, is fore and aft. An indicator is provided on the pilot's instrument panel (figure 1-4, reference 23) which shows the position of the three trimming surfaces.

WARNING

- When using the horizontal trim control, ensure that it is returned to the neutral position after actuation.
- Do not set the horizontal stabilizer in the nose-up range at indicated airspeeds in excess of the airspeed limitation for nose-up trim given in Section V.

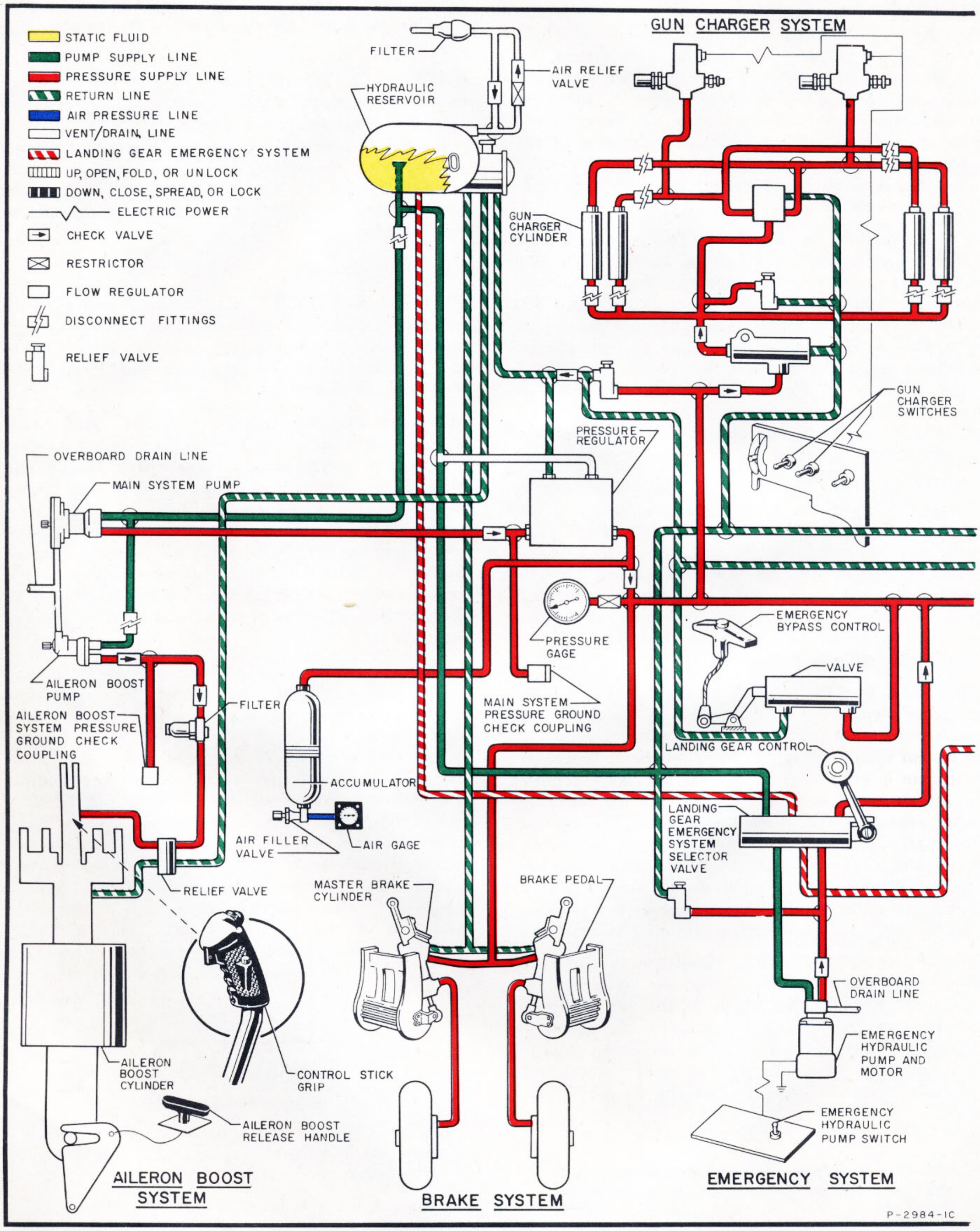


Figure 1-10. Hydraulic System (Sheet 1)

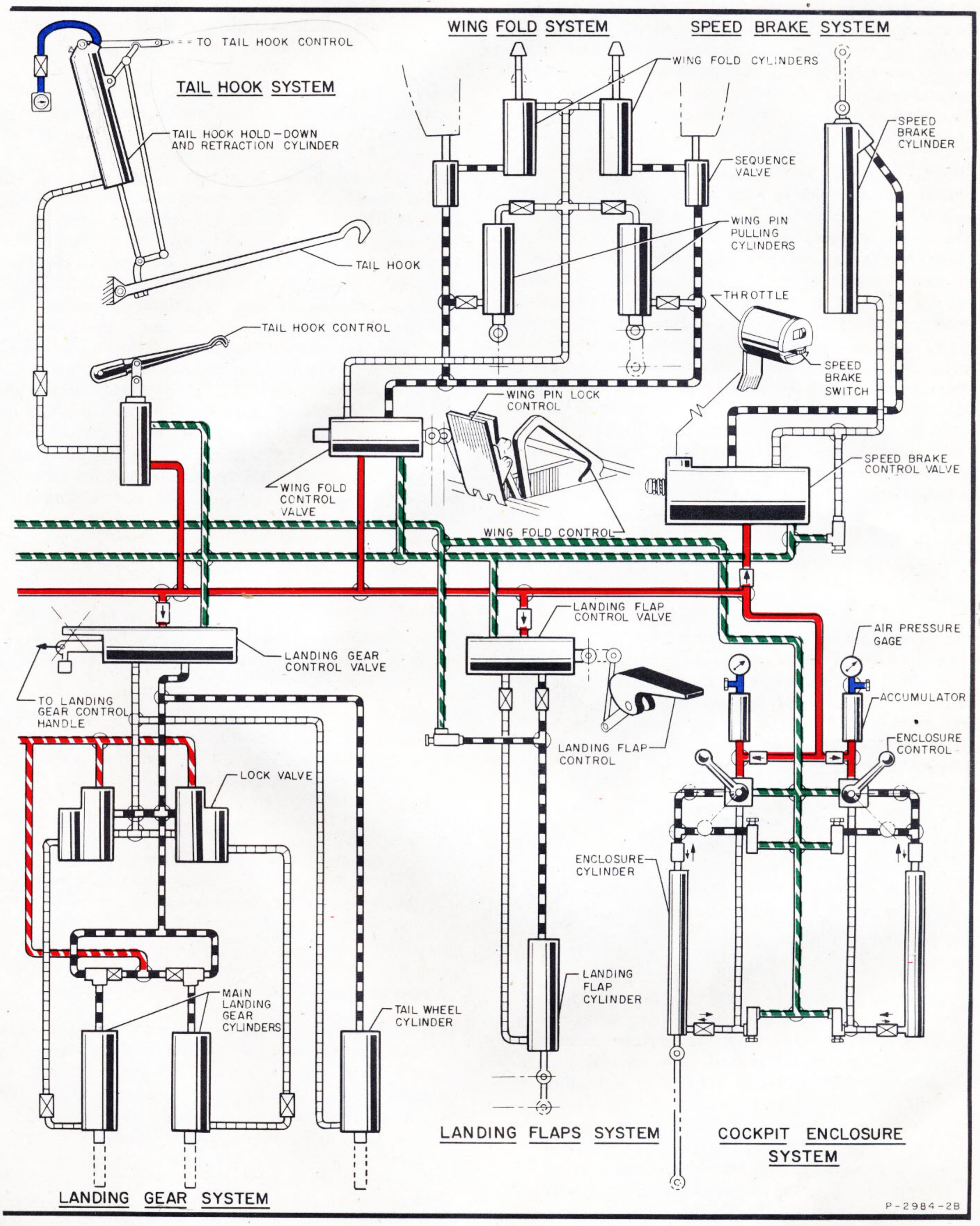


Figure 1-10. Hydraulic System (Sheet 2)

WING FLAPS. The wing flaps are hydraulically operated and controlled by a lever (figure 1-3, reference 7) located on the left-hand console just outboard of the engine controls. A wing flap position indicator (figure 1-4, reference 31) is provided on the instrument panel. The flaps should not be lowered at speeds in excess of 130 knots.

SPEED BRAKE. The hydraulically operated fuselage-bottom speed brake is actuated by the SPEED BRK switch on the throttle grip (figure 1-3, reference 26). 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."

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.

CAUTION

(1)The painted stripes around the inboard gun barrels should be forward of the leading edge of the wings before actuating controls to fold or spread wings.

Note

Because of possible damage to the wing fold wire bundle and guide and the wing structure, it should be noted from the cockpit whether the painted stripe around each inboard gun barrel is visible before folding or spreading wings. If the guns have moved aft they should be repositioned by actuating the gun charger switch to "SAFE" and left in this position until cleared. An alternative procedure to reposition the guns, accomplished only after it has been ascertained that the guns are clear, with no ammunition in the feeder mechanism, and the breech block has not become unlocked, would be to actuate the gun charger switch to "READY" and back to the "OFF" position.

WING FOLDING CONTROLS. The wing folding controls are located on the center console (figure 1-5, reference 7). A WING PIN LOCK door type control, incorporating a spring loaded lock lever on the under side, operates the locking pin latches. The WING FOLD handle, located in the recess under the WING PIN LOCK door, controls the folding operation. To fold the wings, first press the lock lever and lift and rotate the WING PIN LOCK door counterclockwise until full movement is effected (approximately 130 degrees) and the lock lever falls into the detent. This will unlatch the wing locking pins and expose the WING FOLD handle. Next, lift and rotate the WING FOLD handle clockwise approximately 75 degrees. To spread the wings depress the WING FOLD handle into the recess. After the wings are fully spread, press the spring loaded lock lever out of the detent and close the WING PIN LOCK door, making certain that it is locked and flush with the console and that the two warning "flags" are retracted into the leading edge of the wing.

CAUTION

- The WING PIN LOCK door must be opened to its fullest extent and the spring loaded lock lever seated in its detent before lifting the WING FOLD handle.
- Both the WING PIN LOCK door and the WING FOLD handle should be kept in their open (unlocked and folded) positions at all times when the wings are folded.

Note

The angular position of the WING PIN LOCK door when in its full open position restricting the movement of the pilot's knee, serves as a warning to the pilot to spread the wings before take-off.

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.

(1)Before service change of wire bundle guide.

LANDING GEAR CONTROL. The LANDING GEAR control (figure 1-3, reference 22) 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 (figure 1-3, reference 16) 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 (figure 1-4, reference 31), 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 p o s i t i o n 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 (figure 1-3, reference 19) 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. The emergency hydraulic pump will continue to run as long as the secondary bus is energized and the landing gear handle is left in the "EMERGENCY" position. In this position of the emergency selector valve, the emergency hydraulic pump pressure operates the main landing gear only, and not the tail wheel gear. 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 (figure 1-3, reference 3) is located at the after end of the left-hand 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 (figure 1-4, reference 22) is located forward on the center console. Moving the control lever to the "HOOK DOWN" position lowers the hook, disconnects the gun switch circuits and, in conjunction with the landing gear, turns on the landing approach light. A red warning light

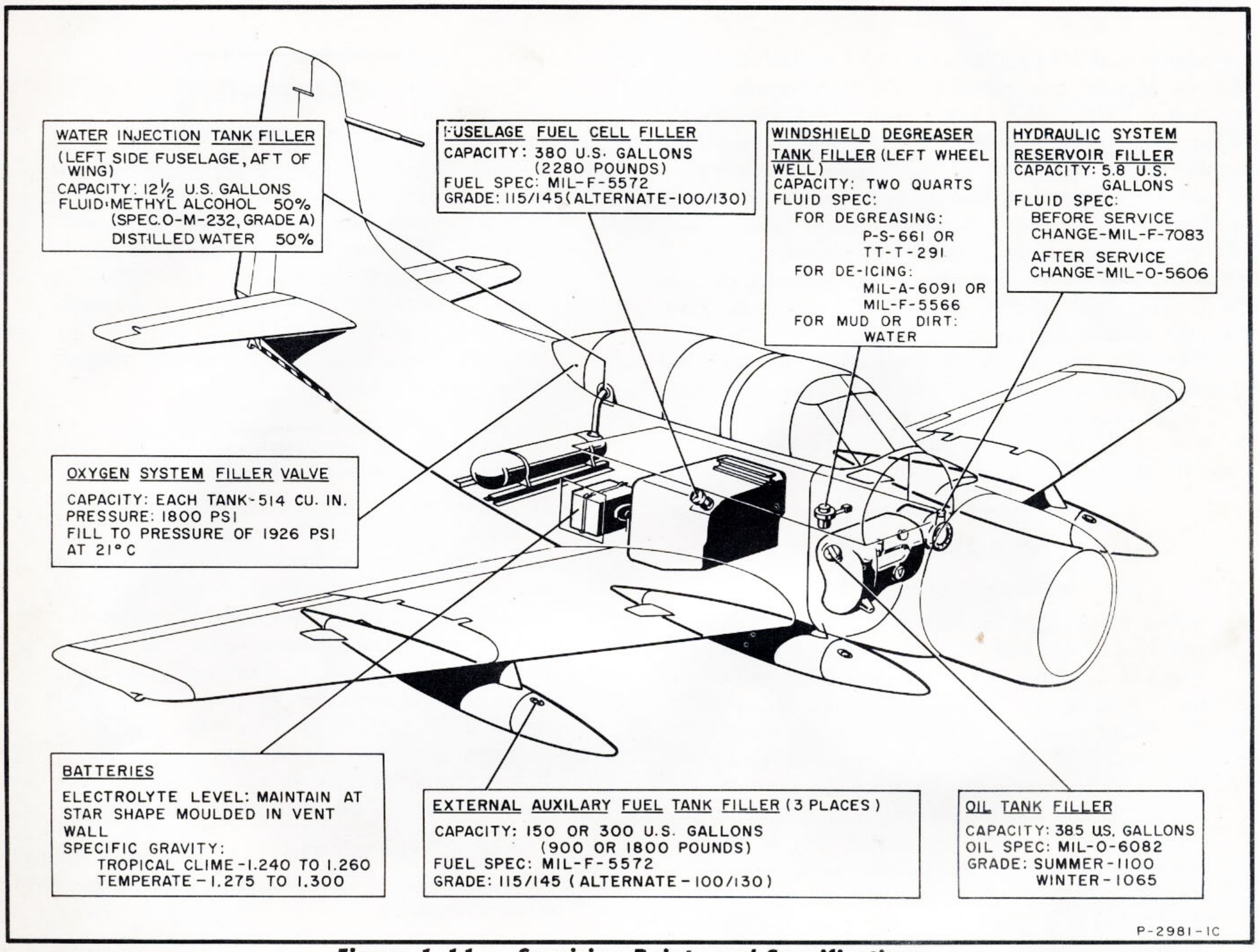


Figure 1-11. Servicing Points and Specifications

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 hydraulically returns the hook to the up position.

Note

If the arresting hook control cable system should fail, the "fail-safe" mechanical linkage will automatically release the up latch. However, the arresting hook will remain retracted until the control lever is lowered, relieving hydraulic pressure in the up line. Lowering of the arresting hook is assisted by air pressure inside the hold-down cylinder.

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. The turn and bank indicator is air driven. 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 (figure 1-4, reference 17), an amplifier and a remote compass transmitter. Approximately three minutes are required for the gyro to reach operating speed after the battery-generator switch has been turned to "BAT & GEN" or "BAT ONLY." The compass is non-tumbling and does not require caging 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 (figure 1-4, reference 10) 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 a 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.

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. Approximately two minutes are required for the gyro to reach a normal operating speed after the battery-generator switch is turned to "BAT & GEN" or "BAT ONLY." 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.

A non-tumbling gyro horizon is installed after service change of the instrument panel.

TORQUE INDICATOR.(1) The torque indicator (figure 1-4, reference 36) provides a reading of propeller shaft torque oil pressure calibrated in pounds per square inch. Registrations on the perimeter of the indicator are from 50 to 350 psi and on the small dial at the top center of the indicator from one to ten psi. Indications are expressed as "torque pressure" and are directly proportional to brake mean effective pressure (BMEP). The indicator is used effectively to check engine operation at all power settings and especially during operation using water injection. (Refer to limitations on the use of water injection, Section V; MIXTURE CHECK AND MANUAL LEANING and USE OF TORQUE INDICATOR, Section VII; ENGINE OPERATING DATA and the Combat Allowance Chart, figure A-7, sheet 2, in the Appendix.)

MISCELLANEOUS EQUIPMENT

CANOPY

A canopy covers the pilot's cockpit and extends aft to enclose the middle compartment. Access to the pilot's cockpit is gained from either side of the fuselage through sliding hatches. The middle compartment can likewise be entered from either side through hinged hatches that swing up when opened.

PILOT'S COCKPIT HATCH CONTROLS. The two hatches for the pilot's cockpit are hydraulically operated. Levers controlling operation of the hatches are installed on either side of the fuselage both inside and outside of the cockpit. The hatch moves in the direction of motion of the lever and can be stopped at any intermediate position by moving the lever to the "STOP" position.

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.

Operation of the hatch in case of hydraulic system failure is assured by means of an accumulator and check valve which will supply pressure for emergency actuation of the hatch. If no hydraulic pressure is available, the cockpit hatches can also be opened manually by means of levers installed on the lower forward edge of each hatch both inside and out.

CAUTION

- The hydraulic system for the cockpit hatches is under pressure at all times. Due to the possibility of inadvertent displacement to the "CLOSE" position when entering or leaving the aircraft, it is recommended that the hatch levers not be placed in the "STOP" position while the aircraft is on the ground.

MIDDLE COMPARTMENT HATCH CONTROLS. The hatches for the middle compartment are manually operated and are controlled by levers (figure 3-1, reference 3,4) located on the forward end of the hatches both inside and out. In addition, a manually operated emergency release handle is installed on the center overhead canopy support. Pulling the emergency release handle down jettisons the hatches on both sides of the middle compartment.

Note

When opening or jettisoning the middle compartment hatches, it is necessary to actuate the hatch levers to their fullest extent. A plastic stop is incorporated with the emergency release handle to prevent inadvertent actuation, and must be broken as the handle is actuated.

CAUTION

The middle compartment hatches should be latched closed at all times during engine run-up or flight. The opened hatches, with braces in place, are designed to withstand a wind stress of 60 knots. Unlatching the enclosure in flight will result in loss of the hatch.

PILOT'S AND ASSISTANT PILOT'S SEATS

The pilot's and assistant pilot's seats will accommodate a seat pad, a back pad, a PK2 pararaft kit and a seat-

(1) Installed after service change.

type parachute. The seats are adjusted electrically and are controlled by switches located on the right-hand front of the bucket portion of the seat. The seats move upward and forward when the switch is moved to "UP" and downward and aft when moved to "DOWN."

CAUTION

Due to the location of the pilot's seat adjustment switch, it is possible to catch the hand between the seat and the center console. When actuating this switch, approach it from the forward part of the seat with the palm of the hand aft.(1) After service change the switch has been rotated 180 degrees, thus precluding this problem.

Note

It is possible to adjust these seats only if an external d-c power source is connected to the airplane or the battery-generator switch is in "BAT ONLY" or "BAT & GEN."

SHOULDER HARNESS. The lower two free ends of the harness fit into the safety belt catch and are held securely as long as the catch is closed. To release the harness and safety belt, open the safety belt catch. Clips on the front of the harness permit it to be adjusted. An inertia reel shoulder take up mechanism is provided. The harness may be locked in position by pushing the handle (figure 4-13, reference 19) located at 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 (figure 4-13, reference 17) are incorporated with the oxygen tube. The oxygen tubes are located to the left of the seats.

AUXILIARY EQUIPMENT

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

Heating and Ventilation System
Communication and other Electronic Equipment
Lighting Equipment
Oxygen System
Automatic Pilot
Armament Equipment
Cargo Loading Equipment
Troop Carrying Equipment
Passenger Carrying Equipment
Litter Carrying Equipment
Internal Auxiliary Gasoline Tanks
Miscellaneous Equipment

(1) Before service change.

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. Complete cruise control information is presented in Appendix I. 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 involved. It should be noted that weight and balance could be adversely affected in operation by unwise or unintended combinations of equipment from the several conversion kits provided with the aircraft. Care must be taken to assure that configurations follow the specified pattern of a particular conversion kit and that any other additions 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. Particular care must be taken in the case of the cargo conversion kit, as the distribution and weight of the cargo itself can vary from loading to loading. 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.

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" (low pitch)

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 gage reading.

r. Uncage gyro instruments.

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

t. FLT INST lights switch . . . . . "OFF"

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

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

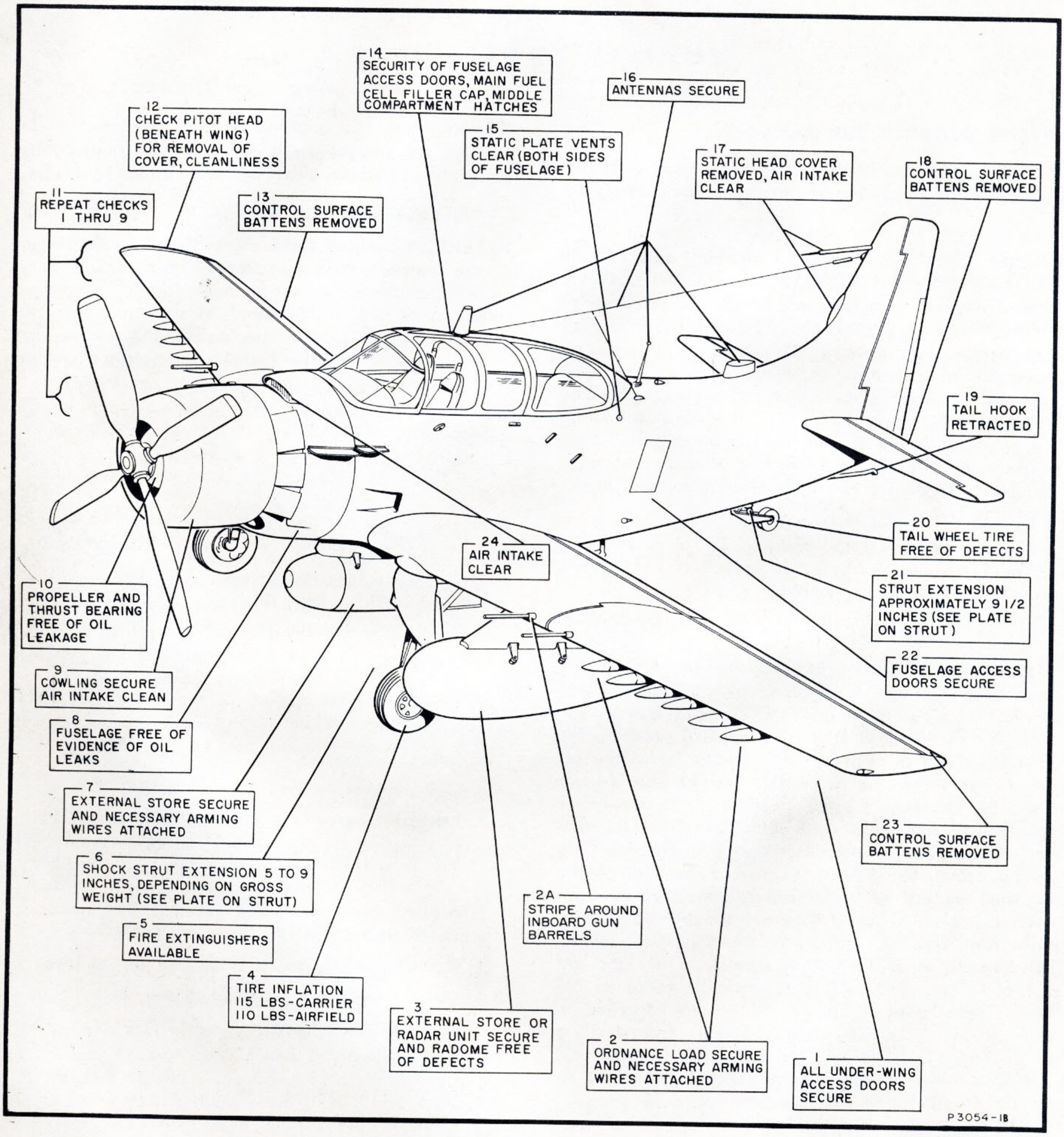


Figure 2-1. Exterior Inspection

w. HEAT control lever . . . . . "OFF" or "WIND & CABIN"

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

y. If the wings are spread, check the control surfaces for free and correct movement.

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.

CLEARING THE ENGINE. To clear the engine, turn propeller through four revolutions (16 blades) with the engine starter. In the event of liquid lock the starter clutch will slip after the torque load exceeds 750 to 950 foot-pounds.

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.

ALTERNATE FUEL. The engine can be operated on an alternate grade of fuel (see figure 1-11); 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.

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. After the engine starts, adjust air flow with the throttle to obtain a smothly running engine.

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 fuel from the carburetor has reached the cylinders. Priming can be continued as needed for smooth engine operation; if the engine ceases to fire increase priming, or if the engine runs rough and smokes, stop priming.

Note

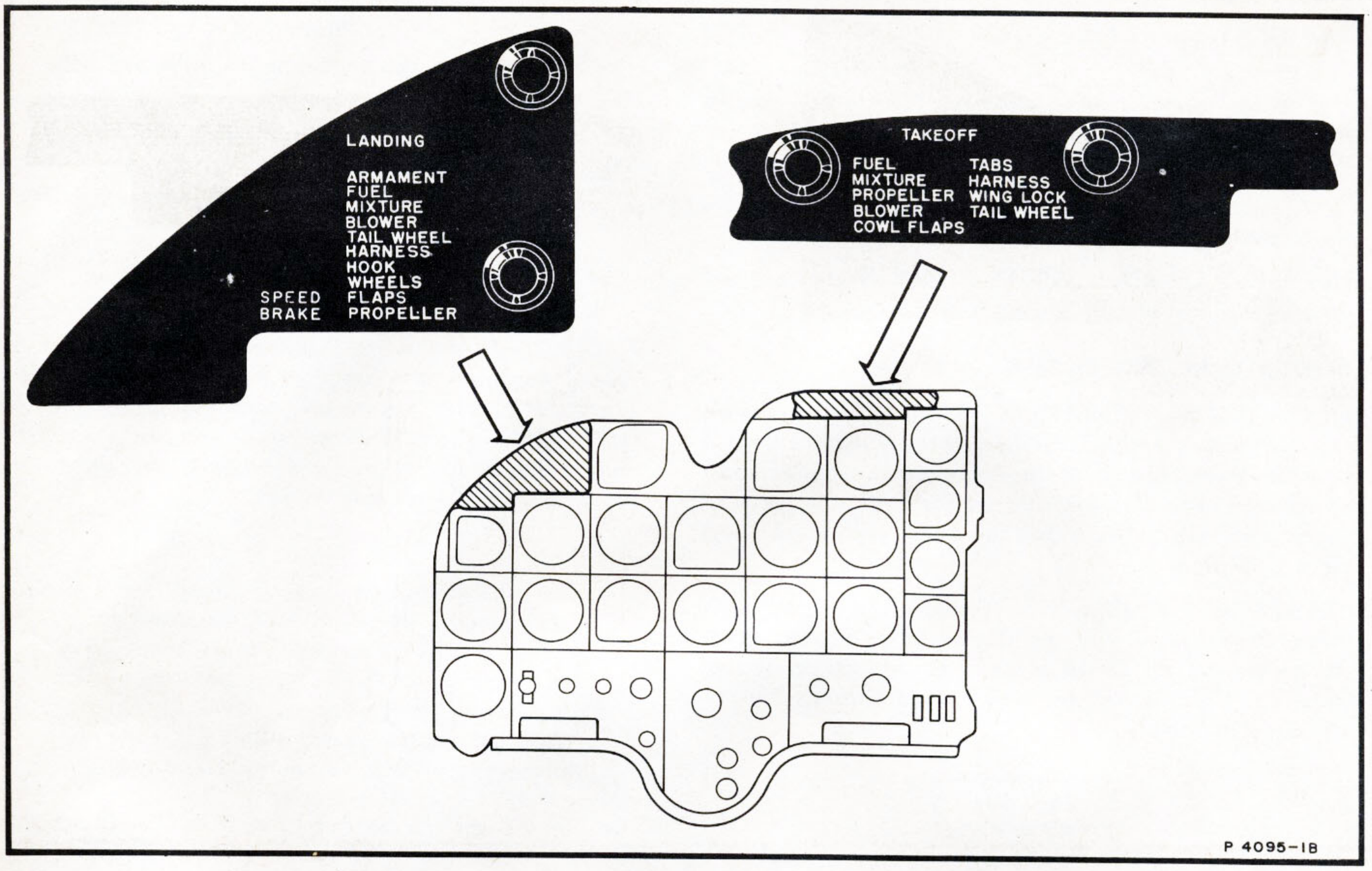
The only use for the primer after the engine is operating on the carburetor fuel (mixture "RICH") is to occasionally add the primer flow to keep the engine running smoothly until warmed-up during cold weather operation when the temperatures range below freezing.

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 runing 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.

h. Check the oil pressure.



Before Service Change
Figure 2-2. Check-off Lists (Sheet 1)

Note[1]

When an external power source is applied for starting and the battery-generator switch is left in the "OFF" position, if the battery charge is low the battery circuit breaker has a tendency to open. This is caused by a high current flow in excess of the five ampere rated capacity of the circuit breaker. 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

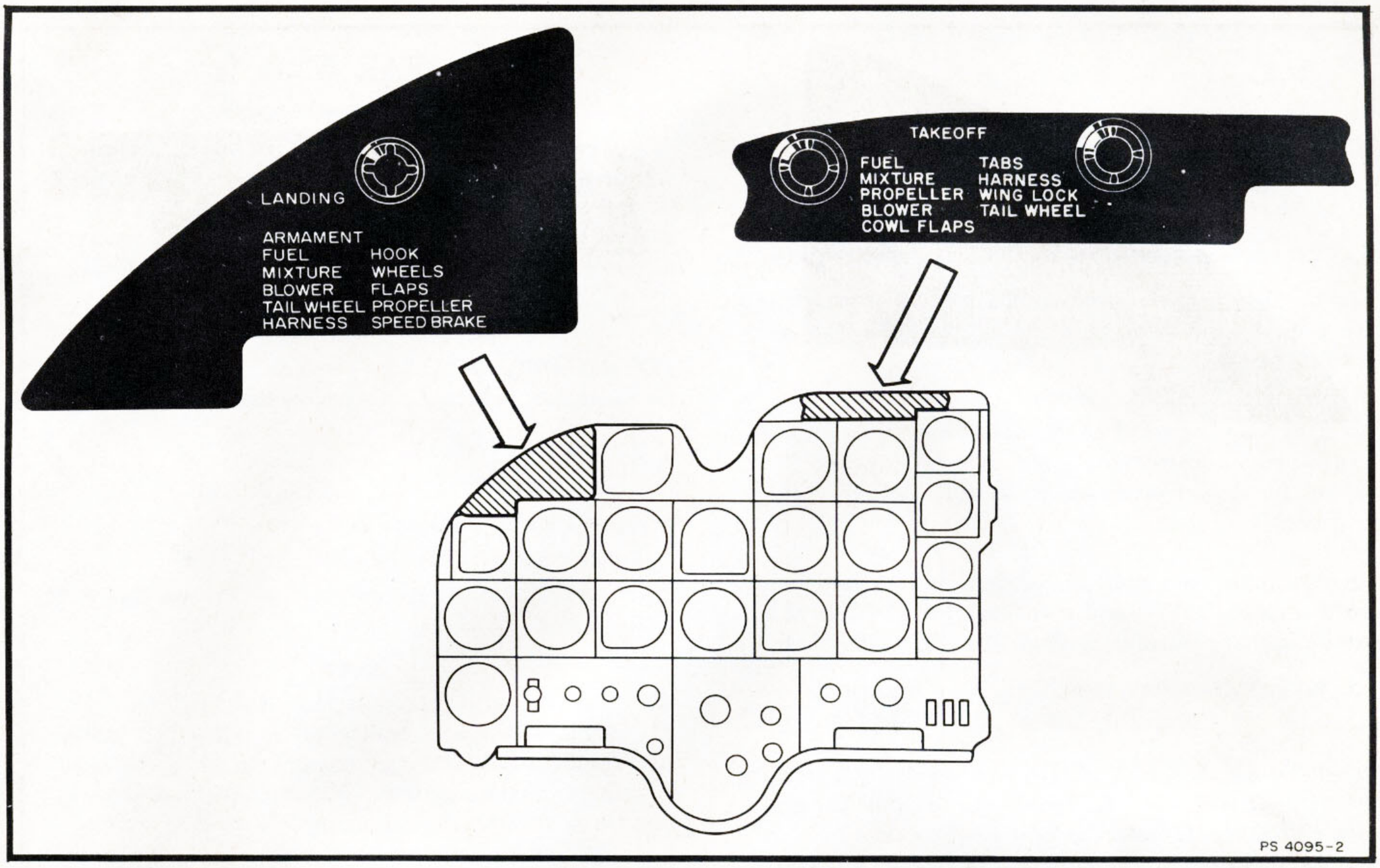
Stop the engine if the rear oil pressure gage does not register within ten seconds or does not reach 40 psi within 20 seconds. Advancing the throttle while the oil is cold will result in cavitation within the oil pump. A loss of oil pressure is associated with such cavitation. During cold weather starting, 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.

ALTERNATE/EMERGENCY STARTING PROCEDURE.[2] When no other external power source is available, an aircraft that has already been started may be used to supply power for starting another through use of a jumper cable engaged to both d-c external 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, to transfer power to the other aircraft it is necessary to depress the momentary contact switch adjoining

[1] BuNo. 132392 through 132476.
[2] BuNo. 132425 and subsequent.



After Service Change
Figure 2-2. Check-off Lists (Sheet 2)

the d-c external power receptacle in the aircraft supplying power. 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 mixture control in "NORMAL," and the supercharger control in "LOW" blower.

d. Continue the warm-up until the oil pressures show stability during manipulation of the throttle.

e. Cylinder head temperatures should be 260° maximum.

CAUTION

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

GROUND TESTS

ELECTRICAL SYSTEM

D-C POWER SUPPLY CHECK

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

b. Determine that all circuit breakers are pushed in.

c. With 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.

D-C EMERGENCY POWER SUPPLY CHECK[1]. 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.

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 votmeter phase selector switch to each of the 400 - 800 cycle phases. The voltmeter should indicate 115±6 volts in each case.

d. With the FLT INSTR PWR SEL switch on "INVERTER 1," turn the phase selector switch to each of the 400 cycle phases. The voltmeter should indicate 115±15 volts in each case.

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 115±5 volts in each case.

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.

[1] Aircraft prior to BuNo. 133862.

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 "NO. 2 INVERTER & 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 3000 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 front and rear oil pressures and oil temperature.

Front oil pressure.....35 psi ± 5
Rear oil pressure.....70 psi ± 5
Oil temperature .....85°C desired
90°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 a conventional tail wheel type landing gear and standard taxiing procedures should be followed. The rudder becomes effective at speeds of over 10 knots. The controls should be set as follows for taxiing:

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

Note

Lock the tail wheel during extended crosswind taxiing to relieve excessive braking action.

WARNING

During extended periods 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

Note

Engine run-up should not be conducted with flaps down.

IDLE MIXTURE. With the engine idling at 650 ± 50 rpm and the fuel pump "ON," 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 detent.

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.

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 full recovery of rpm.

MAGNETO AND POWER CHECK

Note

In order to clean out the spark plugs and assure an accurate magneto check, immediately prior to the check adjust manifold pressure to field barometric pressure with the mixture control in "NORMAL" position. Operate in this condition for approximately 15 seconds.

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 from this reading 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.

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.

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."

PRE-FLIGHT AIRCRAFT CHECK
AIRFIELD AND CARRIER CHECK

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

Note

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

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. Trim settings ..... Note Table I, Trim Settings

k. Throttle friction control .... Adjust as needed

l. Mixture ..... "RICH"

m. Propeller control ..... "INCREASE"

n. Speed brake ..... "CLOSE"

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

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

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

CAUTION

Check proper position of the inboard guns by observing painted stripe around gun barrels before actuating controls to spread wings.

r. Wings ..... Spread and locked

CAUTION

Due to the position of the pilot's seat in relation to the right wing pin lock, shorter pilots may have difficulty in checking to see that the wing is locked down. Arrangements should be made with ground crew or assistant pilot to check the warning flag after the WING PIN LOCK is actuated.

s. Check controls for free and correct movement.

t. Run up engine.

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

v. Erect and uncage gyros as necessary.

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

a. Tail wheel ..... "UNLOCK"

b. Trim settings ..... Note Table I, Trim Settings

c. Catapult handgrip ..... Down

d. Throttle friction control .... Tighten

e. Place head firmly against headrest.

f. Place feet against rudder pedals with legs stiff.

g. Brace right arm, locking elbow against abdomen.

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

TABLE I
TRIM SETTINGS (TAKE-OFF)
Based on 17,600 to 19,800 Pounds Gross Weight
21.6% to 23.4%-MAC Gear Down

FLAPS UP
Rudder ..... 2 units nose right
Stabilizer ..... 2 to 2½ units nose up
Aileron ..... 1½ to 2 units right wing down

(1) Before service change of wire bundle guide.

FLAPS DOWN

Rudder	2 units nose right
Stabilizer	4 to 4½ units nose up
Aileron	1½ units right wing down

CATAPULT LAUNCH (40° Flaps)

Rudder	2 to 3 units nose right
Stabilizer	4 to 4½ units nose up
Aileron	1½ to 2 units right wing down

Note

Adjust stabilizer trim settings a proportionate number of units nose up if % MAC is less or nose down if % MAC is more than for the base values stated.

TAKE-OFF

Note

Take-off is permissible after the oil temperature has risen at least six degrees centigrade, the oil pressure is stabilized and there is no apparent engine instability.

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 18,500 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. Refer to Section V for take-off power limitation.

Note

Immediately prior to take-off adjust the manifold pressure to field barometric pressure with the mixture control in "NORMAL" position and operate for approximately 15 seconds to clean out the spark plugs.

MINIMUM RUN TAKE-OFF. For a minimum run take-off, the controls with the exception of the flaps, should be set in the same position as for a normal take-off. Hold the brakes and advance the throttle to obtain 30 inches of manifold pressure, taking care to keep the tail on the ground. Release the brakes and smoothly but quickly, add full take-off power. Raise the tail quickly to reduce drag. The airplane may be pulled off at an IAS varying from 80 knots at 18,500 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 airspeeds above 110 knots, however the flap control lever should be placed in the "UP" position before 130 knots IAS is reached. 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. 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 the full throttle altitude without reducing power and without exceeding the limiting BMEP. Refer to Appendix I for additional data on climbing speeds and power settings.

Note

It will be noted that the Engine Operating Limits Chart in Appendix I 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. Consequently, a power setting of one inch less manifold pressure would be necessary to prevent exceeding the BMEP 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 over-heat can be checked more quickly by reducing engine speed than by throttling alone.

b. After the climb has been established, 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.

WARNING

Do not open the cockpit sliding enclosure at speeds in excess of the limitation given in Section V except in extreme emergencies, since the pressure differential created by this action may cause damage to the after fuselage structure, and may shatter the middle compartment hinged enclosures, resulting in possible injury to the occupant of that compartment by flying plexiglas.

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

If left down during a landing, the speed brake will come in contact with the runway.

n. Mixture . . . . . "RICH"

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

p. Cockpit canopy . . . . . "OPEN"

q. FLT INSTR PWR SEL . . . . . "Inverter 1"

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. Aileron trim . . . . . 4 units right wing down

LANDINGS

AIRFIELD. Maintain an approach speed at least 10 to 15 percent above the predetermined power-off stalling speed (see figure 6-1). Control at this speed is excellent and rudder control during the roll-out is effective down to approximately 20 knots. Stall warning is apparent only at airspeeds close to a stall, however, and the airspeed must be closely controlled during the approach.

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 ap-

proach 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 the 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 (see 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.

Note

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 proportionately 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 89 knots IAS. Since the aircraft is restricted to a weight of 17,500 pounds for arrested landings, jettisoning of stores is necessary before landing aboard a carrier if the aircraft is loaded to a gross weight exceeding the limitation.

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

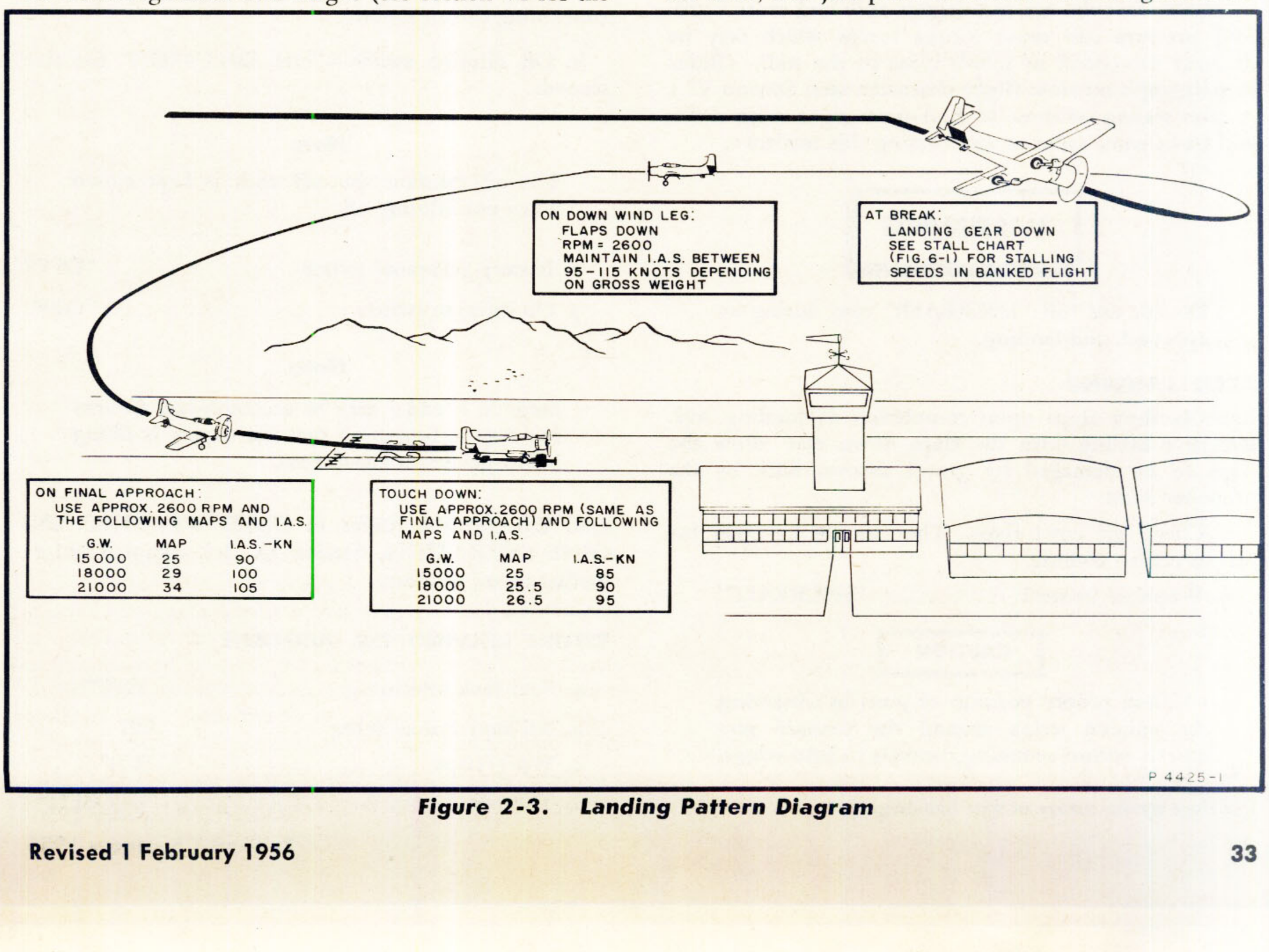


Figure 2-3. Landing Pattern Diagram

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 brakes 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. 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. (Refer to paragraph on slow flight characteristics, Section VI.) A trim setting of three to four 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"

CAUTION

(1)Check proper position of guns by observing the painted stripe around the inboard gun barrels before actuating controls to fold wings.

(1)Before service change of wire bundle guide.

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 best power mixture, which will be indicated by a decrease of approximately 50 rpm on the tachometer. Allow engine to idle until cylinder head temperature drops below 150°C. In addition to properly cooling the engine, this permits better scavenging of engine oil and will serve 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. Fuel booster pump ..... "OFF"
c. Throttle ..... "CLOSED"
d. Mixture control ..... "IDLE CUTOFF"
e. Ignition switch ..... "OFF" after propeller stops rotating
f. Cowl flaps ..... Check to see that they are fully open

g. 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.

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

Note

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

i. Battery-generator switch ..... "OFF"
j. Oil dilution switch ..... "OFF"

Note

Steps h, i, and j 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 ..... "CLOSED"

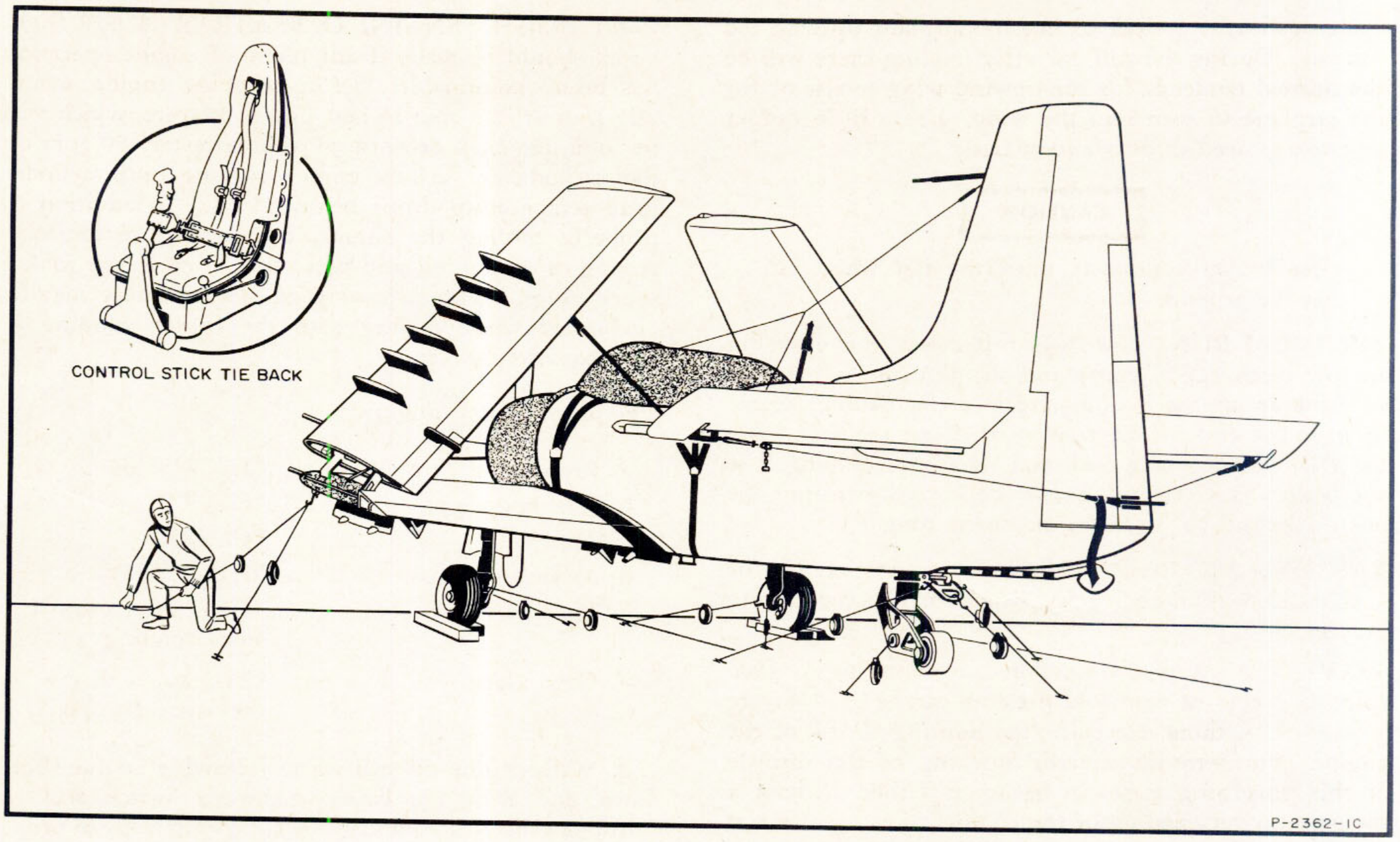


Figure 2-4. Mooring

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 the airplane down and install jury struts on the folded wings. Gust locks must be placed on the rudder and ailerons. Tie the control stick back with the safety belt to secure the elevators. See figure 2-4.

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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." This will permit fuel pressure to build up.

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

e. Move mixture control to "RICH."

f. If, after completing the preceding operations, the engine does not start, prepare for an emergency landing.

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.

MANIFOLD PRESSURE REGULATOR FAILURE. Loss of engine oil pressure will result in failure of the automatic feature of the manifold pressure regulator. When the oil pressure drops below approximately 25 psi, the spring-loaded piston in the manifold pressure regulator drops into the full-low manual schedule, wherein the actual throttle position is only ½ 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 to the full open position will, in most cases, provide up to 40 inches of manifold pressure if desired. Under certain conditions, the use of this procedure may allow the pilot to reach a landing field prior to complete engine failure due to lack of oil.

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.

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

Battery-generator switch should be left "ON" if radar altimeter is being used during the emergency. Place in "OFF" position just before touch down.

f. Place goggles down over the eyes.

g. Mixture control ..... "IDLE CUTOFF"

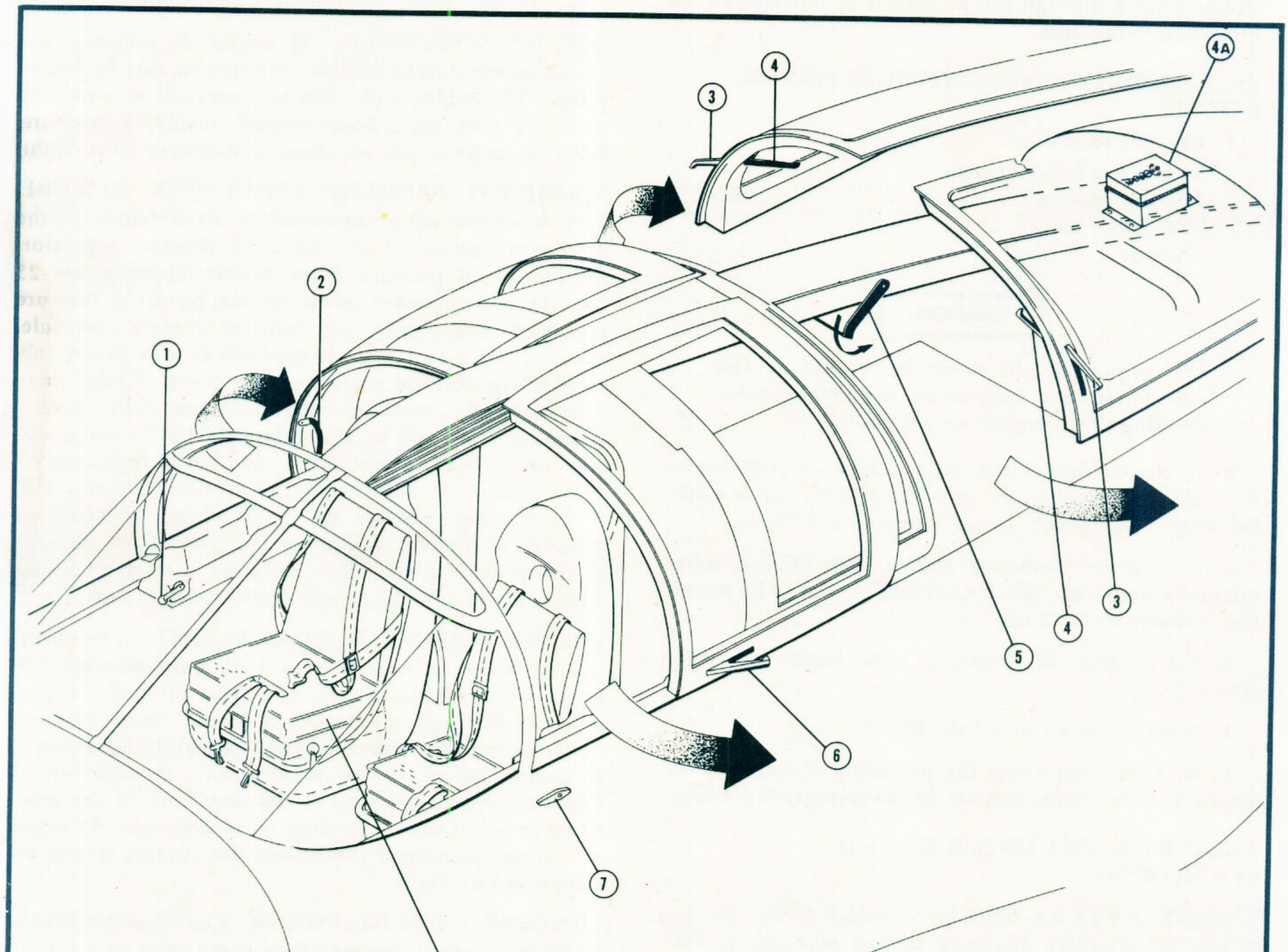
h. Fuel tank selector ..... "OFF"

i. Landing gear ..... "DOWN" or "UP" as warranted by the situation.

j. Wing flaps ..... full "DOWN" when landing is imminent.

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:



1. Hatch actuating control(1)
2. Hatch manual opening lever(1)
3. Middle compartment hatch external opening lever
4. Middle compartment hatch internal opening lever

4A. First aid kit

5. Middle compartment hatches jettisoning handle
6. Hatch manual opening lever(1)
7. Hatch actuating control(1)
8. Parachute and pararaft(1)

(1)Typical both sides.

Figure 3-1. Emergency Equipment and Exits

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 the 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. If crewmen or passengers are situated in the middle compartment, the hatches should be jettisoned upon the order of 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 middle 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. 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	Give warning to crew. Jettison external stores. After jettisoning middle compartment hinged enclosure, open canopy.	Parachute Pararaft Charts	Pilot's seat. Safety belt and shoulder straps tight.	Through hatch, left side of cockpit.
Assistant Pilot	Turn on Emergency IFF. After jettisoning middle compartment hinged enclosure, open canopy. Make radio distress call and position report.	Parachute Pararaft First Aid Kit Canteens	Assistant pilot's seat. Safety belt and shoulder straps tight.	Through hatch, right side of cockpit.
Passengers	Jettison canopy (upon orders of pilot). Secure loose gear. Jettison equipment upon orders of pilot.	Parachutes Pararafts Canteens	Passengers' seats. Safety belts and shoulder straps tight.	Through middle compartment hatches.

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. Make certain the radar altimeter indicator is on the low scale.(1)

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 accompanied 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.

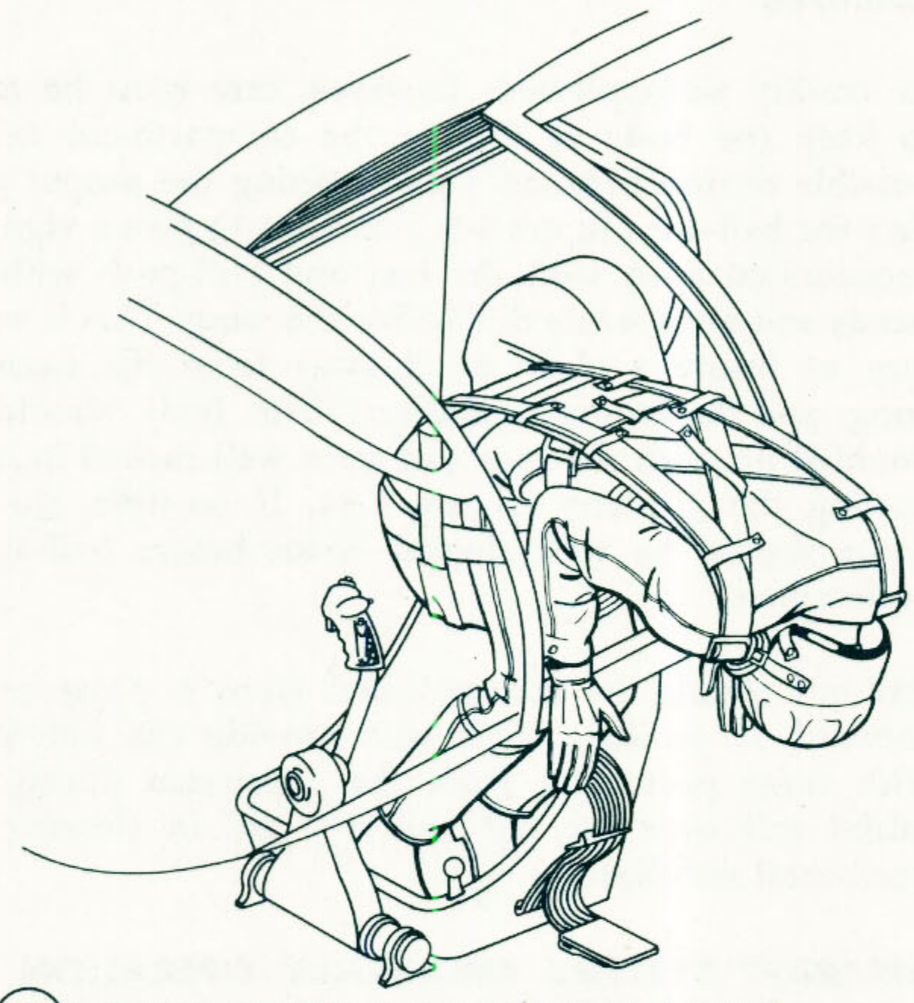
BAIL-OUT PROCEDURE

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. Before bailing out, slow the aircraft down to an airspeed of 120 knots or less and lower landing flaps if practicable.

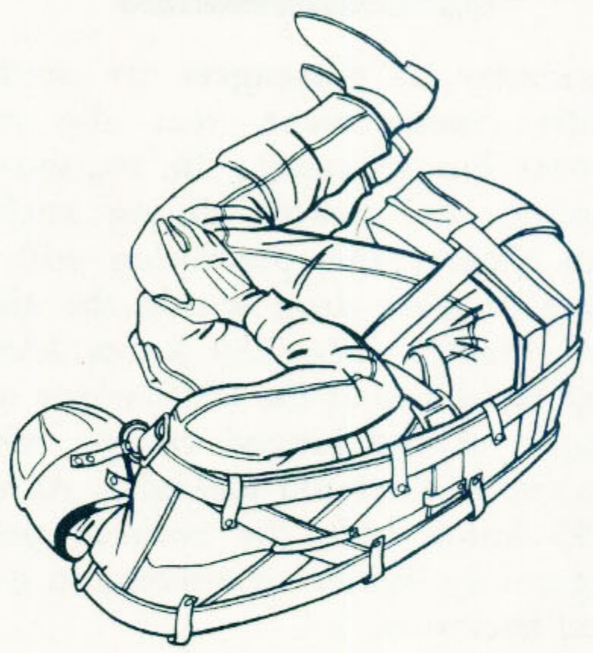
(1) BuNo. 132392 through 132440.

(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. Pilot Bail-out Procedure

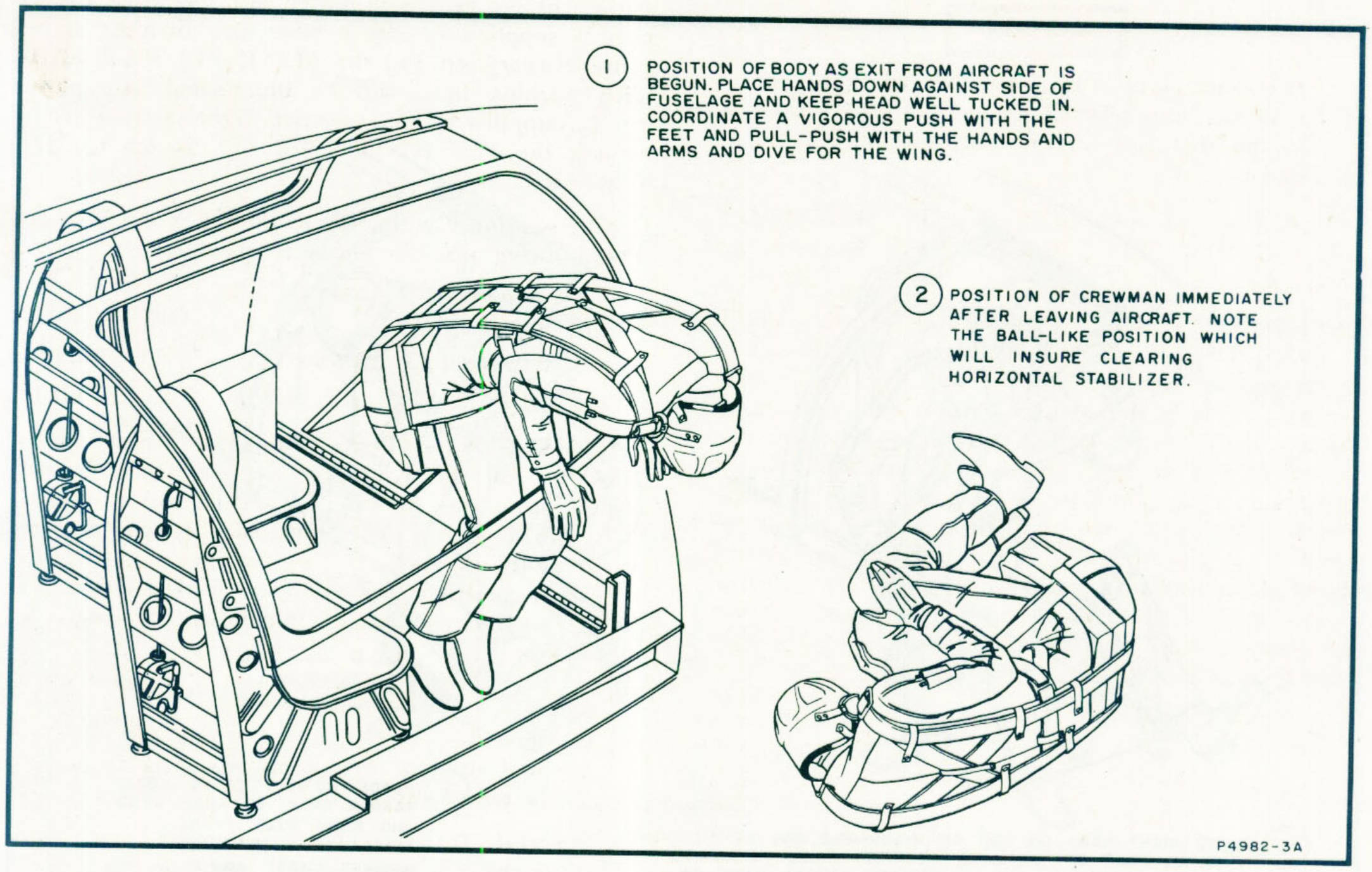


Figure 3-3. Six Place Passenger Bail-out Procedure
Figure 3-4. Deleted

WARNING

It is imperative, if passengers are occupying the middle compartment, that the middle compartment hinged canopy be jettisoned before opening the cockpit sliding enclosure. Failure to observe this precaution will cause an extreme pressure drop within the aircraft. At speeds greater than 250 knots IAS, the result may be failure of the aft fuselage section and collapse of the hinged canopy with an inward burst of shattered plexiglas. At speeds below 250 knots IAS, the reduced pressure may dangerously hinder an attempt to jettison the hinged enclosure.

PILOT BAIL-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 while keeping the body as low to the cockpit rail as possible, should be followed. The knees should be pulled up against the chest and the head and arms should be well tucked in until completely clear of the airplane (figure 3-2).

PASSENGER BAIL-OUT. It is considered that abandoning the aircraft from the middle compartment can be readily accomplished; however, care must be taken to keep the body as low to the compartment rail as possible during bail-out. Upon gaining the proper position for bail-out (figure 3-3, reference 1) give a vigorous coordinated push with the feet and pull-push with the hands and arms while diving for the wing. This is necessary to insure a clean break-away from the fuselage, wing and horizontal stabilizer. The body should be doubled up with the legs and arms well tucked in upon leaving the airplane (figure 3-3). If possible, the airplane should be well slowed down before bail-out is undertaken.

Bail-out should be accomplished from a point as far forward as possible. This will provide the individual with some protection from the slipstream during the initial roll over the rail and will aid in clearing the horizontal stabilizer.

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 boster 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 center-line tank to be displaced by the bomb ejector. It has been found that a center-line 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 figure 5-5 for precise data on limitations and restrictions concerning the jettisoning of fuel tanks.) 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. BOMB DIRECTOR SWITCH ..... "SINGLE OR INTERV"
e. 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 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 is indicated by a GEN WARN light. Such a failure will also cause the loss of a-c generator power, as the monitor bus must be energized before a-c power is available to the a-c circuits. If failure occurs, d-c power will be lost to all except the primary bus, which will continue to be energized by the battery with the battery-generator switch in "BAT & GEN."

For earlier aircraft[1] upon switching to "BAT ONLY," battery power is applied to the secondary bus, and a-c generator power will power the primary bus through an emergency a-c rectifier.

For later aircraft[2] upon switching to "BAT ONLY," battery power is applied to both the primary and secondary bus.

[1] BuNo. 132417 through 133861. Prior aircraft after field modification.

Failure of d-c generator power will also cause the a-c circuits supplied by the number two inverter to become de-energized and the FLT INSTR PWR FAILURE warning light will be illuminated. A-c power can be supplied to the essential flight instruments by turning the FLT INSTR PWR SEL switch to "INVERTER 1."

Upon observing illumination of the GEN WARN light the following procedure should be adhered to:

a. All non-essential electrical equipment ..... "OFF"
b. Battery-generator switch ..... "BAT ONLY"
c. FLT INSTR PWR SEL switch .. "INVERTER 1"

EMERGENCY LIGHTING SYSTEM.[2] Should the d-c generator fail during flight, the a-c generator will furnish power only to the FLT INSTR and the NON-FLT INSTR lights. The emergency system operates automatically unless the landing gear has been extended before d-c generator failure occurs. In the latter case, the lights will continue to operate on battery power.

CAUTION

Conserve battery power by turning off non-essential electrical equipment when flight cannot be terminated.

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 1-8). 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

[2] BuNo. 133862 and subsequent.

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 systsem 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. 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.

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.

BRAKE SYSTEM

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.

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.

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. The distributor valve control lever (see figure 4-1, sheet 1) 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.

MIDDLE COMPARTMENT

The middle compartment is provided with a separate gasoline-fueled heating system. Fuel for the heater is supplied by the engine-driven fuel pump; the heater circuits receive their power from the monitor and secondary busses. The HEATER control panel (see figure 4-1, sheet 2) is located on the left-hand side of the center-line 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° and 250°F. Adjustable outlets for the hot air ducts, three on each side of the middle 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. A vibrator selector switch (figure 4-1) is installed on the heater ignition unit which is just above the rearmost oxygen bottle on the starboard side of the airplane. The switch has two positions, "#1" and "#2." If the heater fails to start or ceases to function, repositioning of this switch may reinstate heater operation.

VENTILATING SYSTEM

PILOT'S COMPARTMENT

Ventilating air is received through an intake on top of the fuselage forward of the windshield. The main flow of ventilating air, routed to a diffuser outlet at the firewall, can be controlled by a VENT lever (see figure 4-1, sheet 1) 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 "eye-ball" 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.

MIDDLE 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 center-line 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 center-line 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 middle 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"

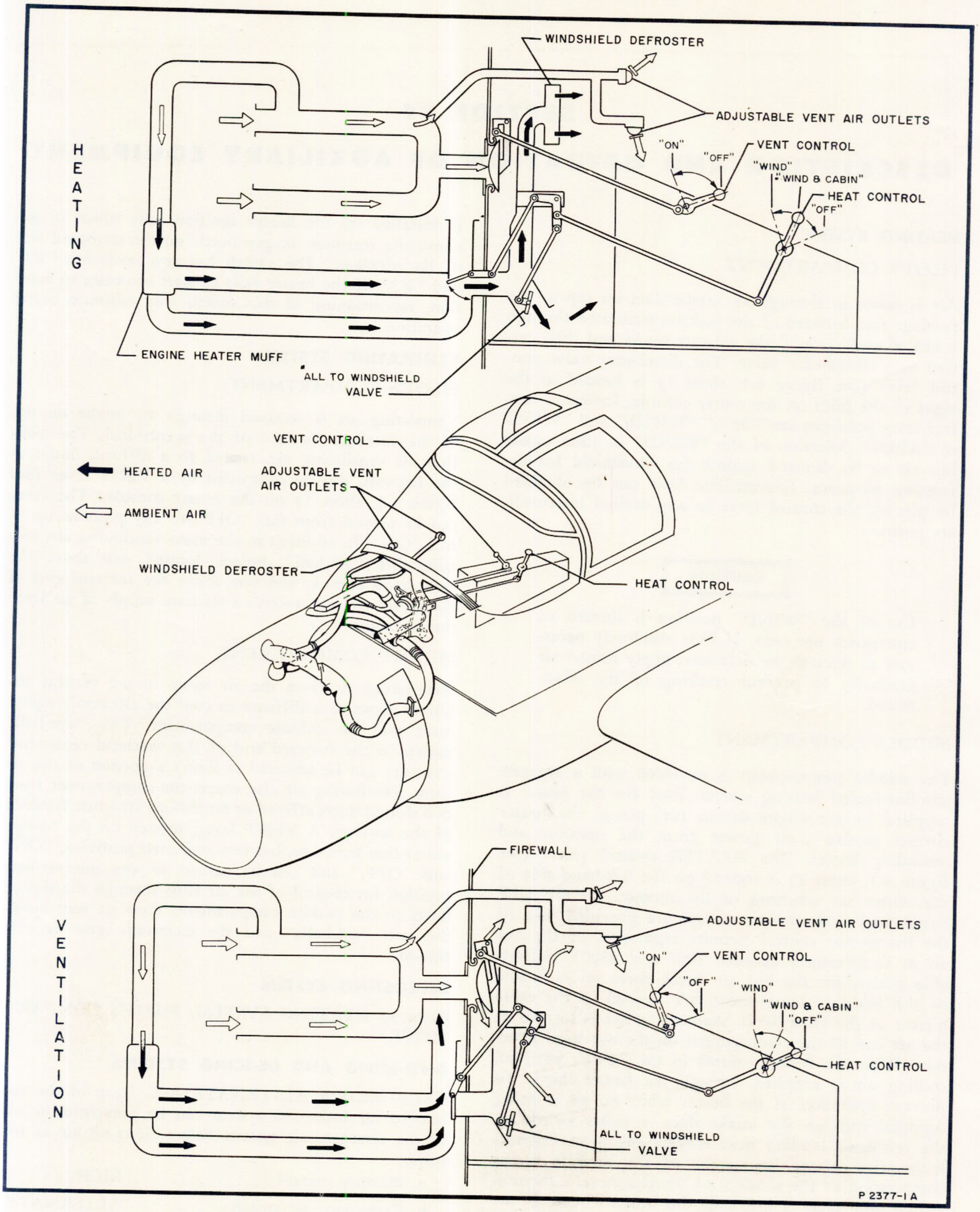


Figure 4-1. Heating and Ventilating System (Sheet 1)

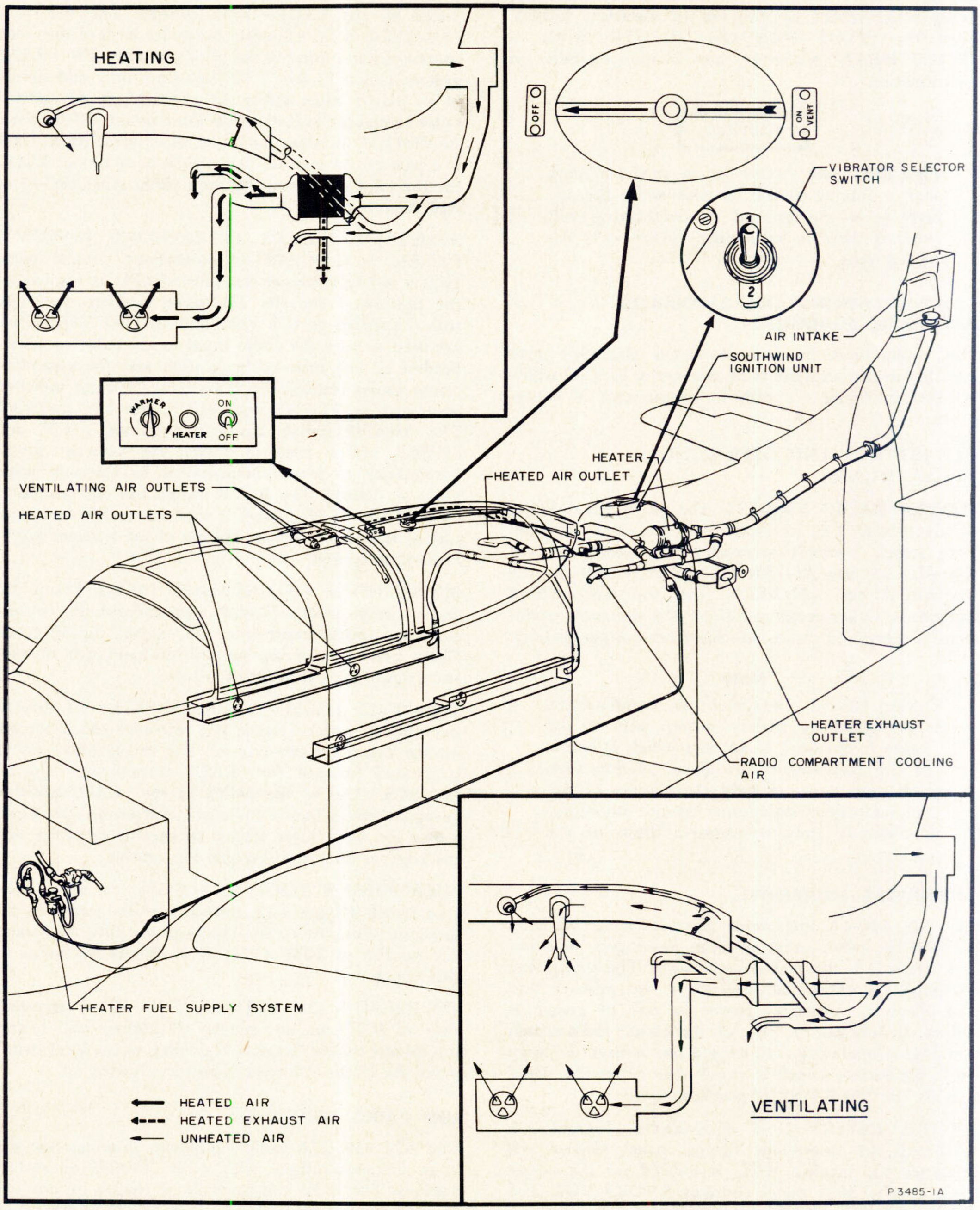


Figure 4-1. Heating and Ventilating System (Sheet 2)

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

The communications and associated electronic gear installed in the airplane is of five types, each of which is listed in figure 4-2 with its components of equipment.

DESCRIPTION AND OPERATING INSTRUCTIONS

MASTER RADIO SWITCH. The MASTER RADIO switch (figure 1-5) is located on the center console. This switch controls secondary bus power to the AN/ARA-25, the AN/ARN-6, the AN/ARR-2A, the AN/ARC-27 or AN/ARC-1, and the AN/ARN-12 equipment. Other communications and electronic equipment is turned on at the associated control panels only.

Note

During ground operations, the secondary bus is energized by battery power only 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, assistant pilot, passengers, or crewmen located in the rear compartment. The interphone equipment is connected directly to the primary bus, and operates on battery power in case of generator failure. It does not go through the master radio switch and begins operating following a one minute warm-up when the battery switch is switched to either the "BAT & GEN" or "BAT ONLY" position.

PILOT'S INTERPHONE CONTROL PANEL. A C-737/AIC-4A interphone control panel (figure 1-5, reference 5), labeled MIX, is located on the center console. The MIX panel contains RADIO VOL, ICS VOL, and HF SENS controls, three RCVR-OUT switches and a TRANS switch. Audio levels of all the radio receiving sets other than the marker beacon, the homing radio and the radio compass receivers is adjusted by the RADIO VOL control. The ICS VOL CONTROL is for adjusting the audio level of the intercommunication input to the pilot's headset. The TRANS switch is used in the "UHF" position only and should be so placed when either AN/ARC-27 or AN/ARC-1 radio equipment is installed in the airplane. Of the three RCVR-OUT switches, only the one identified as UHF is a part of the system. This switch must be on "UHF" for the pilot's reception through either AN/ARC-27 or AN/ARC-1 radio.

ASSISTANT PILOT'S INTERPHONE CONTROL PANEL. A C-736/AIC-4A interphone control panel (figure 4-3A, reference 9), labeled SEL, is located on the right-hand console. The panel contains two controls identified as ICS VOL and RADIO VOL which are used to vary the audio input to the assistant pilot's headset of the intercommunication and the communication radios respectively. Two rotary selector switches, identified as TRANS and RCVR, are also included. The TRANS switch has two positions, "ICS" and "UHF," and is used to switch the assistant pilot's microphone to intercommunication or communication radio as desired. The RCVR switch has two positions, "OUT" and "UHF," and is used to switch communications radio reception in and out of the assistant pilot's headset as desired.

MICROPHONE AND HEADSET JACKS. The pilot's and assistant pilot's headset and microphone connections are incorporated into the oxygen supply tubes. These tubes are located on the left-hand side of each seat (figure 4-13, reference 17).

THROTTLE MICROPHONE SWITCH. The throttle microphone switch (figure 1-3, reference 13) is located on the throttle control lever. The two-position switch is pressed forward for "RAD" transmission and aft for "ICS." Use of the switch in the "RAD" position energizes relays in the radio transmitter-receiver which causes the transmitter section to become operative and the receiver section to become inoperative.

MICROPHONE FOOT SWITCHES. A microphone foot switch (figure 4-13, reference 1) is located on the assistant pilot's foot rest. The assistant pilot may transmit on ICS or UHF (VHF if installed) by means of this switch.

TO RECEIVE ON INTERPHONE. When transmitting on ICS from any station all stations will receive interphone communications regardless of the local switch positions, if the volume controls are turned up.

UHF RADIO EQUIPMENT

The AN/ARC-27A radio equipment provides two-way voice communications with other aircraft or surface stations. The radio 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.

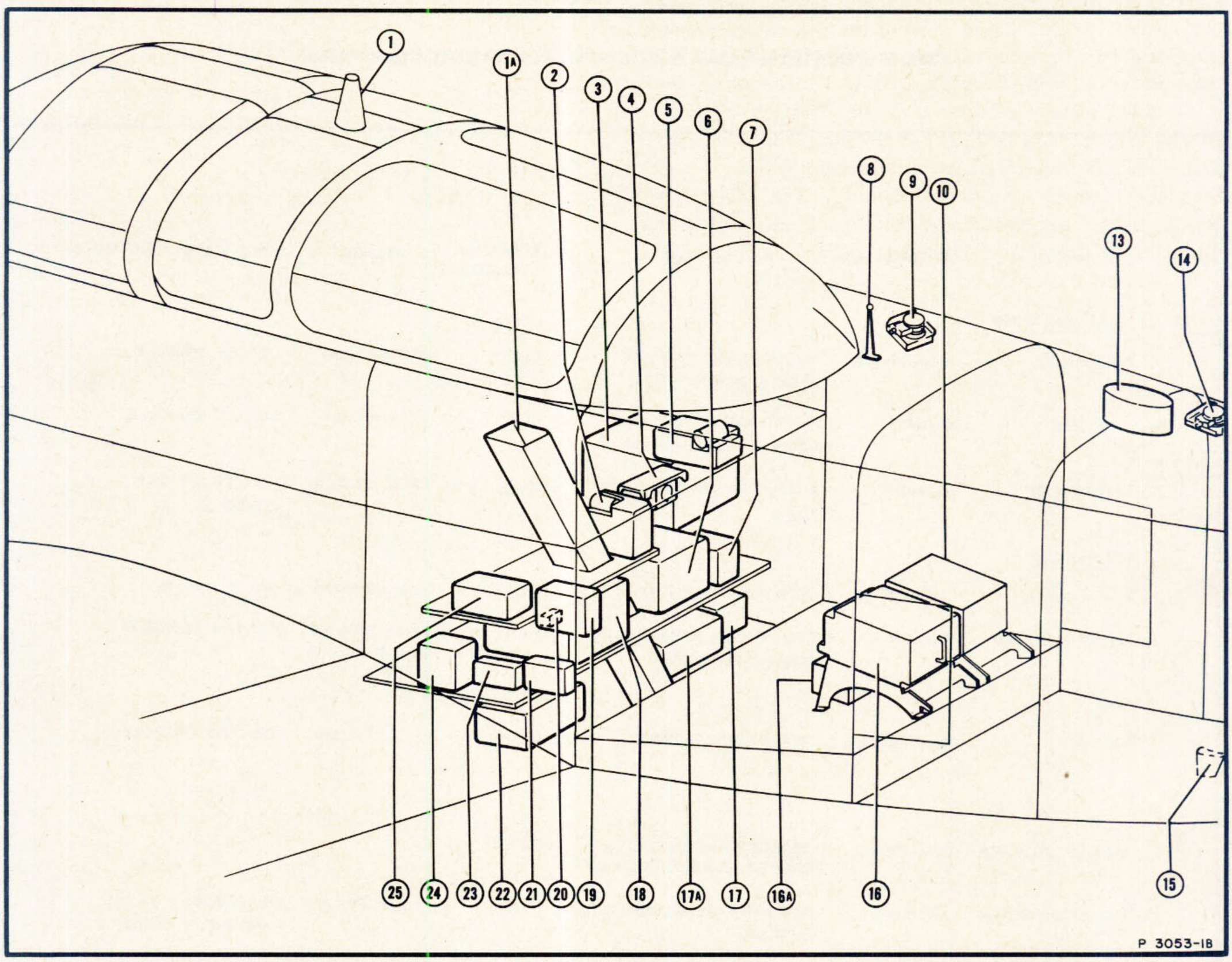
COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT

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	CENTER CONSOLE
VHF RADIO (1)	AN/ARC-1	SHORT RANGE-TWO WAY VOICE COMMUNICATION	PILOT	LINE-OF-SIGHT	CENTER CONSOLE
INTERPHONE	AN/AIC-4A	INTER-COMMUNICATION OF CREW	CREW	CREW STATIONS	CENTER & RIGHT CONSOLE
NAVIGATION					
VHF HOMING	AN/ARR-2A	YG HOMING RECEIVER	PILOT	LINE-OF-SIGHT	RIGHT CONSOLE
RADIO COMPASS	AN/ARN-6	DIRECTIONAL HOMING AND RANGE RECEIVER	PILOT	20-200 MILES, DEPENDING ON VARIABLE CONDITIONS	CENTER CONSOLE
UHF-ADF	AN/ARA-25	DIRECTIONAL HOMING	PILOT	LINE-OF-SIGHT	CENTER CONSOLE
MARKER RECEIVER	AN/ARN-12	RECEIVES AND INDICATES MARKER BEACON POSITION	PILOT		
RADAR ALTIMETER	AN/APN-1	INDICATES ALTITUDE ABOVE SURFACE	PILOT	4000 FEET	INSTRUMENT PANEL AND RIGHT CONSOLE
RADAR ALTIMETER (2)	AN/APN-22	INDICATES ALTITUDE ABOVE SURFACE	PILOT	20,000 FEET	INSTRUMENT PANEL
RADAR					
SEARCH RADAR	AN/APS-19C	PROVIDES RADAR SEARCH AND RADAR BEACON RECEPTION	ASSISTANT PILOT	LINE-OF-SIGHT	ASSISTANT PILOT'S CONTROL PANEL
IDENTIFICATION					
IFF SET	AN/APX-6	IDENTIFIES AS FRIENDLY	ASSISTANT PILOT	LINE-OF-SIGHT	RIGHT CONSOLE
SIF (1)	AN/APA-89	OPERATES WITH AN/APX-6	ASSISTANT PILOT	LINE-OF-SIGHT	RIGHT CONSOLE
ARMAMENT					
BOMB DIRECTOR	MK 3 MOD 4 MK 3 MOD 5 (3)				ASSISTANT PILOT'S FORWARD PANEL

REMARKS:
(1) Installation provisions only.
(2) BuNo. 132441 and subsequent.
(3) After Service Change.

P4429-1C

Figure 4-2. Table of Electronic Equipment



1. AT-141A/ARC Antenna
1A. Drift signal chute
2. AM-40/AIC Interphone Amplifier
3. RT-82/APX-6 IFF Receiver-Transmitter
4. Auto-pilot bank and turn indicator
5. R-4A/ARR-2A Homing Receiver
6. R-101/ARN-6 Radio Compass Receiver
7. AM-608/ARA-25 UHF ADF Amplifier (or) AN/APN-22 Radar Altimeter(1)
8. AT-5/ARR-1 Antenna
9. Dorsal area service light
10. Mk 3 Mod 4/5 Bomb Director power supply
11. Deleted
12. Deleted
13. AS-313A/ARN-6 Antenna
14. Dorsal area service light
15. AS-133/APX Antenna (AN/APX-6)
16. Mk 3 Mod 4/5 Bomb Director Computer
16A. Mk 3 Mod 4/5 Bomb Director Altimeter
17. RT-7A/APN-1 Radar Altimeter Transmitter-Receiver (or) AM-608/ARA-25 UHF ADF Amplifier(1)
17A. KY-81/APA-89 Equipment
18. RT-178/ARC-27 UHF Receiver-Transmitter
19. G-2 Compass Amplifier
20. RE-120/ARA-25 Relay
21. Auto-pilot amplifier adapter
22. Auto-pilot servo amplifier
23. Auto-pilot power junction box
24. G-2 compass adapter
25. R-122/ARN-12 Marker Beacon Receiver

(1) BuNo. 132441 and subsequent.

Figure 4-3. Electronic Equipment Compartment

UHF RADIO CONTROL PANEL. The C-1015/ARC-27A radio control panel located on the center console provides for remote tuning of the RT-178/ARC-27 transmitter-receiver. Identified as UHF, the panel contains three rotary selector switches labeled PRESET-MANUAL, CHAN and OFF-T/R-T/R + G REC-ADF. The PRESET-MANUAL switch is used to select preset frequency tuning or manual tuning. The CHAN selector switch permits the selection of 20 preset frequencies or the guard frequency. The OFF-T/R-T/R +G REC-ADF switch functions as follows:

Setting	*Function*
"OFF"	Set inoperative.
"T/R"	Places transmitter and main receiver in operation, guard receiver in standby.
"T/R + G REC"	Places transmitter and main receiver in operation; permits monitoring of guard frequency through guard receiver.

"ADF" Places transmitter in standby and AN/ARA-25 direction finding system in operation through main receiver.

Note

After service change, AN/ARC-27A transmissions are possible with the control in the "ADF" position.

Three concentric dials on the panel permit manual tuning in steps of 0.1 megacycles. The outer dial sets the first two digits of the frequency, the center dial sets the third digit and the inner dial sets the digit to the right of the decimal point. Also included is a control identified as VOL which is inoperative since audio level is adjusted at the interphone control panels.

OPERATION OF THE UHF RADIO

a. Turn OFF-T/R-T/R + G REC-ADF switch to operation desired.

b. Turn CHAN selector to channel number giving frequency desired. If monitoring of guard channel is desired the OFF-T/R-T/R + G REC-ADF switch must be on "T/R + G REC." If transmission on guard frequency is desired, the CHAN selector must be on "G."

c. For operation on "ADF," refer to paragraph on AN/ARA-25 AUTOMATIC DIRECTION FINDING EQUIPMENT.

AN/ARA-25 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 a continuous directional indication of the source of signals in the 225 to 400 megacycles band. Source indication in degrees of magnetic direction is provided by the number 1 needle of the ID-250/ARN course indicator (figure 1-4, reference 12) for homing.

OPERATION OF THE AN/ARA-25. The AN/ARA-25 is energized whenever the MASTER RADIO switch is turned "ON," and is placed in operation when the OFF-T/R-T/R + G REC-ADF switch is turned to "ADF."

CAUTION

In this airplane, when the AN/ARA-25 is used for homing on ground signals or for air rendezvous, errors up to nine degrees may be experienced. When used as a direction finder errors may be as much as plus or minus thirty degrees. Since these errors vary with operating frequency, the 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.

VHF RADIO EQUIPMENT

AN/ARC-1 VHF radio equipment can be installed in place of the AN/ARC-27 radio equipment for two-way voice communication between the airplane and other aircraft or a surface station. The RT-18/ARC-1 transmitter-receiver is pretuned for nine main channels in the 100 to 156 megacycles frequency range.

CONTROL. The C-865/ARC-1 control panel, identified as VHF, replaces the C-1015/ARC-27 control panel in this installation. It contains a nine-position rotary switch marked CHANNEL and a three-position rotary switch marked GUARD T/R-MAIN T/R & G REC-MAIN T/R. The latter switch permits selection of operation on the guard channel alone, the selected main channel, or operation on the main channel while monitoring the guard frequency.

OPERATION OF VHF RADIO. The VHF transmitter-receiver is energized whenever the MASTER RADIO switch is turned "ON."

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. In earlier aircraft,(1) the R-101/ARN-6 receiving set is remotely tuned by means of the ADF control panel (figure 1-5, reference 3) 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 positions, "DEC" (decrease frequency) and "INC" (increase frequency), and returns to a neutral point when released. The rate of tuning increases as the control is turned farther toward either extreme position. The third rotary switch is identified by its three marked positions: "OFF," "ADF," and "ANT."

In later aircraft,(2) the radio compass control panel has been redesigned to incorporate a CW-VOICE switch and a loop position control. The function selector switch has had a "LOOP" position added and the original "ADF" position has been redesignated "COMP." A LOOP L-R switch has been added to permit selection or control of the loop position.

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

(1) Aircraft prior to BuNo. 133894.
(2) BuNo. 133894 and subsequent.

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 course indicator (figure 1-4, reference 12) on the pilot's instrument panel. In later aircraft,(1) if the AN/ARA-25 automatic direction finding equipment is not in operation, both needles of the ID-250/ARN course indicator will indicate the magnetic relative bearing to the station tuned on the AN/ARN-6 radio compass. 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.

In aircraft incorporating the redesigned radio compass control panel,(2) operation is the same as in the preceding instructions with the following exceptions. To select automatic loop positioning, the function switch must be positioned on "COMP" rather than "ADF." With the function selector switch on "LOOP," 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. Greater accuracy in tuning may be obtained by placing the CW-VOICE switch in the "CW" position. A 900-cycle tone will be heard along with the station modulation. After tuning, return the CW-VOICE switch to "VOICE" to eliminate the 900-cycle tone.

Note

- In earlier aircraft,(3) the radio compass can be tuned only when the FLT INSTR PWR SEL switch is on "INVERTER 2 & AUTO PILOT." During ground operation, the engine must be turned up to d-c generator cut-in speed before output is gained from the number two inverter for radio compass tuning.
- In later aircraft(4) and prior aircraft after service change the radio compass can be tuned with the FLT INSTR PWR SEL switch on either position. During ground operation, "INVERTER 1" should be selected, as output from this inverter is not dependent upon the d-c generator.

ID-250/ARN COURSE INDICATOR

The ID-250/ARN course indicator (figure 1-4, reference 12), located on the pilot's instrument panel, is used in conjunction with the AN/ARN-6 radio compass and the AN/ARA-25 automatic direction finding equipment as an aid to navigation. The indicator face is a compass repeater indicator card slaved to the G-2 compass master direction indicator and repeats the directional indications given by the latter. Two needle pointers are provided. The number one needle provides a visual indication of the direction of signals received by the AN/ARA-25 equipment, and the number two needle performs an identical function for the AN/ARN-6 radio compass. Readings thus observed are magnetic bearings to the selected station or stations, provided the G-2 compass is correctly set.(1) To avoid confusion and erroneous readings, the two needles are interlocked to give a single indication for the AN/ARN-6 when the AN/ARA-25 equipment is not in use.

MARKER BEACON EQUIPMENT

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

MARKER BEACON VISUAL INDICATOR. The marker beacon indicating light (figure 1-4, reference 9) 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

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.

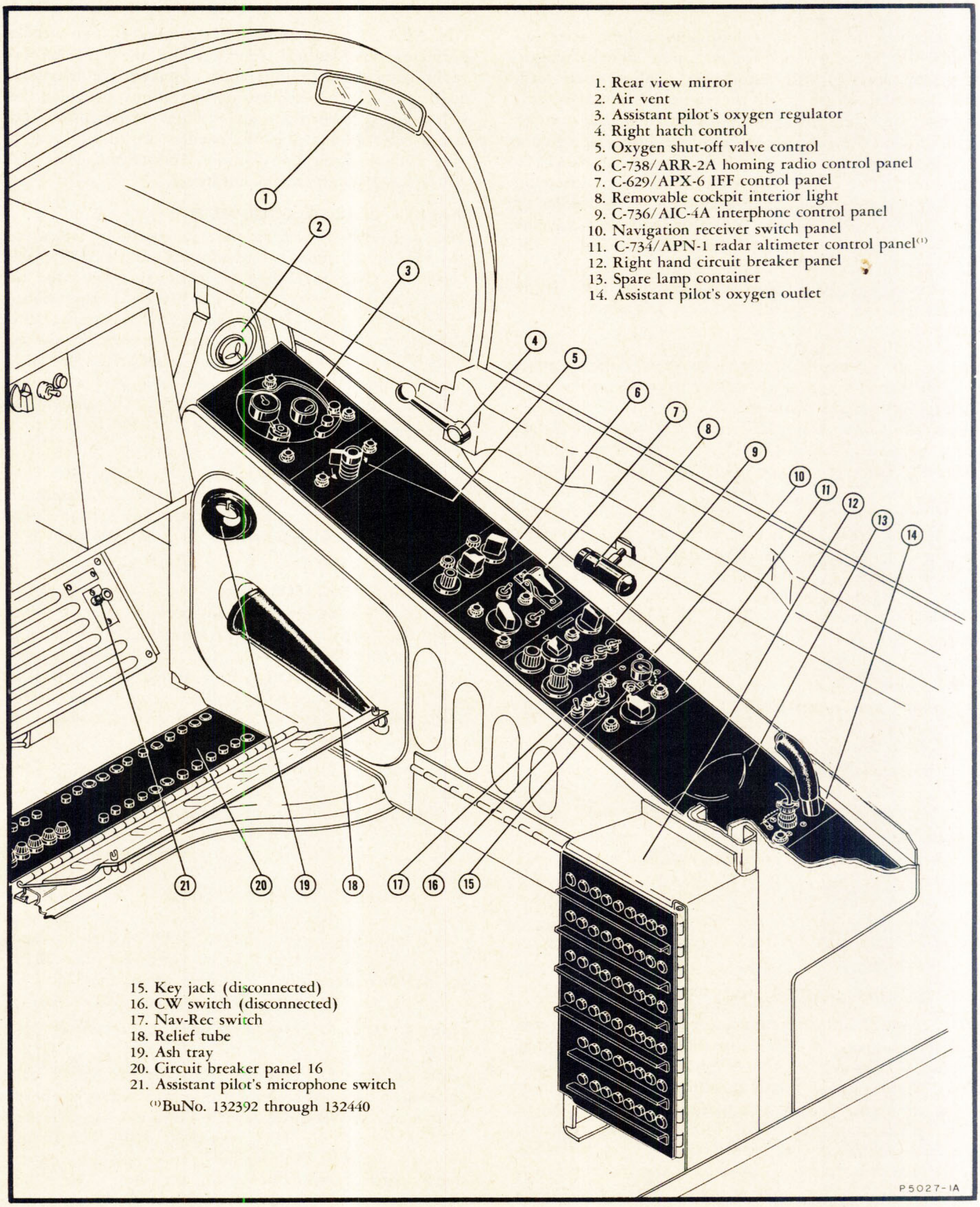
C-738/ARR-2A CONTROL PANEL. The homing radio control panel, labeled NAVIG, is on the right-hand console. The panel contains a six-position rotary selector switch identified as CHANNEL, a control labeled VOL, and a combination two-position switch and continuous control identified as NAV-VOICE. The CHANNEL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

OPERATION OF THE AN/ARR-2A HOMING RADIO. The AN/ARR-2A homing radio is energized whenever the MASTER RADIO switch is "ON." The assistant pilot may monitor the pilot's audio reception by placing the NAV-REC switch (figure 4-3A, reference 17) in the "NAV-REC" position. This enables the assistant pilot to monitor navigation radio reception that is normally available only to the pilot.

(5) AN/APN-1 RADAR ALTIMETER EQUIPMENT

An AN/APN-1 radar altimeter is installed for precise

(1) BuNo. 132434 and subsequent.
(2) BuNo. 133894 and subsequent.
(3) Aircraft prior to BuNo. 132639.
(4) BuNo. 132639 and subsequent.
(5) BuNo. 132392 through 132440.



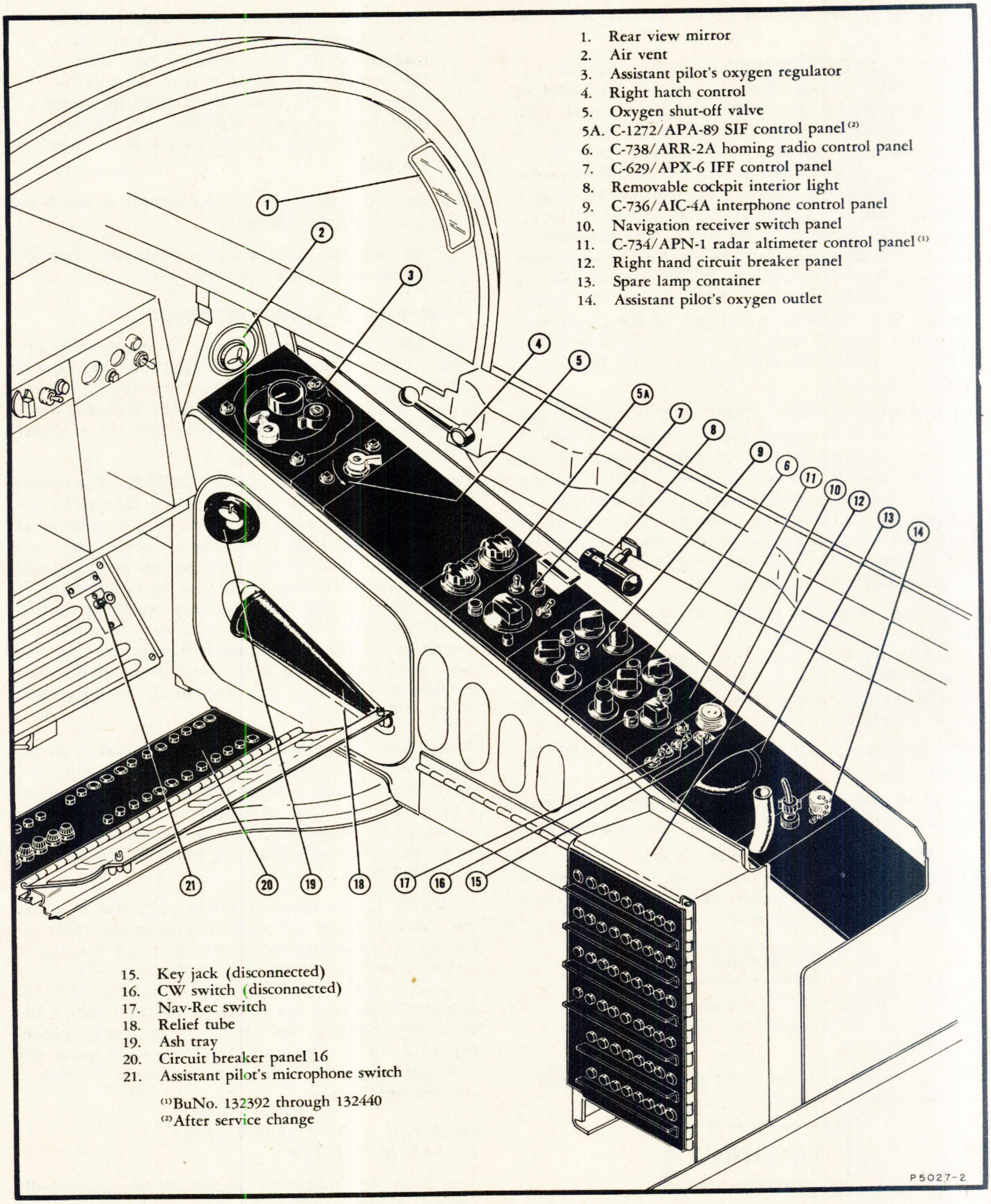
1. Rear view mirror
2. Air vent
3. Assistant pilot's oxygen regulator
4. Right hatch control
5. Oxygen shut-off valve control
6. C-738/ARR-2A homing radio control panel
7. C-629/APX-6 IFF control panel
8. Removable cockpit interior light
9. C-736/AIC-4A interphone control panel
10. Navigation receiver switch panel
11. C-734/APN-1 radar altimeter control panel(1)
12. Right hand circuit breaker panel
13. Spare lamp container
14. Assistant pilot's oxygen outlet
15. Key jack (disconnected)
16. CW switch (disconnected)
17. Nav-Rec switch
18. Relief tube
19. Ash tray
20. Circuit breaker panel 16
21. Assistant pilot's microphone switch

(1)BuNo. 132392 through 132440

P5027-1A

Before Service Change

Figure 4-3A. Cockpit — Right Side (Sheet 1)



1. Rear view mirror
2. Air vent
3. Assistant pilot's oxygen regulator
4. Right hatch control
5. Oxygen shut-off valve

5A. C-1272/APA-89 SIF control panel [2]

6. C-738/ARR-2A homing radio control panel
7. C-629/APX-6 IFF control panel
8. Removable cockpit interior light
9. C-736/AIC-4A interphone control panel
10. Navigation receiver switch panel
11. C-734/APN-1 radar altimeter control panel [1]
12. Right hand circuit breaker panel
13. Spare lamp container
14. Assistant pilot's oxygen outlet
15. Key jack (disconnected)
16. CW switch (disconnected)
17. Nav-Rec switch
18. Relief tube
19. Ash tray
20. Circuit breaker panel 16
21. Assistant pilot's microphone switch

[1] BuNo. 132392 through 132440
[2] After service change

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After Service Change

Figure 4-3A. Cockpit — Right Side (Sheet 2)

indications of the altitude of the aircraft above the surface.

RADAR ALTIMETER INDICATOR. The ID-14A/APN-1 radar altimeter indicator (figure 1-4, reference 8) is installed on the cockpit instrument panel. Two control switches are incorporated at the face of the instrument; the power switch marked ON, which controls the power input to the RT-7A/APN-1 radar altimeter transmitter-receiver located in the radio compartment; and a RANGE switch which selects the desired altitude range (low or high). The numerals 1, 2, 3, and 4, indicating the altitude for the low range in hundreds of feet, and 10, 20, 30, and 40, also in hundreds of feet for the high range, are visible through four windows on the face of the instrument. Thereore, the full scale reading for the low range is 400 feet and the full scale reading for the high range is 4000 feet.

RADAR ALTIMETER LIMIT SWITCH. A panel identified as ALT (figure 4-3A, reference 11), located on the right-hand console, contains a rotary switch which operates in conjunction with a limit indicating light (see following paragraph) and the RANGE switch of the radar altimeter. The rotary switch can be preset to any altitude within range of the indicator. This setting determines the altitude below which the limit indicating light will be illuminated.

RADAR ALTIMETER LIMIT INDICATING LIGHT. The limit indicating light (figure 1-4, reference 7) is located on the pilot's instrument panel adjacent to the radar altimeter indicator. The red light is illuminated when the airplane is at a lower altitude than that preset on the altitude limit switch.

OPERATION OF AN/APN-1 RADAR ALTIMETER EQUIPMENT

a. Turn power control switch on altimeter indicator clockwise. Power is supplied through the secondary bus.

b. Allow one minute for tubes to heat and observe that the needle of the indicator has moved from its sub-zero stop position to some other position indicating that the equipment is energized.

CAUTION

When the airplane is resting on the ground, the indicator pointer may not indicate zero altitude.

c. Set the RANGE switch on the indicator to show the desired altitude range.

WARNING

The high range of the AN/APN-1 altimeter cannot be relied upon below 500 feet over water and 600 feet over land. Below these altitudes when on the high range, the indicator will usually read high and may fail to read below 400 feet no matter how close to the terrain the airplane may actually be. Therefore, when flying below 600 feet under conditions of poor visibility the ID-14A/APN-1 indicator should always be on the low range.

d. Set the limit switch for the altitude at which the limit indicator light will light.

e. To stop the radio altimeter equipment, turn the power control switch counterclockwise.

[1] AN/APN-22 RADAR ALTIMETER

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

HEIGHT INDICATOR ID-257/APN-22. The height indicator (figure 1-4, reference 8) is located on the pilot's instrument panel and shows the true altitude of the aircraft, above the surface, on a "single turn" type of indicator. The altitude pointer advances linearly over the range from 0 to 200 feet and proportionally from 200 to 20,000 feet. The only operating control, the ON-LIMIT switch, is located on the lower left corner of the height indicator is illuminated. As long the off-on control and is also used 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 preset altitude, a red warning light on the lower right corner of the height indicator, is illuminated. As long as the aircraft remains above the preset altitude the light will remain off.

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 at a higher altitude when over water. The drop-out altitude is reduced in banks, climbs or dives of approximately 60 degrees. When drop-out occurs an electrical circuit disables the indicator and moves the indicator needle behind a mask to prevent the pilot from using the indicator when the signals are too weak to give a reliable indication.

OPERATION OF THE AN/APN-22 RADAR ALTIMETER

a. Turn the ON-LIMIT control on the height indicator in a clockwise direction. Power source is the number 2 inverter and the secondary bus. (Power from the

[1] BuNo. 132441 and subsequent.

number 2 inverter will be supplied regardless of the position of the FLT INSTR PWR SEL switch.)

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

CAUTION

Allow at least 12 minutes warm-up time after starting to insure final accuracy. If the temperature is −40°C, 25 minutes should be allowed.

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

d. To stop the AN/APN-22 radar altimeter, turn the ON-LIMIT switch in a counterclockwise direction to its fullest extent.

SEARCH RADAR EQUIPMENT

OPERATING CONTROLS. A C-1184/APS-19C control panel is located on the assistant pilot's instrument panel. The radar scope is located on the top left side of the assistant pilot's instrument panel where it may be observed by both pilots. Operation of the various controls is as follows:

a. FUNCTION SWITCH. This switch turns the AN/APS-19C equipment on and off and selects "STDBY," "BCN," or "SRCH" operation. When the switch is turned through the "STDBY" position a time-delay relay is actuated. This relay automatically postpones operation of the equipment until a three-minute warm-up period has elapsed. If the pilot desires temporarily to discontinue operation, the FUNCTION switch can be turned to "STDBY" until another tactical operation is wanted. In this way, the equipment is kept ready for instant use.

b. TUNE KNOB. This control is an emergency manual tuner to be used if the automatic frequency control (AFC) becomes inoperative. When used in the MANUAL range, the control tunes the receiver for maximum echoes. To retain maximum echoes, adjustment of the control at regular intervals is necessary when the AFC is inoperative. When the control is turned to the extreme counterclockwise "AUTO" position the AFC is in operation and will normally maintain echoes automatically.

c. TILT KNOB. This adjustment is used to change the vertical angle of antenna tilt for the "SRCH" scan.

d. GAIN CONTROL KNOB. The GAIN control regulates the strength of the signals coming from the receiver and the amount of "snow" that appears on the indicator screen. When the GAIN control is in the extreme counterclockwise position, the gain adjustment becomes automatic.

e. SCAN ANGLE TOGGLE SWITCH. This switch controls the selection of the "WIDE" or "NAR" scan angle.

f. RANGE KNOB. The range switch is used to select the scanning range of the radar equipment. The ranges "150," "100," "50," "20," and "8" can be used on all positions of the FUNCTION control. Range "150 BCN" can be used when the FUNCTION switch is on "BCN" only.

g. A filter is provided on the indicator screen to adjust for varying ambient light conditions. Moving the filter lever adjusts the amount of light penetration by means of sliding polaroid filters.

h. FOCUS and BRILL CONTROLS. These two controls located on the scope adjust the clarity and brilliance of the cathode-ray tube display. They should be adjusted to give a sharp, clear display on the indicator screen.

OPERATING PROCEDURES

Note

In the following procedure, it is assumed that careful pre-flight radar adjustments and all screwdriver potentiometer adjustments have been made, and that the controls are in an inoperative position.

SEARCH

a. Turn the FUNCTION selector to "SRCH." After a delay of approximately 3 minutes, the equipment should be operative.

Note

Check scope for "snow" indication. If the snow indication is not satisfactory, or if the target echo is difficult to discern because of too great an amount of snow, "MANUAL" operation of the GAIN control is necessary.

b. When a target echo appears on the screen, turn RANGE switch to the shortest range at which target can be seen. The sequence of operating ranges permits switching to lower ranges, as the aircraft approaches closer to the target.

c. When the operation is completed, turn all controls back to their original positions unless further operations are to be made. In that case, switch the FUNCTION control to the next operation desired or to "STDBY."

BEACON

The procedure for beacon operation is like that of "SRCH" except that the FUNCTION selector is placed on "BCN." RANGE selector is placed on "BCN 150."

RADAR IFF SYSTEM

The AN/APX-6 IFF transponder 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.

IFF CONTROL. A C-629/APX-6 control panel (figure 4-3A, reference 7) 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. The system is energized when the MASTER switch on the IFF control panel is set to any position other than "OFF."

DESTRUCTOR CIRCUIT. Deleted.

AN/APA-89 EQUIPMENT.(1) Provisions are made for installation of the AN/APA-89 equipment (figure 4-3A, sheet 2, reference 5A) which operates in conjunction with the AN/APX-6 IFF system.

AUTOMATIC PILOT

A P-1 Automatic Pilot, electrically powered by 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 (figure 4-3, reference 4), located in the electronic equipment compartment, provides the references needed to produce coordinated 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 (figure 1-5, reference 9).

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.

Note

The RUDDER TRIM switch, which is located on the auto-pilot control panel, is not hooked up in this airplane. The switch can be left in either the "FWD" or "AFT" position for auto-pilot operation.

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 pressing the clutch switch in.

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 rese 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.

(1) After service change.

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 (figure 1-5, reference 12) 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. Servo disconnects cannot be re-engaged during flight.

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

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 (figure 1-7A) is located forward of and above 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 as follows:

FLT INST	NON-FLT INST	CONSOLE
Fuel quantity gage	Carburetor air temperature gage	Left-hand console
Radar altimeter	Front bank oil pressure gage(1)	Center console
Gyro horizon	Eight-day clock	Right-hand console
G-2 compass	Engine gages unit	Ignition switch panel
Airspeed indicator	Radio compass	Landing gear control panel
Tachometer	Elapsed time clock	Generator control panel
Rate of climb indicator	Cylinder head temperature indicator	Interior lights panel
Turn and bank indicator	Trim tab position indicator	AN/APS-19 control panel
Altimeter	Landing gear, flaps position indicator	Bomb director control panel
Manifold pressure gage		Standby compass
Cockpit flood and utility lights		Armament control panel
Course indicator		Cockpit floodlight panel
Accelerometer		Aft heater control panel
		Aft lights control panels

Note

Whenever the FLT INST switch is turned from its "OFF" position, resistors, which serve to reduce the brilliance of some of the red warning lights, are cut into the warning lights system. Because the dimming system will render the warning lights ineffectual during daylight hours, it should be determined that the FLT INST lights switch is in the "OFF" position prior to any daylight flight. The following warning lights are included in the dimming circuit: generator, marker beacon, radar altimeter, inverter, tail hook, and landing gear.

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 of these lights allows selection of either red or white illumination.

(1) If installed.

FLOOD AND UTILITY LIGHTS CONTROL

EARLY AIRPLANES.[1] 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.

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.

LATER AIRPLANES.[2] Control of both the dome light and utility lights is effected through two switches located on the COCKPIT LIGHTS panel associated with the dome light assembly. A WHITE-RED-OFF switch allows selection of either red or white light for the dome light and at the same time turns on the utility lights. When this switch is 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.

LATEST AIRPLANES.[3] Control of both the dome light and the utility lights is effected through three switches located on the COCKPIT LIGHTS panel associated with the dome light assembly. An ALL-OFF-EXT switch turns on only the extendable utility lights when turned to the "EXT" position. No provision is made for controlling the intensity of these utility lights. When the switch is turned to "ALL," both the dome light and the utility lights are illuminated. The intensity of the dome light may be controlled by means of a second switch which can be turned to "BRT," "MED," or "DIM." Furthermore, either white or red light can be obtained from the dome light by means of a guarded switch which can be turned to "WHITE," or "RED."

COCKPIT EMERGENCY FLOOD LIGHTING.[1,2] 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.

MIDDLE COMPARTMENT LIGHTING. The middle compartment is illuminated by a dome light located on the overhead center-line structure at the aft end of the canopy. The switch for this dome light, identified as COCKPIT LTG, is on the left side of the center-line structure just aft of the "eye-ball" air vents. The switch can be turned from "OFF" to either "RED" or "WHITE" for cockpit 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 dome lights are located in the dorsal fuselage area aft of the middle compartment. These lights are controlled through two three-way switches, one located on the middle 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, 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.

EXTERIOR LIGHTS CONTROL. A panel located on the center console and identified as EXTR LTS (figure 1-4A, reference 6) contains switches for operation of the exterior lights. Four toggle switches with the indicated positions "BRIGHT," "OFF," and "DIM" are labeled FUSEL (fuselage lights), WING and TAIL (position lights), and FORM (formation lights). A five-position MASTER switch is used to select the desired function of the lights. In later aircraft[4] the "OFF' position has been removed from the master switch and a three-position "OFF," "ON," and "MOMENTARY" switch installed on the landing gear control panel (figure 1-3,

[1] Airplanes prior to BuNo. 133879.
[2] BuNo. 133879 through 133914.
[3] BuNo. 133915 through 133929 (and prior aircraft after service change).
[4] BuNo. 132670 and subsequent.

reference 21). Prior aircraft will have this switch configuration after service change. A lettered rotary switch labeled FUSEL is used for letter selection during automatic coding of the fuselage lights. A switch labeled PUSH TO KEY and an associated monitor light are included on the panel for manual coding of the fuselage lights.

OPERATION OF EXTERIOR LIGHTS

The following chart lists, exclusive of approach light operation, various combinations of exterior lights switch settings and the results thus obtained. Refer to the next paragraph for approach light operation.

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

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 exterior lights MASTER 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 lights will function automatically whenever the exterior lights MASTER 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 tail light will not flash.

SPARE LAMPS. A receptacle for the stowage of spare lamps (figure 4-3A, reference 13) is located in the right-hand console.

OXYGEN SYSTEM

Oxygen is normally supplied from one 514 cubic inch capacity cylinder located in the after fuselage; however, installation of two additional 514 cubic inch capacity cylinders is provided for in the airplane for use during passenger carrying or other operations requiring an increased oxygen supply. Pioneer 2874-A1 composite diluter-demand oxygen regulators (figure 1-3, reference 23; figure 4-3A, reference 3) are installed in the left and right-hand consoles for the use of the pilot and the assistant pilot. Connection to the oxygen system is made through breathing tubes located on each seat and connected to console receptacles (figure 4-13, reference 17). Oxygen regulators for other crewmen or passengers can be installed in the middle or aft compartments as needed. All oxygen tanks can be refilled through a single filler valve located on the fuselage bulkhead at the aft end of the middle compartment canopy.

DURATION OF OXYGEN SUPPLY. The OXYGEN DURATION CHART, figure 4-4, gives the number of man-hours of oxygen available for various combinations of oxygen pressure versus altitude. The chart is based on an installation of one cylinder only. To obtain total man-hours available, multiply the number of man-hours given in the chart with the number of cylinders installed. An influence on the number of man-hours of oxygen available to the pilot and assistant pilot can be found in a feature of the system itself whenever more than one cylinder is installed. A check valve incorporated in the system permits the pilot and assistant pilot to draw oxygen from all cylinders installed, while passengers can draw from the added oxygen supply only. This feature assures the pilot and assistant pilot of a continuing supply of oxygen from one cylinder, if, by any chance, the other installed cylinders are depleted by inadvertent misoperation of the passengers' oxygen regulators.

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) Man-hour figures shown are based on use of oxygen down to 300 psi.

(3) When carrying additional oxygen it is possible for a lower pressure to exist in the additional bottles than in the single oxygen bottle normally installed. In making a man-hour computation, the oxygen pressure reading should be obtained from one of the middle compartment regulators (if installed) to secure the lowest pressure in the system. Any difference existing between this reading and the pilot's oxygen pressure may be computed as additional man-hours available to the pilot and assistant pilot from one oxygen bottle.

DATA AS OF: 1 SEPTEMBER 1953

EXAMPLE:

(1) Given: Crew and passengers totaling five.
Three cylinders of oxygen installed.
Oxygen pressure 1400 psi.
Altitude of flight 20,000 feet.
"Normal Oxygen" to be used.

(2) Therefore: Number of man-hours available one cylinder = 4.0
Total man-hours available = 4.0 × 3 cylinders = 12.0
Man-hours available for each individual aboard = 12.0 ÷ 5 = 2.4

(3) Result: Use of oxygen for particular flight shall not exceed 2.4 hours.

P4530-1A

Figure 4-4. Oxygen Duration Chart

OXYGEN SYSTEM CONTROLS

OXYGEN SHUT-OFF VALVES. Oxygen shut-off valves (figure 1-3, reference 24; figure 4-3A, reference 5) are installed adjacent to the pilot's and assistant pilot'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% 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," diluted oxygen is delivered under pressure 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 as follows:

e. Blow into the open end of the oxygen tube until the flow indicator face opens.

f. Seal the open end of the oxygen tube with the tongue.

g. 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, regulator outlet elbow, and breathing tube hose clamps for tightness. If leakage still persists, the regulator must be replaced.

h. Put on the mask. Check the mask fit by placing the thumb over the disconnect at the end of the mask tube and inhaling 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.

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

j. Attach clip of breathing tube to proximate strap of 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.

k. 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 closely tied-in with this attachment.

EMERGENCY CONDITIONS

a. Should symptoms occur which suggest the onset of hypoxia, immediately turn the SAFETY PRESSURE lever on the regulator to "ON" 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.

WARNING

Use of safety pressure does not give undiluted oxygen.

c. 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 racks are hung beneath the outboard wing panels for mounting rockets or bombs (outboard wing racks may be designated Aero 14D-2 or Aero 14E). Three bomb racks, one on

each inboard wing panel and one on the center line of the fuselage, are used for mounting bombs, 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 an armament panel located beneath the pilot's instrument panel (figure 4-6A), and, when certain special stores are carried, through additional panels installed on the right-hand console. Electrical release of stores can be controlled directly by the pilot or indirectly through a MK 3 MOD 4/5 Bomb Director. Furthermore, external stores can be jettisoned manually through emergency release handles located in the cockpit.

ARMAMENT FIRING SWITCHES. The control stick grip incorporates a trigger for firing the guns, and two "pickle" switches, one labeled B which is used for the release of stores on the inner wing racks, and one labeled R for release of stores on the outer wing racks. See figure 4-5.

MASTER ARMAMENT SWITCH. A MASTER ARMT switch (figure 4-6A, reference 1) controls the operation of all armament equipment. Unless this switch is "ON," 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 by-passed for check of the armament system by momentarily closing a DISABLING SWITCH (figure 4-7) 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.

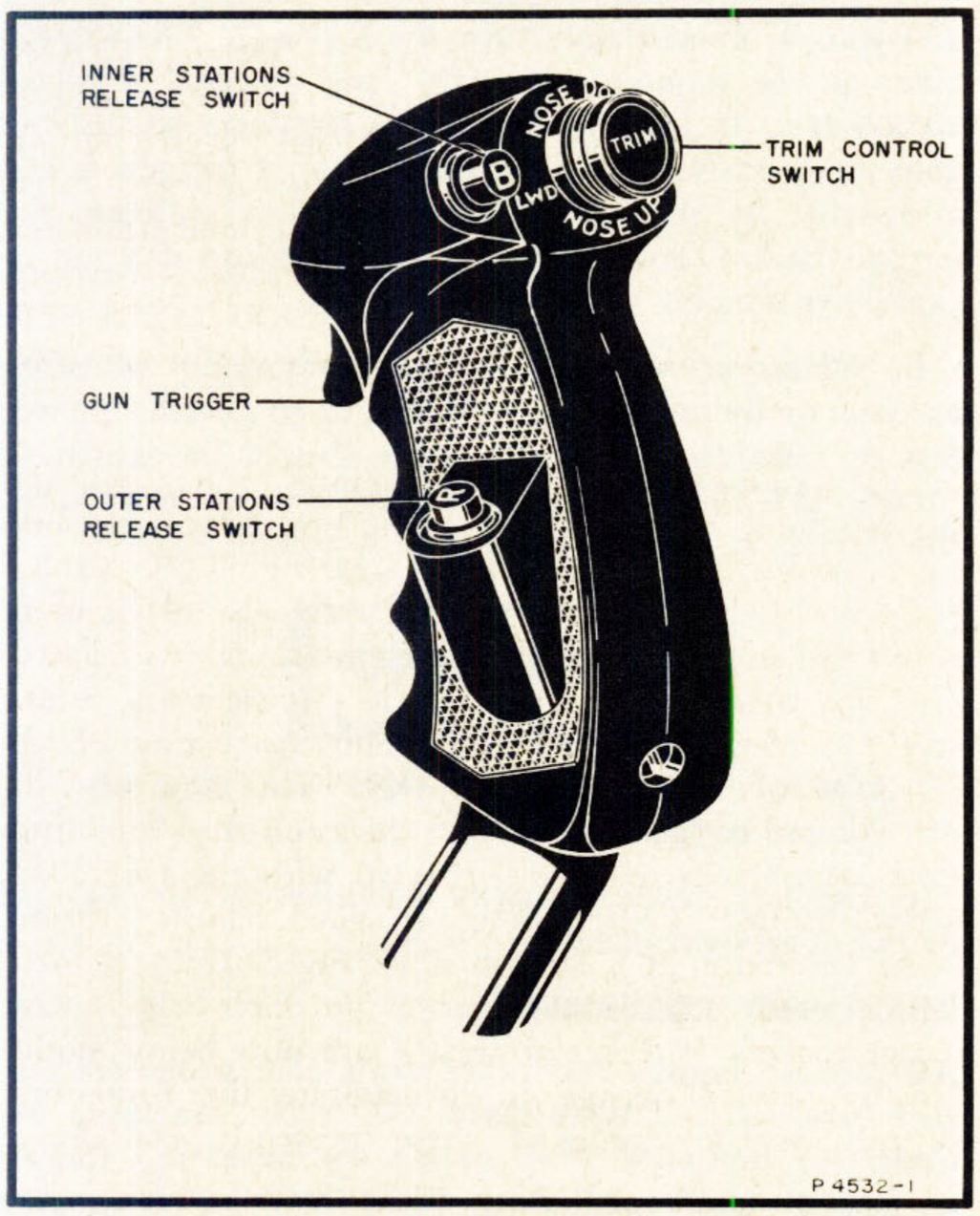


Figure 4-5. Control Stick Switches

Note

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 by service change on the hydraulic by-pass panel on the aft end of the left hand console (figure 1-3, reference 2A). 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 in this new location is the same as explained previously in this paragraph.

GUN CHARGING SWITCHES. Two GUNS switches (figure 4-6A, reference 2) 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 feature 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.

GUN SIGHT SWITCHES. A gun sight light selector switch and rheostat are located on the armament panel (figure 4-6A, sheet 1, references 3 and 14) before service change and on the gunsight panel (figure 1-4, sheet 2, references 34 and 35) after service change. 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."

OUTER STATIONS FUNCTION SELECTOR SWITCH.(1) An outer stations function selector switch is located on the pilot's armament panel (figure 4-6A, reference 12A). This switch has three positions, "BOMBS," "OFF," and "ROCKETS." It must be placed in either "BOMBS" or "ROCKETS" before such 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. A selector switch labeled OUTER STATIONS (figure 4-6A, reference 4) is used to set 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 pairs, the switch is set on station "7."

(1) BuNo. 132669 and subsequent. Prior aircraft after service change.

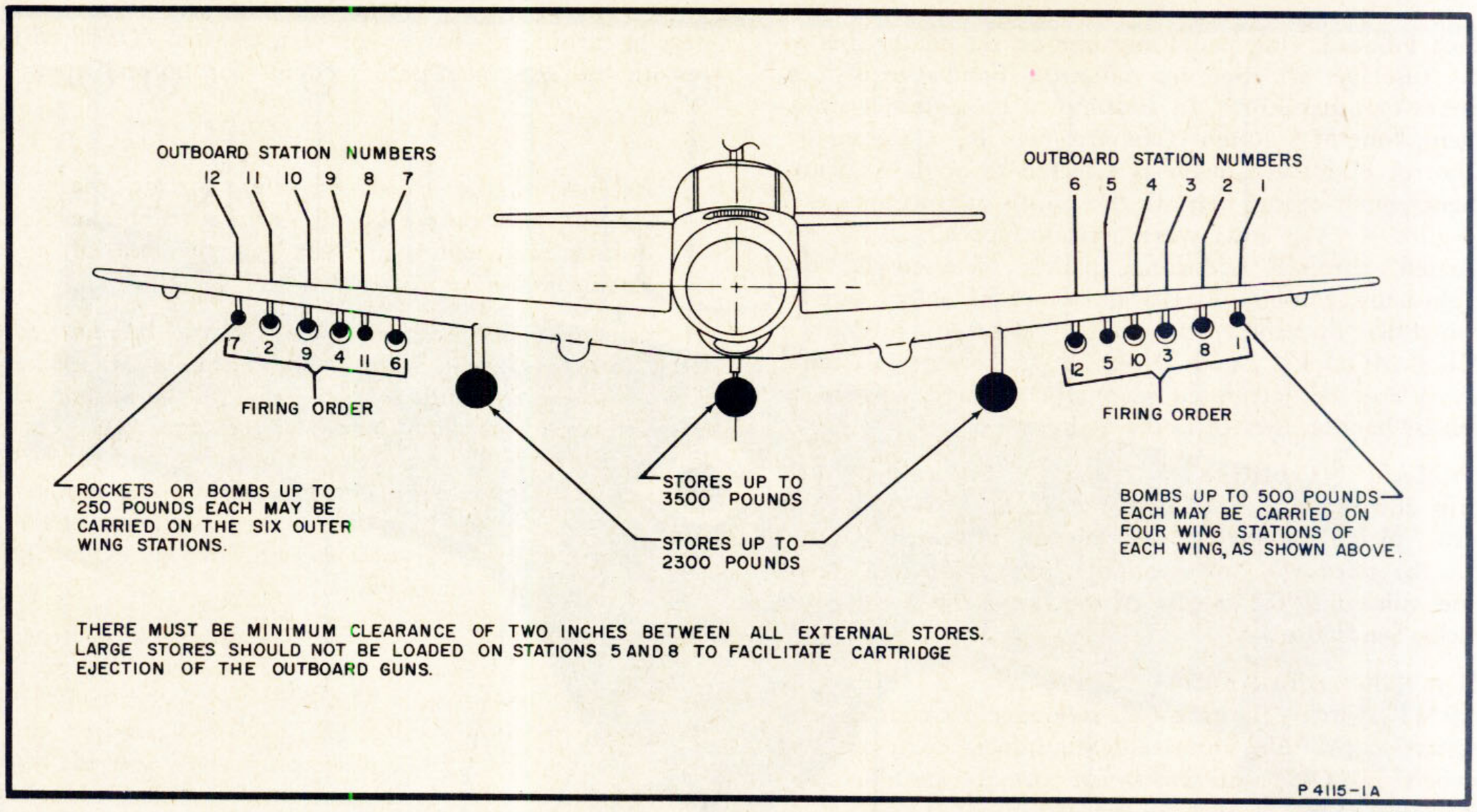


Figure 4-6. External Stores

INTERVALOMETER SWITCHES. A selector switch labeled RELEASES PER SECOND (figure 4-6A, reference 5) is used to set the number of bombs to be dropped or the 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.

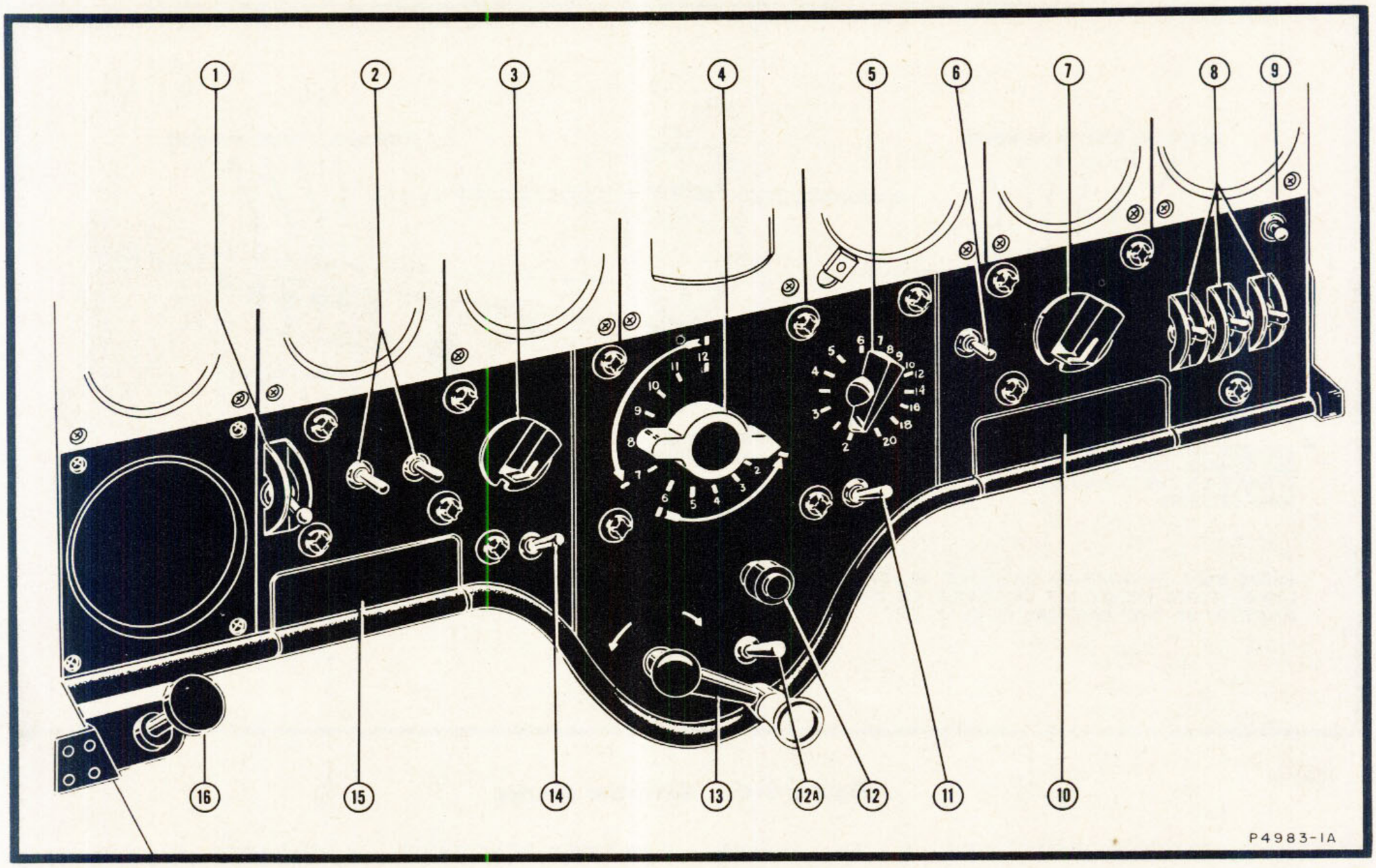
BOMB ARMING SWITCH. Bombs and rockets on all stations are armed by means of a switch adjacent to the intervalometer labeled ARM BOMBS (figure 4-6A, reference 6). Selection of "TAIL" or "NOSE & TAIL" arming is possible. The switch can be centered on "SAFE" for releasing stores unarmed.

INNER STATIONS FUNCTION SELECTOR SWITCH. A selector switch (figure 4-6A, reference 7) adjacent to the ARM BOMBS switch must be set relative to the type of store currently being carried on the inner stations racks. Four indicated positions are provided. To drop any type of stores loaded on the inner station racks, the switch must be set on "BOMBS." If spray tanks are to be operated or flares are to be released, the selector switch must be turned to "SPRAY-FLARES." The "SONO" position is inoperative. Turning the switch to "ROCKET PACKAGES" will allow ripple fire of rockets from packages installed on the inner wing racks.

INNER STATIONS SELECTOR SWITCHES. Three INNER STATIONS switches (figure 4-6A, reference 8) for selection of any of the inner stations racks are provided. If the INNER STATIONS switches are set to "LEFT," "CENTER" and "RIGHT," 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 INNER STATIONS switches are set to "TRAIN BOMBS" and the intervalometer switch is set to "SINGLE PULSE," the stores will be released singly in the sequence left, right, and center, one each time the pickle is depressed. If, however, the intervalometer switch is set to "INTERVAL," the release sequence will be at the interval rate set on the RELEASES PER SECOND selector switch. The switches can be centered on "OFF" as necessary.

BOMB RELEASE HANDLES. Handles located beneath the armament control panel are for emergency jettisoning of stores on all wing racks. The CENTER WING BOMB REL handle (figure 4-6A, reference 15) is used to jettison stores on the three inner stations. Associated with this control is another handle (figure 4-6A, reference 16) identified by the attendant instruction PULL TO LOCK—CENTER STATION. This control will lock the center-line rack so that stores on the remaining inner wing racks may be jettisoned with the CENTER WING BOMB REL handle. A third handle (figure 4-6A, reference 10) labeled OUTER WING BOMB REL is used to jettison all stores on outer wing racks except rockets.[1] Prior aircraft[2] are now being modified by service change to incorporate the foregoing control system. Some of these presently contain a

[1] BuNo.132471 and subsequent.
[2] BuNo. 132641 and prior.



1. Master armament switch
2. Gun charging switches
3. Gun sight light rheostat
4. Outer stations selector switch
5. Releases-per-second selector switch
6. Bomb arming switch
7. Inner stations function selector switch
8. Inner stations release selector switch
9. Outside air temperature selector switch
10. Outer wing bomb release(2) (or) Aileron power boost release(3)

Before Service Change

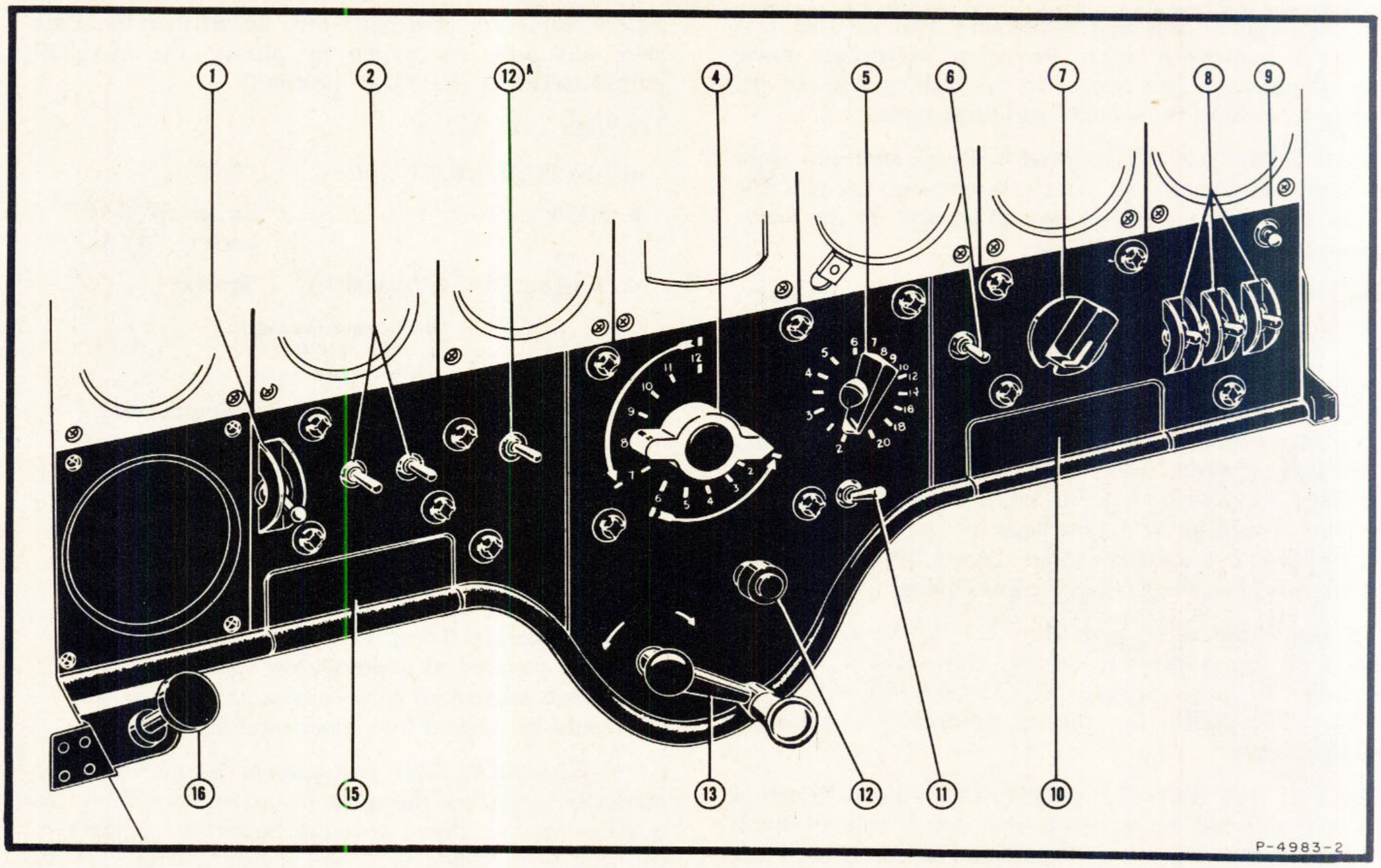
Figure 4-6A. Armament Control Panel (Sheet 1)

handle identified as PULL TO LOCK-WING RACKS(1) (figure 4-6A, reference 16). Use of this control locks the inner wing racks, allowing the center-line store to be jettisoned with the CENTER WING BOMB REL handle.

BOMB DIRECTOR. The Mk 3 Mod 4 Bomb Director installed in the aircraft is an electronic control system designed to release automatically bombs, rockets or other stores at the proper instant during the pull-out phase of a toss-bombing attack. The Mk 3 Mod 5 Bomb Director system includes an interval timer for loft-bombing in addition to its toss-bombing capabilities.

BOMB DIRECTOR SELECTOR. A BOMB DIRECTOR SELECTOR panel (figure 4-7A), located on the assistant pilot's forward console, contains switches which are set to direct control of bomb and rocket releases to either the pilot or the Mk 3 Mod 4/5 Bomb Director. The center selector switch on the panel has three indicated positions, "SINGLE OR INTERV," "BOMB DIR," and "BOMB DIR & INTERV." For control by the pilot of all ordnance releases, this switch is set to "SINGLE OR INTERV." Selection of the "BOMB DIR" position switches control of all bomb and rocket releases to the bomb director. The "BOMB DIR & INTERV" position provides for release of bombs through the combined control of the bomb director and the intervalometer. The intervalometer is not in the circuit, however, when the INNER and OUTER STATIONS switches on the BOMB DIRECTOR SELECTOR panel are in "ROCKETS" for rocket-tossing, regardless of the setting of the BOMB DIRECTOR SELECTOR with regard to the "BOMB DIR" or "BOMB DIR & INTERV" positions. In addition to the main selector switch, two toggle switches located on the BOMB DIRECTOR SELECTOR panel must be set to correspond with the type of stores loaded on the inner or outer stations (i.e., bombs or rockets). These

(1) BuNo. 132417 through 132641.
(2) BuNo. 132471 and subsequent.
(3) BuNo. 132392 through 132470.



11. Interval-single pulse selector switch
12. Sono hold light
12A. Outer stations function selector switch(1)
13. Rudder pedals adjustment crank
14. Gun sight light filament switch
15. Center wing bomb release(2) (or) Emergency bomb salvo release(3)
16. Inner wing racks locking control(4) (or) Center-line rack locking control(5)

(1) BuNo. 132669 and subsequent. Prior aircraft after service change.
(2) BuNo. 132471 and subsequent.
(3) BuNo. 132392 through 132470.
(4) BuNo. 132417 through 132641.
(5) BuNo. 132642 and subsequent. Prior aircraft after service change.

After Service Change

Figure 4-6A. Armament Control Panel (Sheet 2)

switches are "in circuit" only when the main selector switch is in either the "BOMB DIR" or the "BOMB DIR & INTERV" position.

BOMB DIRECTOR CONTROL PANEL. A Mk 27 Mod 1 control panel (figure 4-7A) is located on the assistant pilot's instrument panel for testing and operation of the bomb director. On this panel are the POWER switch with "OFF" and "ON" positions, a BARO PRESS dial for setting the expected barometric pressure at the target, a TARGET ALTITUDE indicator and setting knob, a TEST switch and a null meter.

WARNING

The TEST switch, when operated in proper sequence with the pickle switch, simulates dive conditions and will energize arming circuits. On armed airplanes, personnel and equipment will be endangered if operation of the arming circuits is not prevented.

BOMB DIRECTOR INTERVAL TIMER. A Mk 3 Mod 0 Interval Timer (figure 4-7A, reference 7A), which is incorporated in the Mk 3 Mod 5 Bomb Director System, is located to the right of the bomb director selector panel. Two timer dials, a timer setting knob and a LOFT-TOSS switch make up its controlling units. The timer dials are set by rotating the setting knob clockwise; the LOFT-TOSS switch position controls the type of bombing to be accomplished.

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 gun sight is installed above the pilot's instrument panel. The sight is installed and boresighted parallel to the armament datum line of the aircraft.

GUN SIGHT MIL ADJUSTMENT. A mil adjustment knob provides the pilot with up to 340 mils positive and 65 mils negative lead adjustment. Any positive sight setting in excess of 200 mils, however, should be avoided as contact between the reflector plate and the windshield may result. 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. An adjustable pointer is provided as a further aid in sight setting.

To adjust the sight, turn the "O" on the adjustment knob up for a positive setting, down for a negative setting. Refer to Section VI, ANGLE OF ATTACK RELATIONSHIP, for further information on sight adjustment.

GUN SIGHT RETICLE CONTROL. Reticle selection is accomplished by rotating the reticle control knob located directly above the crash pad at the rear of the sight. Three reticles are available: the night reticle, intended for use where target visibility is very low; the day reticle, used for better image visibility against light backgrounds; and the combination reticle, used under conditions of reduced target visibility which exist at dawn, twilight, or during overcast periods. The night reticle consists of a center pip partially enclosed on each side by two 90 degree arcs located on a 50 mil radius from the center, and is illuminated through a red-orange filter to protect the pilot's night vision. The day reticle illuminates 50 and 100 mil circles for air to air gunnery, and a "ladder" reference scale arranged in 10 mil graduations for rocket firing, strafing, and bombing.

TO OPERATE THE GUN SIGHT.

a. BAT-GEN switch in either "BAT ONLY" or "BAT & GEN" or external power plugged in.

b. Armament master switch . . . . . "ON"

c. Turn dimmer rheostat clockwise to illuminate gunsight light. If light does not come on, move light selector switch to "STANDBY."

d. Rotate the reticle control knob until the desired reticle pattern is visible on the reflector plate.

e. Adjust the dimmer rheostat until the reticle pattern is properly illuminated.

TO GROUND CHECK GUN SIGHT. To ground test the gun sight it is necessary to actuate the armament disabling switch in the left wheel well prior to step "b" above. Proceed with normal operation thereafter. After completion of ground test, de-energize the armament bus prior to taxiing by placing the MASTER ARMT switch in the "OFF" position.

TO FIRE THE GUNS

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

b. GUN switches . . . . . Switch to "SAFE" & back to "READY"

c. Trigger (on control stick) . . . Squeeze

CAUTION

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 and safetying of guns.

Note

If feasible, fire rockets on stations six and seven before firing the outboard guns. This is recommended as a precaution against possible rocket misfire on these station, as the pigtails could be severed by ejected cartridge links.

GUN CAMERA. The gun camera is operated automatically whenever the guns or rockets are fired. An overrun feature allows the gun camera to continue to run for 10 seconds after the firing circuits are de-energized.

BOMBING EQUIPMENT

The three inner stations are designed for the installation of either Mk 51 or Aero 61A bomb racks. In addition, a bomb ejector can be installed on the center-line station. 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 racks of the outer wing panels.

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 by means of the BOMB EJECTOR TEST SWITCH (see figure 4-7) located in the left-hand wheel well.

TESTING BOMB EJECTOR SYSTEM. With a cartridge installed in the bomb ejector, make the following check:

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

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

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

If test lamp on the BOMB EJECTOR TEST panel

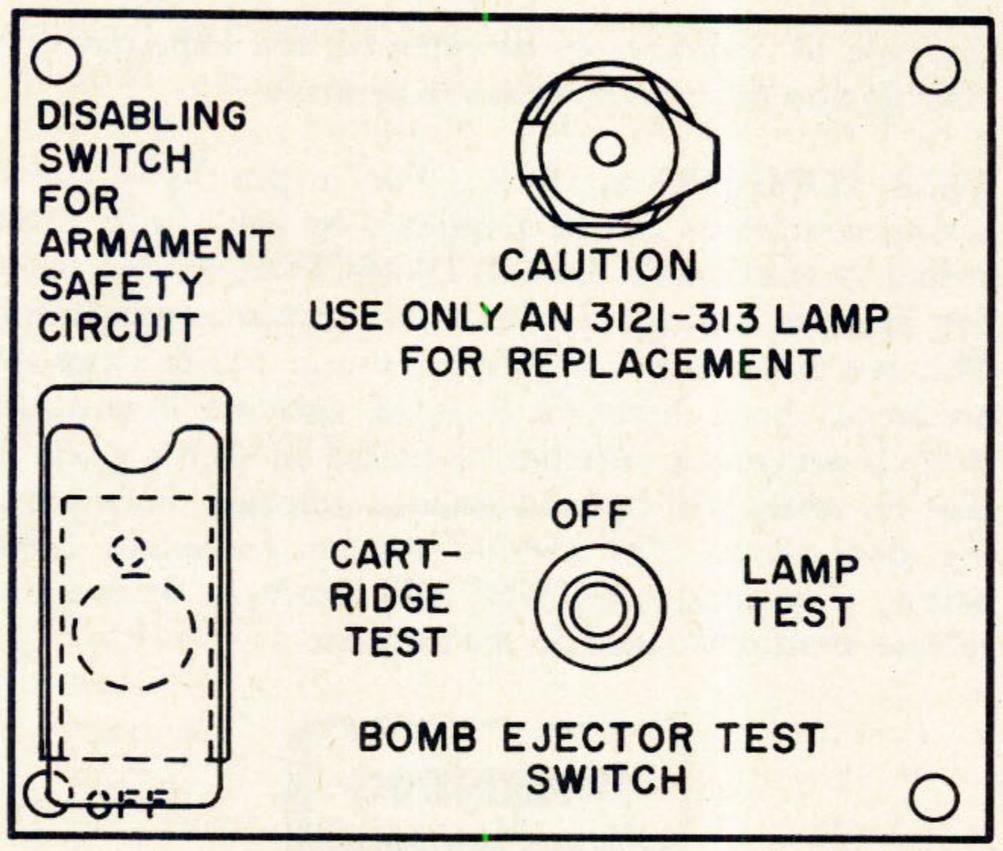


Figure 4-7. Bomb Ejector Test Panel

lights, the circuit is complete. If it does not light, continue with the check as follows:

d. BOMB EJECTOR TEST SWITCH .....“LAMP TEST”

If the test lamp now lights, the bomb ejector cartridge circuit is open and the 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.

RELEASING BOMBS

SINGLE RELEASE

INNER STATIONS

a. MASTER ARMT switch .....“ON”
b. Intervalometer switch ...“SINGLE PULSE”
c. ARM BOMBS switch ...As required
d. Function selector switch .....“BOMBS”
e. INNER STATIONS selector switch .....“TRAIN BOMBS”
f. BOMB DIRECTOR SELECTOR .....“SINGLE OR INTERV”
g. 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.

OUTER STATIONS

a. MASTER ARMT switch “ON”
b. OUTER STATIONS selector .....As needed
c. Intervalometer switch ...“SINGLE PULSE”
d. ROCKET-BOMBS switch(1) .....“BOMBS”
e. ARM BOMBS switch ...As required
f. BOMB DIRECTOR SELECTOR .....“SINGLE OR INTERV”
g. Pickle switch R .....Depress

Note

Five hundred pound bombs loaded as indicated in figure 4-6 are released by setting the OUTER STATIONS selector to positions 2, 3, 4, 6, 8, 9, 10, and 12.

TRAIN RELEASE

INNER STATIONS

a. MASTER ARMT switch “ON”
b. RELEASES PER SECOND .....As required
c. Intervalometer switch ...“INTERVAL”
d. ARM BOMBS switch ...As required
e. Function selector switch .“BOMBS”
f. INNER STATIONS selector switches .....“TRAIN BOMBS”
g. BOMB DIRECTOR SELECTOR .....“SINGLE OR INTERV”
h. Pickle switch B .....Depress

OUTER STATIONS

a. MASTER ARMT switch “ON”
b. OUTER STATIONS selector .....As required
c. RELEASES PER SECOND .....As required
d. Intervalometer switch ...“INTERVAL”
e. ROCKET-BOMBS switch(1) .....“BOMBS”
f. ARM BOMBS switch ...As required
g. BOMB DIRECTOR SELECTOR .....“SINGLE OR INTERV”
h. Pickle switch R .....Depress

SALVO RELEASE

INNER STATIONS

a. MASTER ARMT switch “ON”
b. Intervalometer switch ...“SINGLE PULSE” or “INTERVAL”

(1) BuNo. 132669 and subsequent. Prior aircraft after service change.

c. ARM BOMBS switch . . . As required
d. Function selector switch . "BOMBS"
e. INNER STATIONS selector switches . . . . . "LEFT," "CENTER" and "RIGHT"
f. BOMB DIRECTOR SELECTOR . . . . . "SINGLE OR INTERV"
g. Pickle switch B . . . . . Depress

OUTER STATIONS

a. MASTER ARMT switch "ON"
b. OUTER STATIONS selector . . . . . "7"
c. RELEASES PER SECOND . . . . . "20"
d. Intervalometer switch . . . "INTERVAL"
e. ROCKET-BOMBS switch[1] . . . . . "BOMBS"
f. ARM BOMBS switch . . . As required
g. BOMB DIRECTOR SELECTOR . . . . . "SINGLE OR INTERV"
h. Pickle switch R . . . . . Depress

MANUAL JETTISON

CENTER-LINE RACK ONLY[2]

a. WING RACKS locking control . . . . . Pull
b. CENTER WING BOMB REL handle . . . . Pull

ALL INNER STATIONS EXCEPT CENTER-LINE[3]

a. CENTER STATION locking control . . . . . Pull
b. CENTER WING BOMB REL handle . . . . Pull

ALL INNER STATIONS

CENTER WING
BOMB REL handle . . . . . Pull

OUTER STATIONS[4]

OUTER WING
BOMB REL . . . . . Pull

AUTOMATIC BOMB RELEASE

PRE-FLIGHT ADJUSTMENT AND CHECK. Before any toss or loft-bombing mission, the Mk 63 Mod 2/3 Computer dials (figure 4-3, reference 16) must be properly adjusted by ground personnel to correspond with the type of ordnance to be released, the expected dive velocity and the type of attack to be made.

TOSS BOMBING CHECK. For a pre-flight check, diving conditions can be simulated by use of the TEST switch located on the BOMB DIRECTOR control panel for ground testing of the bomb director equipment. This test necessarily requires the use of power from the armament bus, therefore it is of extreme importance that all armament switches be placed in such a position that no stores will be inadvertently released during testing operations. The ground testing procedure listed below, if properly followed, will preclude inadvertent release of stores loaded on the airplane.

WARNING

Do not test the bomb director circuits while stores are loaded on the airplane unless absolutely necessary. The TEST switch, when operated in proper sequence with the bomb pickle switch, simulates dive conditions and will energize the armament circuits.

a. OUTER STA function selector switch[1] . . . . . "OFF"
b. OUTER STATIONS selector switch . . . . . Empty rack
c. Intervamoleter selector switch . "SINGLE PULSE"
d. ARM BOMBS switch . . . . . "SAFE"
e. Function selector switch . . . . . "BOMBS"
f. Three INNER STATIONS selector switches . . . . . "OFF"
g. INNER STATIONS BOMBS-ROCKETS switch . . . . . "BOMBS"
h. BOMB DIRECTOR SELECTOR switch . . . . . "BOMB DIR"
i. TOSS-LOFT switch (if installed) . . . . . "TOSS"
j. Battery-generator switch . . . . . "BAT & GEN" or "BAT ONLY"
k. ARMAMENT DISABLING switch . . . . . Momentarily depress
l. MASTER ARMT switch . . . . . "ON"
m. POWER switch . . . . . "ON"

After a short warm-up period, depress the TEST switch for about 12 seconds, then release it and immediately depress pickle switch B. Hold down the pickle switch until the bomb director light, located on the left underside of the pilot's glareshield, is illuminated and goes out automatically. If the system is working properly the light should become illuminated ap-

[1] BuNo. 132669 and subsequent. Prior aircraft after service change.
[2] BuNo. 132417 and subsequent.
[3] BuNo. 132642 and subsequent.
[4] BuNo. 132471 and subsequent.

proximately two seconds after the pickle switch is depressed and should remain illuminated about five times that length of time.

LOFT-BOMBING CHECK. For a pre-flight check of the loft-bombing equipment follow the procedure listed for the toss-bombing check from "a" to "h" and continue as follows:

i. TOSS-LOFT switch ..... "LOFT"

j. Interval timer setting ..... 15 seconds

k. PULL-UP SETTING dial (on computer) 300

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

m. ARAMENT DISABLING switch ..... Momentarily depress

n. MASTER ARMT switch ..... "ON"

o. POWER switch ..... "ON"

Depress pickle switch B and hold until the pilot's bomb director light, located on the left underside of the pilot's glareshield, is illuminated and goes out automatically. The bomb director light should become illuminated fifteen seconds after the pickle switch is pressed and should remain on for approximately the same length of time. After the light goes out, turn off the bomb director and return the interval timer and pull-up dials to the positions specified for the mission.

Note

These tests are used to check operation only and give no indication of accuracy of calibration.

BOMB DIRECTOR CONTROLS. Set the BARO PRESS dial to the current atmospheric pressure, corrected to sea-level, of the target area. If the barometric pressure at the target is not known, the BARO PRESS dial is set with the aid of the null-test meter as follows:

a. Turn the POWER switch "ON" and allow a short warm-up period.

b. Set the TARGET ALTITUDE dial to the actual altitude above sea-level of the airplane.

c. Depress the BARO PRESS dial and rotate it until the arm of the null-test meter is vertically centered.

Note

The reading of the BARO PRESS dial now indicates the current local atmospheric pressure corrected to sea-level valve.

d. Reset the TARGET ALTITUDE dial to the actual altitude above sea-level of the target.

e. Turn bomb director POWER switch "OFF."

ATTACK PROCEDURE

a. Turn bomb director POWER switch "ON" from 15 to 30 minutes before bomb director is to be used.

b. Turn gun sight on.

c. Set armament control panel switches for required settings as given under RELEASING BOMBS.

d. Set BOMB DIRECTOR SELECTOR switches as required for particular attack.

e. Begin dive. When dive velocity reaches a relatively constant value and the aim is satisfactory, press the pickle switch (B for inner stations release, R for outer stations release) and hold depressed throughout the attack.

Note

The indicator light will illuminate to indicate the completion of the time-in portion of the dive. The pull-out should be made as soon as possible after the light is illuminated. It will remain illuminated until the bombs are released.

f. Release the pickle switch after the bombs have been released.

Note

If it is decided not to release ordnance after starting a dive, let up on the pickle switch at any time before the stores are dropped and release will be withheld. This will clear the circuits and reset the computer for a new timing run, which may be started immediately.

ROCKET EQUIPMENT

Rockets can be carried on the 12 Aero 14 outer wing racks. In addition to suspension of rockets directly on the racks, rocket packages can be hung on all outer stations for increasing the fire-power of the airplane.

FIRING ORDER. Rockets are fired singly from the outer stations in the order indicated in figure 4-6. Sequence of firing pairs is 7 and 1, 8 and 2, 9 and 3, 10 and 4, 11 and 5, 12 and 6. The firing order of the inner stations is the left-hand rack followed by the right-hand rack.

FIRING ROCKETS

Note

If at all feasible, fire rockets on stations six and seven before firing the outboard guns. This is recommended as a precaution against possible rocket misfire on these stations, as the pigtails could be severed by ejected cartridge links.

SINGLE FIRE

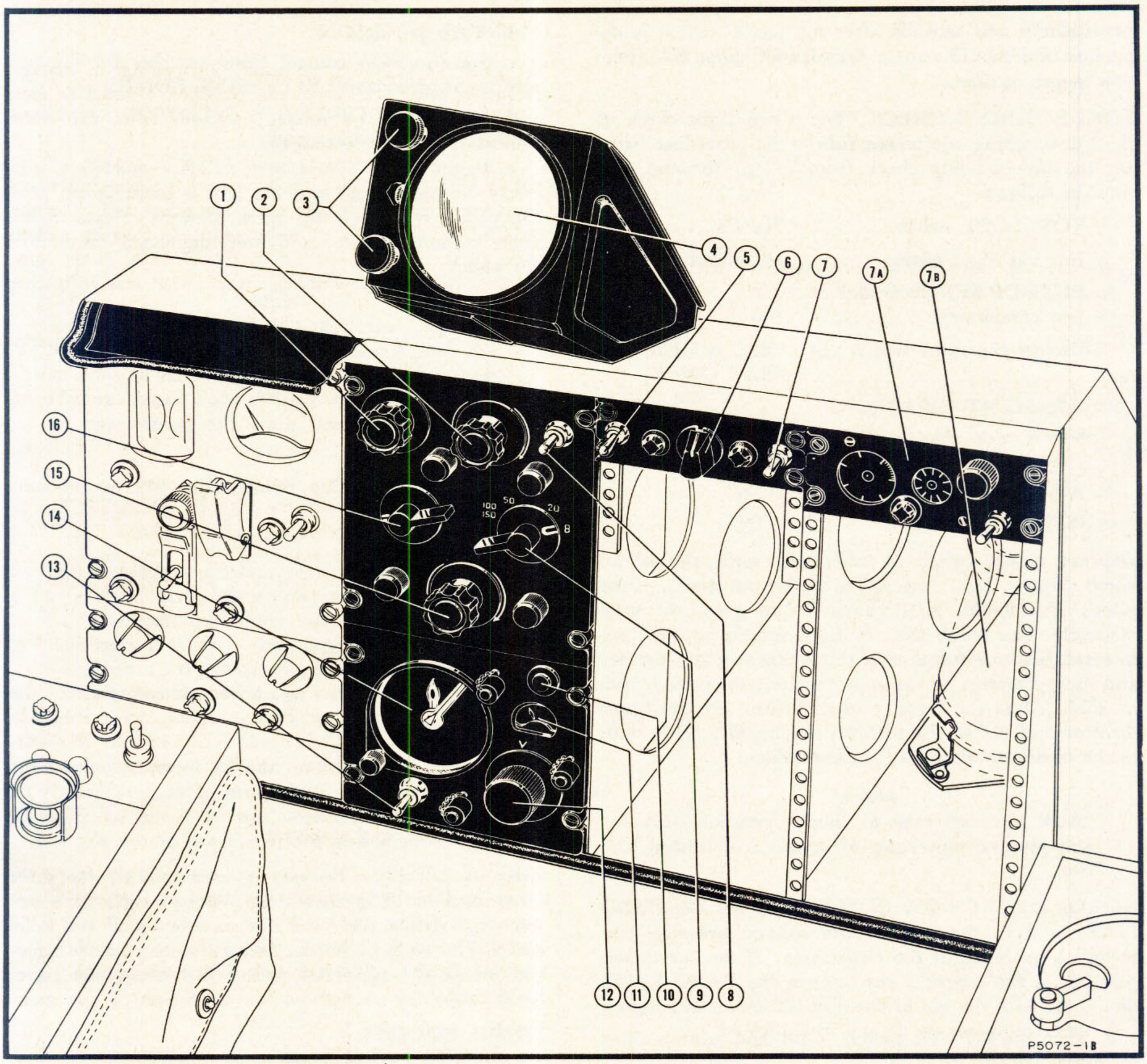
INNER STATIONS. Rockets which are hung directly on the inner stations racks (e.g., 11.75-inch aircraft rockets) are released as follows:

a. MASTER ARMT switch "ON"

b. Intervalometer switch ... "SINGLE PULSE"

c. Function selector switch . "BOMBS"

d. INNER STATIONS selector switch ..... "TRAIN BOMBS"



1. Tilt knob
2. Gain control knob
3. Focus and brilliance controls
4. AN/APS-19C Radar scope
5. Inner stations bomb-rocket selector switch
6. Bomb director selector switch
7. Outer stations bomb-rocket selector switch

7A. Bomb director system interval timer

7B. AN/APS-19C Scope visor stowage

8. Scan angle toggle switch
9. Range control knob
10. Null test switch
11. Null meter
12. Barometric pressure knob
13. Power switch
14. Target altitude indicator
15. Automatic frequency control
16. Function selector switch

Figure 4-7A. Bomb Director and Radar Control Panels

e. BOMB DIRECTOR SELECTOR ..... "SINGLE OR INTERV"

f. PICKLE switch B ..... Depress

OUTER STATIONS

a. MASTER ARMT switch "ON"

b. OUTER STATIONS selector ..... "1"

c. Intervalometer switch ... "SINGLE PULSE"

d. ROCKET-BOMBS switch(1) ..... "ROCKETS"

(1) BuNo. 132669 and subsequent. Prior aircraft after service change.

e. BOMB DIRECTOR SELECTOR ..... "SINGLE OR INTERV"

f. Pickle switch R ..... Depress

Note

- To fire rockets in pairs, place the OUTER STATIONS selector on "7."
- The single fire procedure for outer stations will cause ripple fire of all rockets within a package hung on the selected station.

TRAIN FIRE

INNER STATIONS. Rockets which are hung directly on the inner stations racks (e.g., 11.75-inch aircraft rockets) are released as follows:

a. MASTER ARMT switch "ON"

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

c. Intervaolmeter switch ... "INTERVAL"

d. Function selector switch . "BOMBS"

e. INNER STATIONS selector switches ..... "TRAIN BOMBS"

f. BOMB DIRECTOR SELECTOR ..... "SINGLE OR INTERV"

g. Pickle switch B ..... Depress

OUTER STATIONS

a. MASTER ARMT switch "ON"

b. OUTER STATIONS selector ..... "1" for single releases
"7" for paired releases

c. RELEASES PER SECOND ..... As required

d. Intervalometer switch ... "INTERVAL"

e. ROCKET-BOMBS switch[1] ..... "ROCKETS"

f. BOMB DIRECTOR SELECTOR ..... "SINGLE OR INTERV"

g. Pickle switch R ..... Depress

SALVO RELEASE

INNER STATIONS. The procedure for salvo release of rockets hung directly on the inner stations racks is the same as that for bombs.

OUTER STATIONS. The procedure for salvo release of rockets on the outer stations is the same as that for bombs.

[1] BuNo. 132669 and subsequent. Prior aircraft after service change.

MANUAL JETTISON

OUTER STATIONS. Manual jettisoning of rockets from the outer stations is not possible. Manual or electrical jettisoning of rocket packages from the outer stations is the same as that for bombs.

INNER STATIONS. Rockets hung on the inner stations are jettisoned by the same procedure as for bombs.
ROCKET TOSSING. The procedure for firing rockets through the Mk 3 Mod 4/5 Bomb Director is the same as that for a toss-bombing attack with the following exceptions.

a. Set armament control panel switches for required settings given under FIRING ROCKETS.

b. Set BOMB DIRECTOR SELECTOR switches at "ROCKETS."

Note

The intervalometer is not included in the firing circuit when the BOMB DIRECTOR SELECTOR switches are set at "ROCKETS," therefore outer station rockets can be fired at a maximum of one pair only per dive and cannot be salvoed.

TORPEDO EQUIPMENT

An aircraft torpedo can be carried on each rack of the three inner stations. Torpedoes are released in the same manner as the bombs. Refer to RELEASING BOMBS. No provisions are made for depth setting from the cockpit.

SPRAY TANK EQUIPMENT

Spray tanks can be carried on each rack of the three inner stations. The control and operation of the spray tanks is through the pilot's armament panel, a special SPRAY TANKS panel installed as needed on the right-hand console, and pickle switch B. Armament panel controls are set as follows for operation of the spray tanks:

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

b. Function selector switch ..... "SPRAY-FLARES"

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 as follows:

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

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

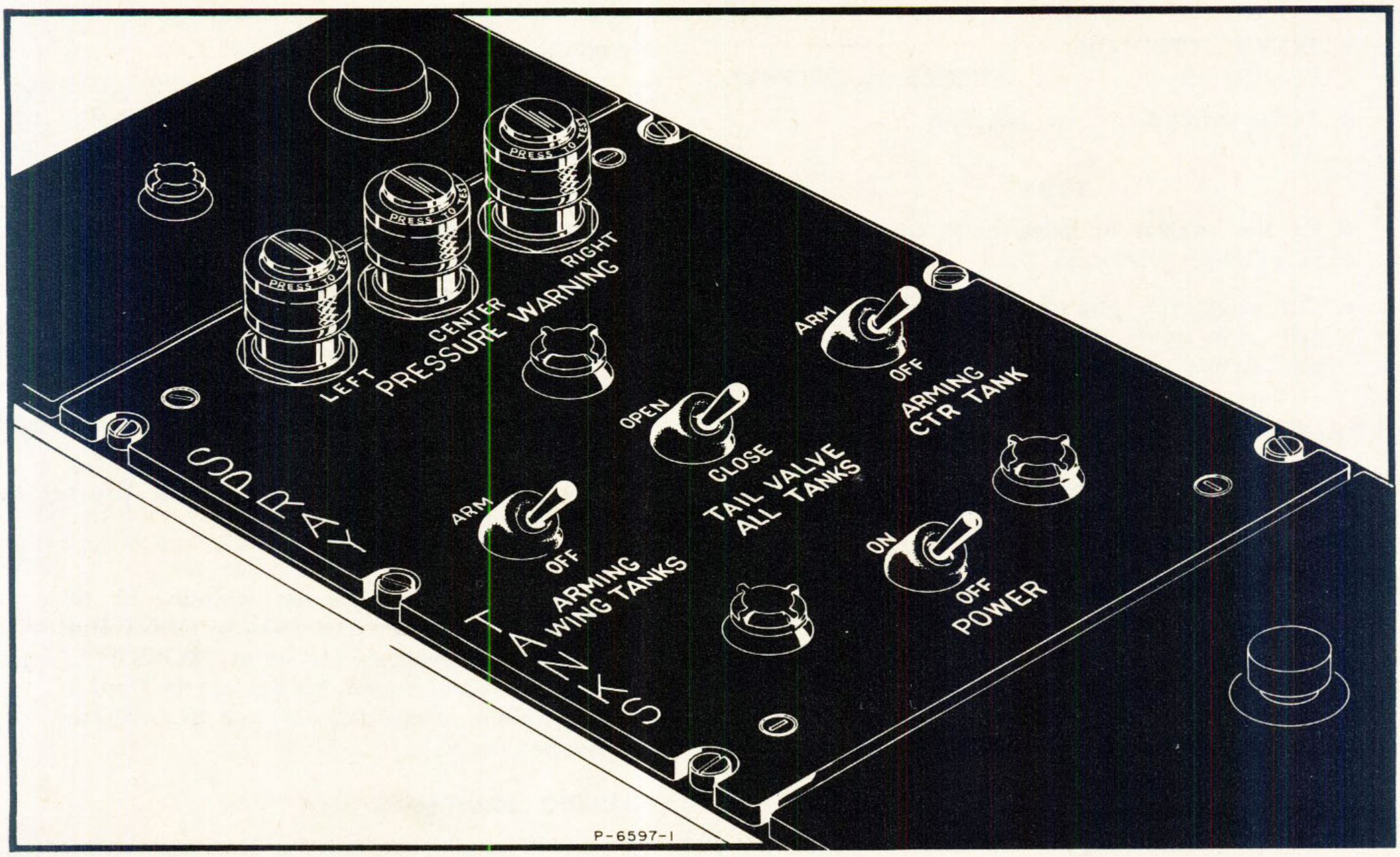


Figure 4-7B. Spray Tanks Control Panel

c. POWER switch . . . . . "OFF"
d. MASTER ARMT switch . . . . . "OFF"

RELEASING SPRAY TANKS. Spray tanks can be jettisoned either electrically or manually as outlined under RELEASING BOMBS.

SONOBUOY/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 which is installed on the right-hand console when needed, and pickle switch B. No provisions are made for the train release of flares, thus they can be released singly only.

RELEASE OF FLARES

a. MASTER ARMT switch . . . . . "ON"
b. Function selector switch . . . . . "SPRAY-FLARES"
c. LEFT flare dispenser switch . . "READY"
CENTER and RIGHT switch . . . . . "SAFE"
d. Pickle switch B . . . . . Depress

CAUTION

The maximum speed permitted for flare launching is 220 knots IAS.

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.

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

Note

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

RELEASING FLARE DISPENSERS. Flare dispensers can be jettisoned either electrically or manually as outlined under RELEASING BOMBS.

CARGO LOADING EQUIPMENT

Provisions are made for the rapid installation of cargo loading and stowage equipment. A kit containing all essential items for conversion to the cargo carrying configuration is provided as required by the needs of

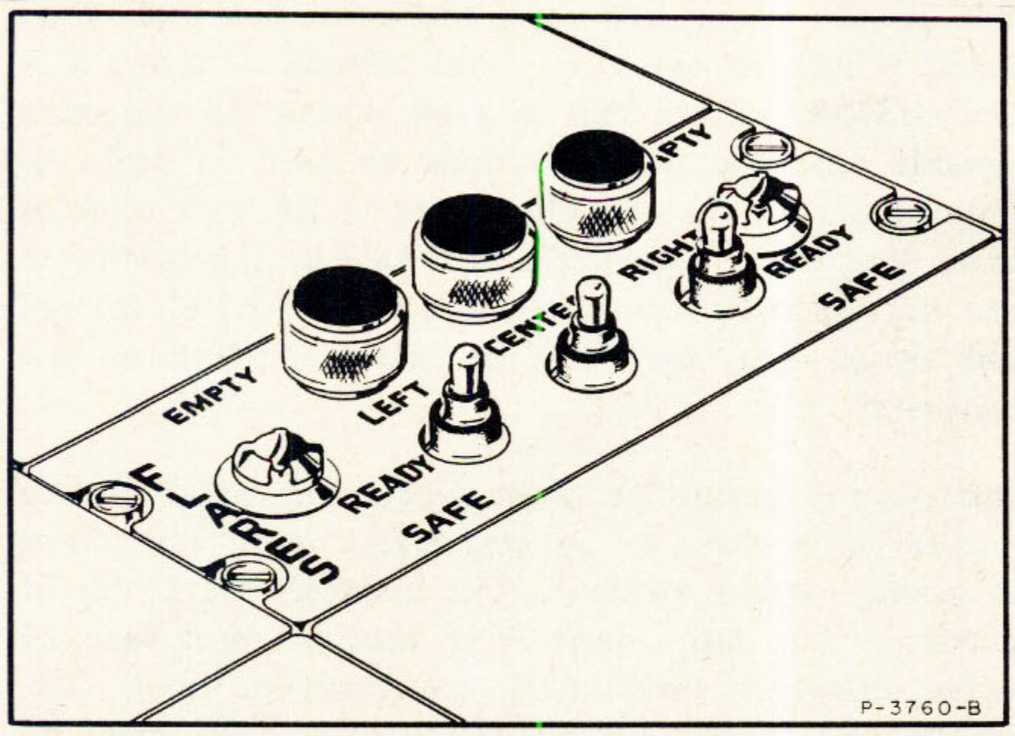


Figure 4-7C. Flare Dispenser Control Panel

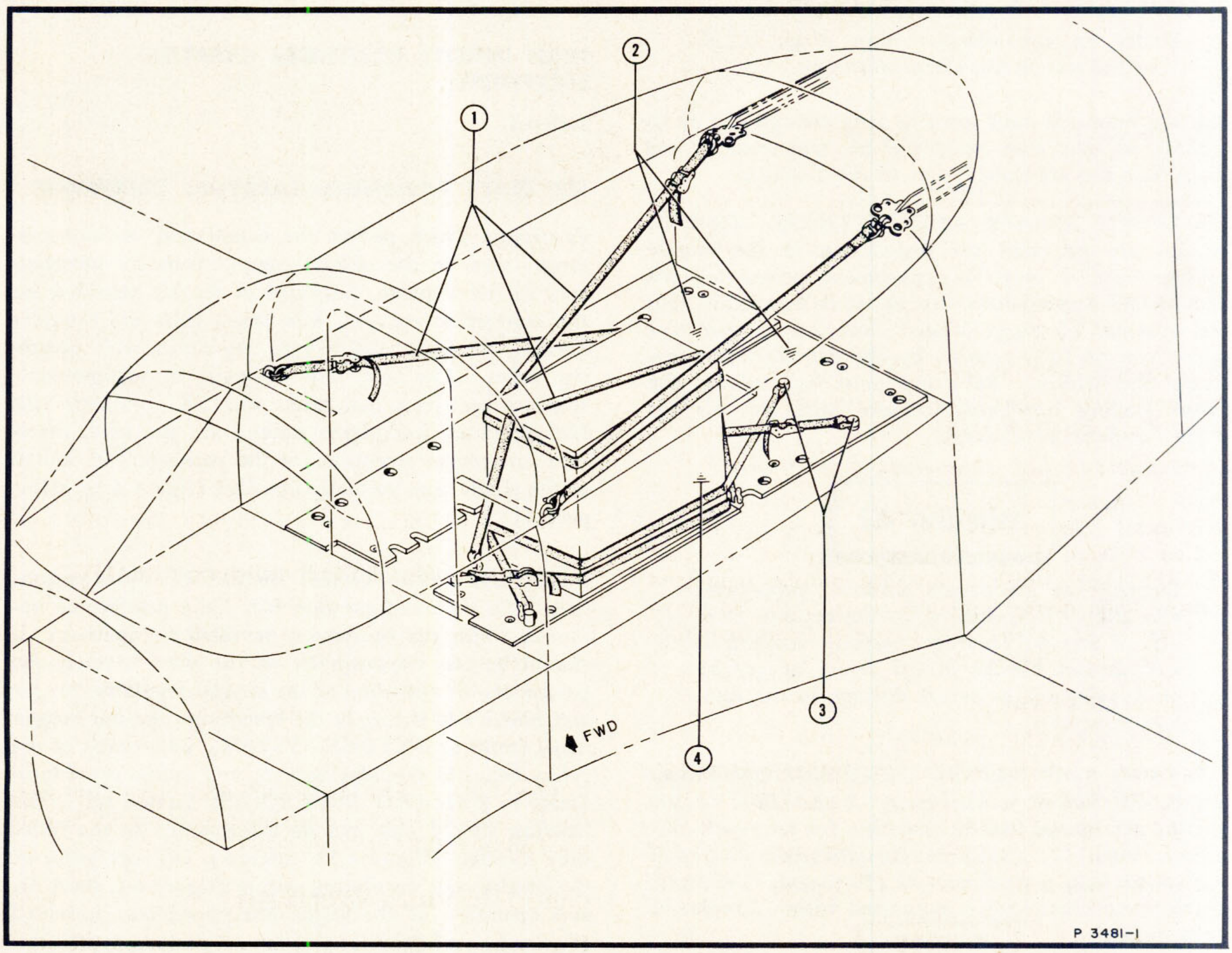
the service. The kit includes special floor panels, tie-down fittings and straps, and a hoist with necessary fittings for use. The middle compartment is used for stowage, providing a maximum cargo capacity of 2000 pounds (see figure 4-8).

CARGO HOIST. The cargo hoist provided with the kit has a maximum capacity of 250 pounds.

CAUTION

The hoist alone can withstand loads heavier than 250 pounds, but the forces transmitted to the wing structure during loading operations prohibit the hoisting of greater weights.

For use, the hoist is suspended from an eye bolt which must be inserted into a fitting located on either wing



1. Tie-down straps
2. Supplementary flooring
3. Tie-down fittings
4. Cargo

Figure 4-8. Cargo Loading Arrangement
Figure 4-9. Deleted

tip. The wings must be folded and the wing jury struts must be attached for hoisting operations. "Steadying lines" should be attached to the cargo to prevent possible damage to the structure of the airplane when the hoist is used.

FLOOR PANELS. Plywood floor panels are furnished with the cargo conversion kit to provide for additional strength and an even distribution of weight. Cargo must be entirely supported by the plywood floor panels; at no time should cargo rest on any uncovered portion of the compartment floor. The floor panels will accommodate cargo units up to 18 inches in width. For cargo units exceeding a width of 18 inches, additional shoring and supplementary flooring is required to carry the load over the wiring trough which runs down the center-line of the middle compartment floor.

CAUTION

Under no circumstances must cargo be allowed to rest on this electrical trough.

Shoring beams, if used, must be long enough (17 or 18 inches) so that their ends will be supported by the main fore and aft floor beams of the airplane.

TIE-DOWN STRAPS AND FITTINGS. Tie-down fittings are provided for installation in the middle compartment to serve as attachment points for the 3500-pound test tie-down straps. It is mandatory that the quantity of cargo loaded does not exceed that which can be fully secured by the provided tie-down straps and fittings. Reference must be made to the cargo loading handbook included with the kit for proper tie-down procedures.

WARNING

Incorrect or inadequate tie-down procedures will allow cargo shifting during catapult take-offs or arrested landings, possibly resulting in a disastrous change in the center of gravity of the airplane or severe damage to the fuselage structure.

LOADING AND WEIGHT DISTRIBUTION. Proper weight distribution is important. A maximum of 300 pounds per square foot is allowable for an evenly distributed load. For a load concentrated upon an area of one square inch, a maximum of 250 pounds is allowed, provided no other load is supported within a radius of eight inches.

For convenience in determining weight distribution, the cargo floor should be considered as divided into four bays of equal area. The total load in any one bay must not exceed 900 pounds. Two bays located on one side of the center line must not contain a total combined weight in excess of 1200 pounds. For a single piece of cargo from 600 to 1200 pounds in weight, a suitable auxiliary platform must be used in order to support the weight near the center of any two adjacent bays. Preferably, this platform should be constructed to rest on all four bays, straddling the electrical trough. The cargo unit may then be safely centered on the platform.

Particular care must be taken concerning cargo loading to prevent a possibly adverse effect upon the center of gravity of the airplane. For instance, the center of gravity of the cargo must at no time be more than 24 inches above the level of the compartment floor. The weight and balance of the aircraft must be carefully checked before each flight. Refer particularly to Chart E, Alternate Kit Service Load Conditions, in the Handbook of Weight and Balance Data, AN 01-1B-40.

HIGH DENSITY PASSENGER CARRYING EQUIPMENT

Deleted.

SIX PLACE PASSENGER CARRYING EQUIPMENT

Provisions which permit the installation of four passenger seats in the middle compartment are incorporated in the airplane. Included in the kit provided for this conversion are seats with safety belts and shoulder harness, footrests, and oxygen regulators with breathing tubes. The seats are designed to accommodate standard seat pack parachutes with PK-2 pararaft kits. No additional interphone stations are provided; therefore interphone reception for the passengers is limited to the single unit normally installed (figure 4-13, reference 11).

PASSENGER PRE-FLIGHT BRIEFING. Since persons carried in this configuration will quite possibly be unfamiliar with the equipment provided for their use, it should be the responsibility of the pilot to brief the passengers on operation of the oxygen regulator, proper attachment and fitting of the breathing tube and oxygen mask (refer to OXYGEN SYSTEM), adjustment of the safety belt and shoulder harness, and escape procedures (refer to BAIL-OUT PROCEDURE, Section III). The briefing should also include information on the relief tube location (figure 4-13, reference 14), operation of the heating and ventilating system (figure 4-1, sheet 2), and operation of the single interphone unit provided (figure 4-3, reference 11). Since all passengers will not be equipped with facilities for interphone reception, each flight should be preceded by a discussion of signals to be used to warn the passengers to prepare for take-off or landing, or to take emergency action.

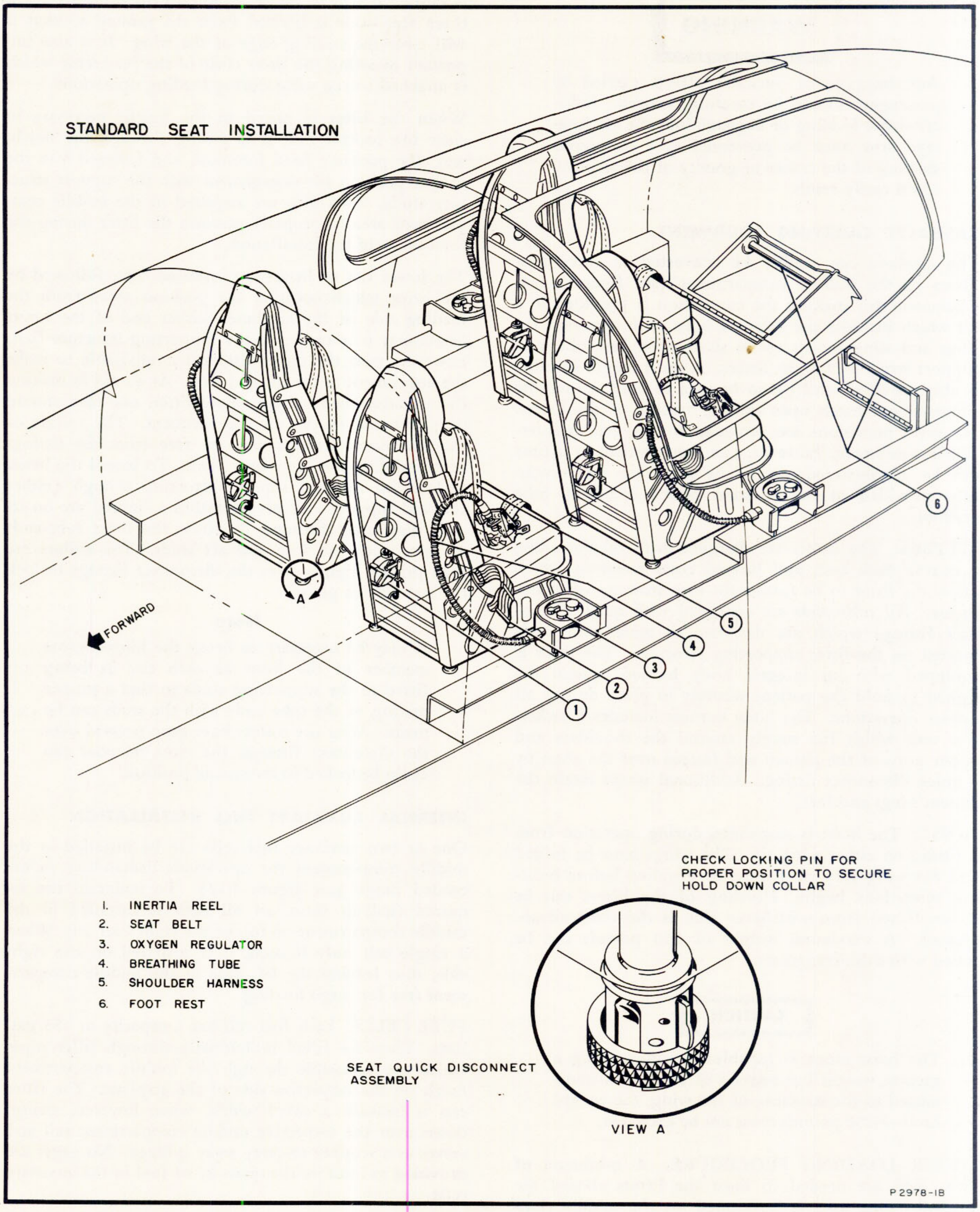


Figure 4-10. Six Place Passenger Arrangement

WARNING

Any baggage or personal effects carried by passengers should be carefully stowed. Indiscriminate loading of baggage into the aft fuselage area must be prevented as a dangerous shifting of the center of gravity of the airplane could easily result.

CASUALTY CARRYING EQUIPMENT

The airplane can readily be converted to carry four litters in the middle compartment (see figure 4-11). Equipment for making the conversion is provided in a kit which includes the litters, a hoist with necessary fittings and sling for its use, a six-foot oxygen tube, and support structure for the litters. A short length of cable is also provided which is to be used to hold the middle compartment hatch open during loading of the litters. No extra provisions are provided for oxygen or interphone equipment; however, one litter patient at a time can be administered oxygen by attaching the oxygen tube provided to the assistant pilot's breathing tube assembly.

LITTERS. The litters are designed with tubular sides, a canvas duck bed, and hinged cross members which allow the litter to be folded for easy stowage when not in use. All tube ends are equipped with quick disconnect fittings which are designed to mate with studs located on the litter supporting structure. The litter is equipped with an integral body harness system designed to hold the patient securely in place during all carrier operations. The body harness includes a jacket-like unit which fits snugly around the shoulders and upper arms of the patient and fastens over the chest by a quick disconnect fitting. Additional straps retain the patient's legs and feet.

HOIST. The hoist is suspended during operation from a fitting on either wing tip. The wings must be folded and the wing jury strut must be installed before hoisting operations begin. Hoisting of the litters can be accomplished from whichever side is the most advantageous. A maximum weight of 250 pounds can be raised with this arrangement.

CAUTION

The hoist alone is capable of withstanding a greater weight but because of the forces transmitted to the structure of the wing, the weight limit of 250 pounds must not be exceeded.

LITTER LOADING PROCEDURE. A minimum of three men are needed to hoist the litters aboard the airplane. One man is positioned on the middle compartment rail to operate the hoist (see figure 4-11) while other men are employed to guide the litter as it is raised. It will be necessary to pull the litter aft about three feet as it is hoisted from the ground so that it will clear the trailing edge of the wing. It is also important to swing the litter clear of the jury strut which is attached to the wing during loading operations.

When the litter is raised to the height necessary to clear the cockpit rail, it is swung through the hatchway, the patient's head foremost, and lowered into the proper position for engagement with the support structure studs. Two men are required in the middle compartment area to properly position the litter during the final phase of the installation.

The lower tier of litters are installed first, followed by the litter which occupies the position away from the loading side of the airplane. Either end of the lower litters may be attached to the supporting structure first; however, with the upper litters it is advisable to make the attachment at the aft end first. As an aid in making the aft attachment of the upper litter, one man should be positioned in the aft compartment. The collars of the disconnect fittings must be free from the fittings before sliding the litter into place. To install the litter, deflect the forward support structure enough (either forward support unit pivots within a limited arc on its own disconnect fittings) to allow the litter tube-ends to mate with the fore and aft studs. The collars are then pressed tightly over the disconnect fittings to lock the assembly in place.

Note

It may be necessary to break the hinged cross member of the litter as each end is being fitted to the supporting studs so that a proper mating of the tube ends with the studs can be made. After the collars have been pressed over the disconnect fittings, the cross member can again be locked in the spread position.

INTERNAL AUXILIARY FUEL INSTALLATION

One or two auxiliary fuel cells can be installed in the middle compartment for operations demanding an extended range (see figure 4-12). To maintain the required fuel/oil ratio, an oil tank is installed in the middle compartment on top of the right fuel cell. When a single cell only is used, it is installed on the right side, thus leaving the left side of the middle compartment free for cargo loading.

FUEL CELLS. Each fuel cell has a capacity of 155 gallons. They are filled individually through filler pipes which are accessible through the middle compartment hatch on the respective side of the airplane. The filler cap is beneath a cover which, when lowered, swings down over the respective middle compartment rail and serves as a scupper to carry away spillage. No gages are provided to indicate the quantity of fuel in the auxiliary cells.

AUXILIARY OIL TANK. The auxiliary oil tank has a service capacity of 12½ gallons. The filler cap is

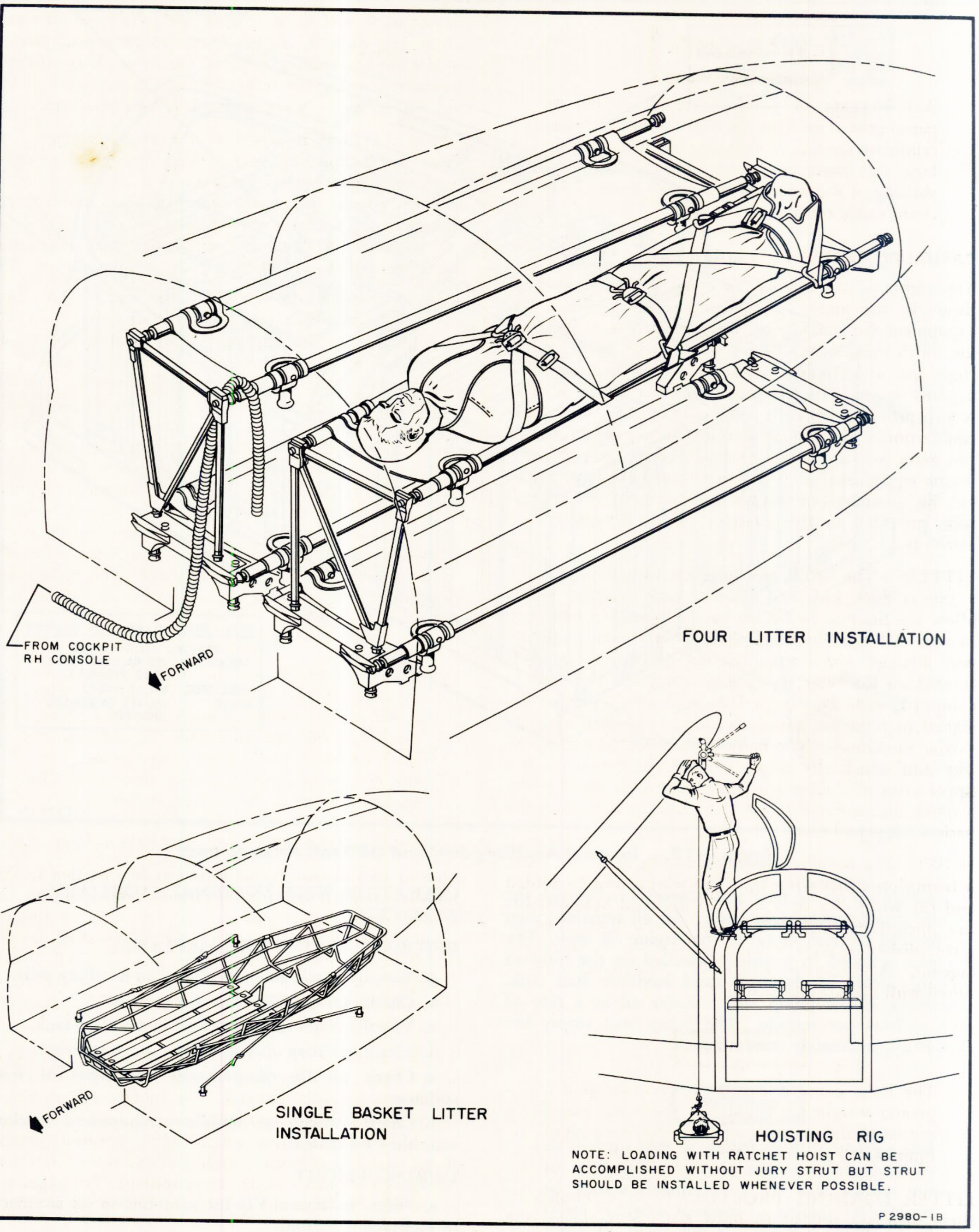


Figure 4-11. Litter Carrying Arrangement

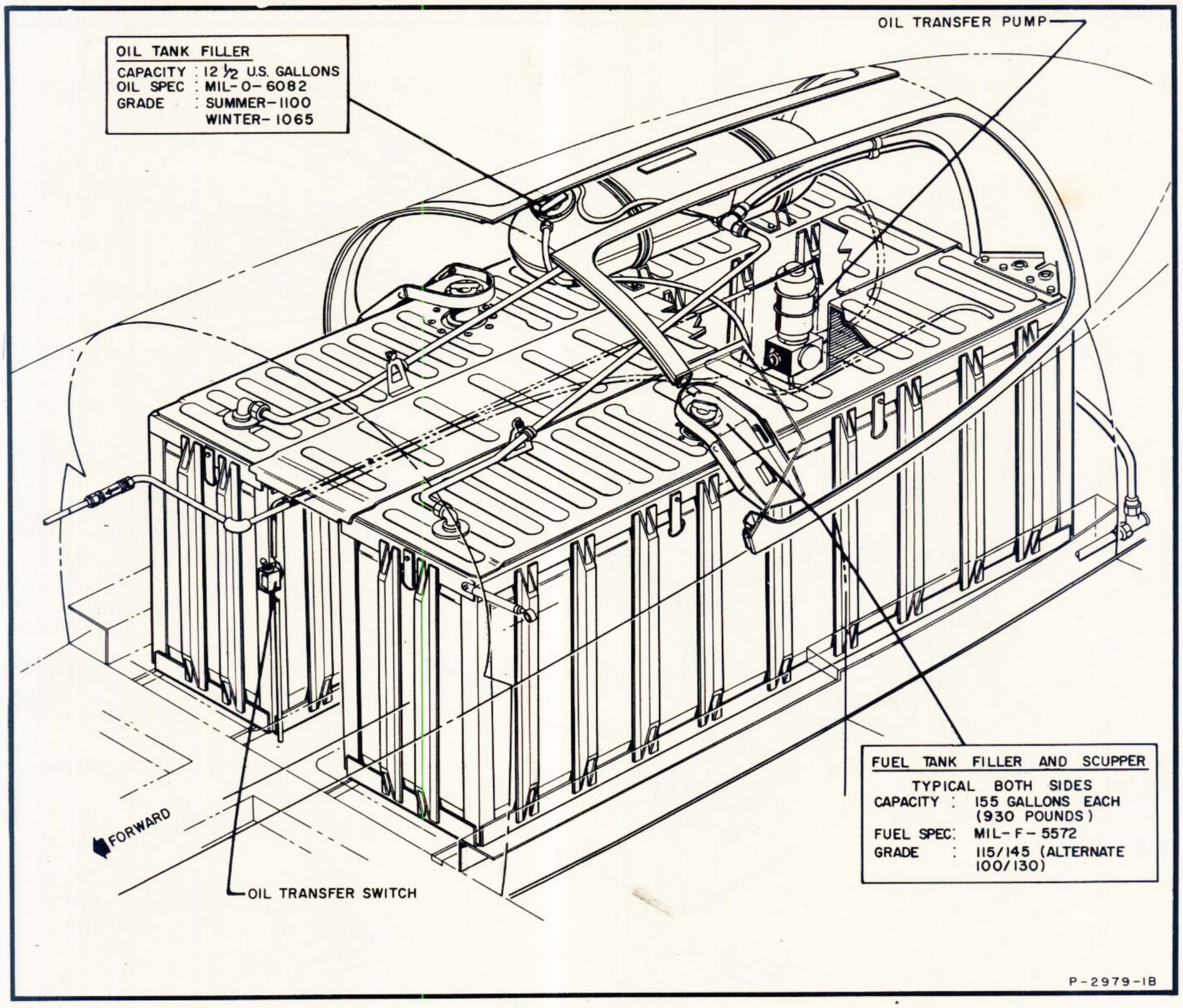


Figure 4-12. Internal Auxiliary Fuel and Oil Tank Arrangement

located on top of the tank and is accessible through the middle compartment right hatch. An oil transfer pump is provided to transfer oil to the engine oil tank. The pump is actuated by a switch installed on the forward inboard corner of the right-hand auxiliary fuel tank. Operation of the pump will transfer oil at a rate of four gallons per minute. The pump will empty the tank in approximately three minutes.

CAUTION

Use extreme care in filling so that no fuel or oil is spilled into the aircraft. Inspection of the middle and aft compartments should be made after fueling of internal auxiliary tanks to determine whether or not pools of overflow fuel are present on the floor or in the scuppers.

OPERATION WITH INTERNAL AUXILIARY FUEL CELLS

BEFORE ENTERING THE AIRPLANE

a. Visually check quantity of fuel in auxiliary cells.

b. Check fuel cell filler caps for security.

c. Visually check quantity of oil in auxiliary tank.

d. Check auxiliary oil tank filler cap for security.

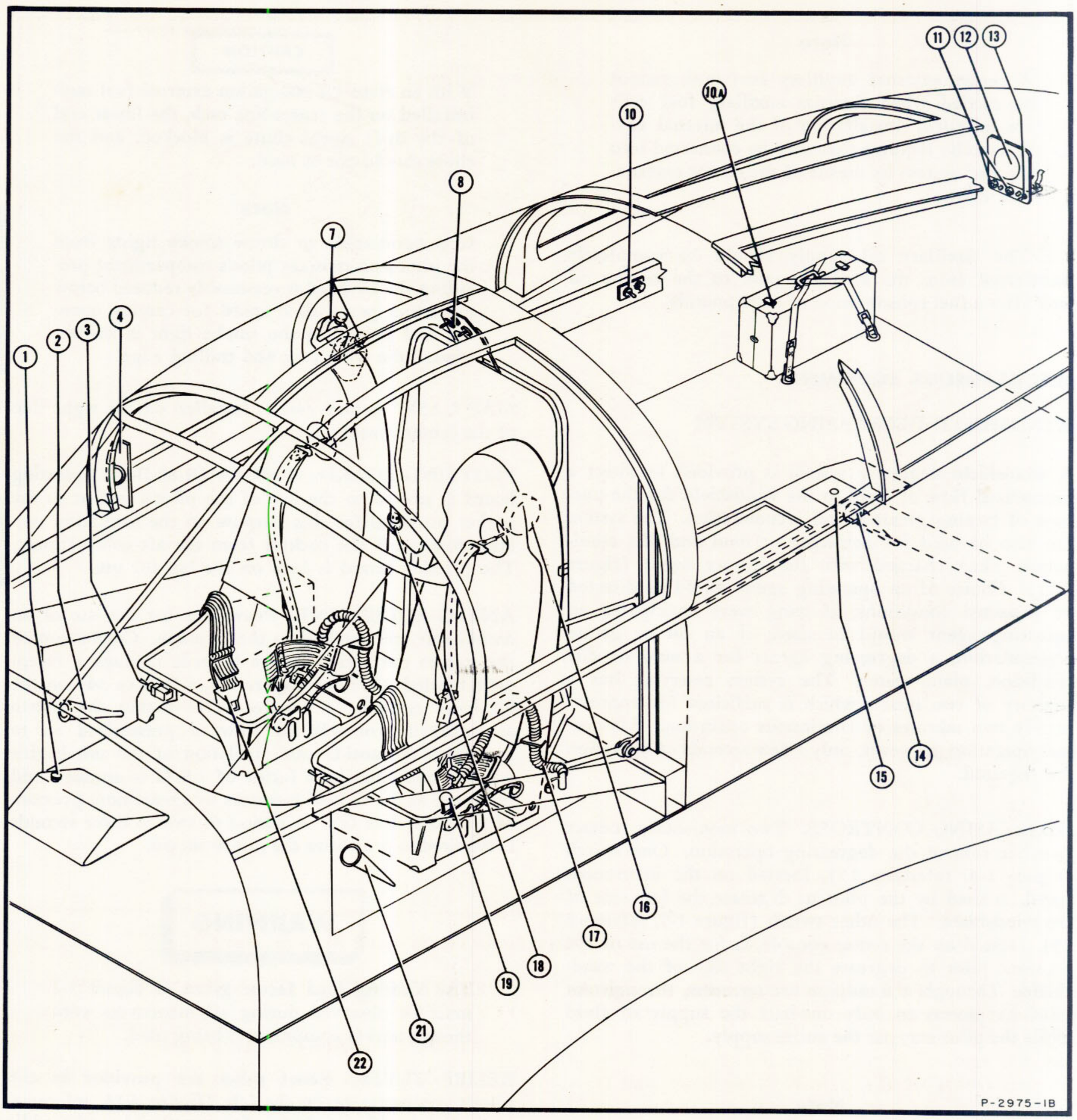
e. Check middle compartment for signs of fuel spillage.

f. Check security of middle compartment hatches after they are closed.

DURING FLIGHT

a. Refer to Section VII for information on sequence of fuel tank selection.

b. Select internal auxiliary fuel by placing fuel selector valve on "CTR EXT."



1. Assistant pilot's microphone foot switch
2. Assistant pilot's relief tube
3. Seat actuating switch(1)
4. Rear view mirrors
5. Deleted
6. Deleted
7. Canteens
8. Cockpit flood light and switch panel
9. Deleted
10. Middle compartment flood light switch panel

10A. Luggage tie-down straps

11. Middle compartment headset and microphone jacks
12. Middle compartment flood light
13. Aft fuselage service lights switch
14. Middle compartment relief tube
15. Drift signal chute and relief tube access
16. Inertia reel(1)
17. Oxygen breathing tube and headset-microphone connections
18. Rear view mirrors
19. Shoulder harness locking handle(1)
20. Deleted
21. Pilot's relief tube
22. Seat belt and shoulder harness(1)

(1)Typical both seats.

Figure 4-13. Miscellaneous Equipment

Note

A center external auxiliary fuel tank cannot be carried when internal auxiliary fuel cells are installed. Installation of the internal auxiliary cells requires that they be connected into the fuel system by means of the center external fuel lines.

c. The auxiliary oil supply should be completely transferred from the auxiliary tank to the engine oil tank after a fuel consumption of 4000 pounds.

MISCELLANEOUS EQUIPMENT

WINDSHIELD DEGREASING SYSTEM

A windshield degreaser system is provided to direct a pressurized flow of fluid to the windshield for the purpose of freeing grease or oil accumulation. The system can also be used for anti-icing or mud and dirt elimination when charged with the proper agent (figure 1-11). Choice of an operating agent would be directed by expected conditions; if icing were anticipated an anti-icing agent would be used; if an oil or grease accumulation, a degreasing agent; for a mud or dirt condition, plain water. The system reservoir has a capacity of two quarts which is sufficient for approximately two minutes of continuous operation. For normal operation, however, only a few seconds of operation are required.

DEGREASING CONTROLS. Two momentary contact switches control the degreasing operation. One switch (figure 1-4, reference 15), located on the instrument panel, is used by the pilot to degrease the left side of the windshield. The other switch (figure 1-5, reference 39), located on the center console, is for the use of the assistant pilot to degrease the right side of the windshield. Through a standpipe arrangement, the assistant pilot has access to only one-half the supply of fluid while the pilot may use the entire supply.

Note

Close canopy before degreasing windshield, as fluid enters cockpit area with canopy open. Yawing the airplane will assist the degreasing operation.

DRIFT SIGNAL CHUTE. A chute extending from the floor of the middle compartment through the bottom of the aircraft is designed for use in dropping drift signals from the aircraft. The relief tube which is located within the upper end of this chute should be removed prior to releasing drift signals.

CAUTION

With an Aero 1A 300-gallon external fuel tank installed on the center-line rack, the lower end of the drift signal chute is blocked, and the chute should not be used.

Note

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 and trailing edge.

MAP CASE. A map case is installed on the right side of the center console.

PLOTTING BOARD. A Mk 6A (R-88-B-645) plotting board is stowed to the left of the pilot's seat or in the pocket provided for this purpose on the insulating curtain closing off the cockpit from the aft compartment. The plotting board is held on the lap for use.

ANTI-G EQUIPMENT. Provisions for the use of an anti-G suit are installed in the airplane. Connection of the suit to the anti-G system is made through a receptacle labeled ANTI-G (figure 1-3, reference 34) on the left-hand 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 load factor of 1.8 G is attained and increased as the G load increases to a maximum pressure of six psi at five G's. A period of two to three seconds is required to pressurize the suit to six psi.

WARNING

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

RELIEF TUBES. Relief tubes are provided in the pilot's compartment on the left (figure 4-13, reference 2) and right (figure 4-13, reference 2) sides. An additional relief tube for the use of pasengers is installed in the drift signal chute (figure 4-13, reference 14) located beneath the middle compartment floor.

WATER CONTAINERS. Two canteens (figure 4-13, reference 7) are located on the bulkhead directly behind the assistant pilot's seat.

REAR VIEW MIRRORS. Two adjustable rear view mirrors are installed on the cockpit windshield bow. A knurled locking knob is provided for controlling the tension on the mirror ball joint.

Note

- The locking knob must be turned in a *counterclockwise* direction to tighten the ball joint.
- Check position of mirrors before closing canopy.
- The rear view mirrors are being replaced by service change to do away with the locking knob feature. The new mirrors will have a simple friction ball joint.

INSULATING CURTAIN. An insulating curtain closes off the aft fuselage area from the middle compartment of the airplane. The curtain is installed to insulate against cold outside air which is ducted to the electronics compartment for cooling purposes. A zippered flap in the curtain permits passage to the aft compartment of the airplane as necessary.

FIRST AID KIT. A first aid kit (figure 3-1, reference 4A) is located on the top shelf formed by the bulkhead at the after end of the middle compartment.

SECTION V
OPERATING LIMITATIONS

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

SECTION VI
FLIGHT CHARACTERISTICS

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

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 left console. The cowl flaps should not be closed during ground operation when warming up the engine, but may be closed after shutdown 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 after shutdown, 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.

Note

The cylinder head temperature should be maintained above 185 degrees centigrade by use of cowl flaps during normal cruise conditions.

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 operations, however, 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 powers 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" position.

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

CAUTION

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

Note

The mixture control should remain in "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 backfiring. This is particularly true when the rate of descent or climatic condition tends to over-cool the engine. The "NORMAL" position may be used during all other flight operations, provided that the cylinder head temperature does not become excessive.

MIXTURE CHECK AND MANUAL LEANING. The relationship between the torque developed with a "Best Power" mixture and the torque developed with a "Best Economy" mixture is one of the most consistent phenomena encountered in the operation of reciprocating engines. The torque for "Best Economy" is approximately 10% less than the torque developed with a "Best Power" mixture. This relationship, therefore, is capable of forming the basis for a sound mixture check and manual leaning procedure in cases where instrumentation is provided for observation of engine torque.

The "NORMAL" position of the mixture control is designed to provide approximately "Best Economy" mixtures at or below maximum cruising power. The basic setting in this range is actually slightly richer than "Best Economy" to insure smooth operation in engines where combustion characteristics have become marginal due to piston ring wear, increased oil consumption, non-uniform valve clearances, spark plug deterioration, etc. In most cases a mixture that results in a torque that is 5-8% lower than "Best Power" torque will provide reliable, smooth operation with negligible losses in economy. Because of production tolerances, abnormal atmospheric conditions, wear, and other factors that have adverse effects on metering characteristics of carburetors, it is sometimes necessary and usually desirable (especially on missions where range or endurance is vitally important) to check "NORMAL" position metering and, if necessary, to manually lean or enrich as follows to insure that a clean burning, "Best Economy" mixture is actually obtained.

MIXTURE CHECK

a. After stabilizing at desired cruise power in "NORMAL" mixture, note torque pressure and move mixture control toward "RICH" until torque pressure peaks or just starts to fall-off on rich side.

Note

If fall-off is not obtained before reaching the "RICH" position, flick primer to obtain additional enrichments.

b. Recheck peak obtained above by returning mixture control toward "NORMAL" until torque pressure just starts to fall-off on lean side.

c. If peak torque pressure is 5-8% (approximately 4-7 psi) above torque pressure observed in "NORMAL," carburetion is satisfactory and mixture control should be returned to "NORMAL." If not, mixture should be manually leaned as follows:

MANUAL LEANING

a. With mixture control set at "Best Power" (peak torque) as in steps "a" and "b" of mixture check, above, adjust throttle (or RPM if at full throttle) to obtain 105-108% of desired cruise power.

b. Manually lean mixture to obtain desired cruise power, i.e., 5-8% (approximately 4-7 psi) drop from peak pressure of step "a."

CAUTION

- Manual leaning beyond the "NORMAL" mixture position is not permitted at powers above maximum cruise power.
- Leaning in excess of 8 percent torque pressure drop should be avoided since lead fouling of spark plugs and adverse effects of any maldistribution of mixture may become serious if the mixture is leaned beyond this point.
- The alternate air system has a 10 percent "scoop enrichment" effect on the carburetor. If manual leaning is used to compensate for the enrichment effect of alternate air, be sure to return the mixture control to "NORMAL" or "RICH" before shifting from alternate to direct air.

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

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

WATER INJECTION(1)

Water injection permits the use of all the power the engine can provide without causing overheating or detonation. The coolant, a mixture of water and methyl alcohol, is introduced into the cylinders to effectively reduce the mixture temperature during high power operations. The additional power gained from the use of water injection results primarily from derichment of the carburetor to the best power mixture by a water reference pressure line to the carburetor derichment valve. This pressure line also links the water injection power control unit to the manifold pressure regulator, which reschedules to a new maximum allowable manifold pressure when the water injection system is in use. See figure 7-1.

USE OF TORQUE INDICATOR. During maneuvers while using full throttle and water injection, the torque indicator may be used to maintain safe engine operation without reference to manifold pressure (refer to USE OF WATER INJECTION). For normal flight operation, however, it is imperative that manifold pressure limits should also be observed as presented on the Engine Operating Limits chart (figure A-6, Appendix), and that the limit first attained (either T.P. or MAP) be used. Manifold pressure should be corrected for non-standard conditions using the Engine Operating Limits Correction chart (figure A-6A, Appendix.)

Note

Torque pressure (TP) is a direct indication of the power actually supplied to the propeller (BHP). Since atmospheric conditions do not affect this function of the engine, no correction need be applied to the torque pressure reading to derive the actual BHP for the atmospheric conditions encountered.

Use of the Engine Operating Limits curve requires conversion of torque pressure readings to BHP values. This is accomplished by applying RPM and a known constant (142), which represents a particular group of factors related to the design of the R-3350-26WA engine. The equation is as follows:

$$BHP = \frac{T.P. \times RPM}{142}$$

EXAMPLE. Assuming a reading of 90 psi on the torque pressure gage, and a tachometer reading of 2200 rpm, BHP is determined to be:

$$BHP = \frac{90 \times 2200}{142} = 1394$$

The equation for converting BHP to T.P. is as follows:

$$T.P. = \frac{BHP \times 142}{RPM}$$

USE OF WATER INJECTION. Combat power ratings are based on engine structural limitations, water injection being used to suppress detonation for a limited period of operation at the maximum power output. To obtain "wet" combat power, set the controls as follows:

a. Fuel tank selector .....“MAIN”
b. Mixture .....“RICH” or “NORMAL”
   master switch .....“ON”
c. WATER INJECTION

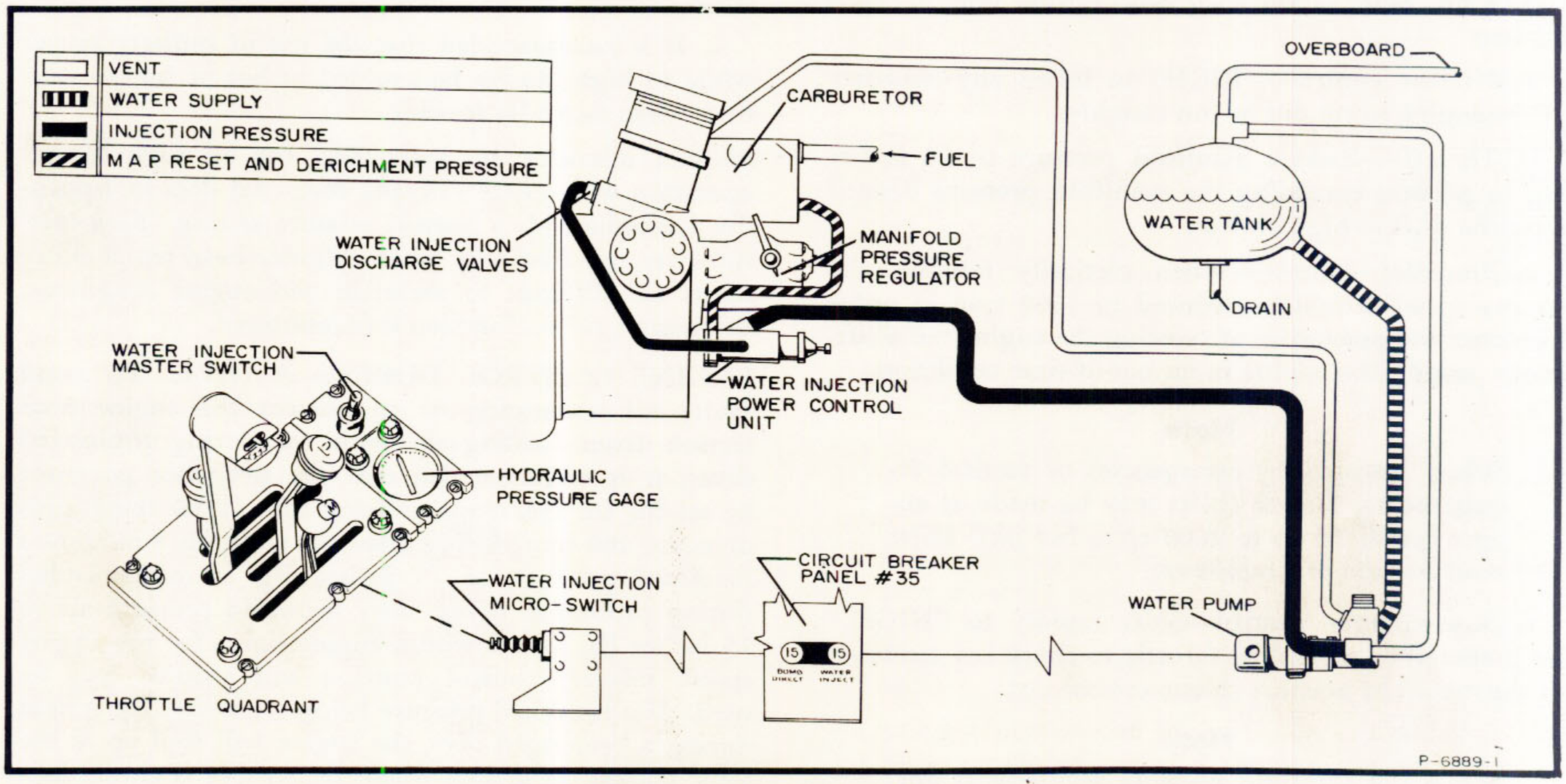


Figure 7-1. Water Injection System

(1) Installed after service change.

d. Propeller ..... Low blower—2900 rpm
High blower—2600 rpm

e. Throttle ..... Advanced beyond normal take-off power stop to maximum of 61.5 inches Hg

WARNING

A manifold pressure in excess of 61.5 inches Hg during "wet" operation may result in immediate engine failure.

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. Since operation in high blower, particularly at high power settings, makes a more severe demand upon the engine, certain specific procedures should be followed to prevent detonation and engine roughness.

a. Use the "RICH" mixture position throughout any high blower, high power climbs.

b. A rich mixture may also be necessary for high power level flight, particularly following any prolonged climb.

c. It is recommended that the use of military power while in high blower be avoided in hot or humid weather, when tactically feasible.

Normal mixtures are authorized for all high blower operation with grade 115/145 fuel. All data in Appendix I recommends a normal mixture setting. Rich mixtures are required only when cylinder head temperature limits are difficult to maintain and engine roughness, detonation, or malfunction is encountered.

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 rpm), 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, mixture 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. 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. It is recommended that the engine be idled for a period of two to five minutes prior to shut-down in order to draw the maximum amount of oil from the engine. This procedure will reduce the probability of liquid lock due to oil remaining in the engine or of such factors as plug fouling and smoky starts.

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, fuselage internal 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.

Note

Before exercising the selection sequence described in this paragraph, consume fuel from each external tank for a period of approximately five minutes soon after take-off. This procedure is recommended to minimize the possibility of fuel being siphoned overboard from full tanks.

SELECTION 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 selector sequence. It is important to note also that the internal auxiliary fuel tanks are drawn from when the tank selector volve is set on "CTR EXT."

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, internal auxiliary, external center-line 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 switch is turned on. 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 outline 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.

SECTION VIII

CREW DUTIES

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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.(1) Radar altimeter RANGE switch ... Low Range
c.(1) Altitude limit switch ..... As desired
d.(1) 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.

e. Gyro horizon ..... Uncage
f. 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 stand-by compass for freedom of operation. Check the gyro horizon for proper erection.

INSTRUMENT TAKE-OFF. Prior to take-off the engine must be checked thoroughly and the check-off list reviewed. 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 1. 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 easily.

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.

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

(1) BuNo. 132392 through 132440.

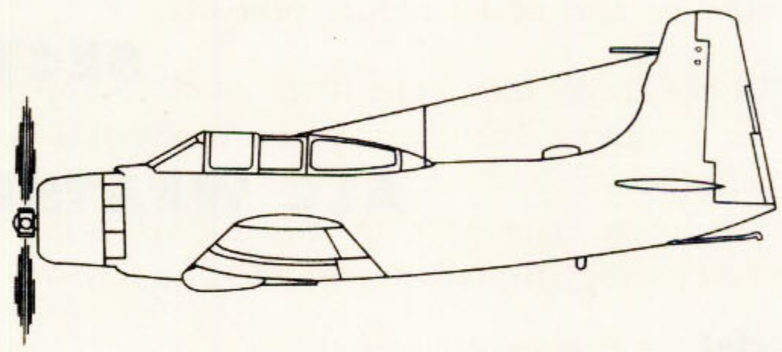
LEVEL FLIGHT - SLOW CRUISE

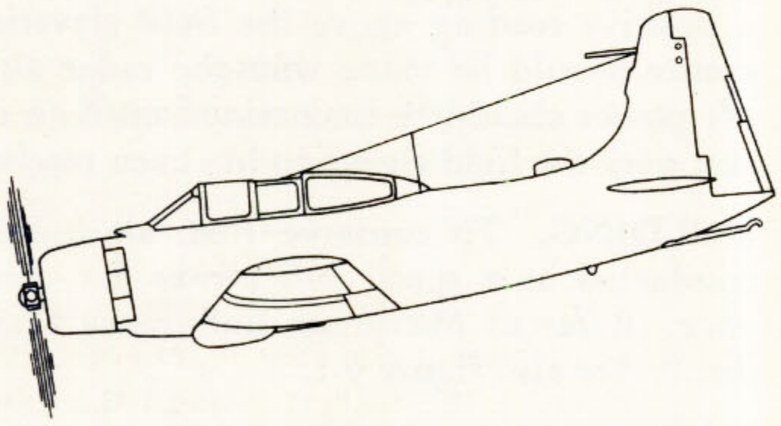
WHEELS AND FLAPS UP

RPM- - - - - -1600

M.P- - - - - - -25 IN.Hg (APPROX)

AIRSPEED- - -120 KN.





LET DOWN - SLOW CRUISE

WHEELS AND FLAPS UP

RATE OF DESCENT- -500 FT/MIN

RPM- - - - - - - - - -1600

M.P. - - - - - - - - - - 23.5 IN. Hg (APPROX)

AIRSPEED - - - - - - 120 KN.

LEVEL FLIGHT - APPROACH SPEED

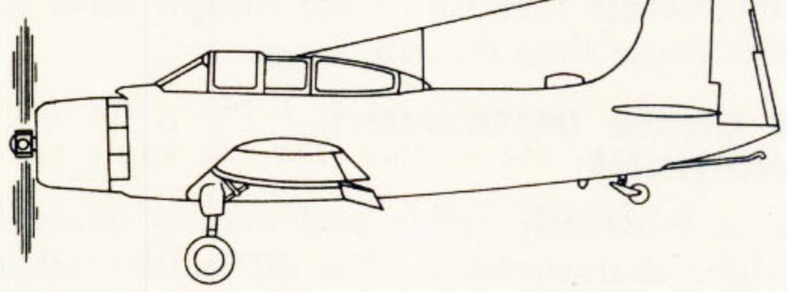
WHEELS - - - - DOWN

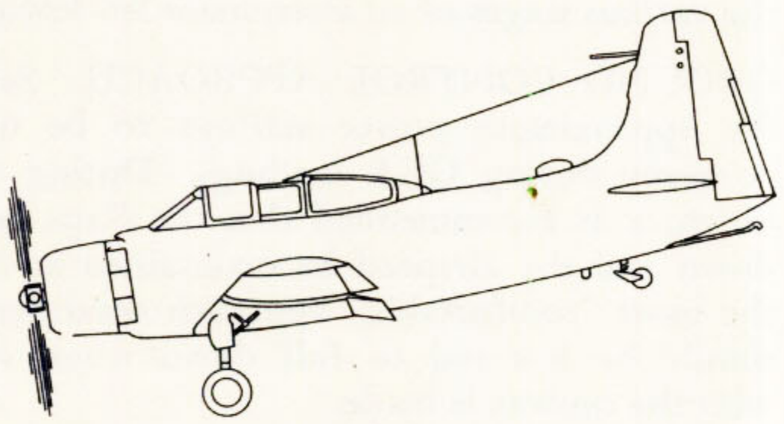
FLAPS - - - - - FULL DOWN

RPM- - - - - - 2200

M.P. - - - - - - 27 IN. Hg (APPROX)

AIRSPEED- - - 105 KN.





LET DOWN - ON GLIDE PATH

WHEELS - - - - - - - DOWN

FLAPS - - - - - - - - - FULL DOWN

RATE OF DESCENT - - 500 FT / MIN

RPM- - - - - - - - - 2200

M.P. - - - - - - - - - - 23.5 IN. Hg (APPROX)

AIRSPEED- - - - - - -105 KN.

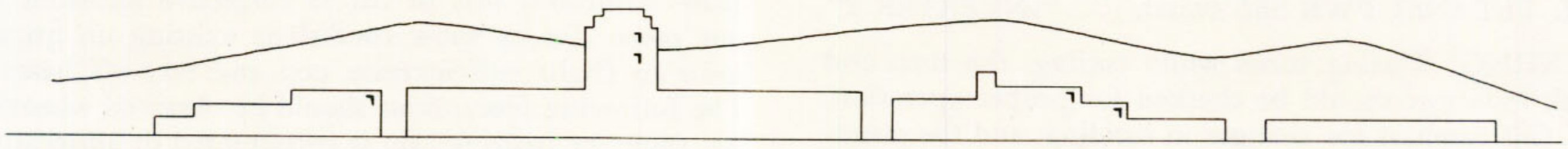


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Figure 9-1. Instrument Approach and Landing Power Requirements

Figure 9-2. Deleted

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, stock number R83K710075, is available for coating the external surface of the windshield and canopy and will permit normal visibility upon encountering rain or salt spray. 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.

g. To recoat, repeat the foregoing procedure.

After application, the windshield may frequently be cleaned and polished without adversely diminishing the rain repellent qualities. 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 a mild soap or detergent and water, clean with a soft cloth and, after drying, polish. Should this procedure remove the film, it may be restored by applying the rain stick repellent only and polishing.

c. If the soiled area requires the use of a cleaner or harsh detergent, the procedure for recoating the surface should be followed.

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 to 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. In severe turbulence, speeds in the range from 150 to 310 knots are recommended. Refer to Section V for limitations.

COLD WEATHER OPERATING PROCEDURES

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.

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.

ALTERNATE OIL

Grade 1100 lubricating oil shall be used at ground starting temperatures down to 1°C (35°F). When temperatures below plus 35°F are expected, or if it would be necessary to use oil dilution, use grade 1065 lubricating oil. When using grade 1065 lubricating oil, inlet temperatures shall be maintained between 65°C and 75°C to obtain proper engine lubrication during engine operation and to prevent accumulation of moisture and volatile products of oxidation in the oil. If it is not possible to maintain these temperature limits, oil pressure should be maintained within the normal operating range and oil temperatures should be kept above 60°C. Grade 1065 oil will generally require preheat for starting at temperatures below −18° (0°F).

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 (−4°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 temperature above 50°C to rid the oil of gasoline.

GROUND TESTS

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

a. Operate all hydraulic systems, except 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 plug, 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. Mk 3 Mod 4/5 Bomb Director "OFF"

e. AN/APN-1 or AN/APN-22 radar altimeter ..... "OFF" until just before take-off

f. AN/APX-6 IFF set ..... "OFF"

g. AN/ARN-6 radio compass ... "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 carburetor air temperature exceeds 38°C in low blower or 16°C in high blower while on alternate air, reduce maximum allowable manifold pressure limits 1 inch for each 6°C in excess of these temperatures. Reduce maximum allowable manifold pressure limit 6 inches when carburetor air temperature indicator needle registers 50°C.

Pilots must be on the alert for atmospheric conditions that may cause carburetor icing. The normal drop in manifold pressure that occurs when the carburetor screen starts to ice is concealed because the manifold pressure regulator automatically opens the carburetor throttle to compensate for the loss in manifold pressure. Throttle or refrigerative ice is not encountered in spinner injection engines. Carburetor ice in these engines consists of moisture or ice in the air metering passage of the boost venturi hangar. 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 (59°F) and below.

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.

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.

DESCENT

Keep cylinder head temperature over 100°C and oil temperature 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 2°C (35°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 heating, 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 six minutes.

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"

i. Oil dilution switch ..... "OFF" (after propeller stops turning)

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.

g. Throttle ..... "CLOSED"

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 following 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.

APPENDIX I

OPERATING DATA

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

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