T.O. 1C-97(K)G-1

USAF SERIES

KC-97C aircraft FLIGHT MANUAL

THIS PUBLICATION REPLACES T.O. 1C-97(K)G-1 DATED 1 AUGUST 1958 AND SAFETY OF FLIGHT SUPPLEMENTS IDM, IDN, IDP, IDQ, IDR, IDT, IDV THERETO. SEE BASIC INDEX, T.O. 0-1-1 AND WEEKLY INDEX T.O. 0-1-1A, FOR CURRENT STATUS OF SAFETY OF FLIGHT SUPPLEMENTS.

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TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 896 , CONSISTING OF THE FOLLOWING:

Page No.	*Issue*	*Page No.*	*Issue*	*Page No.*	*Issue*
Title	Original	8-41	Original	1A2-5 thru 1A2-17	Original
A	Original	8-42 Blank	Original	1A2-18 Blank	Original
i thru ix	Original	8-43 thru 8-77	Original	1A3-1 thru 1A3-22	Original
x Blank	Original	8-78 Blank	Original	1A4-1 thru 1A4-7	Original
1-1 thru 1-87	Original	8-79 thru 8-81	Original	1A4-8 Blank	Original
1-88 Blank	Original	8-82 Blank	Original	1A5-1 thru 1A5-45	Original
2-1 thru 2-135	Original	8-83	Original	1A5-46 Blank	Original
2-136 Blank	Original	8-84	Original	1A6-1 thru 1A6-5	Original
2-137 thru 2-139	Original	9-1 thru 9-17	Original	1A6-6 Blank	Original
2-140 Blank	Original	9-18 Blank	Original	1A7-1 thru 1A7-9	Original
2-141 thru 2-154	Original	1A0-1	Original	1A7-10 Blank	Original
3-1 thru 3-89	Original	1A0-2	Original	1A8-1 thru 1A8-10	Original
3-90 Blank	Original	1A1-1	Original	1A9-1 thru 1A9-6	Original
3-91 thru 3-98	Original	1A1-2	Original	Index:	
4-1 thru 4-194	Original	1A1-3 Blank	Original	1 thru 28	Original
5-1 thru 5-22	Original	1A1-4 thru 1A1-17	Original		
6-1 thru 6-4	Original	1A1-18 Blank	Original		
7-1 thru 7-48	Original	1A2-1 thru 1A2-3	Original		
8-1 thru 8-39	Original	1A2-4 Blank	Original		
8-40 Blank	Original				

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TABLE OF CONTENTS

In order that **YOU** will gain

the MAXIMUM BENEFIT from this manual it is imperative that you read these pages carefully.

What you don't know won't hurt you, it will kill you

SCOPE. This manual contains all the information necessary for safe and efficient operation of the KC-97G. These instructions do not teach basic flight principles, but are designed to provide you with a general knowledge of the airplane, its flight characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and elementary instructions have been avoided.

SOUND JUDGMENT. The instructions in this manual are designed to provide for the needs of a crew inexperienced in the operation of this airplane. This book provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures contained herein.

PERMISSIBLE OPERATIONS. The Flight Manual takes a "positive approach" and normally tells you only what you can do. Any unusual operation or configuration (such as asymmetrical loading) is prohibited unless specifically covered in the Flight Manual. Clearance must be obtained from ARDC before any questionable operation is attempted which is not specifically covered in the Flight Manual.

STANDARDIZATION. Once you have learned to use one Flight Manual, you will know how to use them all. Closely guarded standardization assures that the scope and arrangement of all Flight Manuals are identical.

ARRANGEMENT. The manual has been divided into 10 fairly independent Sections, each with its own table of contents. The objective of this subdivision is to make it easy both to read the book straight through when it is first received and thereafter to use it as a reference manual. The independence of these Sections also makes it possible for the user to rearrange the book to satisfy his personal taste and requirements. The first 3 Sections cover the minimum information required to safely get the airplane into the air and back down again. Before flying any new airplane these 3 Sections must be read thoroughly and fully understood. Section IV covers all equipment not essential to flight but which permits the airplane to perform special functions. Sections V and VI are obvious. Section VII covers lengthy discussions on any technique or theory of operation which may be applicable to the particular airplane in question. The experienced pilot will probably be aware of the information in this Section but he should check it for any possible new information. The contents of the remaining Sections are fairly obvious.

YOUR RESPONSIBILITY. These Flight Manuals are constantly maintained current through an extremely active revision program. Frequent conferences with operating personnel and constant review of UR's, accident reports, flight test reports, etc., assure inclusion of the latest data in these manuals. In this regard, it is essential that you do your part! If you find anything you don't like about the book, let us know right away. We cannot correct an error whose existence is unknown to us.

PERSONAL COPIES, TABS AND BINDERS. In accordance with the provisions of AFR5-13, flight crew members are entitled to have personal copies of the Flight Manuals. Flexible, loose leaf tabs and binders have been provided to hold your personal

copy of the Flight Manual. These good-looking, simulated-leather binders will make it much easier for you to revise your manual as well as keep it in good shape. These tabs and binders are secured through your local materiel staff and contracting officers.

HOW TO GET COPIES. If you want to be sure of getting your manuals on time, order them before you need them. Early ordering will assure that enough copies are printed to cover your requirements. Technical Order 00-5-2 explains how to order Flight Manuals, classified supplements thereto, and Safety of Flight Supplements so that you automatically will get all original issue, changes, and revisions. Basically, all you have to do is order the required quantities in the Publications Requirement Table (T.O. 0-3-1). Talk to your Senior Materiel Staff Officer – it is his job to fulfill your Technical Order requests. Make sure to establish some system that will rapidly get the books and Safety of Flight Supplements to the flight crews once they are received on the base.

SAFETY OF FLIGHT SUPPLEMENTS. Safety of Flight Supplements are used to get information to you in a hurry. Safety of Flight Supplements use the same number as your Flight Manual, except for the addition of a suffix letter. Supplements covering loss of life will get to you in 48 hours; those concerning serious damage to equipment will make it in 10 days. You can determine the status of Safety of Flight Supplements by referring to the Index of Technical Publications (T.O. 0-1-1) and the Weekly Supplemental Index (T.O. 0-1-1A). This is the only way you can determine whether a supplement has been rescinded. The title page of the Flight Manual and title block of each Safety of Flight Supplement should also be checked to determine the effect that these publications may have on existing Safety of Flight Supplements. It is critically important that you remain constantly aware of the status of all supplements – you must comply with all existing supplements but there is no point in restricting the operation of your airplane by complying with a supplement that has been replaced or rescinded. Technical Order 00-5-1 covers some additional information regarding these supplements.

WARNINGS, CAUTIONS, AND NOTES. For your information, the following definitions apply to the "Warnings," "Cautions," and "Notes" found throughout the manual:

WARNING – Operating procedures, practices, etc., which will result in personal injury or loss of life if not carefully followed.

CAUTION – Operating procedures, practices, etc., which if not strictly observed will result in damage to equipment.

NOTE – An operating procedure, condition, etc., which it is essential to emphasize.

COMMENTS AND QUESTIONS. Comments and questions regarding any phase of the Flight Manual program are invited and should be forwarded through your Command Headquarters to Commander, OCAMA, Tinker Air Force Base, Oklahoma. Attention OCNBPF.

CODING

Information on all KC-97G airplanes is covered in this manual. However, some of the information is applicable only to certain groups of airplanes. This information is identified by a code no. reflecting that group of airplanes. Each paragraph applicable only to certain airplanes is coded along the title to the right. Items in illustrations, applicable only to some airplanes are generally coded alongside the nomenclature. When a paragraph or item is not coded it applies to all KC-97G airplanes.

Information which is affected by accamplishment of a TCTO modification, is coded by use of a special symbol bearing the TCTO dash number. When this symbol is used in conjunction with the airplane code no., it adds to or subtracts from that group of airplanes on which the specific TCTO has been incorporated. The TCTO's which are reflected in this manual are listed following the code examples. Most KC-97G airplanes ore in the tanker configuration. Therefore with few exceptions, all illustrations showing the whole airplane depict the tanker configuration. In the cases where the purpose of the illustration is not to show the difference between tanker and cargo airplanes, the A/R pod and boom are not coded.

EXAMPLES OF CODES

3147	Indicates information is applicable only to airplane with serial No. AF53-147
▶	Means "THRU" or "AND ON"
3147 ▶	Indicates information is applicable to all airplanes beginning with serial Nos. AF53-147 and on
3147 ▶ 3151	Indicates information is applicable to airplanes with serial Nos. AF53-147 thru AF53-151
TCTO K553	Indicates information is applicable to airplanes on which T.O. 1C-97(K)-553 has been incorporated
T	Indicates information is applicable to tanker configuration only
C	Indicates information is applicable to Cargo configuration only

RELATION BETWEEN

	AIRPLANE CODE NO.	AF SERIAL NO.	AIRPLANE TAIL NO.
EXAMPLE 1	22701	52-2701	22701
EXAMPLE 2	3147	53-147	30147

TIME COMPLIANCE TECHNICAL ORDERS

NOTE

The following time compliance technical orders (T.C.T.O.'s) are only those which are referred to this publication

- TCTO 133 — Installation of Periscopic Sextant
- TCTO 224 — Installation of Throttle Reverse Lock Plate
- TCTO 239 — DC Electrical Power System Improvement
- TCTO 292 — Emergency Power Provisions for Pitot Heater
- TCTO 299 — Landing Gear Safety Switch Revision
- TCTO 321 — Installation of AN/ARA-25 Direction Finding Group
- TCTO 338 — Revision of Turbo Control Circuit and Installation of Exhaust Back Pressure Switch
- TCTO 515 — Modification of Wing Thermal Anti-ice Electrical Circuit
- TCTO 526 — Modification of Fuel Tank Vent Interconnect Line
- TCTO 529 — Installation of Improved Emergency Escape Hatch Assemblies
- TCTO 531 — Replacement of Propeller RPM Manual Control Circuit Breaker
- TCTO 531A — Replacement of Propeller RPM Manual Control Circuit Breaker
- TCTO 534 — Installation of Propeller De-icing Loadmeters
- TCTO 541 — Installation of B36 Wheels and Brakes
- TCTO 558 — Installation of Wheel Well Overheat Warning System
- TCTO 563 — Installation of Type MF-2 Attitude Gyro
- TCTO 566 — Installation of MB-1 Fire Fighters Oxygen Sets
- TCTO 572 — Installation of AN/ARN-21
- TCTO 582 — Installation of Combustion Heater Timers
- TCTO 590 — Installation of AN/APX-25 Group B Components
- TCTO 591 — Installation of Anti Collision Lights
- TCTO 595 — Installation of Fuel Enrichment System
- TCTO K211 — Installation of AN/APN-69 Rendezvous Radar Set
- TCTO K231 — Installation of Tail Cone Lights
- TCTO K235 — Installation of Type B-6A Driftmeter
- TCTO K239 — Installation of Life Raft Stowage Provisions
- TCTO K504 — Installation of Type MS-28023-1 Wing Flap Position Indicators
- TCTO K509 — Inactivation of Ruddevator Anti-ice System
- TCTO K513 — Installation of Type K-3 Airspeed Indicator
- TCTO K520 — Installation of Boom Operator's Heat Duct
- TCTO K521 — External Power Receptacle Circuit Revision
- TCTO K526 — Installation of Additional Pilot Director Lights
- TCTO K528 — Modification of the Air Refueling Boom Markings
- TCTO K538 — Ventilation of Solar APU
- TCTO K553 — Installation of Aerial Refueling Hydraulic System Surge Dampners
- TCTO KG205 — Spark Advance Switch Guard Replacement
- TCTO KG206 — Installation of AN/ARR-36 Radio Receiver replacing BC-348 Equipment
- TCTO KG211 — Installation of Revised AN/ARC-21 and AN/ART-13 Antenna Systems
- TCTO KG502 — Restoration of Paired Pulse Function in AN/APN-76C Radar Set
- TCTO KG513 — Revision of Receiving Antenna Circuit
- TCTO KGT507 — Installation of Air Refueling Fuel to Engine Fuel System Provisions

A circled checklist number such as (1) appearing on a checklist, means that this step must be coordinated with another crew member

The term PLACES preceded by a number, means the number of places in which the particulor item appears on the illustration. It does not indicate the quantities of the particular item contained in the airplane.

SYMBOLS AND DEFINITIONS

NOTE

It is not intended that this list include abbreviations used in decals and markings on the airplane.

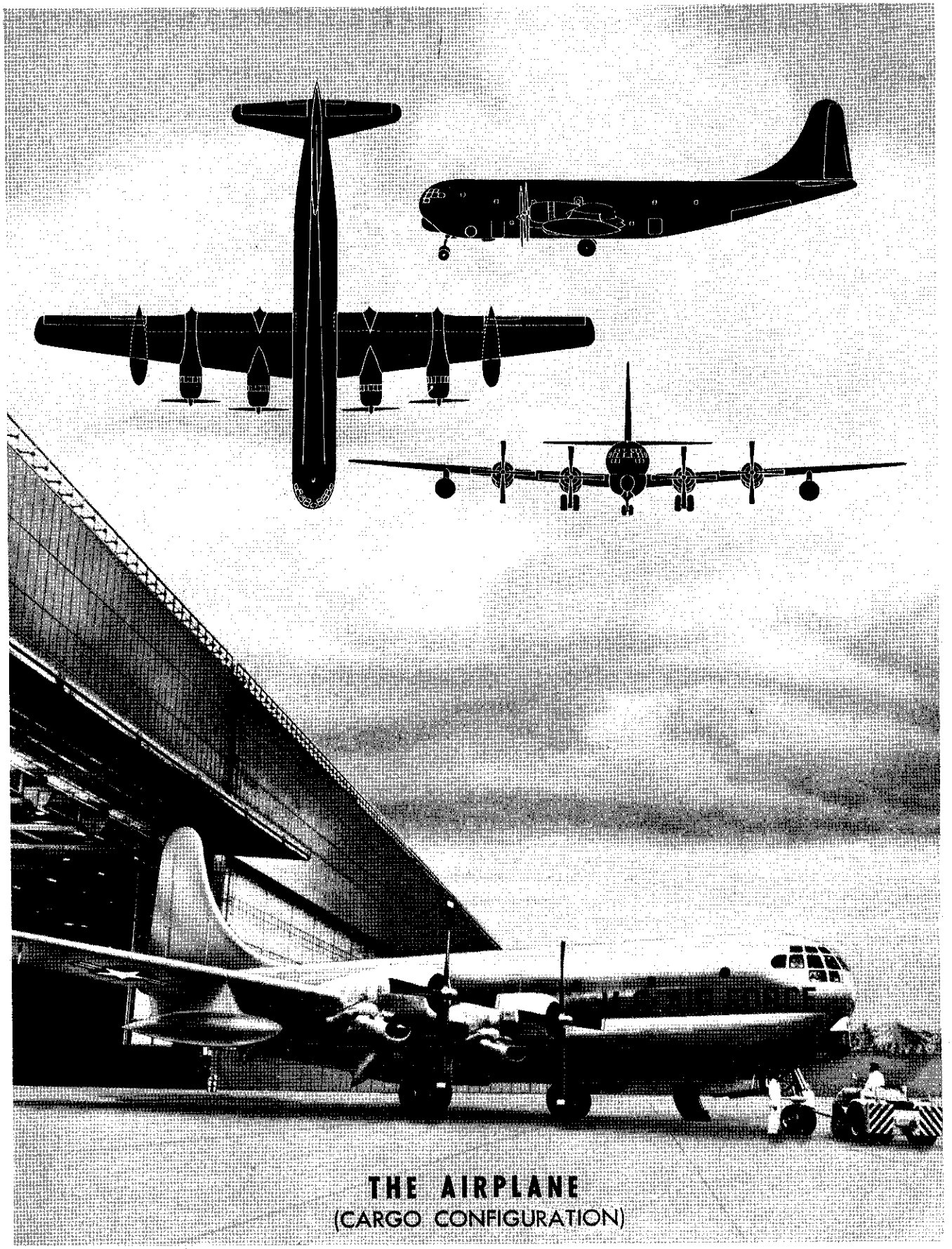
SYMBOL	DEFINITION
AC	Alternating Current
ACCEL	Acceleration
ADF	Automatic Direction Finding
ADI	Anti-Detonation Injection System
ADIZ	Air Defense Identification Zone
ALT	Altitude
AM	Amplitude Modulation (Communication Radios)
AME	Equivalent AM
amp	Ampere
APU	Auxiliary Power Unit
AR	Auto Rich
A/R	Air Refueling
ATA	Actual Time of Arrival
BHP	Brake Horsepower
BMEP	Brake Mean Effective Pressure
(BO)	Boom Operator
°C	Degrees Centigrade
CAS	Calibrated Air Speed (Indicated Airspeed Corrected for Position Error)
CAT	Carburetor Air Temperature (In Degrees Centigrade)
CB	Circuit Breaker
CCW	Counterclockwise Rotation
CFG	Cowl Flap Gap (Inches)
CG, cg	Center of Gravity
CHT	Cylinder Head Temperature, (Degrees Centigrade)
COMP	Compressibility
CONT	Continue or Continued
CORR	Correction or Corrected
(CP)	Copilot
C/R	Climb Rate (Feet Per Minute)
CW	Clockwise Rotation
(CW)	Continuous Wave
CWG	Closed Waste Gate
CWT	Center Wing Tank
CYL	Cylinder
DC	Direct Current
D/F	Direction Finding
DIST	Distance
DN	Down
DR	Dead Reckoning
EAS	Equivalent Air Speed (Calibrated Airspeed Corrected for Compressibility)

SYMBOL	DEFINITION
EBP	Exhaust Back Pressure
ENG	Engine
EPW	Equivalent Performance Weight
EST	Estimated
°F	Degrees Fahrenheit
FF	Fuel Flow
FT, ft	Feet
FWD	Forward
G	Acceleration of Gravity
GAL	Gallons
(GC)	Ground Crew
GCA	Ground Controlled Approach
GMT	Greenwich Mean Time
GPM, gpm	Gallons per Minute
GR	Gross
HF	High Frequency
Hg	Mercury, In Inches. (One Inch Mercury Equals Approximately .49 Pounds per Square Inch)
HR	Hour
IAS	Indicated Airspeed (Instrument Reading Corrected for Instrument Error Only)
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
IN, in	Inches
INST	Instrument
Kts	Knots
LB	Pounds
LOP	Line of Position
LRC	Long Range Cruise
M	Mach Number
MACH	Mean Aerodynamic Chord
MAX	Maximum
MCW	Modulated Continuous Wave
ME	Manifold to Engine
METO	Maximum Except Takeoff
MI	Miles
MIN	Minutes
MP	Manifold Pressure, Inches of Mercury
(N)	Navigator
NAM	Nautical Air Miles
NM	Nautical Miles
NMPP	Nautical Miles Per Pound
No.	Number

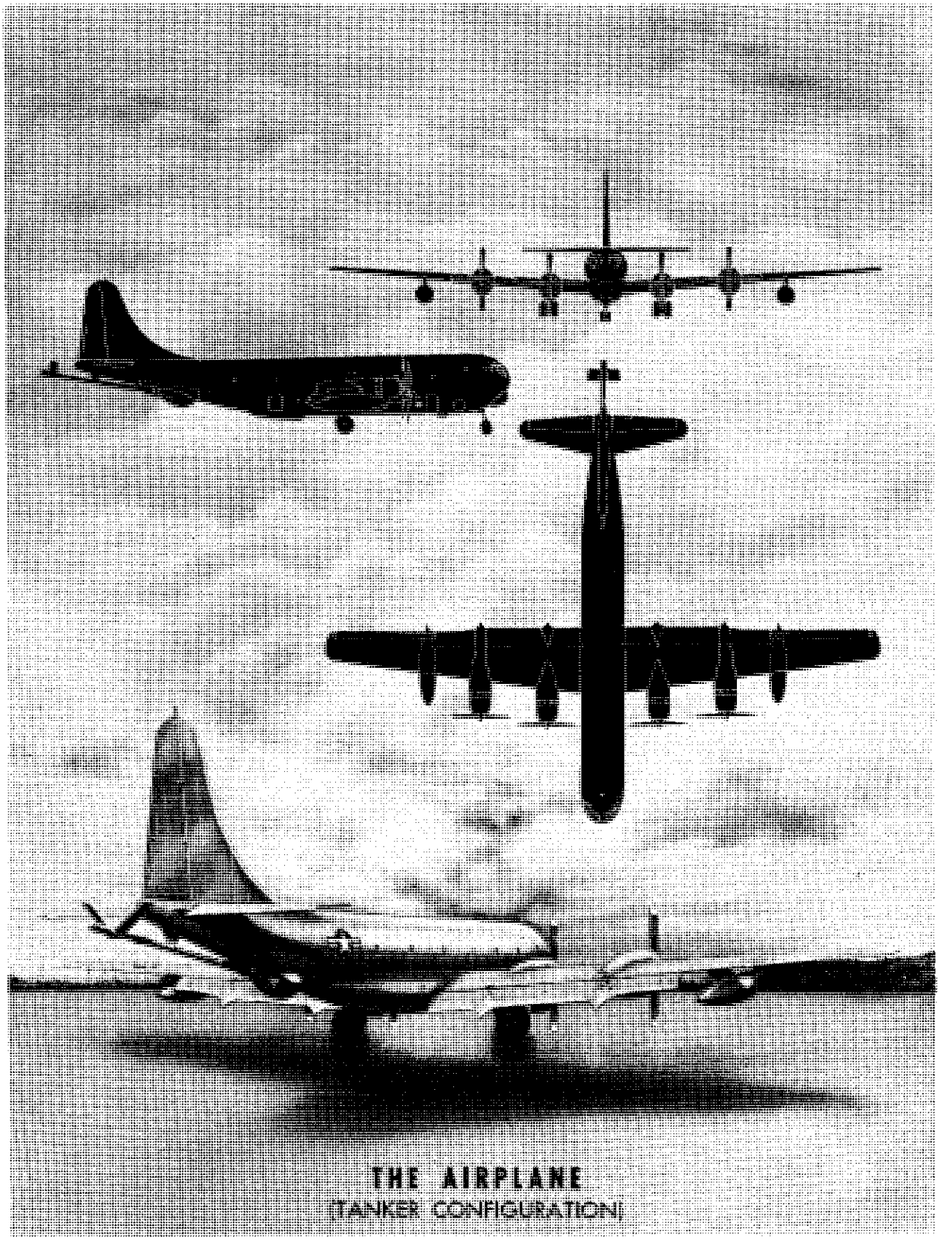
SYMBOLS AND DEFINITIONS

SYMBOL	DEFINITION
OAT	Outside Air Temperature
OWE	Operating Weight Empty
P	Static Pressure In Atmosphere
(P)	Pilot
ph	Pounds Per Hour
pm	Pounds Per Minute
POS	Position
PPI	Plan Position Indicator
PRESS	Pressure
PSI	Pounds Per Square Inch
R/C	Rate of Climb
R/D	Rate of Descent
(RO)	Radio Operator
RPM, rpm	Revolutions Per Minute
SIF	Selective Identification Feature
SL	Sea Level
SPR	Single Point Refueling
SQ	Square
SSB	Single Side Band
STD	Standard
T	Absolute Temperature
t	Temperature °F or °C

SYMBOL	DEFINITION
TAS	True Airspeed, Equivalent Airspeed Corrected for Temperature and Pressure EAS ×
TBS	Turbo Boost Selector
TDC	Top Dead Center
TE	Tank to Engine
TEMP	Temperature
TME	Tank to Manifold to Engine
TO.	Takeoff
TPSI	Torque Pressure In Pounds Per Square Inch
TRPM	Turbosupercharger Revolutions Per Minute
UHF	Ultra High Frequency
V	Velocity
VFO	Variable Frequency Oscillator
VHF	Very High Frequency
VOR	Visual Omni Range
V_W	Wind Velocity, Knots
WT	Weight (Pounds)
XTAL	Crystal
Δ(delta)	Increment
ρ(rho)	Air Density, Slugs Per Cubic Foot
σ(sigma)	Air Density Ratio ρ/ρ_0.

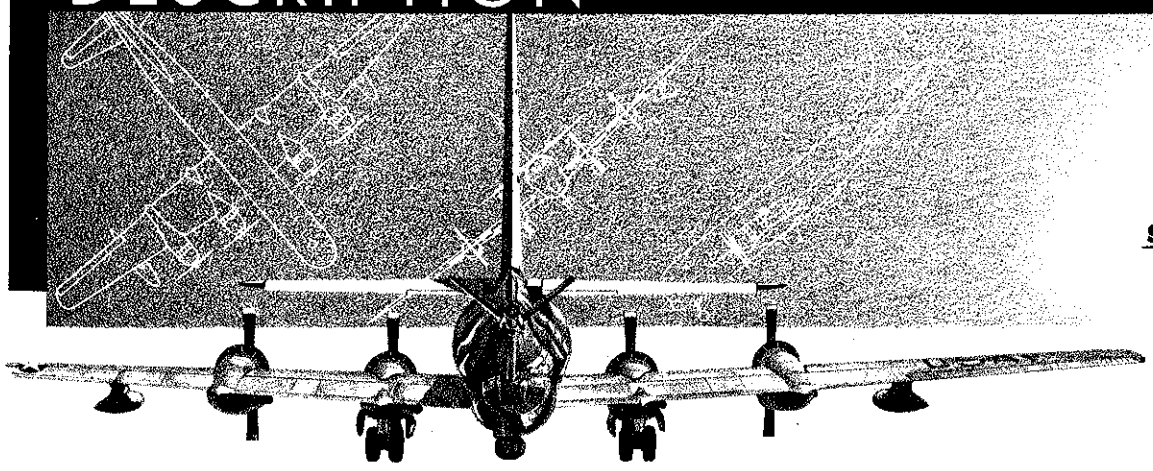


THE AIRPLANE
(CARGO CONFIGURATION)



THE AIRPLANE
(TANKER CONFIGURATION)

DESCRIPTION



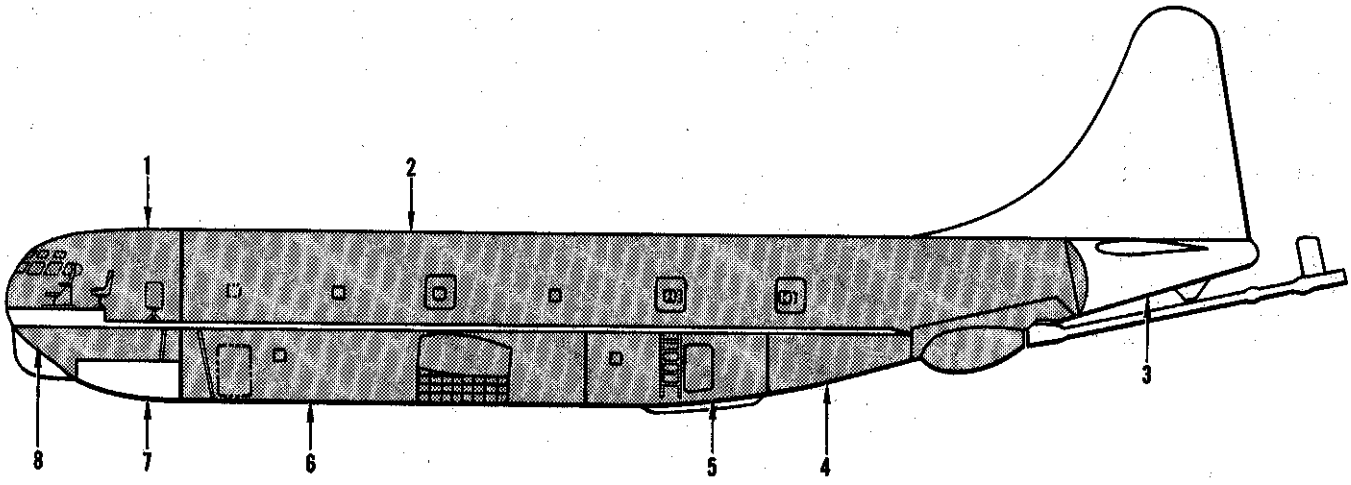
SECTION I

TABLE OF CONTENTS

ITEM	KC-97E	KC-97F	KC-97G
EXTERNAL FUEL TANKS	None	None	One droppable tank under each wing
(T) AIR REFUELING FUEL TANKS	Four tanks in the main cargo compartment	Four tanks in the main cargo compartment	Seven tanks on LH side of main compartment and eight tanks, two on each side of lower fwd and aft compartment
ENGINES	P & W R-4360-65	P & W R-4360-59B	P & W R-4360-59B
TROOP CARRYING CAPACITY	(C) 130 (T) 34	(C) 130 (T) 34	(C) 96 (T) 63

MAIN DIFFERENCES

Figure 1-1



PRESSURIZED AREA

1 CONTROL CABIN
2 MAIN COMPARTMENT
3 TAIL COMPARTMENT (UNPRESSURIZED)
4 STOWAGE COMPARTMENT
5 LOWER AFT COMPARTMENT
6 LOWER FORWARD COMPARTMENT
7 NOSE WHEEL WELL (UNPRESSURIZED)
8 LOWER NOSE COMPARTMENT

COMPARTMENTS

Figure 1-2

AIRPLANE

The Boeing KC-97G airplane is a four engine, long range, high altitude, high speed transport equipped for use primarily as a flying boom tanker for the in-flight refueling of other airplanes. Provisions have been incorporated into the airplanes to convert them into cargo carriers or troop transports. The A/R equipment on tanker airplanes is easily removed or installed to permit maximum utilization of the airplane as either a cargo carrier or tanker. The airplane is powered by four Pratt and Whitney R-4360-59B engines. Each engine drives a Hamilton Standard Hydromatic constant speed propeller with full feathering and reversible pitch features. The fuselage is furnished with complete heating, ventilating and pressurizing equipment for use either in flight or on the ground. The following equipment is operated by the main hydraulic system: brakes, nose wheel steering, windshield wipers, rudder boost and on airplanes 22737 ▶ in the tanker configuration, the boom hydraulic system. Airplanes in the tanker configuration also have an independent hydraulic system that operates the A/R fuel pumps and on airplanes 17260 ▶ 22736 , the boom hydraulic system. All other equipment in the airplane is operated electrically. The normal crew consists of the pilot, copilot, navigator, engineer, radio operator on airplanes 17260 ▶ 3177 and all airplanes which do not have the AN/ARC-21 liaison radio installed and operating, and on tanker airplanes a boom operator.

OVERALL DIMENSIONS

Approximate overall dimensions of the airplane are as follows:

Wing Span	141 feet 3 inches
Fuselage Length	110 feet 4 inches
Height (to top of fin)	38 feet 3 inches
Height (fin folded)	26 feet 7 inches
Tread (between struts)	28 feet 6 inches
Tread (between outboard wheels)	32 feet (approx)
Overall Length	
▼ (boom retracted)	117 feet 5 inches
▼ (boom extended)	136 feet 10 inches

See figure 2-3 for minimum turning radius and minimum ground clearance.

GROSS WEIGHT

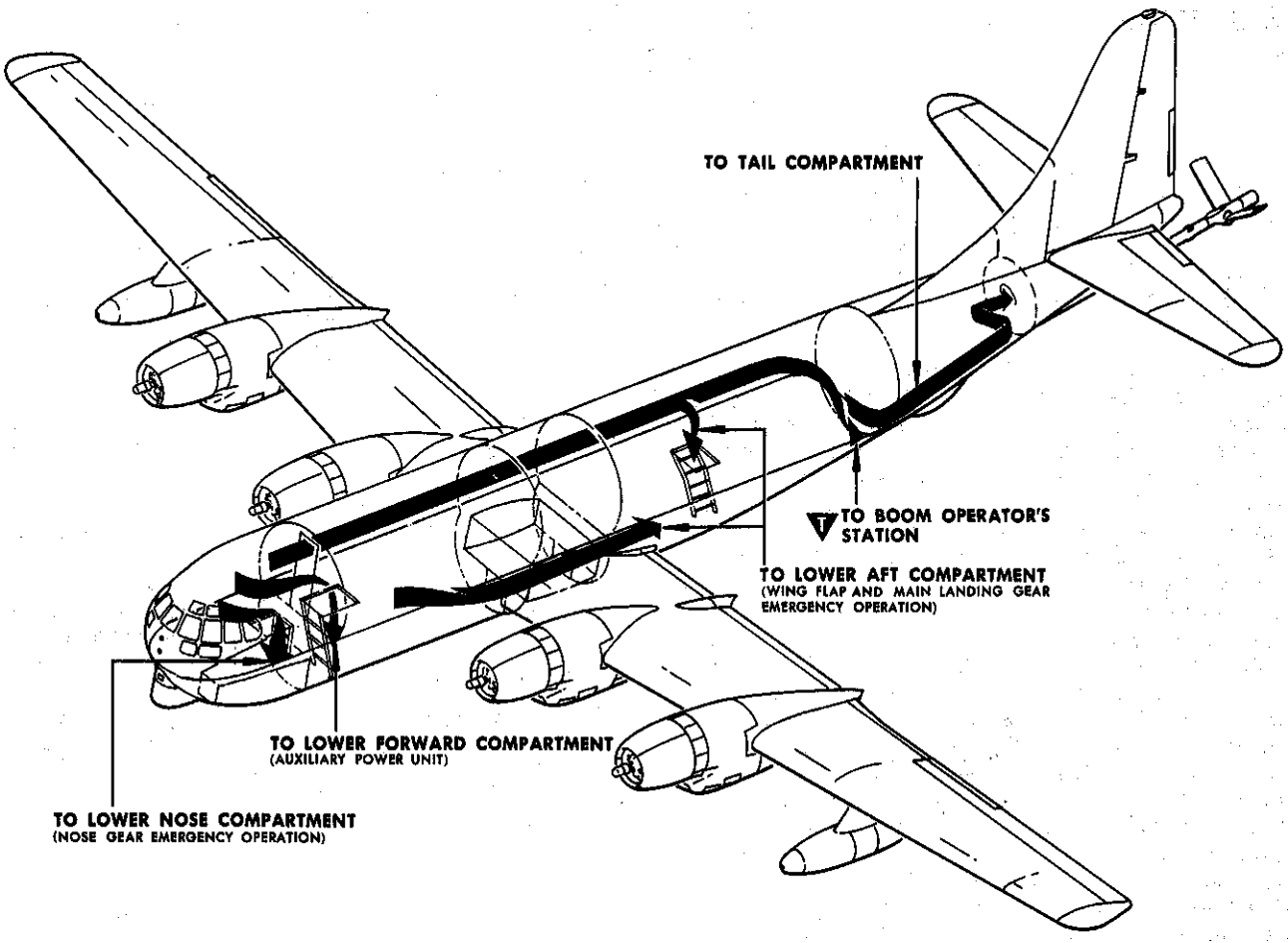
The design gross weight of this airplane is 153,000 pounds. For additional gross weight information see Section V.

SPECIAL FEATURES

Special features of this model are the installation of flying boom air refueling equipment for Code ▼ airplanes, external fuel tanks, and single point refueling. The rudder and vertical fin can be folded onto the horizontal stabilizer for ease of maintenance and to permit the airplane to be housed in average hangars. Structural provisions have also been made for the installation of an aerial delivery system when the airplane is converted for carrying cargo only.

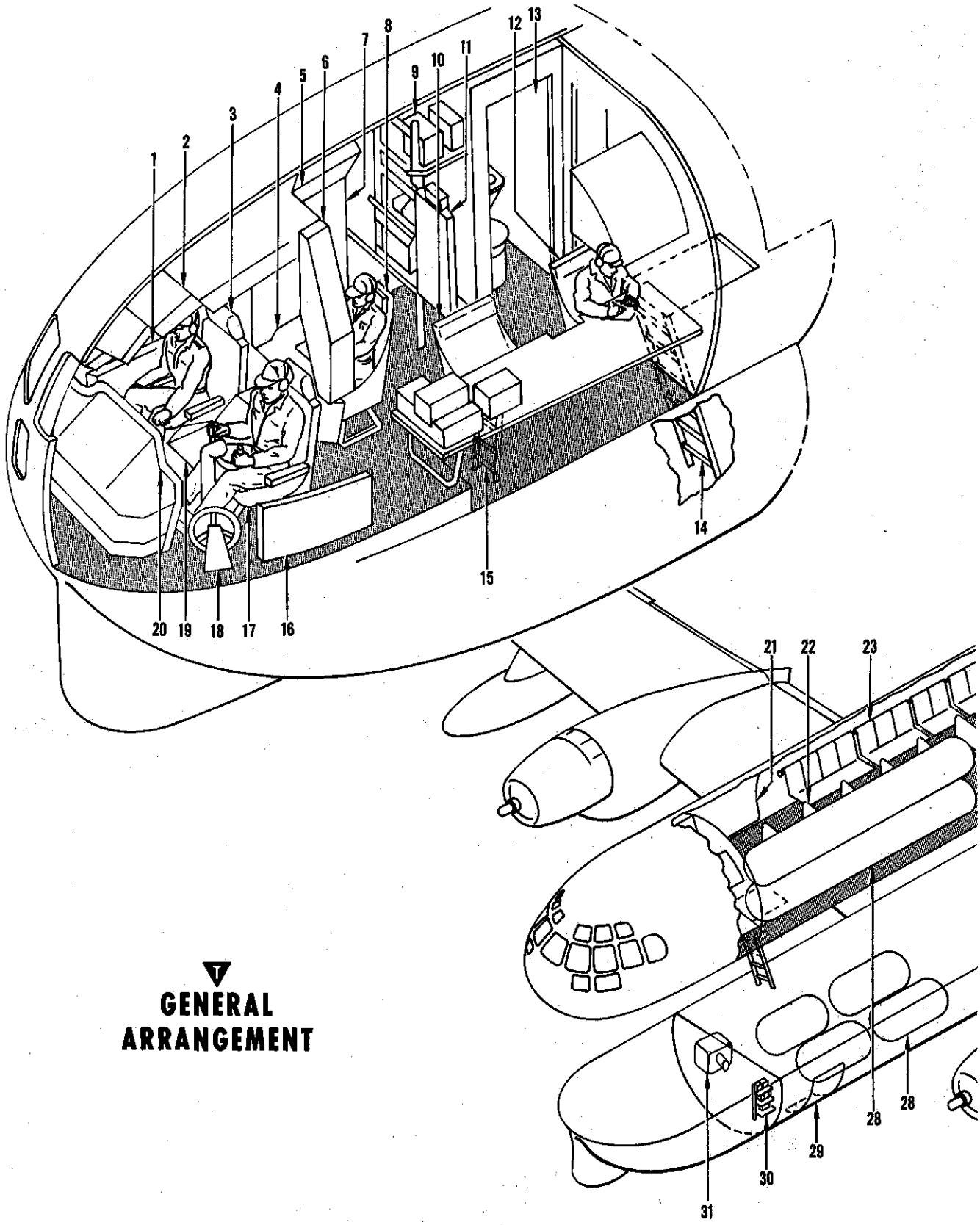
INTERIOR ARRANGEMENT AND CREW MOVEMENT

The fuselage is divided into six pressurized and two unpressurized compartments as shown in figure 1-2. Hatches and ladders are provided for extensive crew movement between compartments as shown in figure 1-3.



CREW MOVEMENT

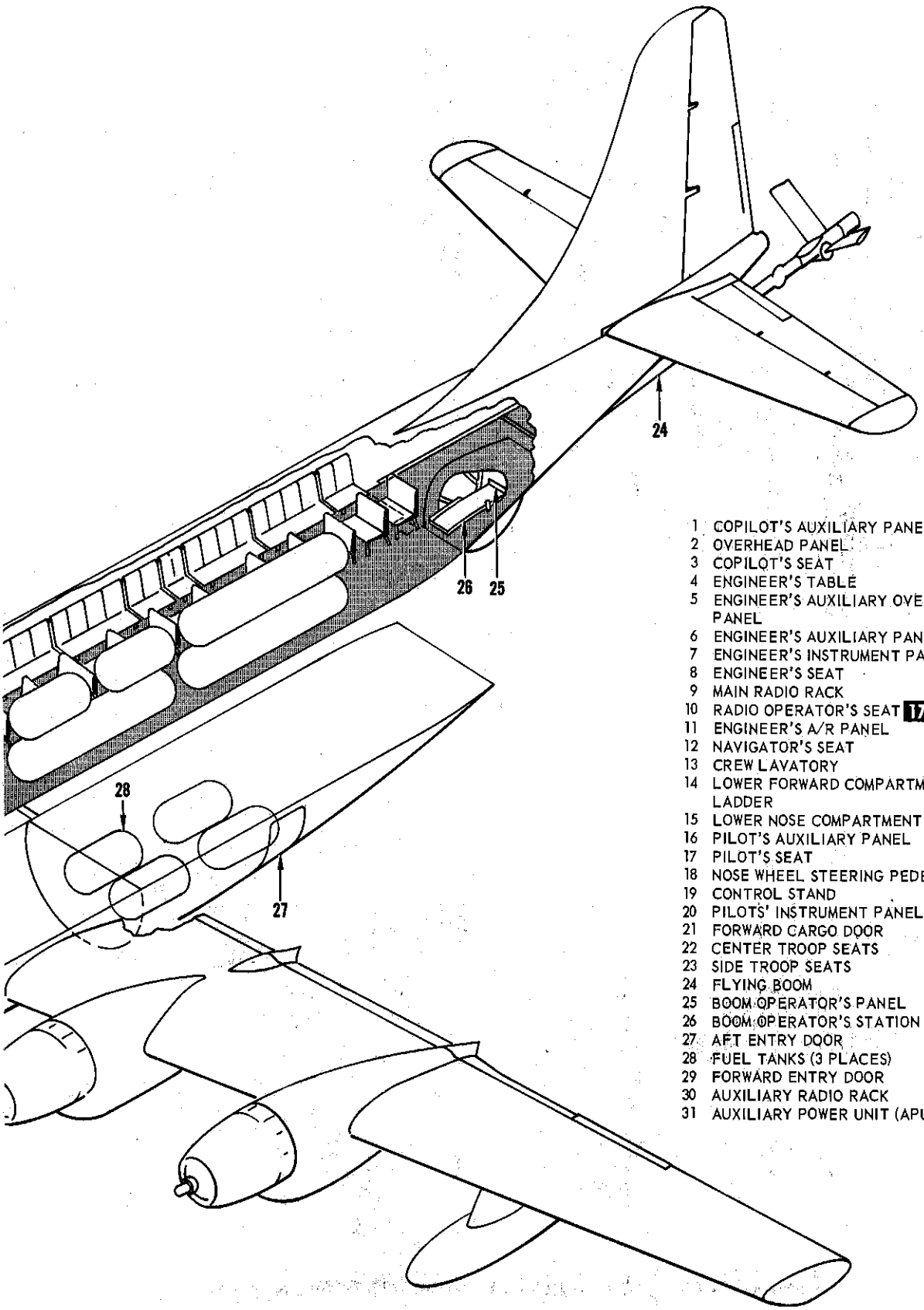
Figure 1-3



GENERAL ARRANGEMENT

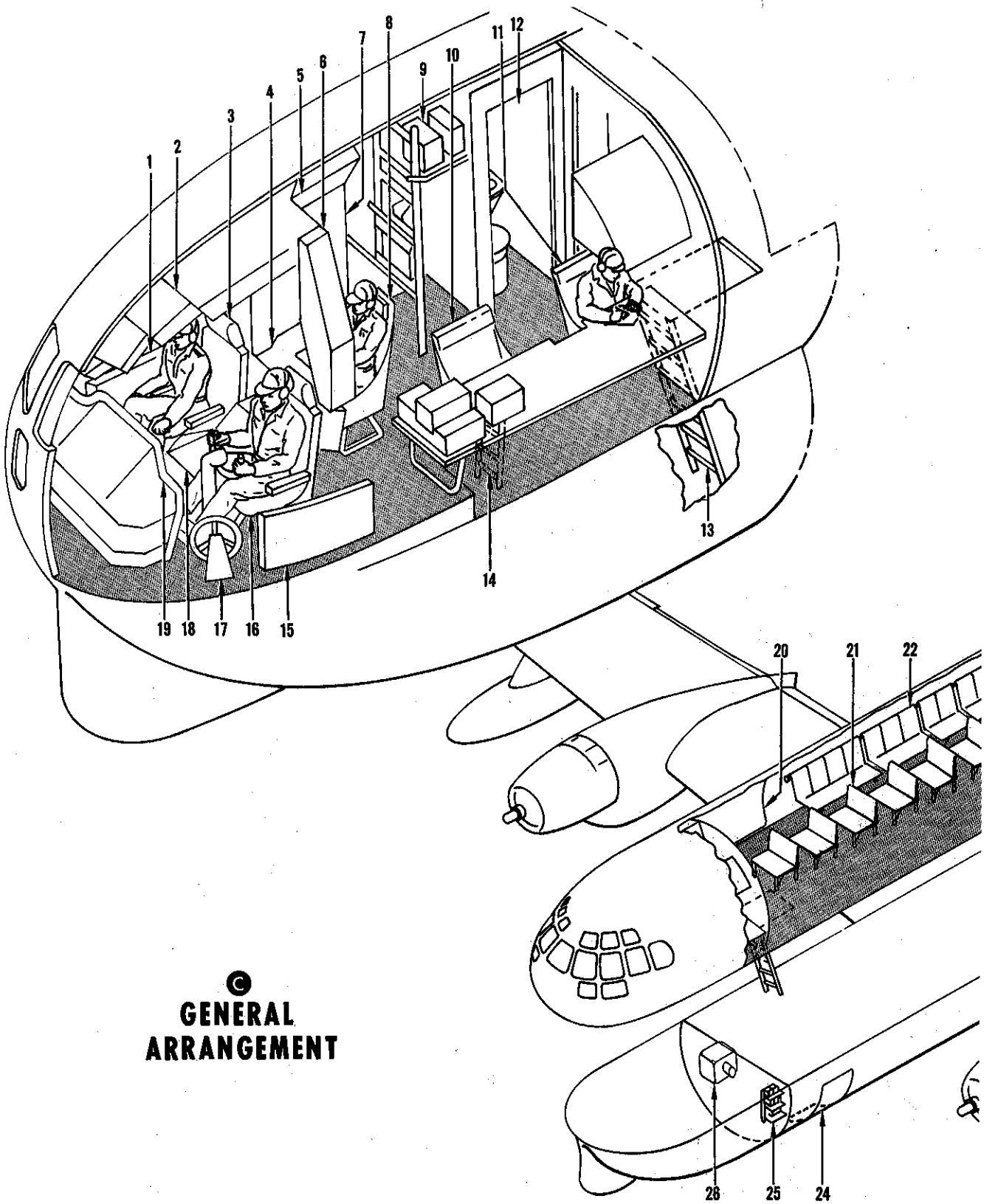
GENERAL ARRANGEMENT

Figure 1-4 (Sheet 1 of 2)



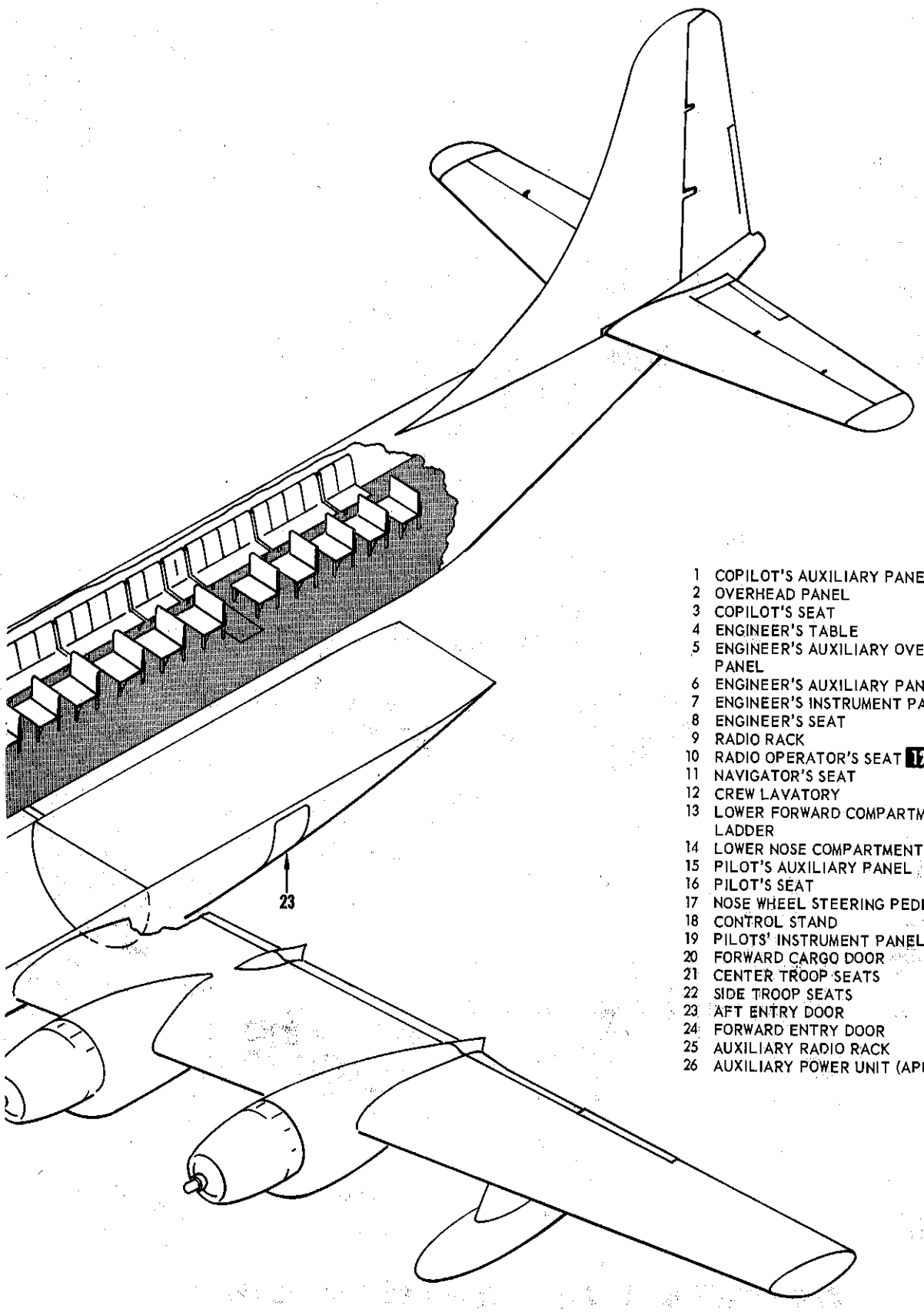
1 COPILOT'S AUXILIARY PANEL
2 OVERHEAD PANEL
3 COPILOT'S SEAT
4 ENGINEER'S TABLE
5 ENGINEER'S AUXILIARY OVERHEAD PANEL
6 ENGINEER'S AUXILIARY PANEL
7 ENGINEER'S INSTRUMENT PANEL
8 ENGINEER'S SEAT
9 MAIN RADIO RACK
10 RADIO OPERATOR'S SEAT 17260 ▶ 3177
11 ENGINEER'S A/R PANEL
12 NAVIGATOR'S SEAT
13 CREW LAVATORY
14 LOWER FORWARD COMPARTMENT LADDER
15 LOWER NOSE COMPARTMENT LADDER
16 PILOT'S AUXILIARY PANEL
17 PILOT'S SEAT
18 NOSE WHEEL STEERING PEDESTAL
19 CONTROL STAND
20 PILOTS' INSTRUMENT PANEL
21 FORWARD CARGO DOOR
22 CENTER TROOP SEATS
23 SIDE TROOP SEATS
24 FLYING BOOM
25 BOOM OPERATOR'S PANEL
26 BOOM OPERATOR'S STATION
27 AFT ENTRY DOOR
28 FUEL TANKS (3 PLACES)
29 FORWARD ENTRY DOOR
30 AUXILIARY RADIO RACK
31 AUXILIARY POWER UNIT (APU)

Figure 1-4 (Sheet 2 of 2)



GENERAL ARRANGEMENT

Figure 1-5 (Sheet 1 of 2)



1 COPILOT'S AUXILIARY PANEL
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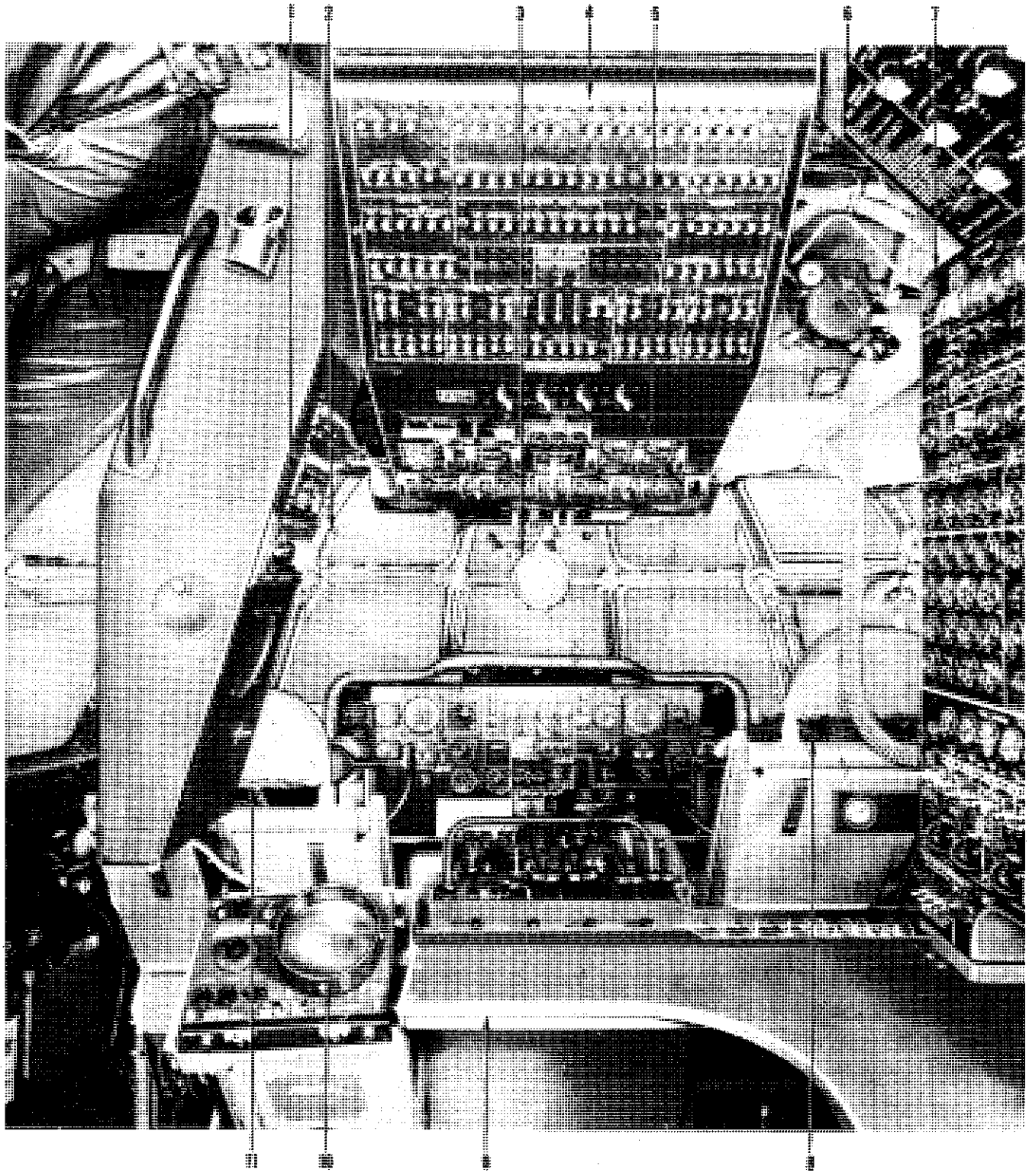
4 ENGINEER'S TABLE
5 ENGINEER'S AUXILIARY OVERHEAD PANEL
6 ENGINEER'S AUXILIARY PANEL
7 ENGINEER'S INSTRUMENT PANEL
8 ENGINEER'S SEAT
9 RADIO RACK
10 RADIO OPERATOR'S SEAT 17260 ▶ 3177
11 NAVIGATOR'S SEAT
12 CREW LAVATORY
13 LOWER FORWARD COMPARTMENT LADDER
14 LOWER NOSE COMPARTMENT LADDER
15 PILOT'S AUXILIARY PANEL
16 PILOT'S SEAT
17 NOSE WHEEL STEERING PEDESTAL
18 CONTROL STAND
19 PILOTS' INSTRUMENT PANEL
20 FORWARD CARGO DOOR
21 CENTER TROOP SEATS
22 SIDE TROOP SEATS
23 AFT ENTRY DOOR
24 FORWARD ENTRY DOOR
25 AUXILIARY RADIO RACK
26 AUXILIARY POWER UNIT (APU)

Figure 1-5 (Sheet 2 of 2)



1 ENGINEER'S AUXILIARY PANEL
2 ESCAPE ROPE
3 SEARCH RADAR INDICATOR
4 OVERHEAD CIRCUIT BREAKER PANEL
5 OVERHEAD PANEL
6 ENGINEER'S AUXILIARY OVERHEAD PANEL
7 ENGINEER'S INSTRUMENT PANEL
8 COPILOT'S STATION
9 ENGINEER'S STATION
10 IGNITION ANALYZER
11 PILOT'S STATION

CONTROL CABIN (TYPICAL)

Figure 1-6

ENGINE

The airplane is powered by four Pratt and Whitney R-4360-59B, 28-cylinder air cooled engines. The engines are equipped with a low tension ignition system and a torquemeter indicating system. A spark advance control is installed to improve airplane range. Each engine is equipped with a single-stage, single-speed internal supercharger, and an exhaust-driven turbosupercharger. Water injection is provided for high power settings. Each engine is capable of developing a maximum power (at sea level) of 3250 bhp dry or 3500 bhp using water injection.

CARBURETOR

Each engine is equipped with a Stromberg injection carburetor. The carburetor is a rectangular barrel, downdraft unit incorporating a throttle actuated accelerating pump. It is equipped with a fuel enrichment valve to supply adequate fuel at high power settings, and an automatic mixture control unit to compensate for altitude and carburetor air temperature variations. Mixture control to the engine is regulated by a rotary type idle mixture control, actuated by the throttle in idle range, and a rotary type manual mixture control, actuated by the mixture control lever through a cable system. For details on the carburetor preheat valve, supercharger, and sheltered air door assembly, see INDUCTION SYSTEM and TURBOSUPERCHARGER in this Section.

THROTTLES AND THROTTLE LOCK LEVER

Equipment Connected To The Throttles

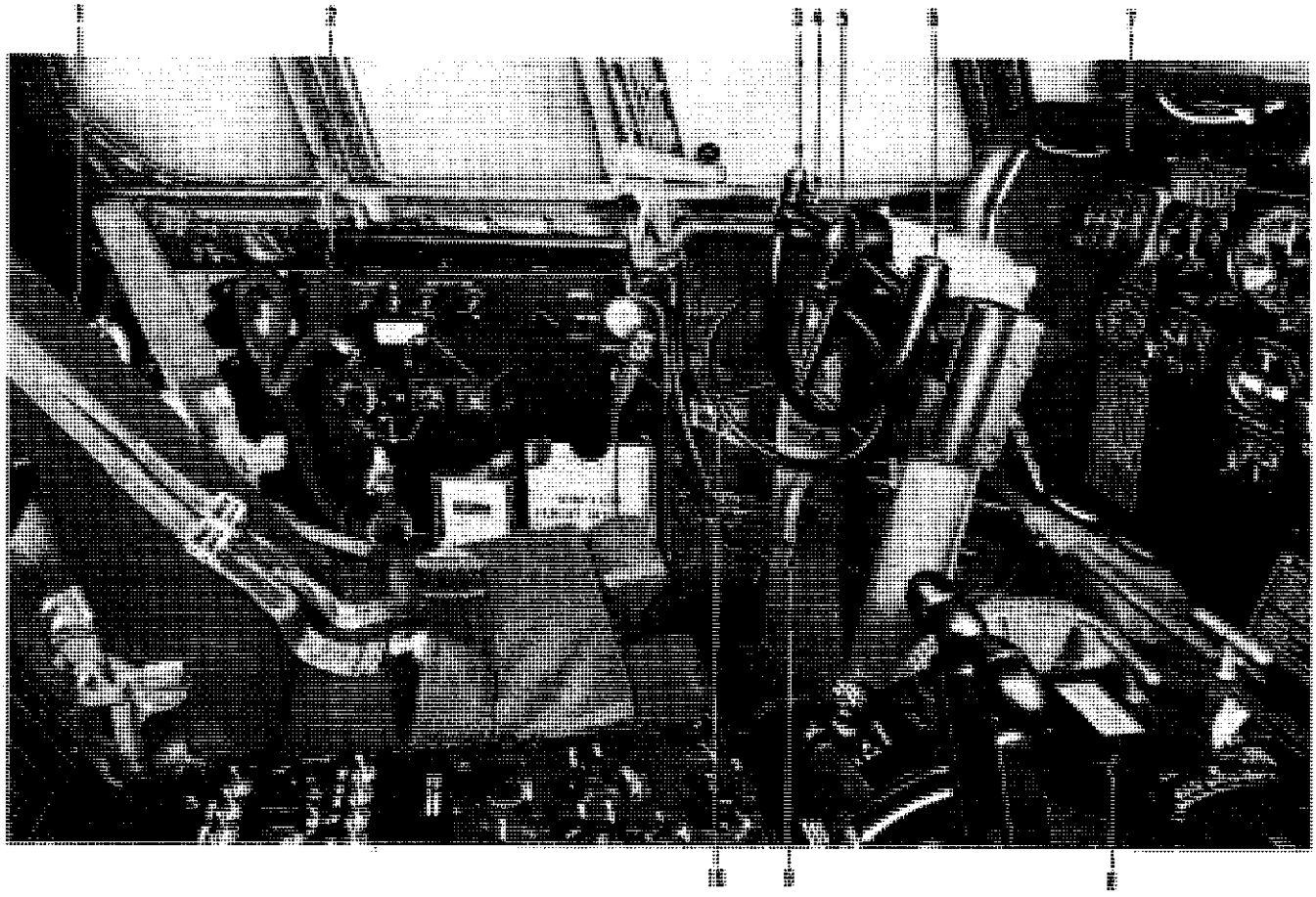
Two sets of throttles (29 and 39, figure 1-16) are on the control stand. One set near the forward end of the stand is for the pilots' use and is interconnected to the other set near the aft end of the stand for the engineer's use. Movement of the throttles automatically actuates the propeller reversing switches, wing flap warning switches, and landing gear warning switches. Movement of the throttles will actuate the respective carburetor controls through a cable system. A reverse throttle lock solenoid prevents propeller reversing during flight. A propeller reverse lock plate (36, figure 1-16) prevents inadvertent reversing of the propellers. A throttle lock lever (13, figure 1-16) to the right of the pilots' throttles, provides a friction braking force to hold the throttles in any desired position. With the water injection pump switch (10, figure 1-16) ON, the water injection (ADI) system operates automatically when the throttles are opened beyond 45 inches manifold pressure, and shuts off when the throttles are closed below 41 inches of manifold pressure. See WATER INJECTION (ADI) SYSTEM in this Section.

Throttle Operation

The pilots' throttles have OPEN--CLOSED--REVERSE OPEN and intermediate positions. The pilots' throttle operation is conventional in the OPEN--CLOSED range. Holding the throttles aft against the CLOSED stop maintains the throttles in forward idle. The throttles can be moved into reverse range by raising the throttle handles 1/4 inch and moving the levers aft beyond the CLOSED stop. A friction can be felt as the propeller reverse pitch switches are actuated. Holding the pilots' throttles forward against the CLOSED stop, while in the reverse range, maintains the throttles in reverse idle. Further movement toward the REVERSE OPEN position opens the throttles. The pilots' throttles must be raised 1/4 inch and moved forward over the CLOSED stop to return the propellers to forward pitch. The engineer's throttles have OPEN--CLOSED and intermediate positions. When the pilots' throttles are moved back into the REVERSE OPEN range, the engineer's throttles move forward into the OPEN range. Once the pilots' throttles are placed in the reverse range, the engineer can control reverse power operation. The pilots' throttles must be moved forward over the CLOSED stop before forward power control is restored to the engineer's throttles. The landing gear warning light will illuminate and the warning horn will sound when any combination of two throttles for engines on opposite sides of the airplane are advanced more than three fourths open in either forward or reverse thrust with the wing flaps in any position except 22 percent to 44 percent and with the weight of the airplane on the landing gear.

PROPELLER REVERSE LOCK

The throttles are equipped with an automatic reverse propeller lock to restrict propeller reversing to ground operation only. The lock, actuated by a solenoid, consists of four mechanical latches which engage the pilots' throttle levers. The throttle lock solenoid is energized by an oleo-actuated relay. The lock is actuated to the UNLOCKED position when any of the landing gear is in contact with the ground. A time delay relay in the solenoid circuit prevents the lock from being actuated to the LOCKED position for a period of eight seconds after the airplane is airborne. This propeller reverse lock operates in conjunction with a propeller reverse warning flag (4, figure 1-16), located at the forward end of the control stand. The propeller reverse lock may be manually unlocked while the airplane is airborne or on the ground by pressing the warning flag. During normal operation, this flag serves as a position indicator for the reverse lock. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel. (See figure 1-34.) For more information concerning this flag see PROPELLER SYSTEM in this Section.



1 PILOT'S SEAT
2 PILOT'S AUXILIARY PANEL
3 PILOT'S MICROPHONE SWITCH
4 AUTOPILOT RELEASE SWITCH
5 NOSE WHEEL STEERING EMERGENCY DISCONNECT BUTTON
6 PILOT'S CONTROL WHEEL
7 PILOTS' INSTRUMENT PANEL
8 CONTROL STAND
9 PARKING BRAKE HANDLE
10 NOSE GEAR STEERING WHEEL

PILOT'S STATION

Figure 1-7

PROPELLER REVERSE LOCK PLATE

2843 ▶ plus T.O. 1C-97(K)G-224 ▶

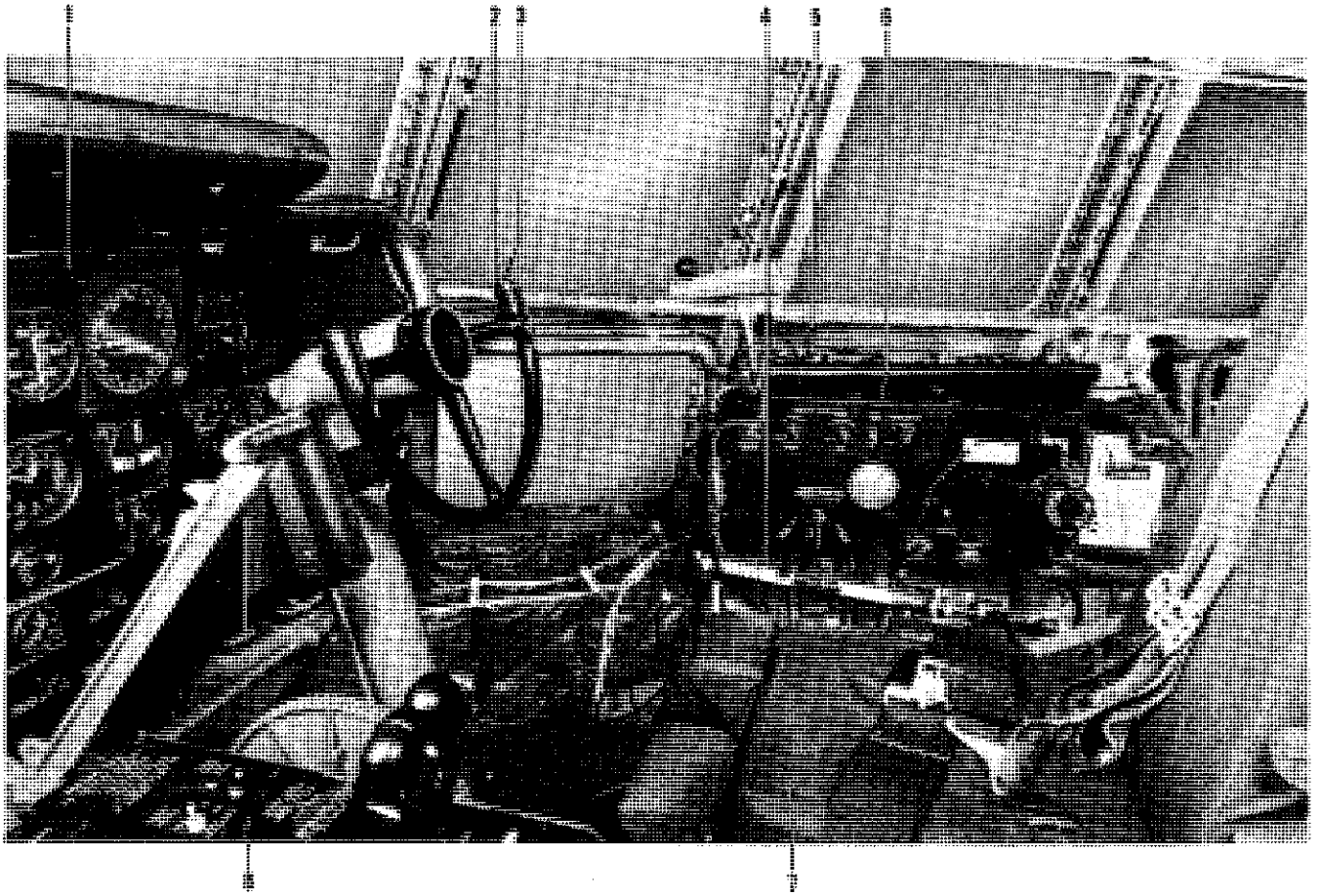
A metal lock plate (36, figure 1-16) on the aft side of the pilots' throttle quadrant prevents the throttle from being moved inadvertently into the propeller reverse range. The lock is hinged on the aft edge and must be opened whenever the throttles are to be operated in the propeller reverse range.

MIXTURE CONTROLS AND MIXTURE LOCK LEVER

Four mixture controls (22, figure 1-16) are on aft end of the control stand. The levers have FUEL CUTOFF--AUTO LEAN--AUTO RICH and intermediate positions. Placing a lever in FUEL CUTOFF shuts off fuel flow at the carburetor. The AUTO LEAN and AUTO RICH carburetor mixture settings are obtained by placing the mixture levers in the appropriate detent position. Manual mixture control may be obtained at other positions using the procedures outlined in NORMAL SPARK CRUISE CONTROL PROCEDURE and SPARK ADVANCE FUEL CONTROL in Section VII. A locking lever (21, figure 1-16) adjacent to the mixture control levers, provides a friction braking force to hold the mixture control levers at any desired position.

INDUCTION SYSTEM

The induction system (figure 1-10) consists of an entry scoop, a sheltered air door and sheltered air inlet



1 PILOTS' INSTRUMENT PANEL
2 AUTOPILOT RELEASE SWITCH
3 COPILOT'S MICROPHONE SWITCH
4 HYDRAULIC HAND PUMP
5 CW KEY
6 COPILOT'S AUXILIARY PANEL
7 COPILOT'S SEAT
8 CONTROL STAND

COPILOT'S STATION

Figure 1-8

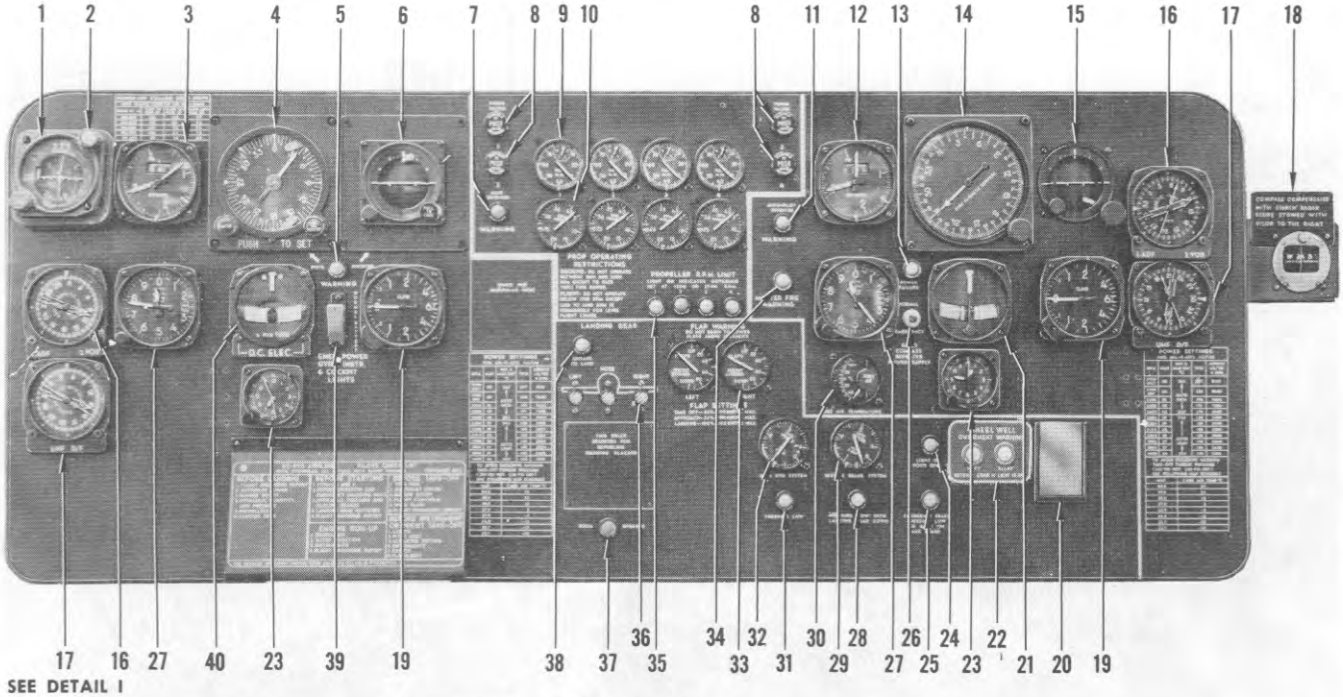
assembly, turbosupercharger, intercooler, carburetor preheat valve, and connecting ducting. Either ram air or supercharged air may be supplied to the carburetor through a bypass door controlled by differential pressure. Supercharged carburetor air temperature is controlled by positioning of the carburetor preheat valve and intercooler flap. For details on turbosupercharger and turbosupercharger controls, see TURBOSUPERCHARGER in this Section.

Sheltered Air Door

An electrically operated sheltered air door and inlet assembly is located aft of the entry scoop on the bottom of the air intake duct. This door enables either ram air or sheltered air to be supplied to the induction system. With the door in the sheltered position, ram air is shut off from the induction system and sheltered air is supplied through the sheltered air inlet. This causes a rapid change of direction in the flow of air as it enters the induction system, which aids in separating moisture particles from the induction air. An air filter is provided in the inlet assembly to filter dust particles from the air.

Carburetor Preheat Valve

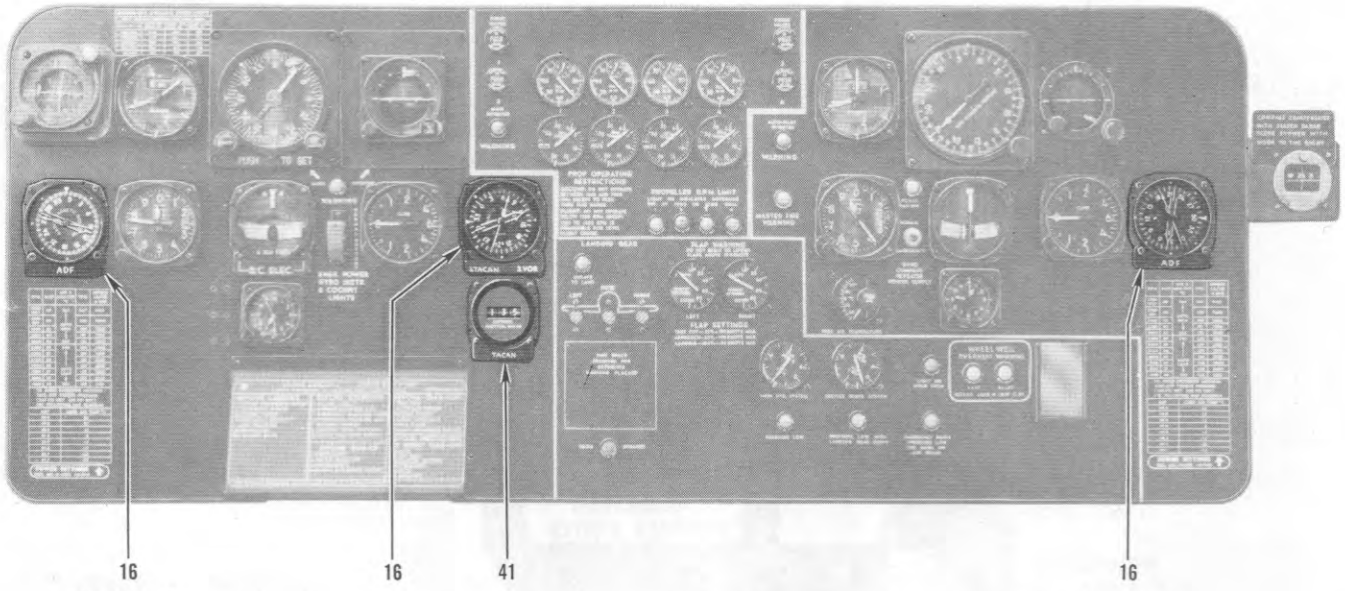
An electrically operated gate-type carburetor preheat valve (figure 1-10) is located downstream from the turbocompressor. It is used to preheat supercharged



1 COURSE INDICATOR
2 MARKER BEACON LIGHT
3 AIRSPEED INDICATOR
4 PILOT'S DIRECTION INDICATOR
5 PILOTS' INSTRUMENT INVERTER WARNING LIGHT
6 ATTITUDE INDICATOR
7 MAIN INVERTER WARNING LIGHT
8 MANIFOLD PRESSURE PURGE VALVE BUTTONS (2 PLACES)
9 MANIFOLD PRESSURE GAGES
10 TACHOMETER
11 AUTOPILOT INVERTER WARNING LIGHT
12 MAXIMUM ALLOWABLE SPEED INDICATOR
13 DIRECTION INDICATOR REPEATER WARNING LIGHT
14 DIRECTION INDICATOR REPEATER
15 COPILOT'S ATTITUDE INDICATOR
16 RADIO MAGNETIC INDICATOR (RMI) (7 PLACES)
17 RADIO MAGNETIC INDICATOR (RMI) (UHF/DF) (2 PLACES)
3178 ▶ LESS TCTO 572 PLUS TCTO 321
18 MAGNETIC COMPASS
19 VERTICAL VELOCITY INDICATOR (2 PLACES)
20 COMPASS CARD HOLDER
21 COPILOT'S TURN AND SLIP INDICATOR
22 WHEEL WELL OVERHEAT WARNING LIGHTS TCTO 558
23 CLOCK (2 PLACES)
24 DOOR WARNING LIGHT
25 EMERGENCY BRAKE LOW PRESSURE WARNING LIGHT
26 DIRECTION INDICATOR REPEATER EMERGENCY POWER SWITCH
27 ALTIMETER (2 PLACES)
28 SERVICE BRAKE LOW PRESSURE WARNING LIGHT
29 HYDRAULIC PRESSURE GAGE SERVICE BRAKE SYSTEM
30 OUTSIDE AIR TEMPERATURE GAGE
31 MAIN HYDRAULIC LOW PRESSURE WARNING LIGHT
32 HYDRAULIC PRESSURE GAGE MAIN HYDRAULIC SYSTEM
33 WING FLAP POSITION INDICATOR 22665 ▶ PLUS TCTO K504
34 MASTER FIRE WARNING LIGHT 2930 ▶
35 RPM LIMIT LIGHTS
36 LANDING GEAR POSITION INDICATOR
37 BOOM ENGAGED INDICATOR LIGHT
38 LANDING GEAR WARNING LIGHT
39 PILOT'S INSTRUMENT INVERTER EMERGENCY POWER SWITCH
40 PILOT'S TURN AND SLIP INDICATOR
41 RANGE INDICATOR TCTO K572

PILOTS' INSTRUMENT PANEL

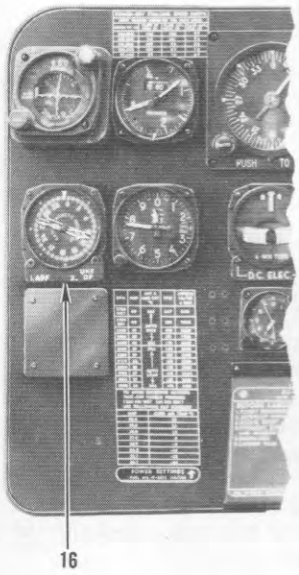
Figure 1-9 (Sheet 1 of 2)



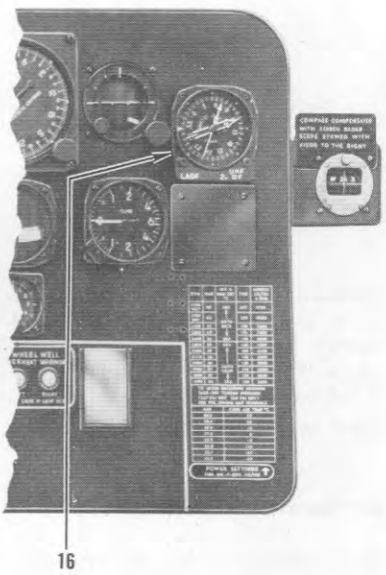
DETAIL II

DETAIL III

DETAIL I 17260 ▶ 3177 PLUS TCTO 572 LESS TCTO 321

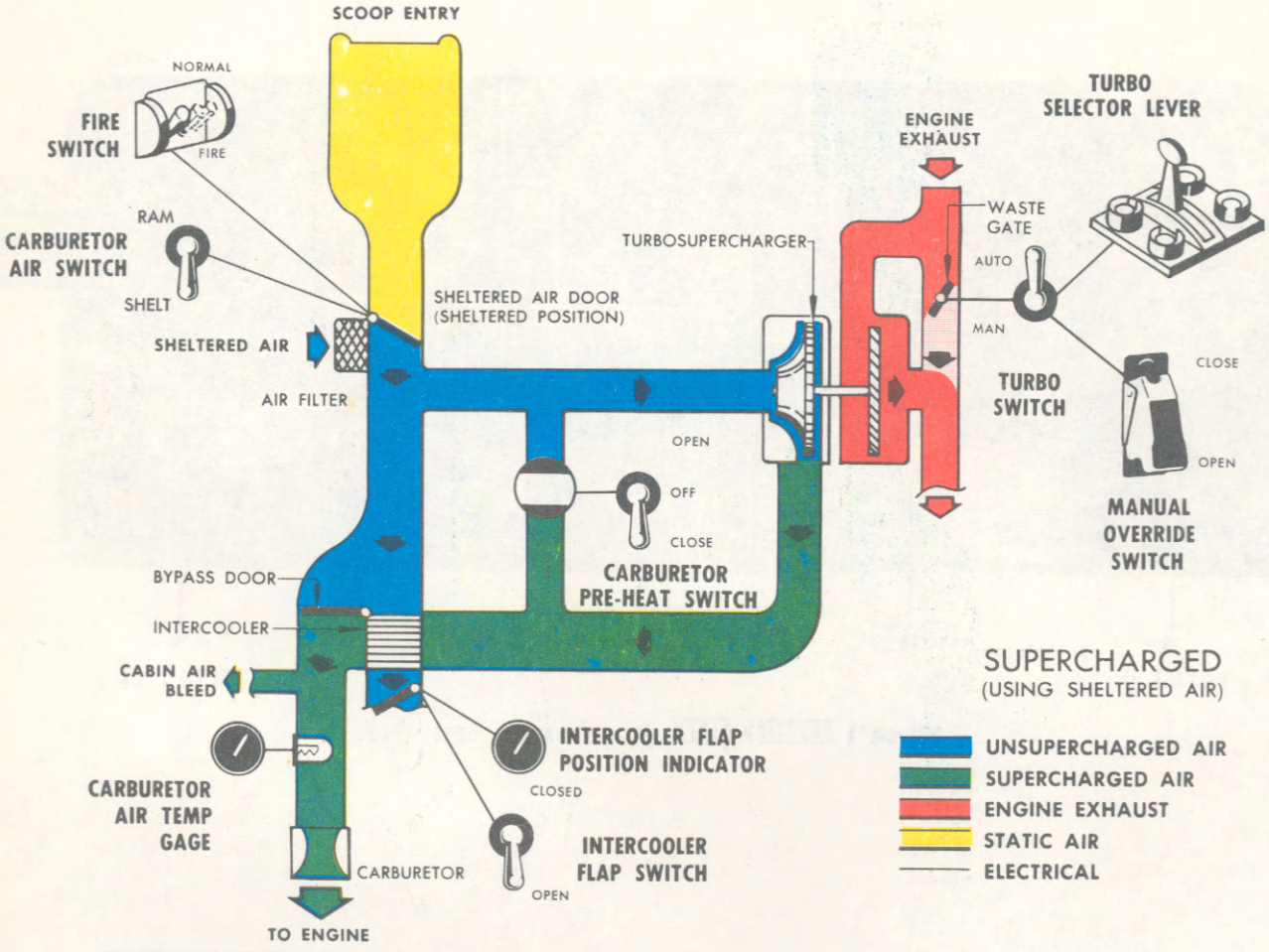


DETAIL II 3178 ▶ PLUS TCTO 572



DETAIL III 3178 ▶ PLUS TCTO 572

Figure 1-9 (Sheet 2 of 2)



INDUCTION SYSTEM

Figure 1-10 (Sheet 1 of 2)

carburetor air. When the valve is in the closed position, all of the supercharged air is directed through the induction system. In the open position, a portion of the supercharged air is bled off and allowed to recirculate through the compressor. This results in higher carburetor air temperature.

Carburetor Air Switches

Four switches (45, figure 1-22) on the engineer's instrument panel, control operation of the sheltered air doors. The switches have RAM--SHELT positions. Gang flappers permit actuation of all four switches to either position at the same time. In the RAM position air enters the air scoop and passes directly into the induction system. In the SHELT position, the shutoff door closes the air intake scoop and allows air to enter the induction system from the bottom of the air scoop. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel and the main circuit breaker panel (figure 1-34).

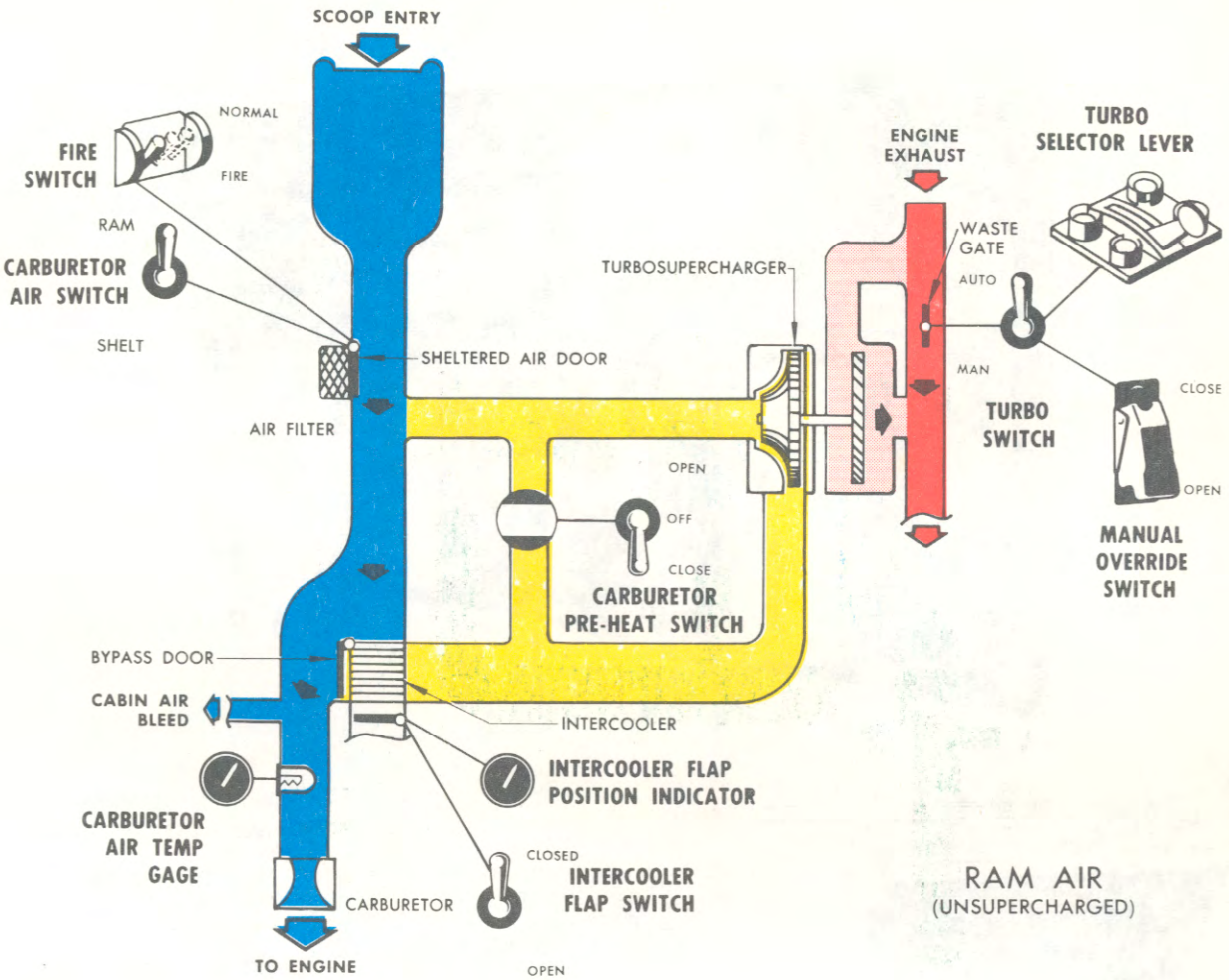


Figure 1-10 (Sheet 2 of 2)

Carburetor Preheat Switches

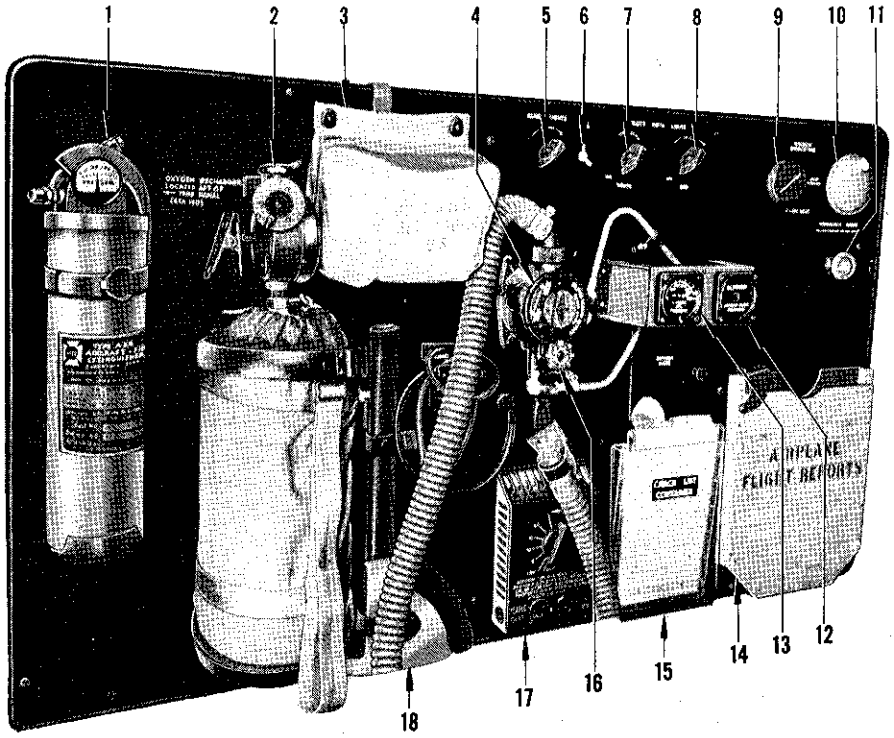
Four OPEN--OFF--CLOSE switches (42, figure 1-22) on the engineer's instrument panel, control the carburetor preheat valves. The switches are spring-loaded only from the OPEN position to the OFF position. Gang flappers permit actuation of all four switches to any position at the same time. The supercharger must be operating before preheat is possible. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

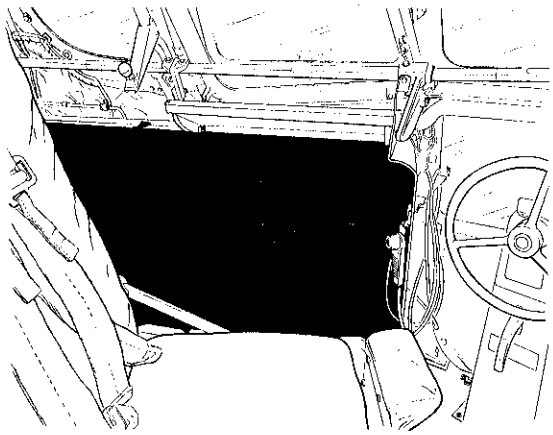
Carburetor Air Temperature Gages

A resistance bulb type carburetor air temperature gage (76, figure 1-22) for each engine induction system is located on the engineer's instrument panel. The gages indicate carburetor inlet air temperature in degrees Centigrade. The circuits are supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

Intercooler

An intercooler (figure 1-10) located downstream from the turbocompressor, is used to provide cooling of supercharged air to the carburetor. Intercooler operation is controlled electrically by positioning of the intercooler flap, which limits the amount of ram air passing through the intercooler. Four switches on the engineer's instrument panel control operation of the intercooler flaps.





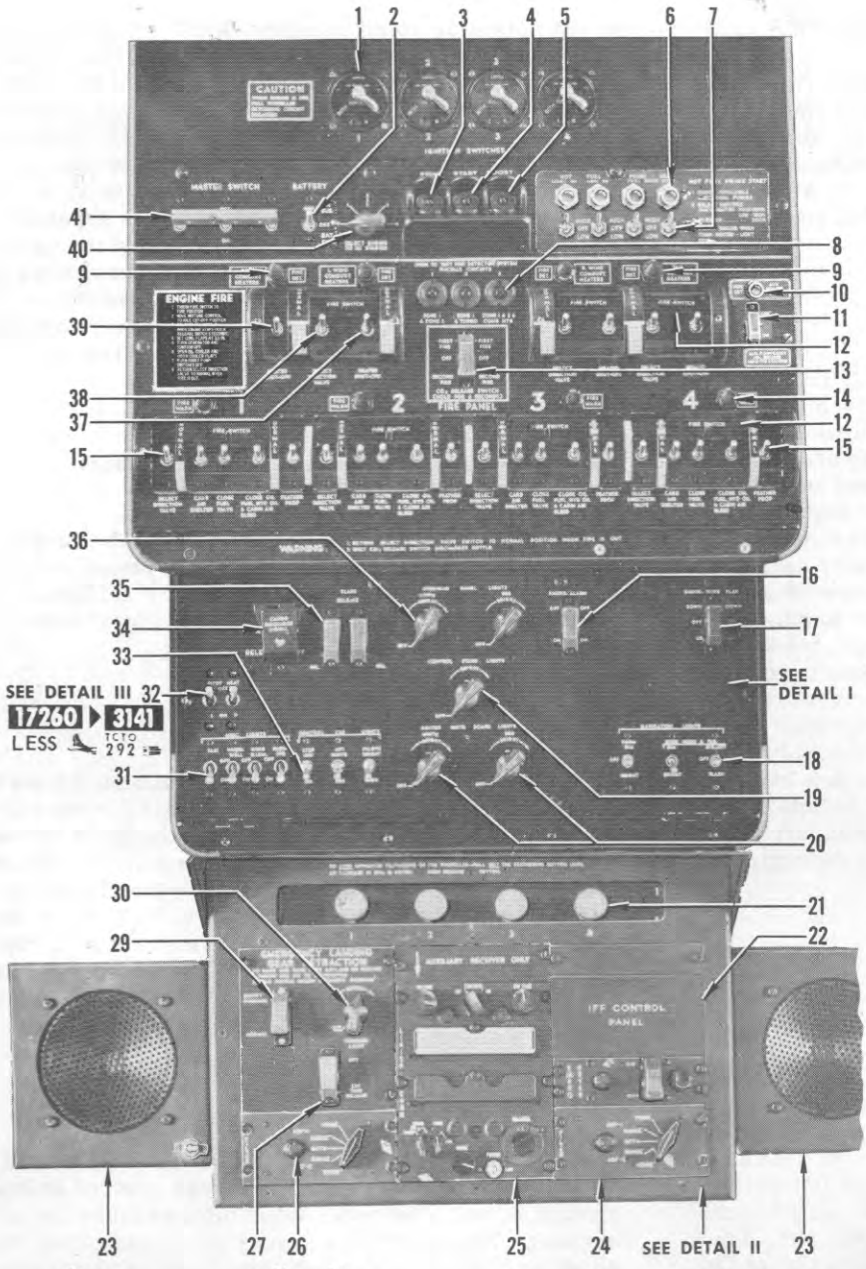
1 FIRE EXTINGUISHER
2 OXYGEN BOTTLE
3 FIRST AID KIT
4 OXYGEN FLOW REGULATOR
5 PILOT'S AUXILIARY PANEL LIGHT RHEOSTAT
6 DOME LIGHT SWITCH
7 PILOTS' INSTRUMENT PANEL LIGHT RHEOSTAT (LEFT SIDE WHITE)
8 PILOTS' INSTRUMENT PANEL LIGHT RHEOSTAT (LEFT SIDE RED)
9 WINDOW DEFROSTING CONTROL KNOB
10 ASH TRAY
11 WINDSHIELD WIPER SPEED CONTROL KNOB
12 OXYGEN FLOW INDICATOR
13 OXYGEN PRESSURE GAGE
14 AIRPLANE FLIGHT REPORT CONTAINER
15 PILOT'S CHECK LIST CONTAINER
16 OXYGEN REGULATOR EMERGENCY VALVE KNOB
17 PILOT'S HEATED SUIT CONTROL PANEL 17260 ▶ 2859
18 FIRE AXE

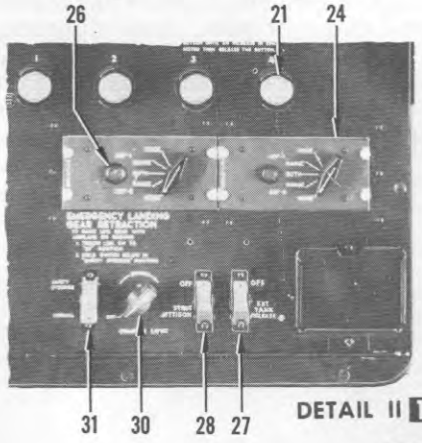
PILOT'S AUXILIARY PANEL

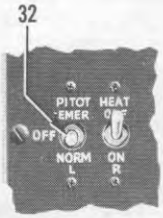
Figure 1-11

INTERCOOLER FLAP SWITCHES

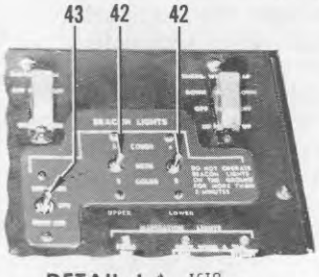
Four OPEN--OFF--CLOSED switches (43, figure 1-22), on the engineer's instrument panel, control the intercooler flaps. The switches are spring-loaded to return to the OFF position from both the OPEN and the CLOSED positions. Holding the switch in the OPEN position increases the amount of flap opening allowing cooling air to pass through the intercooler. Holding the switch in the CLOSED position decreases the amount of flap opening. Gang flappers permit actuation of all four switches to either position at the same time. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).







DETAIL III 3142 ▶ PLUS TCTO 292



DETAIL I TCTO 591

1 IGNITION SWITCHES
2 BATTERY SWITCH
3 PRIMER SWITCH
4 STARTER SWITCH
5 IGNITION BOOST SWITCH
6 HOT FUEL PRIME INDICATOR LIGHTS
7 HOT FUEL PRIME SWITCHES
8 FIRE DETECTOR SYSTEM TEST BUTTONS
9 COMBUSTION HEATER FIRE DETECTOR LIGHT (2 PLACES)
10 APU FIRE WARNING LIGHT
11 APU CO_2 RELEASE SWITCH
12 FIRE SWITCH GANG
13 CO_2 RELEASE SWITCH
14 FIRE WARNING LIGHTS
15 POWER PACKAGE FIRE SWITCHES (GANG BAR) (2 PLACES)
16 EMERGENCY ALARM SWITCH
17 EMERGENCY WING FLAP SWITCHES
18 NAVIGATION LIGHT SWITCHES
19 CONTROL STAND LIGHTS RHEOSTAT
20 PILOTS' INSTRUMENT PANEL LIGHTS RHEOSTAT
21 PROPELLER FEATHERING BUTTONS (2 PLACES)
22 IFF CONTROL PANEL 2901 ▶ 3339
23 LOUDSPEAKER (2 PLACES)
24 RADIO COMPASS FILTER PANELS (2 PLACES)
25 AUXILIARY LIAISON RECEIVER CONTROL PANEL 3279 ▶ PLUS TCTO KG206
26 RADIO COMPASS FILTER LIGHT (2 PLACES)
27 EXTERNAL FUEL TANKS RELEASE SWITCH (2 PLACES)
28 STRUT JETTISON 17260 ▶ 3195 LESS TCTO 330
29 LANDING GEAR EMERGENCY RETRACTION SWITCH WITH TCTO 299
30 COMPASS LIGHT RHEOSTAT (2 PLACES)
31 MISCELLANEOUS LIGHT SWITCHES (2 PLACES)
32 PITOT HEAT SWITCHES
33 CONTROL CABIN LIGHT SWITCHES
34 CARGO DISCHARGE SIGNAL SWITCH
35 FLARE RELEASE SWITCHES
36 OVERHEAD PANEL LIGHT RHEOSTATS
37 ANTI-ICING HEATER SHUTOFF SWITCH
38 ANTI-ICING HEATER SELECT DIRECTION VALVE SWITCH
39 BODY HEATER FIRE SWITCH
40 ENGINE STARTING SELECTOR SWITCH
41 MASTER SWITCH (DC POWER)
42 ANTI-COLLISION LIGHTS COLOR SELECTOR SWITCHES TCTO 591
43 ANTI-COLLISION LIGHTS SWITCH TCTO 591

OVERHEAD PANEL

Figure 1-12

INTERCOOLER FLAP POSITION INDICATORS

Four intercooler flap position indicators (74, figure 1-22) on the engineer's instrument panel show intercooler flap positions in inches of opening. The reading is taken from the flap screw driving mechanism. The indicator circuits are supplied with 26 volt AC through the four engine instrument fuses on the AC power panel (figure 1-34).

TURBOSUPERCHARGER

The turbosupercharger (figure 1-10) is an exhaust-driven centrifugal air compressor which is used to maintain carburetor inlet pressure at altitude by compressing intake air above the existing atmospheric pressure. This results in greater power output, fuel economy and better performance of the engine during high altitude cruising operation. The output of the compressor is increased or decreased by closing or opening the wastegate. Closing the wastegate directs more exhaust gases against the turbine which causes the compressor to rotate at higher speeds, resulting in a higher manifold pressure. The wastegate is controlled by an automatic control system, or a manual control system. A small percentage of the compressor output is used to pressurize the cabin. A solenoid brake is incorporated in the wastegate motor which locks the motor when it is not receiving power. An integral oil pump provides lubrication to the turbosupercharger from a separate oil tank mounted inside the engine oil tank.

Turbosupercharger Automatic Control System

The automatic control system regulates the wastegate position to maintain approximately constant carburetor inlet pressure, within the limits set by the governor and, on airplanes 31796 ▶ plus ECP 338 ◀, the overboost limiting system. It is composed of an independent wastegate control circuit for each engine, all connected to a single selector control unit. The turbo control unit (figure 1-13) consists of the turbo selector lever (30, figure 1-16) and the turbo calibrating knobs (31, figure 1-16) for each of the wastegate control circuits. Each wastegate control circuit has the following units electrically connected in a bridge circuit: the main turbo selector lever potentiometer, a calibrating knob potentiometer, a potentiometer for the pressure control which senses carburetor inlet pressure, a potentiometer for the governor which limits the maximum turbine rpm, and a balance potentiometer connected to the shaft of the wastegate motor to stabilize the system. An amplifier and the wastegate motor complete the wastegate control circuit. A change in the position of any of the potentiometers unbalances the bridge circuit. This unbalance is transmitted to the amplifier which relays a signal to the wastegate motor until the bridge circuit is re-balanced. The action of the control system is nearly instantaneous. On airplanes 22678 ▶ plus those incorporating ECP 320 ◀, the wastegate will automatically open when there is a discontinuity in the amplifier circuit. Each control circuit is separately fused with a 2 amp slow blow fuse located in the turbosupercharger main junction box near the amplifiers in the lower nose compartment. The automatic control system is supplied with 115 volt AC power through either the SUPCHG CONTR circuit breaker or fuse on the AC power panel (figure 1-34).

Turbosupercharger Manual Control System

A manual control system is provided in case of automatic system malfunction. A separate power source, transformer and control switches (figure 1-13) permit the manual control system to transmit power directly to the wastegate motor.

Turbo Selector (TBS) Lever

As the TBS lever (30, figure 1-16) is advanced from 0 toward 10, the wastegate control bridge circuits are unbalanced so that each exhaust wastegate is moved toward the closed position. When the lever is moved toward the zero position the bridge circuits are unbalanced so that the wastegates are driven toward the open position. The output of each compressor is regulated by the automatic control system, once the initial carburetor inlet pressure has been established by positioning the TBS lever.

Turbo Calibrating Knobs

Each of the four calibrating knobs (31, figure 1-16) permits adjustment of its wastegate control bridge circuit to set a uniform manifold pressure for all engines. They provide a means of compensating for small variations in the individual engine and turbosupercharger control characteristics. Each calibrating knob is shielded by a barrier to prevent accidental repositioning. Each barrier has an index mark. Each calibration knob is protected by a 1/16 amp fuse located in the junction box in the floor under the engineer's seat.

Turbo Switches

The turbo switches (28, figure 1-16) have AUTO--MAN positions. When these switches are placed in the AUTO

position, the turbosuperchargers are controlled by the automatic system. When placed in the MAN position the turbosupercharger wastegate is controlled by means of the manual override switches.

Manual Override Switches

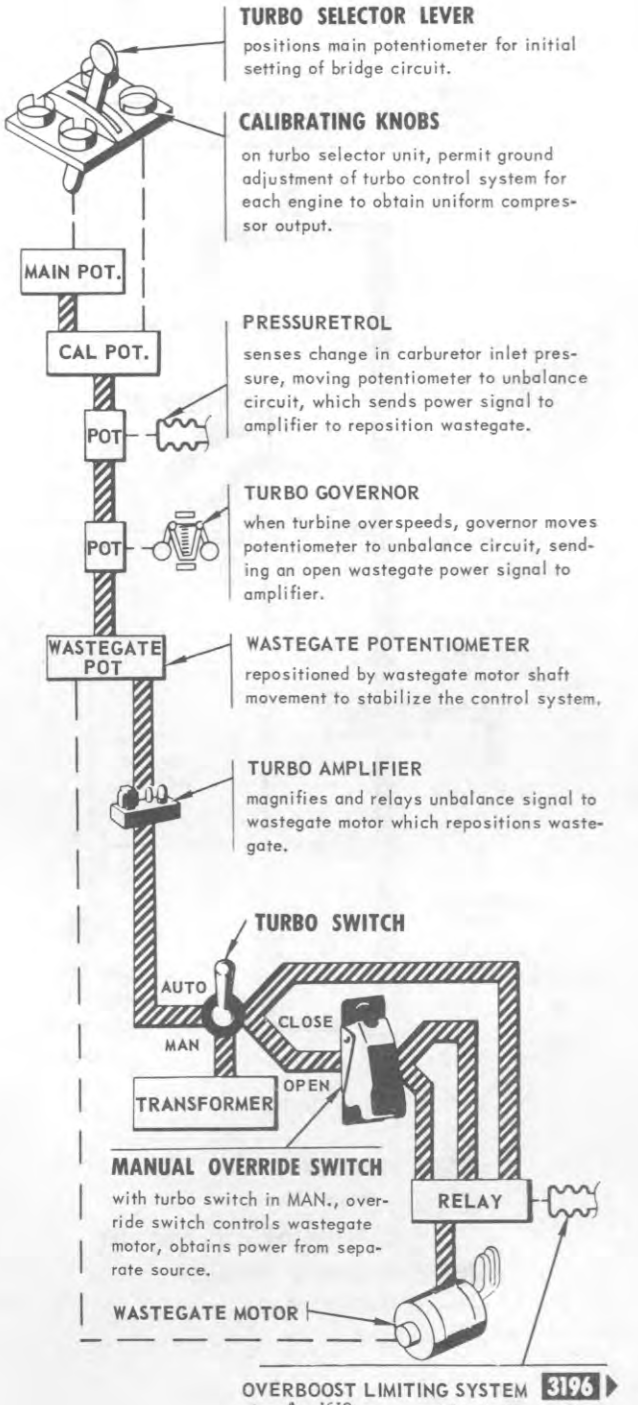
The manual override switches (27, figure 1-16) have CLOSE--OFF--OPEN positions. When the turbo switches are at MAN, nudging the override switches to the CLOSE position causes the wastegate to close which results in a rise in manifold pressure. When the turbo switches are on MAN, nudging the override switches to the OPEN position causes the wastegate to open which results in a drop in manifold pressure. The manual override switches are spring-loaded from the OPEN and CLOSE positions to the OFF position, and may be guarded to the OPEN position. The manual control system is supplied with 115 volt AC power through the TURBO BOOST circuit breaker or fuse on the AC power panel (figure 1-34).

CAUTION

The manual override switches should be operated with caution because of the fast action of the wastegate motor and the lack of governor overspeed control in the manual system. See TURBOSUPERCHARGER SYSTEM OPERATION, MANUAL CONTROL in Section VII. Do not energize all four wastegate motors with the manual override switches for more than 5 minutes continuous operation to avoid overheating the transformer.

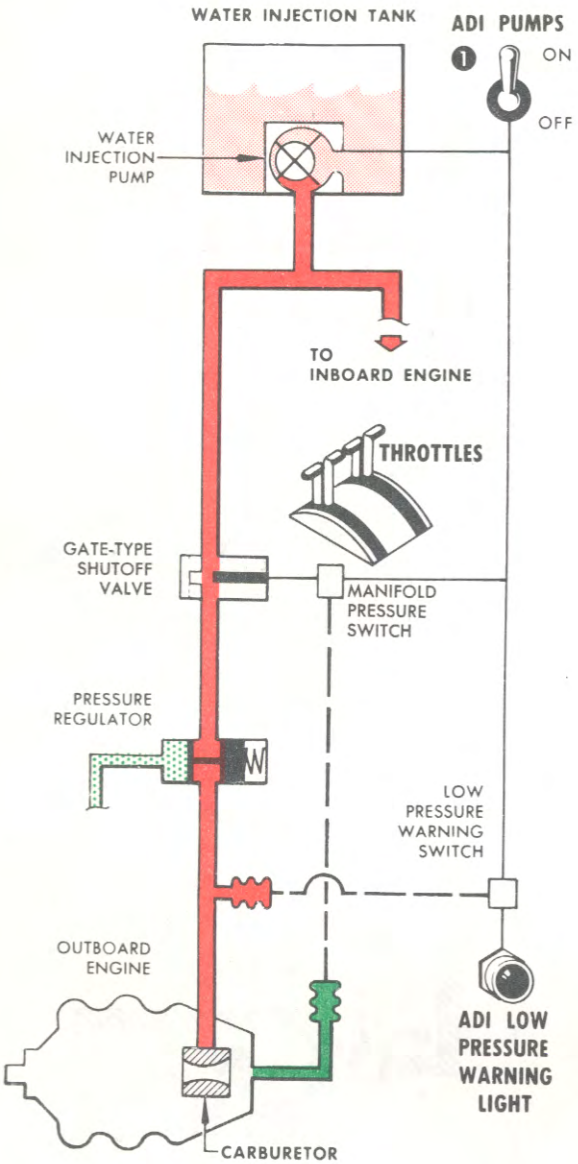
Turbosupercharger Overboost Limiting System 3196 ▶ plus TCTO 338

The overboost limiting system is a safety device to protect the powerplant from the effects of overboost due to an accidental wastegate closure by overriding either the automatic control system or the manual control system. The system consists of an exhaust back pressure sensing switch and a relay (figure 1-13) for each engine. The exhaust back pressure sensing switch, sensing an exhaust back pressure in excess of the maximum operating pressure will cause the relay to connect the wastegate motor directly to the 230 volt open signal of the manual override system transformer. The wastegate will be driven open until the maximum operating pressure is reached. The exhaust back pressure sensing switch will then cause the relay to return the turbosupercharger to its previous control. The circuit breakers for the exhaust back pressure sensing switch and the relay are on the overhead circuit breaker panel (figure 1-34). If the circuit breaker is tripped the wastegate will be driven to the full open position. The wastegate open power source is supplied with 115 volt AC through the TURBO BOOST circuit breaker or fuses on the AC power panel (figure 1-34).



TURBOSUPERCHARGER CONTROL SYSTEM

Figure 1-13



❶ This switch operates ADI system for all engines, one engine shown.

ADI PUMPS SWITCH ON, MANIFOLD PRESSURE ABOVE 45 INCHES

WATER INJECTION SYSTEM

Figure 1-14

WATER INJECTION (ADI) SYSTEM

The water injection system (figure 1-14) is used to increase the power output of the engine. The system consists of two 30 US gallon water injection fluid tanks, two water injection pumps, a water injection regulator unit with a gate type shutoff valve on the front wing spar for each engine, and a manifold pressure switch on each engine. With the water injection pump operating, the system is automatically controlled by the regulator unit above 45 inches MP. The manifold pressure switch automatically opens the shutoff valve at 45 inches MP, allowing water injection fluid to flow to the pressure regulator, which controls the flow of fluid to the carburetor. The shutoff valve closes automatically when manifold pressure drops below 41 inches MP. Each water injection tank contains a water-alcohol mixture, given in figure 1-47, and supplies the two engines on that side of the airplane. Duration of the supply at 3500 brake horsepower per engine is approximately 10 minutes.

Water Injection (ADI) Pump Switch

An ADI pump, ON--OFF switch (10, figure 1-16) on the forward end of the control stand energizes the water injection pump circuit. When the water injection pump switch is ON, both pumps supply pressure to a water shutoff valve. Operation is then initiated by manifold pressure. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel and the main circuit breaker panel (figure 1-34).

Water Injection (ADI) Lights

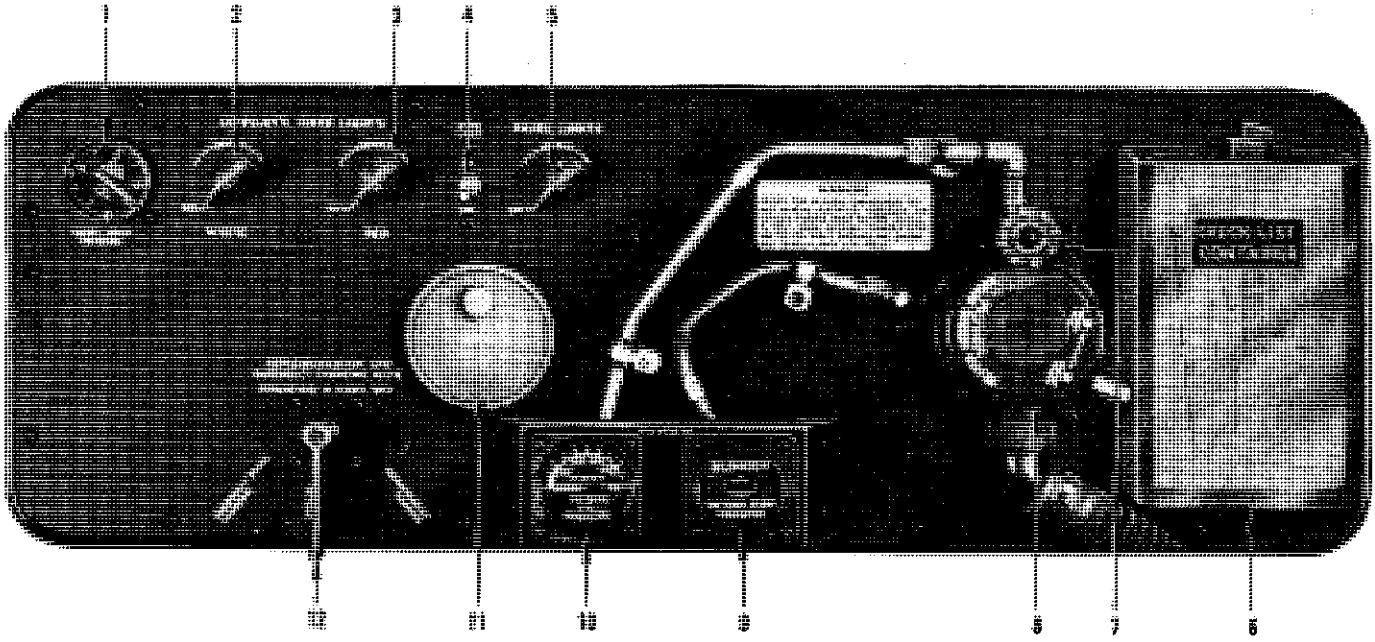
Four amber water injection pressure warning lights (5, figure 1-16) are on the forward end of the control stand. Water injection fluid low pressure at the regulator is indicated if a light remains illuminated at power settings above 45 inches manifold pressure, with the water injection pump switch on. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

ENGINE COOLING SYSTEM

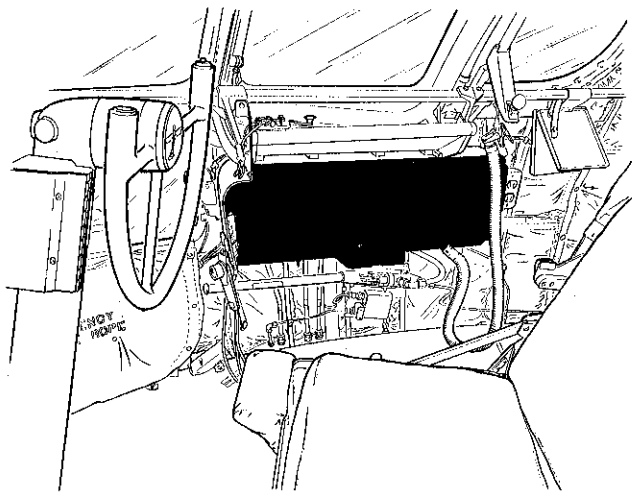
The flow of cooling air for each engine is controlled by two ground-adjustable and seven electrically operated, flight adjustable, cowl flaps. The cowl flaps are actuated by seven jackscrews driven by a single electric motor through a flexible drive shaft system.

Cowl Flaps Switches

Four cowl flap switches (35, figure 1-22) one for each engine, are on the engineer's instrument panel. These



1 EMERGENCY BRAKE SYSTEM PRESSURE GAGE
2 PILOTS' INSTRUMENT PANEL LIGHT RHEOSTAT (RIGHT SIDE WHITE)
3 PILOTS' INSTRUMENT PANEL LIGHT RHEOSTAT (RIGHT SIDE RED)
4 DOME LIGHT SWITCH
5 COPILOT'S AUXILIARY PANEL LIGHT RHEOSTAT
6 COPILOT'S CHECK LIST CONTAINER
7 OXYGEN REGULATOR EMERGENCY VALVE KNOB
8 OXYGEN FLOW REGULATOR
9 OXYGEN FLOW INDICATOR
10 OXYGEN PRESSURE GAGE
11 ASH TRAY
12 DEPRESSURIZATION AND EMERGENCY CHARGING VALVE HANDLE



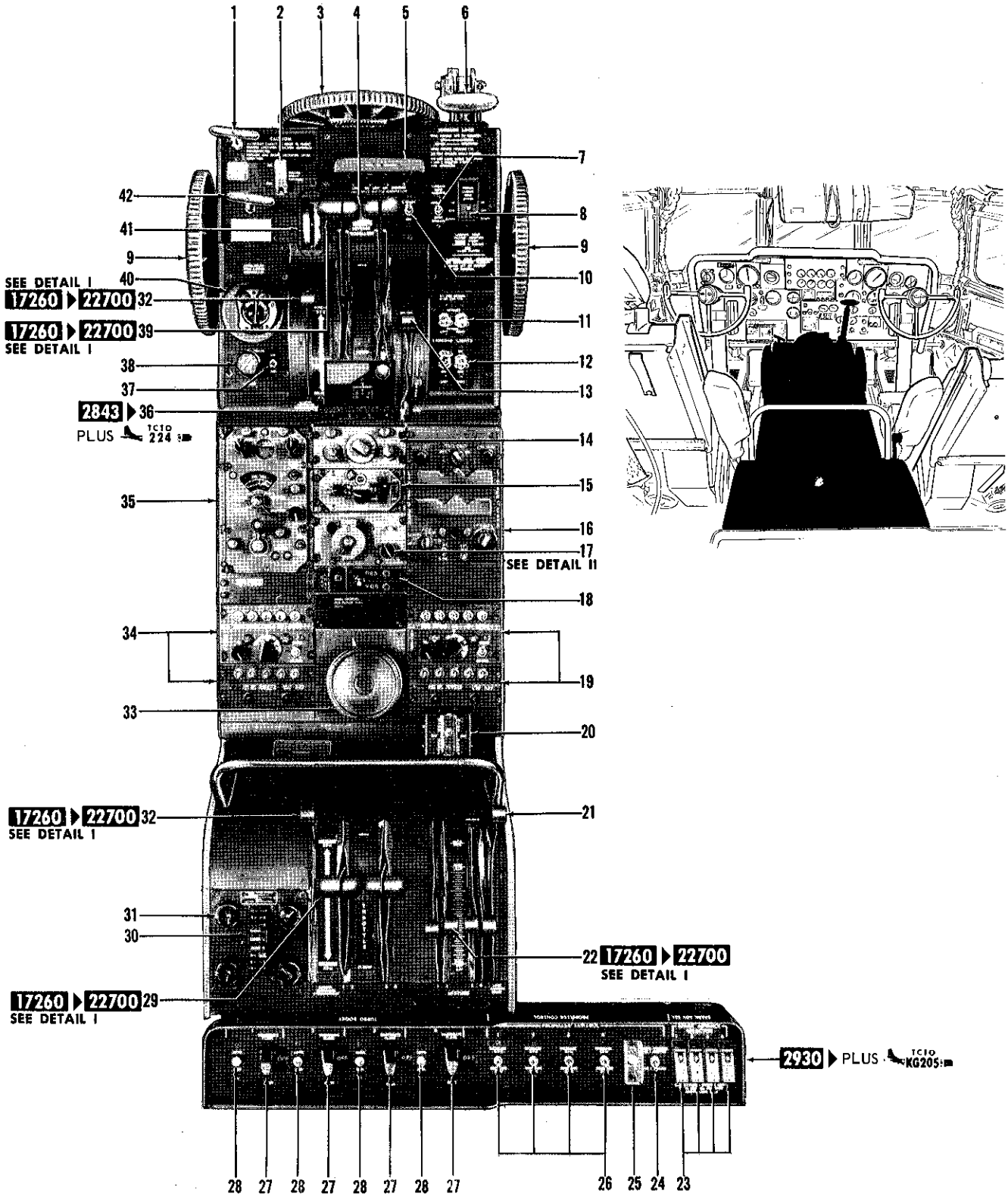
COPILOT'S AUXILIARY PANEL

Figure 1-15

switches electrically control the opening and closing of the cowl flaps. The switches have OPEN--OFF--CLOSE positions and are spring-loaded from the OPEN and CLOSE positions to the OFF position. Gang flappers permit simultaneous actuation of all four switches to either position. The cowl flaps will remain stationary when the switch is released to OFF. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel and the main circuit breaker panel (figure 1-34).

Cowl Flap Position Indicators

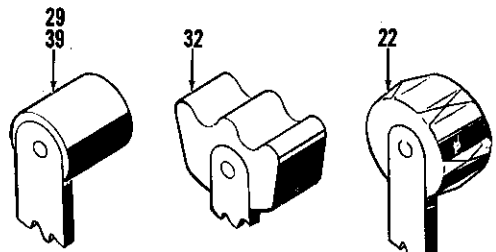
The position of the cowl flaps are indicated in inches of opening by four cowl flap position indicators (78, figure 1-22) on the engineer's instrument panel. The reading is taken from the flap screw driving mechanism. The indicator circuits are supplied with 26 volt AC through the four engine instrument fuses on the AC power panel (figure 1-34).



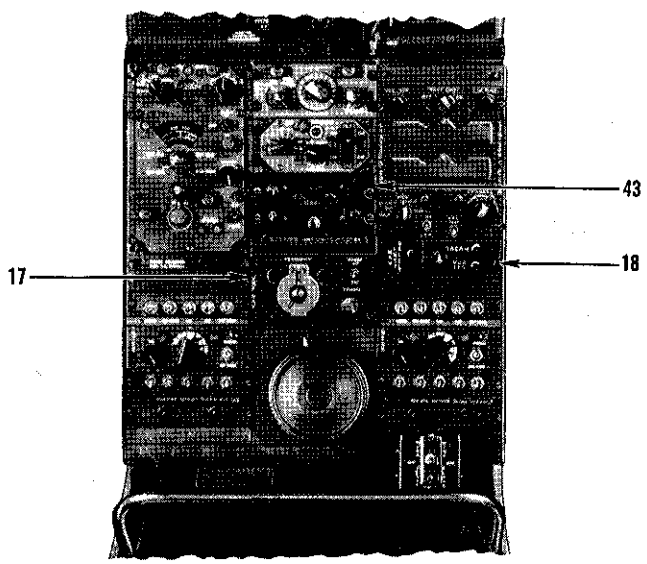
CONTROL STAND

Figure 1-16 (Sheet 1 of 2)

1 AUTOPILOT EMERGENCY DISCONNECT HANDLE
2 RUDDER BOOST PRESSURE SWITCH
3 AILERON TRIM CONTROL WHEEL
4 PROPELLER REVERSE WARNING FLAG
5 WATER INJECTION (ADI) LIGHTS
6 SURFACE LOCK HANDLE
7 LANDING GEAR WARNING HORN RELEASE SWITCH
8 LANDING GEAR SWITCH
9 ELEVATOR TRIM CONTROL WHEEL (2 PLACES)
10 WATER INJECTION (ADI) PUMP SWITCH
11 LANDING LIGHT RETRACTION SWITCHES
12 LANDING LIGHT SWITCHES
13 THROTTLE LOCK LEVER
14 UHF RADIO CONTROL PANEL
15 VHF RADIO CONTROL PANEL
16 LIAISON RADIO CONTROL PANEL
17 VHF NAVIGATION RADIO CONTROL PANEL (2 PLACES)
18 NAVIGATION INSTRUMENT SELECTOR PANEL (2 PLACES)
19 COPILOT'S INTERPHONE CONTROL PANELS
20 WING FLAP SWITCH
21 MIXTURE LOCK LEVER
22 MIXTURE CONTROLS (2 PLACES)
23 SPARK ADVANCE SELECTOR SWITCHES
24 PROPELLER AUTO CONTROL SWITCH
25 PROPELLER RESYNCHRONIZER SWITCH
26 PROPELLER GOVERNOR SELECTOR SWITCHES
27 TURBO MANUAL OVERRIDE SWITCHES (4 PLACES)
28 TURBO SWITCHES (4 PLACES)
29 ENGINEER'S THROTTLES (2 PLACES)
30 TURBO SELECTOR LEVER
31 TURBO CALIBRATING KNOBS
32 MASTER PROPELLER SYNCHRONIZER LEVER (3 PLACES)
33 RUDDER TRIM CONTROL WHEEL
34 PILOT'S INTERPHONE CONTROL PANELS
35 RADIO COMPASS CONTROL PANEL
36 PROPELLER REVERSE LOCK PLATE
37 AUTOPILOT MASTER SWITCH
38 AUTOPILOT CLUTCH SWITCH
39 PILOTS' THROTTLES (2 PLACES)
40 AUTOPILOT TURN AND PITCH CONTROLLER
41 ELEVATOR TRIM TAB INDICATOR
42 EMERGENCY CABIN PRESSURE RELEASE HANDLE
43 UHF NAVIGATION RADIO CONTROL PANEL. TCTO 572



DETAIL I 22701



DETAIL II TCTO 572

Figure 1-16 (Sheet 2 of 2)

FUEL ENRICHMENT SYSTEM

TCTO 595

The fuel enrichment system consists of a carburetor bypass line, metering orifice, solenoid actuated valve and a control switch for each engine to provide richer mixtures to give additional engine cooling during hot weather operations. The system is to be used for meto power climb and during refueling flight to improve airplane performance. This increased overall performance is attained by reduced cowl flap settings at the cost of increased fuel consumption. This increased fuel consumption must be considered in mission planning for the period the system is to be used.

Fuel Enrichment Switches

TCTO 595

Four ON--OFF switches (94, figure 1-22) on a separate panel attached to the left edge of the flight engineer's instrument panel control the fuel enrichment system. When placed in the ON position the solenoid actuated valves will be energized to increase fuel flow approximately 200 pounds per hour. Control power is 28 volts DC through the oil dilution circuit breaker on the overhead circuit breaker panel (figure 1-34).

IGNITION SYSTEM

Four magnetos provide low tension ignition for each engine. The magnetos supply low voltage current through the primary ignition leads to 56 transformer coils which are mounted near the spark plugs. This low voltage is converted into higher voltage and is fed through short leads to the spark plugs. Magnetos are designated L1, L2, R1 and R2, and each magneto furnishes ignition to the left or right spark plug in two rows of cylinders. For example: Rows B and D by the L1 magneto.

NOTE

The right spark plugs are on the intake side of the cylinders and the left spark plugs are on the exhaust side of the cylinders. Cylinder rows are designated A, B, C and D.

A solenoid operated spark advance system controlled by a switch on the engineer's panel (28 volts) permits spark to be advanced from normal spark to spark advance. The normal setting is used during normal engine operation while the spark advance setting provides more efficient operation for certain cruise control configurations during manual leaning. Two starter vibrators are incorporated in each engine ignition system circuit to boost magneto input at low starting rpm until magneto output is sufficient to operate the engine.

Ignition Switches

Four rotary-type engine ignition switches (1, figure 1-12) are on the overhead panel. Each switch has BOTH--LEFT--RIGHT--OFF positions for the right and left hand magneto circuits.

Ignition Boost Switch

Ignition boost is selected for each engine individually by an engine starting selector switch on the overhead panel. See ENGINE STARTING SELECTOR SWITCH in this Section. Once the engine has been selected the starting vibrators are energized by the boost push button switch (5, figure 1-12) on the starter control base, located on the overhead panel. Depressing the switch provides a hotter spark for starting. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

Spark Advance Selector Switches

A spark advance selector switch (23, figure 1-16) for each engine is provided on the aft end of the control stand. The switches have two positions, NORMAL and SPARK ADVANCE. Each switch is individually guarded to the NORMAL for normal operation. During long range cruise operations the switches can be positioned to SPARK ADVANCE to improve range. When positioned to SPARK ADVANCE the spark timing is advanced. The circuit is supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

NOTE

The SPARK ADVANCE position is to be used only as outlined in SPARK ADVANCE CRUISE CONTROL PROCEDURE in Section VII.

PRIMING SYSTEM

Engine priming is electrically controlled by a push button switch (3, figure 1-12) adjacent to the starter switch. The starter selector switch controls engine selection. Each engine is primed through a solenoid valve located in the fuel line between the heater tank and the carburetor. This valve when actuated allows fuel to be injected into the engine blower housing for normal or cold weather starts. Fuel is supplied to the primer solenoid by the fuel booster pumps. The primer circuit is supplied with 28 volt DC through a circuit breaker on the overhead panel (figure 1-34).

Hot Fuel Prime System

The airplane is provided with a hot fuel prime system which reduces engine preheat time during cold weather. The system consists of a hot fuel prime tank mounted inside each engine nacelle, and electrical controls in the forward compartment for operating the system. Two heater elements within each hot fuel prime tank, when energized, raise the temperature of the fuel to 220°F (105°C) within three minutes. When only one heater element is energized, the fuel heats to 220°F (105°C) within six minutes.

HOT FUEL PRIME SWITCHES

Four hot fuel prime toggle switches (7, figure 1-12), one for each engine, are provided on the overhead panel. Each switch has three positions, HIGH--OFF--LOW. When positioned to HIGH, both heater elements are energized using 300 amperes. When the switch is positioned to LOW, only one element will be energized using 150 amperes. When the required temperature is reached, the switch should be placed in the OFF position. If this is not done, a heater control relay on the engine nacelle solenoid panel automatically maintains the temperature until the switch has been positioned to OFF. The circuit is provided with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

HOT FUEL PRIME INDICATOR LIGHTS

Four press-to-test lights (6, figure 1-12), are located directly above the four hot fuel prime switches on the overhead panel. Each light will illuminate when it's respective hot fuel prime switch is positioned to HIGH or LOW. The light will automatically go out when the required fuel temperature is reached. The lights are supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

STARTER SYSTEM

Each engine is started by a direct-cranking electrical starter mounted on the engine accessory drive case. The starter is controlled by a starter switch and an engine starting selector switch on the overhead panel.

Engine Starting Selector Switch

A rotary type OFF--1--2--3--4 switch (40, figure 1-12) on the overhead panel, is used to select the engine to be started. When the switch is in the 1--2--3--4 position, starter, primer, and ignition boost circuits are connected to the selected engine. When the switch is in the OFF position, the starter, primer, and ignition boost circuits are disconnected from all engines.

Starter Switch

Direct cranking starters are controlled by a push-button switch (4, figure 1-12) on the overhead panel. The starter, prime and boost switches are grouped on a raised and guarded base. Each switch controls all four engines, through a rotary engine starting selector switch, adjacent to the raised base. The starter control circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

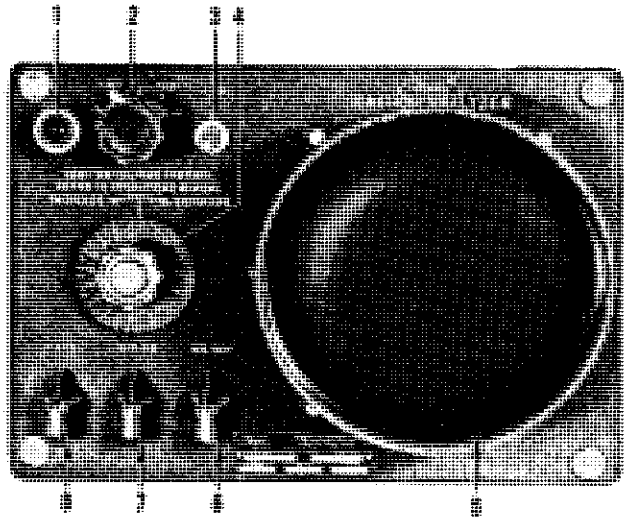
ENGINE INDICATORS

Ignition Analyzer System

The ignition analyzer system provides a means of detection, identification, and location of engine ignition troubles during both flight and ground operation. This analysis of ignition performance is made by interpreting and comparing the magneto voltage wave patterns of a malfunction system with those produced by a properly operating system, each specific trouble producing a characteristic pattern. The system consists essentially of an ignition analyzer, a switch panel assembly, four pick-up or breaker assemblies, a relay and resistor box assembly, four filter units, and connecting leads. The ignition analyzer is located at the left of the engineer's table and directly behind the pilot's seat. The ignition analyzer switch panel is mounted above the ignition analyzer on the engineer's auxiliary panel (3, figure 1-23). The analyzer system is joined to the magneto primary circuits at the ignition switch allowing the varying magneto primary and reflected secondary voltages to be registered as patterns on the analyzer viewing screen. These patterns will form a pattern sequence from left to right across the screen, one pattern for each cylinder fired by the selected magneto. Adjustment of horizontal and vertical position controls on the analyzer determines the position of the wave pattern on the screen; and horizontal and vertical gain controls on the analyzer enlarge the pattern horizontally and vertically for detailed study of the patterns.

POWER SUPPLY

The regulated AC power supply circuit for the ignition analyzer is protected by a fuse or circuit breaker



1 ANALYZER POWER INDICATOR LIGHT
2 ANALYZER MAGNETO SELECTOR SWITCH
3 ANALYZER POWER SWITCH
4 VOLTAGE CONTROL SWITCH
5 ANALYZER SCREEN
6 HORIZONTAL GAIN CONTROL SWITCH
7 VERTICAL POSITION SWITCH
8 HORIZONTAL POSITION SWITCH

IGNITION ANALYZER

Figure 1-17

(figure 1-34) on the AC power panel. The DC power supply circuit is protected by a circuit breaker on the overhead circuit breaker panel (figure 1-34). A system fuse on the analyzer switch panel (3, figure 1-18) also protects the AC circuit to the analyzer system.

SYSTEM POWER SWITCH

This switch (5, figure 1-18), located on the analyzer switch panel delivers power to the ignition analyzer system. The switch has two positions, ON and OFF. In the ON position the power circuit to the ignition analyzer is closed. In the OFF position this circuit is open.

ANALYZER POWER SWITCH

An ON--OFF switch (3, figure 1-17), on the ignition analyzer, controls power from the analyzer switch panel to circuits within the analyzer housing. In the ON position, this circuit is closed. In the OFF position, it is open. Both the system power switch and the analyzer power switch must be in the ON position to energize the analyzer circuits.

ANALYZER MAGNETO SELECTOR SWITCH

This switch (2, figure 1-17) located on the ignition analyzer, is installed to provide magneto selection when the ignition analyzer is used as a portable unit. The switch in this airborne installation operates in conjunction with the engine and magneto selector switch on the analyzer switch panel and is always positioned to LEFT 1 when the analyzer is being used.

HORIZONTAL POSITION SWITCH

The wave form picture on the analyzer screen is shifted to the left or right by this rotary type switch (8, figure 1-17) on the ignition analyzer.

VERTICAL POSITION SWITCH

The wave form picture on the analyzer is shifted up or down by this rotary type switch (7, figure 1-17) on the ignition analyzer.

HORIZONTAL GAIN CONTROL SWITCH

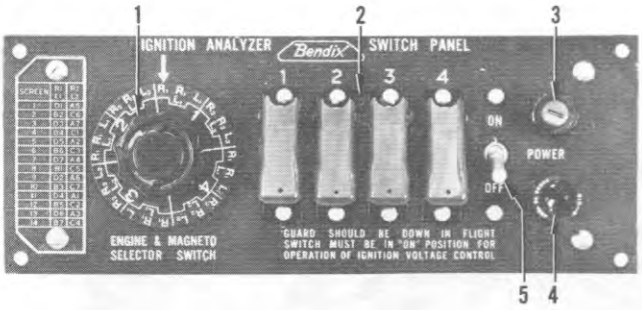
This rotary type switch (6, figure 1-17), located on the ignition analyzer, enlarges the wave form picture in a horizontal direction, thereby spreading out the wave form to permit more detailed observation.

ANALYZER INTERNAL CONTROL PANEL

The internal control panel (figure 1-19), is located inside of the ignition analyzer. On most installations it is accessible through a hinged door in the top of the ignition analyzer. On other installations it is necessary to remove the ignition analyzer housing to gain access to the panel. The following controls are on the panel: a focus knob, bias knob, sync knob, intensity knob, vert. gain knob and a high tension-low tension switch. The intensity knob is used to adjust the intensity of the pattern to the degree of brightness desired. The focus knob is used to adjust the pattern to a sharp, distinct outline. Both the intensity knob and the focus knob are coordinated to give the clearest wave-form image. The bias knob is used to filter out stray signals. The vert. gain knob enlarges the pattern in a vertical direction. The sync knob does not function in this airplane installation. The high tension-low tension switch should be left in the HIGH TENSION position as better operation will result.

NOTE

Adjustment of the above internal controls is to be made only by qualified electronics personnel if adjustment is required.



1 ENGINE AND MAGNETO SELECTOR SWITCH
2 RELAY-RESISTOR SWITCHES
3 SYSTEM FUSE
4 SYSTEM POWER INDICATOR LIGHT
5 SYSTEM POWER SWITCH

IGNITION ANALYZER SWITCH PANEL

Figure 1-18

ENGINE AND MAGNETO SELCTOR SWITCH

This switch (1, figure 1-18), on the analyzer switch panel, provides a means of selecting the engine and each individual ignition circuit to be tested by the ignition analyzer. The selector is divided into four numbered quadrants, one quadrant for each engine. Each quadrant is divided into two sectors. Each sector has three switch positions, one position for the magneto firing the left side circuit of two rows or fourteen cylinders, one position for the magneto firing the right side circuit of the same row of cylinders and one position for both of these magnetos. This makes a total of six positions for each engine and a total of twenty-four positions on the selector switch.

RELAY-RESISTOR SWITCHES

Four guarded switches (2, figure 1-18) are located on the ignition analyzer switch panel. In the OFF position these numbered switches connect resistors in the circuits which protect the primary magneto circuits of the four correspondingly numbered engines. In the ON or unguarded position these switches energize relays which by-pass the resistors, thereby allowing the use of the ignition voltage control of the ignition analyzer.

VOLTAGE CONTROL SWITCH

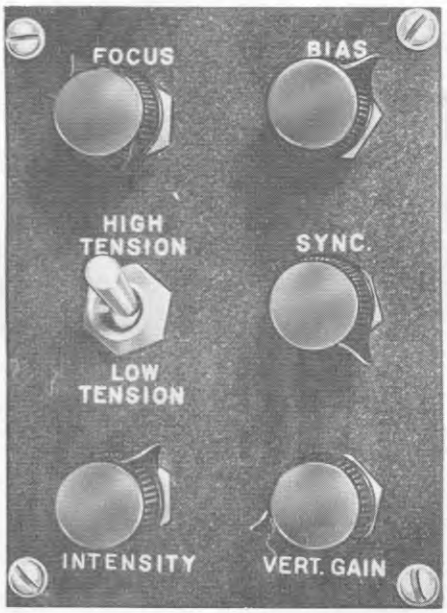
This switch (4, figure 1-17), on the ignition analyzer, enables the flight engineer on a ground check to foresee ignition system difficulties and correct the condition before failure actually occurs. The most common of these failures would be fouling and incorrect gaps of spark plugs. The voltage control is a rotary switch marked with an OFF position with numbered positions from 0 to 50. It is engaged by pulling the knob out and rotating. When released it becomes inoperative, but will remain at the same dial number position. When this switch is engaged a variable shunt resistance is connected across the primary of the magneto being tested. As the switch is moved in the direction of decrease, the magneto load is increased thus reducing voltage at the spark plug. The position of the switch when misfiring or complete stoppage of firing occurs is used as an indication of the condition of the ignition system.

ANALYZER SCREEN

This screen (5, figure 1-17), is a modified cathode-ray oscilloscope which shows the varying magneto primary and reflected secondary voltages as wave form patterns. Ignition performance is analyzed by interpreting and comparing the characteristic magneto voltage wave patterns produced by a malfunctioning system with the wave forms produced by a properly operating system. The operation of this screen is regulated by controls located on the ignition analyzer control panel, the internal control panel, and the ignition analyzer.

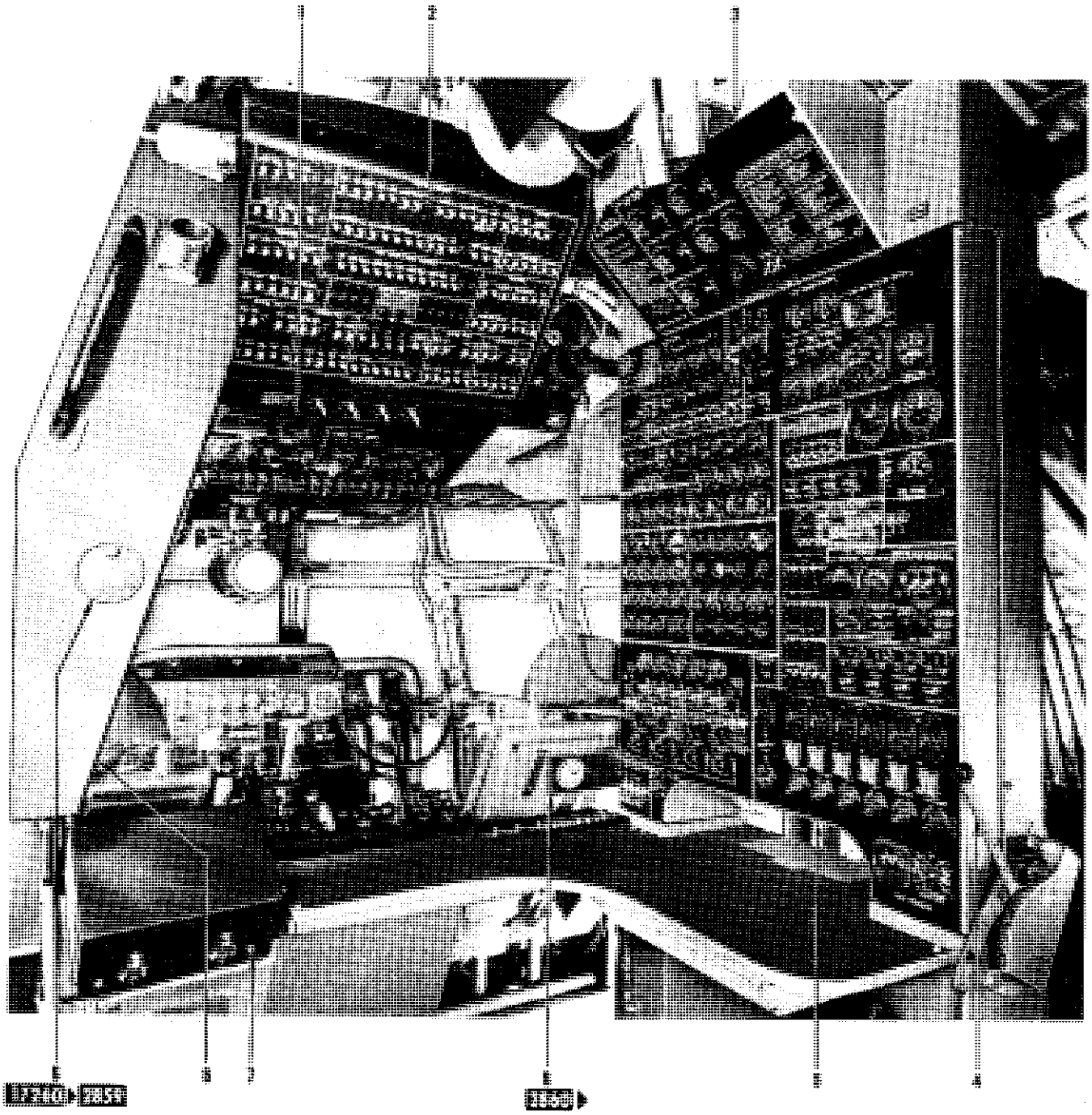
ANALYZER SYSTEM POWER INDICATOR LIGHT

This light (4, figure 1-18) on the analyzer switch panel will illuminate when the system power switch is positioned to ON indicating that power is supplied to the system.



IGNITION ANALYZER INTERNAL CONTROL PANEL

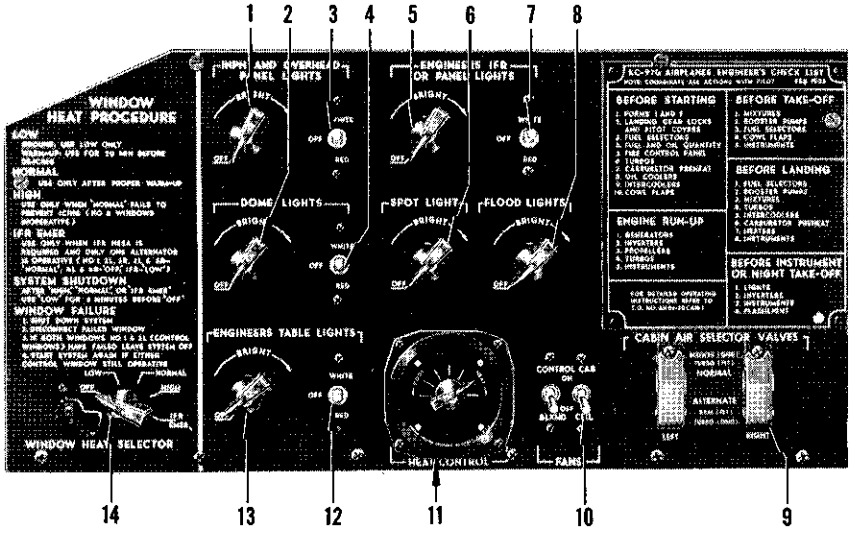
Figure 1-19

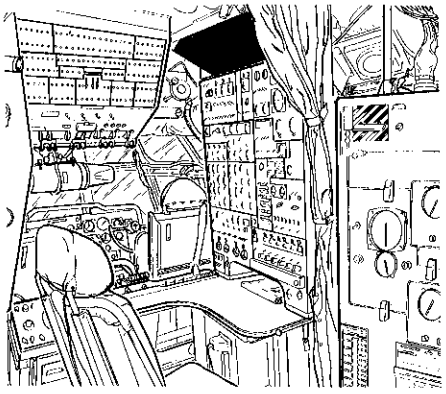


1 OVERHEAD PANEL
2 OVERHEAD CIRCUIT BREAKER PANEL
3 ENGINEER'S AUXILIARY OVERHEAD PANEL
▽T 4 ISODRAULIC HANDLE
5 ENGINEER'S INSTRUMENT PANEL
6 ENGINEER'S ASH TRAY (2 PLACES)
7 IGNITION ANALYZER
8 ENGINEER'S AUXILIARY PANEL

ENGINEER'S STATION (TYPICAL)

Figure 1-20





1 OVERHEAD PANEL LIGHTS RHEOSTAT
2 DOME LIGHTS RHEOSTAT
3 OVERHEAD PANEL LIGHTS CONTROL SWITCH
4 DOME LIGHTS CONTROL SWITCH
▼T 5 ENGINEER'S (A/R) LIGHTS RHEOSTAT
6 SPOT LIGHT RHEOSTAT
▼T 7 ENGINEER'S (A/R) LIGHTS CONTROL SWITCH
8 FLOOD LIGHTS RHEOSTAT
9 CABIN AIR SELECTOR SWITCHES 3106 ▶
10 CONTROL CABIN FAN SWITCHES
11 HEAT CONTROL RHEOSTAT
12 ENGINEER'S TABLE LIGHTS CONTROL SWITCH
13 ENGINEER'S TABLE LIGHTS RHEOSTAT
14 WINDOW HEAT SELECTOR SWITCH

ENGINEER'S AUXILIARY OVERHEAD PANEL

Figure 1-21

ANALYZER POWER INDICATOR LIGHT

This light (1, figure 1-17), located on the ignition analyzer, illuminates when the ignition analyzer is receiving power. The light should be illuminated when the power switch on the ignition analyzer and the power switch on the analyzer switch panel are in the ON position.

Tachometers

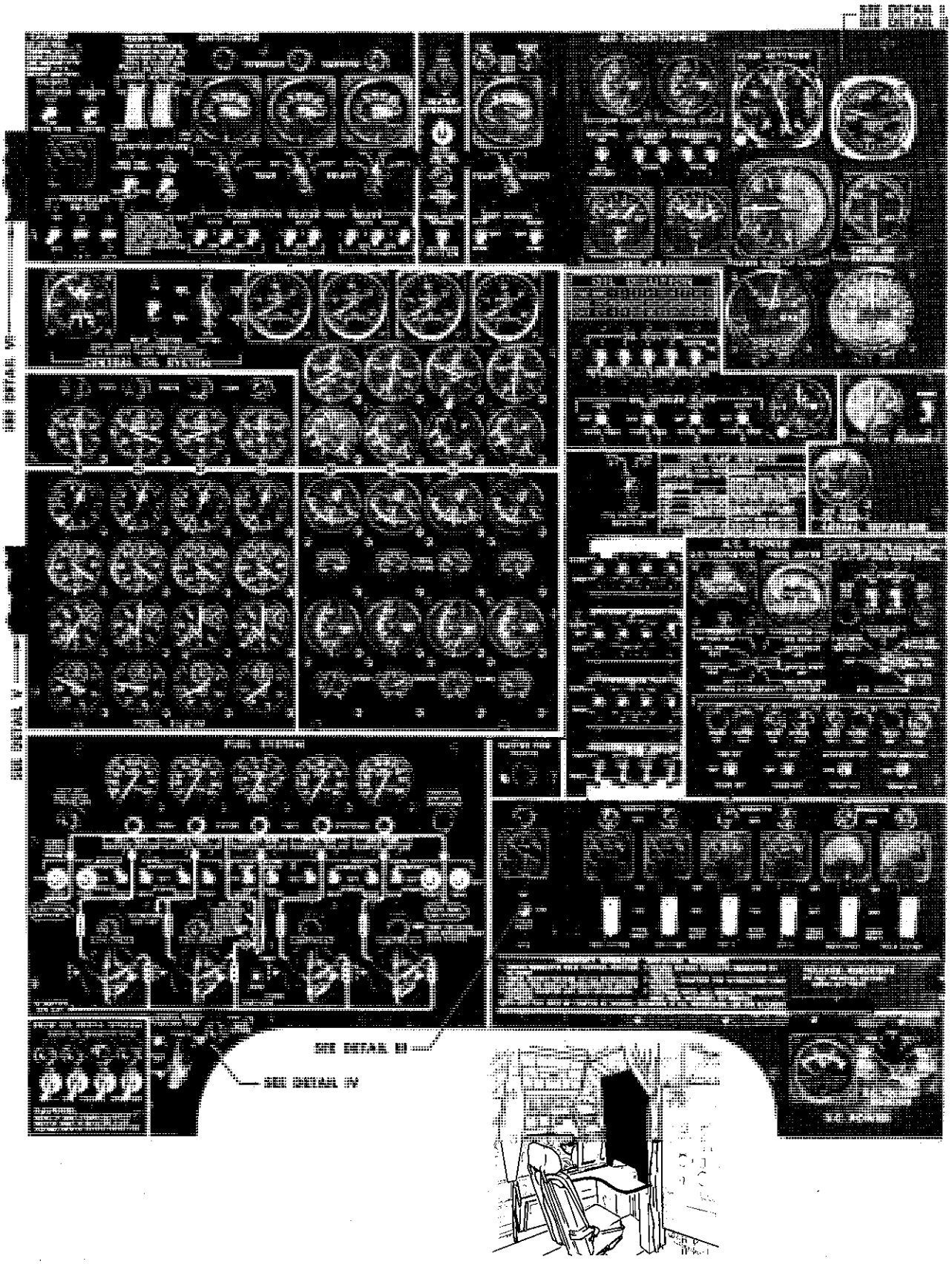
Four single-indicating engine tachometers are on both the pilots' and the engineer's instrument panels (10, figure 1-9 and 81, figure 1-22). The tachometers are generator motor units. Each tachometer generator is engine-driven and generates its own current which controls the indicator motor at a synchronized speed. The pilots' tachometers measure engine speeds in increments of 100 rpm and the engineer's tachometers measure engine speeds in increments of 20 rpm.

Torquemeters

Four individual torquemeters (77, figure 1-22) are on the engineer's instrument panel. The torquemeters indicate torque pressure in psi and are used as a direct means of measuring power output. When combined with engine rpm and a factor, a direct calculation of brake horsepower output at the propeller can be made. The indicating circuit is supplied with 26 volt AC through circuit protection on the AC power panel (figure 1-34).

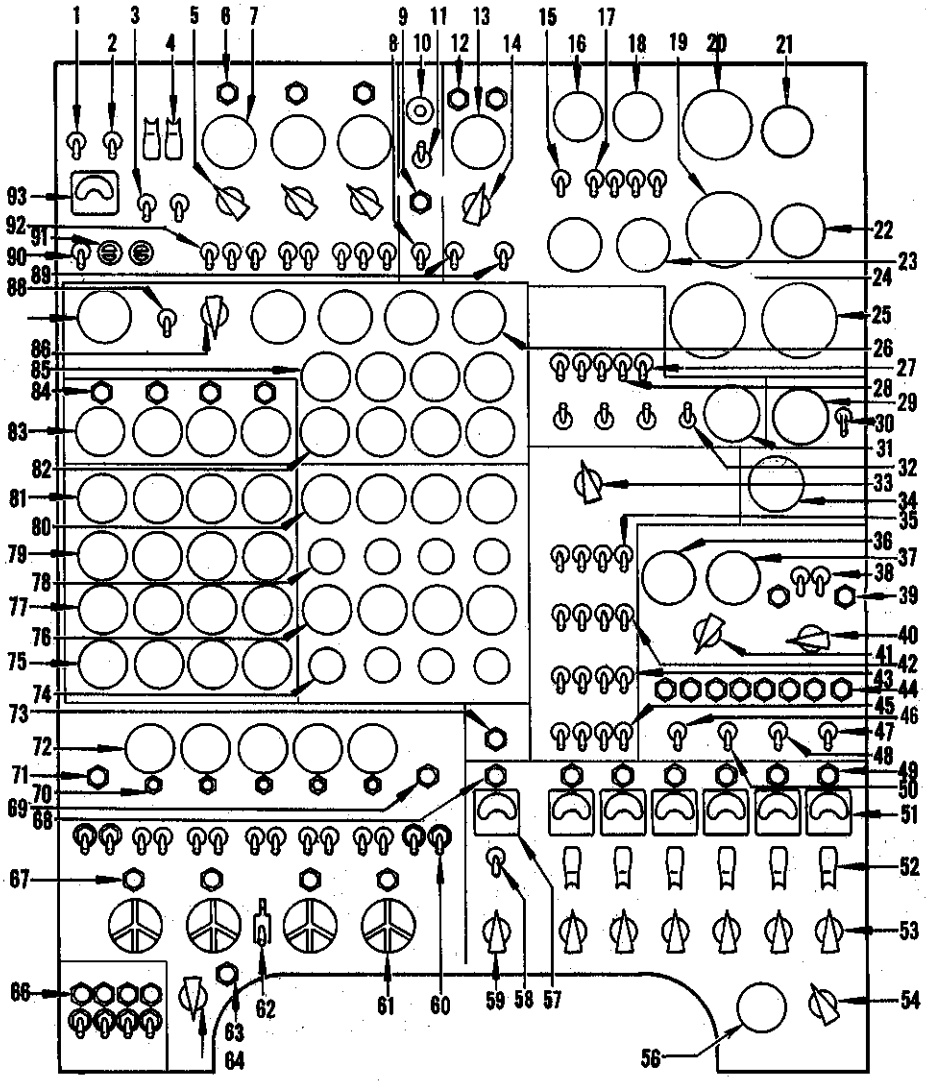
Manifold Pressure Gages and Purge Valve Buttons

Four manifold pressure gages (9, figure 1-9 and 79, figure 1-22) are on both the pilots' and engineer's instrument panel. The manifold pressure gages give a direct reading of manifold pressure in inches of Hg. Four manifold purge valve buttons (8, figure 1-9) on



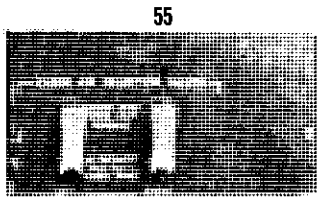
ENGINEER'S INSTRUMENT PANEL

Figure 1-22 (Sheet 1 of 3)

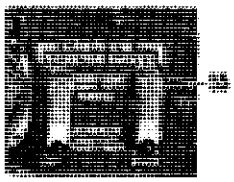


1 BALANCE BY-PASS SWITCH
2 MASTER ANTI-ICE SWITCHES
3 LIMITED ANTI-ICE SWITCHES
4 EMERGENCY ANTI-ICE SWITCHES
5 TEMPERATURE GAGE SELECTOR SWITCHES
6 ANTI-ICE OVERHEAT WARNING LIGHTS
7 ANTI-ICE HEATER AND DUCT TEMPERATURE GAGES
8 HEATER (AND APU) FUEL VALVE SWITCH
9 HEATER (AND APU) FUEL LOW PRESSURE WARNING LIGHT
10 HEATER OVERHEAT TEST SWITCH
11 HEATER OVERHEAT RESET SWITCH
12 BODY HEATER OVERHEAT WARNING LIGHTS
13 BODY HEATER TEMPERATURE GAGE
14 BODY HEATER TEMPERATURE SELECTOR SWITCH
15 AIR CONDITIONING MASTER SWITCH
16 MAIN CABIN TEMPERATURE GAGE
17 TURBO BLEEDER SWITCHES
18 CONTROL CABIN TEMPERATURE GAGE
19 CABIN VERTICAL VELOCITY INDICATOR
20 PRESSURE ALTIMETER 22737 ▶
21 AIRSPEED INDICATOR 3106 ▶
22 CABIN AIR PRESSURE INDICATOR (CABIN ALTIMETER)
23 CABIN AIR FLOW INDICATORS
24 CABIN PRESSURE RATE-OF-CHANGE SELECTOR
25 CABIN ALTITUDE SELECTOR
26 ENGINE OIL TANK QUANTITY GAGES
27 OIL DILUTION MASTER SWITCH
28 OIL DILUTION SELECTOR SWITCHES
T 29 A/R TANK DIFFERENTIAL PRESSURE GAGE 17260 ▶ 3195
T 30 A/R TANK PURGE SWITCH 17260 ▶ 3195 ▶
31 CLOCK 22701 ▶
32 OIL COOLER FLAP SWITCHES
33 CYLINDER HEAD TEMPERATURE SELECTOR SWITCH
T 34 A/R HYDRAULIC OIL TEMPERATURE GAGE
35 COWL FLAP SWITCHES
36 AC VOLTMETER
37 FREQUENCY METER
38 ALTERNATOR SWITCHES
39 NESA BUS OFF WARNING LIGHTS
40 ALTERNATOR BUS SELECTOR SWITCH
41 AC VOLTAGE AND FREQUENCY SELECTOR SWITCH
42 CARBURETOR PREHEAT SWITCHES
43 INTERCOOLER FLAP SWITCHES
44 INVERTER WARNING LIGHTS
45 CARBURETOR AIR SWITCHES
46 ESSENTIAL INVERTER SWITCH
47 PILOTS' INSTRUMENT INVERTER SWITCH
48 AUTOPILOT INVERTER SWITCH
49 GENERATOR WARNING LIGHTS
50 SECONDARY INVERTER SWITCH
51 DC LOADMETERS
52 GENERATOR SWITCHES
53 GENERATOR VOLTAGE RHEOSTATS
54 DC VOLTMETER SELECTOR SWITCH
55 CABIN AIR SELECTOR SWITCHES (2 PLACES)
56 DC VOLTMETER
57 APU DC LOADMETER
58 APU GENERATOR SWITCH
59 APU GENERATOR RHEOSTAT
60 BOOST PUMP SWITCHES
61 FUEL SELECTOR SWITCHES
62 CENTER TANK LINE VALVE SWITCH
63 SINGLE POINT REFUELING SECONDARY VALVE CLOSED LIGHT
64 SINGLE POINT REFUELING TEST SWITCH
65 PROPELLER OIL REFILL SWITCHES
66 PROPELLER OIL QUANTITY WARNING LIGHTS
67 FUEL VALVE POSITION WARNING LIGHTS
68 APU GENERATOR WARNING LIGHT
69 RIGHT EXTERNAL TANK LOW FUEL FLOW WARNING LIGHT (TANK EMPTY WARNING LIGHT)
70 FUEL QUANTITY GAGE TEST SWITCHES
71 LEFT EXTERNAL TANK LOW FUEL FLOW WARNING LIGHT (TANK EMPTY WARNING LIGHT)
72 FUEL TANK QUANTITY GAGES
73 MASTER FIRE WARNING LIGHT
74 INTERCOOLER FLAP POSITION INDICATORS
75 FUEL FLOWMETERS
76 CARBURETOR AIR TEMPERATURE GAGES
77 TORQUEMETERS
78 COWL FLAP POSITION INDICATORS
79 MANIFOLD PRESSURE GAGES
80 CYLINDER HEAD TEMPERATURE GAGES
81 TACHOMETERS
82 OIL TEMPERATURE GAGES
83 FUEL PRESSURE GAGES
84 FUEL LOW PRESSURE WARNING LIGHTS
85 OIL PRESSURE GAGES
86 OIL TANK SELECTOR SWITCH
87 CENTRAL OIL TANK QUANTITY GAGE
88 OIL TRANSFER PUMP SWITCH
89 BODY HEATER SWITCHES
90 PROPELLER DEICING SWITCH
91 PROPELLER DEICING INDICATORS
92 ANTI-ICING COMBUSTION HEATER FUEL VALVE SWITCHES
93 PROPELLER DEICING SYSTEM LOADMETER
94 FUEL ENRICHMENT SWITCHES ◣ TCTO 595 ◢

Figure 1-22 (Sheet 2 of 3)

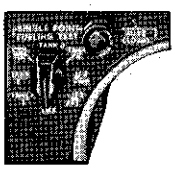


DETAIL I
17260 ▶ 22736

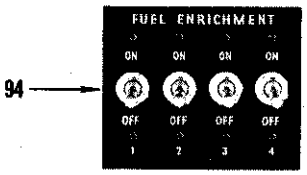


DETAIL II
22737 ▶ 22806

DETAIL III
17260 ▶ 2893



Detail IV
17260 ▶ 22664



DETAIL V
TCTO 595

DETAIL VI
TCTO 534

ENGINEER'S INSTRUMENT PANEL (CONT)

Figure 1-22 (Sheet 3 of 3)

the pilots' instrument panel provide a means of removing moisture from the manifold pressure gage lines. At idling speeds, a suction is developed and depressing the valve allows the moisture to be drawn into the engine.

Cylinder Head Temperature Gages

Four cylinder head temperature gages (80, figure 1-22) of the direct current type are on the engineer's instrument panel. The cylinder head temperature gages are resistance bulb type units and indicate cylinder head temperature in degrees Centigrade. There are two resistance bulbs on each engine, one is in cylinder B2 and the other in cylinder A2. The circuits are supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

Cylinder Head Temperature Selector Switch

A selector switch (33, figure 1-22) on the engineer's instrument panel allows selection of the desired set of cylinders for cylinder head temperature indication. The selector switch has B2--A2 positions. With the selector switch in either position, each of the cylinder head temperature gages will, for its respective engine, indicate the temperature of the individual cylinder selected. The selector switch is a part of the cylinder head temperature gage circuit, and is protected by the engine instrument circuit breaker on the overhead circuit breaker panel.

Fuel Flowmeters

Each engine has a fuel flowmeter, located on the engineer's instrument panel (75, figure 1-22). The flowmeters show rate of fuel flow in hundreds of pounds per hour. The indicator circuits are supplied with 26 volt AC through the engine instrument fuses in the AC power panel (figure 1-34). The indicator circuits have separate circuit protection on the AC power panel on airplanes 3106 ▶ .

Fuel Pressure Gages

Four fuel pressure gages (83, figure 1-22) on the engineer's instrument panel indicate fuel pressure in psi for each engine. The indicator circuits are supplied with 26 volt AC through the engine instrument fuse on the AC power panel (figure 1-34).

Fuel Low Pressure Warning Lights

A fuel low pressure warning light (84, figure 1-22), adjacent to each fuel pressure gage, illuminates when fuel pressure is low. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

Oil Pressure Gages

Four oil pressure gages (85, figure 1-22) are on the engineer's instrument panel. The gages indicate en-

gine oil pressure in psi. The indicator circuits are supplied with 26 volt AC through the engine instrument fuses on the AC power panel (figure 1-34).

Oil Temperature Gages

A resistance bulb type oil temperature gage for each engine (82, figure 1-22) is on the engineer's instrument panel. The gages indicate engine oil temperature in degrees Centigrade. The indicating circuits are supplied with 28 volt DC through circuit breakers on the overhead circuit breaker panel (figure 1-34).

PROPELLER SYSTEM

The airplane is equipped with Hamilton Standard, hydromatic propellers having four solid aluminum blades. This propeller has a non-rotating control unit, incorporating an independent oil system, mounted between the engine nose section and the propeller. Controls are provided to automatically snychronize engine speeds, reverse, or feather any or all propellers. Deicing is accomplished through a boot type electric heating element mounted along the leading edge of each blade. Current is transmitted from the airplane 28 volt DC circuit to the heating elements through the slip ring assembly attached to the propeller barrel. An oil replenishing system is provided to replace oil lost from the propeller independent oil system with engine nose section oil.

NOTE

An external contactor control switch is incorporated in the number one blade of each propeller to terminate unfeathering and unreversing.

PROPELLER GOVERNOR SELECTOR SWITCHES

Four propeller DECREASE RPM--OFF--INCREASE RPM governor selector switches (26, figure 1-16), on the aft end of the control stand are used to manually control and synchronize the propeller speeds for each of the four engines. Normally, the automatic synchronizing system of propeller control is used, but in case of malfunction, operation of the selector switches will override the master lever and synchronizer operation. The selector switches are spring-loaded from the INCREASE RPM and DECREASE RPM positions to the OFF position. The circuit is supplied with 28 volt DC through a circuit breaker on the overhead circuit breaker panel (figure 1-34).

PROPELLER AUTO CONTROL SWITCH

The automatic propeller synchronizing system is referred to No. 1 or No. 2 engine as the master engine by a NO. 1 MASTER--OFF--NO. 2 MASTER switch (24, figure 1-16) on the aft end of the control stand. This switch is used in the propeller synchronizing system to select either engine No. 1 or No. 2 as a master which the other engines follow. Once the master engine has been selected, the other engines act as slaves, synchronizing with the master engine. Alternate selection of a master engine is provided in case of a master engine failure. A safety feature in the synchronizing system limits the range of control the master engine has over the slave engines (plus or minus approximately 175 rpm from the master engine speed). In case of master engine malfunction, this feature prevents the propeller rpm of the slave engines from going either above or below the controlled range. The circuit is supplied with 28 volt DC through an ON--OFF, switch-type circuit breaker on the overhead panel (figure 1-34).

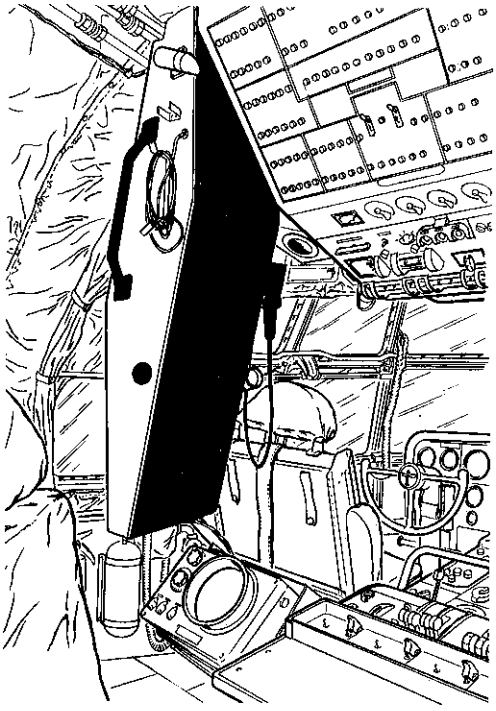
MASTER PROPELLER SYNCHRONIZER LEVER

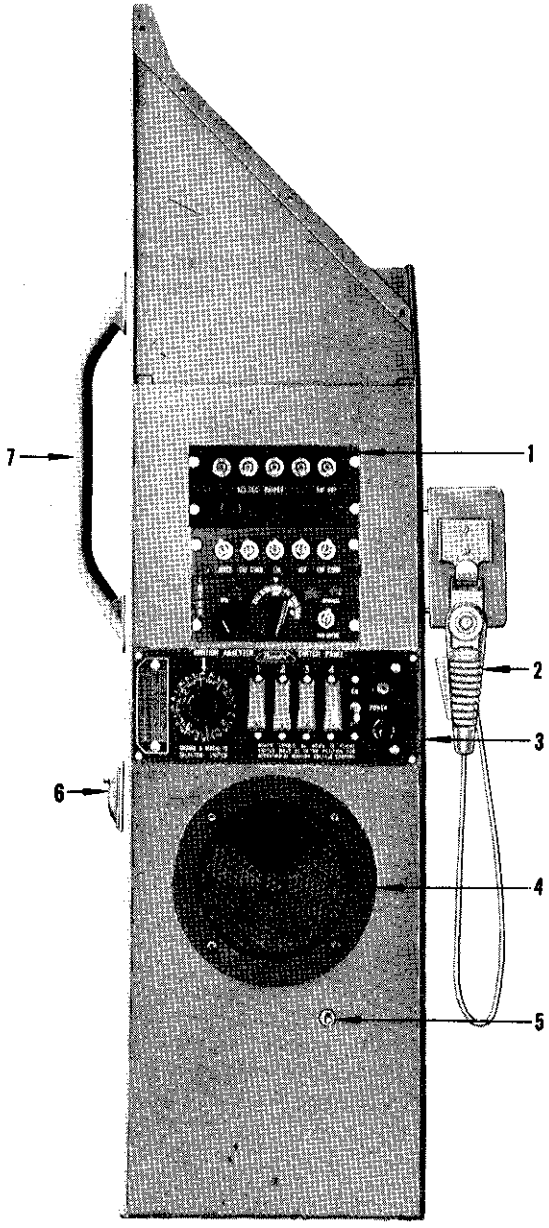
Two levers (32, figure 1-16) on the control stand, one to the left of the pilots' throttles and the other to the left of the engineer's throttles, are used to operate all four propeller governors simultaneously when selecting desired engine rpm. The levers are interconnected so that movement of one lever throughout the range from DECREASE RPM position to INCREASE RPM position is duplicated by the other lever. Forward movement of the synchronizer levers causes an increase in rpm while aft movement causes a decrease in rpm. The levers are used in conjunction with automatic propeller synchronizing and are operative only when the propeller auto control switch (24, figure 1-16) is in the NO. 1 MASTER or NO. 2 MASTER position. When a propeller synchronizer lever is placed in the full INCREASE RPM position, the master synchronizer motor drives the four propeller governors to their maximum rpm limits. When these limits are reached by all four propellers, a holding relay cuts off all synchronizing action. Synchronizing action will remain off as long as the propeller synchronizer levers are in the full INCREASE RPM position. Thus failure of the master engine on takeoff will have no effect on the speed of the slave engines. Circuit breaker protection is provided by the circuit breaker switch provided for propeller auto control on the overhead circuit breaker panel (figure 1-34).

RESYNCHRONIZER SWITCH

A spring-loaded resync-off switch (25, figure 1-16) on the aft end of the control stand, is used to syn-

1 INTERCOMMUNICATION PANEL
2 MICROPHONE
3 IGNITION ANALYZER SWITCH PANEL
4 LOUDSPEAKER
5 LOUDSPEAKER CONTROL SWITCH
6 ASH TRAY 17260 ▶2859
7 HANDHOLD





ENGINEER'S AUXILIARY PANEL

Figure 1-23

chronize the propellers after rpm selection has been made with the master propeller synchronizer levers. Because of normal tolerances in setting individual governor limits, the slave engines may not be in the synchronizing range (plus or minus 175 rpm from the master engine rpm). In this case the master propeller synchronizer levers will not set the speed of the propellers in proper synchronization, thus causing propeller noise beat. When using the resynchronizer switch, by pushing to RESYNC, holding, and releasing a few times, complete engine synchronization can be obtained. This switch is used immediately after any movement of the master propeller synchronizer levers except when they are in full INCREASE RPM or full DECREASE RPM position. Circuit breaker protection for the resynchronizer switch is the same circuit breaker as used for the auto control switch on the overhead circuit breaker panel (figure 1-34).