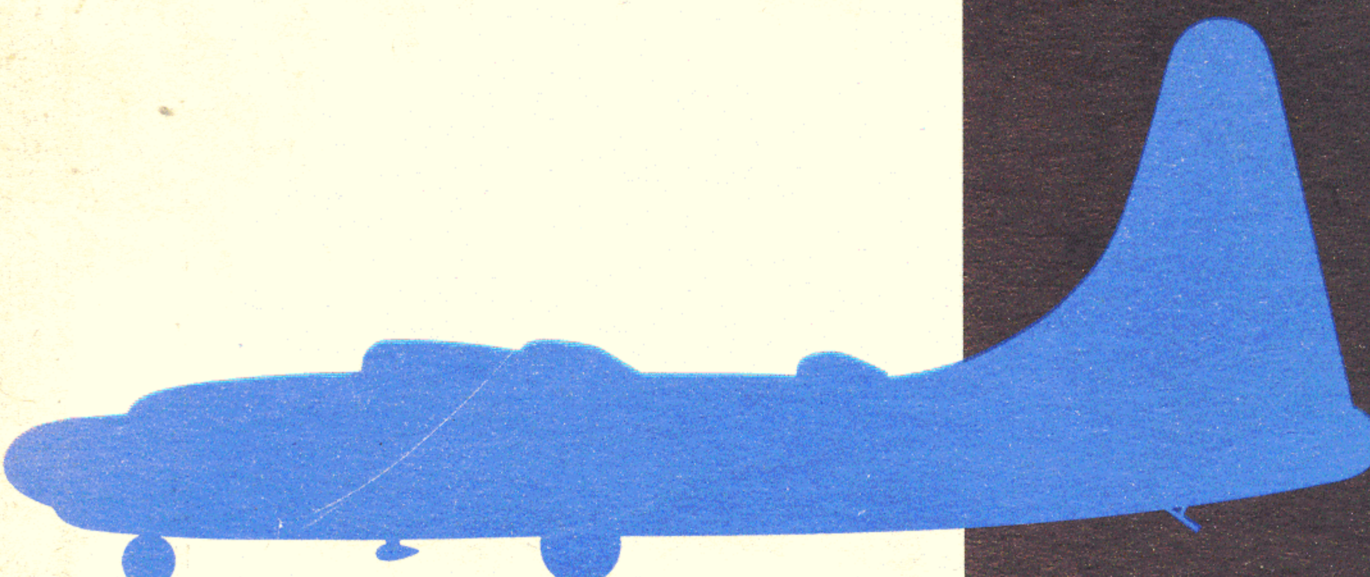
AAF MANUAL 51-126-7

AIRPLANE COMMANDER TRAINING MANUAL FOR THE B-32

DOMINATOR



HEADQUARTERS, ARMY AIR FORCES

RESTRICTED

AIRPLANE COMMANDER TRAINING MANUAL FOR THE DOMINATOR

Hq. Army Air Forces
Washington 25, D. C., 15 July 1945

The use and authentication of this manual are governed by the provisions of AAF Regulation 50-17.

By command of General ARNOLD:

HEADQUARTERS ARMY AIR FORCES — OFFICIAL — WAR DEPARTMENT

Ira C. Eaker
Lieutenant General, United States Army
Deputy Commander, Army Air Forces

Additional copies of this manual should be requested from:
Hq. AAF, Office of Flying Safety, Safety Education Division,
Winston-Salem 1, North Carolina

INITIAL DISTRIBUTION: HEADQUARTERS AAF • AAF TRAINING COMMAND

Con. P. Curran Printing Co., St. Louis - 7-16,-45 - 3M


U.S.

Introduction

This manual is the text for your training as a B-32 pilot and airplane commander.

The Air Forces' most experienced training and supervisory personnel have collaborated to make it a complete exposition of what your pilot duties are, how each duty will be performed, and why it must be performed in the manner prescribed.

The techniques and procedures described in this book are standard and mandatory. In this respect the manual serves the dual purpose of a training checklist and a working handbook. Use it to make sure that you learn everything described herein. Use it to study and review the essential facts concerning everything taught. Such additional self-study and review will not only advance your training, but will alleviate the burden of your already overburdened instructors.

This training manual does not replace the Technical Orders for the airplane, which will always be your primary source of information concerning the B-32 so long as you fly it. This is essentially the textbook of the B-32. Used properly, it will enable you to utilize the pertinent Technical Orders to even greater advantage.

H. H. Arnold

COMMANDING GENERAL, ARMY AIR FORCES

Contents

The first edition of this manual is necessarily general in scope. Specific procedures outlined are designed primarily for transition training. More advanced flying technique for the B-32 will be described in subsequent editions.

The B-32 Dominator

The B-32's Past

The history of your B-32 Dominator starts in 1940, when the Army accepted Boeing, Martin and Consolidated Vultee designs for VHB aircraft. Martin designs were not completed, but the end results of those Boeing and Convair plans are the present B-29 and B-32 airplanes. Between the first 32 design and the airplane you're flying today, however, is a long succession of changes.

The originally planned XB-32 was an airplane with several similarities to the present Superfortress. It had pressurization and remotely controlled turrets. It also had a double tail, wing guns and cannon, and other features which it doesn't have today. The Army decided not to put all its eggs in one basket, but to have at first only one airplane with the new features of the 29, and to duplicate its purpose in another model of more conventional design.

So Consolidated re-designed the B-32, and in the process practically started over again and built a new airplane, the changes putting the B-32 program behind the B-29. The XB version first flew Labor Day, 1942, in San Diego. The B type first flew late in 1944. The B-32 you are flying today is still a brand new airplane, and it is still undergoing changes to make it a better airplane.

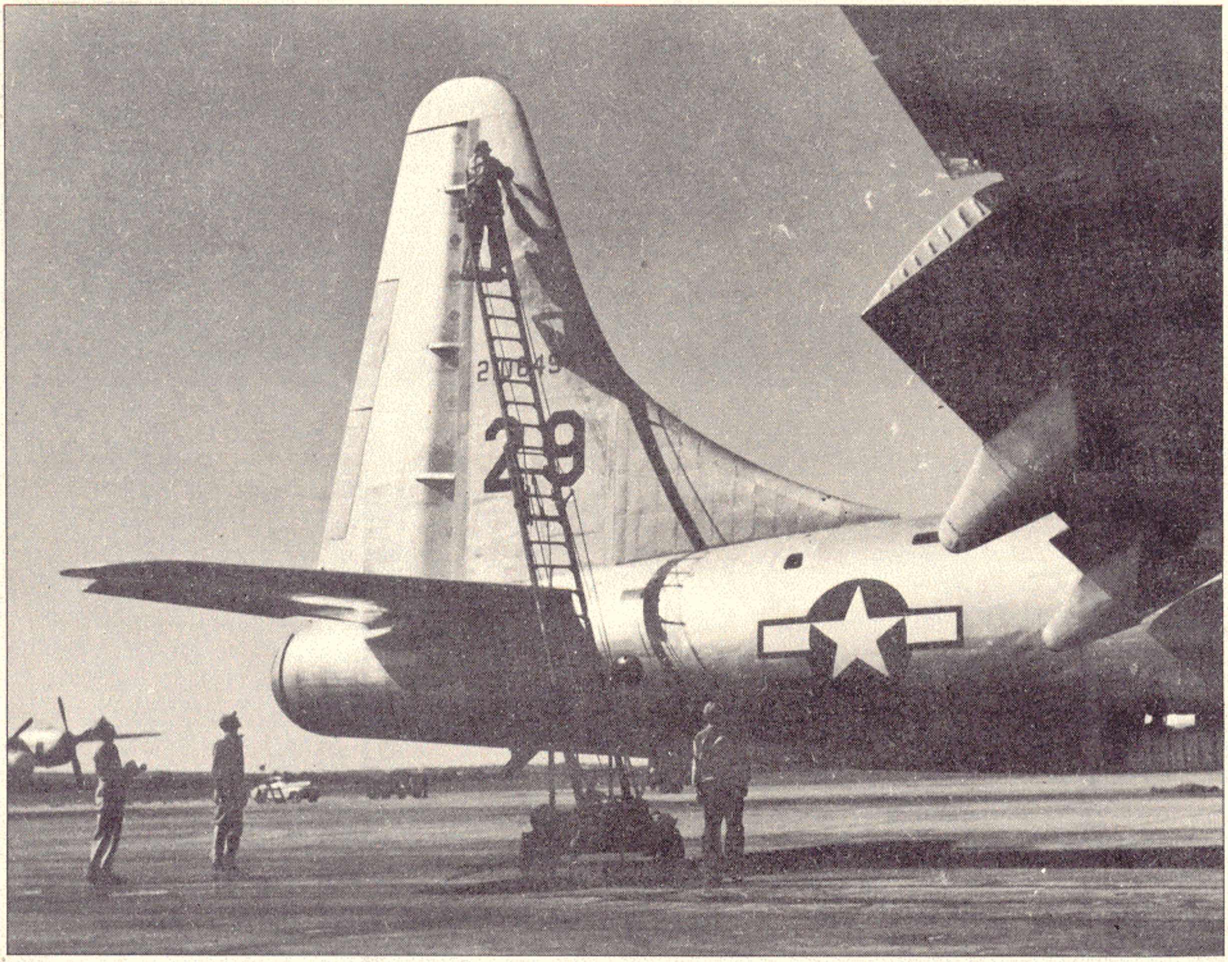
The B-32's Future

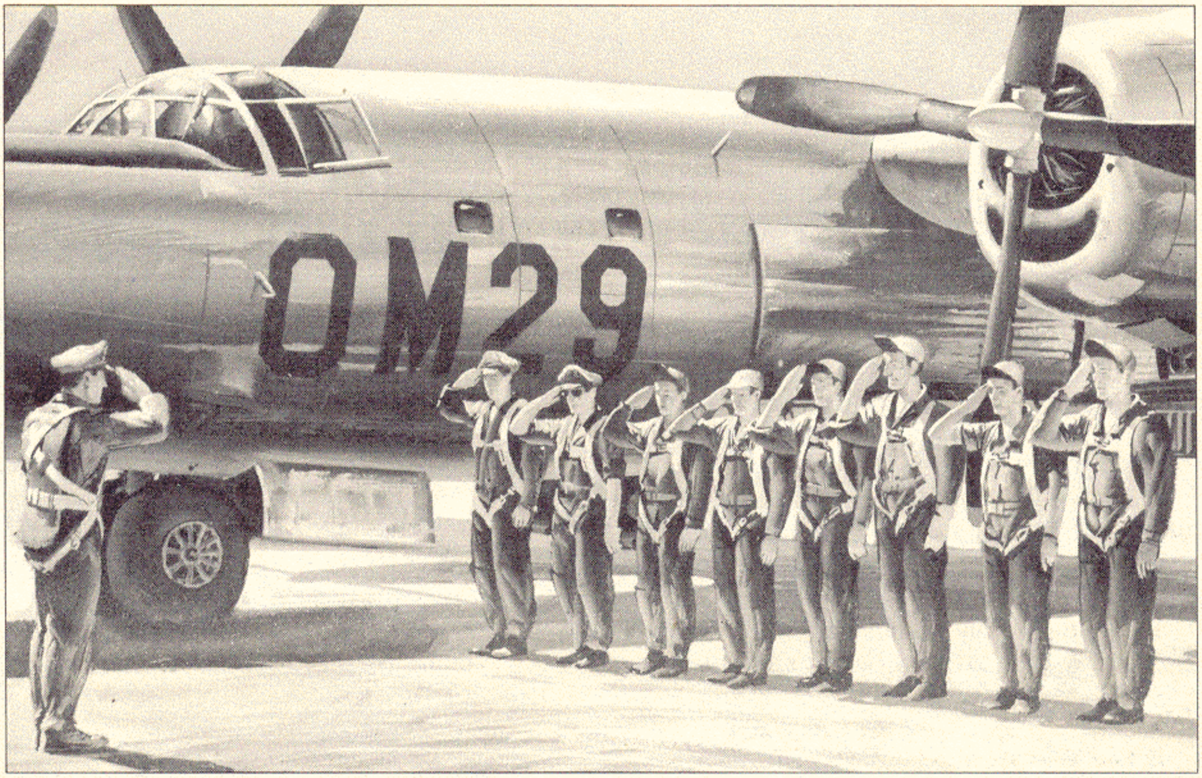
You won't find here any predictions about the future of the Dominator. That story can't be truthfully set down anywhere, yet. But when it is, it will be written by you. You and all the others who fly the B-32, service it, and maintain it, will sky-write its record in the combat theater when the chips are down. No matter how good the airplane is to begin with or how well it performs in transition, the way you handle it can build up or tear down its reputation. Now is the time to add every bit you can to your knowledge of the B-32, to get the most out of its potentialities. For this airplane has potentialities. It is stable and maneuverable. It's a surprisingly easy airplane to fly, and it has plenty of power, speed, range, and load capacity.

In the final analysis, however, it will be up to you to find out and to demonstrate how good an airplane this Dominator is.

About This Training Manual

The first part of this manual concerns inspections, checks, and flying procedures. The sequence of subjects in the procedures section is chronological, following the order in which you consider them in actual operations. The last part of the manual presents brief and condensed reference summaries of systems and equipment on the airplane. Emergency procedures, or emergency operations of equipment, are taken up under the subject to which they refer. For example, emergency landing flight procedures, like landing with engines out or gear up, follow the normal landing amplified checklist. Emergency operation of hydraulic units is treated at the end of the hydraulic system section, electrical system emergencies at the end of the electrical system section, etc.





The Airplane Commander

Teamwork makes a good bomber crew. As the airplane commander you are responsible for achieving and maintaining teamwork. The proficiency of each crew member as part of the team is your responsibility as much as is your ability to fly the B-32. To operate as a fighting unit at top efficiency you must know your own job and know your crew.

Knowing your own job means knowing all you can find out about your airplane and developing the highest possible skill in operating it.

Knowing your crew means knowing the duties and responsibilities of each man, his qualifications for those duties, and the manner in which he performs them. Your copilot and aerial engineer, with whom you start your B-32 training, are the nucleus of your team. Begin your career as airplane commander by showing as much interest in their training as you can and continue this policy with the rest of the crew when they join you later. Take a genuine interest in your men: learn something about their experiences, their families, their plans and ideas. Help them with their personal problems as well as their training progress.

As commanding officer of your small aerial army you must maintain crew discipline. Your personal interest in your men and your companionship with them can assure good discipline rather than detracting from it if you handle it right. Be friendly and understanding but be firm. Demonstrate that you know your job by the way you perform your duties. Be uncompromising in your insistence on the proper performance of crew duties before everything else. Make fair decisions after due consideration of all the facts, but make them in such a way as to impress upon your crew that your decisions are made to stick.

ENFORCE THESE RULES ON EVERY FLIGHT

Smoking

1. No smoking during ground operation.
2. No smoking during and immediately after takeoff.
3. No smoking during fuel transfer operations.
4. No smoking at any time any occupant detects fumes.
5. No smoking in bomb bay or fuselage section at any time they contain auxiliary fuel.

Parachutes

1. See that each person aboard has a parachute on every flight and that there is one extra parachute aboard for every four persons. As a minimum, carry two extra parachutes, one in the forward and one in the aft compartment.
2. Insist that all persons aboard wear parachute harness at all times from takeoff to landing.

Propellers

1. Allow no person to walk near propellers at any time, whether or not propellers are turning.
2. See that no person leaves the airplane when propellers are turning unless you personally ordered him to do so.

Oxygen Masks

1. See that oxygen masks are carried on all day flights of four hours or more in which altitude may exceed 8,000 feet; on all flights in which altitude may exceed 10,000 feet; and on all combat and tactical night flights.
2. Have all persons start use of oxygen at 8,000 to 10,000 feet on all day flights where altitude at any time will exceed 10,000 feet.
3. Have all persons use oxygen from the ground up on all combat and tactical flights at night and all training flights at night during which altitude may exceed 10,000 feet.

Training

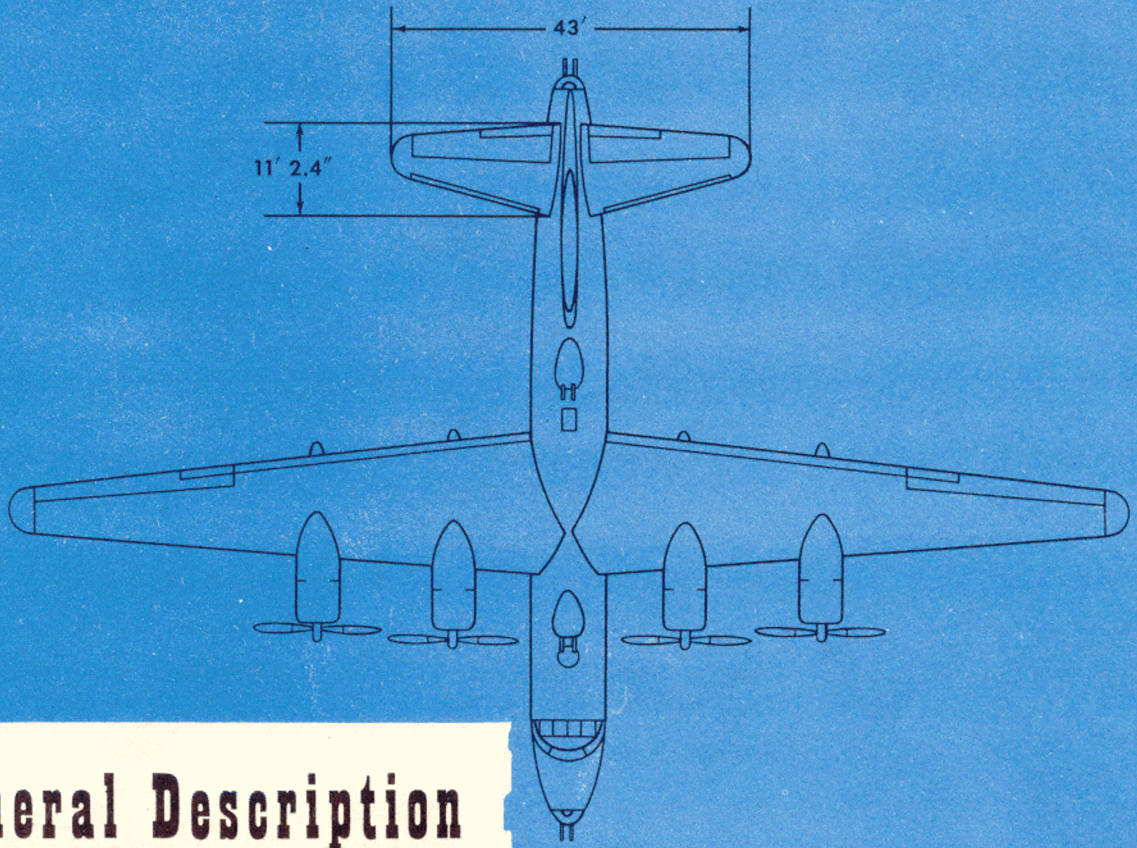
1. Tell your crew the purpose of each mission and what you expect each to accomplish.
2. Keep the crew busy throughout the flight. Get position reports from the navigator; send them out through the radio operator. Put the engineer to work on the cruise control and maximum range charts and require him to keep a record of engine performance. Give them a workout. Encourage them to use their skill. Let them sleep in their bunks—not in a B-32. A team is an active outfit. Make the most of every practice mission.
3. Practice all emergency procedures at least once a week: bailout, ditching, and fire drill.

Inspections

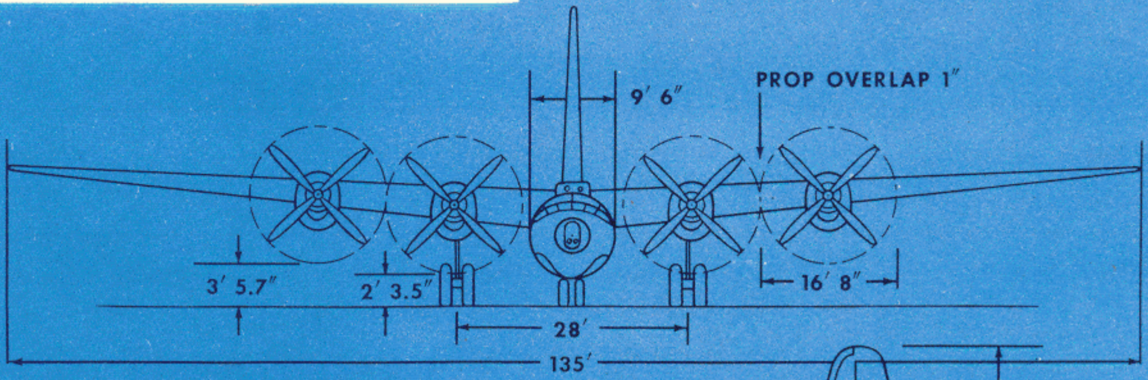
1. Check your airplane with reference to the particular mission you are undertaking. **Check everything.**
2. Check your crew and passengers for equipment, preparedness, and understanding of all duties in transition training. Make your preflight crew and passenger check in accordance with CFTC Memorandum 50-2-4.

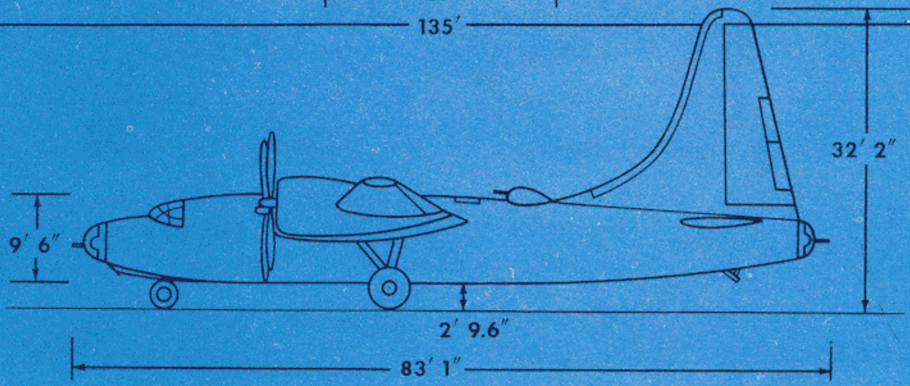
Interphone

1. Keep the interphone chattering. Ask for immediate reports of aircraft, trains, and ships just as you would expect them in combat—with proper identification.
2. Require interphone reports every 15 minutes from all crew members when on oxygen.



General Description



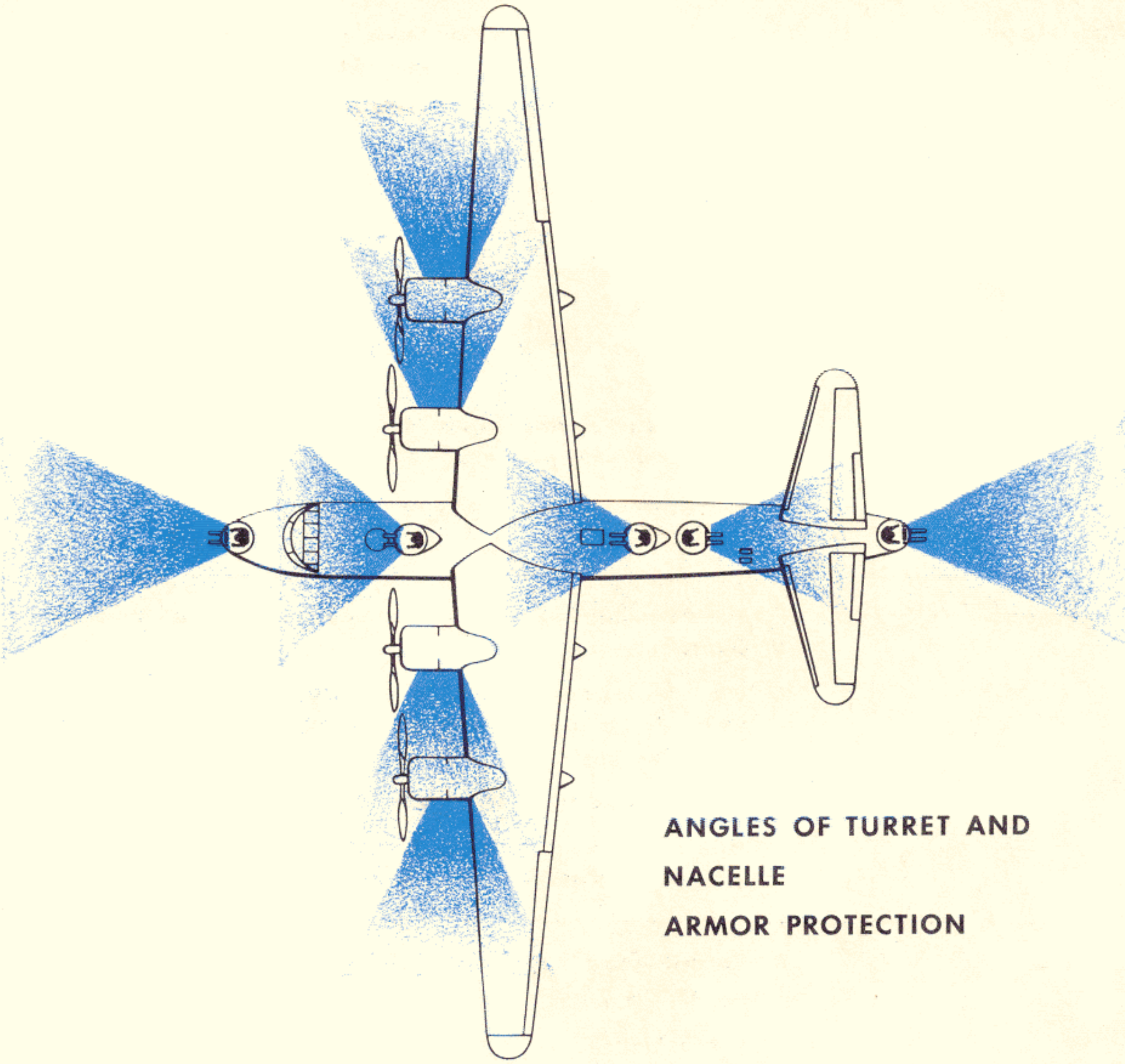


Airplane	Consolidated Vultee Aircraft Corporation B-32, all metal, high wing, long range, heavy bombardment airplane
Weight	Empty—Approximately 61,000 lbs Design gross weight—100,000 lbs Recommended maximum gross for takeoff—100,800 lbs Maximum allowable gross—123,250 lbs
Engines	Four 18-cylinder Wright Cyclones, R-3350-23A, air-cooled, each with two exhaust-driven turbo-superchargers having electronic regulator control, 2200 hp at 2800 rpm
Propellers	Four-bladed Curtiss electric, reverse pitch on inboards
Cowl Flaps	Eight per engine, electrically controlled and electrically operated by flexible shafts and screw jacks Settings—0° to 20°
Fuel Tanks	Four self-sealing tanks in wing center section, total capacity 5460 U. S. gallons Four removable self-sealing bomb bay tanks, total capacity 3000 U. S. gallons
Oil Tanks	Four self-sealing tanks in wing center section, total capacity 306 U. S. gallons
Landing Gear	Tricycle, three sets of dual wheels, completely retractable, operated by hydraulic power Retractable tailskid, fitted with air-oil shock strut, operating with main gear
Wing	Full cantilever, internally-braced, stressed-skin Davis wing Permanently attached center section, two removable outer panels, and two wing tips, to which leading and trailing edge sections, flaps, and ailerons attach Hot air anti-icers in leading edge

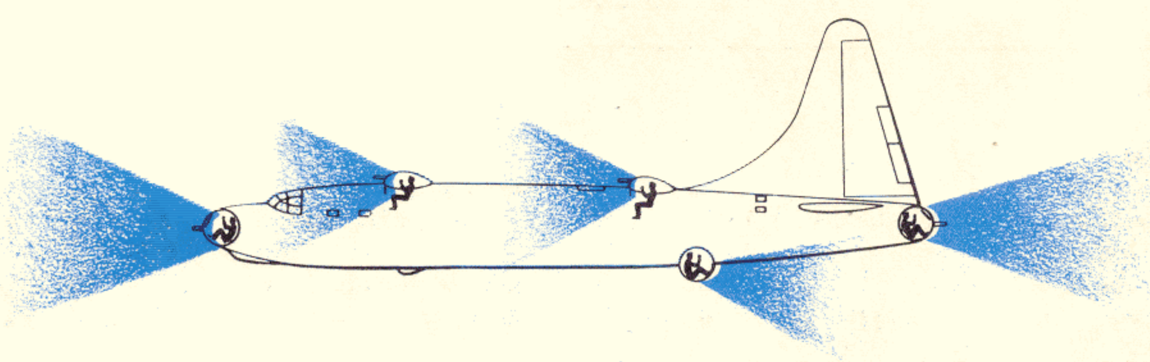
Wing Flaps	Two Alclad-covered Fowler flaps in wing center section on each side of fuselage, spanning center section from fuselage to aileron Hydraulically-operated and electrically-controlled Outboard flaps mechanically interconnected and inboard flaps mechanically interconnected
Empennage	Full cantilever stabilizer with fabric-covered elevators, dual trim tabs Single dorsal and vertical fin, with fabric-covered rudder and two rudder tabs Rudder and elevator noses reinforced with Alclad skin, statically and dynamically balanced De-icer boots on first 200 airplanes, hot air anti-icers on subsequent airplanes
Armament	Ten .50 caliber M-2 machine guns, mounted two each in five locally-controlled turrets Nose, tail, and lower are electric-hydraulic ball turrets, lower turret hydraulically retractable; upper turrets electrically operated; all turrets heated Total rounds ammunition—5800 NOTE: Transition airplanes have turrets removed, and 700 lbs of ballast in tail section of fuselage.
Bomb Load	Carried in two bomb bays, providing total of 48 stations maximum at one time Possible loads: 40 500 lb bombs 12 1000 lb bombs 8 1600 lb bombs 8 2000 lb bombs 4 4000 lb bombs

Areas

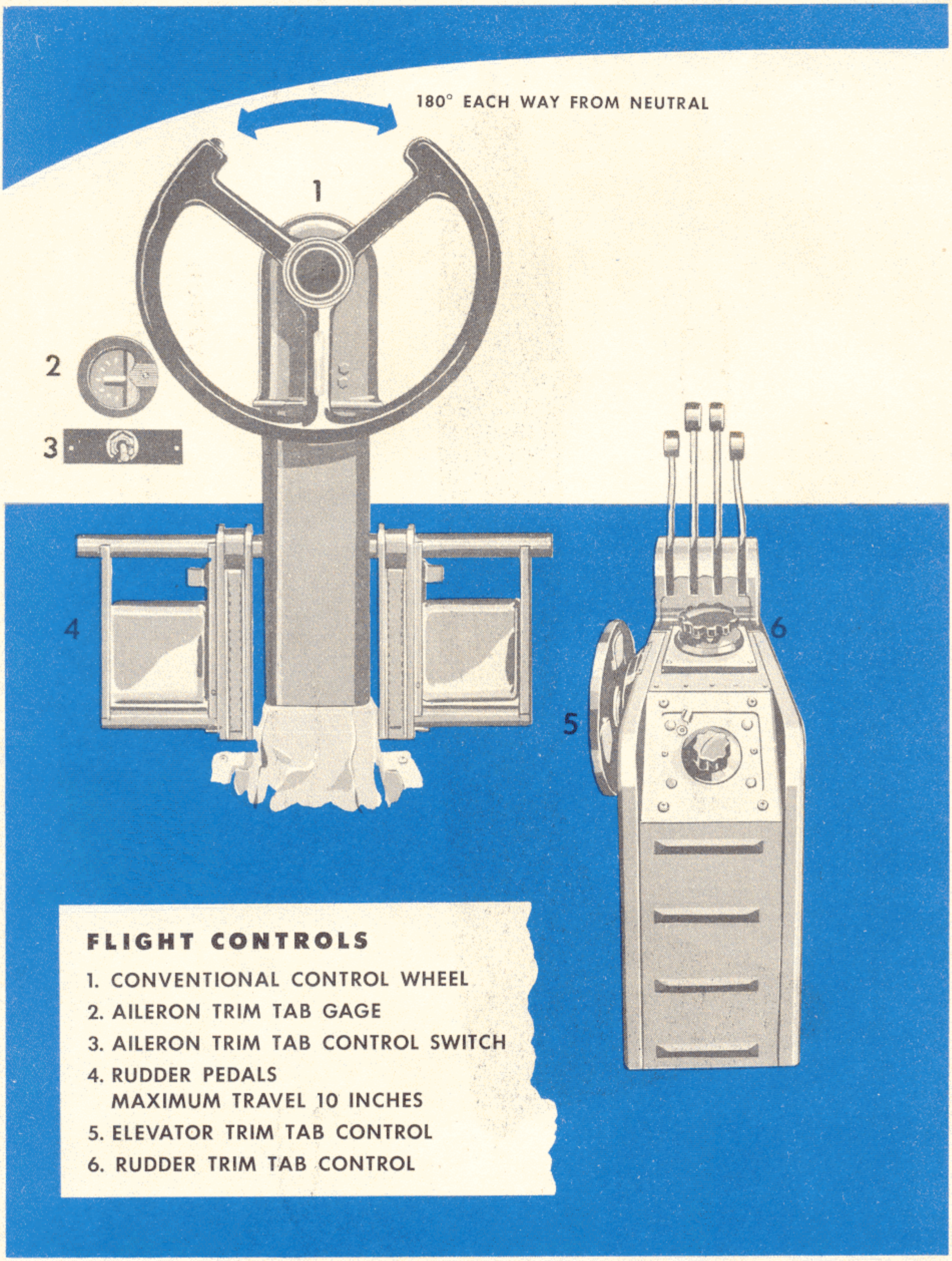
Total wing, including ailerons	1532.52 sq. ft.
Wing, flaps extended	1544.94 sq. ft.
Flaps, total each set	128.25 sq. ft.
Ailerons, each, including tab	50.65 sq. ft.
Aileron tabs, each	2.3 sq. ft.
Horizontal stabilizer, including elevators	333 sq. ft.
Elevators, each, including tab	56.08 sq. ft.
Elevator tabs, each	4.65 sq. ft.
Vertical stabilizer, including rudder	267.8 sq. ft.
Rudder, including tabs	107.3 sq. ft.
Rudder tabs, each	5.8 sq. ft.



ANGLES OF TURRET AND
NACELLE
ARMOR PROTECTION



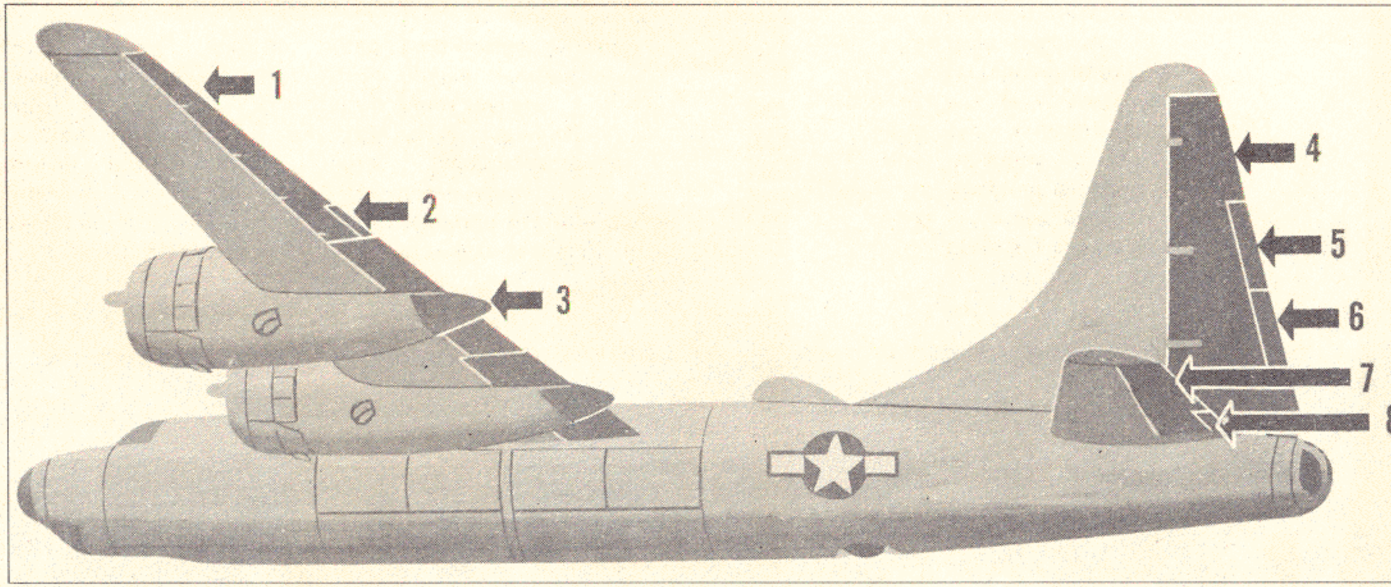

ANGLES OF FIRE
ELEVATION
AZIMUTH



FLIGHT CONTROLS

1. CONVENTIONAL CONTROL WHEEL
2. AILERON TRIM TAB GAGE
3. AILERON TRIM TAB CONTROL SWITCH
4. RUDDER PEDALS
   MAXIMUM TRAVEL 10 INCHES
5. ELEVATOR TRIM TAB CONTROL
6. RUDDER TRIM TAB CONTROL

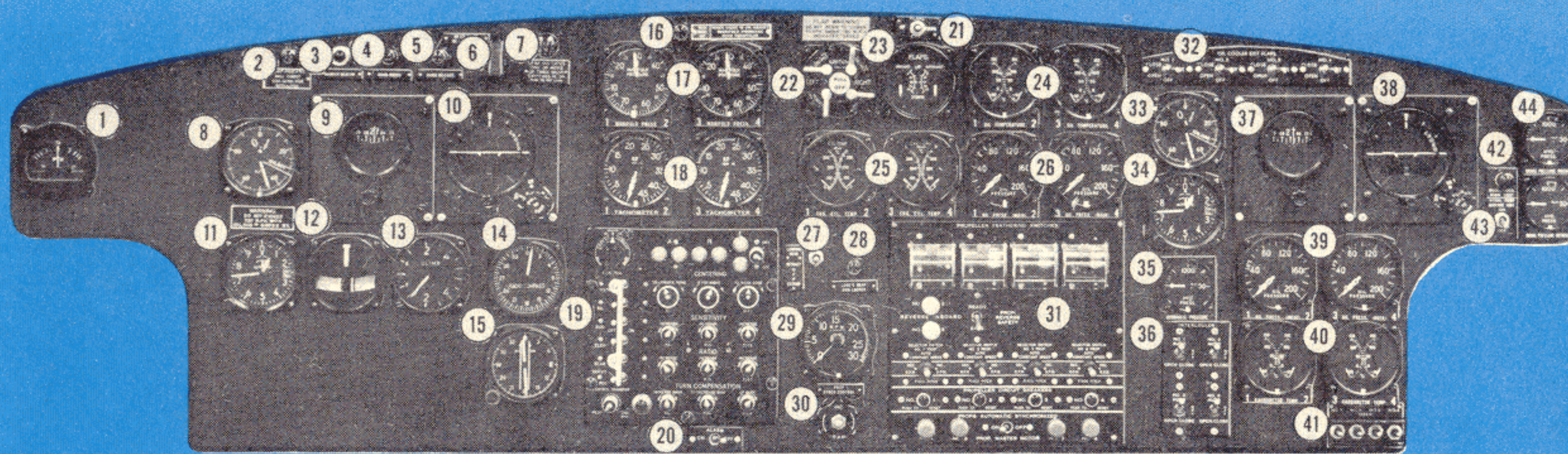
CONTROL SURFACE MOVEMENTS



1. AILERONS • 20° UP AND DOWN
2. AILERON TRIM TABS • MANUAL TRIM DEFLECTION 10° UP AND DOWN
   SERVO DEFLECTION 20° UP AND DOWN
3. FLAPS • 40° (TOTAL)
4. RUDDER • 20° LEFT AND RIGHT
5. RUDDER TRIM TAB • SERVO DEFLECTION 8° LEFT AND RIGHT
6. RUDDER TRIM TAB • MANUAL TRIM DEFLECTION 10° LEFT AND RIGHT
7. ELEVATOR • 25° UP • 15° DOWN
8. ELEVATOR TRIM TAB • 10° UP • 14° DOWN

Note

Aileron trim tabs are operated and controlled electrically by a motor housed in each aileron. Tab balance (servo) deflection is mechanically produced by the control linkage, in order to take some load off the controls.

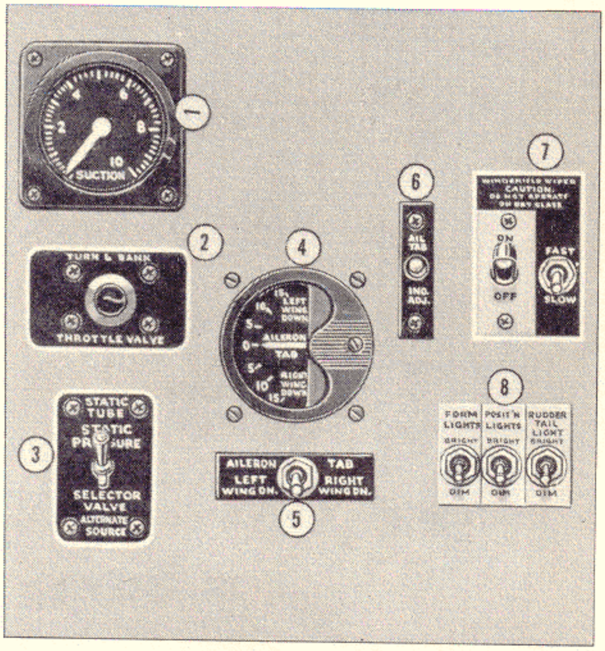


MAIN INSTRUMENT PANEL

1. PDI
2. Ball turret warning light
3. Radio marker beacon
4. Bomb doors warning light
5. Bomb release warning light
6. Bomb salvo switch
7. Salvo switch warning light
8. Airspeed indicator
9. Directional gyro
10. Flight indicator
11. Altimeter
12. Turn and bank indicator
13. Rate of climb indicator
14. Radio compass
15. Flux gate compass repeater
16. Both inverters out warning light
17. Manifold pressure gages
18. Tachometers
19. C-1 autopilot panel
20. Alarm bell switch
21. Flaps switch
22. Ignition switches
23. Flap position indicator
24. Oil temperature gages
25. Cylinder head temperature gages
26. Main oil pressure gages
27. Landing gear switch
28. Landing gear down-lock light
29. Master tachometer
30. Proportional synchro-control knob
31. Propeller control panel
32. Oil cooler exit flap switches
33. Airspeed indicator
34. Altimeter
35. Main hydraulic pressure gage
36. Intercooler switches
37. Directional gyro
38. Flight indicator
39. Nose oil pressure gages
40. Carburetor temperature gages
41. Cowl flap switches
42. Brake pressure warning light
43. Hydraulic pump over-ride switch
44. Brake hydraulic pressure gages

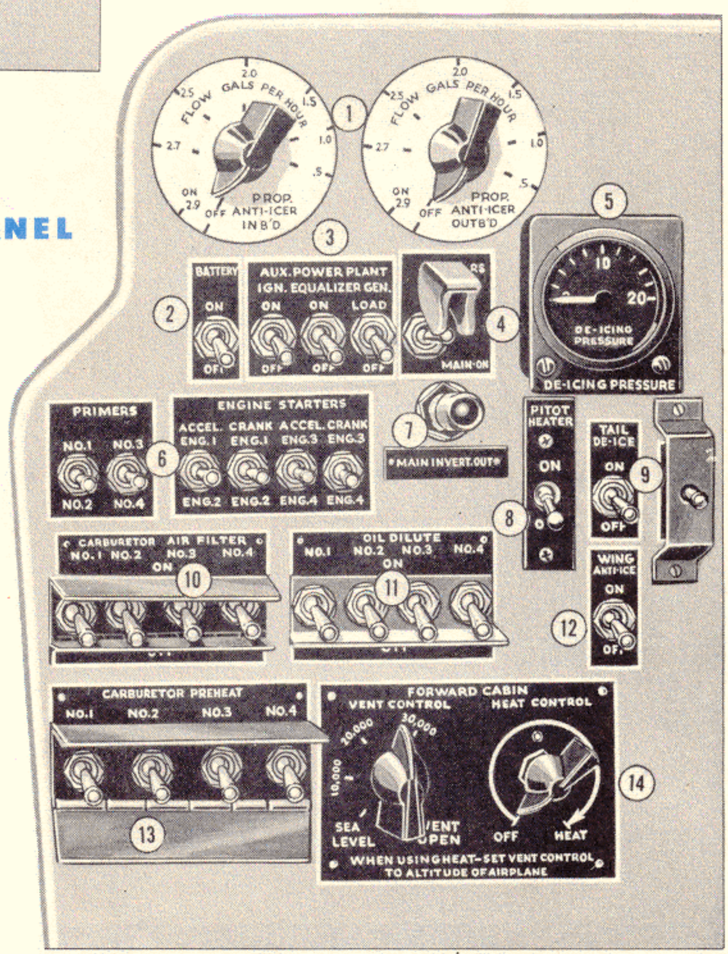
AIRPLANE COMMANDER'S AUXILIARY PANEL

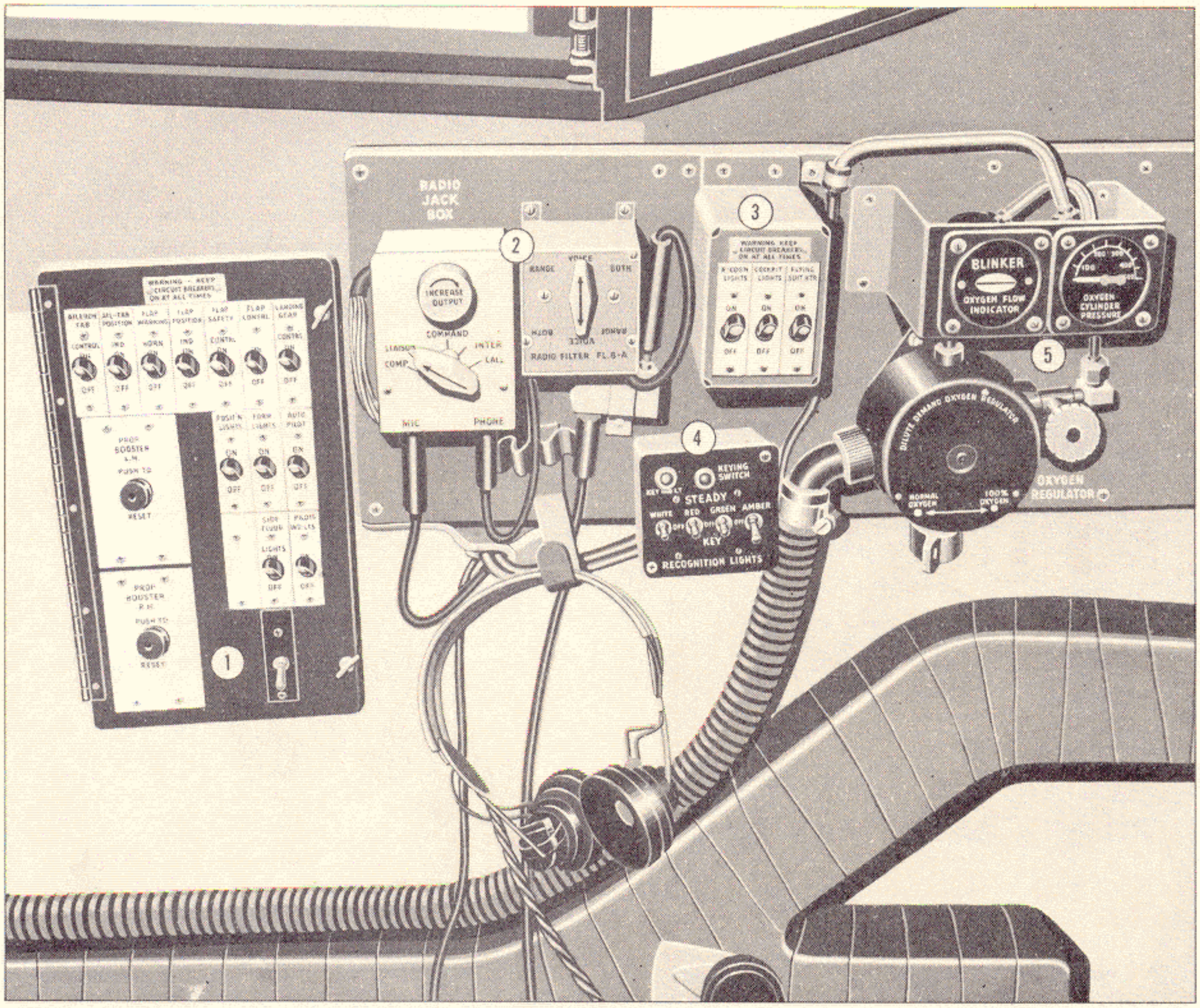
1. Suction gage
2. Turn and bank needle valve
3. Static pressure selector valve
4. Aileron tab indicator
5. Aileron tab switch
6. Aileron tab indicator adjustment
7. Windshield wiper circuit breaker and switch
8. Formation, position, and tail lights switches



COPILOT'S AUXILIARY PANEL

1. Anti-icer flow controls
2. Battery switch
3. APP switches
4. Inverter switch
5. De-icer pressure gage
6. Engine priming and starting switches
7. Main inverter out warning light
8. Pitot heater switch
9. Tail de-icer switch
10. Carburetor air filter switches
11. Oil dilution switches
12. Wing anti-icer switch
13. Carburetor pre-heat switches
14. Forward cabin ventilating and heat controls



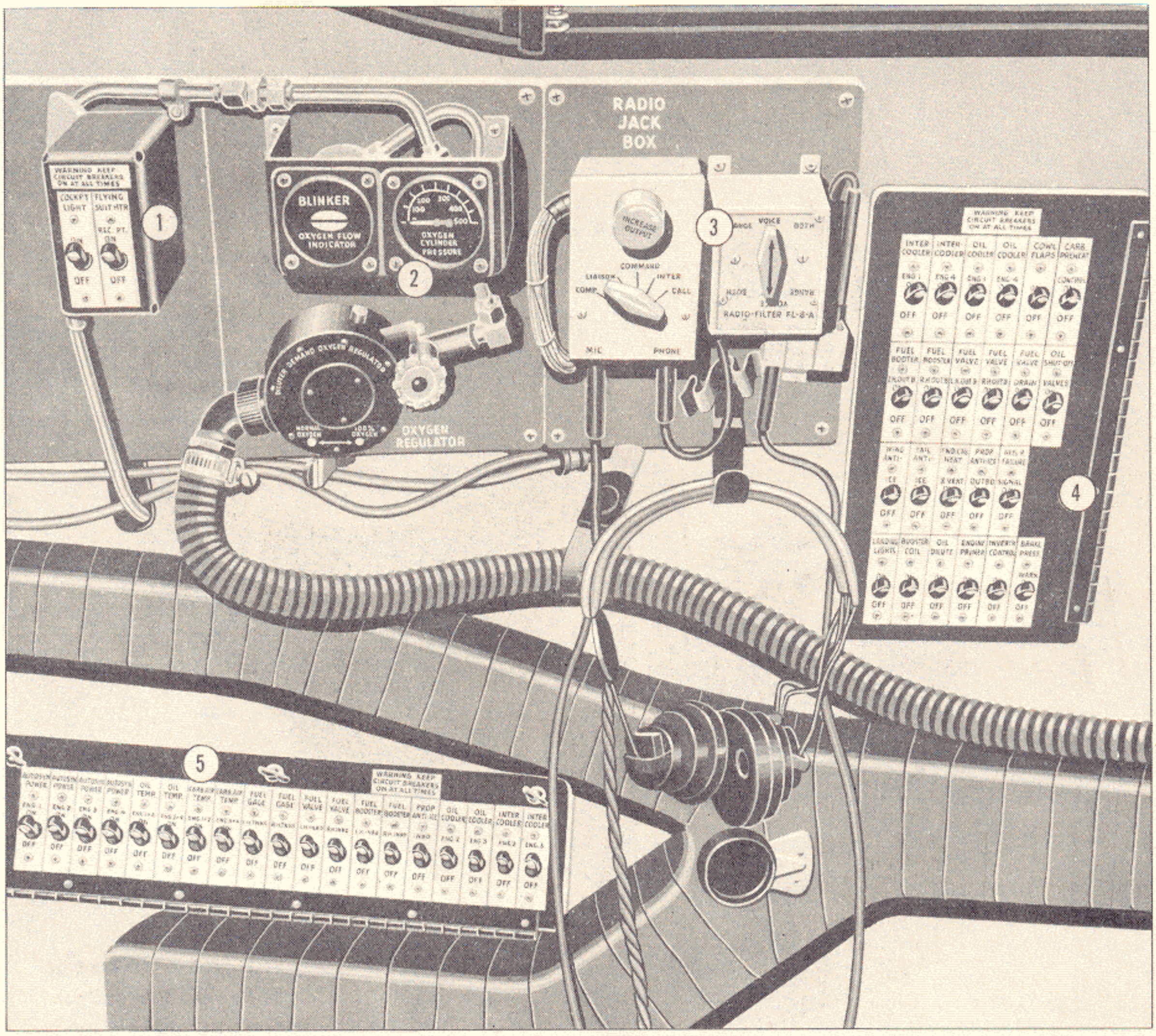


AIRPLANE COMMANDER'S CIRCUIT BREAKER PANEL

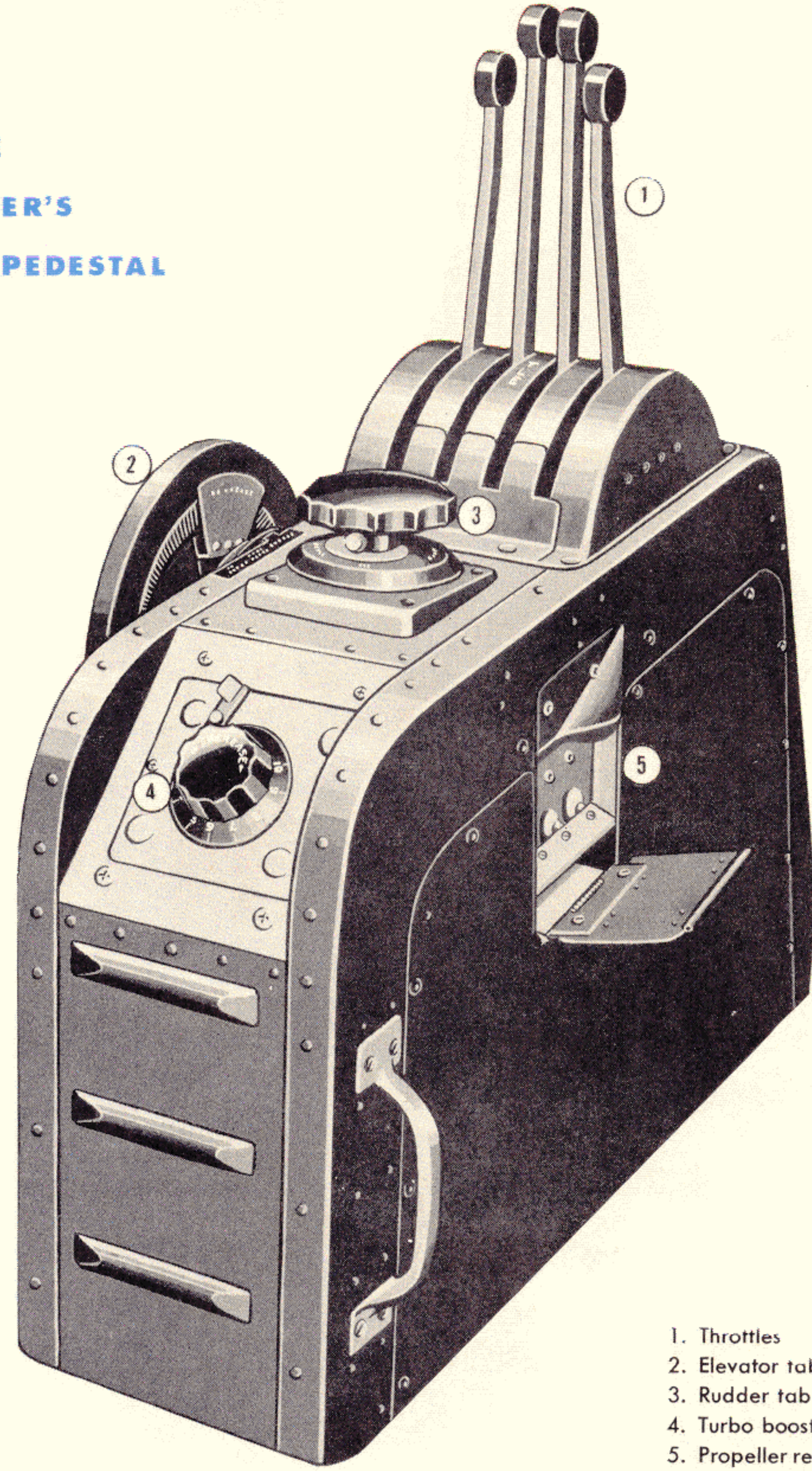
1. Circuit breakers
2. Radio jack box and filter
3. Circuit breakers
4. Recognition light control panel
5. Oxygen panel

COPILOT'S CIRCUIT BREAKER PANEL

1. Circuit breakers
2. Oxygen panel
3. Radio jack box and filter
4. Circuit breakers
5. Circuit breakers

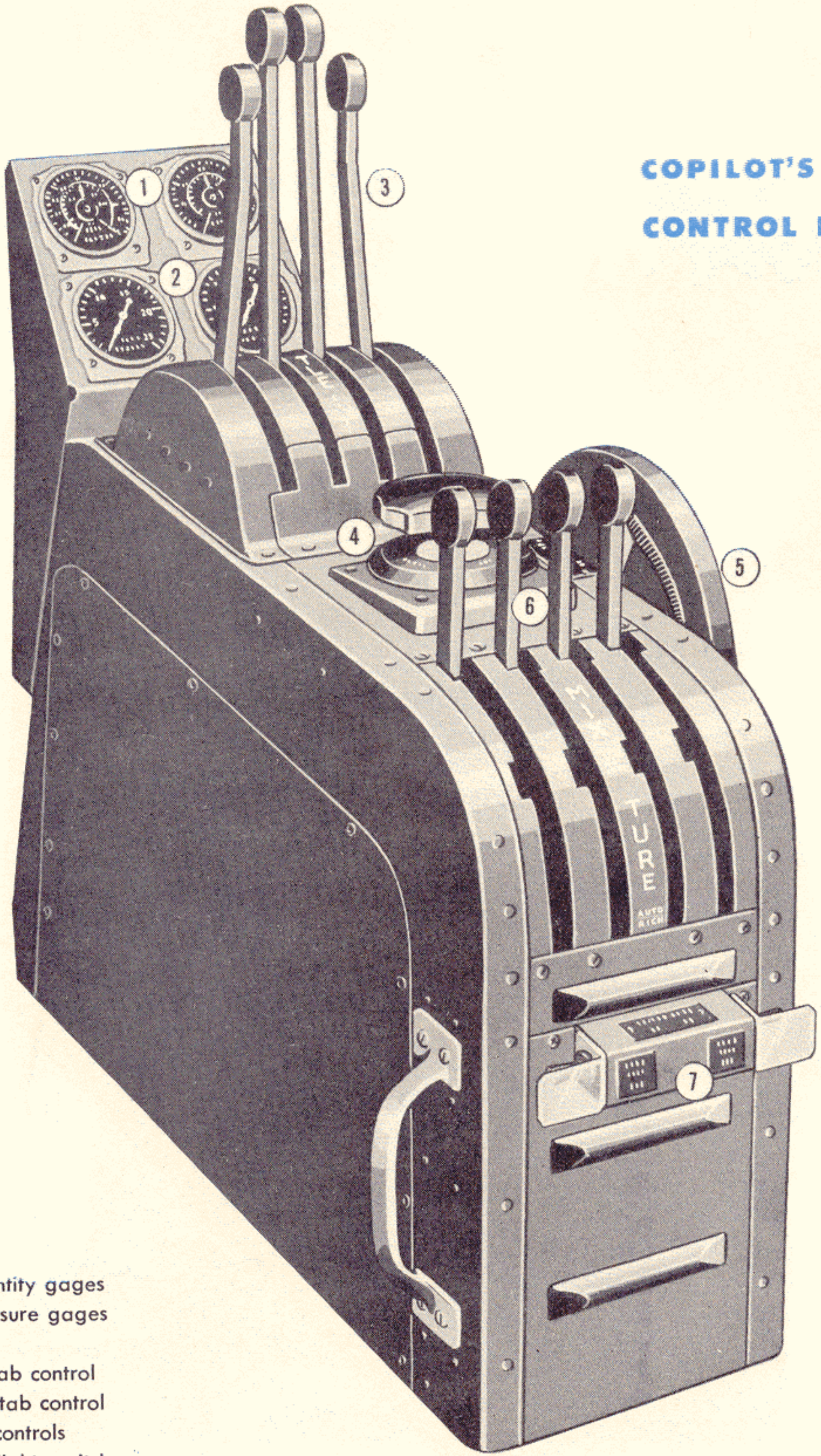


AIRPLANE COMMANDER'S CONTROL PEDESTAL

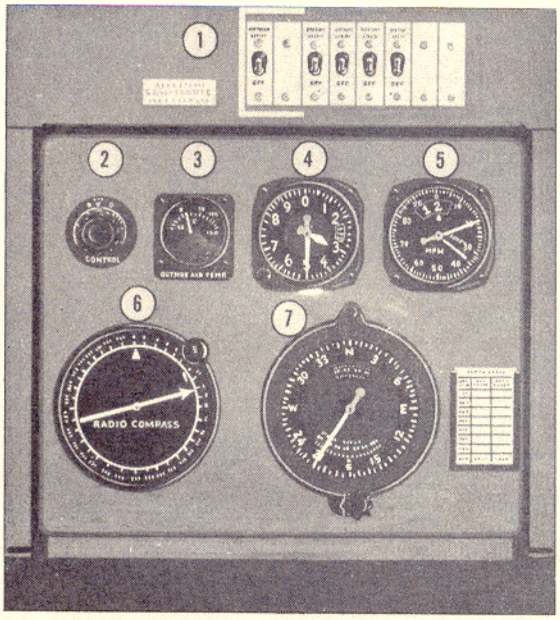


1. Throttles
2. Elevator tab control
3. Rudder tab control
4. Turbo boost selector
5. Propeller reverse switches

COPILOT'S CONTROL PEDESTAL



1. Fuel quantity gages
2. Fuel pressure gages
3. Throttles
4. Rudder tab control
5. Elevator tab control
6. Mixture controls
7. Landing lights switches

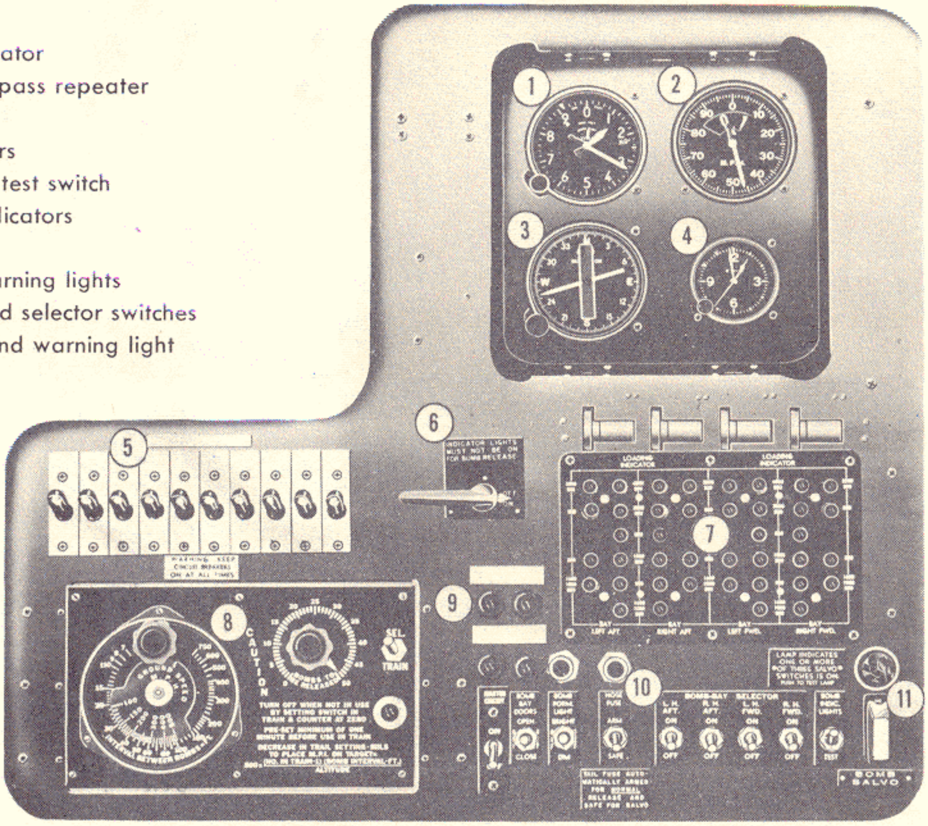


NAVIGATOR'S PANEL

1. Circuit breakers
2. Autopilot turn control knob
3. Free air temperature
4. Altimeter
5. Airspeed indicator
6. Radio compass indicator
7. Master flux gate indicator

BOMBARDIER'S PANEL

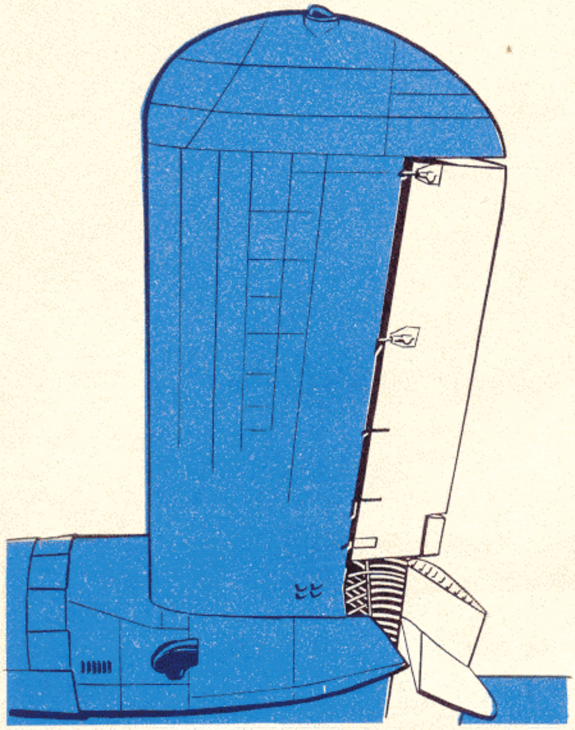
1. Altimeter
2. Airspeed indicator
3. Flux gate compass repeater
4. Clock
5. Circuit breakers
6. Indicator light test switch
7. Bomb load indicators
8. Intervalometer
9. Bomb door warning lights
10. Door, light, and selector switches
11. Salvo switch and warning light



Preflight Inspections

It is your responsibility as airplane commander to know before each flight that your airplane is in proper flying condition. Transition training procedure requires you to perform the accompanying airplane commander's preflight inspection, signing the inspection checklist form before takeoff. Continue to make this inspection before all flights throughout your career as a B-32 airplane commander. For speed and efficiency, always make the inspection the same way, following the route shown in the diagram.

AIRPLANE COMMANDER'S PREFLIGHT INSPECTION

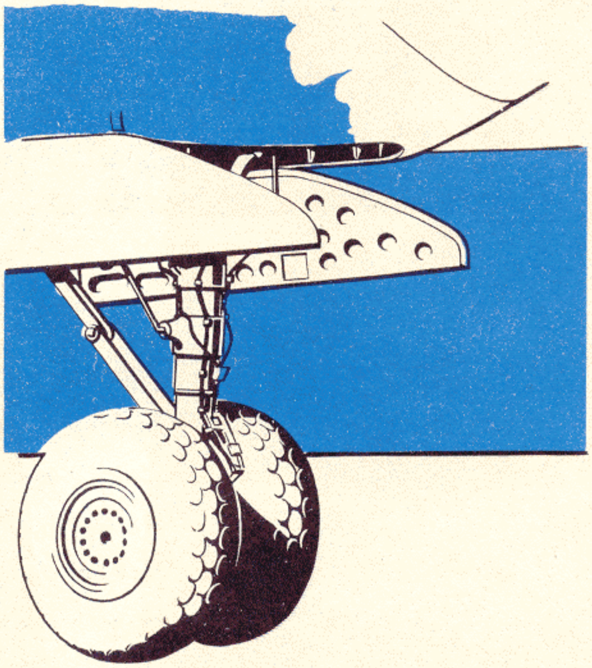


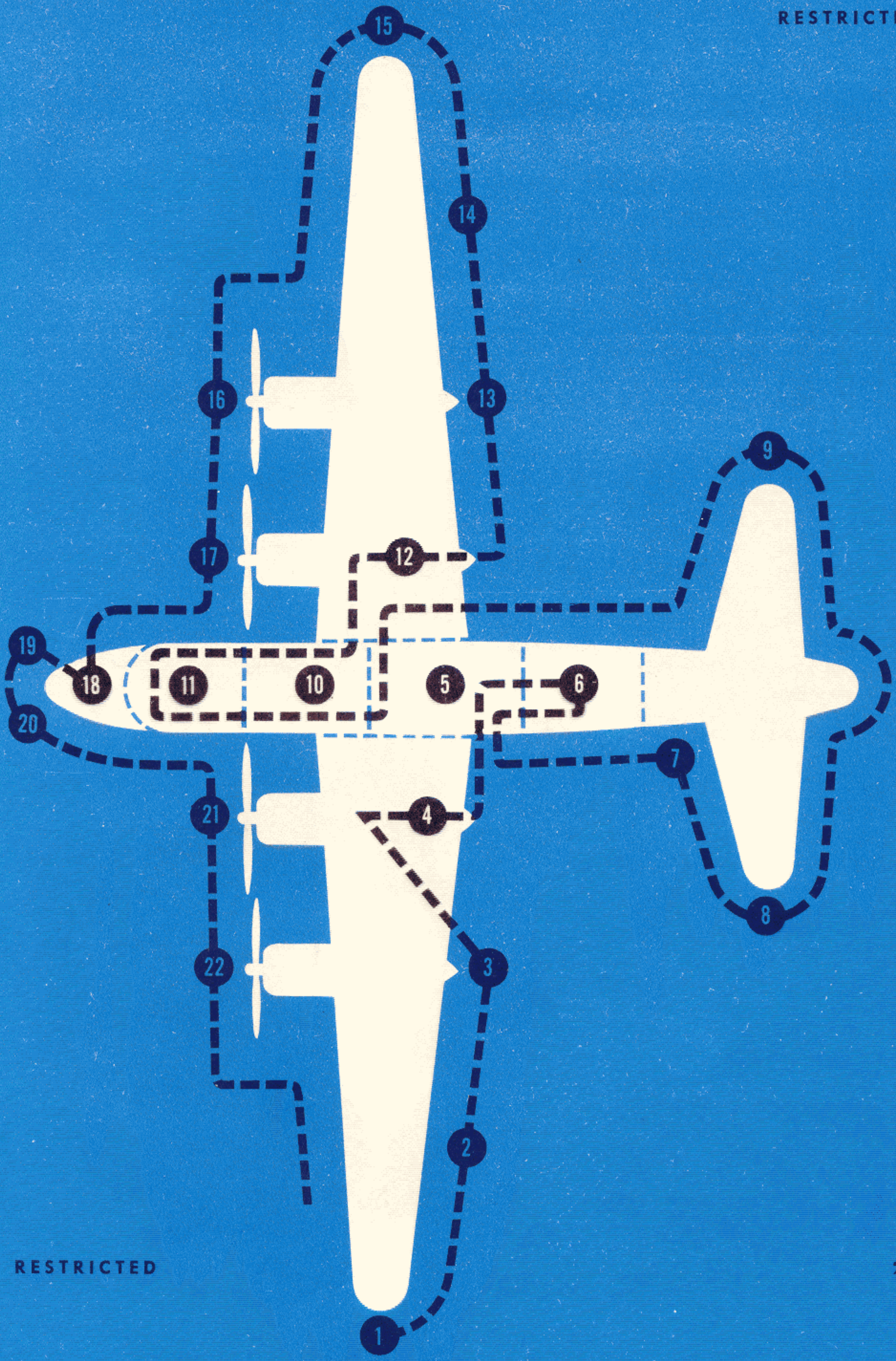
1. **Left wing tip:** Check leading edge of wing tip for condition, and wing tip skin for cleanliness, freedom from wrinkles, missing rivets, damage. Check running light to see that it is clean and undamaged. Walk around to aft side of wing tip.

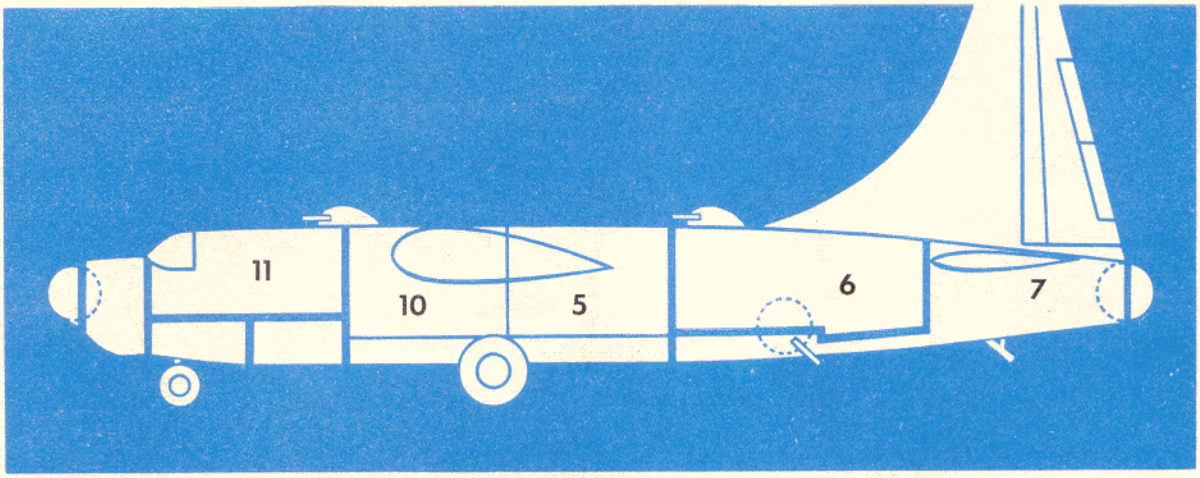
2. **Left aileron:** Check condition of aileron fabric and aileron hinges. Check condition of aileron tab.

3. **No. 1 nacelle and left outboard flap:** Check nacelle for loose fasteners, evidence of oil leaks. Use a flashlight to look up into primary heat exchanger dump flap and make sure that Y valve is open, so that primary heated air dumps overboard. Check flaps for condition, flap hinges, and visible cables and pulleys for fraying. Check condition of wing between No. 1 and No. 2 nacelles. Check stress plates for security. Check fuel cell area for leaks, particularly around selector valve area.

4. **Left main gear, No. 2 nacelle, and left inboard flap:** Check oleo strut for proper inflation (2-11/16" clearance). Check gear accumulator pressure (normal—350 to 450 lbs). Check tire inflation, using gage if practicable (normal pressure up to 100,000 lbs gross load—77 psi). Check tires for condition and slippage and brakes for evidence of hydraulic leaks. Inspect all hydraulic lines in wheel well for security and evidence of leaks. Look for signs of fuel leaks in well, and check fuel draincocks to be sure they are safetied. Check liquidometer gage for fuel quantity. Check down locks for security and see that ground locks are removed. Check shock strut down lock assembly and latch release lever for clearances—approximately ⅛" each. Check No. 2 nacelle and inboard flap as you did No. 1 nacelle and outboard flap. Check fuel cell area for leaks. Enter rear bomb bay.




15
14
13
16
9
17
12
19
18
11
10
5
6
20
7
21
4
22
3
8
2
1

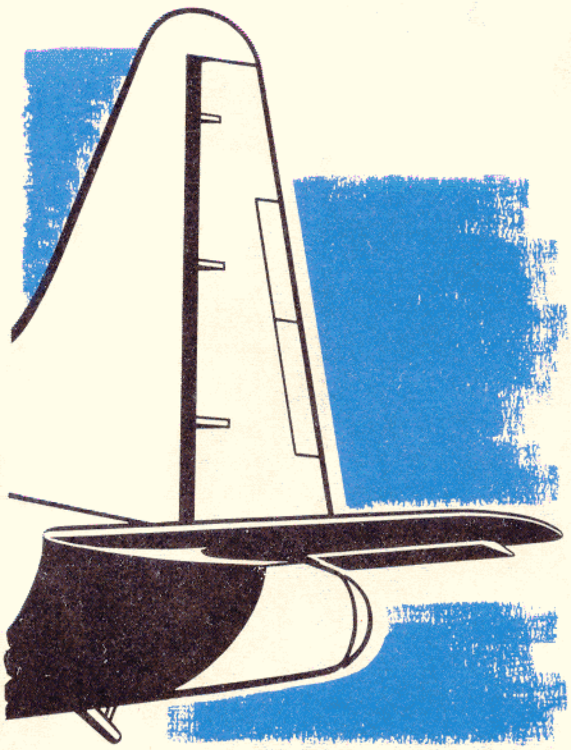


5. **Rear bomb bay:** Check flap cables and pulleys for fraying and for proper tension. Check for hydraulic leaks around flap motors. Check condition of flaps, looking out along spar from top of bomb bay. Check all electrical and hydraulic lines for security. Check for evidence of hydraulic leaks throughout bomb bay, including area around bomb door motors. Check CO_2 and oxygen bottles, hand crank, gear box, prop anti-icer pumps, radio equipment, and any other necessary equipment present for security, proper stowage, and freedom from damage. Enter rear compartment.

6. **Rear compartment:** Check for proper stowage and security of equipment, including extra hydraulic and anti-icing fluid if present, covers for nacelles, turrets, and windshields. Check lower turret for full retraction and security. Check presence and accessibility of parachutes, and inspect each pack for general condition of pack, elastics, ripcord pins and seal. Look at inspection record card on each pack to be sure pack has been inspected and re-packed at proper time. Check scanning blisters for cleanliness. Check tail section for security of ballast in training ships, and for proper stowage and security of any other equipment carried there. Exit through bomb bay, left side.

7. **Aft fuselage section:** Check left side of rear fuselage for general condition. Check tailskid air-oil shock strut for proper pressure (550 to 650 psi). Proceed aft to left side of tail.

8. **Left side of empennage:** Check left elevator and left side of rudder for condition of fabric and skin, of hinges, and of tabs. Check condition of tail de-icer boots, if present, looking for cracks and damage. Walk around to rear of airplane and check running lights and bomb release light for cleanliness and freedom from damage. Stand back from tail and note position of all elevator, rudder, and aileron tabs, and cross-check the positions of the tab indicators when you get up to the flight deck.



9. **Right side of empennage:** Repeat the foregoing checks on the right side of the rudder and the right elevator. Walk forward, checking condition of the right aft fuselage section. Note top turret for proper position. Then enter forward bomb bay.

10. **Forward bomb bay:** Inspect fuel selector valves and hose connections for security, and look carefully for signs of fuel leaks. Check liquidometer gages for fuel quantity. Check main and brake hydraulic reservoirs for correct fluid levels. Check brake accumulators, main hydraulic selector valve, and all hydraulic lines and connections for security and for leaks. Check all electric and fuel lines for security. Look for leaks in fuel cell areas. Check fuel draincocks for safetying. Inspect visible control cables for proper tension and for signs of fraying. Check recognition lights for cleanliness and freedom from damage, and lower antennas for security. Enter flight compartment.

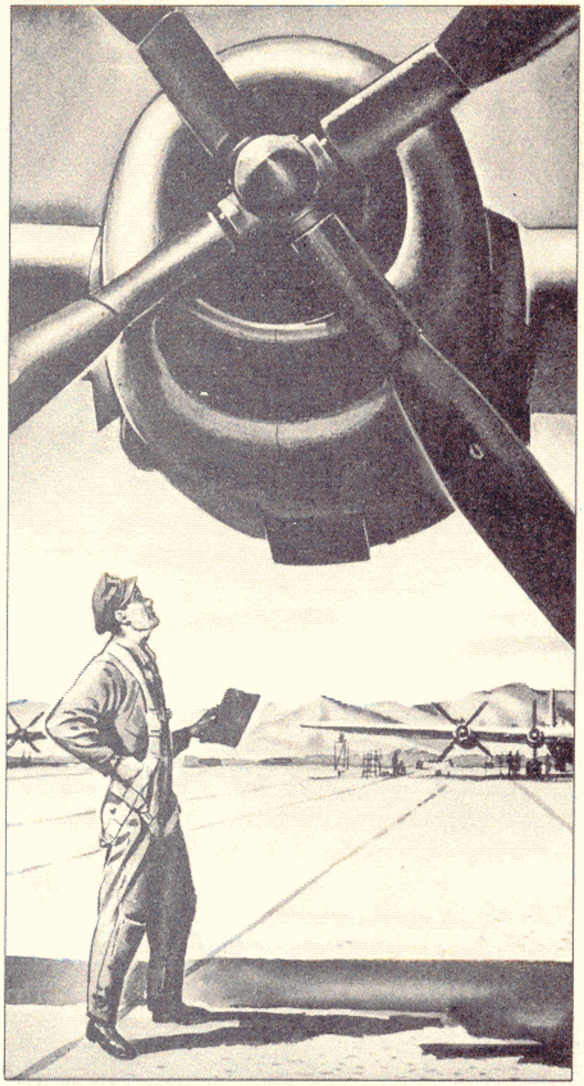
11. **Flight compartment:** Check emergency hydraulic reservoir for correct fluid level. Check whole compartment for security and proper stowage of equipment. Check parachutes for presence and accessibility and repeat the inspection of each pack which you made on those in the rear compartment. Check positions of tab indicators to see that they agree with the positions of the tab surfaces. Check ignition and battery switches for OFF position so that you can safely check the props when you go out again. Check Forms 1, 1A, and F (loading). Check for availability and proper stowage of maps and radio aid charts. Check spare light bulb and turbo fuse boxes to see that necessary bulbs and fuses are there. Check forward upper turret, if present, for security. Exit through forward bomb bay, right side.

12. **Right main gear, No. 3 nacelle, and right inboard flap:** Repeat the checks you made on the left gear, No. 2 nacelle, and the left inboard flap.

13. **No. 4 nacelle and right outboard flap:** Repeat the checks you made on No. 1 nacelle and left outboard flap.

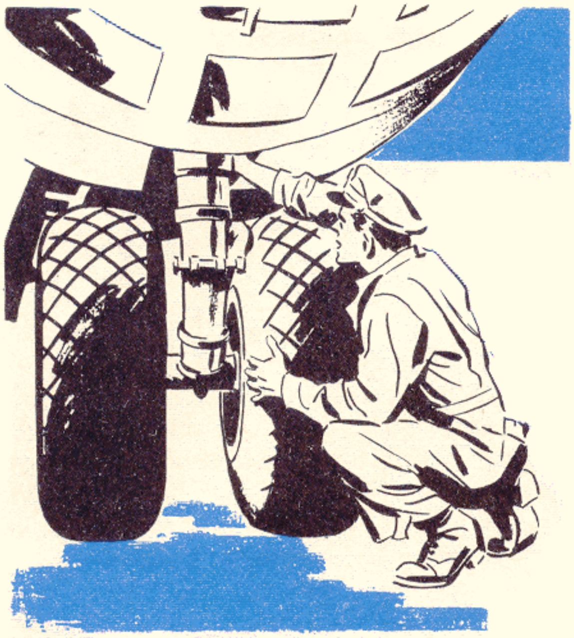
14. **Right aileron:** Repeat the checks you made on the left aileron.

15. **Right wing tip:** Repeat the checks you made on the left wing tip.



16. **No. 4 propeller and engine:** Inspect nose section for oil leaks, or foreign matter wedged into scoops or between cylinders. Check engine for general cleanliness. Check propeller for cleanliness, for nicks and abrasions, and for security of mounting. Look for anti-icer fluid leaks, and visually check the security of the anti-icing slinger ring.

17. **No. 3 propeller and engine:** Repeat the checks you made on No. 4 propeller and engine. Then enter nosewheel well.



18. **Nose gear assembly:** Check nose gear tires for condition, proper inflation (45 to 50 psi), and slippage. See that wheels are in line with centerline of airplane. Check the oleo strut for proper inflation (3⅛" clearance). Check down locks for security. Check hydraulic lines, pistons, and connections for leaks. Check for buckling of skin at suspension points, indicating beginning of structural failure from excessive torque loads. Exit nosewheel well to right side.

19. **Right nose section:** Check general condition of right side of nose section. Check landing light for full retraction and for cleanliness. Rub cover of static pressure source to drain condensation. See that pitot cover is removed. Walk around to front and check nose turret for proper position. If your airplane has no nose turret, check the passing light for cleanliness and freedom from damage.

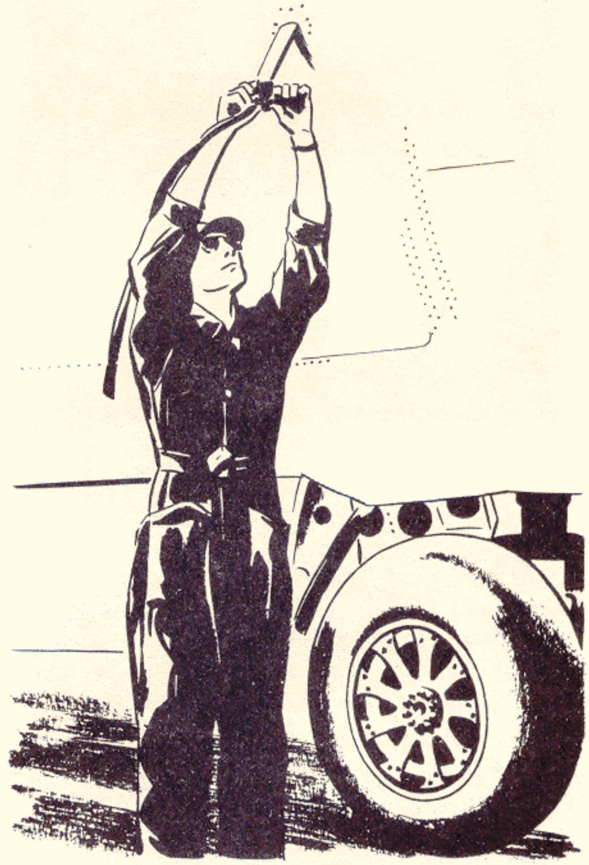
20. **Left nose section:** Repeat the checks you made on the right nose section.

21. **No. 2 propeller and engine:** Repeat the checks you made on No. 4 propeller and engine.

22. **No. 1 propeller and engine:** Repeat the checks you made on No. 4 propeller and engine. Then assemble crew for inspection.

AERIAL ENGINEER'S PREFLIGHT INSPECTION

Check over the following preflight inspection, performed by your aerial engineer, so that you are aware of what is done to your airplane before flight. This is a sample inspection as performed in transition training operations. Check your student aerial engineer periodically to be sure that he knows these inspection duties and can perform them efficiently.



1. Remove pitot cover.
2. Enter flight deck; check all switches on bombardier's panel for OFF position.

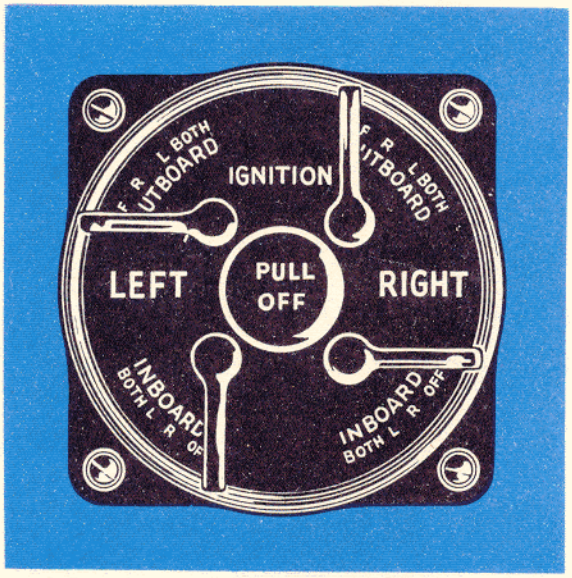
3. Check Forms 1 and 1A and parachutes, if aboard.

4. Set generator voltmeter to APP, all generator switches to OFF position.

5. Turn electric hydraulic pump control to OFF position. Check circuit breaker for ON position.

6. Check fire extinguisher.

7. Check oxygen pressures and masks, if aboard—six gages: bombardier's, airplane commander's, pilot's, navigator's, radio operator's, and forward settee gage.



8. Check ignition switches for OFF position.

9. Check all propeller switches for normal positions.

10. Check all electrical units for OFF positions, landing gear and flap switches for neutral.

11. Check engine controls.

12. Check propellers clear, and turn battery on.

13. Start APP; idle with APP generator switch in LOAD position.

Note: If external power source is available, use it instead of APP for ground operation.

14. Check controls for freedom of movement and position, with assistance of another man checking outside.

15. Set tabs for right wing down, right rudder, and nose down.

16. Lock controls.

17. Set APP throttle to RUN position and check output.

18. Check cowl flaps and leave open.

19. Check propeller master motor and control knob, leaving control at 2800 rpm.

20. Check propeller anti-icers.

21. Check instrument panel lights, landing lights, recognition lights, formation, passing, and running lights.

22. Open and close intercooler flaps manually. Then open or close flaps manually, depending on temperature, and set to AUTOMATIC position to check automatic operation.

23. Open and close oil cooler flaps manually. Then open or close manually, depending on temperature, and set to AUTOMATIC position to check automatic operation.

24. Turn fuel selector valves to TANK TO ENGINE position, and drain valve to CROSS-FEED.

25. Turn fuel selector valve circuit breakers to OFF position.

26. Turn No. 1 booster pump to LOW position, and move mixture control out of IDLE CUT-OFF momentarily until you note a rise in pressure, then return mixture control to IDLE CUT-OFF. Turn off booster pump. Repeat this procedure on Nos. 2, 3, and 4 engines.

Note: This procedure checks the operation of the lock pins in the selector valves when the current is cut, thus insuring flow to the engine in event of solenoid failure. Avoid leaving mixture control out of IDLE CUT-OFF any longer than absolutely necessary because that procedure may produce liquid lock in the lower cylinders.

27. Turn fuel selector valve circuit breakers to ON position.

28. Check all other circuit breakers for ON position.

29. Set parking brakes and check accumulator pressure drop.

30. Check main and spare inverters, leaving switch in MAIN ON position.

31. Check AC voltage.

32. Check fluid level in emergency reservoir.

33. Turn hydraulic pump control switch to ON position and check brake pressure.

34. Lower inboard and outboard flaps with emergency hydraulic system.

35. Open bomb bay doors with emergency hydraulic system.

36. Return all selector switches to OFF and switchover valve to BRAKE SYSTEM ON.

37. Check brake over-ride switch; check all electrical switches for OFF position.

38. Turn pitot heat to ON position for 10 seconds; then to OFF.

39. Turn APP and battery switches to OFF position.

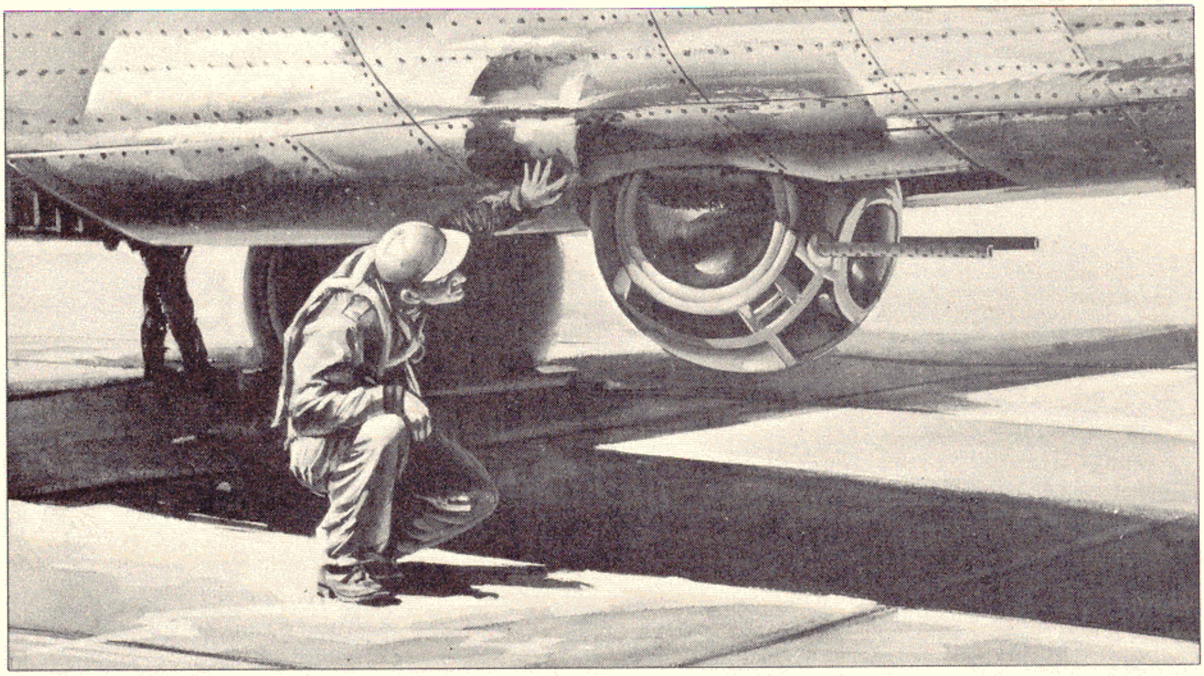
40. Turn electric hydraulic pump control switch to OFF position.

Exit Through Bomb Bays and Check

1. Lower exterior of airplane.
2. Pitot mast for heat.
3. Control access plates.
4. Nosewheels, tires, strut, for inflation and condition.
5. Nosewheel well and mechanism.
6. Circuit breakers under flight deck, station 3.0.
7. Turbo amplifiers, spare, and battery.
8. Main wheel well and mechanism, including accumulator in wheel well.
9. Main wheels, tires, struts, gear mechanism, for condition and inflation.
10. Outboard fuel tank level indicator.
11. Brake bleeder valve.
12. Chocks in place for quick removal.
13. Cables, pulleys, and turnbuckle safetying, under the flaps.
14. Engine cowlings, Nos. 1 and 2 (or 3 and 4) engines.
15. Exhaust bolts, through flap opening.
16. Condition of aileron fabric.
17. Tabs, for right wing down.
18. Fuel cell vents and access plates.
19. Flaps, upper surface, for rubbing.
20. Oil cooler air exit and flap for position.
21. Engine and cabin air intakes.
22. Fuselage and empennage, including rupture discs for CO_2 bottles.
23. Tailskid and shock strut inflation.
24. De-icer boots, if installed.
25. Control surface fabric on empennage.
26. Tabs, for right rudder and nose down.
27. Other side of airplane: repeat inspection.

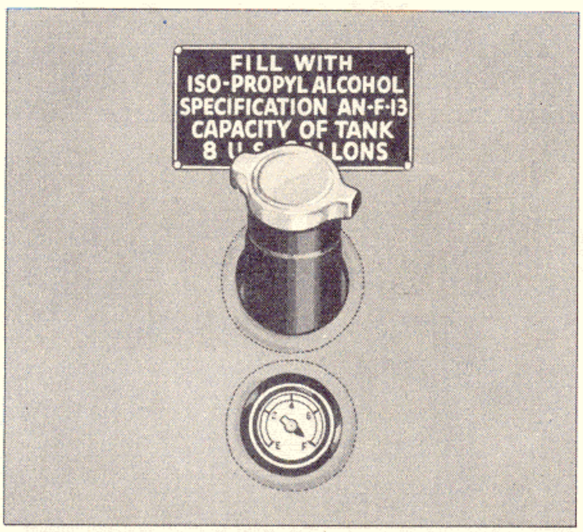
Enter Bomb Bays and Check

1. Forward compartment: APP controls and unit, brake valves, hydraulic units and lines.



2. Fluid level in main and brake reservoirs.
3. Accumulators.
4. Control cables, pulleys, turnbuckles, tension regulators, and attachments.
5. Hydraulic units: selector valve, hydraulic pump, pressure switch, etc., and selector valve relay circuit breaker for ON position.
6. Inboard fuel tanks fluid level indicators, fuel lines, and fuel valves in bomb bays.
7. Access plates under center section.
8. Flap cables, drums, and motors.
9. Aileron control locks, autopilot servo unit, and CO_2 bottles.
10. Propeller anti-icer tank for leaks.

Enter Aft Cabin and Check



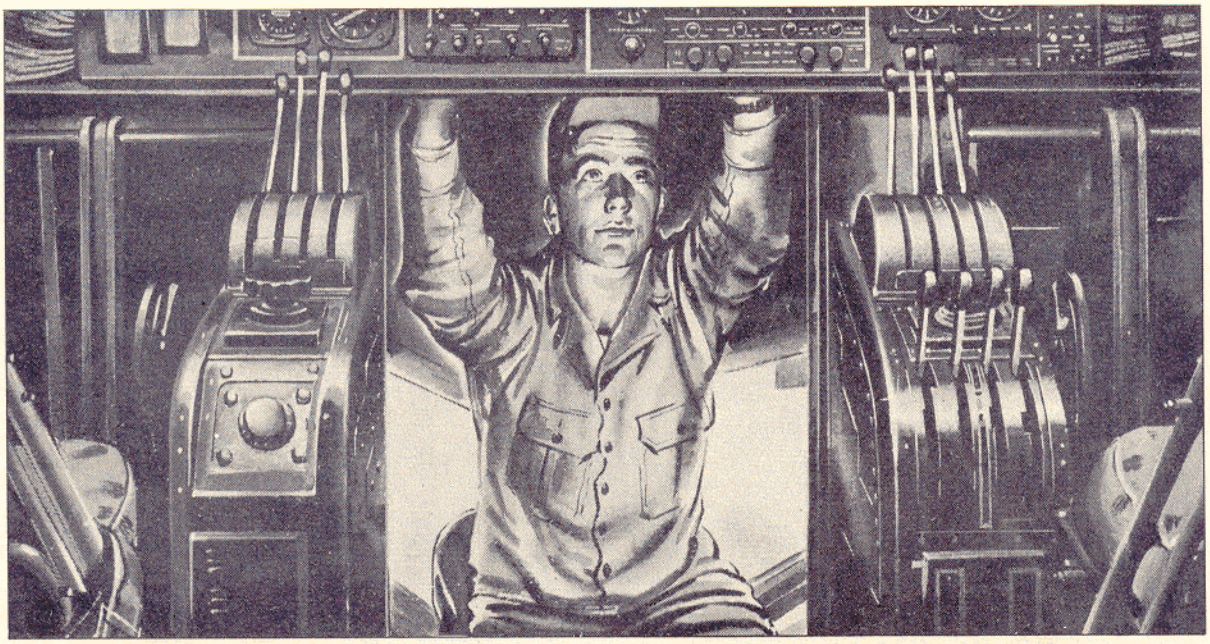
1. Anti-icer fluid level and reservoir filler cap.
2. Oxygen pressure and masks, if aboard.
3. Fire extinguisher.
4. Turrets locked.
5. Hatches closed.

Enter Tail Compartment and Check

1. Empennage attachment bolts.
2. Control cables, pulleys, control locks, and attachments.
3. All loose equipment for proper stowage.
4. Tail turret locked.
5. Return to cockpit and set tab controls to neutral. Turn battery on to set aileron tab; off after operation.

Climb on Top of Airplane and Check

1. Aileron fabric.
2. Aileron tabs for neutral.
3. Fuel and oil quantity and proper installation of caps.
4. Engine cowling and fasteners.
5. Engine exhaust bolts through cowl flap opening.
6. Carburetor, for leaks, with mixture control on and booster pump on HIGH.
7. Antennas for security.
8. Intercooler flaps for proper position.
9. De-icer boots, if installed, and tabs on empennage for neutral.
10. Turrets.
11. Life rafts.
12. Clean windshields.

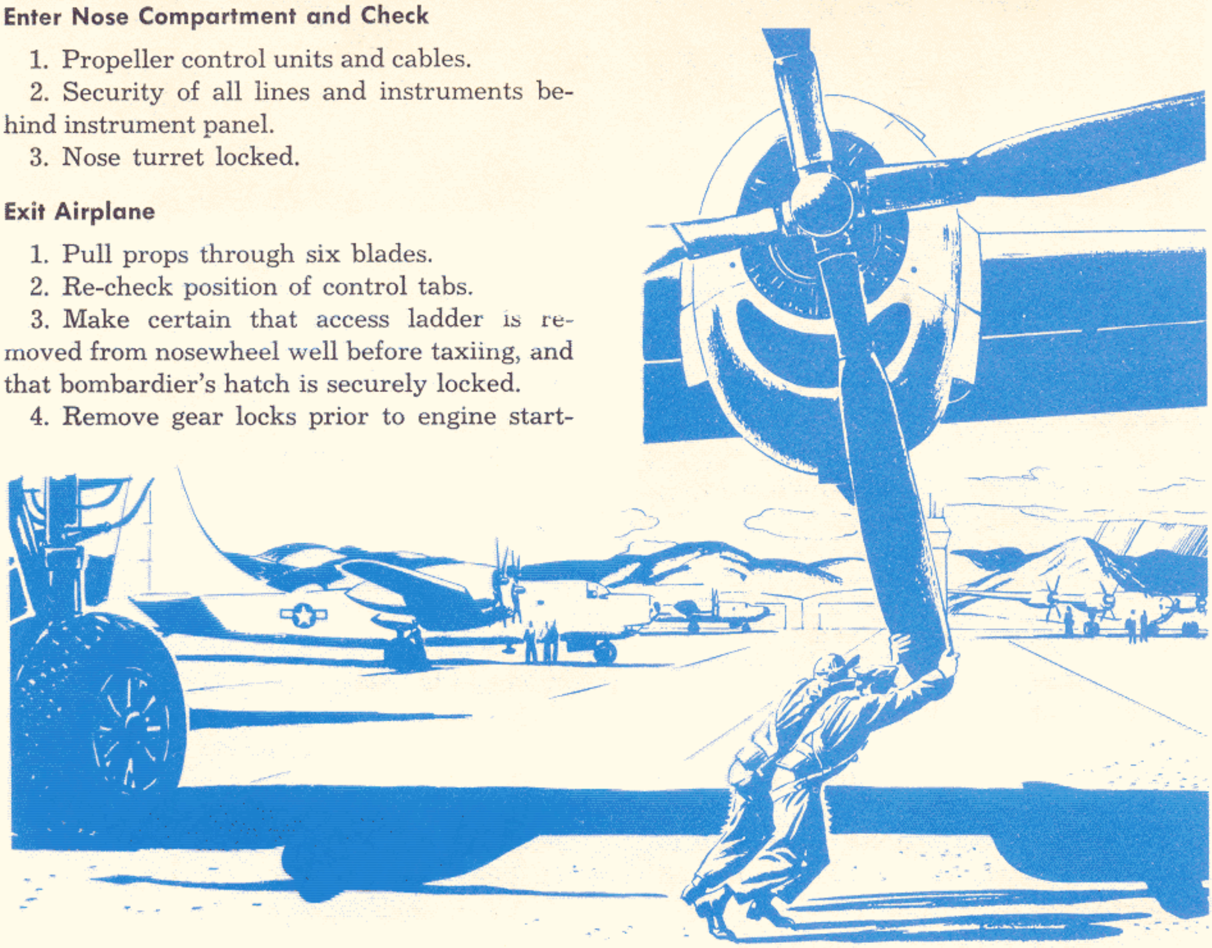


Enter Nose Compartment and Check

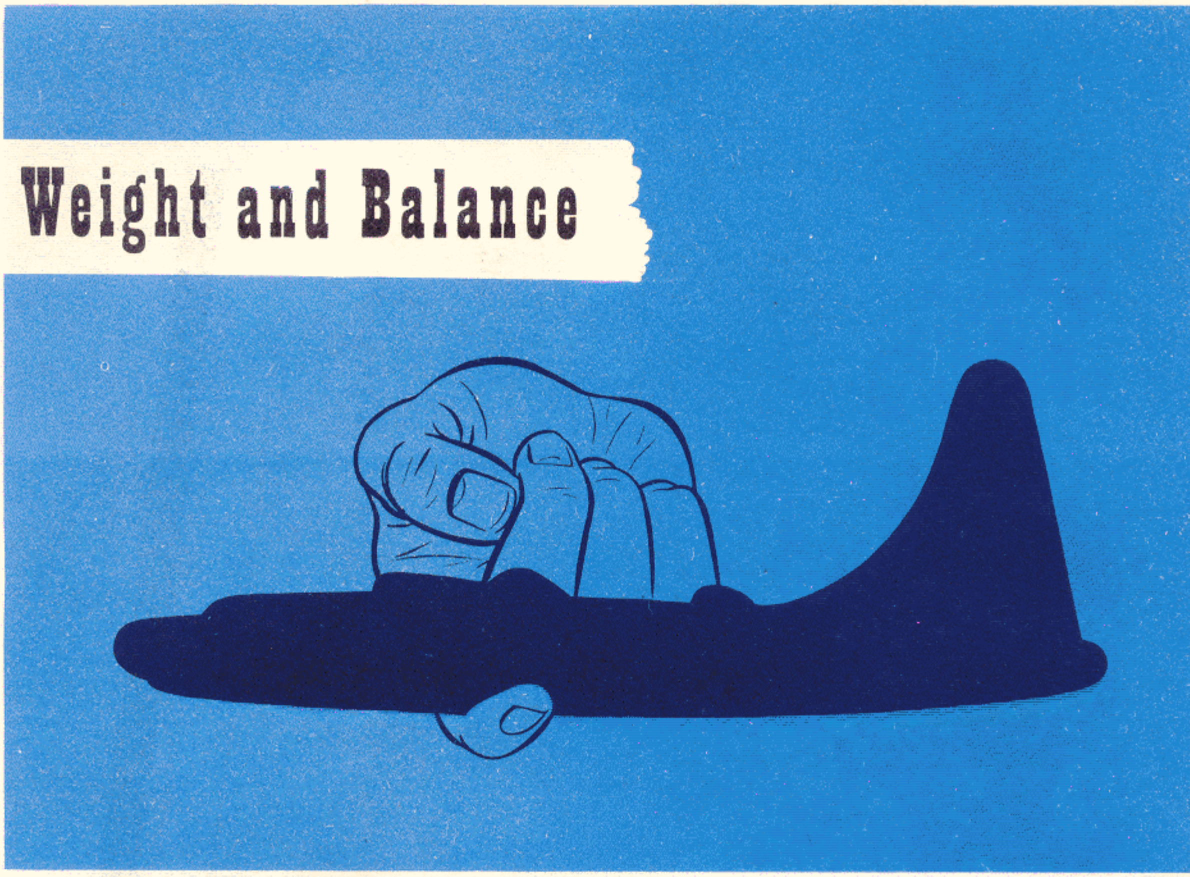
1. Propeller control units and cables.
2. Security of all lines and instruments behind instrument panel.
3. Nose turret locked.

Exit Airplane

1. Pull props through six blades.
2. Re-check position of control tabs.
3. Make certain that access ladder is removed from nosewheel well before taxiing, and that bombardier's hatch is securely locked.
4. Remove gear locks prior to engine start-



Weight and Balance



Weight and balance is as important in the B-32 as it is in any large airplane. Proper loading permits getting the most out of this high performance ship, while improper loading cuts down on the efficiency of the airplane and may even cause a crash.

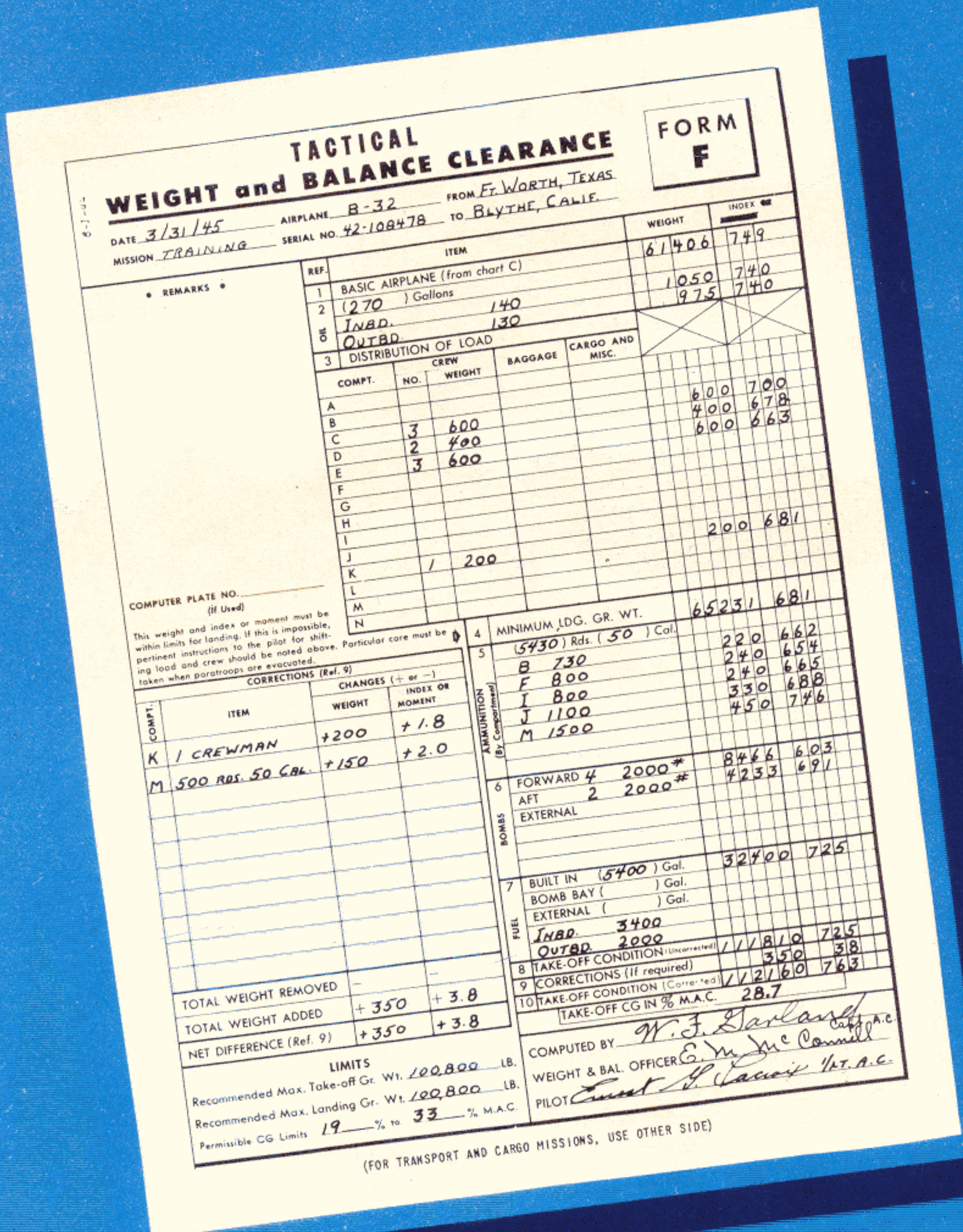
The routine of transition training often causes pilots to slight weight and balance precautions. In your daily flights with lightly loaded B-32's, without armament, weight distribution is of less importance and you tend to overlook it. But while you are in transition, form the habit of making out the loading list carefully and submitting it regularly so that later you automatically think of proper loading and the Form F as your first inspection.

You should know how to use a load adjuster and how to make out a Form F. Remember that the tactical Air Force you join expects you to know weight and balance. Read and understand the weight and balance information in T. O. AN 01-1B-40. Examine your copilot and flight engineer on their knowledge of weight and balance.

Check the basic weight of your B-32 carefully. Remember that yours is a new airplane which may have undergone modification affecting the basic weight. Be sure the basic weight you are using applies to your airplane.

For best operation the center of gravity must be well within the allowable range of limits, as near 25% MAC as possible. If it is not within limits, you have difficulty getting on the step, and have to use excessive trim, slowing your airspeed and increasing your fuel consumption.

The forward CG limit of the B-32 is 19% MAC, and the aft limit is 33% MAC. All loads in all compartments of the airplane not part of the basic airplane must be calculated with the load adjuster. For practice and to be sure you understand the procedure, follow through the sample Form F computation in this section.



TACTICAL WEIGHT and BALANCE CLEARANCE

FORM F

DATE 3/31/45 AIRPLANE B-32 FROM Ft. Worth, Texas

MISSION Training SERIAL NO. 42-108478 TO Blythe, Calif.

• REMARKS •

REF.	ITEM	WEIGHT	INDEX
1	BASIC AIRPLANE (from chart C)	61406	749
2	(270) Gallons		
OIL	Inbd. 140	1050	740
	Outbd. 130	975	740
3	DISTRIBUTION OF LOAD		

COMPT.	CREW NO.	CREW WEIGHT	BAGGAGE	CARGO AND MISC.	WEIGHT	INDEX
A						
B	3	600			600	700
C	2	400			400	678
D	3	600			600	663
E						
F						
G						
H						
I						
J	1	200			200	681
K						
L						
M						
N						

REF.	ITEM	WEIGHT	INDEX
		65231	681
4	MINIMUM LDG. GR. WT.		
5 AMMUNITION (By Compartment)	(5430) Rds. (50) Cal.	220	662
	B 730	240	654
	F 800	240	665
	I 800	330	688
	J 1100	450	746
	M 1500		
6 BOMBS	FORWARD 4 2000#	8466	603
	AFT 2 2000#	4233	691
	EXTERNAL		
		32400	725
7 FUEL	BUILT IN (5400) Gal.		
	BOMB BAY ( ) Gal.		
	EXTERNAL ( ) Gal.		
	Inbd. 3400		
	Outbd. 2000	111810	725
8	TAKE-OFF CONDITION (Uncorrected)	350	38
9	CORRECTIONS (If required)	112160	763
10	TAKE-OFF CONDITION (Corrected)		
	TAKE-OFF CG IN % M.A.C.	28.7	

COMPUTER PLATE NO. ________ (If Used)

This weight and index or moment must be within limits for landing. If this is impossible, pertinent instructions to the pilot for shifting load and crew should be noted above. Particular care must be taken when paratroops are evacuated.

CORRECTIONS (Ref. 9)

COMPT.	ITEM	CHANGES (+ or −) WEIGHT	INDEX OR MOMENT
		+200	+1.8
K	1 Crewman	+150	+2.0
M	500 Rds. 50 Cal.		
	TOTAL WEIGHT REMOVED	−	−
	TOTAL WEIGHT ADDED	+350	+3.8
	NET DIFFERENCE (Ref. 9)	+350	+3.8

LIMITS

Recommended Max. Take-off Gr. Wt. 100,800 LB.

Recommended Max. Landing Gr. Wt. 100,800 LB.

Permissible CG Limits 19 % to 33 % M.A.C.

COMPUTED BY W. F. Garland Capt. A.C.

WEIGHT & BAL. OFFICER E. M. McConnell 1/Lt. A.C.

PILOT Ernest G. Lacroix

(FOR TRANSPORT AND CARGO MISSIONS, USE OTHER SIDE)

OVERLOADING

CG TOO FAR FORWARD

CG TOO FAR AFT

EFFECTS OF IMPROPER LOADING

Overloading

1. Causes a higher stalling speed.
2. Results in lowering of airplane structural safety factors.
3. Reduces maneuverability.
4. Increases takeoff run.
5. Lowers angle and rate of climb.
6. Decreases ceiling.
7. Increases fuel consumption for given speed (decrease in miles per gallon).
8. Decreases range.
9. Lowers tire factors.

CG Too Far Forward

1. Produces oscillating tendency with resultant strain on pilot during instrument flying.
2. May cause critical condition during flap operation.
3. Increases difficulty in getting nose up during landing.
4. Overstresses nose gear.
5. Results in dangerous condition if tail structure is damaged or surface is shot away.

CG Too Far Aft

1. Creates unstable condition.
2. Increases stall tendency.
3. Increases pilot strain in instrument flying.
4. Results in dangerous condition if tail structure is damaged or surface is shot away.
5. May result in a stall before recovery is possible from a sudden up or down gust. In this situation the elevator is trimmed to keep the nose down. Each bump throws the nose up. In case of a severe bump there is little elevator travel left to bring the nose down, making recovery difficult.

Abbreviated Checklists

You already know the value of the checklist. On the B-32 it is even more important than it was on your B-24 or B-17. The B-32 is bigger with more equipment and more procedures to remember, and you must use the checklist correctly to fly the airplane safely.

In transition training the second student airplane commander, stationed on the flight deck behind you, reads off the checklist items. With a combat crew your copilot reads them. Be sure that each item is read clearly, audibly, and completely. The man reading the checklist should index each item with his thumb to be sure he overlooks nothing. Have the crew member who performs the prescribed duty repeat the item in its entirety as soon as the action is complete. For example, the copilot reads "Gear switch—NEUTRAL" and the engineer checks the switch, then repeats "Gear switch—NEUTRAL."

Only by following this procedure faithfully can you be sure that the instruction is understood, that the action is completed, and that nothing is overlooked. Don't let the man reading the checklist proceed to the next item until the prescribed crew member has repeated the instructions, indicating that the action has been done.

All checklists for the airplane are included in this section in their abbreviated forms, convenient for reference and study. The amplifications of these checklists, describing each action in detail, are taken up in subsequent sections of this manual, in the order you deal with them in normal operations.

BEFORE STARTING ENGINES

1. Crew inspection—COMPLETED.
2. Forms 1 and 1A and loading—CHECKED.
3. Flight controls—CHECKED.
4. Pitot covers—REMOVED.
5. Wheel chocks—IN PLACE.
6. Electrical units—OFF.

Radios	Carburetor heat
Booster pumps	Oil coolers
Autopilot	Intercoolers
Prop master motor	Lights
Pitot heater	Windshield wipers
Inverter	Hydraulic pump
Anti-icer	

7. Gear switch—NEUTRAL.
8. Battery—ON.
9. APP—IDLE.
10. Gyros—UNCAGED.
11. Turbos—OFF.
12. Mixture controls—IDLE CUT-OFF.
13. APP—RUN, LOAD, VOLTAGE CHECKED.
14. Inverter—SPARE ON, CHECKED.
15. Cowl flaps—OPEN.
16. Intercoolers—AUTOMATIC.
17. Oil coolers—AUTOMATIC.
18. Carburetor air filters—AS REQUIRED.
19. Propeller controls:
    Ready switch—SAFE.
    Selector switches—AUTOMATIC.
    Master motor switch—ON.
    Master tach—2800 RPM.
    Reverse switches—NORMAL.
20. All circuit breakers—ON.
21. Electric hydraulic pump—ON.
22. Parking brakes—ON.
23. Fuel valves—TANK TO ENGINE.
24. Booster pumps—LOW.

STARTING ENGINES

1. Fire guard—POSTED.
2. Master ignition—ON.
3. Start engines—3, 4, 2, 1.
4. Fuel and oil pressures—CHECKED.
5. Remove wheel chocks.
6. No. 1 and No. 4 engine generators—ON.
7. APP equalizer—ON.
8. Inverter—MAIN ON, CHECKED.
9. Flight indicators and suction—CHECKED.
10. Booster pumps—OFF.
11. Interphone and alarm bell—CHECKED.
12. Exercise flaps—CHECKED.

BEFORE TAXIING

1. All instruments—CHECKED.
2. Radio, altimeter, time—CHECKED.
3. Wheel chocks—REMOVED.

BEFORE TAKEOFF

Items with asterisk for subsequent takeoffs.

*1. Mixture controls—AUTO RICH.
2. Propeller controls—CHECKED.
   Reverse
   *Automatic
*3. Master tachometer—2800 RPM.
*4. Magnetos and turbos—CHECKED.
*5. Gyros—SET AND UNCAGED.
*6. Wing flaps—AS REQUIRED.
*7. Trim tabs—SET.
*8. Flight controls—CHECKED FREE.
*9. Doors and hatches—CLOSED.
*10. Cylinder head temperatures—CHECKED.
*11. Booster pumps—HIGH.
*12. Turbos—SET TO 8.
*13. Cowl flaps—AS REQUIRED.
*14. Generators—CHECKED AND ON.
*15. Interphone—CHECKED.

AFTER TAKEOFF

Items with asterisk for subsequent takeoffs and running takeoffs.

*1. Brakes—APPLIED.
*2. Gear—UP.
*3. Power reduction—42", 2400 RPM.
*4. Wing flaps—UP.
*5. Power reduction—AS REQUIRED.
*6. Cylinder head temperatures—CHECKED.
*7. APP—AS REQUIRED.
*8. Booster pumps—OFF.

BEFORE LANDING

*Items with asterisk for subsequent landings and running takeoffs.

1. APP idle, load, and equalizer—ON.
2. Radio call and altimeter—CHECKED.
*3. Crew positions—CHECKED.
*4. Electric hydraulic pump—ON.
*5. Fuel valves—TANK TO ENGINE.
*6. Booster pumps—HIGH.
7. Autopilot—OFF.
*8. Brake pressure—CHECKED.
*9. Mixture controls—AUTO RICH.
*10. APP throttle—RUN.
*11. Wing flaps—10°.
*12. Gear—DOWN.
*13. Master tachometer—2300 RPM.
*14. Gear check—DOWN AND LOCKED.
*15. Cowl flaps—AS REQUIRED.

FINAL APPROACH

*Items with asterisk for subsequent landings and running takeoffs.

*1. Turbos—SET.
*2. Master tachometer—2400 RPM.
*3. Flaps—40°.

AFTER LANDING

1. Ready and reverse—ON GROUND ONLY.
2. Reverse switches—NORMAL AND SAFE.
3. Cowl flaps—OPEN.
4. Booster pumps—OFF.
5. Turbos—OFF.
6. Master tachometer—2800 RPM.
7. Wing flaps—UP.
8. No. 2 and No. 3 generators—OFF.
9. Bomb doors—OPEN (airplane commander's option).

SECURING AIRPLANE

1. Parking brakes—ON.
2. Master ignition—CHECKED (700 rpm).
3. No. 1 and No. 4 engine generators—OFF.
4. Mixture controls—IDLE CUT-OFF.
5. Ignition switches—OFF.
6. Fuel valves—OFF.
7. Electrical units—OFF.
8. Flight controls—LOCKED.
9. Wheel chocks—IN PLACE; brakes—OFF.
10. Load, equalizer, and battery—OFF.
11. APP—IDLE, THEN OFF.

SCANNERS' CHECKLIST

Be sure that your scanners know how and when to perform all the following duties:

1. Participate in crew inspection.
2. Check flight controls on signal from pilots.
3. Post fire guards for starting engines.
4. Pull wheel chocks after engines are started.
5. Take positions in rear compartment and stand by on interphone.
6. Check interphone with pilot before taxiing.
7. Check flaps for 20° positions before takeoff.
8. Call airplane commander after takeoff when gear is up, flaps are up, and if engines show smoking or torching.
9. Call airplane commander every 15 minutes to report condition of engines.
10. Call airplane commander on landings, reporting main gear and tailskid down and flap positions.
11. Check flaps on running takeoffs for 20° positions.

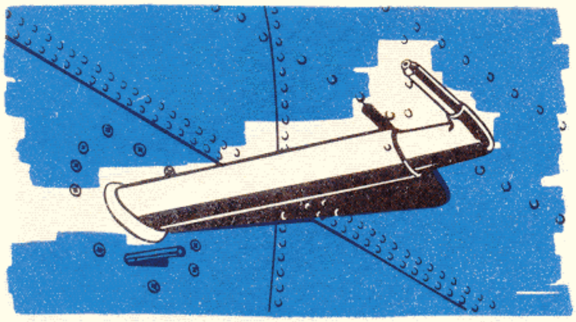
Before Starting Engines

AMPLIFIED CHECKLIST

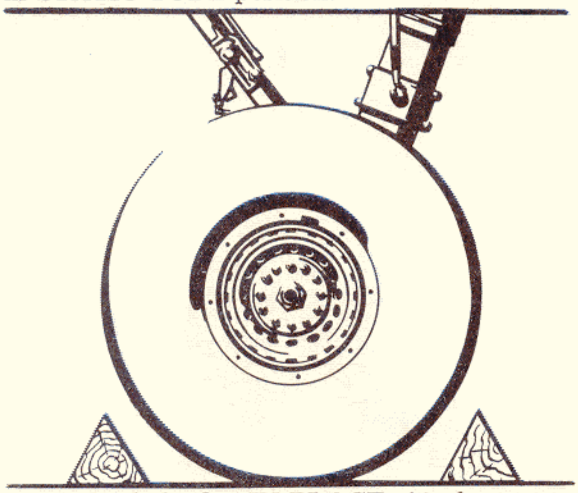
1. **Crew inspection—COMPLETED.** The airplane commander's reply to this item indicates that he has inspected the crew (in accordance with CFTC Memorandum 50-2-4 for transition training) and that his own and the aerial engineer's preflight inspections have been made and airplane and crew found ready for flight.

2. **Forms 1 and 1A and loading—CHECKED.** The airplane commander's reply indicates that he has checked Forms 1 and 1A and the loading list or Form F to see that they are satisfactory and that any defects found in preflight inspections are properly entered on Form 1A.

3. **Flight controls—CHECKED.** Airplane commander and copilot check operation of flight controls, with the assistance of the two scanners, one stationed at the right wing tip and one at the left wing tip. As the airplane commander exercises each control surface, the scanners call out the positions of the surfaces to airplane commander and copilot. At the same time both airplane commander and copilot check cockpit controls for free movement to extreme positions: 180° each way wheel turn, 10" rudder pedal travel, full fore and aft column travel.



4. **Pitot covers—REMOVED.** The airplane commander looks out to see that the pitot cover is off the left mast and the copilot does the same for the right mast. Airplane commander checks static pressure selector switch to see that it is in STATIC TUBE position.



5. **Wheel chocks—IN PLACE.** Airplane commander and copilot look back from their respective windows to see that wheel chocks are in place in front and behind the main gear, out a few inches from the tire. Airplane commander and copilot report "IN PLACE LEFT," and "IN PLACE RIGHT."

6. **Electrical units—OFF.** The copilot calls out the units, and each crew member checks the switches nearest his position to be sure that they are in OFF position. These switches and the crew member who checks each are as follows:

Radios—airplane commander checks command set and radio compass; designated crew members check other sets

Booster pumps—engineer

Autopilot—airplane commander

Prop master motor—engineer

Pitot heater—copilot

Inverter—copilot

Anti-icer—copilot

Carburetor heat—copilot

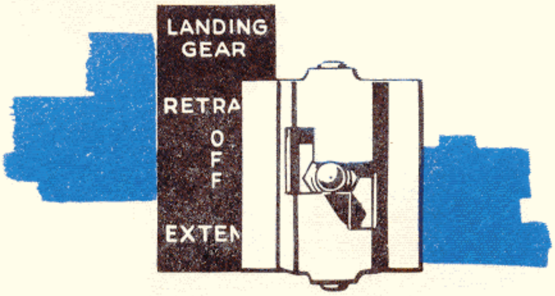
Oil coolers—engineer

Intercoolers—engineer

All lights—all crew members

Windshield wipers—airplane commander and bombardier

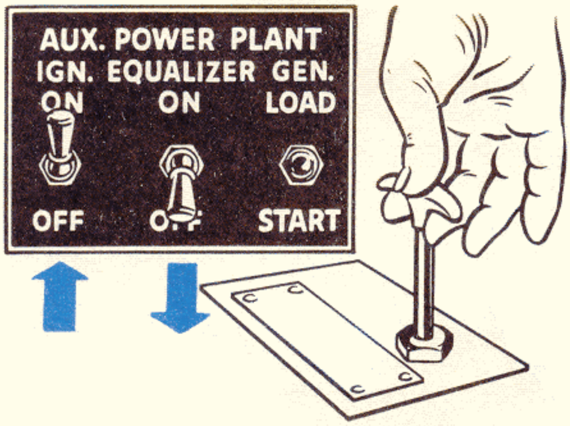
Hydraulic pump—engineer



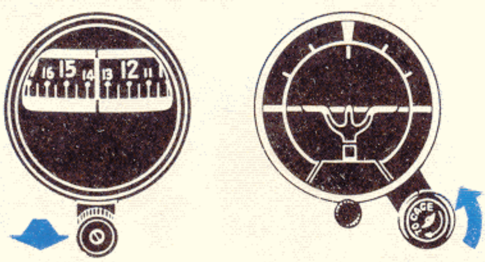
7. **Gear switch—NEUTRAL.** Engineer checks to see that the landing gear switch is in NEUTRAL position, and that the guard is set so that the switch cannot be inadvertently moved to UP position.

8. **Battery—ON.** The copilot checks to see that props are clear, then turns battery switch to ON position.

Note: Recommended procedure for the B-32 is to use an external power source for ground operation during inspections and for starting. If you follow that procedure, leave battery switch off at this point. You can start the APP now and let it idle until engines are started, adjusting your checklist accordingly. However, it has been standard practice to use APP for starting when external power source is not available.

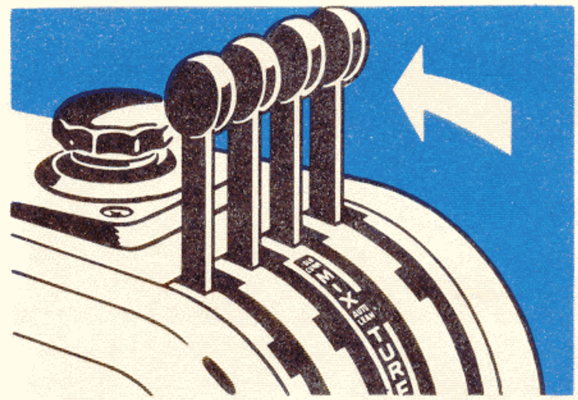


9. **APP—IDLE.** The copilot turns the APP ignition switch to ON position and opens the APP throttle, located on the floor at the right of his seat, to IDLE position. He holds the APP generator switch in START position until the APP starts. Pumping the throttle briefly chokes the engine when necessary in cold weather. He leaves the generator switch in neutral position to let the APP warm up for a few minutes because the application of load too soon may shear the generator drive shaft.



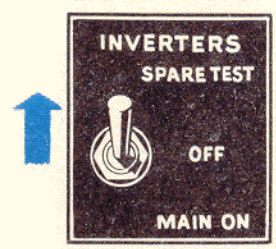
10. **Gyros—UNCAGED.** Airplane commander and copilot check to see that all flight instruments are uncaged, reporting "UNCAGED LEFT" and "UNCAGED RIGHT."

11. **Turbos—OFF.** Engineer checks to see that turbo regulator control knob is set to 0.



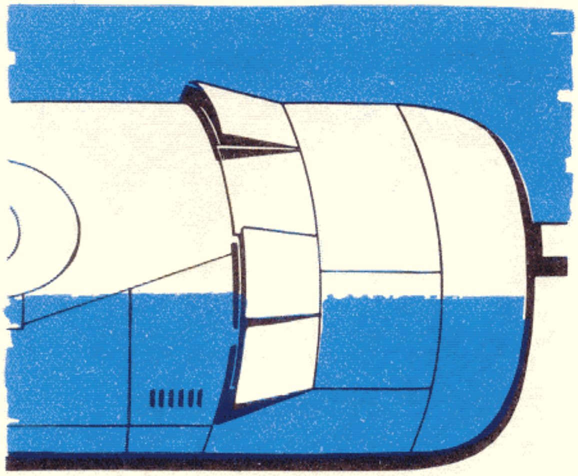
12. **Mixture controls—IDLE CUT-OFF.** Engineer checks to see that mixture controls are in IDLE CUT-OFF position.

13. **APP—RUN, LOAD, VOLTAGE CHECKED.** At this point the APP normally has had time to warm up and the copilot pulls the throttle up to RUN position, then turns the APP generator switch to LOAD. In cold weather it may be necessary to allow more time for the APP to warm up. Engineer checks the APP voltage at the generator panel.

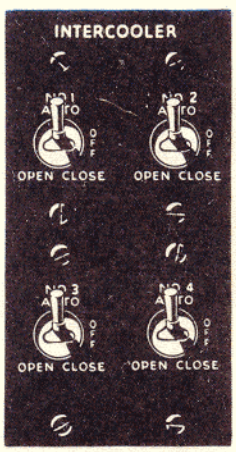


14. **Inverter—SPARE ON, CHECKED.** Copilot turns the inverter switch to SPARE TEST position. You turn the inverter on before starting in order to insure the proper position of the waste gates. You use spare, rather than main, inverter at this point because under the low power output of APP or external power source the automatic changeover relay might kick over to the spare inverter. Copilot checks the warning light on the main panel which indicates that both inverters are out. If this light is on, the spare inverter is out.

15. **Cowl flaps—OPEN.** Airplane commander and copilot check from their respective windows to see that cowl flaps are open, reporting "OPEN LEFT" and "OPEN RIGHT." Never

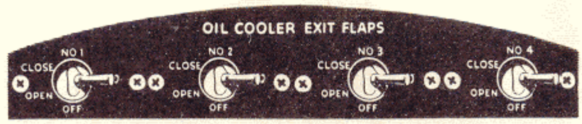


close cowl flaps on the ground to speed engine warm-up; uneven engine cooling and burning of the ignition harness might result.



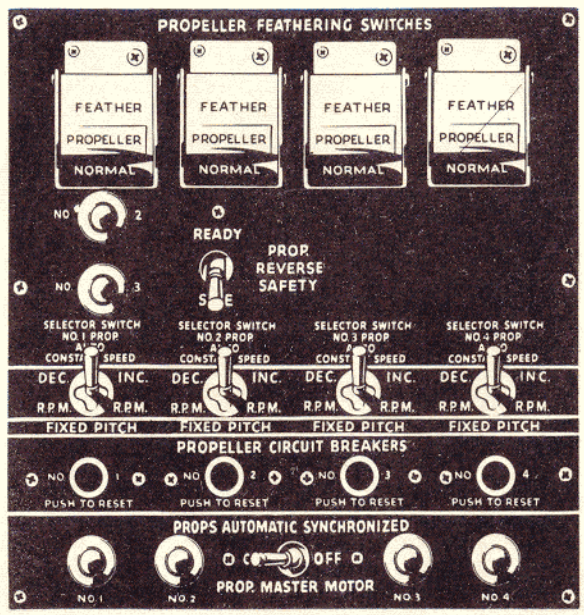
16. **Intercoolers – AUTOMATIC.** Engineer sets intercooler control switches to AUTOMATIC position.

Note: Normal operation of intercoolers and oil coolers is in AUTOMATIC position (items 16 and 17). However, keep careful watch on carburetor, cylinder head, and oil temperatures. If the automatic system fails, or if temperatures run high and you suspect malfunctioning of the automatic system, operate the intercoolers and oil coolers with the switches in MANUAL. Return switches to AUTOMATIC position as soon as practicable after takeoff, unless the automatic system has failed.



17. **Oil coolers – AUTOMATIC.** Engineer puts the oil cooler control switches in AUTOMATIC position.

18. **Carburetor air filters–AS REQUIRED.** When ground conditions warrant, carburetor air filters are used at the direction of the airplane commander. Normally you don't need carburetor air filters except for operation in dust conditions. Copilot reports "NOT REQUIRED" or "ON," as the case may be.

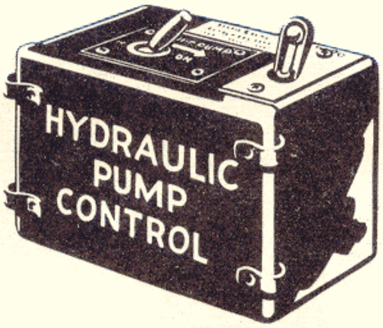


19. **Propeller controls:**

Ready switch–SAFE
Selector switches–AUTOMATIC
Master motor switch–ON
Master tach–2800 RPM
Reverse switches–NORMAL

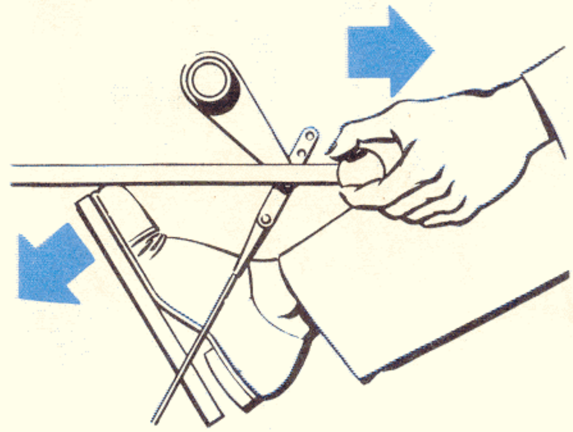
The engineer checks or sets each item at desired position.

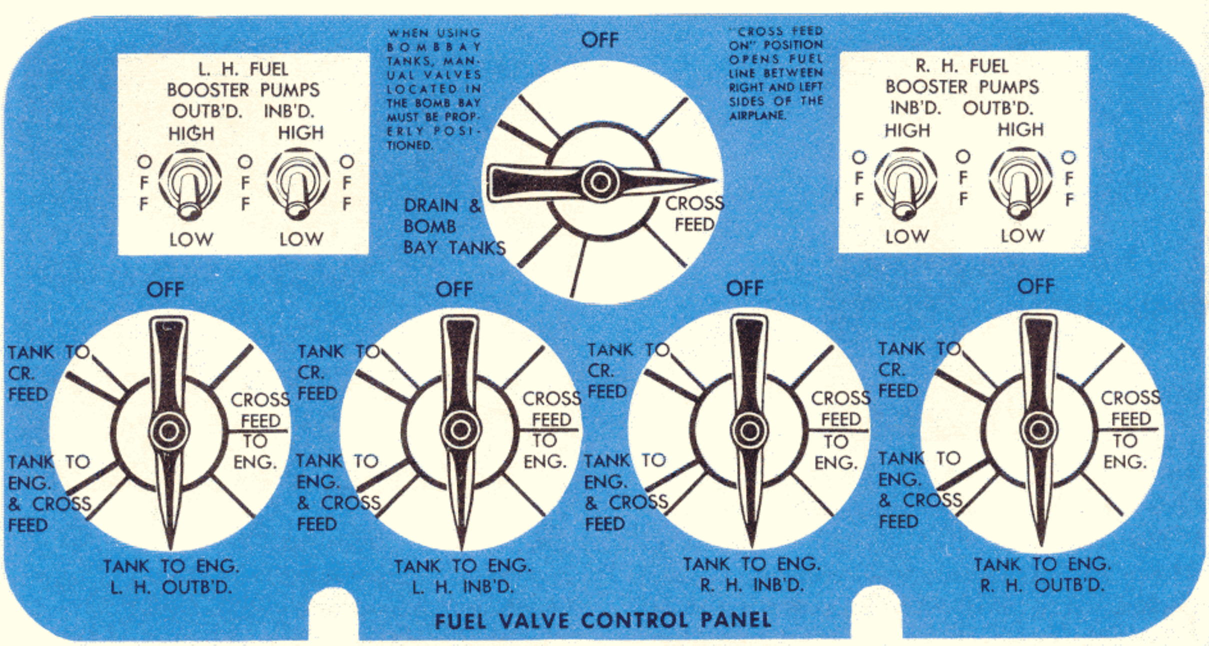
20. **All circuit breakers–ON.** Each crew member checks all circuit breakers at his station to see that they are in ON position and reports to the copilot.



21. **Electric hydraulic pump—ON.** Engineer turns the electric hydraulic pump control switch at station 4.0 to ON position, re-checking the pump circuit breaker for ON position.

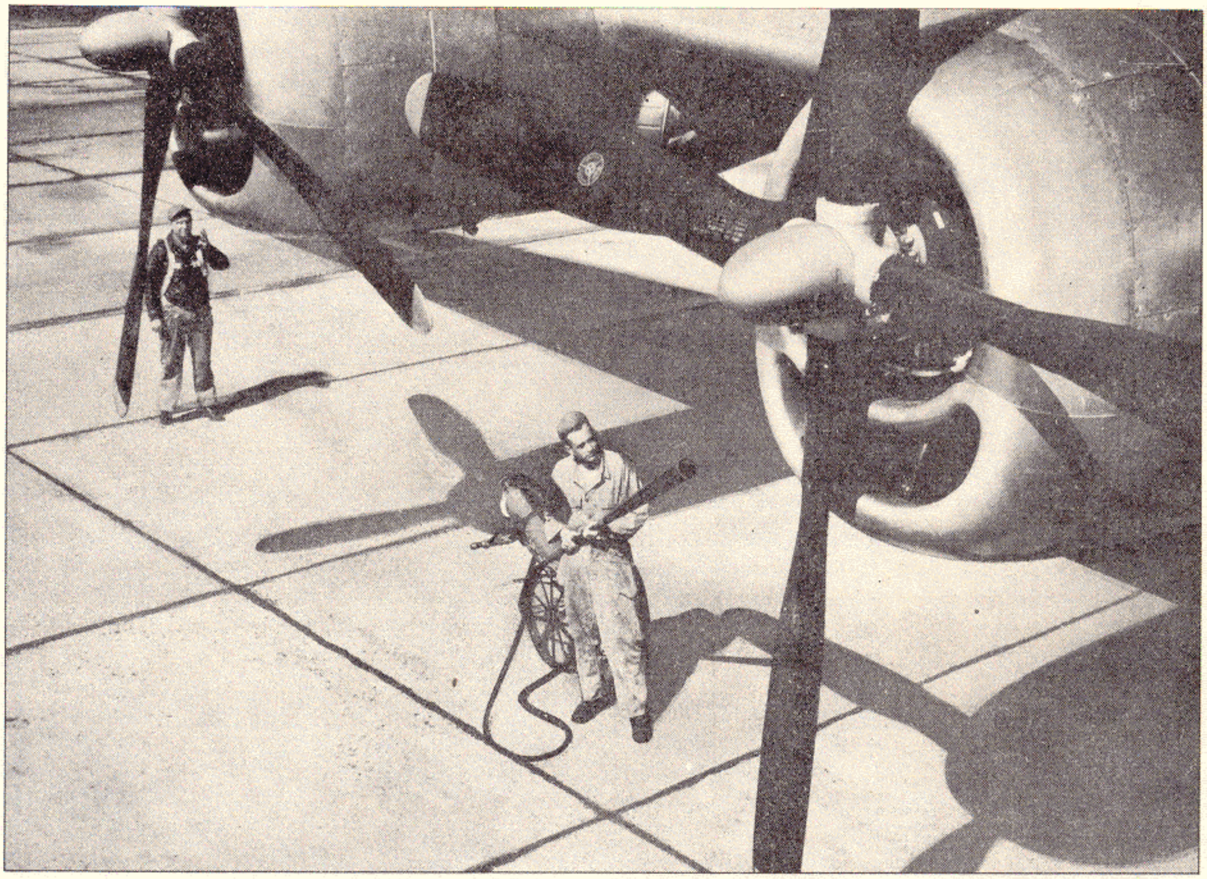
22. **Parking brakes—ON.** Copilot checks brake pressure gages for a minimum pressure of 850 psi. Airplane commander then depresses the brake pedals fully, pulls out on the two lock levers, and releases pedals. During this operation, copilot should watch the pressure gages for a drop in pressure. If the pressure drops below 850 psi, the electric pump should cut in to bring the pressure up.





23. **Fuel valves—TANK TO ENGINE.** Engineer turns all tank selector valves to TANK TO ENGINE position, and drain valve to CROSS-FEED position.

24. **Booster pumps—LOW.** Engineer turns all four booster pump switches to LOW position.



Starting Engines

AMPLIFIED CHECKLIST

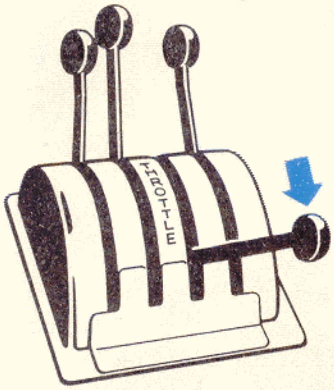
1. **Fire guard—POSTED.** Copilot looks out to see that scanner is posted at wing tip and a ground crewman is standing by as fire guard at No. 3 engine.

2. **Master ignition—ON, CALL CLEAR.** Engineer turns the master ignition switch to ON position. Copilot checks to be sure that nobody is near prop, calls "CLEAR" and hand signals fire guard that he is about to start No. 3 engine.

3. **Start engines 3, 4, 2, 1.** Airplane commander sets throttle and reports "READY ON . . .," indicating that he is ready for the copilot and engineer to start the designated engine. Copilot and engineer start engines in the order 3, 4, 2, 1.

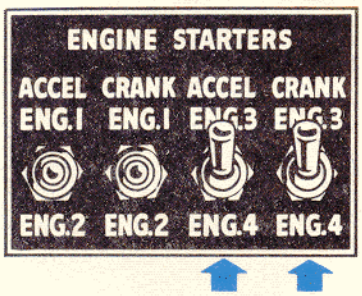
Note: When No. 3 engine is running, and before No. 2 is started, check vacuum gage to see that No. 3 vacuum pump is operating. Have engineer retract flaps to check operation of the hydraulic pump on No. 3 engine. After the flight similarly check operation of the No. 2 vacuum pump and hydraulic pump after stopping No. 3 engine and before stopping No. 2 engine.

NORMAL ENGINE STARTING PROCEDURE

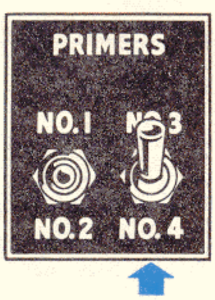


NOTE: See also Engines section for additional tips and precautions on starting. See Cold Weather Operations for low temperature starting.

1. Airplane commander retards throttle to the approximate 1000-1200 rpm position. The throttle controls the amount of air delivered to the engines during starting procedure. If it is too far open, the mixture is too lean for starting; if it is not far enough open, the mixture is too rich. In cold weather and at higher altitude bases it is better to keep the throttle near the lower limit of the 1000-1200 range.



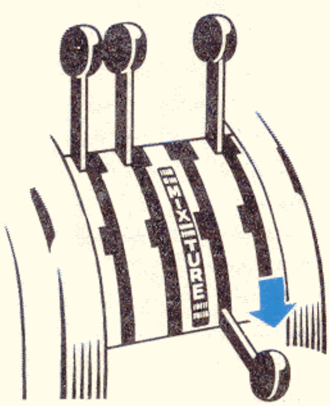
2. The copilot reports "ACCELERATING No. . . . ," and holds the accelerating switch to the desired position for 10 to 12 seconds. Excessive acceleration overspeeds and burns out your starter, and under-acceleration does not turn the engine over fast enough for starting. On accelerating No. 3 and No. 4, copilot has the engineer check APP voltage at the voltmeter, to see that the APP voltage returns to normal before he starts cranking.



3. Copilot then reports "CRANKING No. . . . ," and holds the crank switch to the desired engine, continuing to hold the accelerating switch in position.

4. After the props go through approximately two revolutions, the copilot holds the primer switch to the desired engine and the engineer turns the ignition switch to BOTH position.

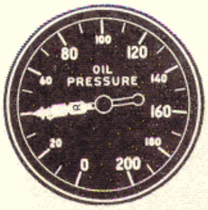
Note: If the engine does not fire, don't crank for longer than a minute. Let the starter motor cool between starting attempts. Don't operate the primer when the engines are not turning over.



5. After the engine fires, run on prime alone until you get at least 800 rpm and it is certain that the engine is going to continue to run.

6. At the direction of the copilot, the engineer moves the mixture control to AUTO RICH. If the engine stops, the engineer must return the mixture to IDLE CUT-OFF, otherwise excess fuel goes to the blower section, increasing the possibility of an engine induction fire or of a liquid lock developing on the next starting attempt.

Note: The AUTO RICH and AUTO LEAN positions deliver the same amount of fuel when the engine is operating below 1200 rpm since only the idling system delivers fuel at engine speeds below 1200 rpm.



10 SECONDS

MAIN

7. As soon as the engine is running, engineer and copilot check oil pressures for rise. If the main oil pressure does not show 40 psi in 10 seconds or the nose oil pressure does not show 45 psi in 30 seconds, move the mixture control back to IDLE CUT-OFF immediately and investigate the trouble. Lubrication is extremely important during starting of high performance engines. Don't overspeed the engines; except for momentary advancing of throttle to 1500 rpm for clearing out engines, 1200 rpm is the top limit until the oil temperature reaches 55°C., or in emergencies until you note a 10° rise in oil temperature.

30 SECONDS

NOSE

8. After the engine is running smoothly with the mixture control in AUTO RICH and the copilot has completed the oil pressure checks, he reports "No. . . . IN; OIL PRESSURE CHECKED," indicating that he is ready to start the next engine at the airplane commander's direction.

Caution **Beware of trick techniques for starting engines.**

They may cover up faulty engine operation.

Stick to these proved procedures.

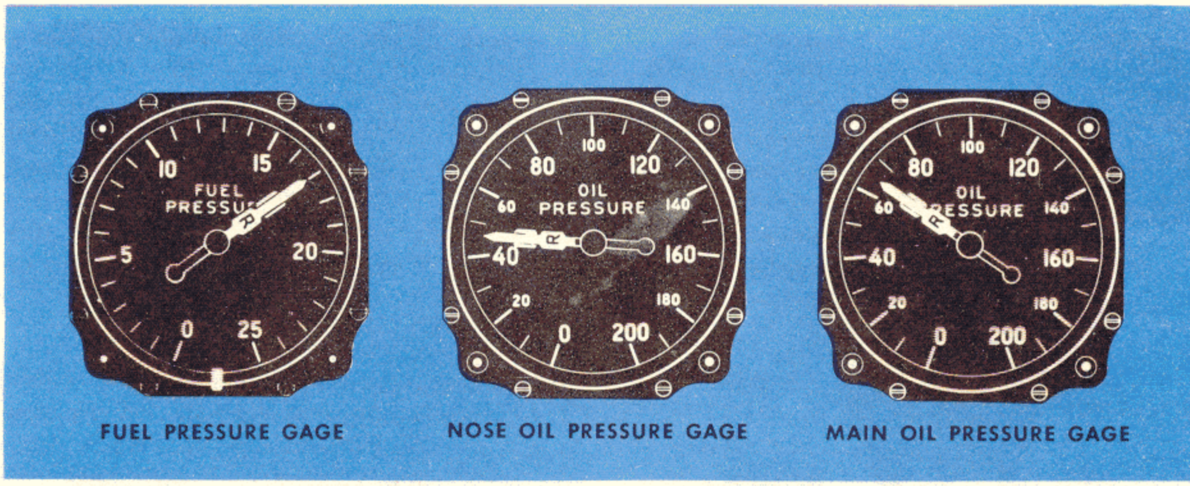
4. **Fuel and oil pressures—CHECKED.** Engineer checks fuel pressure for an operating range of 16 to 18 psi and oil pressure for ranges of 45 to 50 psi nose pressure and 60 to 70 psi main pressure, with the rpm between 1000 and 1200. If pressure indications are other than normal, he reports the gage reading instead of reporting CHECKED.

If oil temperature is low, oil pressure may be higher than normal; in this situation continue the warm-up. In an operational emergency, if you have a steady oil pressure indication **after a rise of at least 10°** in oil temperature, you can consider that satisfactory for takeoff. In general practice if oil temperature is only slightly low but has indicated a rise of at least 10°, it is safe to utilize taxiing as part of the warm-up period. **However, do not attempt engine run-up or takeoff until gages indicate operating limits.**

If oil temperature is higher than 85°, check to see that the oil cooler doors have opened in AUTO settings. If they have not, open them with the manual switch and leave the switch in neutral position. In hot weather you may get slightly high oil temperatures because of the lack of ram cooling. You can consider these temperatures safe if they don't exceed 95° for continuous operation or 105° for short periods. You can help keep temperatures down by heading the airplane into the wind for ground operation, holding ground operation time to a minimum, and decreasing power.

If high oil temperatures occur in cold weather, close the oil cooler flaps with the manual switch and watch the oil temperature carefully. Congealed oil in the cooler may be causing the oil to by-pass the cooler.

Cross-check oil temperature and oil cooler flaps frequently during starting and warm-up as a check on the automatic operation of the

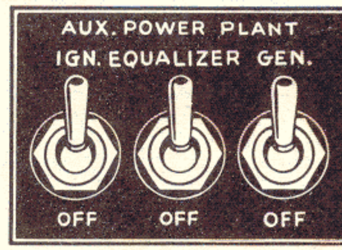


oil temperature control. The oil temperature should rise steadily with the flaps closed until it reaches 85°. Then it should remain constant with the flaps opening and closing to control the temperature as necessary. Normally on the ground in all but extremely cold weather the flaps stay full open, or nearly so, after warm-up.

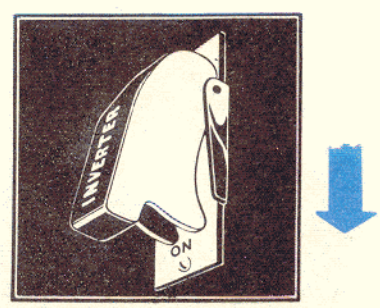
5. **Remove wheel chocks.** Copilot and airplane commander signal scanners or other designated crew members to remove wheel chocks.

6. **No. 1 and No. 4 engine generators—ON.** Engineer turns on the outboard generators and checks their voltage output at the generator panel. Only the outboard generators are used at this point because they have the 2-speed drive which gives full output as low as 800 rpm.

Note: After starting No. 4 engine, you can turn on No. 4 generator, if desirable, to provide generator current for starting No. 2 and No. 1 engine.



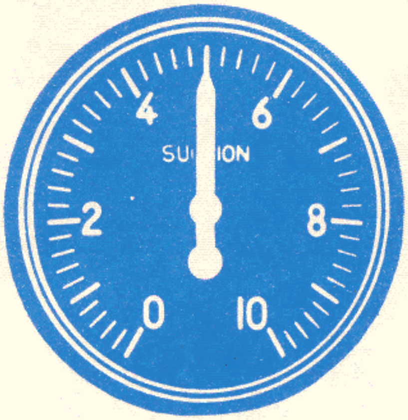
7. **APP equalizer—ON.** The copilot turns the APP equalizer switch to ON position, which connects the APP generator in parallel with the engine-driven generators and equalizes the loads.



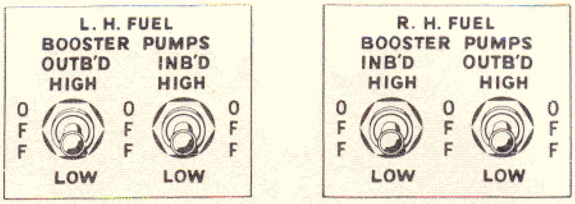
8. **Inverter—MAIN ON, CHECKED.** Engineer checks both 26-volt and 115-volt output of the spare inverter on the AC voltmeter at the generator panel. Copilot then returns switch to neutral, waits 3 to 5 seconds to prevent arcing of relay points, then turns it to MAIN ON position. Engineer checks 26-volt and 115-volt output of main inverter. Then copilot checks both

push-to-test inverter warning lights to be sure they are working.

Note: Leave inverter switch in MAIN ON position after check. In flight, never turn inverters off or change inverters by use of manual switch except in emergencies when automatic changeover relay fails.



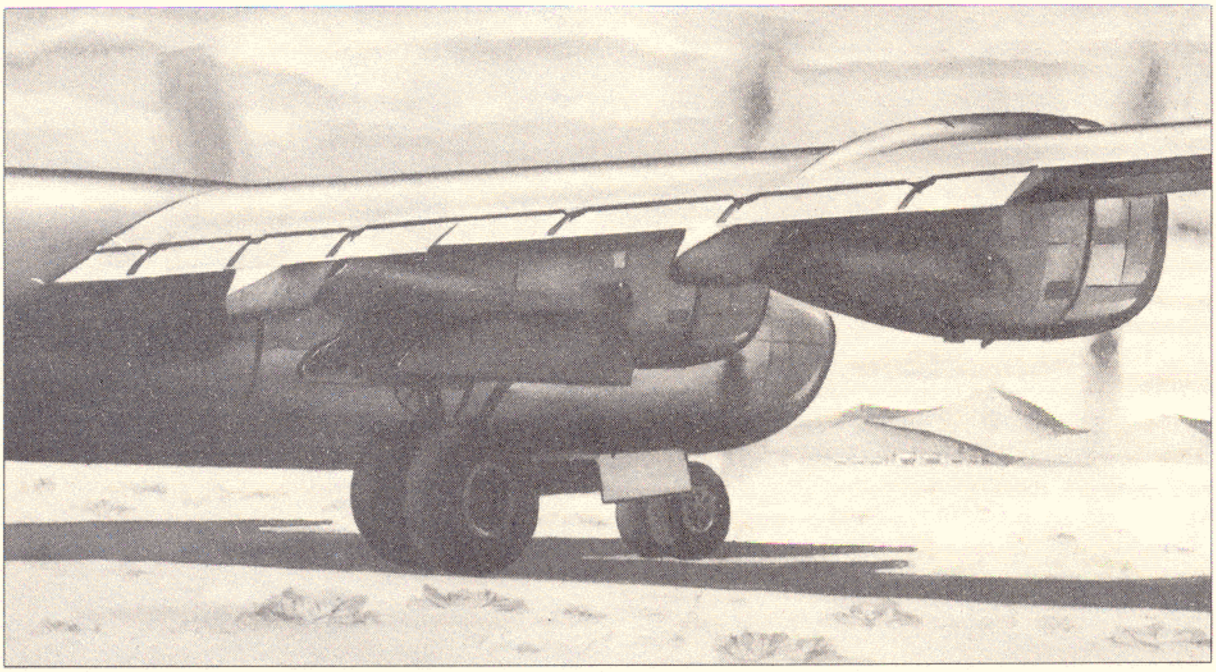
9. **Flight indicators and suction—CHECKED.** Airplane commander and copilot check to see that their gyros are working, and the airplane commander checks the suction gage on his auxiliary panel for a range of 5 to 5½" Hg. They report "CHECKED LEFT" and "CHECKED RIGHT."

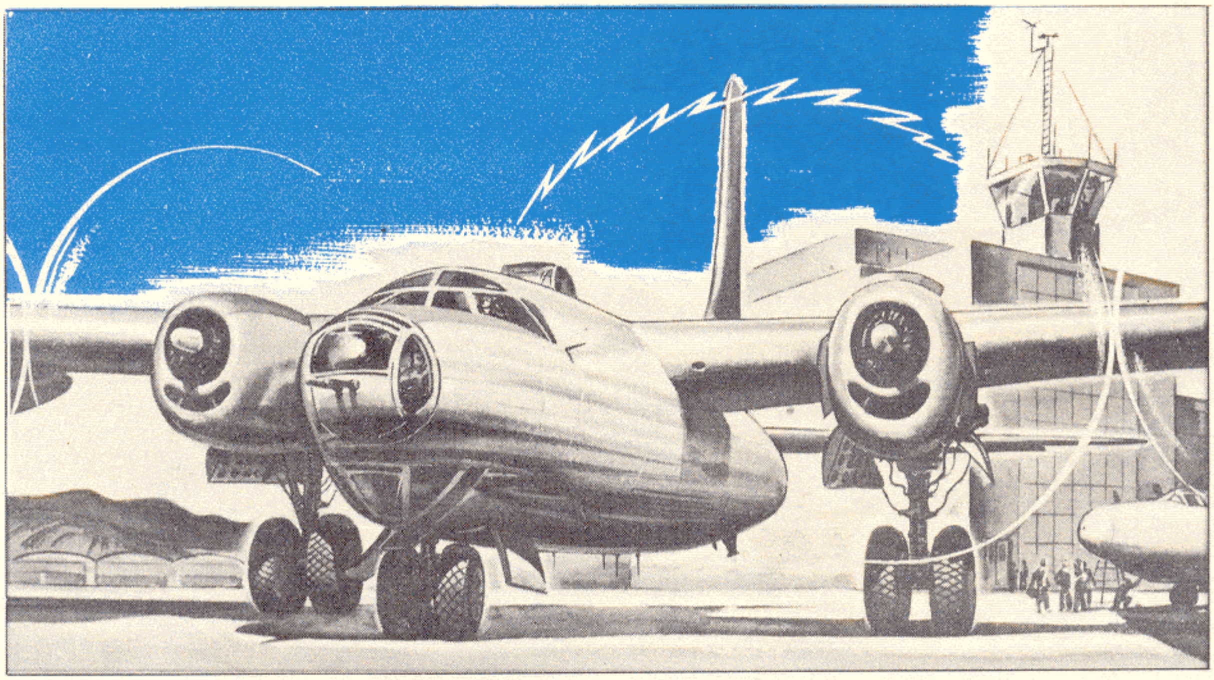


10. **Booster pumps—OFF.** Engineer turns all booster pumps to OFF position and checks fuel pressure for engine-driven pump operation. Minimum fuel pressure on the ground at idling speeds should be at least 15 psi with the engine-driven pumps alone operating.

11. **Interphone and alarm bell—CHECKED.** The copilot checks the operation of the interphone by calling all stations, during which he gets a report on the engines from the scanners. He checks the operation of the alarm bell by giving a certain number of rings and having the scanners in the aft compartment report what they heard. He also has scanners stand by to check and report on flap operation during exercising of flaps.

12. **Exercise flaps — CHECKED.** Engineer operates the flaps through one complete cycle, checking the operation of the main hydraulic system by noting the rise of pressure on the open center hydraulic gage.





Before Taxiing

AMPLIFIED CHECKLIST

1. **All instruments—CHECKED.**

a. Airplane commander sets throttles to 1000 rpm.

b. Copilot re-checks brake hydraulic pressures for 850 to 1030 psi.

c. Engineer re-checks oil pressures and temperature. See Item 4, **Starting Engines, Amplified Checklist.**

d. Engineer re-checks cylinder head temperature for a maximum of 260°. CHT should be well below maximum before taxiing unless the weather is extremely hot; otherwise something is wrong.

e. Engineer re-checks fuel pressures. With the booster pumps in OFF position, at engine idling speeds, the fuel pressure may not come up to operating range of 16 to 18 psi.

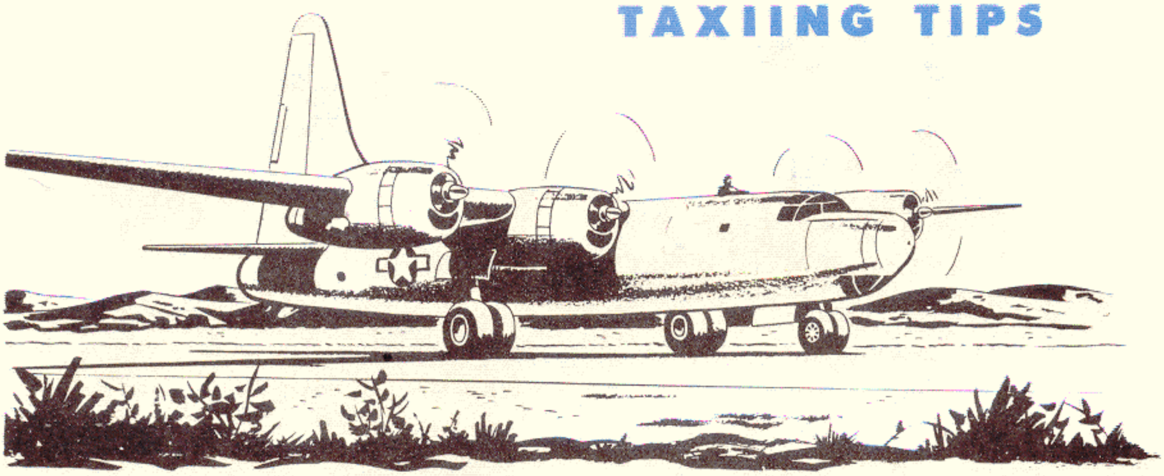
f. Engineer re-checks master tachometer for a setting of 2800 rpm.

g. Engineer re-checks the landing gear switch for neutral position and for guard in place to prevent accidental tripping of switch to UP position.

2. **Radio, altimeter, time—CHECKED.** While copilot and engineer are checking instruments, airplane commander calls the tower for taxiing instructions, radio, altimeter, and time check, setting his instruments accordingly.

3. **Wheel chocks—REMOVED.** Airplane commander and copilot look out their windows to see that chocks are pulled, reporting "REMOVED LEFT" and "REMOVED RIGHT." Airplane commander releases parking brakes and you're ready to roll.

TAXIING TIPS



In general the same technique and precautions for taxiing any large tricycle gear airplane apply to taxiing your B-32.

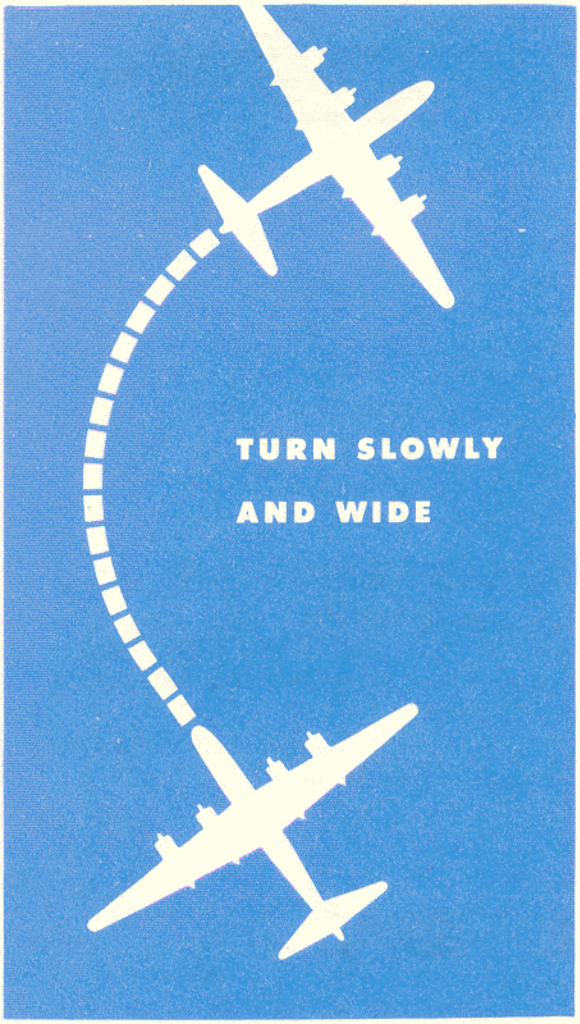
1. Always establish radio contact with tower before leaving the line. You take up a lot of room, and it is imperative that tower know where you are in order to handle ground traffic safely.

2. Keep looking around to both sides and to front. Post a crew member in astro glass hatch to watch traffic. Have all crew members at take-off stations and on interphone, with those who are in suitable positions helping to watch traffic, particularly scanners at scanning blisters.

3. At strange bases make sure before you taxi that taxiways and runways you plan to use are strong enough to hold up your airplane if you have any doubt about it.

4. Turn slowly and wide. Your airplane must be moving before you try to turn. Your two nosewheels are on one axle so that they rotate together. This design eliminates shimmying without incorporation of a shimmy damper unit, but causes some slippage when you make turns. Short turns result in excessive tire wear, and a short turn from dead stop might even cause buckling of nose section. If nose is turned before you start out, let airplane roll for a short distance in direction of nosewheel before attempting to straighten it out.

5. Except for demonstration purposes in



transition training, taxi with controls locked. Even slight cross wind on large side surfaces of your airplane makes it difficult to keep it straight, and in high wind it is absolutely necessary to lock controls to hold airplane, in training or any other operations. It is important, however, for student pilots to taxi with controls unlocked when it is safe to do so in order to appreciate the force exerted by the wind on control surfaces.

6. Taxi slowly. It is easy to build up excessive speed in this airplane, particularly when taxiing long distances downwind. It may be impossible to use sufficient rpm to prevent fouling of plugs and still maintain reasonably slow taxi speed. In that case cut inboard engines.

7. Use brakes sparingly. Excessive overheating and possible brake expander tube failure results from use of brakes for long periods. Don't ride brakes continuously to slow speed; apply them intermittently. Don't use throttle against brake on same side. When you apply brakes you may notice a slight delay in taking hold with a grabbing action just as airplane comes to stop, possibly turning nose gear out of line. These are normal characteristics for this expander tube. Eliminate the difficulty by pumping brakes briefly when you first apply them until they feel solid; then use them lightly. Release brakes just before airplane comes to a shuddering halt and let it roll to a stop.

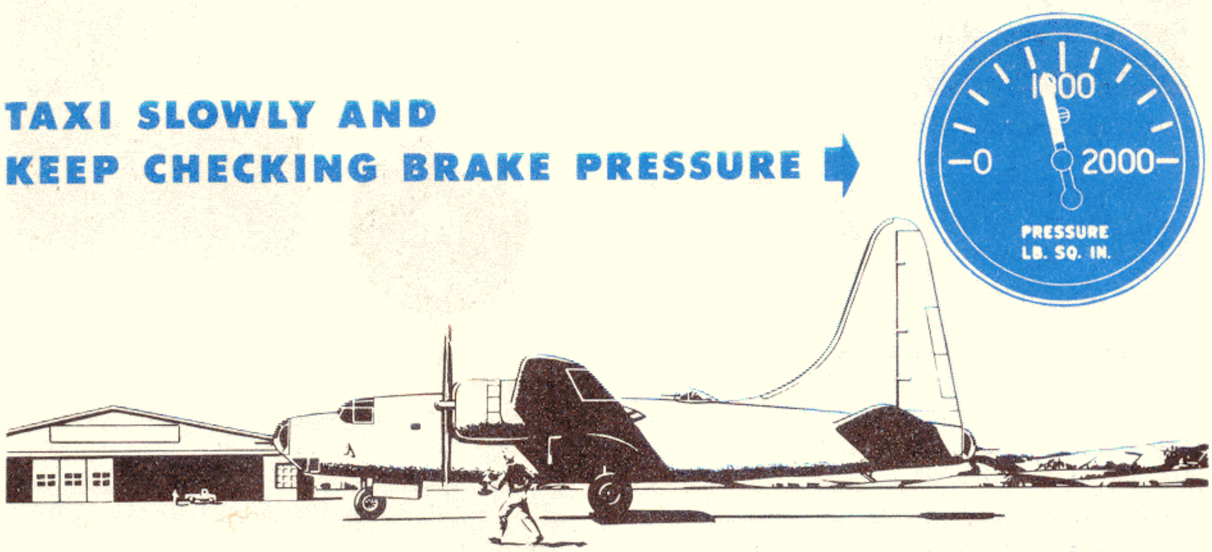
8. **Keep checking brake pressure continually.** If you see brake pressure continue to drop below 850 psi, indicating that electric pump is failing to cut in, immediately operate brake override switch until pressure returns to 1030 psi. If brake warning light comes on, indicating that pressure is down to approximately 600 psi, stop airplane immediately if possible with remaining pressure and have it towed back to line. At 600 psi you have only about two complete brake applications left.

9. APP must always be in operation while you are taxiing. Engine-driven generators alone may not be putting out sufficient juice to operate electric hydraulic pump, particularly for emergency stops. Keep checking electrical output.

10. Maintain sufficient rpm to keep engines clear. Advance rpm when stopped for clearance to cross runways and, if necessary, stop on taxiway and run up engines momentarily.

11. Always operate with mixtures controls in AUTO RICH. Watch cylinder head temperatures in hot weather during extended ground operation. If CHT's get too high it is better to shut down engines before they reach maximum limit of 260°C. and save fuel and engines.

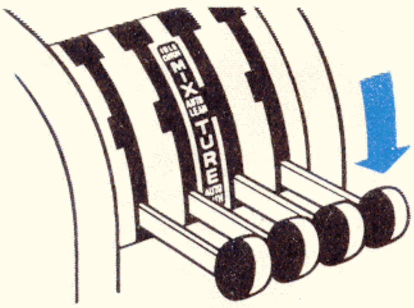
12. Always stop with nosewheels in line with centerline of airplane to minimize nosewheel side loads at re-start of taxiing and during engine run-up.



Before Takeoff

AMPLIFIED CHECKLIST

*Items with asterisk for subsequent takeoffs.

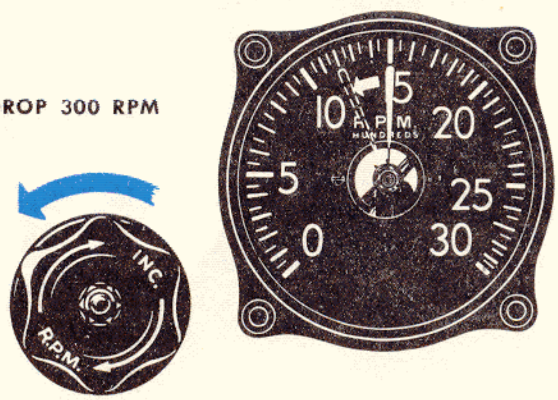


*1. **Mixture controls—AUTO RICH.** Engineer re-checks mixture controls to see that they are in AUTO RICH position.

2. **Propeller controls—CHECKED.**

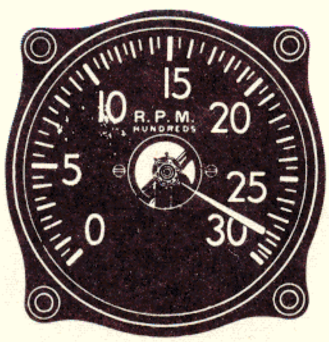
a. Reverse prop control check: Airplane commander sets throttles for 1000 rpm. Engineer turns reverse safety switch to READY position; then turns reverse switch to REVERSE position. Check to see that green prop tel-lights go out as engineer trips reverse switches and that amber reverse tel-lights come on as props reach reverse pitch position. With experience you can tell by sound of your engines when props have reached full reverse pitch. It normally takes only 3 or 4 seconds for props to reverse completely. Engineer should also check for momentary rpm rise as props go through flat pitch. Engineer immediately returns reverse switch to NORMAL and safety switch to SAFE position. There is a possibility of stalling your engines at low power settings while props are in reverse. Remember that you can return prop pitch to normal before props complete the reverse cycle, if necessary. Merely return reverse switch to NORMAL and ready switch to SAFE.

DROP 300 RPM



*b. Automatic prop control check: Airplane commander sets all throttles at 1500 rpm. Engineer rotates prop synch-control knob counterclockwise until a drop of 300 rpm shows on the engine tachometer and checks to see that engine speed remains constant at the reduced speed without hunting or surging. Maximum allowable difference between master tachometer and engine tachometers is plus or minus 50 rpm. Use the engine tachs as the reference in case of variance. Airplane commander also observes instruments as a double check. The engineer rotates the knob full clockwise until master tach indicates 2800 rpm and checks to see that engine tachs show the original 1500 rpm.

Note: The foregoing procedure tests the automatic synchronization of propellers, operation of the propeller pitch change motor, and the increase-decrease control circuits. Feather control operation is tested once a day in the preflight.

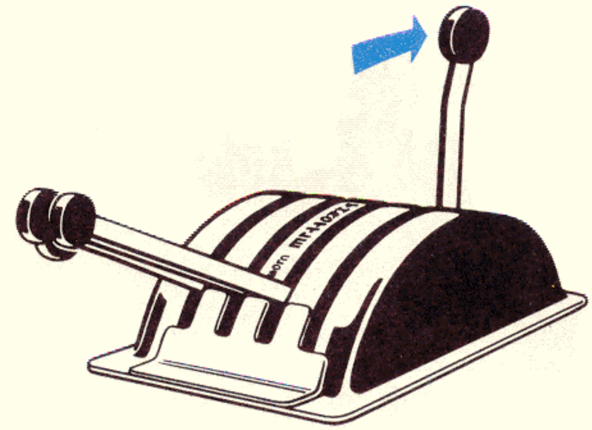


*3. **Master tachometer—2800 RPM.** Engineer re-checks master tachometer for a setting of 2800 rpm.

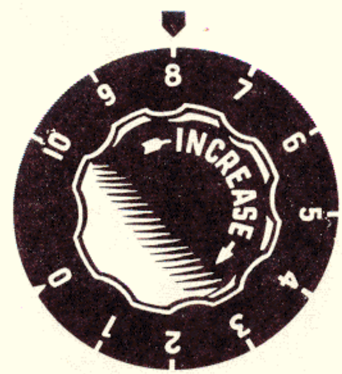
*4. **Magnetos and turbos—CHECKED**

a. Airplane commander checks magnetos and full throttle power setting by advancing throttle to 2200 rpm and having engineer check individual magnetos on that engine. Then airplane commander advances throttle to full open position and notes amount of power available with throttle alone. He retards throttle to idling position of 1000 rpm and advances next engine. Normal sequence is to work from right to left across the airplane, starting with No. 4, then No. 3, No. 2 and No. 1.

b. After full throttle check on No. 1 engine, airplane commander turns the TBS dial to position 8 (normal takeoff position), and checks manifold pressure again to see that desired takeoff power is available. Leaving TBS at 8, airplane commander reduces No. 1 throttle to



idling, 1000 rpm, and proceeds to check the other engines in sequence 2, 3 and 4. Keep all throttle movements slow to avoid sudden surg-

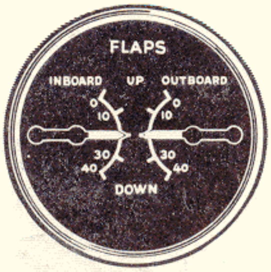


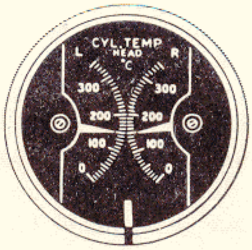
ing of power. After turbo check on No. 4 engine the airplane commander turns TBS dial to 0 position until immediately before takeoff.

c. When the wind is strong and the airplane is not parked directly into wind, it is advisable to advance opposite throttle to 2000 rpm while you make the full throttle check on an outboard engine. Watch cylinder head temperatures carefully. Keep the time of full throttle operation to a minimum on the ground in order not to overheat engines.

*5. **Gyros—SET AND UNCAGED.** Airplane commander and copilot set and uncage their gyro instruments.

*6. **Wing flaps — AS REQUIRED.** For light loads engineer puts down 20° flaps, observing





the flap indicator. Copilot calls the scanners on interphone and each scanner checks flaps positions through his scanning blister and reports settings to the copilot.

*7. **Trim tabs—SET.** Airplane commander sees that trim tab controls are set for takeoff.

*8. **Flight controls—CHECKED FREE.** Airplane commander moves all flight controls through their full range.

*9. **Doors and hatches—CLOSED.** Crew members check closing and securing of all doors and hatches and report to the copilot. Airplane commander and copilot close their windows; engineer checks nose compartment entrance hatch, astro hatch, and nosewheel hatch. Scanners secure the aft cabin hatches. Be sure bomb bay doors are closed.

Note: Check the following items immediately before takeoff.

*10. **Cylinder head temperatures—CHECKED.** Engineer re-checks head temperatures for a range of 50°C to 260°C.

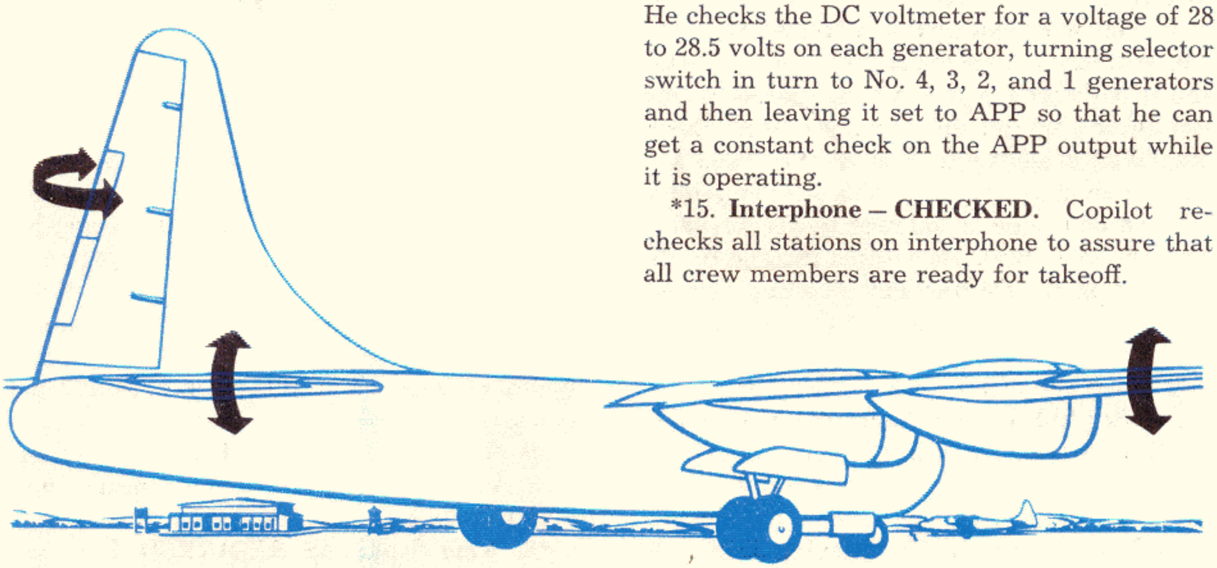
*11. **Booster pumps—HIGH.** Engineer turns all booster pumps to high position.

*12 **Turbos—SET TO 8.** Airplane commander rotates TBS knob to setting of 8.

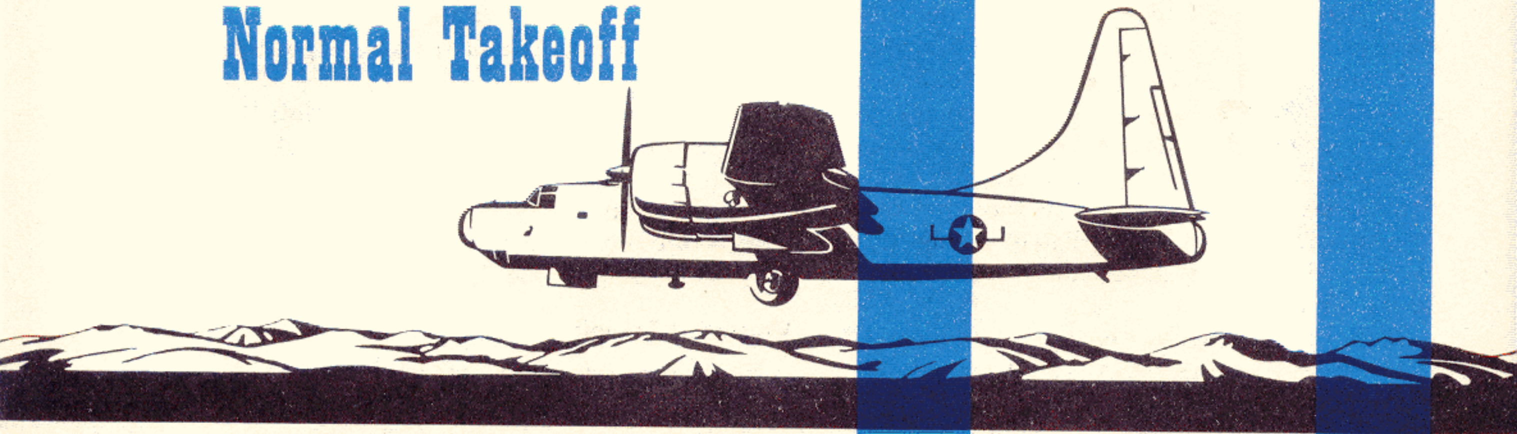
*13. **Cowl flaps—AS REQUIRED.** Airplane commander directs copilot to close cowl flaps to trail setting. Copilot reports setting when he completes the action.

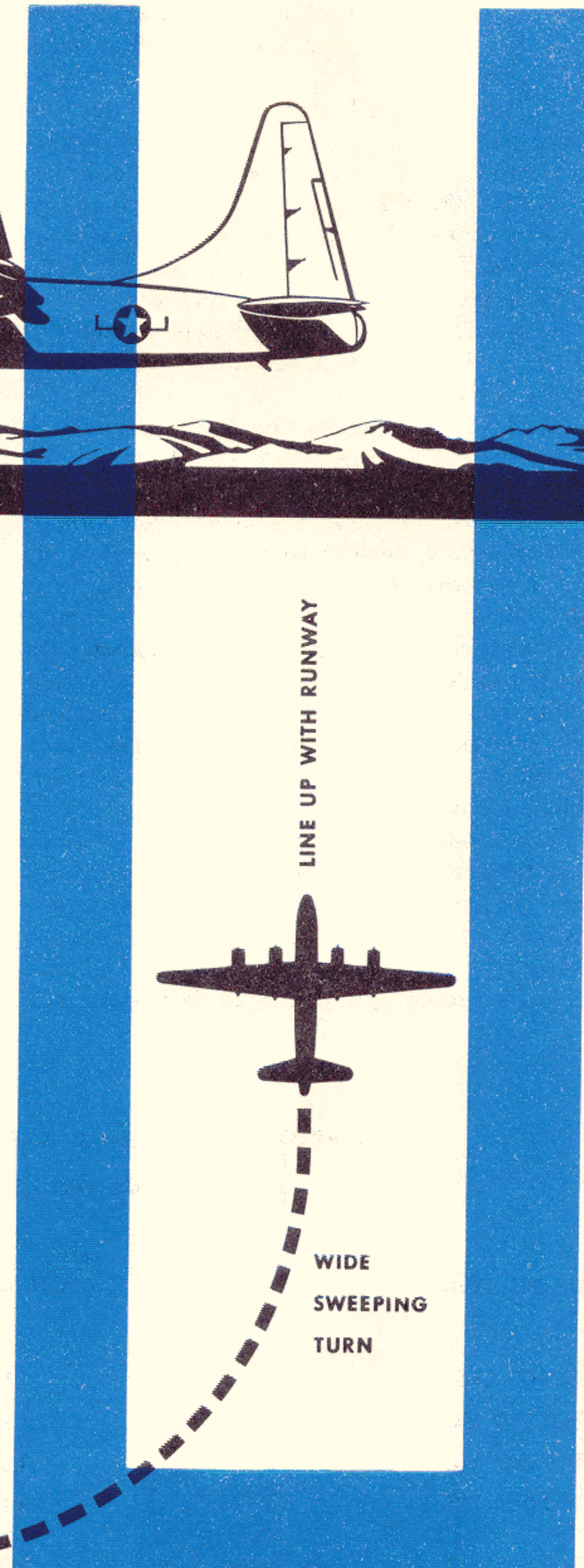
*14. **Generators—CHECKED AND ON.** Engineer turns No. 2 and No. 3 generators on, rechecking No. 1 and No. 4 to be sure they are on. The engineer should make the voltage check with the engine turning up 1800 rpm. He checks the ammeter to see that all generators are putting out and that the load is evenly distributed among them. Then he turns the AC voltmeter selector switch to the 26-volt position to see that the voltage is normal and to the 115-volt position to check for a range of 100 to 120 volts. He checks the DC voltmeter for a voltage of 28 to 28.5 volts on each generator, turning selector switch in turn to No. 4, 3, 2, and 1 generators and then leaving it set to APP so that he can get a constant check on the APP output while it is operating.

*15. **Interphone — CHECKED.** Copilot rechecks all stations on interphone to assure that all crew members are ready for takeoff.



Normal Takeoff





Your B-32 has no surprises in store for you in takeoff, unless it may be the fact that you find it easier to handle than you expected. Otherwise the takeoff technique is about the same as that for any large tricycle gear airplane. The large tail on your airplane makes directional control easier than on other airplanes of this type, and rapid acceleration gives you a comparatively short takeoff run.

The following paragraphs include some general tips on takeoff technique:

1. Obtain tower clearance before takeoff and also make sure to look for yourself for any traffic the tower might have missed.

2. Line up with runway. Use wide sweeping turn to get onto runway and use up as little runway as possible in lining up.

3. Keep a continuous check on instruments during takeoff, with the help of your copilot and engineer.

4. Release brake. Normally you can advance all throttles evenly, with smooth and steady action. If you need directional control in early part of takeoff run, walk throttles forward, holding airplane straight by leading with throt-

tles. Don't throttle back or use brakes to maintain direction unless you lose control as a result of poor technique or an emergency.

5. Have copilot follow through on throttles and make certain that they are full forward. Throttles are of ratchet type and do not creep.

Note: Takeoff settings are 49 inches manifold pressure and 2800 rpm. When you first open throttles fully, engine tachometers may indicate slight overspeed. However, the automatic synchronizers should immediately reduce this overspeed to normal. Don't allow overspeed of more than 2880 rpm.

6. Have your engineer help you watch manifold pressure and rpm throughout takeoff and warn you if they exceed limits.

7. Use rudder control as soon as you get it.

8. As your speed increases to approximately 70 to 80 mph, ease back on control column to get takeoff attitude. Field conditions, loading, and experience dictate what this takeoff attitude should be. With any given set of conditions, you can control length of run and takeoff airspeed by your attitude. Normally, use plenty of runway and a safe airspeed and fly your airplane off runway.

The takeoff and stalling speeds in the following table are only approximate. Flight check and feel out your own airplane to get a comparison of its takeoff and stalling characteristics.

9. Maximum cylinder head temperature is 260°C for 5 minutes during takeoff. If your head temperatures ran high during ground operations or you note them rising abnormally on takeoff, use a longer ground run and get an airspeed of 200 mph or more as soon as possible after takeoff.

10. Don't be overanxious to gain altitude immediately after takeoff. Get enough initially to clear obstructions; brake and retract your wheels; and allow airspeed to build up to 160 mph before retracting flaps and to 180 mph before establishing climb.

Crosswind Takeoffs

You can handle a crosswind takeoff with no particular difficulty in your B-32. Proper leading with the upwind throttles and rudder pressure hold the airplane straight on the runway, and the inherent directional stability of tricycle landing gear helps to keep it straight and prevent any tendency to weathercock.

It is good practice in crosswinds to fly the airplane off the runway at airspeeds 5 to 10 mph higher than you use normally, particularly in takeoffs from a rough surface. This prevents the possibility of bouncing off the ground and then dropping back, putting a side load on the gear. It also enables you to establish a crab safely, in order to hold your takeoff ground track immediately after leaving the ground. Establish your crab by coordinated use of controls.

APPROXIMATE TAKEOFF AND POWER-ON STALLING SPEEDS AT VARIOUS WEIGHTS WITH 20° OF FLAPS

GROSS WEIGHT	TAKEOFF IAS	STALLING SPEED IAS
90,000 LBS	118	95
100,000 LBS	123	100
110,000 LBS	129	105
120,000 LBS	133	110

Touch-and-go Takeoffs

Use the following procedure for touch-and-go (running takeoffs):

1. Bring airplane in for normal 2-point landing.

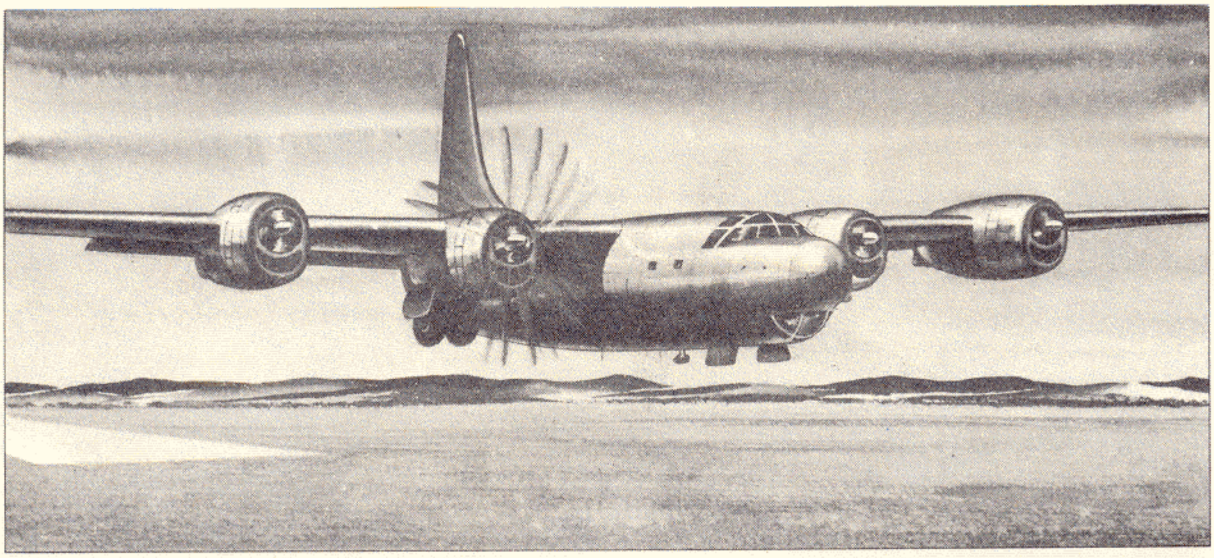
2. At your direction after airplane is definitely on ground, engineer raises flaps to 20°, sets trim tabs for takeoff, re-checks master tach for 2400 rpm setting and TBS knob for desired setting and then notifies you that airplane is ready for takeoff. Scanners check flaps for 20° and notify copilot over interphone.

Note: You don't have to use full takeoff power and rpm for touch-and-go takeoffs. Your airplane is already rolling at approximately half takeoff speed. Turbo setting should be enough so that when you advance throttles you get approximately 43″ manifold pressure and 2400 rpm. If you don't get these settings with full throttle, turn TBS knob up until you do get them. If full throttle gives you higher settings than these, leave the higher power on until you are retracting your wheels.

3. You don't have to use throttle for directional control during touch-and-go since your airspeed is high enough to give you good rudder control throughout the ground roll.

4. Apply throttles slowly and smoothly. There is always a tendency to over-accelerate in a touch-and-go takeoff, so take special care not to apply power too fast. Remember that you are already going much faster than normally, and it doesn't take much more to get you into the air.

5. Fly the airplane off the runway and when airborne proceed as you do for normal takeoffs.



EMERGENCY TAKEOFFS

Engine Failure on Takeoff

Note: See also general tips on procedures for engine failures, under **Engines** section.

The large rudder and generally good flight characteristics of the B-32 make it an easier airplane to handle than other 4-engine bombers under conditions imposed by engine failures on takeoff. Particularly in the light B-32's you fly in transition training, even losing two engines on the same side on takeoff is not a dangerously critical condition if you use proper technique. As gross loads increase on the airplane, loss of an engine becomes more critical. However, although flight-tested information is scanty as yet, the tests which have been run indicate that the B-32's characteristics under engine failure conditions at heavier loads will probably still be better than those of other airplanes of this type.

Follow this procedure if an engine fails on takeoff.

1. If you are still on ground and have enough runway, stop. Use brakes and reverse props if possible.

2. If airborne get directional control first with rudder and aileron. Don't let the dead engine wing drop. Correct with trim tabs. With two engines out on one side don't use more than approximately 7° rudder tab if possible to avoid the chance of blanketing out your rudder and causing tail stall.

3. Maintain airspeed, nosing down to pick up speed if necessary and possible.

4. While you are taking care of control, have engineer get gear up immediately.

5. Have engineer bring up flaps to between 5° and 8°. Leave this setting while you go around until you lower flaps again for landing.

6. Reduce power as soon as you have everything under control and can safely do so.

7. Don't make a turn until you have a safe airspeed and then turn away from the dead engine if practicable. If conditions necessitate turning into the dead engine, be sure to maintain airspeed and trim in the turn.

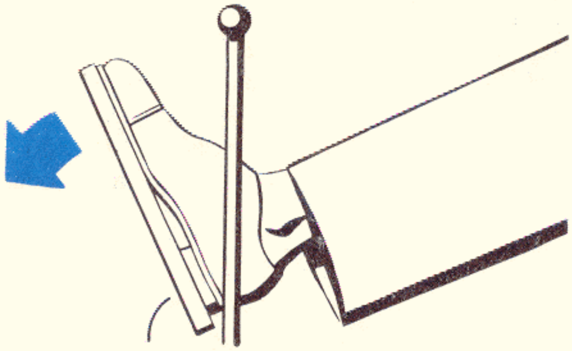
Runaway Props and Turbos

See emergency procedures under **Propellers** and **Turbo-superchargers** sections, respectively, for instructions on handling these conditions.

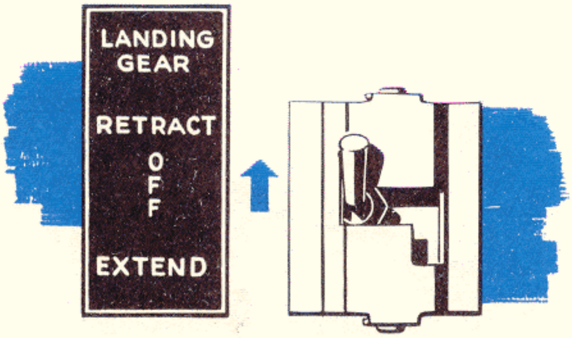
After Takeoff

AMPLIFIED CHECKLIST

*Items with asterisk for subsequent takeoffs and running takeoffs.



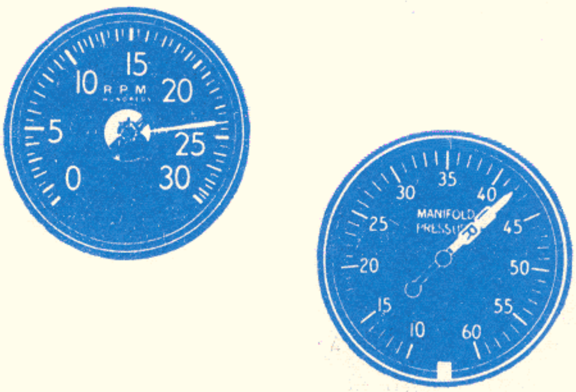
*1. **Brakes – APPLIED.** Before retracting wheels brake them smoothly to stop their rotation completely. Spinning of wheels or braking in any but down and locked position puts uneven strain on the gear structure.



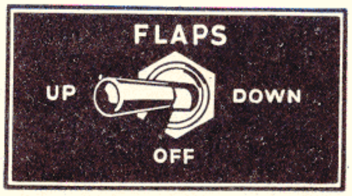
*2. **Gear—UP.** Engineer raises gear at your command as soon as you have completed braking wheels. **Caution: Be absolutely certain airplane is definitely airborne before you call for gear up.**

Scanners in aft compartment call you at this point and report that gear is up on both sides.

Engineer checks nosewheel up-lock from bombardier's compartment and reports to you.



*3. **Power reduction—42", 2400 RPM.** When you have sufficient airspeed, make your first power reduction. This reduction can come when gear is up, or in lighter airplanes when gear is coming up, depending on your own technique. Turn TBS to pull 42". Engineer reduces rpm to 2400. For operational flights you can use settings of 43" and 2400.



*4. **Wing flaps—UP.** Direct engineer to raise flaps when wheels are up and airspeed reaches

160 mph. Be prepared for tendency to nose down as flaps come up, and correct with trim. At night or when flying a heavily loaded B-32, you can handle this characteristic by having engineer raise flaps in 10° stages, allowing time between stages for you to operate trim tabs to compensate for changing flight attitude. Scanners should call you on interphone and report flap action.

*5. **Power reduction—AS REQUIRED.** For transition training airplane commander reduces manifold pressure to 38″ and directs engineer to reduce rpm to 2300. For operational flights set power at predetermined settings as worked out on climb control charts.

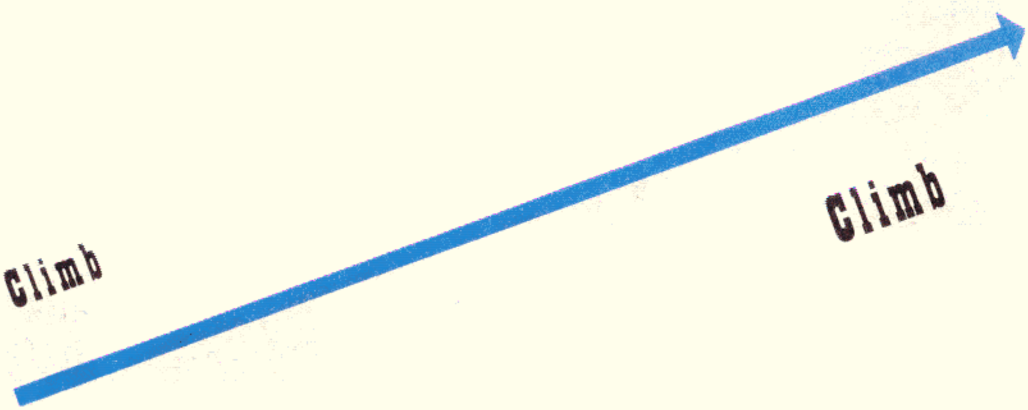
*6. **Cylinder head temperatures—CHECKED.** After power is set engineer re-checks cylinder head temperature and adjusts cowl flaps accordingly. Maximum CHT in climb is 248°C. If possible keep cowl flaps closed, achieving engine cooling with a higher airspeed. This gives more efficient climb conditions than airspeed prescribed by climb control chart for your particular load. You get a loss of approximately 1 mph for every degree cowl flaps are open.

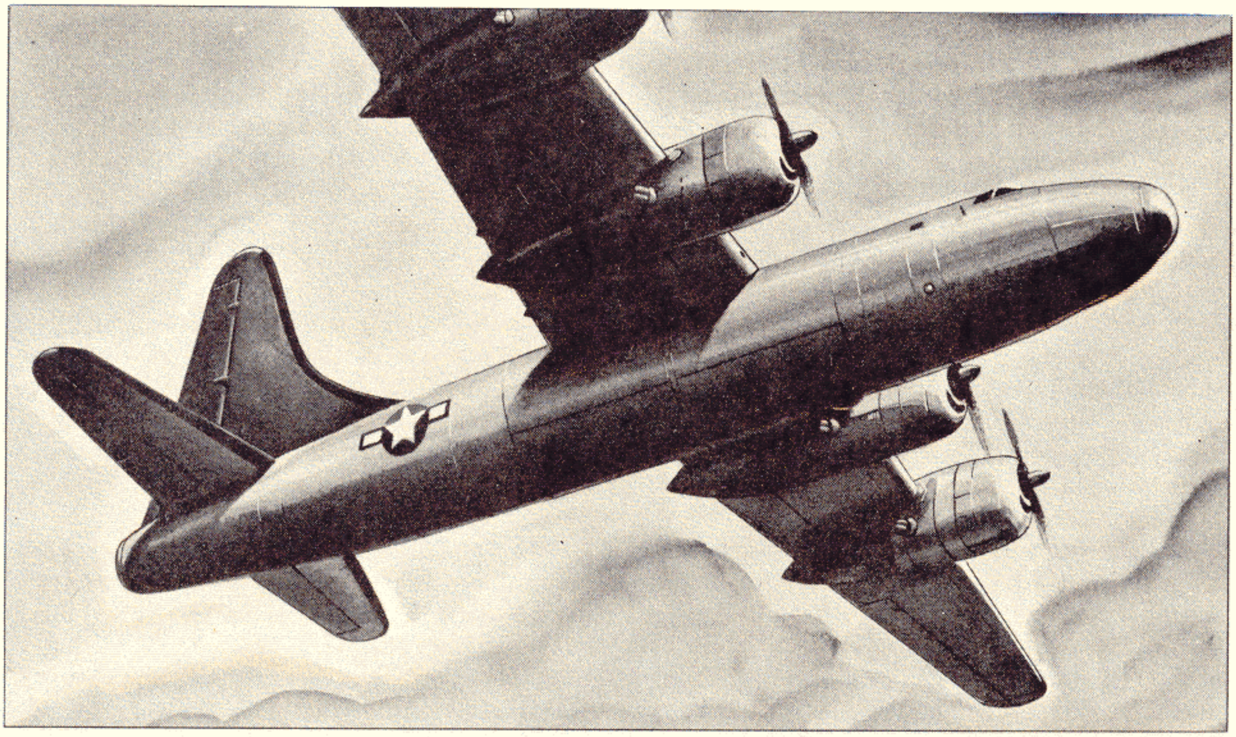
*7. **APP—AS REQUIRED.** If you are not shooting stop landings in daytime, or do not need additional electric power, copilot turns off APP at this point. Turn off equalizer switch; then load switch; then set throttle to idle for a period before turning off APP ignition. If you are using only a few electrical units, you don't need APP. If you are operating at night or using turrets, radar, lights, radios, etc., leave it on. Check ammeters to see how much load is on line if you are not sure.

*8. **Booster pumps—OFF.** At approximately 1000 feet engineer turns off fuel booster pumps one at a time and checks fuel pressure as he does so. If you are going to fly above 10,000 feet, don't forget to turn booster pumps on again as you need them.

NOTE

Once you are in the air, your scanners should call you every 15 minutes to report condition of engines. If they don't, call them and get them on the ball or find out what's wrong.





Climb

Extended climbs require special techniques and considerations. In general these are the same for the B-32 as for any airplane. The B-32 is designed for long range high altitude bombardment, and getting up to high altitude is one of the more critical parts of any long range mission. Climb is always more or less critical because your airplane is operating under changing external conditions. You are normally using continuous high power settings and extra fuel, and you must observe the extra precautions necessitated by those conditions. The decreasing temperature and pressure which you get with altitude affects engine performance, as well as flight characteristics and the comfort of your crew.

The following tips set forth some of the factors you must take into consideration in climb:

1. Smooth flying technique becomes increasingly important if you want to stay in formation or get maximum performance from your airplane. Keep airplane trimmed at all times.

2. As you get up to altitude some degree of flaps increases efficiency of climb. With this Davis airfoil approximately 5° flaps gives you most efficient lift-to-drag ratio. On the basis of this fact, experiment will show you how much flaps to use and at what point in your climb to use them to get increased rate of climb at same airspeed.

Note: Always use 5° of flaps over 20,000 feet altitude.

3. Just as you have to smooth out and modify your flying technique as you increase altitude, so does your autopilot. Keep making flight adjustments on autopilot panel as necessary while using autopilot to climb. Remember to set up

and use autopilot as soon after takeoff as possible so that it stays warmed up during the climb. If you wait until you get to high altitude to turn the autopilot on, low temperature may prevent autopilot from warming up satisfactorily within reasonable length of time.

4. If you are using APP, remember to change altitude compensator as you ascend at 5000 feet and 10,000 feet. Above 10,000 feet keep a check on voltage output of APP; it begins to lose efficiency at this altitude. Shut it down when voltage drops below normal.

5. Although temperature is much lower at altitude, your cooling system becomes less efficient as you go up because of decrease in air density. With the aid of copilot and engineer, keep careful running check during climb on all engine instruments. If all CHT's run high during a sustained climb, hold the climbing power setting and level off until head temperatures return to normal. Then re-establish climb at slightly higher airspeed. **This gives you the necessary cooling with better rate of climb than you would get if you opened cowl flaps on all four engines at your former airspeed.** If individual CHT's run high, adjust cowl flaps to take care of the situation.

6. For long-range cruise missions climb at rated power, 42″ and 2400 rpm, regardless of gross weight. Rated power climbs result in more economical operation than climbs at lower power settings because the former get you to cruising altitudes and AUTO LEAN mixtures more quickly.

7. Turn fuel booster pumps to LOW position above 10,000 feet, and when you need extra pressure turn them to HIGH position. Decrease in atmosphere pressure increases the volatility of your fuel, in turn increasing possibility of vapor lock at altitude. Watch fuel pressures carefully and keep them within operating limits.

8. Remember that you and your crew need oxygen and heat as you ascend. See that crew begins use of oxygen at proper time. Keep them warm enough to operate efficiently.

9. See **Cold Weather Operation; Heating, Ventilating, Anti-icing and De-icing Equipment;** and **Oxygen System** sections for additional information applicable to climb.

Cruise

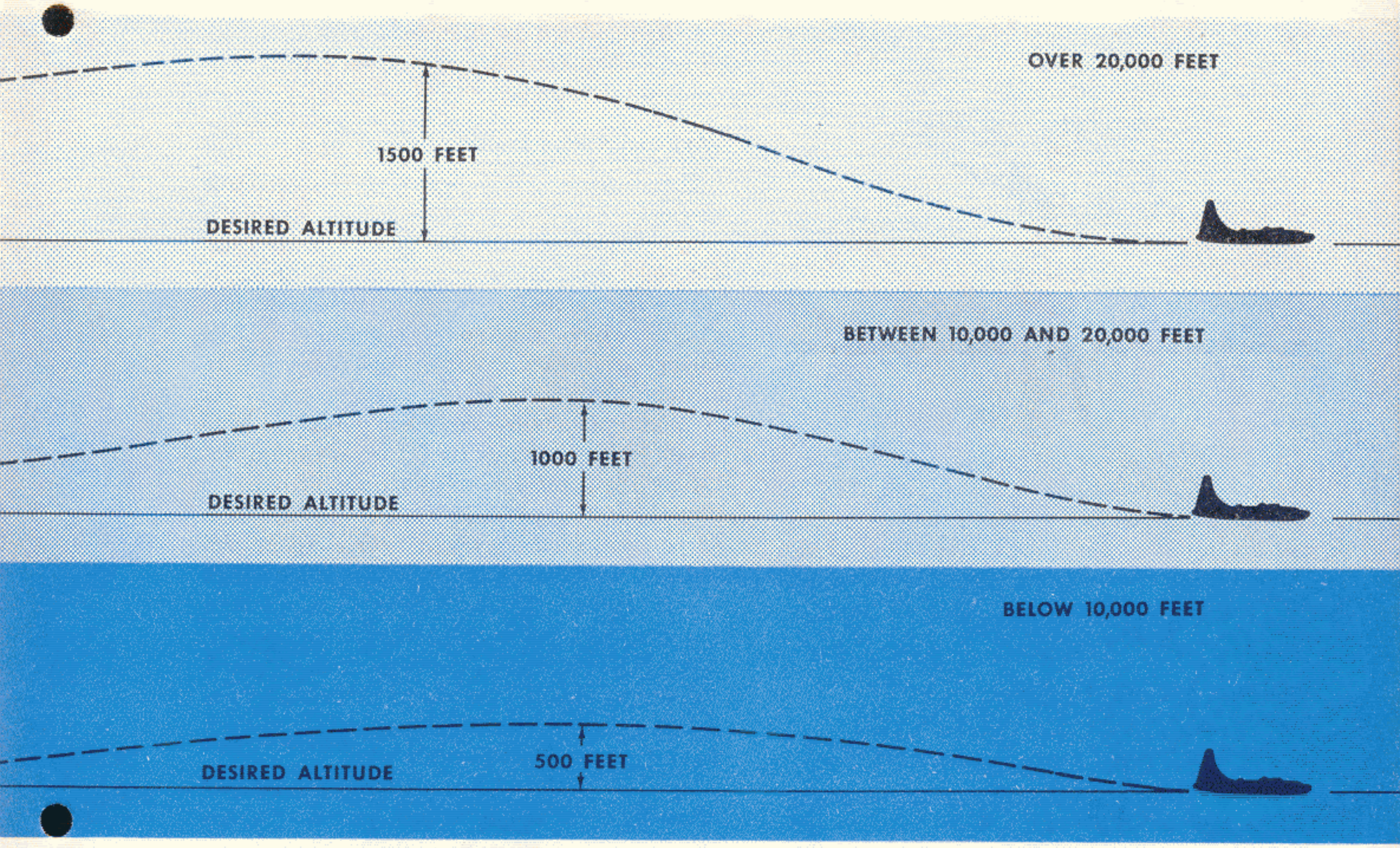
Leveling Off

Approach your cruising level from the top, in both altitude and airspeed—never from below. For cruising altitudes below 10,000, climb 500 feet higher and then come down to cruising altitude. For cruising altitudes between 10,000 feet and 20,000 feet, climb 1000 feet above; for altitudes above 20,000 feet, climb 1500 feet above. Remember to use 5° of flaps for flight above 20,000 feet.

When you reach the top of your climb, hold your climbing power and a zero rate of climb until you reach necessary airspeed (approximately 210 mph with high gross loads) and then set your pre-determined cruising power. If you make the power reduction before you reach sufficient airspeed, you may have to open cowl flaps to get proper cooling. This causes excessive drag with additional loss of airspeed and increased fuel consumption.

Next, nose the airplane down slightly and make a shallow dive to your cruising level. Trim the airplane carefully. Use elevators to hold cruising airspeed and adjust power slightly to maintain altitude.

Then complete the remaining steps in the cruising checklist, listed in the following amplification.



Cruising Amplified Checklist

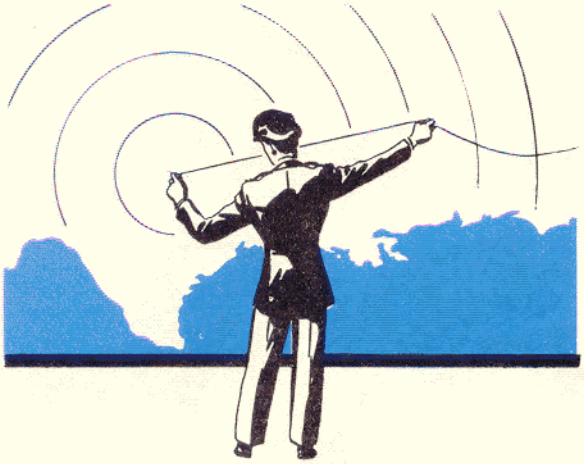
1. **Power settings—29″, 2000 RPM.** For training cruise set throttles for 29″ manifold pressure and have engineer adjust props for 2000 rpm. For operational missions use the pre-determined power settings from your cruise control chart. In some cases, to get certain specified power settings you may find that you need more turbo boost than you get with TBS at position 8. If necessary, turn the TBS knob past the stop into the red-lined area in order to get manifold pressures within operating range for cruise. Remember that TBS positions are only relative; the safety stop and red-lined area are there mainly to prevent you from exceeding 49″.

2. **Mixture controls – AS REQUIRED.** For training flights use AUTO LEAN mixtures with power settings for local cruise. On operational missions power settings and cylinder head temperatures dictate use of mixture controls. Always use AUTO LEAN for settings of 2200 rpm and 35″, or below, provided you can keep CHT's below 232°.

3. **Cowl flaps – AS REQUIRED.** Use cowl flaps individually to keep CHT's within operating limits in cruising flights, below 232° for AUTO LEAN mixture, and below 248° for AUTO RICH.

Flight Planning

For any operational mission, regardless of what kind of cruise you want to accomplish, plan your fuel and power management in advance. Know how to use your climb control and cruise control charts. Consider the factors affecting cruise control—wind, rough air, altitude, trim, changes in airspeed and attitude, weather, weight, drag, power settings, and engine management—and know how to use them or control them. While any one of these factors



may or may not affect your range or endurance, certainly the combined cumulative effect of several can mean failure of your mission unless you use proper techniques for handling them. Correct basic flying techniques and thorough knowledge of your airplane reduce the adverse effects to a minimum.

Maximum Endurance Cruise

The technique of flying for long periods of time is obviously to operate at the airspeed where engines use fuel at the lowest possible rate. You get this condition when you use the least engine power that keeps the airplane flying. The precise airspeed depends on the gross weight of the airplane and is somewhat lower than IAS for maximum range. Get the proper airspeed from your cruise control charts.

Use the following procedures:

1. Establish desired airspeed from cruise control data and then fly at constant IAS for a given weight bracket. This is important in order to conserve fuel.

2. Maintain altitude by use of power. Set your rpm at 1400 and pull whatever manifold pressure is necessary to maintain airspeed and altitude. You hold 1400 rpm as a minimum to avoid loss of current from inboard generators.

3. Reduce your airspeed as weight decreases during flight. The less the airplane weighs, the longer it flies. In extreme emergencies lighten airplane by jettisoning removable equipment. Be careful not to unbalance airplane, however, as that would affect flight characteristics and cut down endurance.

4. Remember that endurance decreases with altitude. Stay down where you can get the most time out of your ship.

Maximum Range Cruise

The purpose and outstanding characteristic of the B-32 is long range bombing. Maximum range, therefore, is the most useful cruise category in the tactical operation of this airplane.

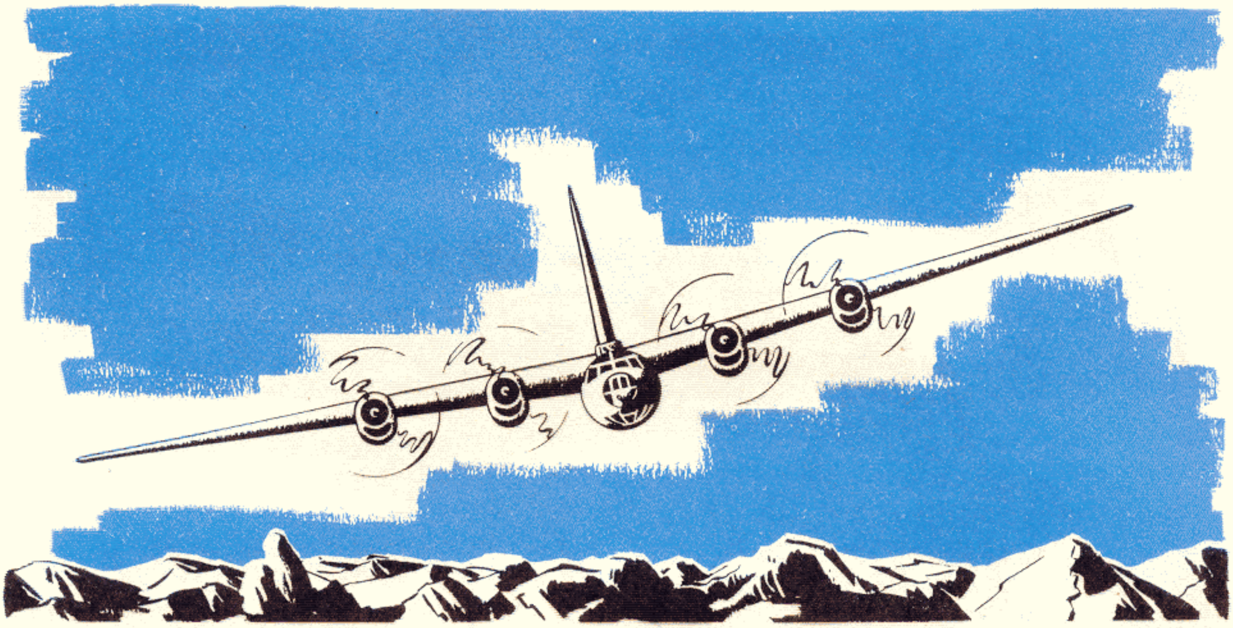
You fly maximum range at the speed and altitude which give you the greatest ground mileage from each gallon of fuel consumed. In still air this is a higher airspeed than you use for maximum endurance. When you add a little power to the settings used for maximum endurance, you get a relatively large increase in airspeed compared to the increase in fuel flow. As you add further power, both airspeed and fuel flow increase, and as you approach high power settings, the increase in airspeed over fuel flow falls off rapidly. Within this overall range, however, there is a range of airspeeds at which you obtain maximum miles per gallon of fuel. Your maximum range cruise control charts give you this airspeed band.

The best airspeed for maximum miles per gallon, however, is not enough; you must translate this into maximum ground miles, which means taking wind into consideration. With a headwind, fly at the upper limits of your maximum range band of airspeeds. With a tailwind, fly at the lower limits.

The lower portion of this airspeed band is difficult to use in formation. The formation leader should use an airspeed at the bottom of the band. This allows other airplanes in the formation to stay within the economical range of airspeeds in spite of the airspeed changes they are constantly making to stay in formation.

Weight of your airplane materially affects IAS for maximum range, as it does for maximum endurance. However, once you determine this IAS for your load condition, you keep it at all altitudes, varying power as necessary.

Make your descents in maximum cruise by holding your recommended cruising airspeed and reducing power to the lowest permissible power settings in order to extend your range.

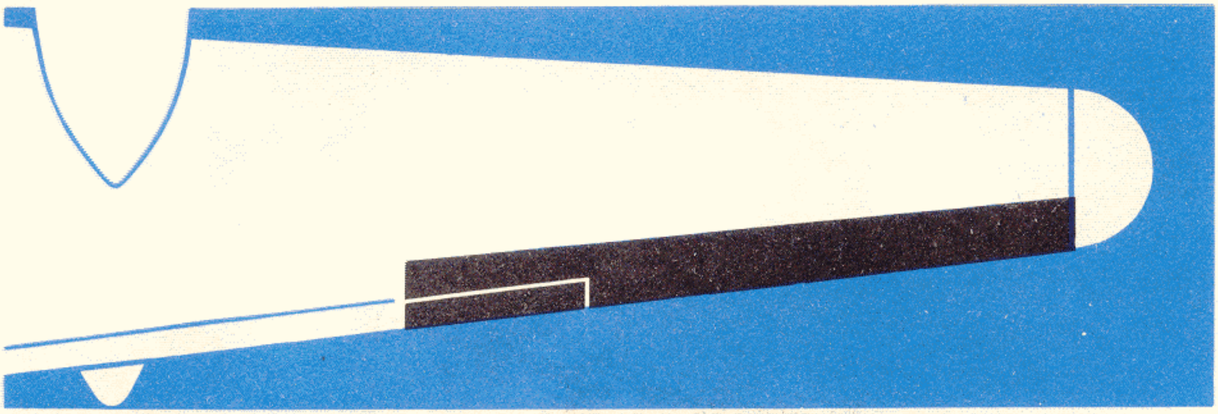


Flight Characteristics

You are not likely to have any quarrel with the flight characteristics of your B-32; you'll find them thoroughly satisfactory. All control pressures and responses are excellent for an airplane of this size. The airplane accelerates rapidly, both on takeoff and when you apply power in flight. Stalling characteristics are as good and in some cases better than those in many smaller airplanes.

Rudder

The rudder is the heaviest of the controls, but there is no delay in its reaction, even at low speeds. One of these days you'll lose an engine on takeoff and from then on rudder will be your pet control. Rudder trim is also adequately effective. A few degrees of rudder trim eliminates yaw caused by loss of an outboard engine, and approximately 7° takes care of two engines out on the same side at cruising airspeeds and power settings. However, don't let your airspeed get below 150 mph with two engines out on the same side.



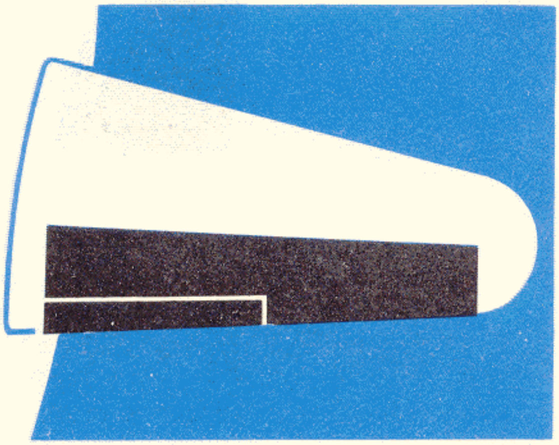
Aileron

The aileron control is sensitive and light. Adverse yaw from aileron drag on entering and leaving turns is slight. The aileron is effective at the low speeds of landing and takeoff. However, the same precautions against excessive aileron control at low airspeeds which apply to any other airplane apply also to the B-32. The electric switch for aileron tab control may be unfamiliar to you at first, but it is easy to use when you get onto it, and aileron trim is sensitive.

Elevators

Elevators are as smooth and light as an AT-6 . . . almost. Elevators become effective early on the takeoff run, and they give you definite positive reaction in a stall. The elevators are the only controls without servo tabs; they don't need them. Some mushiness of the elevator trim tabs makes it necessary to take special care when trimming the airplane at altitude. They are satisfactory at lower altitudes, however, once you are used to them.

For banks up to about 40° elevator pressure is normal. In banks above 40° the pressure increases rapidly, and it is difficult to hold altitude in banks of 60° or more. For this reason, don't make steep banks in the traffic pattern or any time you are close to the ground.



Flaps

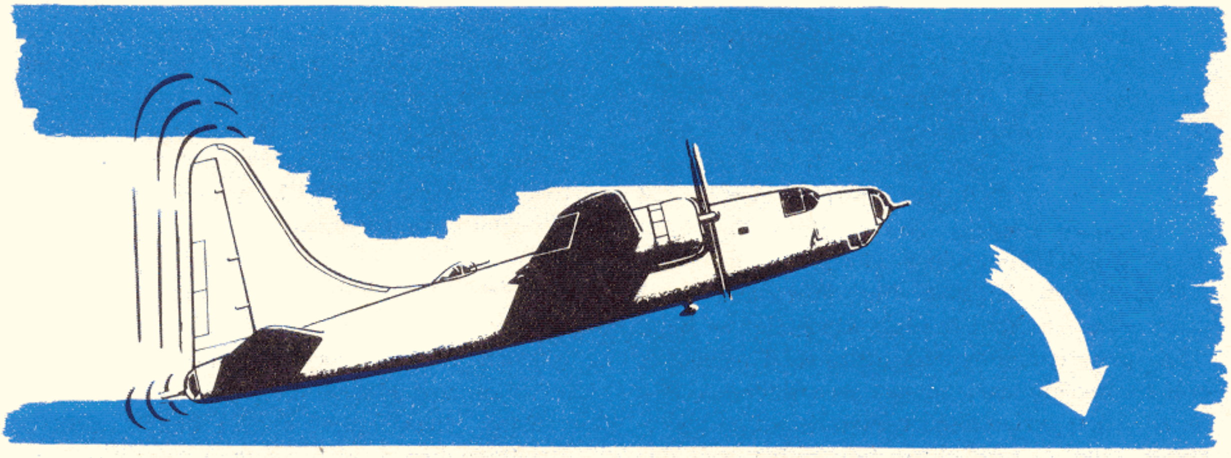
With any given load, full flaps lower your power-off stalling speed about 25 mph. When you lower flaps there is a marked tendency for the airplane to nose up, and a similar tendency to nose down when you raise flaps. You have to make fairly large changes in elevator trim tab settings to take care of the situation. When lowering flaps for landing or retracting them after takeoff, you may prefer to lead this reaction with the elevator tabs to take the rush out of the procedure.

Caution

If your inboard flaps go down alone the airplane tends to nose up strongly. It may take full elevator travel to hold it down, and at low airspeeds this leaves no control margin in event of a stall. With outboard flaps alone the airplane tends to nose down, but less strongly. Be extremely cautious of this situation if you lower flaps by the emergency system. In emergency hydraulic system flap operation, the two sets of flaps operate independently. Have the crew member who operates the emergency selector

valves work closely with another man who watches coordination of flaps on the flap indicator. Get your scanners worked in on this operation also, watching through their blisters and reporting by interphone, because the flap indicator might be off.

Always use 5° of flaps for flight above 20,000 feet. This setting improves flight characteristics at altitude. For maximum performance takeoffs, 40° flaps gives you the shortest ground run and the shortest distance for clearing a 50′ obstacle.



Stalls

Stalling characteristics are clean. The airplane forewarns you of a stall by a severe tail shake 3 to 5 mph before you reach stalling speed. A slight rolling movement develops in and around the ailerons prior to the actual break of the stall. During the final phase of the stall you notice aileron snatch. If you allow the stall to progress hold the wheel firmly to prevent any whip which might be transmitted from the aileron to the wheel. After complete stall the airplane falls straight forward without any tendency to spin.

*STALLING SPEEDS

Power-off—Gear Down

Gross Wt.	40° Flaps	30° Flaps	20° Flaps	0° Flaps
80,000 lbs	106	113	117	131
90,000 lbs	111	118	122	137
100,000 lbs	116	123	128	144
110,000 lbs	120	128	133	151
120,000 lbs	125	133	139	156

*Estimated figures, not flight checked.

Spins

Don't attempt spins in this airplane. If you get into a spin, however, use multi-engine spin recovery technique.

Loss of Engines

This subject has already been discussed in relation to takeoff and to rudder, under those headings. In addition to that information, there is little to say about loss of engines in normal level flight. One inboard engine out in cruise is hardly noticeable in a light airplane; 1 or 2 degrees of rudder tab adequately corrects any yaw. A few more degrees corrects for loss of an outboard engine. The airplane has been flown at approximately 90,000 lbs, with Nos. 1, 2, and 3 out. Again rudder trim, and some aileron trim to hold the left wing slightly high, adequately corrected the attitude. This fact is offered merely as a matter of interest and a basis of comparison and certainly not as a suggested practice procedure. Remember that this 1-engine operation was in a light airplane under experimental conditions. The results, however, speak well for the B-32's flight characteristics.

In addition to trim, 5° to 8° of flaps are helpful in maintaining altitude with two engines out.

Restricted Maneuvers

Don't attempt these maneuvers: loop, roll, spin, inverted flight, Immelman.

Restrict banks to 60° with light training airplanes and to 30° with 120,000 lbs. gross weight. Although Technical Order restrictions exceed these limits, remember that they are based on structural limitations and do not consider practical operating factors. Stay under these limits except in emergencies.

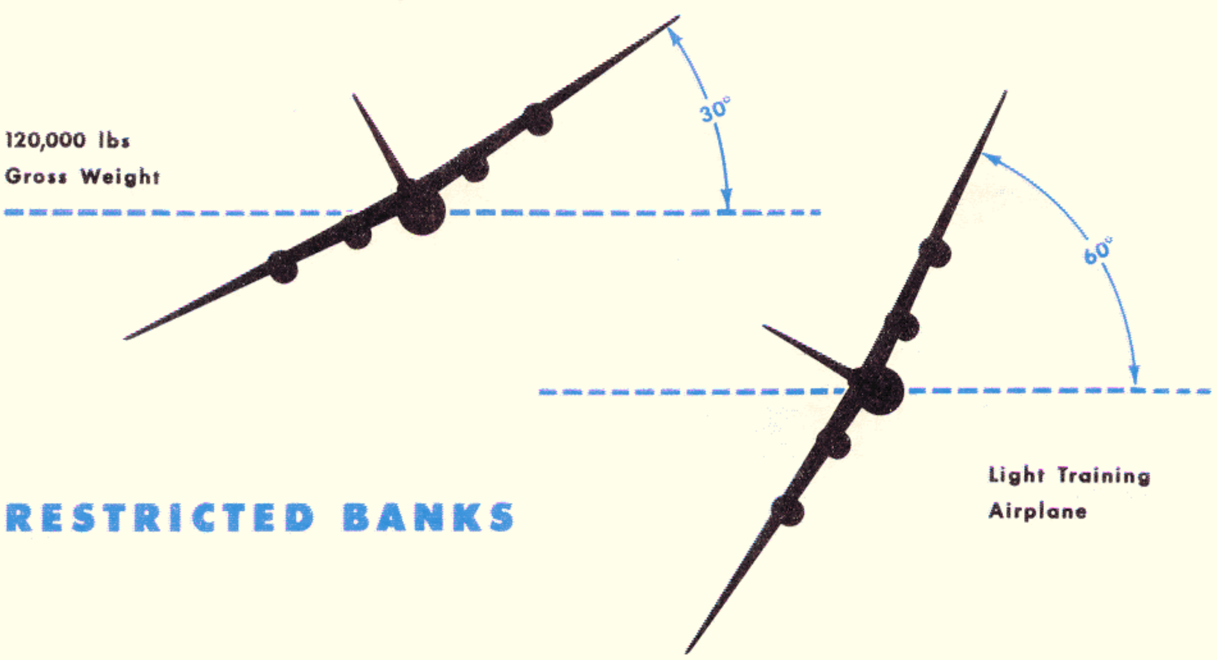
Airspeed Limitations

Don't exceed:

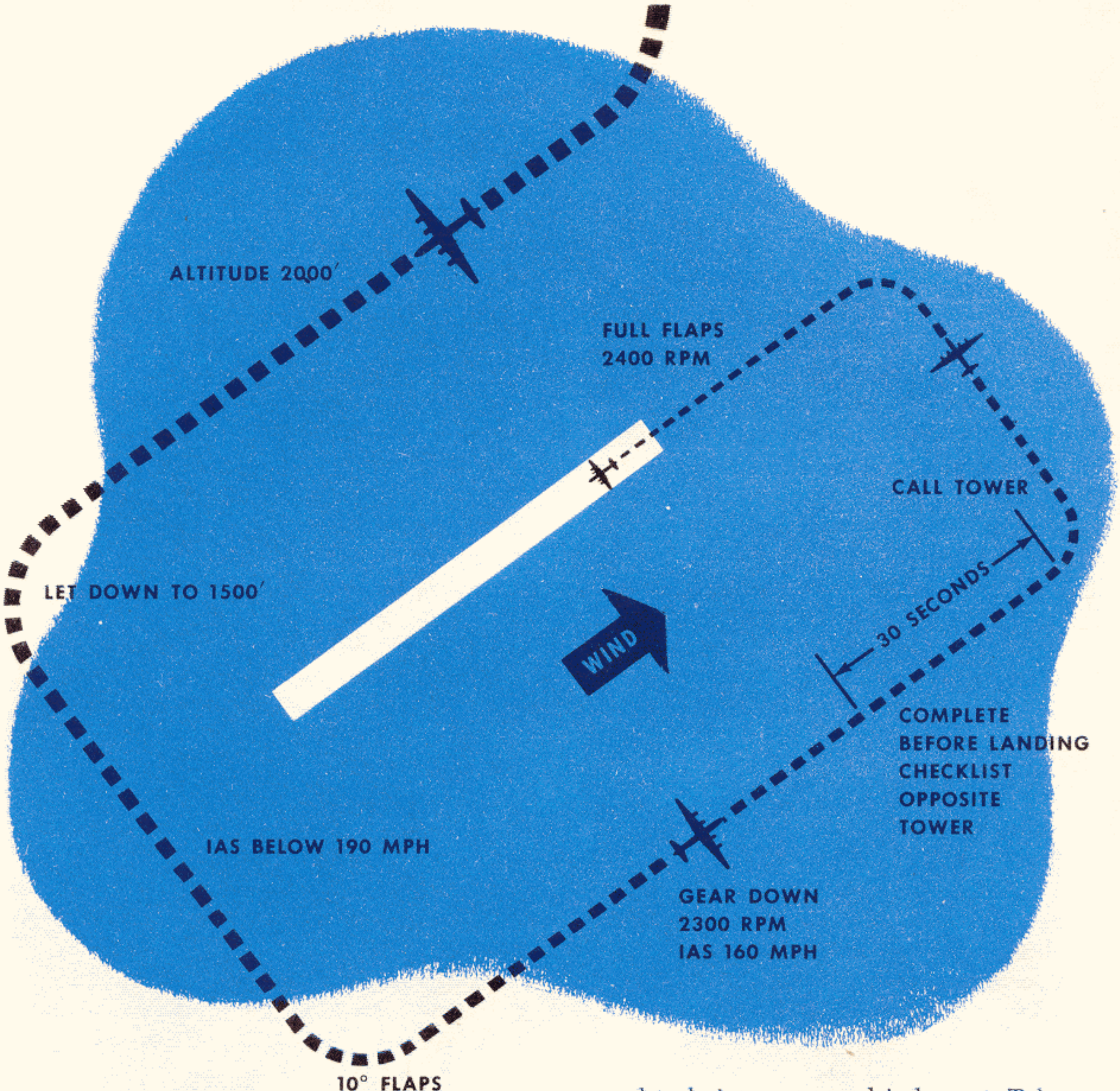
330 mph at 100,000 lbs gross

240 mph at 118,000 lbs gross

Note: These figures are Technical Order restrictions based on structural limitations. For safe practical operations, keep your airspeed well below these limits except in emergencies.



RESTRICTED BANKS



Before Landing

Start your Before Landing Checklist soon enough so that you can have it completed by the time you are opposite the tower on your downwind leg. There is no advantage to rushing through your traffic pattern and landing procedures. Such action demonstrates neither good technique nor good judgment. Take your time and do things right.

Leave yourself enough time so that while you are flying the last half of your downwind leg you can be planning the placing of your base leg. A good method to follow is to time your turn onto the base leg for about 30 seconds past the end of the runway. Call the tower as you turn onto the base leg, so that they can keep track of you for additional instructions if necessary. Advise the tower at this time of your intention to make a stop landing or a touch-and-go landing.

BEFORE LANDING

AMPLIFIED CHECKLIST

*Items with asterisk for subsequent landings and running takeoffs.

1. **APP idle, load and equalizer—ON.** Copilot starts APP about 10 minutes out in order to give it time to warm up. Then he is ready to turn on equalizer and load switches when he starts the Before Landing Checklist.

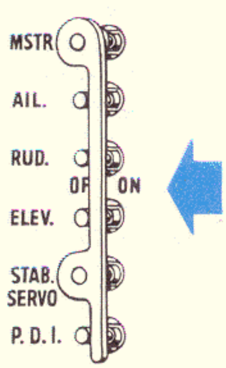
2. **Radio call and altimeter—CHECKED.** Airplane commander calls tower for landing instructions and altimeter setting.

*3. **Crew positions—CHECKED.** Copilot notifies crew in aft cabin by interphone to prepare for landing. Crew members acknowledge instruction and report that they are at stations. Airplane commander notifies crew on flight deck and also looks to see for himself that they are at their stations.

*4. **Electric hydraulic pump—ON.** Engineer checks to see that the hydraulic pump switch is in ON position and checks the circuit breaker.

*5. **Fuel valves—TANK TO ENGINE.** Engineer checks all tank selector valves to see that they are in TANK TO ENGINE position, with drain valve in CROSSFEED position.

*6. **Booster pumps—HIGH.** Engineer turns all four booster pumps to HIGH position.



*7. **Autopilot—OFF.** If the autopilot is on, airplane commander turns it off.

*8. **Brake pressure—CHECKED.** Copilot meters brakes until pressure drops to 850 psi and checks to see that the electric hydraulic pump cuts in and returns pressure to 1030 psi.

*9. **Mixture controls—AUTO RICH.** Engineer checks mixture controls to see that they are in AUTO RICH position.

*10. **APP throttle—RUN.** Copilot pulls up APP throttle to RUN position. Have copilot check this throttle regularly; it may creep down. Engineer checks APP voltage.

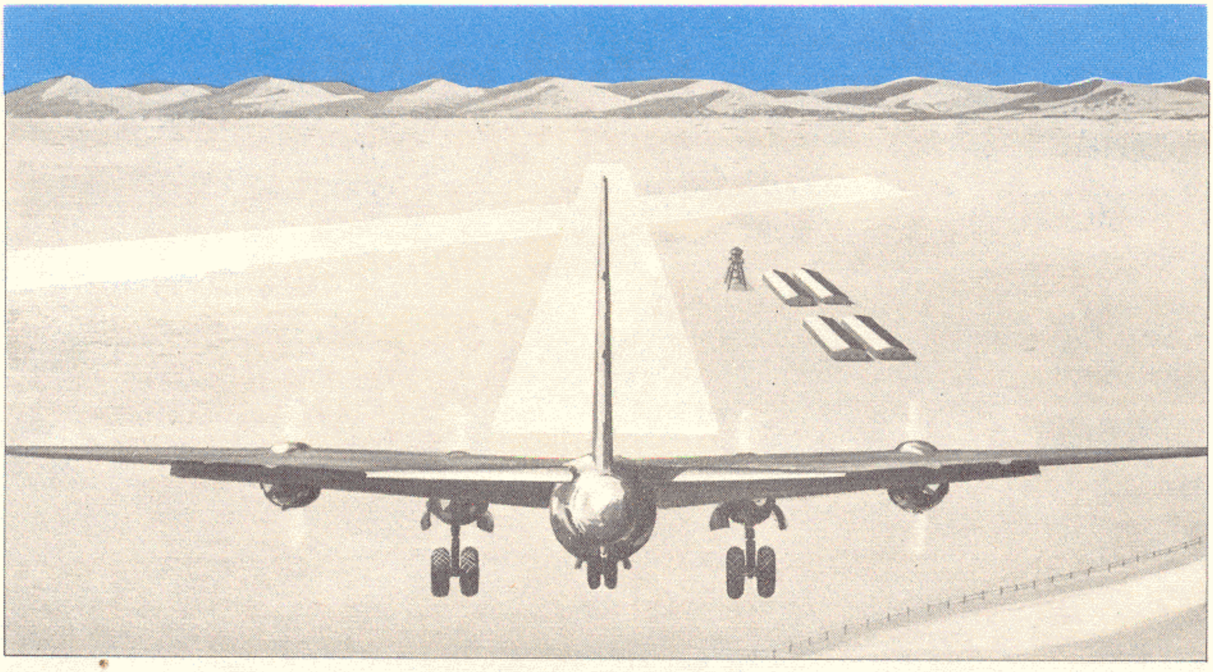
*11. **Wing flaps—10°.** At direction of airplane commander, engineer lowers wing flaps 10° Don't lower flaps above 190 mph IAS. Scanners watch flaps from their blisters and report flap operation to copilot.

*12. **Gear—DOWN.** At the direction of the airplane commander, engineer brings gear down. Your airspeed must be below 190 mph IAS before you attempt to bring gear down; otherwise nose gear may not extend enough to lock.

*13. **Master tachometer—2300 RPM.** After tripping landing gear switch, and before gear is down and checked, engineer turns the prop synch-control to 2300 rpm setting on the master tach. Wheels cause considerable drag. You need additional power to maintain desired airspeed after gear is down.

*14. **Gear check — DOWN AND LOCKED.** Scanners call over interphone and report gear and tailskid down. They can check tailskid through tailskid access door. Engineer also checks main gear from flight compartment windows and checks from nose compartment to see that the nose gear is locked.

*15. **Cowl flaps — AS REQUIRED.** Engineer and copilot keep a running check on engine instruments and cylinder head temperatures. Normally cowl flaps should be cracked for landing.



Final Approach

AMPLIFIED CHECKLIST

*Items with asterisk for subsequent landings and running takeoffs.

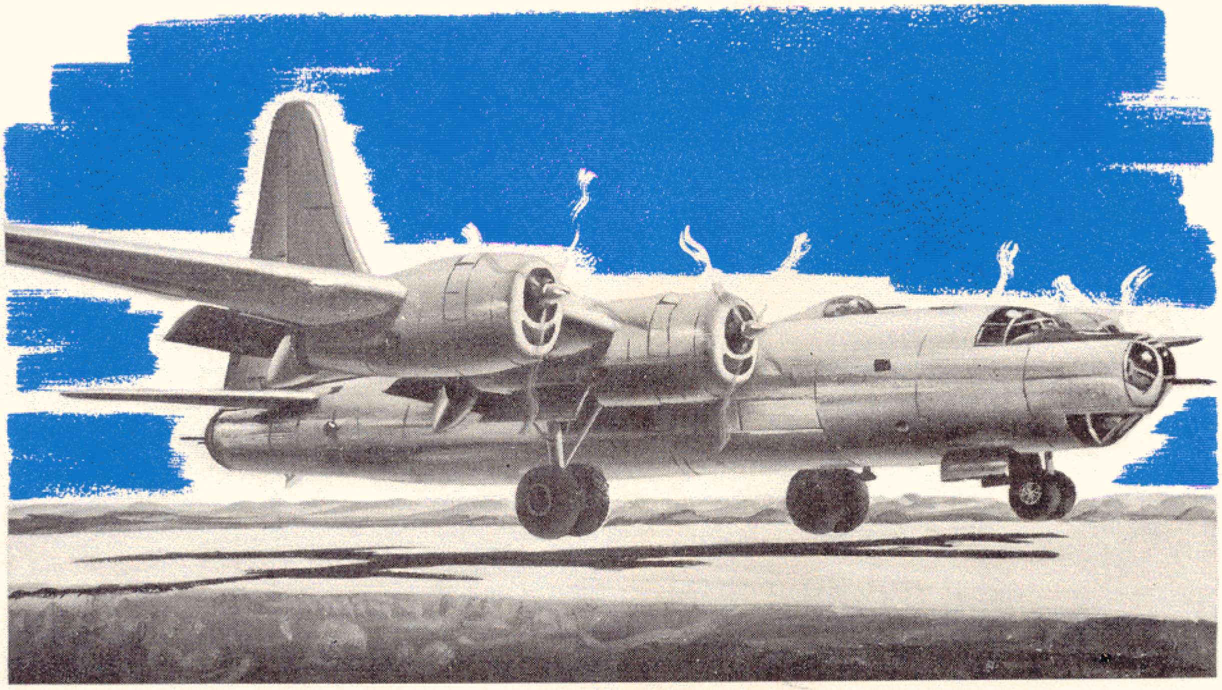
Start your turn onto the final approach early, to avoid making a steep turn or going by the runway and having to S back. Use power to adjust your approach glide angle to make good a point just short of the runway.

*1. **Turbos—SET.** Airplane commander turns TBS to required setting, generally position 6 for a stop landing.

*2. **Master tachometer—2400 RPM.** Engineer sets the prop synch-control for 2400 rpm on the master tachometer.

Note: Turbo setting of 7 to 7½ with 2400 rpm gives you approximately 42″ to 43″ if you apply full throttle for a go-around.

*3. **FLAPS—40°.** At the direction of the airplane commander, engineer lowers full flaps. Normally you use full flaps for all landings. You experience no difficulty if you have to go around with full flaps down. Scanners check for full flaps and report to copilot on interphone.



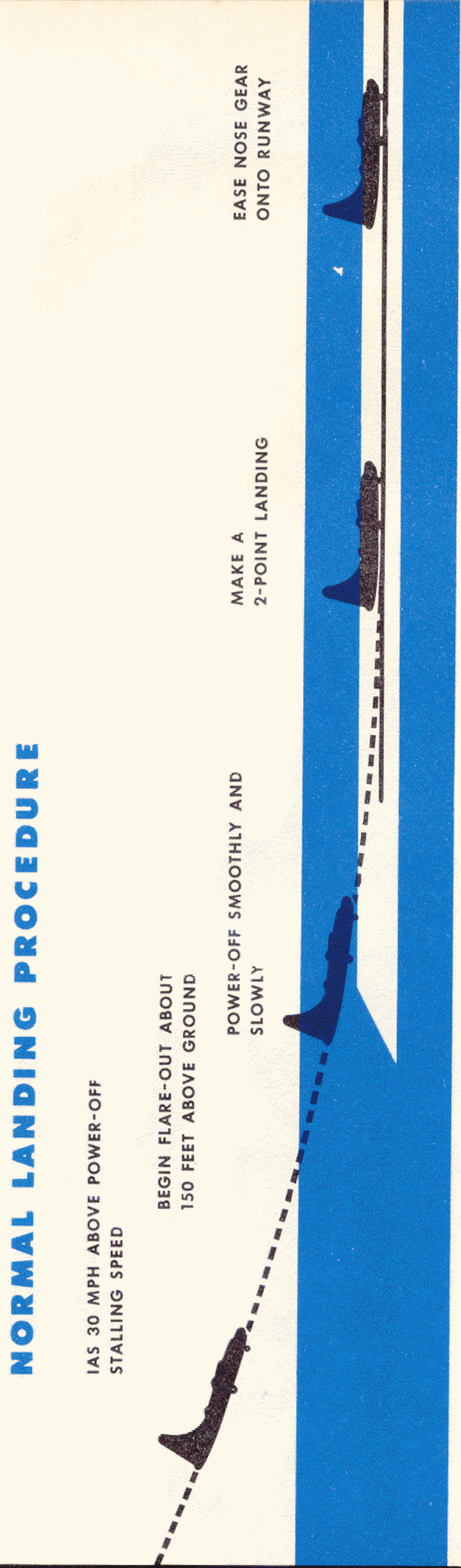
Normal Landings

Consistently good landings in the B-32 require a combination of good judgment, technique, and timing. Still this airplane is easier to land than other large airplanes. Its landing characteristics are consistently good in normal, crosswind, and emergency landings.

Get your airplane down in the first third of the landing strip. You can do this by using power carefully to adjust your approach glide and properly timing your flare-out. You can easily control your flare-out if your approach airspeed is high enough, and if you start breaking your approach soon enough. Keep your airspeed about 30 mph above power-off stalling speeds. In training airplanes this is about 140 mph indicated. But don't make a habit of a 140 mph approach. Instead learn power-off stalling airspeeds with flaps and gear down and base your landing airspeeds on the correct margin above stalling speed.

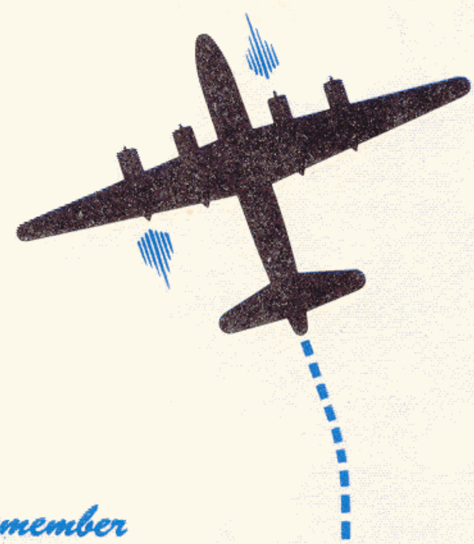
Start the flare-out about 150 feet above the ground, varying this altitude on the basis of wind velocity and your own technique. If you break your approach too soon or use too little airspeed, you tend to sink and slam onto the runway. On the other hand, if you break your approach too low or use too much airspeed, you tend to fly into the runway.

Take power off smoothly and slowly as you change attitude so that you decelerate without developing sink. Make a 2-point landing with your attitude as you make contact with the ground just about the same as takeoff attitude. Ease the nose gear onto the runway before you lose elevator control. You may notice a shrug as your nose gear touches the ground. This shrug is caused by nose drift which you can prevent by smooth technique. There should be no tendency of the nose gear to develop this shrug into a shimmy.



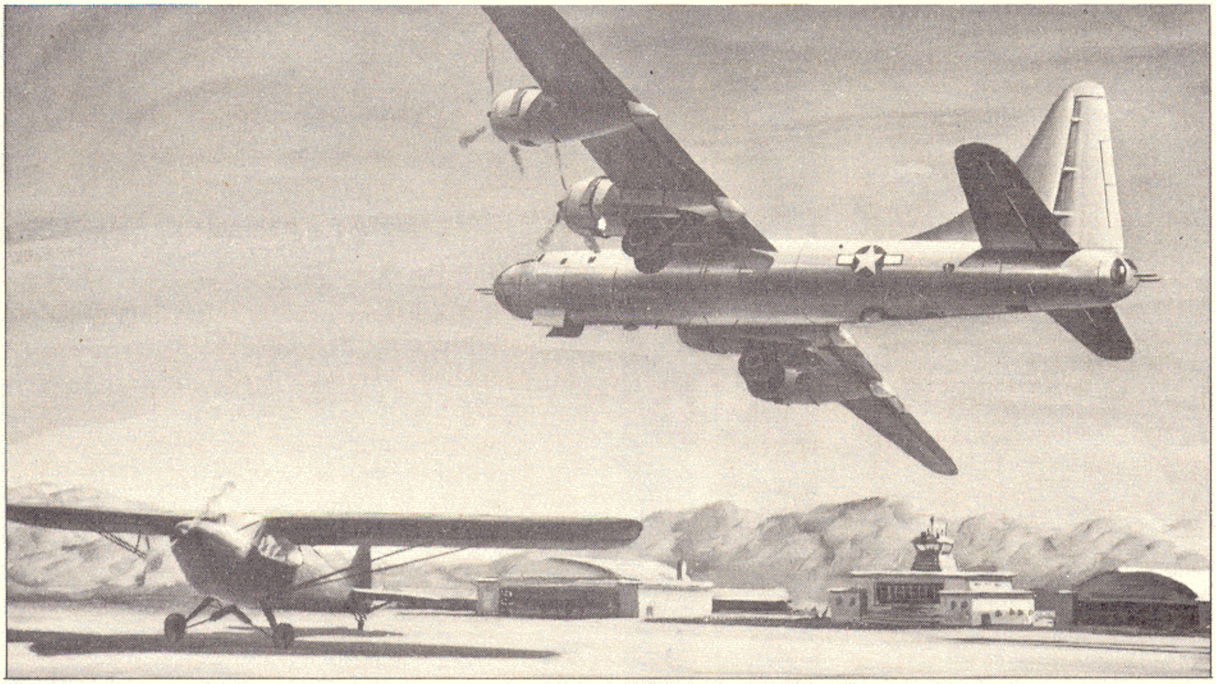
Ground roll procedure in this airplane is normal, with the exception of the use of reverse pitch on your props. The **After Landing Amplified Checklist** in the section following gives you precise procedure for using reverse pitch. Remember, however, that while you are using reverse props, you correct direction with the opposite throttle from the one you are used to using with conventional props. It takes a few attempts to get used to this procedure, but try to remember that **if you start rolling to the left, advance No. 3 throttle; if you start rolling to the right, advance No. 2 throttle.** The inboard throttles are a little longer than the outboard to permit easier handling in reverse pitch.

The reverse pitch is there solely to permit the use of props to stop the airplane. Reverse pitch makes possible surprisingly short stops, and saves wear and tear on brakes. However, don't run your engines up too high with props in reverse and don't use reverse pitch for ground operations other than landing, unless absolutely necessary. Without the ram cooling of landing speeds, reverse operation heats up engines too quickly. Reverse pitch wasn't added for use in parking the airplane.



Remember

WITH REVERSE PITCH—ADVANCE No. 3 THROTTLE IF ROLLING TO THE LEFT. ADVANCE No. 2 THROTTLE IF ROLLING TO THE RIGHT.



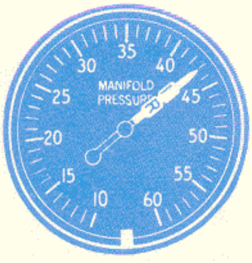
GO-AROUND

Go-arounds in the B-32 are relatively safe and easy. The airplane responds quickly to the application of power. Keep in mind the things which make a go-around critical – engine failure, full flaps, low initial airspeed, high gross loads, and low altitudes.

Always avoid the necessity of going around if possible. Keep the tower informed of your position. Space yourself properly in traffic. If you are in trouble, notify the tower well in advance so that the operator can clear the field for you. Use the best technique you are capable of to avoid undershooting. Follow prescribed traffic patterns so that you will not force others to go around.

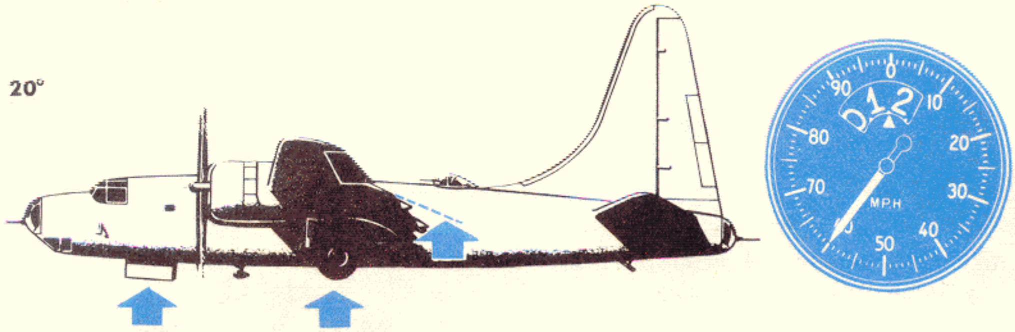
Even though your own procedure may be perfect, always be ready for a go-around because one may be forced on you by unforeseen circumstances. Other traffic, accidents on the runway, misunderstood instructions, or emergency landing by another airplane are a few of the situations which might necessitate the tower operator's sending you around.

If you are already on the ground when you start your go-around, proceed as you would for a regular touch-and-go landing. If you are still in the air, use the following checklist for go-around:



1. **Power – 2400 RPM, 43".** Engineer sets synch-control knob for 2400 rpm. Airplane commander advances throttles to full open position and turns up TBS, if necessary, to get 43".

2. **Gear–UP.** At your direction engineer puts



gear switch in UP position. Again scanners should check and report gear action.

3. **Wing flaps—20°.** As soon as gear starts up have engineer raise flaps at your direction to 20°. Scanners should check and inform you of flap position.

4. **Airspeed – AT LEAST 160 MPH.** Keep careful running check on your airspeed. Get and keep at least 160 mph as soon as you can, nosing down slightly to get it if you have necessary altitude.

5. **Cowl flaps—AS REQUIRED.** Engineer and copilot keep running check on CHT's and adjust cowl flaps as needed to keep temperatures within operating limits.

6. **Power—AS REQUIRED.** After you have safe airspeed with flaps and wheels up, readjust power for traffic or normal climb, as desired.

CROSSWIND LANDINGS

The approved technique for crosswind landings in the B-32 is a combination of crab and upwind wing slightly low. Although you have good aileron, rudder, and elevator control throughout your landing approach, remember that your B-32 is going to take longer to respond to control pressures because of its weight. This means merely that you should anticipate control and apply the normal amount sooner, rather than using more control pressure.

The critical part of any crosswind landing is the instant you make contact with the ground, the problem being to make this contact with zero drift and with the airplane headed straight down the runway.

Follow this procedure for crosswind landings:

1. Fly normal traffic pattern with your base leg moved out past end of runway approximately a half-mile farther than for normal landing. Reason for this procedure is to allow more time to establish heading giving you correct ground track.

2. Make your approach slightly longer and the last third of approach lower than usual. Use this extra time and lower approach to line up with runway and accurately estimate your drift. Use full flaps in normal manner.

3. Crab slightly into wind and lower upwind wing to help kill drift.

4. Just before you make contact with runway, apply rudder and aileron pressure to level wings and line up airplane with center of runway. Remember to anticipate control action. You can use some throttle on outboard engine of low wing to help raise wing. Proper timing is essential for smooth execution of this maneuver. If you remove correction too soon, you are drifting again when you hit runway. If you hold correction too long, you are still in a crab when you hit. Either of these errors makes directional control more difficult in early part of landing roll and puts extra strain on gear and tires.

5. When you are on runway, lower nose gear as soon as possible to get maximum advantage from inherent stability of tricycle gear.

LOW VISIBILITY APPROACH

Low visibility, or close-in, approach is necessary when the following conditions are present:

a. When visibility is such that you cannot make a normal pattern and still maintain visual contact with the field.

b. Where there are no radio facilities for an instrument approach.

c. When no alternate field is available.

Use the following procedure for low visibility approach:

1. Call tower and get careful briefing on field conditions.

2. Give tower operator your plan of procedure so that he can clear field for you and give other assistance. If possible, get permission for left-hand pattern so airplane commander can always be on field side.

3. Approach field in direction in which you are going to land, at an altitude as high as ceiling and visibility permit.

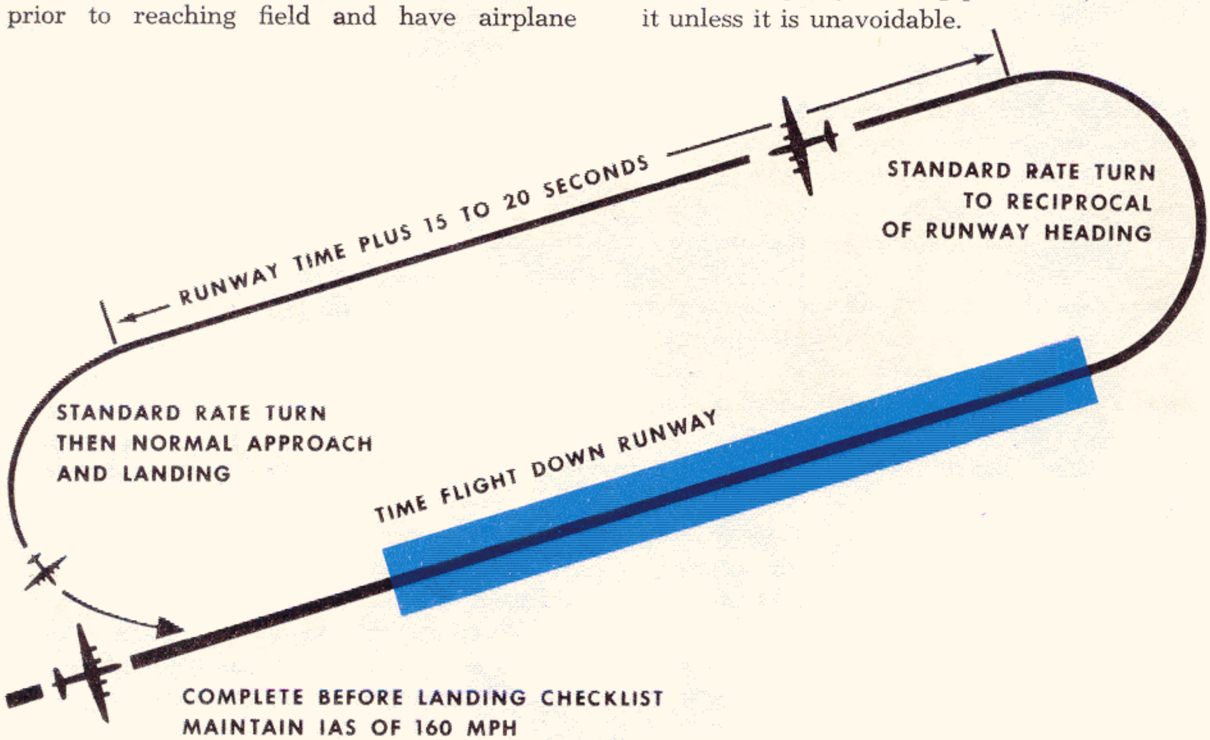
4. Complete your Before Landing Checklist prior to reaching field and have airplane trimmed with power set to maintain IAS of 160 mph.

5. Fly down runway. At end of runway make 180° standard rate turn and fly back on reciprocal heading. If necessary, time your flight down runway and fly same length of time back on reciprocal heading.

6. Fly 15 to 20 seconds past end of runway; then start another standard rate turn back to runway heading. Complete lowering of flaps and slow airplane to 30 mph above stalling speed. If necessary to make steep turn, remember that stalling airspeed is higher in turn and make allowance for it. Amount of altitude to lose during turn depends on situation. Plan your approach so there is no danger of overshooting.

7. Roll out on runway heading and proceed with normal approach and landing.

Note: Although low visibility is not necessarily emergency landing procedure, don't use it unless it is unavoidable.



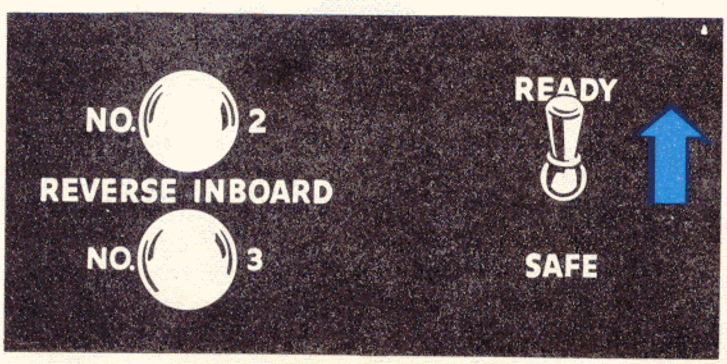
After Landing

AMPLIFIED CHECKLIST

1. **Ready and reverse—ON GROUND ONLY.** When you intend to use reverse thrust during landing, notify your crew beforehand. Proper sequence for calling for reverse switches is for airplane commander to call "READY" when the main gear comes in contact with the ground, and "REVERSE" when the nose gear is on the ground. Engineer places the ready switch in READY position and the reverse switches in REVERSE position when the airplane commander calls for them. Initiate the reverse action as early as practicable after contact with the ground in order to gain maximum effectiveness.

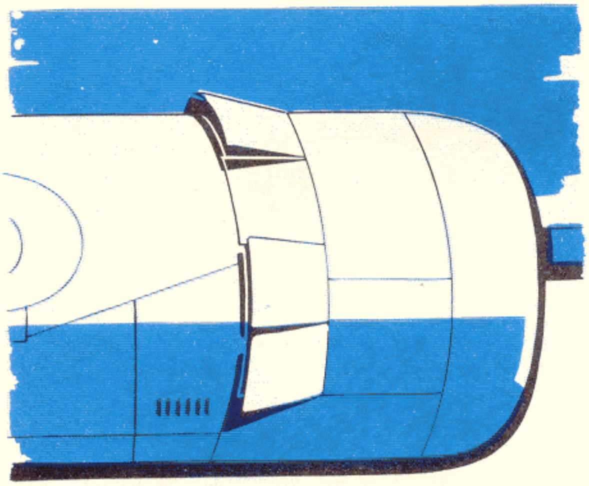
When you start the reverse action your throttles should be fully retarded. As props pass through flat pitch advance throttles slowly to keep engines from dying. When props reach full reverse pitch setting the amber tel-lights come on. Continue to advance power until you get the desired braking effect. Remember that the sound of flat pitch is the signal for advancing power. Have your copilot guard his throttles to prevent your advancing too much power during the reverse procedure. If you use more than 15" Hg during reverse action the engines overspeed at flat pitch position.

You can use throttles to maintain directional control, but remember to apply power with the right throttle if you start turning to the left, and with the left throttle if you start turning to the right. Use brakes if necessary, but reverse thrust is effective and rêduces ground roll appreciably even without brakes. It has most effect when used early, to kill initial speed after landing. Reverse thrust loses effectiveness as speed decreases. Don't ride throttles trying to bring airplane to a complete stop unless brakes are out. During normal operations reverse and ready switches should be placed to NORMAL and SAFE as soon as airspeed drops to approximately 50 to 60 mph.

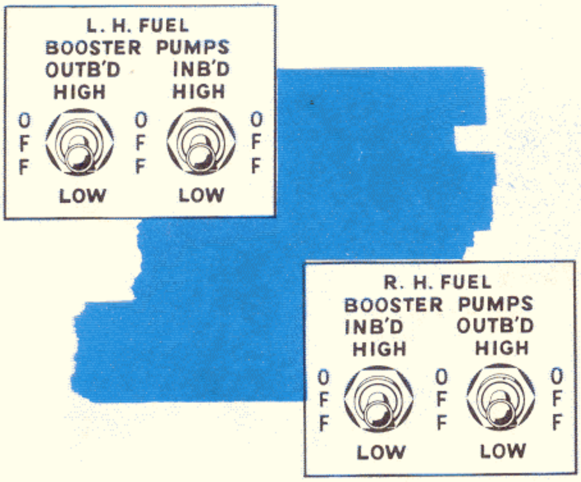


LIMIT POWER IN REVERSE TO 15" HG.

2. **Reverse switches—NORMAL AND SAFE.** At your direction engineer returns safety switch to SAFE and reverse switch to NORMAL. If you get into trouble with reverse props, you can return them to normal pitch immediately by flipping reverse and safety switches to NORMAL and SAFE. Props come back to normal pitch even if reverse cycle is not yet complete.

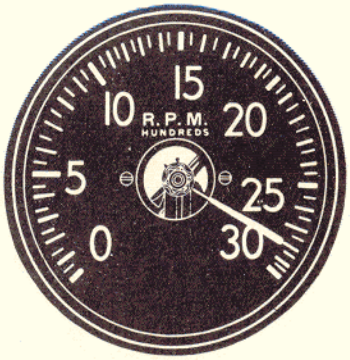


3. **Cowl flaps — OPEN.** Engineer operates switch to open cowl flaps fully. Airplane commander and copilot look out to check that cowl flaps open.



4. **Booster pumps—OFF.** Engineer turns all booster pump switches to OFF position.

5. **Turbos — OFF.** Airplane commander has engineer turn TBS knob to 0 setting.



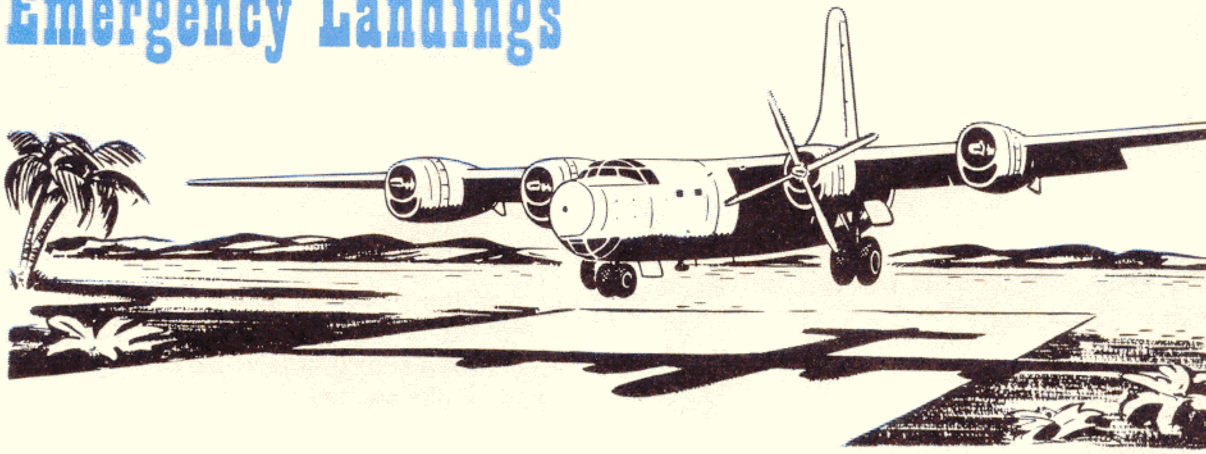
6. **Master tachometer—2800 RPM.** Engineer turns synch-control knob for a setting of 2800 rpm on master tachometer.

7. **Wing flaps—UP.** Engineer operates switch to raise flaps.

8. **No. 2 and No. 3 generators—OFF.** Engineer turns off No. 2 and No. 3 generators. These generators do not generate power at low rpms of taxiing, and are kept in OFF position in case of possible failure of reverse current relays.

9. **Bomb doors—OPEN.** (Airplane commander's option). Airplane commander opens bomb doors with bomb salvo switch if desired. You can leave bomb doors open for all ground operation so that crew members can use bomb bays as a quick exit in case of fire on ground. This procedure also eliminates fire hazard by ventilating bomb bays where fuel fumes might accumulate. Keep them closed in bad weather, however, to prevent splashing of mud and water into bomb bays.

Emergency Landings



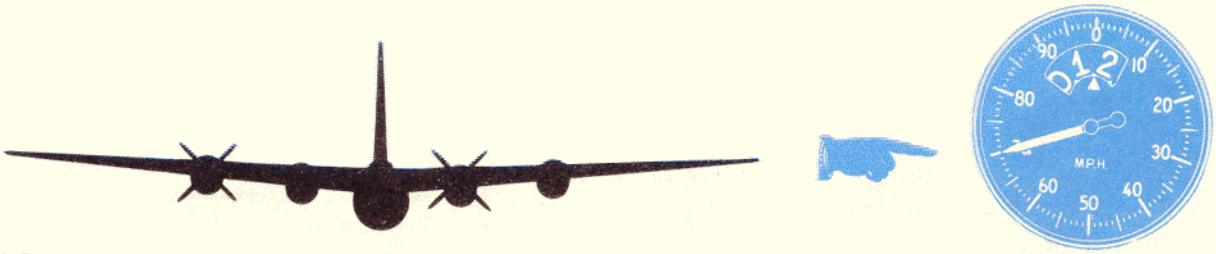
Landing With One or More Engines Out

Successful landings with engines out in your B-32 take skill, caution, and a good knowledge of your airplane. When you bring those factors to bear, such landings are not overly difficult. Exercise proper respect for these emergencies but don't be unreasonably afraid of them just because you're in a bigger airplane. The general rules for engine-out landings which you followed with your last 4-engine airplane apply as well to the B-32. In addition, observe the following precautions:

1. Notify tower as soon as possible of your predicament and intentions, so that tower personnel can prepare for you and give you all possible help.

2. Fly traffic at a higher altitude and maintain safe airspeeds: at least 160 mph for one engine out; at least 170 mph for two engines out; and all you can get for three engines out. This is one occasion when you don't have to comply with traffic altitudes, airspeeds, or patterns. Take advantage of this fact to plan and fly an approach which gives you plenty of safety margin.

3. Use all your skill to avoid undershooting or overshooting, if possible. You can safely



REMEMBER, YOU DON'T HAVE TO COMPLY WITH TRAFFIC ALTITUDES • FLY HIGHER

make go-arounds with one or even two engines out in a lightly loaded airplane, but why take a chance?

4. Training procedures prescribe traffic patterns and airspeeds for simulated engine-out landings. Remember, however, that these are for training purposes, and they don't necessarily limit your actions in real emergencies. Use training procedures as a basis and apply your best judgment to conditions affecting your own situation.

5. Keep gear up until you are on final approach.

6. Use 8° to 10° flaps in traffic at low airspeeds. Don't put full flaps down until field is "made."

7. Back off on trim as you make power reductions.

8. Flare out and land as you do in normal landings.

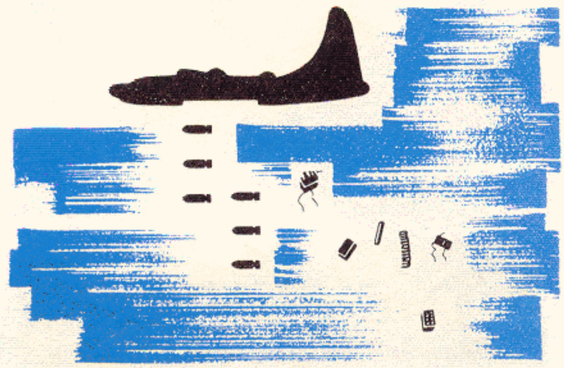
9. In any emergency situation where danger exists of crack-up, ground loop, or any severe impact, notify all crew members to brace themselves adequately for landing. Use all cushioning, seat belts, and shoulder harnesses available. See additional instructions for crash landings under the following heading.

Crash Landing—General Procedure

The conditions affecting each emergency landing are different. No one set of rules applies to all cases. These general instructions may or may not fit your own situation. Be familiar with all crash landings procedures and use judgment in picking those which apply to your own emergency.

1. First decide whether situation calls for crash landing or bailing out whole crew if choice is possible. Choose bailout unless you are reasonably sure you can make successful landing. Be sure you have tried all emergency procedures possible to correct failures which produced emergency. If you decide to crash land, notify crew so they can begin preparations. Start emergency radio procedure immediately.

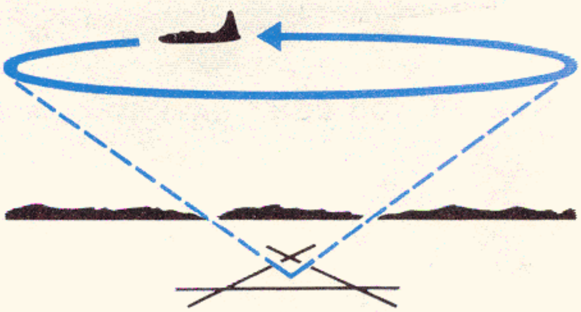
2. Jettison un-needed removable equipment. What to jettison and what to keep depends on particular emergency, but have crew throw



out everything possible to lighten airplane and prevent injury on impact. Anything loose may become a lethal projectile inside airplane when you hit. Following are some things you may be able to get rid of: bombs (jettison in safe, over uninhabited or enemy terrain), bomb sight, sun visors, radio receivers, navigator's table and drafting machine, cup container, map case (save maps if needed), back to navigator's seat, transmitters, liaison set, headsets, portable oxygen units, oxygen hoses, ammunition and ammunition boxes.

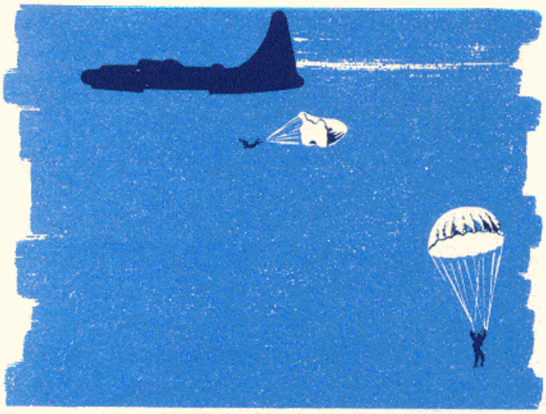
If crash landing far from bases, save any radio equipment you may be able to use to direct searchers, particularly emergency set which is light and portable. Save fire extinguishers, axes, and flashlights; you may need them to help in getting out of airplane. If landing in wild country, save first aid kits, sextants, canteens, and any rations aboard. If you have a copy of **AAF Survival Manual**, hang onto it. If you don't have a copy, get one before you start operations over wild country.

Be sure that anything you keep in airplane is securely fastened or held, so it won't hit somebody on impact.



3. If possible, circle until fuel supply is less than 200 gallons per tank.

4. Remove top hatches and windows. Jettison covers or put them in bomb bay. Use axe if necessary to remove astro hatch cover and interior doors, to prevent jamming. Be sure bomb bay and bottom hatches are closed, bottom turret retracted.



5. When general preparations are complete and if situation permits, notify crew members that those not necessary to landing may bail out if they choose.

6. See that everybody remaining on board gets into crash position. Precise crew positions for crash landing are not yet prescribed for this airplane, but crew members should pick spots where they can face aft, with backs braced against solid structures. Use parachutes for cushioning if possible. Airplane commander and copilot check safety belts and wear shoulder harnesses, correctly adjusted and locked. See your **Pilots' Information File** if you are not familiar with shoulder harness use. Have crew members keep fire extinguishers, axes, and other necessary equipment accessible for quick exit but secured against impact. Stay out of nose compartment for landing and stay away from turrets if possible.

7. If your gear works, **land wheels down.**

8. Make long approach, so crew members can complete at your direction as many as possible of following procedures:

a. Lower full flaps.

b. Lower gear.

c. Stop APP.

d. Feather inboard engines, to prevent getting blade through cabin.

e. Turn off generators.

f. Shut off fuel boost.

g. Close fuel selector valves when sure of landing. At low power settings 10 to 15 seconds fuel remains in lines.

9. If possible, just before hitting, warn crew members.

10. Just before touching ground, throttle clear back and put mixture controls in IDLE CUT-OFF; then gradually open throttles to clear fuel from carburetor without causing surge in power.

11. Turn off all ignition switches and battery switch.

12. Have everybody get out quick, taking fire extinguishers and axes with them. You may have to use this equipment to get someone else out.

13. If hatches jam and you have to chop holes in the airplane to get trapped crew members out, chop at the areas marked on the fuselage for emergency entry. Check on these locations now so you know where they are.

Airfield Crash Landing Procedures

Follow these additional procedures if you are making a crash landing at an airfield:

1. Call tower early so that crash facilities are ready.
2. Contact operations officer through tower for additional instructions. It may be preferable for you to go to another base.
3. **Land on runway**, with or without landing gear.

Specific Gear Failure Procedures

Consider general crash landing instructions, and if they apply, follow them. In addition, follow these specific procedures:

1. With no gear down, use normal landing attitude and slide airplane in on its belly.
2. With main gear down, nose gear up or flapping, land in normal attitude but hold nose up as long as practicable, then lower it gently if you can. Prop tips do not touch ground in this situation. Whether or not to use brakes and reverse props is still problematical. If you use them they throw more weight on nose structure; but on the other hand, if you don't use them, the abrasive action continues longer. The only time this situation occurred to date, pilot did not use brakes or reverse props and airplane slid approximately 2600 feet with negligible damage.
3. With one main wheel down, nosewheel down or up, land in normal attitude but with wing slightly low on good wheel side. Hold other wing up as long as possible, then be prepared for sharp ground loop when wing hits. Use opposite brake to minimize ground loop, if possible.
4. With nosewheel down, main gear up, proceed as for belly landing.

Landings After Hydraulic Failures

If your normal hydraulic system fails and you use the emergency hydraulic system for the operation of any units, consider the subsequent landing as an emergency landing. Be sure to call the tower and have the field cleared for an emergency landing. Everything may be operating properly, with gear and flaps lowered in proper position by the emergency hydraulic system, but remember that you can't get them up if you have to go around. Go-around with full flaps and gear down would necessitate excessive power, with resulting excessive engine temperatures. This situation would increase the possibility of engine fire or failures. Losing an engine at low airspeeds, with full flaps and gear down would mean a crash landing straight ahead as your only procedure. Therefore, have the tower clear the field, and use every precaution possible to make the first landing attempt good.

Securing Airplane

AMPLIFIED CHECKLIST

Don't neglect your checklist just because you're back on the ground again. Double-check everything, if necessary. Remember you have to fly the airplane again.

1. **Parking brakes—ON.** Airplane commander sets parking brakes.

2. **Master ignition—CHECKED** (700 RPM). Engineer turns master ignition switch off and on momentarily to check by sound that it grounds out complete ignition system. If switch is working, all engines stop firing. Don't let engines stop completely, however.

Then run engines at 1200 rpm for 30 seconds in order to scavenge oil properly and avoid possible liquid lock.

3. **No. 1 and No. 4 engine generators—OFF.** Engineer turns outboard generators off. If these generators are left on at low rpms, there is a slow drain on battery from reverse current relay cut-outs.

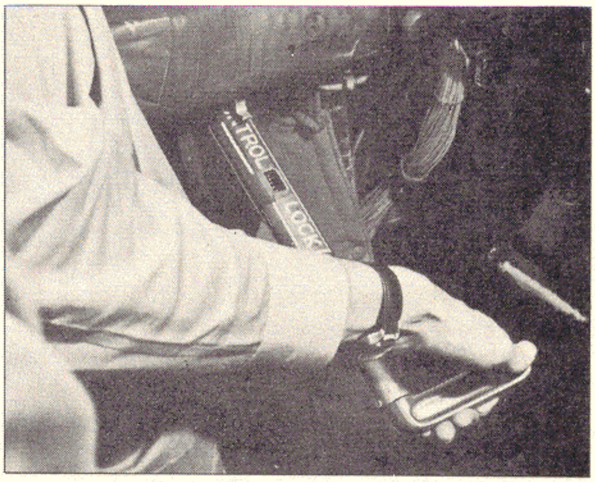
4. **Mixture controls—IDLE CUT-OFF.** Engineer moves mixture controls to IDLE CUT-OFF one at a time, in order 3, 4, 2, 1. After cutting No. 3 and before cutting No. 2, airplane commander checks suction gage for operation of No. 2 vacuum pump. Engineer starts flaps down and then raises them, checking operation of No. 2 hydraulic pump by noting rise on main hydraulic pressure gage. Let No. 3 engine stop completely before making these checks, as both gages show pressure as long as both engines are turning.

5. **Ignition switches — OFF.** Engineer turns ignition switches to OFF position, one at a time.

6. **Fuel valves—OFF.** Engineer turns fuel selector valves to OFF position. Do this while you still have electrical power or valves do not operate.

7. **Electrical units—OFF.** Crew members turn all electrical unit switches OFF. See item 6 in **Before Starting Engines, Amplified Checklist.**

8. **Flight controls—LOCKED.** Airplane commander locks controls in following order: rudder, elevators, aileron. Always try control column and pedals to be sure they are securely locked.



9. **Wheel chocks—IN PLACE; brakes—OFF.** Airplane commander and copilot look back from windows to make sure scanners have put wheel chocks in place. Airplane commander releases parking brakes.

10. **Load, equalizer, and battery—OFF.** Engineer turns APP load switch to neutral, equalizer switch and battery switch to OFF positions.

11. **APP—IDLE, THEN OFF.** Copilot pushes APP throttle down to IDLE position, allowing APP to idle for short period, then turns APP ignition switch to OFF position.

Night Flying

Your airplane and everything in and about it operates exactly the same at night as it does in the daytime. Everything, that is, except you. Your own vision is the only thing affected by the darkness. But this fact merely means that night flying requires more exacting technique on your part. Darkness, in affecting your vision, puts limitations on your judgment of distance, altitude, and speed. It makes it easier to overlook faulty maintenance in inspections, to misread instruments, or switch and control settings, and to detect equipment failures. It also increases the possibility of taxiing accidents. You can neutralize these night hazards, however, by increased vigilance and extra precautions. Re-read the information on night vision in your **PIF**, and keep in mind the special techniques for night operations included in the following paragraphs.

Night Inspections

Night inspections of airplane and crew are doubly important, because it is easier to miss sources of trouble and because any trouble which shows up later in flight is always harder to cope with at night. Be sure that at least you, your copilot, and your engineer always have a good flashlight handy for preflight inspections and for possible flight compartment use.

While you are making your exterior inspection have your engineer turn on the battery switch, start the APP and turn on all exterior and interior lights so you can check their operation. The interior lights make your interior inspection easier. Location and uses of interior and exterior lights are described in **Electrical System** section of this manual.

Check windows, windshields, and scanning blisters to be sure they are clean. Scattered light on unclean surfaces reduces the contrast between faint lights and their backgrounds. Check radio operation and set proper frequencies, and have your radio operator double check all radio equipment. Radio failure at night is more serious than in daytime.

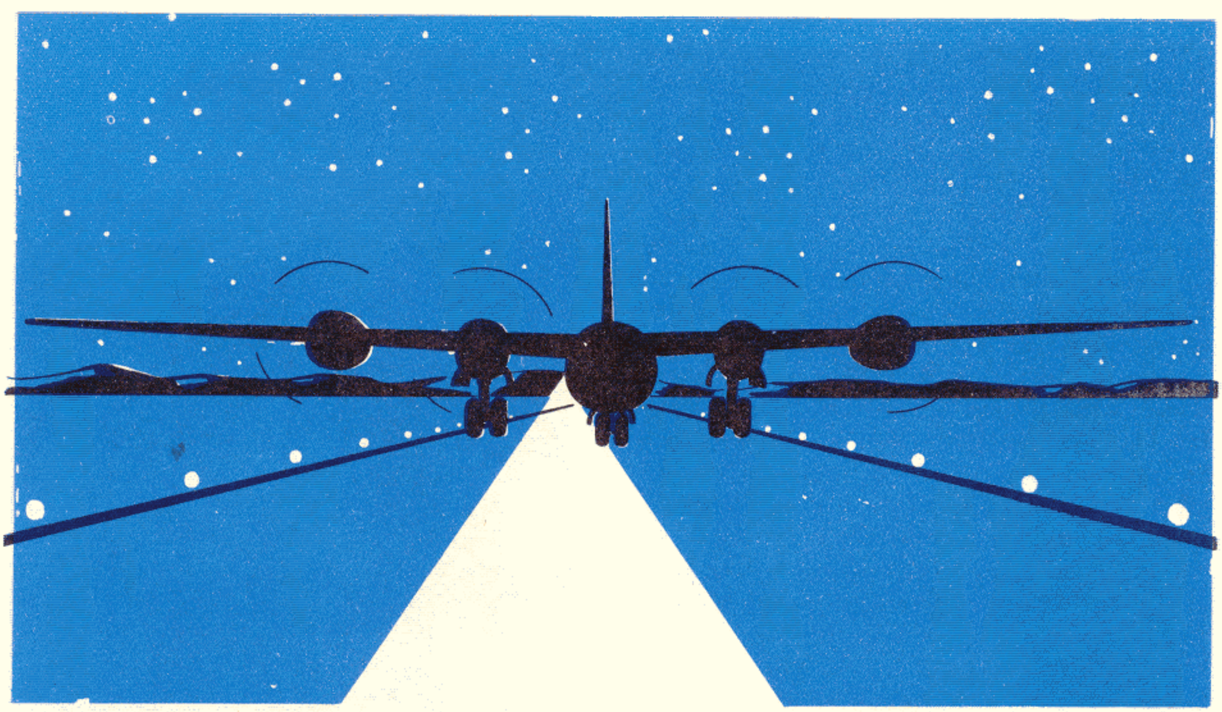
Ground Operation at Night

When taxiing at night use your landing lights alternately to reduce the load on the electrical system imposed by both lights, and to prolong their life. However, don't hesitate to use both of them if necessary. If you taxi toward a landing runway, turn off your landing lights to avoid blinding incoming pilots. Turn flight compartment lights as low as possible to reduce glare and aid forward visibility. Make turns with the inside landing light on.

In congested taxiing areas, have a man walk ahead of each wing to direct taxiing by light signals. Post an observer in the astro glass hatch to help watch ground traffic. In case of brake trouble, stop immediately and have your airplane towed to the line. Faulty brakes are almost certain to cause taxiing accidents at night.

If in doubt where to turn, ask the tower. Get tower clearance for crossing runways.

When you park at the end of the runway for run-up, make certain you have left enough clearance for incoming aircraft to land. Turn off your landing lights for run-up to relieve the system and avoid overheating the lights. Turn flight deck lights as bright as possible to give you all the light necessary to check everything before takeoff. When you complete your run-up and finish with the checklist, turn off the flight deck lights you don't need and turn the rest as low as possible for takeoff. Be doubly sure all crew members are at their proper stations and set for takeoff; check them by interphone.



7

Night Takeoffs

Get tower clearance for takeoffs before taxiing onto the runway. Use your landing lights momentarily, if necessary, to line up straight with the runway. Be sure that your nose gear is straight. Flash your landing lights down the runway long enough to see that the way is clear.

If you have good visibility at night, with clear ground references, you can take off contact. If visibility is poor and no horizon is visible, take off on instruments. If you are taking off on instruments, stay on them. Never try to fly half instruments and half contact.

Maintain proper airspeed and a constant heading. It is imperative to hold a constant heading until you reach sufficient altitude for a turn. Be particularly careful to hold your heading while you are braking your wheels after takeoff, before bringing up the gear.

Have all crew members briefed to watch for traffic throughout the flight as well as on takeoff.

Night Flight Precautions

Remember the illusions possible in night flying. Don't try to orient yourself with the terrain by single or scattered lights. Unless you have excellent visibility on a bright night, ground references are unreliable except over large cities where there are enough lights to make a good pattern. Depend on your instruments as your major reference at night; use scattered lights only as a secondary reference. Check instruments more frequently than in daytime, with a filtered flashlight, if necessary. Don't unnecessarily increase the intensity of flight deck lights. This impairs vision for at least 30 minutes after the lights are turned down. Remember also that flashes of lightning can temporarily blind you. If there are repeated flashes of lightning it may be necessary to turn all flight deck lights on as bright as possible and go entirely on instruments.

In case of radio failure, attract the attention of the tower by flying over the field 500 feet above traffic and repeatedly flashing landing lights, or signalling with the recognition lights. Get clearance to enter traffic by light gun signals from the tower.

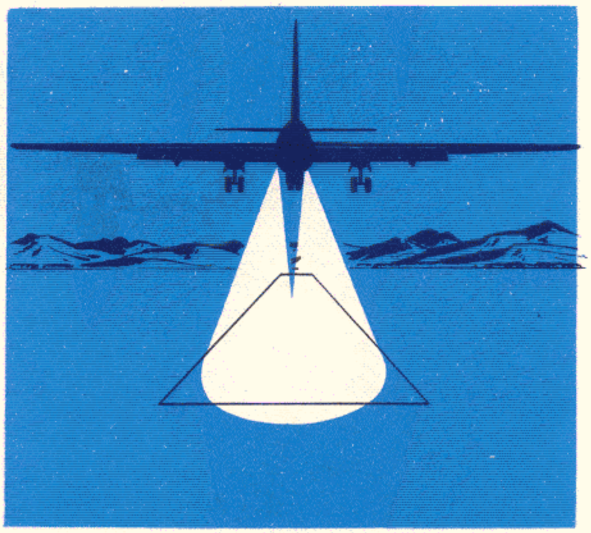
Night Landings

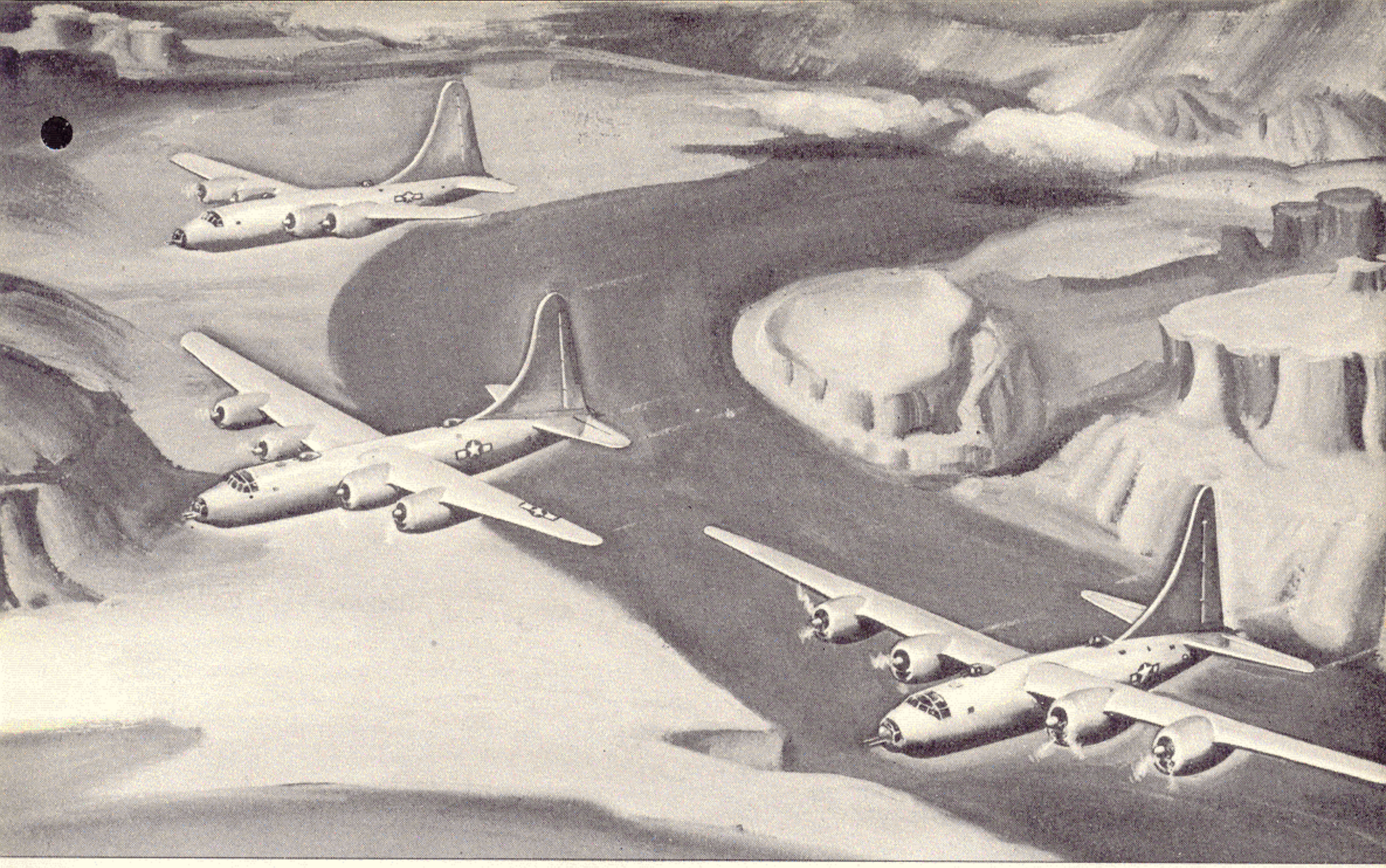
Fly compass headings on the different legs of the traffic pattern. Judge where to start your turn onto the final approach by the appearance of the runway lights. As you come along the base leg, the runway lights look like a single row of lights. Start your turn onto the approach at the moment the two rows of lights seem to separate. Make a medium turn, and complete roll-out from the turn just as the two rows of runway lights are squared away at full width.

Avoid a low approach at night. Maintain constant glide, constant airspeed, and constant rate of descent, by making slight changes in power and attitude.

Your landing lights are most effective from about 500 feet. They are helpful in picking up the ground for you, but don't sight down the beam. Instead use the whole lighted area ahead and below for reference. Don't rely on landing lights alone; use runway lights as secondary reference. Landing lights alone may induce you to level off for landing too late. Runway lights alone may cause you to level off too high, especially if there is dust or haze over the field.

If you are uncertain of your final approach, carry a little more power. This prevents stalling out high. Carry power until you are sure of making contact with the ground. Avoid cutting power too high or too soon.





Formation Flying

Since most B-32 transition students are returned combat pilots, you probably know that the formation flying you get in transition training can only review basic principles for you and help you familiarize yourself with handling a bigger airplane in formation. The changing tactical situations, differences in practices among the various theaters, and the new uses to which formation flying is being put, all make it impractical to teach combat formation in transition.

In the final analysis, good formation technique is a matter of practice, once you learn the basic principles and problems. If you don't know them already, you must learn these basic principles as applied to the particular model you fly during transition training. Practice them until you can assemble and hold your B-32 in any formation, at any altitude, regardless of size, shape, or tightness of the formation.

Formation Principle

Formation flying is based on a double principle: the formation affords the greatest concentration of striking power, in both time and degree, and also the greatest protection. There is no way other than flying a formation to hit a target hardest in the shortest possible time. The matter of protection is simple mathematics: three times as many eyes to spot an enemy and three times as many guns to bring him down in each 3-plane element, plus the advantages of combination of angles of fire and angles of protection.

Along with the advantages of formation flying come disadvantages. It's more difficult than individual flying. It takes more precise and skillful technique. It increases the seriousness, from a technical standpoint, of all the factors which affect normal flight, both those factors inherent in the airplane and those inherent in the atmosphere. You have to minimize all these adverse factors by perfecting your skill, in order to get the most out of the potential striking power and the potential protection of your own element of the formation.

Holding Position

No formation is any better than its individual elements. Your primary job is to hold your position in the formation. Out of position you may expose yourself to enemy fire, make your bombs ineffective, disrupt other elements, and restrict fields of fire of friendly aircraft.

Use smooth coordinated power to hold your position. Think ahead and anticipate changes. If and when you get formation sticks on your airplane this problem will be greatly simplified. Use your TBS control for power changes. If you are using power below that requiring turbo boost, set power on your outboard engines and use your inboard throttles to hold position. Use the latter procedure also at high altitudes where use of turbo boost would cause manifold pressure surge. The greater length of the inboard throttles makes them fairly easy to operate separately.

The response of your airplane to changes in power and airspeed varies considerably with changes in load and altitude. Under similar conditions it takes twice as long to make a given correction at 25,000 feet as it does at 5000 feet.

Rapid changes in airspeed, altitude, and direction are likely to be necessary just before and after you reach the target area. Be prepared for them; there may not be time for adequate signals. Keep thinking ahead of what you're doing.

Formation Leadership

Good formation depends as much on good leadership as it does on the ability of wing men to hold position. Be sure that there is careful briefing on formation positions, power settings, assembly procedure, and timing. Insofar as possible, forewarn flight members of anticipated maneuvers. Fly as steadily as possible. Use the power settings at the lower range of the best cruise band, on the cruise control chart. Signal in time to let wing men anticipate maneuvers.

In training, as well as combat, insist on good formation discipline. Don't allow single-engine fighter maneuvers in a 4-engine formation.

Work from a standard set of formation signals so that all members recognize them immediately.

FORMATION SIGNALS

ASSUME NORMAL FORMATION

SIGNAL

Rock the wings. A slow, repeated rocking motion of the airplane around its longitudinal axis. Wing movement to be slower and of greater amplitude than in "flutter ailerons."

MEANING

Assume normal formation. From any other formation, go into normal close-up formation.

OPEN UP FORMATION

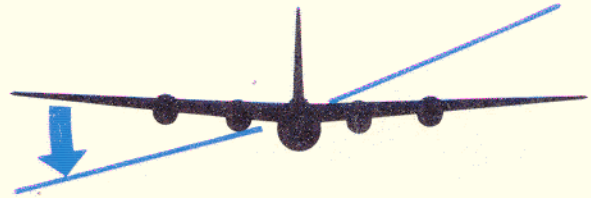
SIGNAL

Fishtail or yaw. By rudder control, cause the airplane to move alternately and repeatedly right and left.

MEANING

Open up formation. Where applicable, this signal may be used to order a search formation.

CHANGE FORMATION



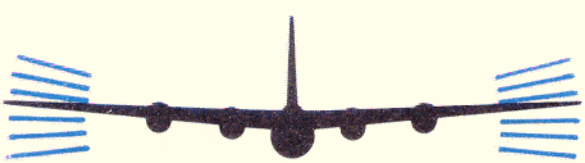
SIGNAL

Dip right or left wing.

MEANING

Change formation. (a) From any formation other than echelon, go into echelon of flights to the right or left. (b) If in echelon of flights, right or left, go into echelon of individual airplanes to the same side. (c) If in echelon of individual airplanes, go into echelon of flights on the same side if the wing is dipped to the side on which the aircraft are echeloned. (d) If in echelon of flights or individual airplanes and wing is dipped on side away from echelonment, form same echelon to the opposite side.

ATTENTION



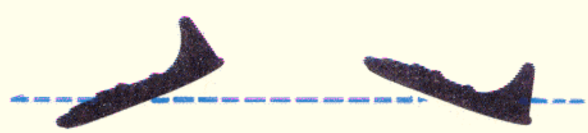
SIGNAL

Flutter ailerons. Repeated and comparatively rapid movements of the ailerons.

MEANING

Attention. This signal is used on the ground and in the air to attract the attention of all pilots. Airplane commanders should stand by for radio messages or further messages. When on the ground in proper position to take off, the signal means "Ready to take off."

PREPARE TO LAND



SIGNAL

Series of small dives or zooms.

MEANING

Prepare to land. This signal is an order to each airplane commander in the formation to take the necessary steps preparatory to landing. In the absence of additional signals, land in the normal landing formation of the unit. Any change in the landing formation is given by radio or Aldis lamp.

KEEP YOUR EYE ON LEAD AIRPLANE

Cold Weather Operation

Cold weather operation presents special problems for you to solve. These problems are present in the case of B-32's as much as for any other airplane. Remember that cold weather operation of airplanes doesn't necessarily imply sub-arctic latitudes. It gets cold even in Texas. Whenever you start putting on extra clothing, it's cold enough to think of special care for your airplane.

The following paragraphs include most of the procedures you should add to your checklists when the temperature is below 0°C. Consult also the **Aircraft Checker's Report, Winterization Check List**, AAF Form 263B, in the airplane data case.

Preflight

Most preflight procedures for cold weather operation fall within the scope of duties of your engineer and ground crew. It is your responsibility as airplane commander, however, to know what these procedures are and see that they are carried out.

1. Before each flight in freezing weather check all fuel strainers and sumps for evidence of ice. If airplane is stored in heated hangar, drain some fuel off at fuel cocks to get water out of tanks before taking airplane into cold for starting.

2. Inspect fuel tank vents, on under side of wing, outboard of No. 1 and No. 4 engines, to be sure they are free from ice. If vents are ice-plugged, condensation may take place in fuel cells, and resulting water may freeze and stop fuel flow.

3. Check oil drains and sumps for fluid oil. If no oil comes out when cocks are open, drains are clogged with ice and congealed oil. Apply heat to thaw them. After you drain off water and as soon as oil begins to flow, be sure to close and safety drains.

4. Wipe shock strut piston tubes and all other exposed hydraulic piston tubes clean of snow, dirt, or ice. Then wipe pistons with rag soaked in type of hydraulic fluid used in system.

5. Remove all snow, ice, and frost from external surfaces, checking hinges and controls for freedom from ice. Get snow off wings, fuselage and tail surfaces by gentle brushing with brooms or evergreen boughs. Removing ice is

more difficult; use great care not to scratch or mar wing surfaces in any way. Two men can clear ice from wing by vibrating a rope across the surfaces. Moisture condensation may cause ice accumulation inside wings. Remove this ice with heat before takeoff. You can get stubborn ice formations off any part of airplane by use of portable heater or by applying hot water on small areas and flushing with denatured alcohol.

6. When temperatures fall below —21°C., apply external heat to bombardier's and pilots' compartments. You can bring in heat through bombardier's access door and bomb bay doors. Warm instrument panels with radiant bathroom type heater. Don't allow heated blast to play directly on instruments. As soon as engines start firing, check instruments for irregularities.

7. Warm bombsight and autopilot units with heated covers provided with each unit. If conditions permit, warm up these units for two hours. In any case, run them one-half hour prior to takeoff with heated covers on and operating.

8. In cold weather starting with temperatures below 0°C., apply external heat to both fore and aft sections of engine until CHT's reach 20°C. Allow at least an hour for this operation.

9. Under low temperatures, battery loses efficiency. If cold weather operation is over extended period, remove battery and store in temperature of about 20°C. In any case make sure that specific gravity of battery is high enough to prevent battery freezing. Always use external source of power to start APP and engines in cold weather. APP may need preheating, as well as engines.

10. Operate ailerons, elevators, rudder, and all trim tabs through their full travel three or four times to check ease of operation and to see that they are not frozen up.

11. Check engine breather line outlets for frozen condensation.

Starting Engines

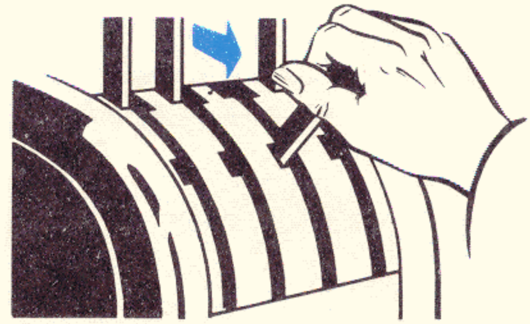
Follow normal starting procedures, observing the following precautions:

1. Always use external source of power.

2. If external power supply is not available or if weather is cold but not to the degree making external power necessary, use APP but be sure to let APP come completely up to speed before applying load to it.

3. Don't close cowl flaps to speed engine warm-up.

4. After starter engages and engine is turning over, wet blower by moving mixture con-



PRIME *Cautiously* WITH MIXTURE

trol momentarily out of IDLE CUT-OFF. Then operate primer in normal manner. If you suspect underpriming, you can get better priming spray by putting booster pump in HIGH position. If necessary, you can get additional prime by use of mixture control. However, operation of primer and mixture control together discharges large amount of raw fuel into blower section. Always keep in mind that priming fuel goes to blower section and not into cylinders; it takes several engine revolutions before good mixture of fuel and air reaches engine. Don't mistake this delay in firing for evidence of underpriming.

Raw fuel draining from supercharger drains indicates overpriming. If this happens, shut off ignition switch, open throttles, and have engine pulled through by hand to eliminate excess fuel.

5. Don't set throttle so far open for cold weather starting as for normal starts. Smaller throttle opening gives you richer mixture for cold weather starts.

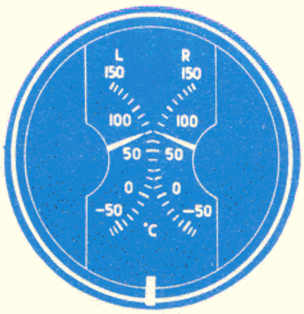
6. Operate engine on primer alone for first few seconds after cold weather start to insure that engine is going to run and to prevent operating at too high rpm before engine is sufficiently lubricated.

7. If engines do not start after three or four

attempts, make a thorough check of everything before trying another start. If engine is not sufficiently pre-warmed, these unsuccessful starting attempts may cause formation of ice on spark plug points. In this case, have plugs removed and cleaned.

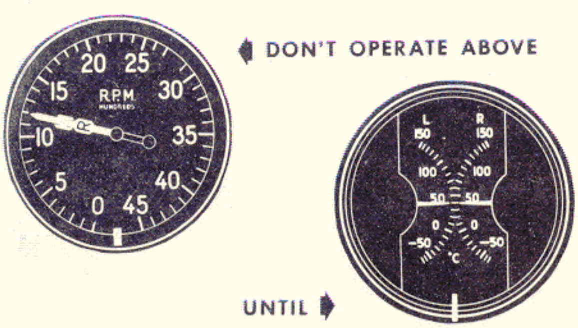
Engine Warm-up

1. After oil dilution, ground run engines for 30 minutes with oil temperature at 70°C. in or-



der to evaporate gasoline from oil. If you don't do this, it is possible to get scavenging difficulties during or just after takeoff with excessive discharge of oil through breather lines. The results are dangerous loss of oil and fire hazard.

2. Keep cowl flaps open.



3. Don't operate above 1200 rpm until oil temperature reaches 40°C.

4. High oil temperatures may develop rapidly, causing oil cooler shutters to open wide if oil coolers are in AUTOMATIC position. If this happens, close shutters with switch in MANUAL CLOSE and watch oil temperature carefully. If cause of trouble is congealed oil in cooler core by-passing hot oil back to engine, closing of shutters dissipates congealed oil and brings temperature back down again.

5. After starting, oil pressures may send gage needle clear up against peg. If this happens when you don't have time for normal warm-up, you can operate oil dilution system. Don't overdo oil dilution, but remember that properly diluted cold oil has same lubricating effect as warm oil. Fuel pressure drop occurs during oil dilution; this indicates that dilution system is working. If you don't get this drop during dilution, stop and investigate.

Taxiing and Takeoff

1. Don't turn on electrically heated clothing or any other electrical equipment not absolutely needed, until generators are operating.

2. Leave covers on all surfaces if possible until just before takeoff to prevent formation of frost.

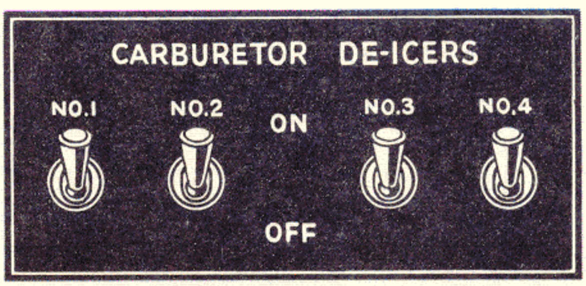
3. Use extreme caution when taxiing on snow or ice.

4. Use extra care in checking instruments prior to takeoff. Remember that cold weather affects operation of instruments.

5. Use brakes sparingly and slowly; expander tubes become brittle in cold weather.

6. Just after takeoff raise and lower gear and flaps several times to keep accumulated slush and mud from freezing gear or flaps in up or down position.

During Flight



1. If you have any suspicions that carburetor icing conditions prevail, use carburetor preheat immediately after takeoff. It is easier to prevent carburetor ice than to eliminate it.

2. If you are in icing zone, check immediately after takeoff on operation of wing anti-icing system, tail de-icing system, propeller and windshield anti-icing systems, pitot heat system, and cabin heat and defrosting system.

3. Heating system becomes effective as soon as you are airborne. Use it to keep crew comfortable. Re-check your **Pilots' Information File** for information on use of heated clothing and care of personnel in cold weather operations.

4. Utilize all your anti-icing and de-icing systems properly if you get into icing conditions. Operate tail de-icer boots intermittently instead of continuously. Be sure to turn them off before landing; otherwise they affect control action. Keep your windshields free of frost and your pitot tubes free of ice.

Preparation for Landing

1. Keep cowl flaps closed when approaching for landing with low power settings in order to avoid excess cooling. Open them again when you are on ground.

2. Use a flatter approach and more power than normal to insure within-limits engine operating temperatures in case go-around becomes necessary.

3. Use higher airspeeds for approach and landing when you have ice on wing and tail surfaces to prevent stall.

4. Use reverse props for stopping, instead of brakes. Braking action may be unpredictable on ice or snow; besides, cold makes expander tubes brittle and liable to failure.

After Landing

Use all normal after-landing procedures with the addition of the following points:

1. Dilute oil when oil temperature has cooled to 40°C.

a. Operate engines at 1000 to 1200 rpm.

b. Maintain oil temperature below 50°C. If necessary shut down engine and dilute in two or more periods to keep oil temperature below this limit.

c. Keep main oil pressure above 15 psi. If necessary shut down engine and dilute in two or more periods to keep oil pressure above this limit.

d. Oil dilution temperature chart:

IF OAT is:	Dilute for:
−4° to −12°C	2 minutes
−12° to −29°C	4 minutes
−29° to −46°C	7 minutes
−46° to −51°C	8 minutes
−51° to −56°C	9 minutes

e. Release dilution switch only after engine stops. This is important because only diluted oil must be circulated through the oil system.

f. Clear spark plugs after oil dilution by brief engine run-up: 1300 to 1400 rpm should be sufficient. Don't let oil temperature rise above 50°C. or oil pressure drop below 15 psi.

g. If oil servicing is necessary, dilute oil in two periods, one before and one after adding oil.

2. After completing oil dilution open each sump draincock and drain off any condensation or oil sludge.

3. Clean fuel strainers and drain all fuel tank sumps immediately.

4. Remove ice and frost from propellers. Move propellers by hand to check for free action. If they rotate with difficulty, remove lower spark plugs and allow diluted oil to drain from bottom cylinders.

5. Install protective covers on airplane surfaces.

6. If necessary to park on snow or ice, place a layer of fabric, straw, boughs, or other material under wheels to prevent tires from freezing to surface.

7. Leave parking brakes off to prevent freezing.

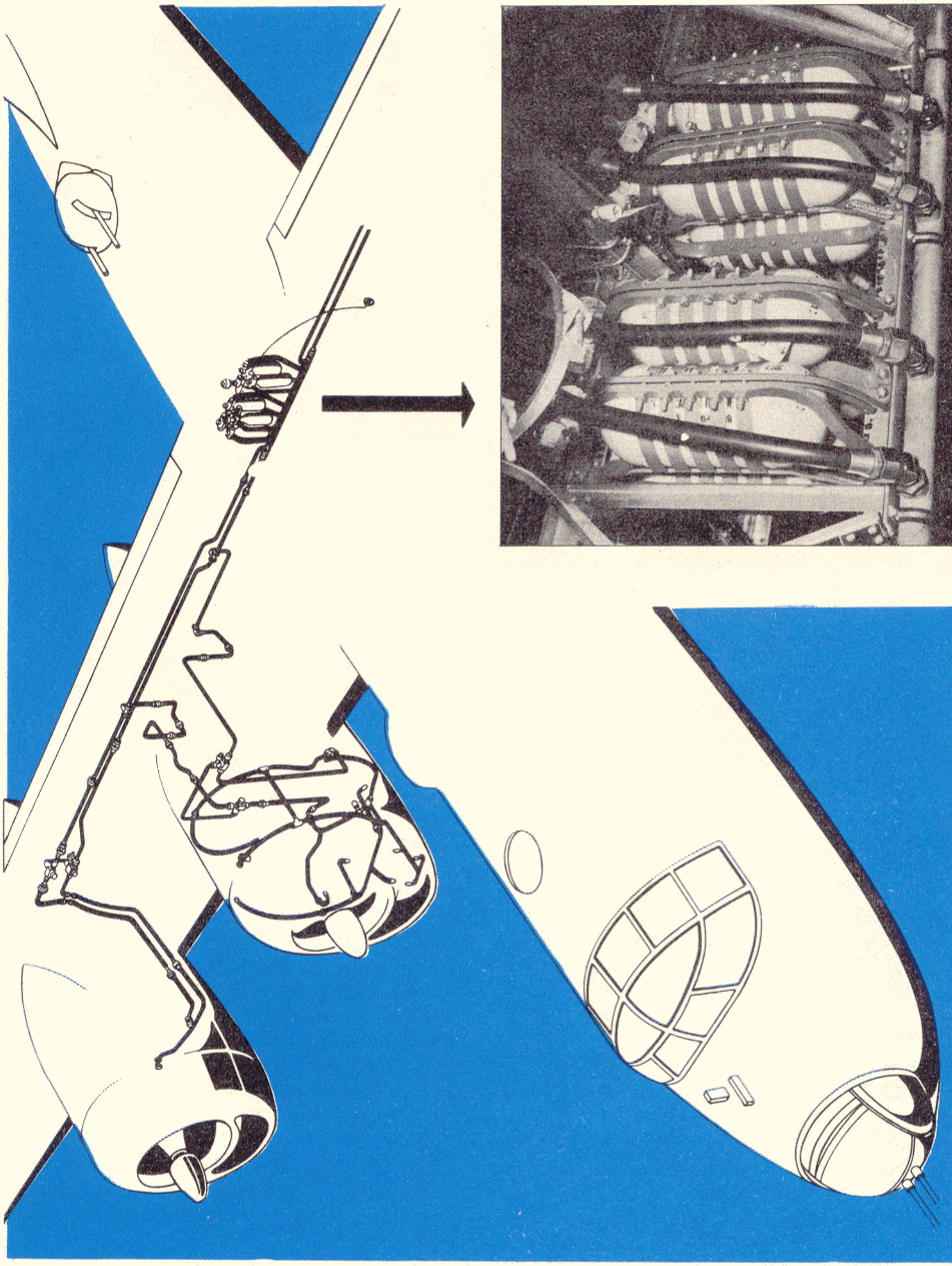
8. If weather permits, leave sliding windows in flight compartment partly open to permit circulation of air and prevent frosting of windows.

Fire

Fires in B-32's and other airplanes with a similar power plant set-up have received considerable attention. Many of the early causes of fires have since been eliminated by design and equipment changes. Many other causes have been identified as faulty operation.

Don't approach your B-32 training so fire-conscious that you fly with one hand on the wheel and the other on the fire extinguisher switch; but on the other hand, don't discount fire hazards. Under certain conditions of repeated faulty operation, fires are certainly likely to occur. Be sure you know and follow correct procedures. Know your extinguisher system and its limitations. Know procedures for combatting fires. But remember that it is of more immediate importance to know how to prevent the starting of fires.

The procedures discussed in this section are based on the best available data to date. Keep in mind that new information on prevention and handling of fire will develop as additional B-32 experience accumulates. Be sure you are constantly up to date on all procedures which might bear on prevention of fires in your airplane.



Fire Extinguisher Systems

The first 35 B-32's incorporate a fire extinguisher system comprising 24 CO_2 bottles, 12 in the aft section of each outboard nacelle. The bottles are connected by tubing to each nacelle. This system provides a CO_2 supply sufficient to put out fires in all four engines. Control T handles on the floor to the right of the copilot permit the discharge of six CO_2 bottles to the engine selected.

Airplanes subsequent to No. 35 incorporate a one-shot fixed system, consisting of seven CO_2 bottles located in the aft bomb bay. Operation of this system discharges the total supply of CO_2 to extinguish a fire in any one selected engine. Four guarded electrical toggle switches, located to the right of the copilot, operate the system. Setting a switch for a given engine directs the flow from all seven bottles to that engine nacelle. There is no means of operating this system manually. If the switch fails to work it, check the circuit breaker.

The fire extinguisher system directs the flow of CO_2 to the nacelle accessory section and in addition to the following units: one line to the oil cooler, two lines to exhaust tail pipe shrouds, two lines into the turbo inlets of the induction system, one line to the primary heat exchangers.

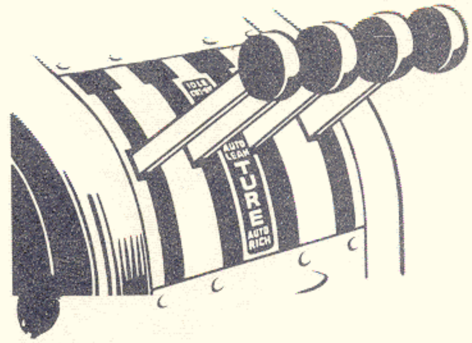
A rupture disc is connected to the CO_2 lines, to indicate whether or not the bottles have been discharged. The aerial engineer should inspect the rupture disc in his preflight inspection.

Standard equipment aboard the airplane includes two CO_2 hand fire extinguishers for combatting cabin fires. One is in the forward cabin, on the floor between stations 2.0 and 3.0 on the right side. The other is mounted at station 8.0, on the aft wall of the aft cabin.

Induction System Fires—Prevention

Note: Aerial engineer's carburetor check in his preflight inspection is an initial fire prevention check, and must be made regularly.

1. Induction system fires are most likely to occur during ground operation and takeoff, as a result of rapid changes in throttle opening, and during cruise, when you attempt manual leaning.



Caution

NEVER LEAN MIXTURE MANUALLY BETWEEN AUTO LEAN AND IDLE CUT-OFF.

2. Induction fire prevention is a problem of maintenance as well as operating technique. During engine starting and subsequent warm-up, when you encounter backfires or erratic engine operation, have the following checks performed:

a. Check carburetor idle adjustment.

b. Check for leaks in induction system.

c. Check exhaust valves for guttering or burning.

d. Check mixture control travel with AUTO RICH and AUTO LEAN positions on carburetor.

e. Check carburetor impact tubes and pressure metering screen for foreign matter.

3. During starting and warm-up observe the following operating precautions:

a. Avoid overpriming.

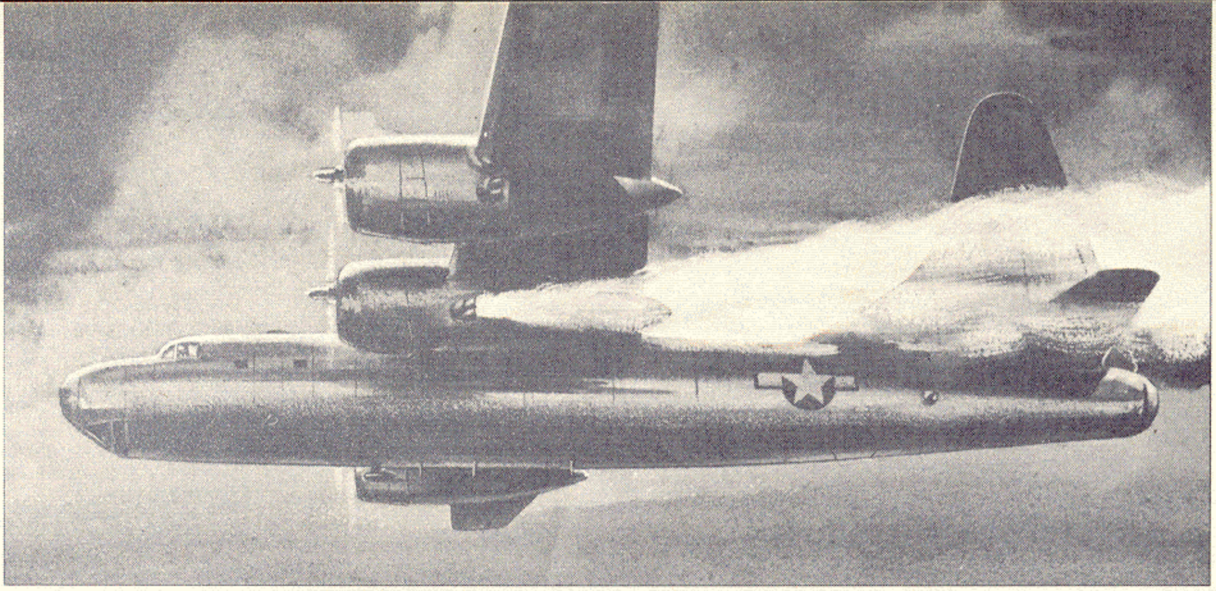
b. Use correct throttle settings and correct procedures for starting.

c. Warm up engines in prescribed manner, making sure that cylinder head temperatures are up to 50°C. before applying full throttle.

4. During takeoff apply power smoothly and steadily. Have scanners watch for any unusual smoke from engines and report to you immediately. Don't jockey throttles. If you get evidence of prop overspeeding, you are probably applying power too rapidly.

Induction System Fires—Indications

Induction system fires are indicated by the following conditions, occurring in the order listed:



1. Sudden drop in manifold pressure and rpm.

2. Regaining or partial pick-up of the initial loss in manifold pressure and rpm, resulting from windmilling.

3. Heavy black smoke from engine exhaust.

4. Final phase: heavy white smoke billowing from exhaust.

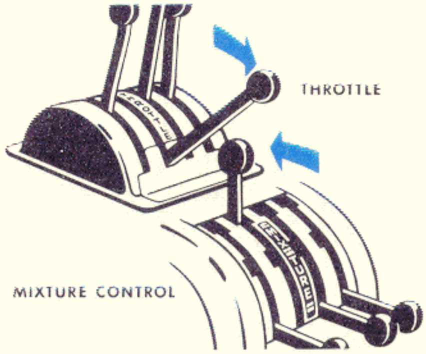
Note: In ground operation a series of backfires may cause induction system fire. Backfires indicate too lean a mixture. Treat all backfires as an indication of induction system fire and handle accordingly. Flames and black smoke from the exhaust tailstack during ground operation indicate too rich a mixture. In this case momentarily open the throttle fully to lean out the mixture.

Induction System Fires—Procedure

If you can snuff out an engine induction fire before the white smoke occurs by closing the throttle to cut off air and closing mixture control to cut off fuel, you are not likely to get engine damage. You can probably resume operation of the engine. If on the other hand you allow the fire to progress, you are apt to lose not only the engine but the whole airplane.

The following procedure is only for induction system fires. Procedure for nacelle fires is listed under that heading in this section. Follow this procedure for any induction system fire, regardless of whether or not you think you can control it by simply throttling back. If you get the fire on takeoff when it would be unsafe to cut an engine because of low airspeed or high gross weight, throttle back as much as practicable; get safe airspeed and altitude, and then complete this procedure.

1. Crew member spotting fire announces **"Fire in No.** . . . . . .," using CALL position on radio box.



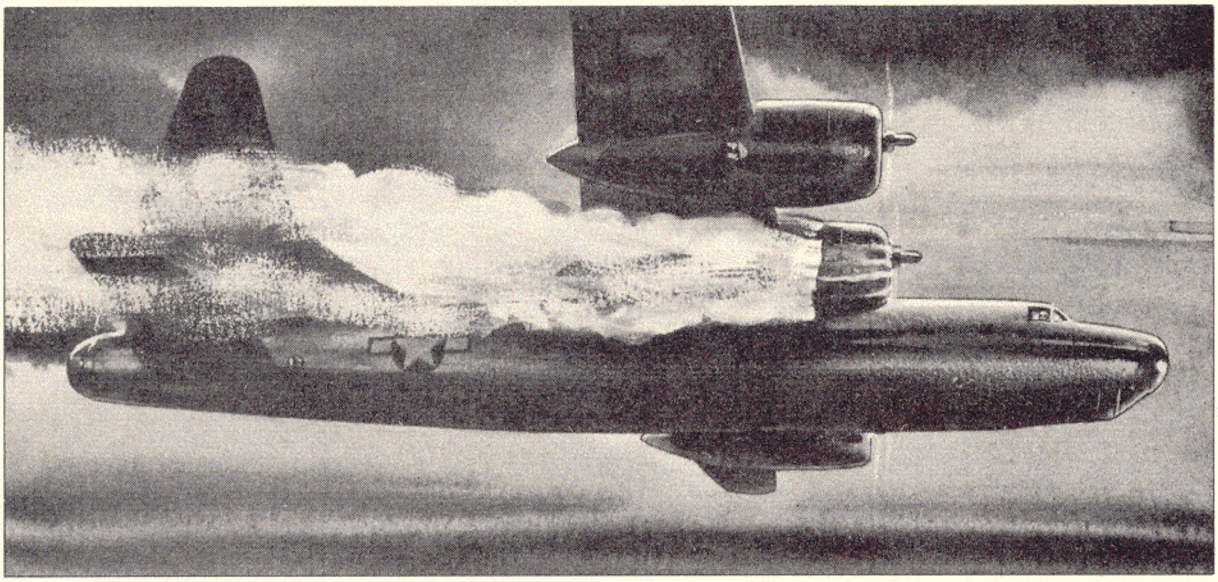
2. Close throttle of engine on fire.

3. Have engineer or copilot move mixture control to IDLE CUT-OFF; turn booster pump to OFF position and fuel selector valve to OFF position.

4. If smoke stops immediately, apply engine power normally. Advance throttle smoothly, watching engine operation and exhaust carefully.

5. If smoke does not stop in approximately 10 seconds, follow feathering procedure, and have copilot operate fire extinguisher system.

6. During foregoing procedure keep cowl flaps open until fire is out; then close them to reduce drag.



Nacelle Fires

From the standpoint of discussing exact handling procedures, the distinction between induction system fires and nacelle fires is sometimes impractical. Generally, however, induction system fires are confined to the induction system when they start, and if handled soon enough by correct action, they may be extinguished without loss of the engine.

Nacelle fires are identifiable by smoke or flame around the nacelle, other than from the exhaust alone, particularly around cowlings or issuing from cowl flaps. The joker in the situation is that any induction system fire can become a nacelle fire and eventually a whole wing or fuselage fire.

Oil, fuel, and foreign material in the engine nacelles are fire hazards. Maintain clean engines. Make sure that the carburetor is checked for leaks and that excess oil is cleaned from the nacelle. Have all oil and fuel line connections checked for security and freedom from chafing and rubbing. Check induction system for leaks. Check oil dilution solenoid for proper seating. If oil was diluted, be sure to ground run engines for 30 minutes with oil temperature at 70°C.

If a nacelle fire is reported, proceed as follows:

1. Turn fuel selector valve and oil cut-off, if present, to OFF position.
2. Move mixture control to IDLE CUT-OFF.
3. Close throttle.
4. Feather propeller.
5. Open cowl flaps.

Note: Although the foregoing steps are necessarily listed in sequence, they are actually done as nearly as possible all at once. The precise order of action is determined by whatever control is handiest, with copilot, engineer, and airplane commander cooperating in the necessary actions.

6. When engine stops, have engineer turn off ignition switch immediately.
7. Have engineer turn off generators.
8. Have copilot operate fire extinguisher for affected engine.
9. Determine cause of fire as early as possible. If you can continue flight, come back in immediately.
10. If you succeed in extinguishing fire, close cowl flaps to reduce drag.

Cabin Fires

Cabin or bomb bay fires may result from electrical faults, advanced engine fires, or crew carelessness, among other things. Use all preventive precautions possible. Have somebody wipe up spilled hydraulic fluid. Don't allow smoking on the ground, or during landings and takeoffs, fuel transfer, or any time fuel fumes are noticeable. Provide for disposal of cigarette butts. Don't allow waste paper, rags, or other clutter to accumulate in the airplane. Have crew members carry only safety matches or lighters. Inspect wiring for evidence of wear. If you detect fumes, ventilate cabin and bomb bays. You can keep bomb bay doors open on the ground, if practicable.

If you get a cabin fire, have your crew follow this procedure:

1. Close all windows, doors, and vents, including doors to bomb bays.
2. Use hand extinguishers, directing CO_2 at base of fire.
3. Shut off all electrical units.
4. If on ground, get help by radio or runner.
5. Remember there is an axe strapped to side of nosewheel well. Use it if necessary.

Bailout

Preflight Precautions

It is your responsibility as airplane commander to see that the following procedures are carried out at required times in order to assure successful bailout if it ever becomes necessary.

1. Before each flight check to see that all crew members and passengers have parachutes, and that parachutes are satisfactorily fitted. Check color patches on chest packs and harnesses to be sure each man has correct type chest pack for his harness. See that all crew members are familiar with bailout signals, proper exits to use for bailout, and operation of hatches. In your transition training these procedures are part of your preflight crew inspection.

2. Most of your crew members have had parachute training. But check anyway to see that everyone aboard inspects his parachute properly and is familiar with proper parachute technique. Inspection of parachutes and parachute technique are covered in detail in your **Pilots' Information File.** Re-check this information if you are not sure of it.

3. Check to see that extra parachutes are aboard. Carry one extra parachute for every four persons, with at least one extra parachute in forward compartment and one in aft compartment.

4. Have crew members wear parachute harnesses at all times. When crew members are not wearing chest packs, have them keep them in pack slings provided for that purpose. Have each man keep his pack near him at all times.

5. Hold bailout drills as often as possible. In ground bailout drills, simulate bailout emergency, using warning bell signals. On bailout signal time crew members as they leave stations and go out in proper order through assigned hatches. Have them try constantly to improve bailout procedure time.

When to Bail Out

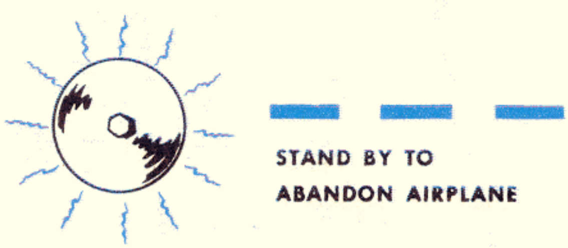
The airplane commander must always make the decision whether or not to bail out the crew. Don't shirk your responsibility by putting it up to them. You usually don't have time for argument, anyway. Once the decision to bail out is made, see that crew members complete necessary subsequent duties and get out quickly on the bailout signal.

It is your duty **to consider carefully the advisability** of ordering everybody out except copilot, engineer, and yourself if you are at least 2000 feet above land when any of the following emergencies arise:

1. Uncontrolled fire in any part of the airplane or engines.
2. Structural or induction system ice prevents you from maintaining level flight at least 2000 feet above ground at IAS at least 25 mph above normal stalling speed.
3. One-half hour fuel supply remains and you are lost: i.e., you don't know your position well enough to assure safe completion of flight.
4. Mid-air collision, no matter how slight the damage from the collision is estimated to be.
5. Forced landing, not on airfield, appears to be necessary during the hours of darkness.

How to Bail Out

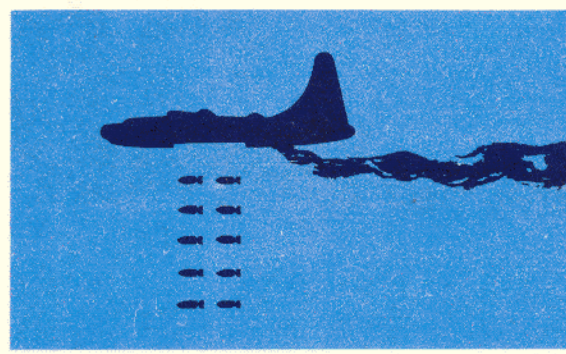
Once you have decided on bailout, follow this procedure:



1. Notify crew to stand by to abandon airplane. Alarm bell preparation signal is three short rings. At first alarm, crew members should put on parachute packs. Remember that fuselage or electrical system fire may have burned out alarm bell system. Be sure that crew members in aft compartment know what goes on.

Note: After the prepare-to-bail-out signal, if you want to call off the emergency, send someone back to notify crew members verbally. Don't touch bell again or . . . no crew.

2. Have radio operator send distress message, giving all pertinent information.

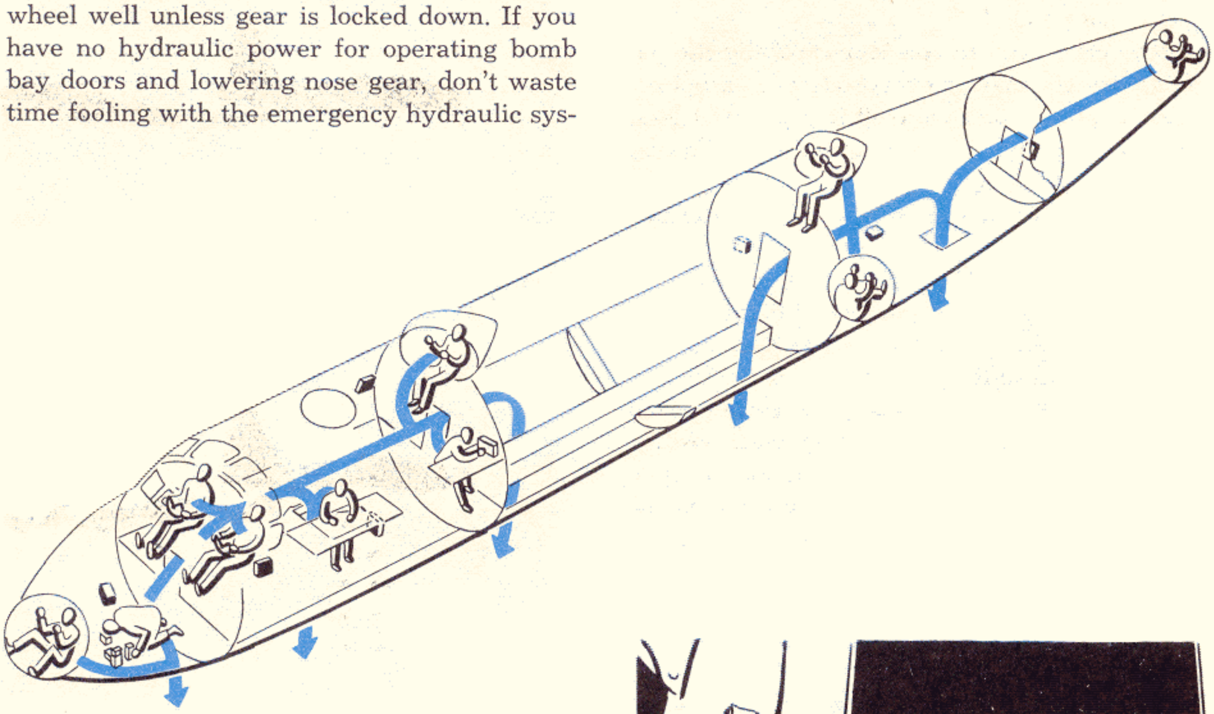


3. Jettison bombs or bomb bay tanks, using salvo switch.

4. Notify crew to abandon airplane. Alarm bell signal for bailout is one long ring.
5. For bailout, set up autopilot; reduce power for rate of descent approximately 1000 to 1500 feet per minute, at airspeed about 30 mph above stalling. Lock throttles. This is general procedure, to be modified according to your own judgment of the situation.

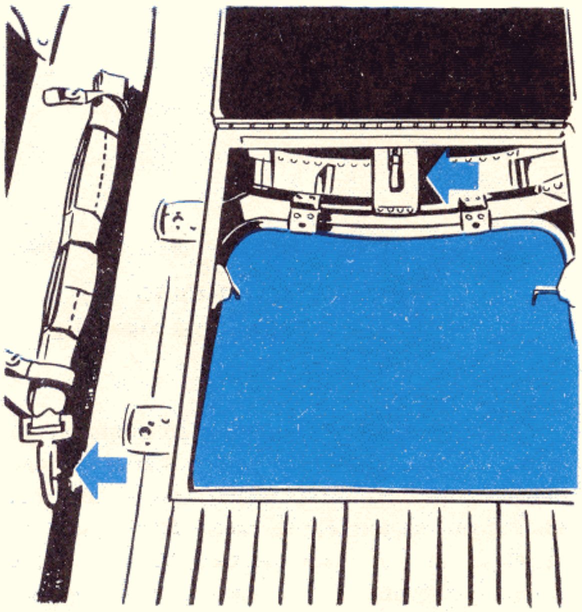
Where to Bail Out

If you can open bomb bays, and fire, lack of time, or other obstacles don't interfere, have everybody go out bomb bays. They are the easiest exit to use. Camera hatch is a secondary aft compartment exit and nosewheel well—provided you can get the nosewheel down—is secondary flight compartment exit. Don't use nosewheel well unless gear is locked down. If you have no hydraulic power for operating bomb bay doors and lowering nose gear, don't waste time fooling with the emergency hydraulic system unless you have plenty of time and nothing else to do. In this case you can use the camera hatch in the rear and the bombardier's hatch in the nose. In case you are dubious about using nose hatch because of props, it is worth noting that it has been done in an emergency by several people with all props operating. Nobody hit.



Note

Standard equipment on your B-32 includes two static lines for bailing out crew members who are unconscious or wounded so that they cannot pull a ripcord. One static line is stowed near floor on right side of flight deck. The other is near floor on right side of aft cabin. Nosewheel well and camera hatch have hooks built into them for these static lines. Attach one end of line to hook and other end to disabled man's ripcord and throw him out.



Ditching

Precise information on the reaction of B-32's to ditching is not yet available, nor have the best ditching stations for each crew member been determined. However, headquarters organizations are experimenting with these problems at present and will provide you with complete details on exact ditching procedure as soon as possible.

Since the conditions affecting ditching are different each time, successful procedure depends in any case largely on the skill and judgment of airplane commander and crew at the time of the emergency. The information in the following paragraphs is of a general nature, applicable to any emergency water landing. See that your crew members are adequately briefed on it before any overwater flight.

Before all overwater flights, include in your preflight crew and passenger inspection a check to see that all personnel have life vests and know how to inspect and operate them.

Study and learn the information on ditching and ocean survival in the **AAF Survival Manual.**

Preparation

The decision to ditch the airplane is up to you. In many cases there is no choice; ditching is indicated by the conditions of the emergency. When there is a choice of procedure, don't wait too long before you decide to ditch. Leave enough time to take care of all preparations and to send radio distress messages. The chances of getting back after ditching are directly proportionate to the adequacy of your radio procedure.

As soon as you have decided to ditch, notify crew members. The prepare-for-ditching warning bell signal is six short rings. Then have your radio operator start sending distress messages and full information on your situation, and continue as long as he safely can.

Jettison everything you can spare to lighten the airplane and remove the danger of injury from loose equipment flying around on impact. Follow applicable instructions for jettisoning under general crash landing procedures, in **Emergency Landings** section. Remember to keep the emergency radio, axe, first aid kits, flashlights, any extra water or rations you have, parachutes, and other equipment which might be useful for life on a raft. But be sure everything is handy for quick removal and secured against the impact.

Don't jettison oxygen masks and walk around oxygen bottles. You can use these for underwater breathing in case you are trapped below the waterline. See your **Pilots' Information File** for instructions on this procedure.

Make certain that bomb bays, all lower hatches, and interior doors are securely closed. See that gear and lower turret are fully retracted and gear doors completely closed. Jettison covers of the upper aft cabin hatch, the astro glass, and, if the water is calm, pilots' side windows. Chop the astro glass at the hinges if necessary.

Ditching Stations

The alarm bell signal for the actual ditching is one long ring. All crew members take ditching stations at this signal.

Airplane commander and copilot should check safety belts and wear shoulder harnesses properly adjusted and locked. All other crew members should get into seated positions, facing aft, with backs braced against a solid structure if possible. Have them use parachutes for cushioning. Don't station anyone in nose compartment or tail compartment. Assigned positions and exits for each crew member will be standardized soon; meanwhile work out your own procedure and stations for your crew members and practice using them in ditching drills. Don't wait until the emergency to work out these details.

Handling the Airplane

The consideration of wind conditions is of more importance when you are preparing to ditch than it is when you are making a normal landing. Wind, in ditching, affects not only your flight, but also the condition of your landing strip—the water. Whenever you fly over water, study the appearance of the surface in relation to the wind so that if you have to ditch you will be better able to judge wind direction and velocity.

Re-read the ditching section of your **Pilots' Information File** for general information of judging wind on water, and for suggestions as to proper landing attitude, and use of flaps and power.

Always ditch before your fuel is completely exhausted so that you can use power to control your attitude and help you pick your spot to set the airplane down.

Remember that there are two impacts in the ditching touch-down; one when the tail strikes the water and a second, a harder one when the forward part of the fuselage slams in. Have everybody on board hold his position until the airplane comes to rest.

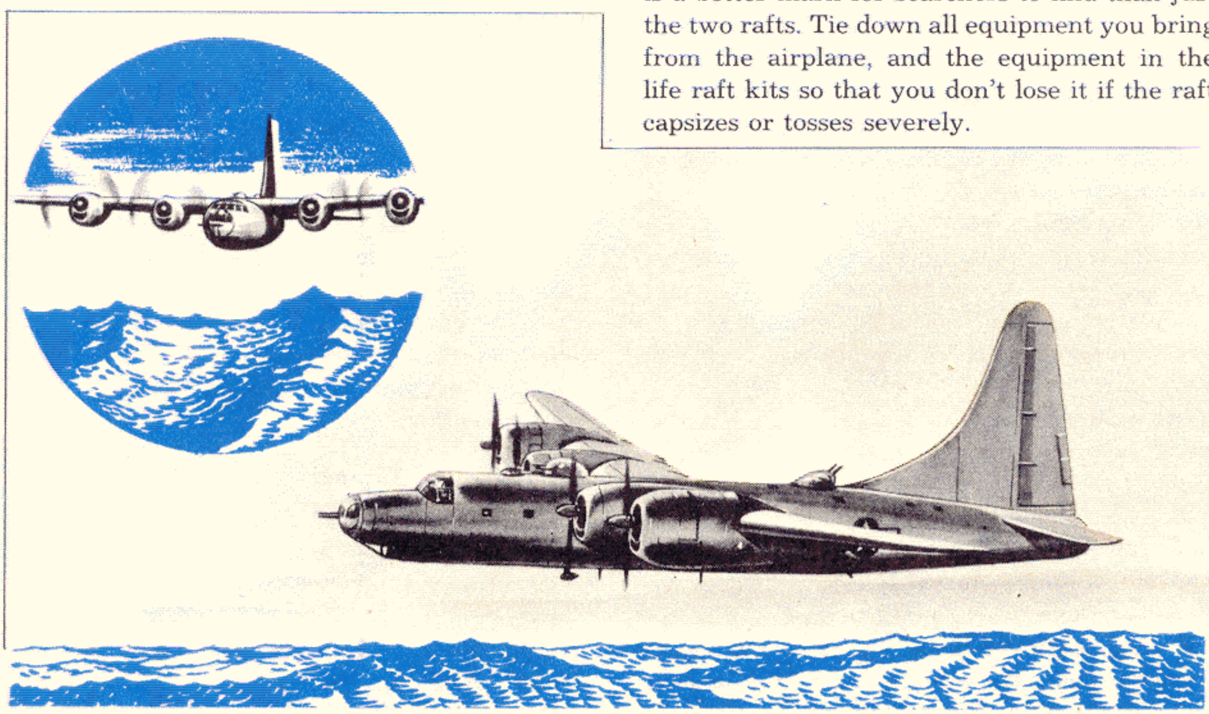
Escape Procedure

In your ditching drill assign each of the following duties to a specific crew member and assign each an exit and an order for leaving the airplane. Practice escape procedure under simulated ditching conditions.

As soon as the airplane comes to a stop pull the life raft handles. One handle is on the right side of the rear bulkhead in the forward cabin. The other is on the right side of the front bulkhead in the aft cabin. Either handle opens both life raft compartments, located on top of the fuselage ahead of the rear turret. The rafts unfold and inflate automatically on the opening of the compartments. You can also open these compartments from the outside, inflating the rafts by operating the CO_2 release handle. The rafts are attached to the airplane by lines which are light enough to break if the airplane sinks. Bring the rafts alongside by the lines and climb carefully—don't jump—into them.

Designated crew members carry out the emergency equipment through the assigned exits. Throw the emergency radio out the rear top hatch; it floats. Be sure you have a line tied to the radio and hold onto the line so you can recover the radio. Otherwise in darkness or rough seas you may not find it again.

When all crew members are aboard, tie a line between rafts to keep them together. Stay near the airplane, but not so close that it would damage or upset the raft if the airplane sinks suddenly. As long as it stays afloat, the airplane is a better mark for searchers to find than just the two rafts. Tie down all equipment you bring from the airplane, and the equipment in the life raft kits so that you don't lose it if the raft capsizes or tosses severely.

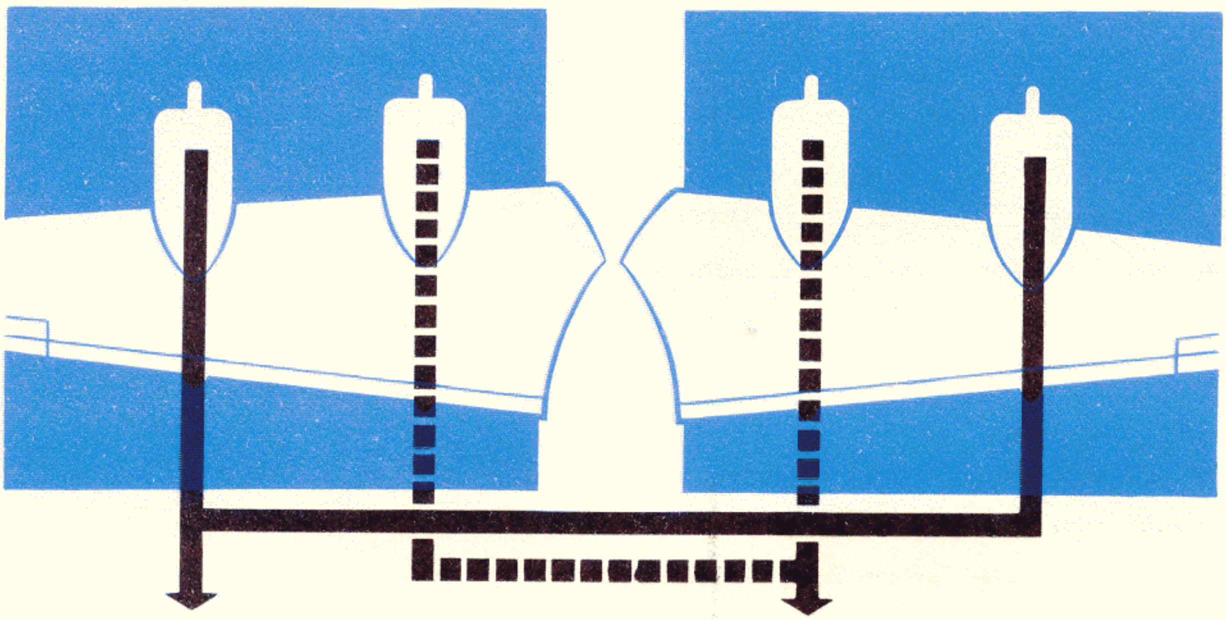


Engines

Type	*R-3350-23A, 18-cylinder, Wright Cyclone, staggered 2-row, radial air-cooled conventional 4-cycle engine
Engine length	76.26"
Engine diameter	55.12"
Approximate engine weight	2660 lbs
Cylinder bore	6.125"
Stroke	6.312"
Compression ratio	6.85:1
Total displacement	3346.43 cubic inches
Propeller gear ratio	20:7 (.350)
Engine-driven impeller gear ratio	6.08:1
Impeller diameter	13"
Carburetors	Ceco (Chandler-Evans) fully automatic
Starters	Jack and Heintz combination inertia and direct cranking
Magnetos	Dual Scintilla
Generators	Outboard engines: 200-amp, 28-30 volt, engine-driven, direct current, P-2 generators with two-speed overdrive Inboard engines: 300-amp, 28-30 volt, engine-driven, direct current, R-1 generators
Superchargers	General Electric exhaust-driven turbo-superchargers, two per engine
Fuel pumps	AN4102 rotary, 4-vane, positive displacement
Vacuum pumps, engines 2 and 3	Pesco rotary, 4-vane, positive displacement
Hydraulic pumps, engines 2 and 3	Early airplanes: Vickers 7-cylinder piston-type Later airplanes: Pesco gear-type

*Note: R-3350-23 engines modified in accordance with T.O.'s 02-35JA-8, -10, and -12 carry the designation R-3350-23A, with a 1-inch yellow band around the nose of the engine. Transition and OTU airplanes have engines so modified. The modifications are numerous small changes which convert the engine from a training status engine (TSE) to a war status engine. Among other changes these modifications include the installation of ducted baffling and rocker box crossover tubes for improved cooling.

EQUIPMENT LOSS PER ENGINE LOSS



If No. 1 engine or No. 4 engine fails, you lose:

Fuel pump
Two-speed generator
Heat exchanger for wing anti-icing

If No. 2 engine or No. 3 engine fails, you lose:

Fuel pump
Generator
Vacuum pump
Hydraulic pump
Heat exchanger for cabin heating

Engine Operating Procedures

Pertinent sections of the amplified checklists in this manual cover normal starting procedures and the normal use of engine controls for various conditions of flight. The **Preflight Inspections** section covers items of preflight inspection applicable to the engines. Specific instructions for starting in extremely low temperatures are given in the **Cold Weather Operation** section.

Notes on Power Changes

Remember – increase power by increasing rpm first, then throttles; decrease power by reducing manifold pressure first, then rpm.

With any given manifold pressure there is a practical limit to the rpm. Low rpm with a high manifold pressure results in high cylinder head temperatures and in detonation. If the rpm is too high for the manifold pressure, fuel consumption goes up.

Always be sure to use full throttle before you add turbo boost. Failure to do this causes leaning out of the mixture and possible detonation.

In operating your B-32 engines, use the mixture controls in the AUTO positions only. Never attempt manual leaning between these stops. Leaning between AUTO RICH and AUTO LEAN may build up cylinder head temperatures, while leaning between AUTO LEAN and IDLE CUT-OFF may result in loss of an engine. The slight gain, if any, in fuel consumption from manual leaning does not justify the practice.

ENGINE OPERATING CHARTS

The settings in the accompanying chart are intended as a guide for transition flying only. The IAS and fuel consumption figures for given manifold pressures have not been flight checked. Flight tested engine operating tables as well as cruise control charts will be furnished to you by your headquarters as soon as they are available.

See the **Flight Characteristics** section of this manual for additional airspeed limitations for various flight conditions.

1. SPECIFIC ENGINE FLIGHT CHART

Takeoff: Use settings in this column for normal takeoff.

Non-combat emergency: Use these settings for go-around, emergency pull-ups, stall recoveries, and similar situations.

Maximum continuous: Reduce to these settings from takeoff or emergency power as soon as possible; for example, as you are retracting your wheels when you have a safe airspeed on takeoff.

Maximum cruise: These are the highest power settings in which you can use AUTO LEAN mixture. Above them use AUTO RICH; below them AUTO LEAN operation is permissible if you can keep head temperatures under 232°C.

Local cruise: Use these settings for local transition flying unless otherwise directed.

Local climb: Use these settings for climbing on local flights unless otherwise directed. Power settings up to maximum continuous are permissible when required.

Ground operation: Use these values as maximum. Normally engine speeds on the ground should be between 1000 and 1200 rpm, or as needed to control taxiing speed.

Maximum range, 4 and 3 engines: These settings are only approximate. Don't use them instead of cruise control charts. But if you ever have to get maximum range on a training flight in an emergency, when cruise control charts are unavailable, you can get it with these settings.

Engine Flight Chart on Next Page ☛

Operating Condition	Takeoff	Non-combat Emergency (Military Rated)	Maximum Continuous (Normal Rated)	Maximum Cruise	Local Cruise	Local Climb	Ground Operation	Maximum Range, 90000#, 10000′	Maximum Range, 3-engine
Time Limit	5 Min.	5 Min.	Unlimited	Unlim.	Unlim.	Unlim.	Minimum	Unlim.	Unlim.
Max. Head Temp	260°C.	260°C.	248°C.	232°C.	232°C.	248°C.	260°C.	232°C.	232°C.
Mixture	AUTO RICH	AUTO RICH	AUTO RICH	AUTO LEAN	AUTO LEAN	AUTO RICH	AUTO RICH	AUTO LEAN	AUTO LEAN
RPM	2800	2600	2400	2200	2000	2300	2000	1400	1400
MP In. Hg.	49	47*	42**	35	29	35	30***	X	X
Fuel**** Gal/Hr	20.5 Gal/Min	18.5 Gal/Min	945		370			250	
% Normal Rated Power	110	110	100	80	60			40	
IAS****	118		280		220	190		175XX	175XX

*—Manifold pressure for military rated power: 48″—sea level to 5000′; 47″—above 5000′

**—Manifold pressure for normal rated power: 43″—sea level to 5000′; 42″—above 5000′

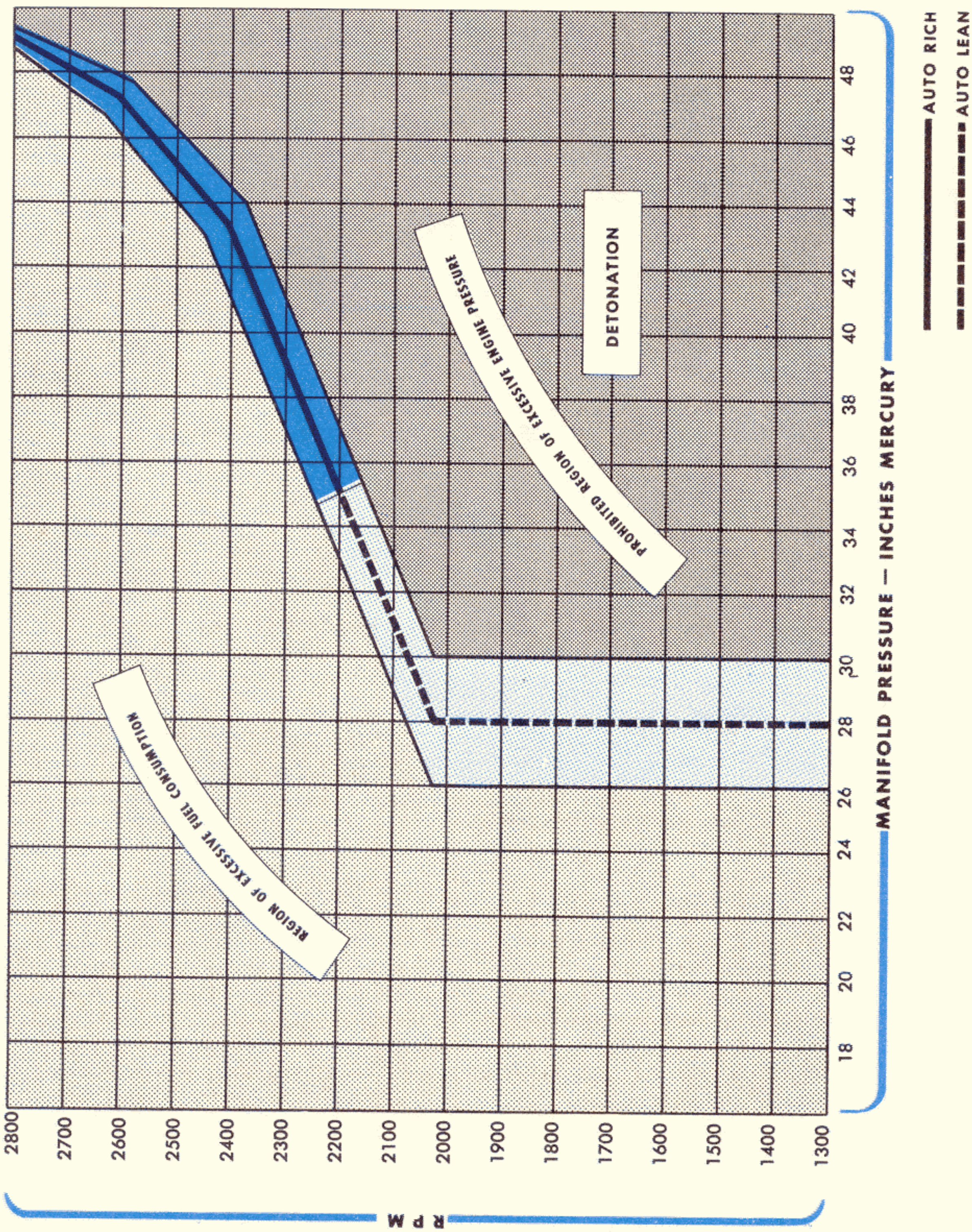
***—For ground operation limit MP to 30″ and rpm to 2000, except for turbo run-up & check

****—GHP and IAS figures not flight checked; use as approximate values only.

X—Manifold pressure to maintain airspeed (approximately 28″)

XX—When cruise control charts are not available increase IAS 5 mph for each additional 4000 pounds of weight or reduce about 5 mph for each 4000 pounds under 90,000 pounds.

2. ENGINE OPERATING LIMITS



3. ENGINE TEMPERATURE AND PRESSURE RANGES

	Desired	Minimum	Maximum	Minimum Idling
Nose Oil Pressure PSI	45-50*	30	50**	25
Main Oil Pressure PSI	60-70*	60	80**	25
Oil Temp. C.	55-85**		95	
Fuel Pressure PSI	16-18	15	19	14
Cylinder Head Temp. C.	205	50	260	

*—When starting, if main oil pressure does not register 40 psi in 10 seconds, or if nose oil pressure does not register 45 psi in 30 seconds, shut down and investigate.

**—Oil pressures are dependent on oil temperatures. Higher than maximum oil pressures register until the oil temperature reaches 55° to 80° C. However, if high oil pressures persist after temperature reaches normal, investigate the trouble. It probably results from improper oil pressure adjustment.

Factors Affecting Engine Starting

1. **Priming.** The B-32 priming switch activates a solenoid-operated primer valve connected to the fuel line which shoots raw fuel, unmetered by the carburetor, into the blower section. The engine impeller must be turning over for proper distribution of the priming spray. Don't prime these engines before you engage them with the starting motor because otherwise you load up the engines and the improperly distributed priming fuel can collect in the lower cylinders and cause liquid lock. Normally prime is sufficient to run an engine between 1000 and 1200 rpm.

Be careful not to overprime. Overpriming not only makes starting difficult, but tends to wash oil from the cylinder walls, which may cause liquid lock. Black smoke or grayish mist from the exhaust system, or liquid fuel running out of the supercharger drain valve, indicates overpriming. If you overprime, see that the ignition switch is in OFF position and the mixture control in IDLE CUT-OFF, then open the throttle wide and turn the engine over for several revolutions.

Backfiring indicates underpriming. In this case, carefully give the engine more prime.

Cold weather starting generally requires more priming. Keep in mind, however, that increasing the prime alone may not solve your starting difficulties; other things could be wrong. Remember also that inadvertent over-priming is more frequent in cold weather starting than under normal conditions. Before you overdo your priming in low temperatures, remember that you can pre-heat your oil and use special priming fuels.

2. **Props pulled through.** Don't attempt a start until the props have been pulled through at least six blades, as a check for a liquid lock. Don't let more than two men pull through a blade. **Caution: Never pull props backward to clear a liquid lock.**

3. **Mixture controls.** Start this engine with the mixture controls in IDLE CUT-OFF position. For normal starting, don't attempt to prime with the mixture controls, except in emergencies when the primer solenoid fails. Priming with the mixture can easily result in overpriming, liquid lock, and fire hazard.

4. **Fuel pressure.** Fuel pressure affects priming, since the force of the priming spray depends on the pressure. Remember that at the time of priming you have no gage indication of fuel pressure because the mixture control is in IDLE CUT-OFF position. Priming fuel comes off the line behind the IDLE CUT-OFF valve and fuel pressure ahead of it. LOW position of the fuel booster pump switch should give you sufficient pressure for priming. If necessary you can use HIGH position. In that case, however, have the fuel pressure adjustment checked because the necessity of using HIGH boost indicates that something is wrong with the system.

5. **Oil dilution.** Dilute your oil when you anticipate starting in a temperature below 0°C. See **Cold Weather Operation** for proper dilution procedure.

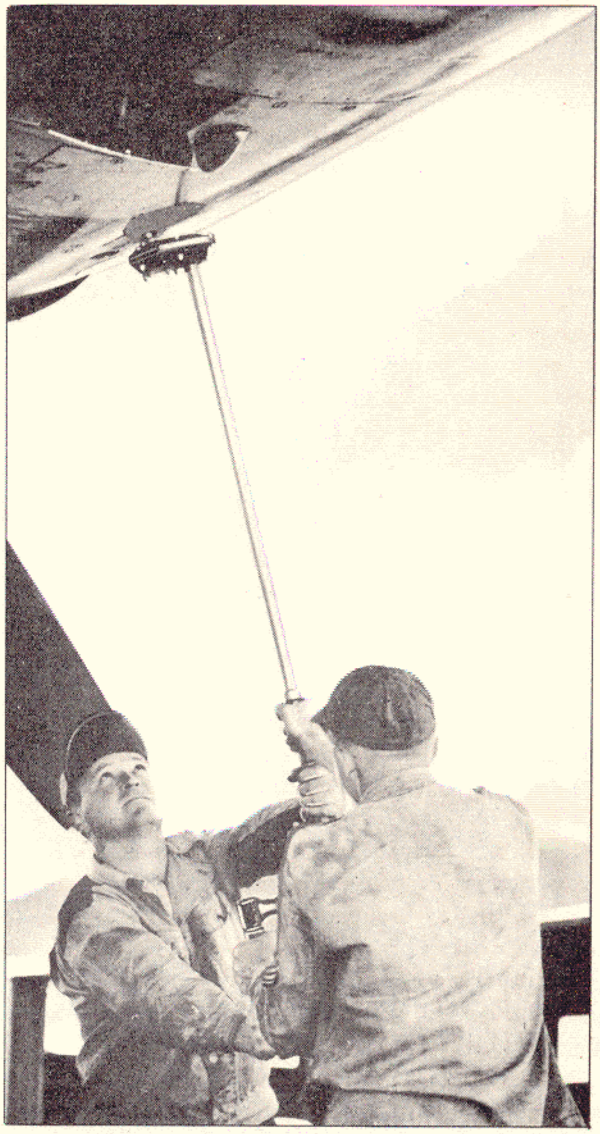
6. **APP output.** If you are unable to energize your starting motors it is probably because the APP output is too low or else is not getting out into the line. Have it checked.

7. **Prop pitch.** If your props are not in full high rpm, the drag on them may be too great, stalling your engine as soon as it starts.

8. **Starter motor rpm.** If the starter motor doesn't build up enough rpm before you crank the engine, it may not be able to turn the engine over, or it may turn it over too slowly to be effective. However, if you suspect this difficulty, have it checked before you overdo your energizing and burn out the starter. Remember that your prop is turning much more slowly than your engine. Four prop blade revolutions equal three engine revolutions.

Hand Cranking

Hand crank and portable gear box for starting the engines without the use of the electric starting motor are stowed in the aft bomb bay. The crank is mounted on the aft bulkhead and



the gear box secured on the catwalk just below it. Use the following procedure for hand cranking:

1. Pull props through at least half a complete revolution in normal direction of rotation to insure that engine and starter jaws are not engaged.
2. Insert gear box into socket assembly on right lower side of nacelle. Insert hand crank into gear box.
3. Push manual meshing button on nacelle to lift starter brushes off commutator.
4. Rotate crank until starter flywheel reaches operating speed (22,000 rpm), approximately 95 turns of crank.
5. Remove crank and gear box and push meshing button, holding it in until engine starts.
6. If first starting attempt fails, again pull prop through at least one-half revolution before next attempt.

Common Causes of Engine Failures

The following list includes some of the more common pilot error causes of engine failure. Check to be sure that you know how to avoid them, and if you are doubtful, study up on them. Check also the **Propellers** section of this manual for detailed feathering procedure, and the pertinent amplified checklist sections for technique of handling less than four engines under various flight conditions.

Improper fuel system management:

1. Failure to use cruise control charts in planning mission or failure to apply data to flight.
2. Use of high power settings and AUTO RICH mixture with low fuel supply.
3. Failure to set fuel selector valves at TANK TO ENGINE for takeoff and climb.
4. Failure to transfer fuel when necessary or use of improper transfer procedure.
5. Failure to use booster pumps for takeoff, landing, or at high altitude.

Improper power control:

1. Failure to reduce manifold pressure at high altitude.
2. Failure to increase rpm before increasing manifold pressure.
3. Failure to use AUTO RICH mixture with power settings above maximum cruise.
4. Failure to check automatic intercooler operation to maintain carburetor temperature within proper limits in icing conditions.

Improper operating technique:

1. Accelerating too often or too fast; stiff-arming throttles.
2. Allowing excess rpm and airspeed in dives.
3. Using improper corrective procedures for over-speeding turbos or props.
4. Feathering too soon; feathering wrong engine.
5. Faulty starting technique.

General Rules for Engine Failures

No one set of engine failure rules applies to all cases, or even necessarily to one individual case. The following instructions, however, can serve you as an abbreviated checklist, of which the amplification must be your own thorough knowledge of your airplane and sound judgment.

1. Take it easy. Do things slowly in a hurry. Think!
2. Get your airplane under control:
   - Get directional control
   - Increase power
   - Reduce drag
   - Gain airspeed
   - Hold altitude
   - Balance power
   - Trim airplane

   If in formation, stay in if possible, at least until out of enemy fighter range.
3. Determine cause and extent of engine failure, and equipment lost thereby.
4. Feather when you are sure it is necessary and when you are sure which engine to feather. See **Propellers** section for feathering procedure.
5. Use controls smoothly and cautiously, particularly on turns. Avoid steep banks and when practicable turn away from dead engines. If situation requires a turn in direction of dead engine, be sure to maintain airspeed and proper trim.
6. Stick with airplane if there is no uncontrollable fire and if you can maintain directional control, altitude, and airspeed.

Propellers

Type	Curtiss Electric
Control	Automatic Synchronizer Control System
Number blades	Four
Blade diameter	16′ 8″
Weight (including 25 lbs for cuffs)	825 lbs
Pitch settings	Low (for 2800 maximum rpm): 17.0° plus or minus 0.2°
	High: 57.0° plus or minus 1.0°
	Feather: 84.7° plus or minus 1.0°
	Reverse: −15.8°
Prop tip overlap	1″

Principle of Operation

The propeller system on your B-32 is completely electrical, controlled by switches on the main instrument panel. In operation you select the desired engine speed by manually setting a master tachometer. The propeller control automatically maintains this speed, with close accuracy, by adjusting blade pitch. The control thus provides automatic synchronization of all engines and all propellers.

The system also provides fixed pitch, reverse pitch on the inboard props, and feathering operations, all of which you control by switches on the propeller panel.

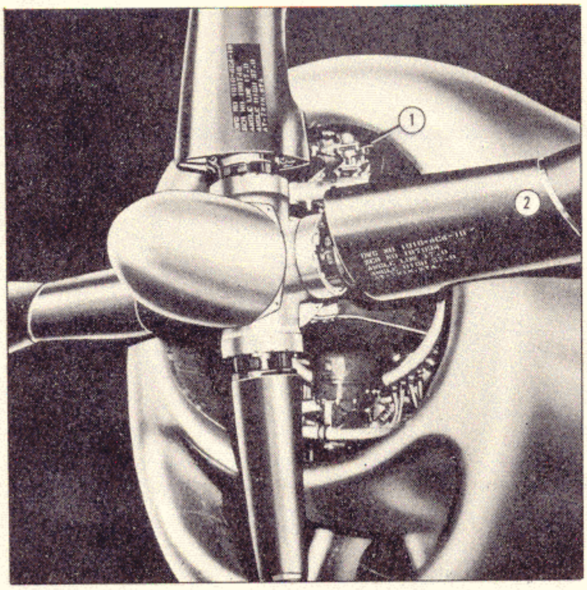
1. **Hub assembly.** The hub assembly consists of a spider machined from a solid steel alloy forging, and serves as a mount for the six slip rings, four blade assemblies, slinger ring, and power unit. In addition, the hub assembly is drilled and insulated to carry electric power conduits from the slip rings to the power unit.

2. **Blade assemblies.** The four hollow steel propeller blades are threaded at the shank root to receive the bevel gears. A retaining nut and a stack of anti-friction bearings secure the blade in the hub socket. Aluminum alloy cuffs around the blade shanks provide improved engine cooling, particularly during ground operation.

3. **Power unit.** The power unit consists of a reversible electric motor, speed reducer, power gear assembly, magnetic brake assembly, and cam-operated limit switches.

The reversible electric motor receives its power from the airplane power supply through the brush and slip ring assembly. The reversible feature makes possible the increase or decrease of rpm, depending on the direction of rotation of the motor, as controlled by the panel selector switches.

The speed reducer converts the relatively high rpm and low torque of the electric motor into high torque and low rpm for the necessary force to change the blade angle.



1. Engine Alternator 2. Cuff Sheet

The power gear assembly transmits the torque force from the speed reducer through the system of bevel gears to the blade assembly to effect blade angle change.

The limit switches serve as stops to limit blade angle change by cutting the electrical supply to the reversible motor when the blade reaches the predetermined pitch setting for high rpm, low rpm, reverse, and feather positions.

The brake assembly consists of two solenoid-operated brakes which stop the electric motor armature when the blades reach the selected angle. During the increase rpm operation, one brake acts as a drag to prevent too fast an increase. The brakes hold the rpm constant when you operate the propellers in fixed pitch. If the electrical current cuts out, the brakes hold the props at the angle they are in at that time.

Propeller Control System Principle

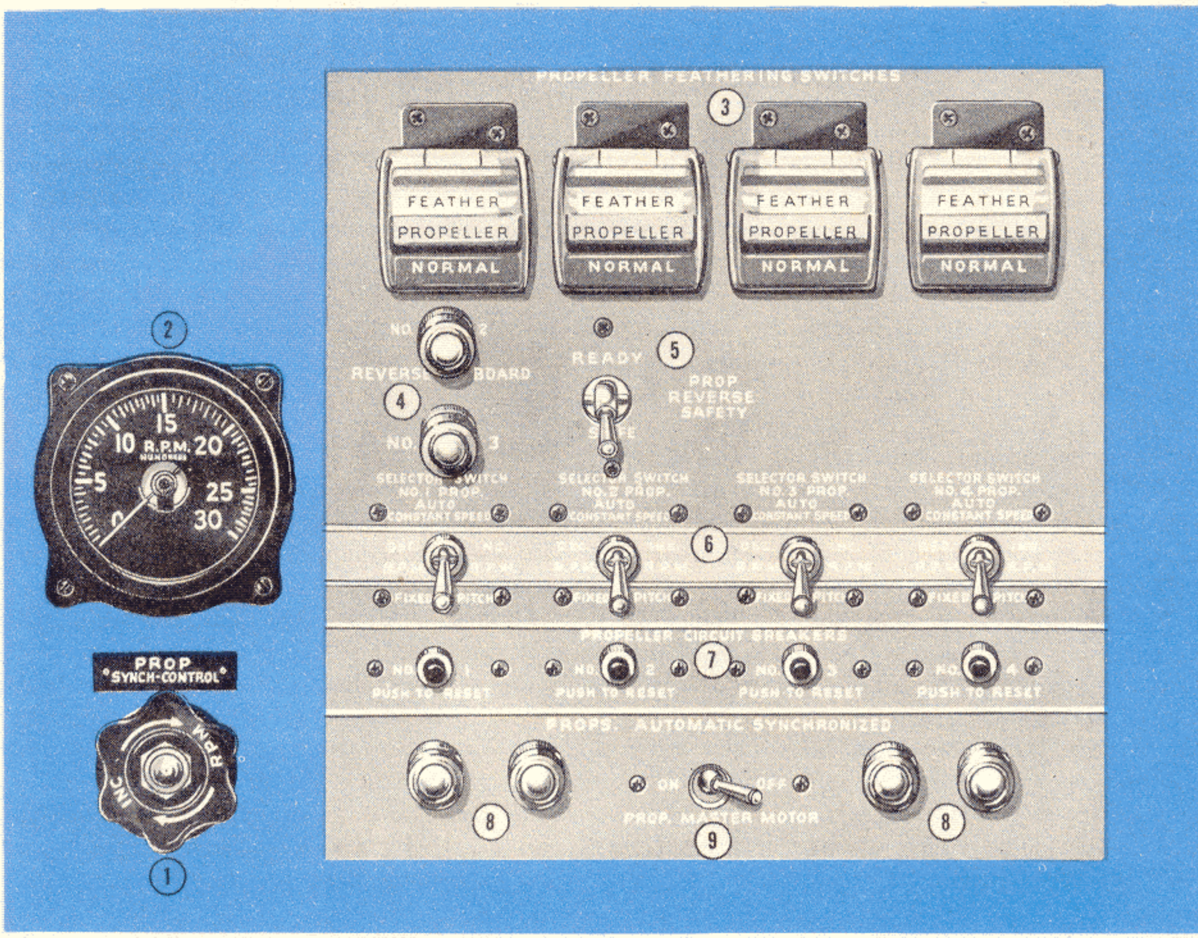
When you select desired engine speed, the control system synchronizes the speeds of the four engines by means of a proportional synchronizer and engine-driven alternators. Two voltage boosters in the system, located on each of the two shelves forward of the main instrument panel, boost the normal 28-volt airplane power supply to approximately 72 volts for rapid feathering and reversing. Each booster supplies two propellers.

The proportional synchronizer incorporates one master motor and four contactor units connected electrically with their respective engine-driven alternators. The master motor drives four armatures, one in each contactor unit, at a synchronized speed selected on the master tachometer. The engine-driven alternators are essentially 3-phase alternating current generators. Their output is proportionate to the rpm of the engines and is transmitted to the respective contactor unit for each engine in the proportional synchronizer.

Through a system of contacts, the difference in selected master motor output and engine-driven alternator output actuates a bell rotor. This rotor in turn actuates the pitch-change motor in the props. The change in pitch speeds or slows the engines to bring them into synchronization with the master motor speed, which you selected on the master tachometer.

Propeller Control Panel

1. **Master motor switch.** The master switch is both an ON-OFF switch for the motor and a circuit breaker for the master motor circuit. If the switch opens because of overload, re-set it by moving the toggle to ON position.
2. **Prop synch-control.** This knob on the propeller panel controls the setting of the master tachometer and operates to increase or decrease the speed of the master motor. Turn the knob clockwise to increase rpm, and counter-clockwise to decrease rpm.
3. **Master tachometer.** The master tach on the propeller panel indicates in equivalent engine rpm the speed of the master motor, which you regulate with the synch-control knob. In the on-speed condition of the engines, i.e., all engines synchronized at selected rpm, engine rpm and master tachometer rpm are the same, but the master tachometer regulates engine rpm, instead of indicating it as do the engine tachs.
4. **Props synchronized tel-lights.** The four green tel-lights at the bottom of the panel go on to indicate that the respective propeller is on-speed and within the limits of the synch-control knob.



PROPELLER PANEL

1. Synchronizer Control Knob
2. Master Tachometer
3. Feathering Switches
4. Reverse Tel-lights
5. Reverse Safety Switch
6. Selector Switches
7. Circuit Breakers
8. Automatic Tel-lights
9. Master Motor Switch

5. **Selector switches.** You select desired propeller operation by the 4-position selector switches in the middle of the panel. Up position is AUTOMATIC CONSTANT SPEED, the normal setting. Dead center position of the toggle is FIXED PITCH. Left center and right center are momentary-contact positions for DECREASE RPM and INCREASE RPM, respectively.

6. **Propeller circuit breakers.** These circuit breakers are push-to-set type, which you can't open by hand after setting. When you get an overload in the automatic or manual propeller circuit, the respective button snaps out, exposing red and luminous bands. Re-set it by pushing it in until you can't see the indicating bands. In an emergency in case of a continuous overload, you can close the circuit by holding the button all the way in.

There are also two re-set circuit breaker switches to the left of the airplane commander's seat. These are in the feathering, reverse, and return from reverse circuits and are in the circuit only during voltage boosting operations. Operate them the same way as you operate the prop panel circuit breakers.

7. **Feather switches.** The four feather switches at the top of the prop panel have FEATHER and NORMAL positions. These switches break the normal circuit at the same time they make the feathering circuit so that you can feather regardless of the position of any other propeller controls.

8. **Prop reverse safety switch.** This switch is normally in SAFE position. When you are going to reverse your props, put the switch in READY position. This switch acts as a line switch to prevent inadvertent reversing of the propellers. In READY position it breaks all other control circuits and closes the line switch of the reverse circuit. Then when you trip the reverse-normal switches the reverse circuit operates regardless of the position of other propeller controls.

The reverse-normal switches are behind a spring-loaded door on the inboard side of the airplane commander's control pedestal. They consist of four toggle switches, two for each inboard prop, connected by a link so that they operate together. Two of these switches close or open the reverse circuits, and the other two cut the voltage booster in or out.

9. **Reverse tel-lights.** Two amber tel-lights, one for each inboard prop, go on when these props reach their full reverse pitch.

Normal Operation of Propellers

You normally operate the airplane in flight and on the ground with the props in AUTO CONSTANT SPEED. With this condition, you make changes in engine rpm by changing the setting on the master tachometer.

See the pertinent sections of the amplified checklists for specific procedures of propeller operation, both normal and reverse, and for proper rpm settings for various conditions of flight.

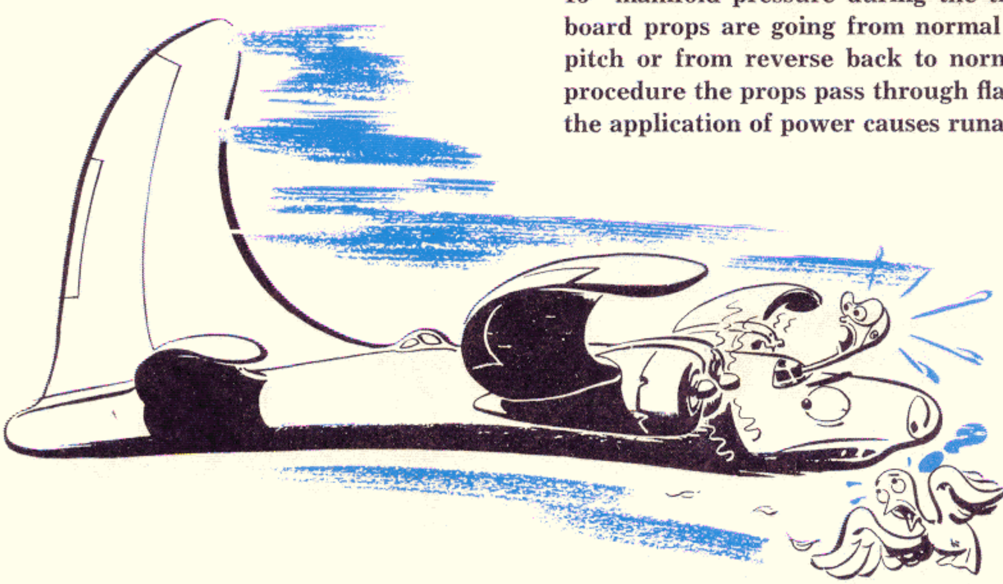
Notes on Reverse Prop Operation

1. The reverse pitch feature of these props is provided solely as an additional brake to help stop the airplane in landings **when all gear are on the ground.**

Sooner or later every new B-32 pilot wonders what happens if you reverse the props in the air. The answer is easy: you stop flying. Don't try it.

2. Watch head temperatures carefully when you are operating the props in reverse, both in landing and in ground check. Don't use high power settings with the props in reverse, except in emergencies, and then only for short intervals.

3. **Caution: Never open throttles to more than 15″ manifold pressure during the time the inboard props are going from normal to reverse pitch or from reverse back to normal. In this procedure the props pass through flat pitch and the application of power causes runaway props.**

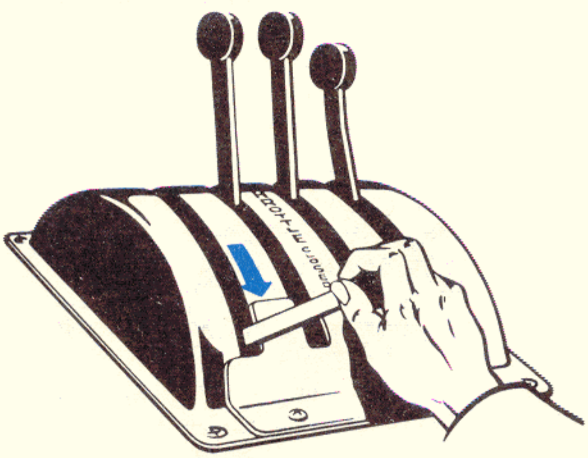


NEVER REVERSE PROPS IN THE AIR

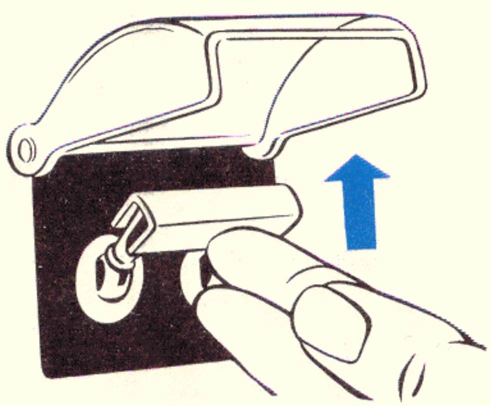
PROPELLER EMERGENCIES

Feathering

1. Remember the cautions you have heard about featheritis. Before you feather, always be sure that it is necessary and that you know which engine to feather.



2. Close throttle.



3. Place feather switch in FEATHER position.

4. Move mixture control to IDLE CUT-OFF.
5. Check fuel booster pump for OFF position.

6. Turn fuel selector valve control to OFF position.

7. Turn ignition switch to OFF when propeller stops turning.

8. Turn generator switch to OFF.

9. Close cowl flaps.

Note: When you intend to bring a feathered propeller back in later, allow the prop to windmill slowly to prevent liquid lock. Do this by feathering with the DECREASE RPM switch until prop almost reaches feathered pitch but still turns slowly. Or, if necessary, feather in the usual manner and then return feather switch to NORMAL and bring prop back to slow revolution by blipping the INCREASE RPM switch.

Unfeathering

1. Check:
   a. Mixture control—IDLE CUT-OFF.
   b. Propeller selector switch—FIXED PITCH
   c. Feather switch—NORMAL

2. Turn fuel selector valve control to TANK TO ENGINE.

3. Turn ignition switch on.

4. Hold propeller selector switch in INCREASE RPM position until engine tachometer indicates 1000 rpm, then release propeller selector switch to FIXED PITCH position.

5. Move mixture control to AUTO LEAN.

6. Open throttle to approximately 20" Hg and increase rpm with propeller selector switch to approximately 1700 rpm.

7. Warm up engine to approximately 120°C.; place propeller selector switch in AUTOMATIC; then slowly advance throttle to desired setting.

8. Turn generator switch on.

9. Adjust mixture controls and cowl flaps to desired settings.

Fixed Pitch Operation

If you lose constant speed control through failure of some part of that system, as an emergency measure you can use your propellers in selective fixed pitch for all flight operations.

For selective fixed pitch operation, move selector switch to FIXED PITCH position. Get the desired rpm for power setting and airspeed by holding the switch momentarily in INCREASE RPM or DECREASE RPM until the engine tach shows desired rpm.

Runaway Propeller

A runaway prop allows the engine to overspeed. Follow this procedure:

1. Immediately partially reduce power with throttle.

2. Check prop circuit breakers.

3. Check to be sure selector switch is in AUTO position.

4. Hold selector switch in DECREASE RPM position.

5. If last step fails, blip feather switch, being careful not to reduce rpm too much.

PROPELLER DON'TS

1. Never operate prop controls when engines are not running because pitting of slip rings may result.

2. Don't make propeller ground checks unless APP is running or external power source is used.

3. Don't let prop overspeed exceed 2880 rpm.

4. Don't apply power with inboard throttles in excess of 15" manifold pressure when going to or from reverse pitch.

Turbo-superchargers

Each engine on the B-32 has two model B-31 turbo-superchargers which boost the manifold pressure for takeoff and provide increased air pressure at high altitudes.

Engine exhaust gas passes through the collector ring and tailstack to the nozzle box of each supercharger, expands to atmosphere through the turbine nozzle, and drives the bucket wheel at high speed. There are two exhaust stacks (flight hoods) per turbo. One is for exhaust from the turbo bucket wheel; the other is a by-pass stack containing the waste gate. The exhaust gas does not pass to the nozzle box when the turbo is not operating, but through the by-pass stack. When the waste gate is closed, the exhaust gases are directed from the by-pass stack to the nozzle box. The output of the two turbos is teed together at the carburetor air inlet.

A ramming air inlet duct supplies air to the impeller which increases its pressure and temperature. However, in order to avoid detonation, the air supplied to the carburetor passes through the intercooler where the temperature is reduced. The internal engine impeller, driven by the engine crankshaft, again increases air pressure as it enters the intake manifold. High intake manifold pressure results in greater power output.

Supercharger Regulator Operation

The amount of turbo boost is determined by the speed of the bucket wheel, and the speed of the bucket wheel is determined by the pressure difference between the atmosphere and the exhaust in the tailstack and by the amount of gas passing through the turbine nozzles. If the waste gate is opened, more exhaust gas passes to the atmosphere via the waste pipe and decreases the tailstack pressure.

Electronic Turbo-supercharger Control

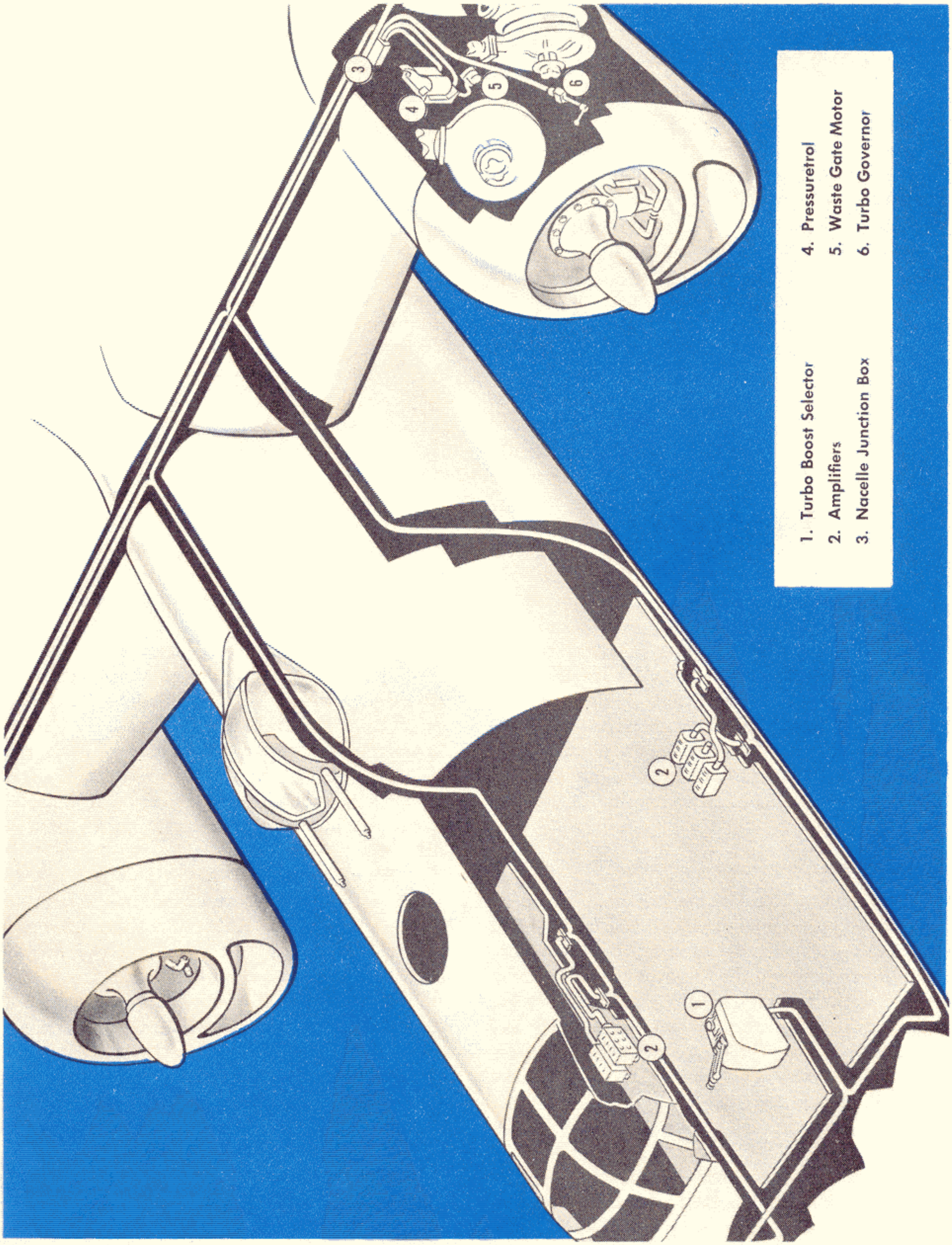
The electronic control system for the turbo-superchargers on the B-32 maintains constant carburetor inlet pressure by automatically regulating the position of the exhaust waste gate. It is designed to maintain whatever pressure the pilot selects, regardless of changes in atmospheric pressure at varying altitudes. The control gets its electrical power from the 115-volt inverter system. Fuses for the control system are located below the navigator's seat on the aft face of the nosewheel well. The following paragraphs describe the major components of the electronic control system.

1. **Turbo boost selector.** The turbo boost selector is the manual control for the electronic turbo control system. The figures on the selector knob represent settings which give carburetor inlet pressure necessary to produce desired manifold pressure for any flight condition. The other control units of the system, except those which act as protective controls, operate automatically to hold pressures at the level selected by the pilot with the turbo boost selector.

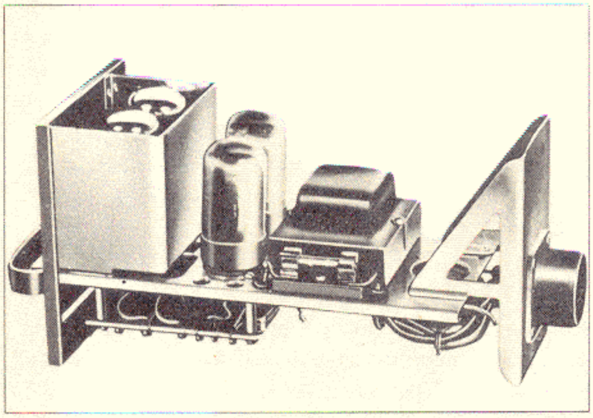
The turbo boost selector is located on the aft top face of the airplane commander's control pedestal. The selector unit contains four small calibrator potentiometers which require adjustment only to compensate for small differences in engine or turbo-supercharger performance. Once the calibrators are set the pilot can control the turbo boost on all four engines simultaneously by turning the large control knob on the unit.

2. **The Pressuretrol.** A Pressuretrol unit automatically controls the pressure in the induction system at the carburetor inlet. This unit electrically measures the pressure of the air supplied by the turbo-supercharger to the carburetor and controls the automatic operation of the system to maintain whatever pressure the pilot has selected. It consists of a voltage dividing potentiometer operated by a pair of bellows, connected to the induction system near the carburetor inlet. The Pressuretrol unit operates from the left turbo in each engine.

3. **The turbo-supercharger governor.** The governor is a dual safety device driven by a flexible drive shaft which is geared to the left


1. Turbo Boost Selector
2. Amplifiers
3. Nacelle Junction Box
4. Pressuretrol
5. Waste Gate Motor
6. Turbo Governor

turbo-supercharger of each engine. One part of the mechanism, called the overspeed control, prevents the turbo from exceeding its safe operating limit. The other part, the accelerometer, anticipates the pressure increase from turbo acceleration and provides a signal to start opening the waste gate in time to prevent the overshooting of manifold pressure.



4. **The amplifier.** This is an intermediate unit between the control units and the waste gate motor. It receives two kinds of signals from the other control units. One kind calls for rotation of the waste gate motor to close the gate; the other, for rotation to open it. After amplifying the signal, the amplifier determines the direction of movement called for and controls accordingly the power delivered to the waste gate motor.

5. **The waste gate motor.** One waste gate motor operates the waste gates for both turbos on each engine. When the waste gate motor operates the waste gate in response to control signals, it also operates a balancing potentiometer which produces a signal opposed to the original control signal. When the rotation of the motor is enough to make the two signals exactly neutralize each other, the power from the amplifier is cut off, and the waste gate motor stops.

Operating Instructions

Operating instructions for turbo-superchargers are covered in amplified checklists under appropriate flight operations sections of this manual.

Turbo-supercharger Emergencies

Runaway turbos:

1. Indication: excessive manifold pressure. Possible causes: amplifier failure, amplifier tube failure, electrical failure, or control mechanism failure.
2. Remember that you can over-ride turbo pressure by throttles.
3. Check 2-ampere fuses on amplifier chassis and in turbo junction box.
4. Replace amplifier with spare if necessary.
5. If opening tube is blown leaving waste gate open, and no spare amplifier is available, use closing tube in opening tube socket to open waste gate. Opening tube is left tube as viewed from handle end of amplifier tray.

Torching turbo in flight:

1. Ease throttle back a little, about 1 inch.
2. If smoke stops immediately after retarding throttle, re-apply power.
3. If smoke does not stop, treat as an induction system fire.

AC power failure:

1. Check inverter circuit breaker under flight deck.
2. Check turbo amplifier fuses in box aft of wheel well doors.

No turbo operation:

1. Check turbo boost selector fuse in wheel well box in flight deck if all turbos fail to raise manifold pressure.
2. Check amplifier fuses if only one turbo is affected.

Excessive manifold pressure on no-turbo run-up:

1. Have system checked for leak in ducting between turbo and carburetor or for waste gates out of rig. In this condition you get high manifold pressure during run-up, but loss of boost and turbo overspeed at altitude.

Fluctuating manifold pressure:

1. Possible cause: slight leak in duct system causing operation of overspeed governor below critical altitude.
2. Retard throttle and lower manifold pressure. This increases carburetor inlet pressure and opens the waste gate, slowing turbo to its operating speed.

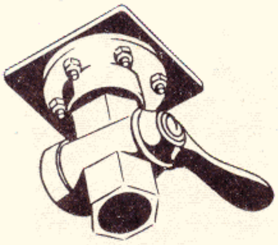
Fuel System

Description

1. **Fuel tanks.** Fuel is carried in four tanks in the center wing section. Each tank is composed of three self-sealing cells, connected consecutively, instead of alternately as on the B-24. Total fuel capacity is approximately 5460 gallons.

2. **Selector valves.** Four selector valves direct the fuel from the tanks to the engines or into the crossfeed lines. A fifth selector valve directs the fuel from the crossfeed lines to the drain valves, and connects the left and right wing systems through the crossfeed. No. 2 and No. 3 selector valves and the drain valves are on the front spar in the bomb bay area. No. 1 and No. 4 selector valves are on the front spar between the inboard and outboard engines. Each selector valve has three port flanges attached to a magnesium body. Two solenoids control each port. When operation of the selector valve is completed, micro-switches cut off the electrical power from the solenoids. Therefore, if there is an interruption in the electrical circuit, the valve remains in its last position.

The selector drain valve is located in the center of the crossfeed line between No. 2 and No. 3 selector valves. Turning this valve to CROSSFEED connects right and left crossfeed lines. Turning OFF isolates right and left crossfeed lines. With this valve in DRAIN position you can drain fuel from all tanks through a manual shut-off for the drain system. On airplanes equipped with bomb bay tanks the fuel line from them is connected to the drain port. Disconnect the bomb bay fuel hose at the manual drain valve before draining fuel.



DRAIN COCK

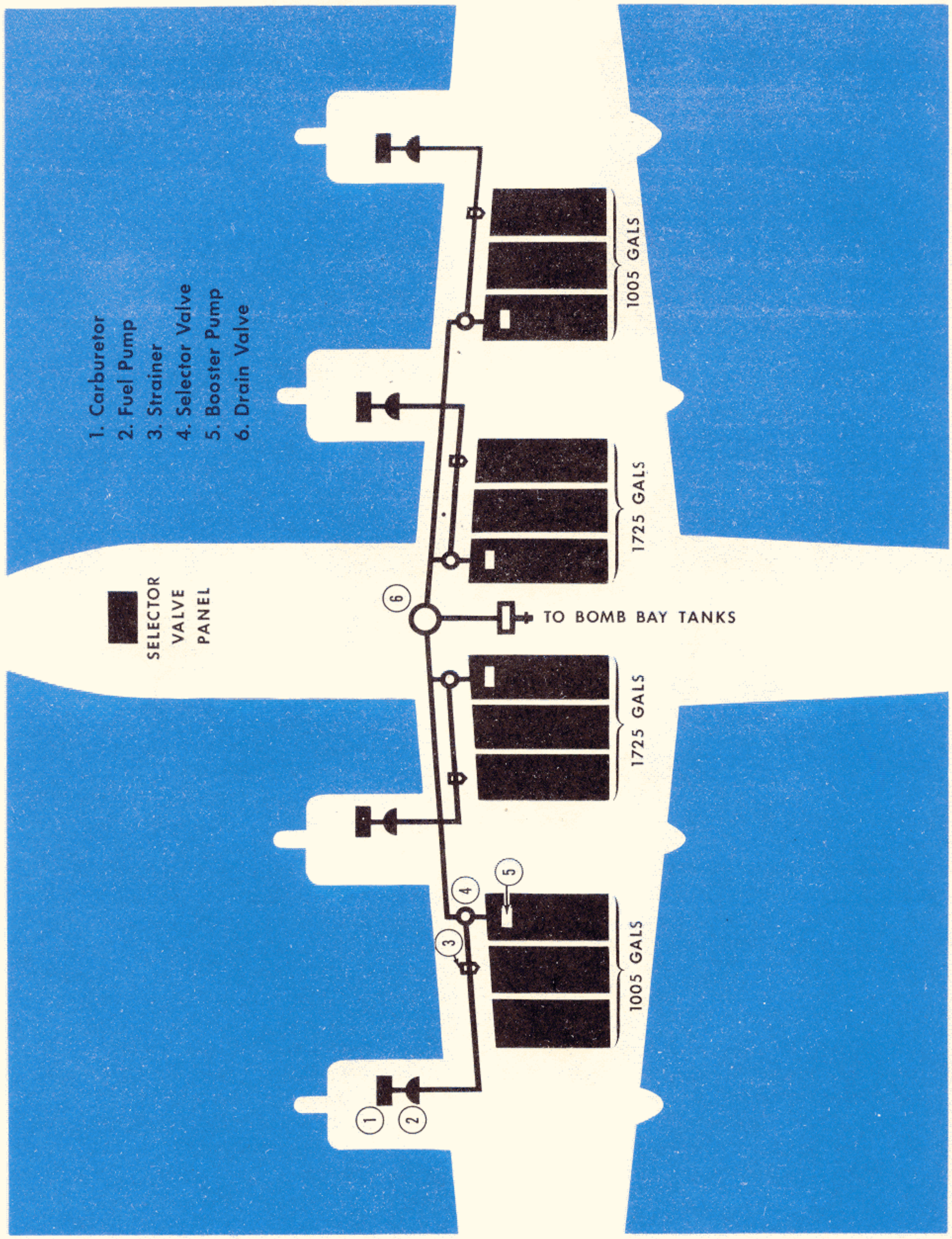
3. **Booster pumps.** Each tank has a submerged type booster pump at the bottom of the inboard cell. The booster pumps provide pressure to the priming solenoid for engine starting, supply vapor-free fuel to the engine-driven pump at high altitudes, and act as emergency fuel pumps in the event of failure of an engine-driven pump. The pumps are electrically operated, constructed integrally with a 24-volt DC motor. The booster pump switches are mounted on the fuel selector panel. Each has HIGH, LOW, OFF positions. HIGH position gives a fuel pressure of approximately 21.5 psi, and LOW gives a pressure of about 8 to 10 psi.

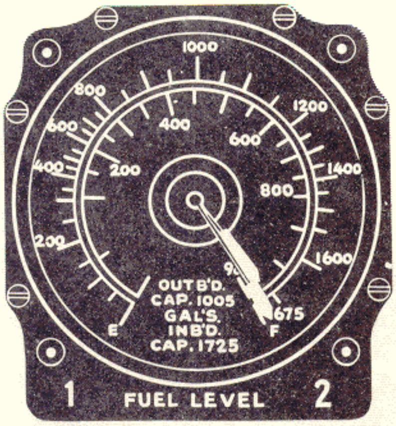
Note: No fuel pressure is indicated with the mixture control in IDLE CUT-OFF and the booster pump in ON position. This results from the fact that a fuel cut-off valve, connected to the mixture control, is incorporated on the carburetor, and the fuel pressure gage connection is beyond the cut-off valve. This does not, however, affect the operation of the primer because its fuel supply by-passes the cut-off valve.

4. **Engine-driven fuel pumps.** These pumps are installed on each engine. Each pump has a by-pass valve which allows the booster pump to pump fuel to the engine in the event of failure of the engine-driven pump.

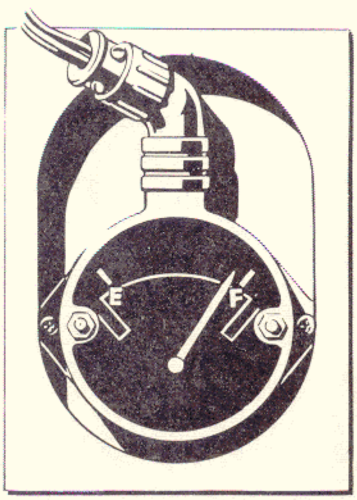
5. **Gages and indicators.** Each tank has a liquidometer fuel level gage. Positions of the liquidometer floats in the tanks transmit electrically to dual indicators on the instrument panel. One indicator shows fuel levels in the right wing tanks and the other shows levels in the left wing tanks. Float type gages in the main gear nacelles for the outboard tanks and in the bomb bays for the inboard tanks permit checking fuel levels from the ground.

A fuel pressure transmitter is located in each nacelle. The transmitter connects to the carburetor by a fuel pressure line. The pressure differential is transmitted to dual indicators on the instrument panel.


1. Carburetor
2. Fuel Pump
3. Strainer
4. Selector Valve
5. Booster Pump
6. Drain Valve
SELECTOR VALVE PANEL
TO BOMB BAY TANKS
1005 GALS
1725 GALS
1725 GALS
1005 GALS



ELECTRIC FUEL LEVEL GAGE



FLOAT TYPE GAGE

6. **Vent system.** A venting system maintains normal pressure in the tanks. The system either relieves excess pressure or provides air to replace the fuel consumed. All of the vent lines terminate at openings in the lower surface of the wing, slightly outboard of No. 1 and No. 4 engines.

Bomb Bay Fuel System

Four removable self-sealing tanks, each approximately 750 gallons capacity, comprise the bomb bay fuel system. The tanks are installed on the bomb racks, one on each side of the catwalk in each bomb bay section. Quick-disconnect couplings in the lines make it possible to drop the tanks in flight. A sight gage is installed on the end of each tank near the center of the bomb bay. The tanks are constructed so that they can be used interchangeably. Each tank has two outlet openings but only one is used, depending on the location of the tank in the bomb bay. The alternate opening is closed with a cover provided for that purpose. Vent lines lead from the top of each tank to openings in the fuselage skin over the bomb bay. Each tank has a drain outlet in the bottom, and a strainer at the fuel outlet.

Two 3-way selector valves at fuselage station 5.0 direct the flow of fuel from the bomb bay tanks into the main fuel system at the manually operated drain valve. Each selector valve connects to two tanks and to the bomb bay system booster pump. The booster pump comprises a standard engine-driven fuel pump mounted directly on an explosion-proof, direct current motor. The pump assembly is mounted on the catwalk near the center of the bomb bay.

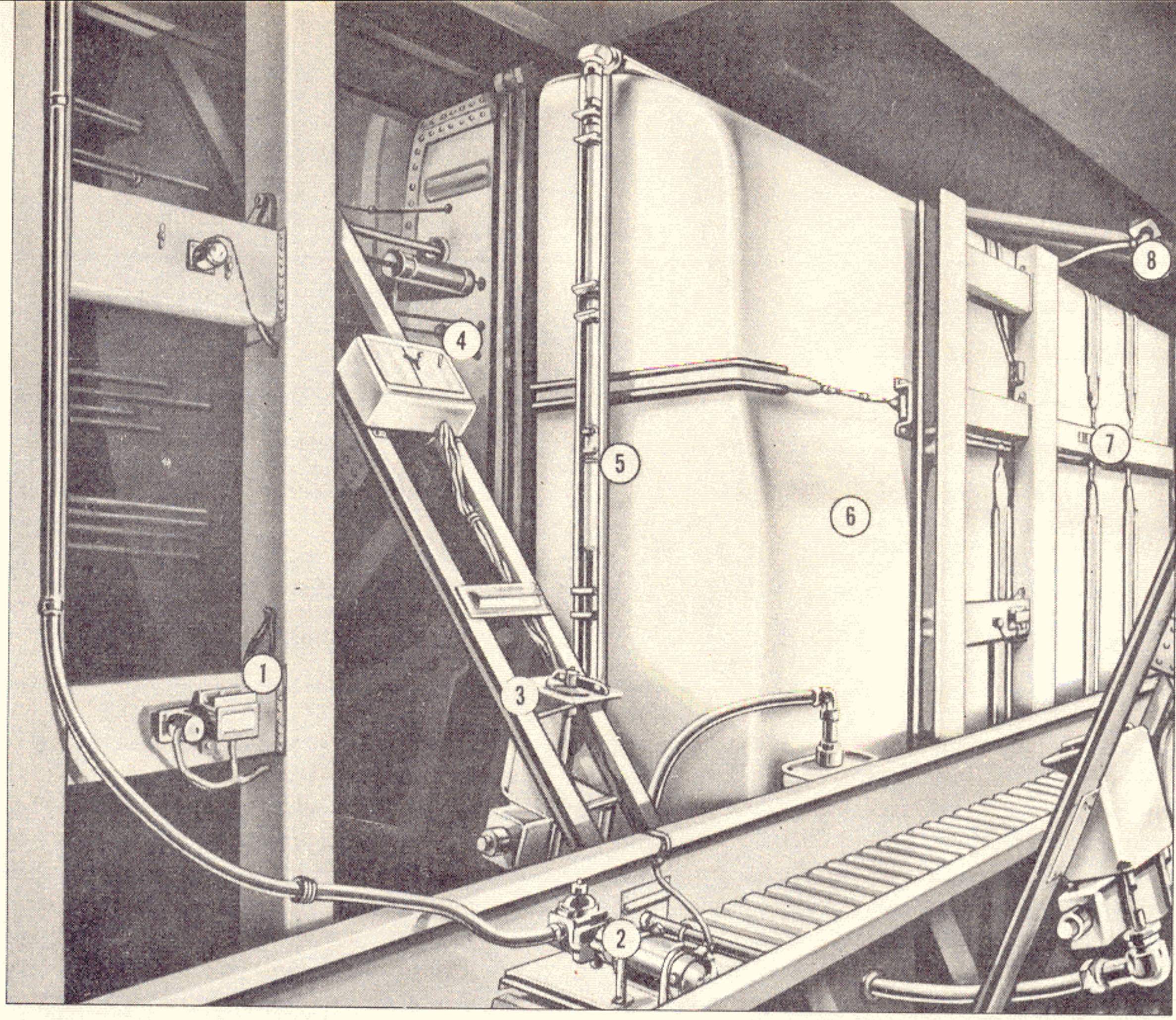
Self-sealing hose and quick-disconnect couplings in the lines are used throughout the bomb bay fuel system.

Use bomb bay fuel by the following procedure:

1. Set bomb bay tank manual selector valve to desired bomb bay tank.
2. Turn on bomb bay fuel booster pump.
3. Open manual drain valve.
4. Turn drain selector valve on fuel selector panel to BOMB BAY OR DRAIN ON.
5. Turn selector valve to CROSSFEED TO ENGINE for engine or engines which you desire to operate on bomb bay fuel.

To drop the tanks in flight use the following procedure:

1. Close toggle switches on the lower channel of inboard bomb racks for each tank to be dropped.
2. Close the switch to open bomb bay doors.
3. Set bombardier's bay selector switch at bay containing tank to be released.
4. Set intervalometer to closest interval and maximum number of bombs.
5. Close bomb release switch.



BOMB BAY FUEL SYSTEM

1. Toggle Switch
2. Booster Pump
3. Selector Valves
4. Pump Switch
5. Sight Gage
6. Fuel Tank
7. Tank Supports
8. Vent System

Normal Fuel System Operation

Under ordinary operating conditions, feed each engine from its respective tank by setting each selector valve to TANK TO ENGINE position and the drain selector valve to CROSS-FEED position. This is the proper procedure for takeoff, and for landing also, provided you have sufficient fuel in all tanks on landing. Proper fuel pressure for flight is 16 to 18 psi.

On long missions it is necessary to transfer fuel from the inboard to the outboard tanks, as the latter do not hold as much as the inboard tanks. Normal procedure is to begin transfer of fuel as soon as there is room in the tanks to do so, thus constantly balancing the fuel. In any case do not drain the outboard tanks below 200 gallons before transferring fuel.

The Fuel Management Chart shows the various methods of utilizing fuel in different tank to engine combinations, as well as methods of transferring fuel.

USE THE BOOSTER PUMPS IN THE FOLLOWING WAY:

Condition	Booster Pump Setting
Starting engines	LOW
Takeoff and landing	HIGH
Flight above 20,000 feet	LOW
One tank feeding more than one engine—any altitude	As necessary
Low fuel pressure on engine-driven pump	As necessary
Engine-driven pump failure	HIGH
Transferring fuel	LOW on feeding tank; OFF on tank being fed

Note: Under normal operations, if an engine-driven pump fails and you use fuel boost to supply pressure, turn the turbo-supercharger control to 0 position, since fuel boost does not increase with carburetor duct pressure and a lean mixture results, causing detonation.

Emergency Operation

Proper procedures for managing the fuel system under various emergencies is usually dictated or modified by circumstances of the emergency. The following, however, are examples of typical fuel system emergencies, with suggested procedures for handling them.

Fuel tank failure:

1. Let the engine windmill at reduced power and transfer remaining fuel immediately to another tank.
2. When faulty tank is drained, set selector valve to CROSSFEED TO ENGINE in order to by-pass tank.
3. Set selector valve of another tank to TANK TO ENGINE AND CROSSFEED in order to supply fuel to the crossfeed line.

Fuel tank failure (alternate procedure):

1. Set selector valve of faulty tank to TANK TO ENGINE AND CROSSFEED, booster pump HIGH.
2. Set selector valve of another tank to TANK TO ENGINE AND CROSSFEED, booster pump OFF.
3. If the gages are still working on the faulty tank, watch quantity and pressure carefully and switch the selector valve to CROSSFEED TO ENGINE, booster pump OFF, before the tank runs dry and cuts out your engine. **Note:** In an emergency where you need every bit of the fuel in the faulty tank, use the foregoing procedure until the tank gets low and then run the fuel out on one engine, the respective engine for that tank, by setting the selector valve to TANK TO ENGINE.

Engine fuel line failure or engine fire:

1. Set selector valve to OFF.
2. Follow feathering procedure.
3. If you need the fuel in the tank, set selector valve to TANK TO CROSSFEED, booster pump HIGH, and set selector valve for a low tank to TANK TO ENGINE AND CROSSFEED, booster pump OFF.

Failure of part of crossfeed line:

1. If crossfeed line is damaged on one side, isolate faulty side by turning selector drain valve to OFF position.

Fuel line failure between tank and selector valve, if accessible:

1. Turn booster pump OFF.
2. Cut faulty line and crimp it.

Engine fuel pump failure:

1. Turn booster pump on HIGH.

Failure of engine-driven pump and booster pump:

FUEL MANAGEMENT CHART

Condition	Selector Valve No. 1	Selector Valve No. 2	Selector Drain Valve	Selector Valve No. 3	Selector Valve No. 4
1. All four tanks feeding all four engines, takeoff condition	TANK TO ENGINE	TANK TO ENGINE	CROSSFEED	TANK TO ENGINE	TANK TO ENGINE
2. Inboard tanks feeding all four engines	CROSSFEED TO ENGINE	TANK TO ENGINE AND CROSSFEED	CROSSFEED	TANK TO ENGINE AND CROSSFEED	CROSSFEED TO ENGINE
3. Outboard tanks feeding all four engines	TANK TO ENGINE AND CROSSFEED	CROSSFEED TO ENGINE	CROSSFEED	CROSSFEED TO ENGINE	TANK TO ENGINE AND CROSSFEED
4. Left inboard and outboard tanks feeding all four engines	TANK TO ENGINE AND CROSSFEED	TANK TO ENGINE AND CROSSFEED	CROSSFEED	CROSSFEED TO ENGINE	CROSSFEED TO ENGINE
5. Right inboard and outboard tanks feeding all four engines	CROSSFEED TO ENGINE	CROSSFEED TO ENGINE	CROSSFEED	TANK TO ENGINE AND CROSSFEED	TANK TO ENGINE AND CROSSFEED
6. Tanks 1, 2, and 3 feeding all four engines	TANK TO ENGINE AND CROSSFEED	TANK TO ENGINE AND CROSSFEED	CROSSFEED	TANK TO ENGINE AND CROSSFEED	CROSSFEED TO ENGINE
7. Tanks 2, 3, and 4 feeding all four engines	CROSSFEED TO ENGINE	TANK TO ENGINE AND CROSSFEED	CROSSFEED	TANK TO ENGINE AND CROSSFEED	TANK TO ENGINE AND CROSSFEED
8. Tanks 1, 2, and 4 feeding all four engines	TANK TO ENGINE AND CROSSFEED	TANK TO ENGINE AND CROSSFEED	CROSSFEED	CROSSFEED TO ENGINE	TANK TO ENGINE AND CROSSFEED
9. Tanks 1, 3, and 4 feeding all four engines	TANK TO ENGINE AND CROSSFEED	CROSSFEED TO ENGINE	CROSSFEED	TANK TO ENGINE AND CROSSFEED	TANK TO ENGINE AND CROSSFEED
10. Drain all four tanks	TANK TO CROSSFEED	TANK TO CROSSFEED	DRAIN (also open manual drain valve)	TANK TO CROSSFEED	TANK TO CROSSFEED

1. Set selector valve of another tank to TANK TO ENGINE AND CROSSFEED, booster pump HIGH.

2. Set selector valve of faulty tank to CROSSFEED TO ENGINE to avoid transferring fuel back into the tank while engine is supplied with pressure.

Selector valve failure:

1. If fuel supply to engine is cut off or if you can't get fuel at TANK TO ENGINE position, check circuit breaker.

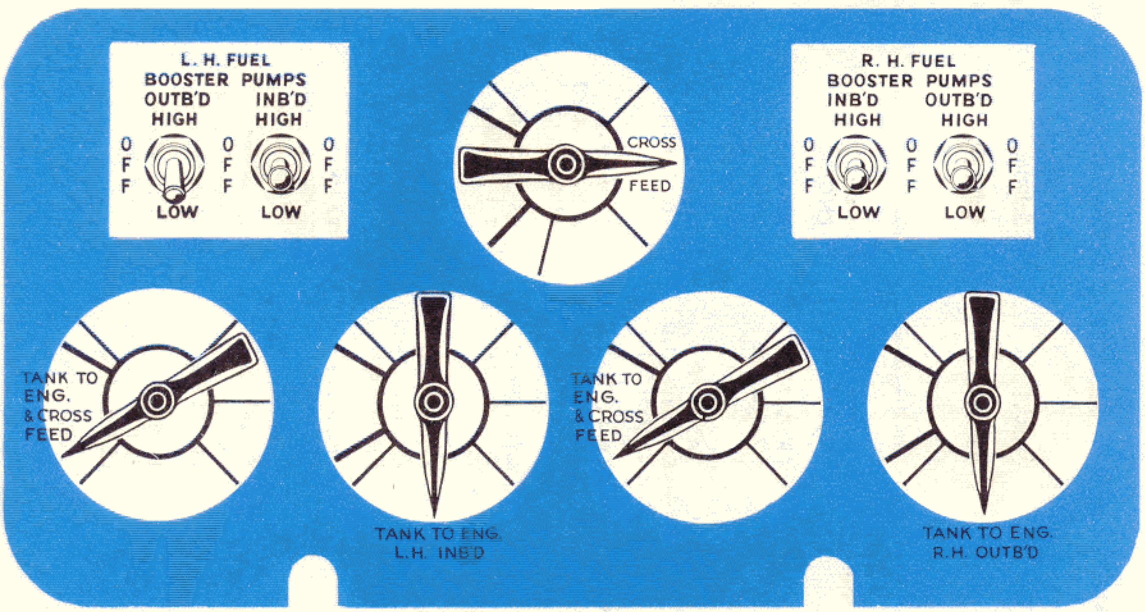
2. If trouble is not in circuit breaker, try faulty selector valve at TANK TO ENGINE AND CROSSFEED position.

3. If port to engine fails on an outboard selector valve, you can't do anything about it, but if port to tank fails, turn faulty valve control to CROSSFEED TO ENGINE and turn another selector valve to TANK TO ENGINE AND CROSSFEED, with booster pump on HIGH.

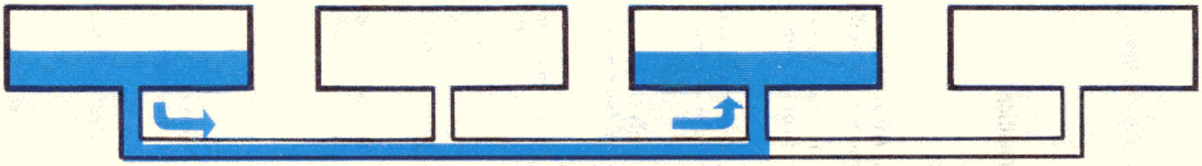
4. If an inboard selector valve or drain valve fails, you can remove Dzus fasteners on valve cover and operate valve manually.

Fuel Transfer

You transfer fuel from one tank to another by opening the respective selector valves from the tanks to the crossfeed lines and turning booster pumps LOW for the tank from which you are transferring and OFF for the tank being filled. Drain selector valve must be on CROSSFEED. If the engines for these tanks are operating, the selector valves should be set to TANK TO ENGINE AND CROSSFEED. For an engine not operating, set the selector valve to TANK TO CROSSFEED. The following diagram shows example of fuel transfer procedure. **Note:** Watch gages carefully to prevent overflowing tanks. If rapid fuel transfer is absolutely necessary, turn booster pump for tank to be drained to HIGH position.



TO TRANSFER FUEL FROM NO. 1 TO NO. 3



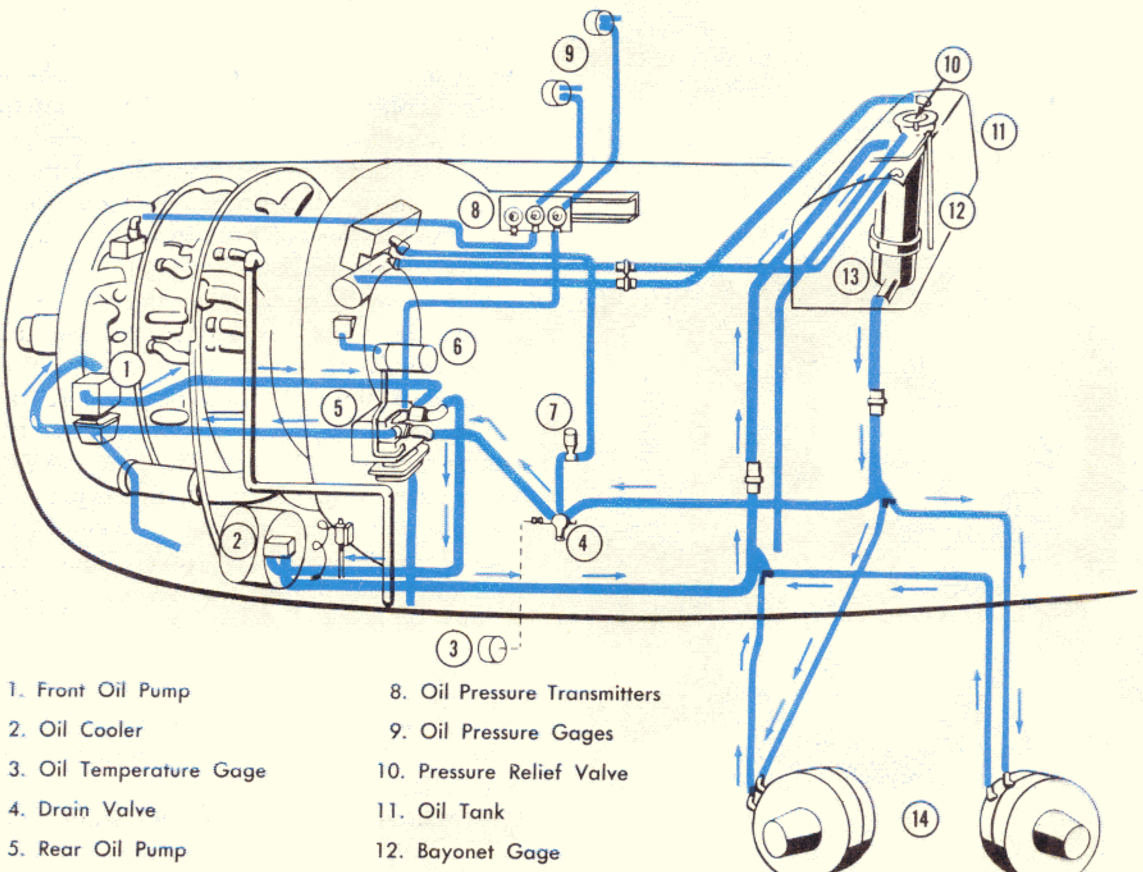
Oil System

Independent oil systems provide constant lubrication and partial cooling for each engine and its accessories on the B-32. Each system consists basically of an oil cell, sump, Y drain valve, and oil temperature regulator.

The self-sealing oil cells are located in the wing center section. Each cell contains an oil hopper of synthetic rubber. As oil returns to the cell from the oil temperature regulator, it circulates through the hopper and is thus prevented from mixing with the cold oil of the cell. As oil is consumed, it is replaced from the cell, through holes in the bottom of the hopper. Vertical fins mounted in the base of the hopper reduce any tendency of the oil to set up a swirling action.

The oil temperature regulator, located beneath each engine in the oil-out line, maintains uniform oil temperature to the engine throughout the various operating conditions. The oil dilution system is controlled by switches on the copilot's auxiliary panel. See **Cold Weather Operation** for oil dilution procedure. A bayonet gage on the filler casting measures oil quantity. The gage is accessible through a door on the upper wing surface. The oil temperature bulb on the Y drain valve transmits oil-in temperature to an indicator on the copilot's panel.

Oil pressures are measured at the front and rear of the engine. The pressures are transmitted to dual nose pressure and main pressure gages on the instrument panel.



1. Front Oil Pump
2. Oil Cooler
3. Oil Temperature Gage
4. Drain Valve
5. Rear Oil Pump
6. Generator
7. Oil Dilute Solenoid
8. Oil Pressure Transmitters
9. Oil Pressure Gages
10. Pressure Relief Valve
11. Oil Tank
12. Bayonet Gage
13. Hopper
14. Turbos

Hydraulic System

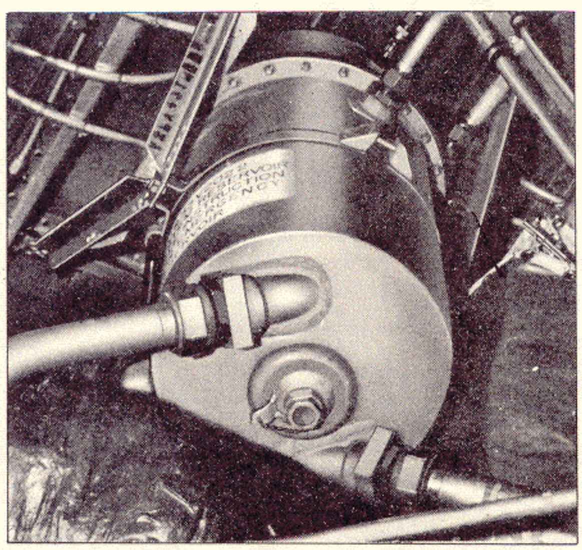
Hydraulic power on the B-32 operates the bomb bay doors, inboard and outboard flaps, landing gear, brakes, and the retraction and extension of the belly turret. There are four distinct hydraulic systems in the airplane:

1. Main (open center type) system.
2. Brake (accumulator type) system, containing a separate tank, pump, and lines.
3. Emergency system, containing separate tank, selector valves, and lines, for use in case of main system failure.
4. Turret system, a completely independent unit for extension and retraction of belly turret.

Main Hydraulic System

The main hydraulic system operates the bomb bay doors, flaps, and landing gear. It is an open center system, which means that the hydraulic fluid circulates freely in a completely closed circuit when no hydraulic mechanisms other than engine-driven pumps are operating.

1. **Tank.** The main system tank, capacity 3.1 gallons, is located in the center of the forward



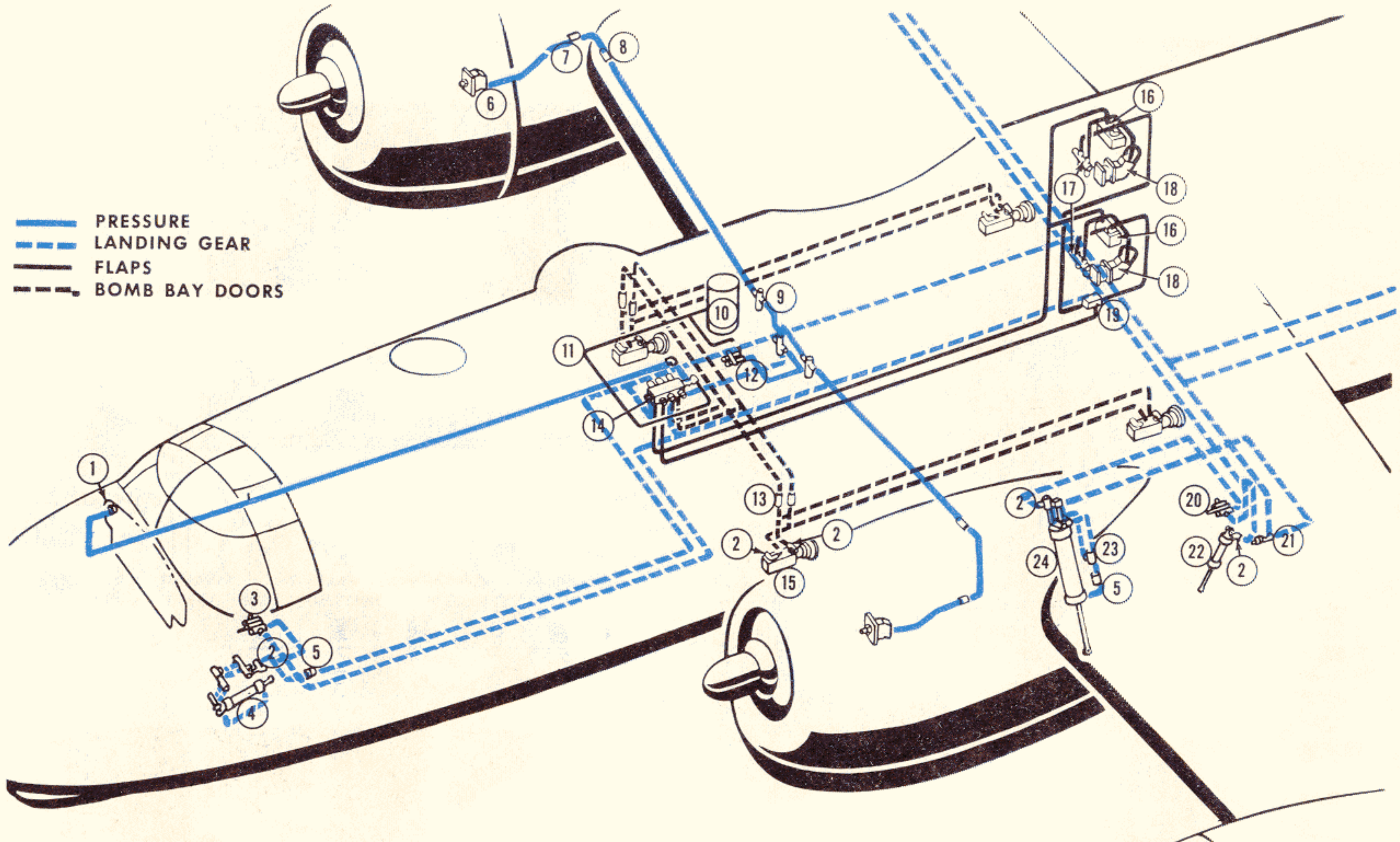
bomb bay. The tank contains filters with relief valves (set to 8 psi) which bypass fluid to the bottom of the tank in case of clogging. The main system tank is filled from the emergency tank, as described under **Emergency Hydraulic System** in this section.

2. **Pumps.** From the tank, fluid flows through check valves and firewall disconnects to the two engine-driven pumps on No. 2 and No. 3 engines.

3. **Main selector valves.** Fluid flows from the pumps through disconnects, check valves, filter, and past the main system pressure relief valves (set to 1500 psi) to the main selector valve. This selector valve, located under the upper bomb rack support beam in the forward bomb bay, contains four separate solenoid-operated valves bolted together. Three of these are operation-controlled valves for bomb bays, flaps and landing gear. The fourth is a pressure control valve which holds pressure fluid for the selector valve when the operating valve is in use. The main system pressure gage comes off the unit (pressure) side of the valve. The pressure indicating gage is mounted on the right side of the main instrument panel. A hydraulic fuse in the gage line prevents loss of fluid in case of gage line failure.

You normally operate the units of the main system electrically, by switches on the instrument panels. Solenoids actuate both the selected operating valve and the pressure control valve, which operates simultaneously with all operating valve solenoids. The pressure control valve blocks return flow and directs pressure to the selected operating valve. When the hydraulic unit completes travel, limit microswitches de-energize the solenoids and all valves return to neutral. From the selector valve, return fluid from units passes through a check valve to the tank. This procedure is normal electrical-control operation of the main selector valve. You can also operate the valve manually.

4. **Manual operation of the main selector valve.** If the panel switches don't operate your hydraulic units, you may have a failure of the main system electrical circuit. In this event try



1. Open Center Pressure Gage
2. Shuttle Valve
3. Nose Gear Unlatching Jack
4. Nose Gear Cylinder
5. Restrictor
6. Engine-driven Pump
7. Disconnect Couplings
8. Check Valve
9. Filter
10. Main Reservoir
11. Return Line
12. Open Center Relief Valve
13. Check Restrictors
14. Main Selector Valve
15. Bomb Door Hydraulic Motor
16. Flap Lock Valve
17. Pressure Relief Valve
18. Flap Hydraulic Motor
19. Proportional Flow Divider
20. Main Gear Unlatching Jack
21. Main Gear Down-lock Jack
22. Main Gear Auxiliary Cylinder
23. Main Gear By-pass Valve
24. Main Gear Cylinder

operating the selector valve manually. The manual operation is the same for bomb bay doors, flaps, or landing gear. Using opening of the bomb bay doors as an example, the following is the proper procedure:

a. Push in and turn pressure control button until it locks in. Pressure control button is on the right side (facing forward) of aft valve.

b. Push in button marked BOMB DOORS OPEN and hold it until doors are fully open. Then release button. Buttons are labeled on most airplanes. Learn identifications from the accompanying illustration in case placards are missing.

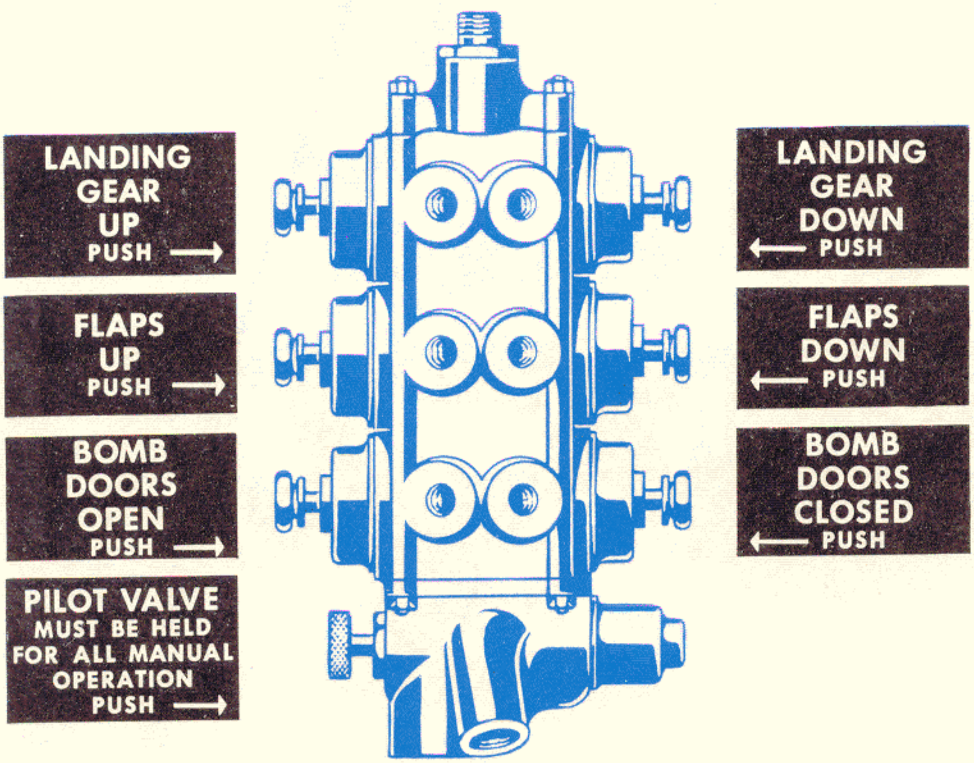
c. Pull out pressure control button. This returns valves and pressure to normal.

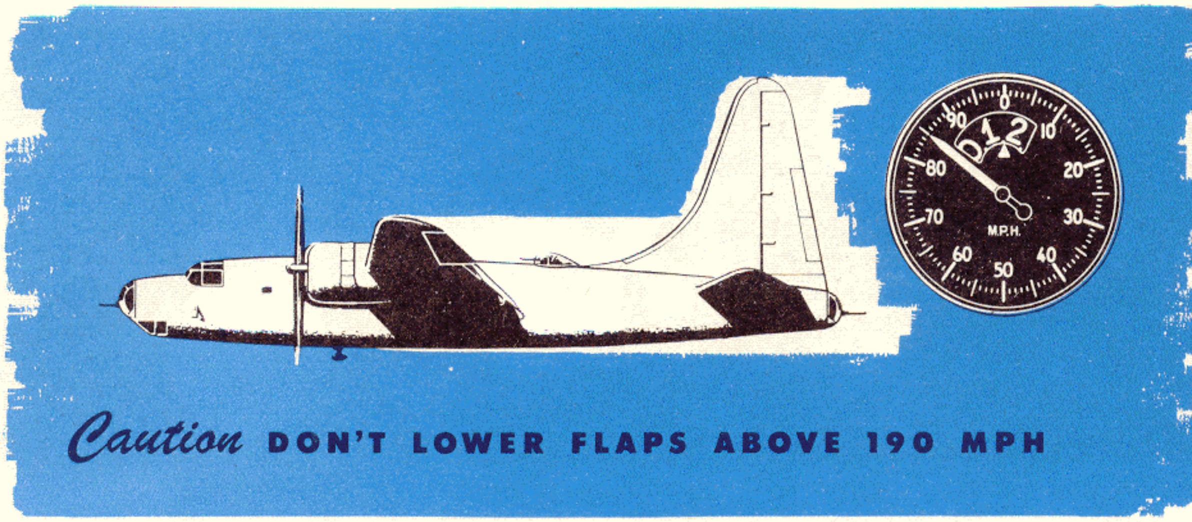
5. **Bomb bay doors**—description and operation. A toggle switch on the bombardier's panel electrically controls the hydraulic operation of the roll-type bomb doors when the bombardier's master circuit switch is on. Turning the switch to OPEN actuates the main selector valve solenoids and the valve directs fluid into the doors-open lines. The fluid flows through bomb door restrictors which meter it into four hydraulic motors. The motors open the doors, the action being stopped by a micro-switch when each bomb door is full open. Bomb doors open also on operation of salvo switches on the bombardier's panel, main panel, and aft bulkhead of flight deck.

If the electric circuit fails you can open or close the doors by manual operation of the main selector valve as described in foregoing paragraphs. In the event of complete open center system failure, you can operate the doors by use of the emergency system, as described under the heading **Emergency Hydraulic System** in this section.

6. **Flaps — description and operation.** The trailing edge of the wing center section on each side incorporates two Fowler flaps. A toggle switch in the center of the instrument panel electrically controls the operation of the flaps. An indicator adjacent to the switch shows flap positions, left pointer indicating inboard flaps and right pointer indicating outboard flaps.

Fluid from the main selector valve actuates



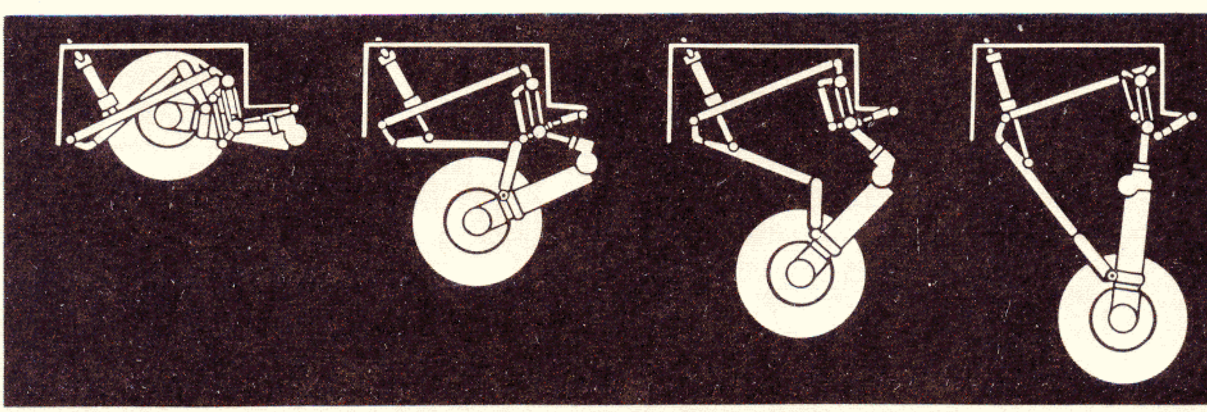


two hydraulic motors which operate the flaps, one motor for the inboard set and the other for the outboard. In operation, the fluid flows through flap lock valves before reaching the motors, unlocking the flaps for retraction or extension. The lock valves are necessary to prevent creeping when flaps are extended, since fluid is not locked in up or down lines when the main selector valve is in neutral. A proportional flow divider functions in both the up and down operations to synchronize travel between inboard and outboard flaps. Limit switches at the center track of the right outboard and left inboard flaps stop the action when the flaps are fully retracted or extended. If the main selector valve fails to return to neutral at the end of flap retraction, relief valves operate to prevent damage to the flap structure.

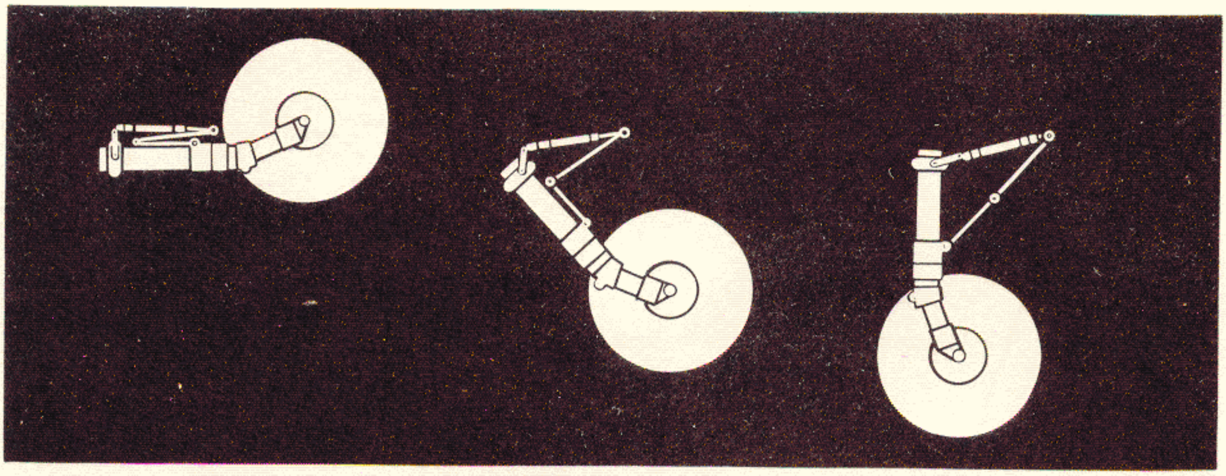
A horn sounds to warn against takeoff with insufficient flap extension, operating if the throttles are advanced more than 65° when the flap extension is less than 18°.

If the electrical circuit fails, you can operate flaps by the procedure outlined under paragraph 4 of this section. In case of complete failure of the open center system you can **lower** the flaps by use of the emergency system, as described under the heading **Emergency Hydraulic System** in this section. There is no way to **retract** the flaps in case of failure of the normal system, however.

7. **Landing gear—description and operation.**



LOWERING MAIN LANDING GEAR



LOWERING NOSE GEAR

The main gear on your airplane comprises four 56-inch tires and tubes, and four wheel and brake assemblies, interchangeable with those of the B-24. The caster type nosewheel has dual wheels, with 39-inch tires, splined to the axle. The co-rotation of the dual nosewheels prevents shimmying without the need for a separate damper. The nosegear swivels through a full 360°. The tailskid is hydraulically-operated with the landing gear. It contains an air spring which has a travel of about 5 inches.

A switch in the center of the instrument panel electrically controls the operation of the landing gear. A green signal light adjacent to the switch goes on when all gear are down and locked.

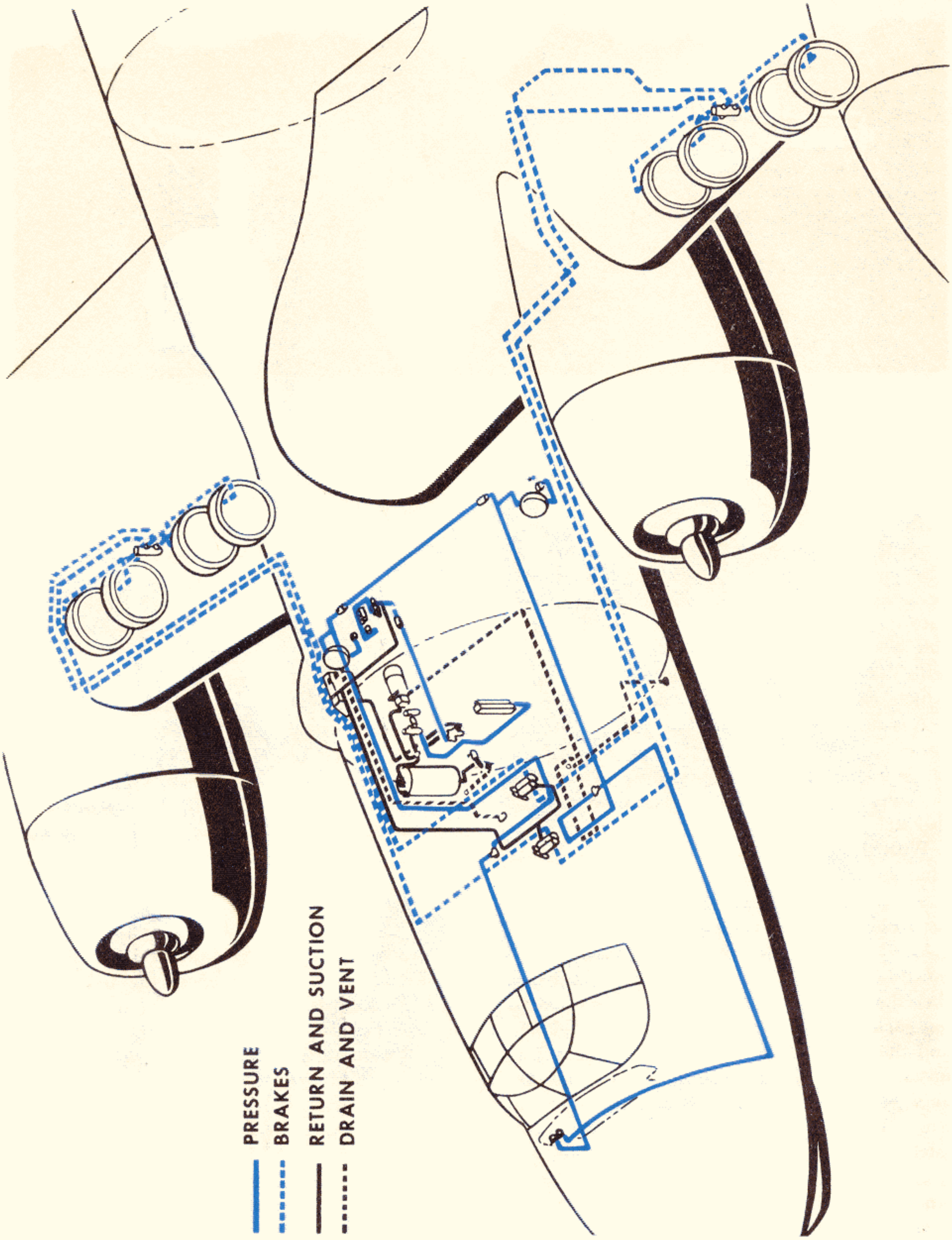
With the switch in the GEAR UP position, fluid flows from the main selector valve to the nose gear actuating cylinder through a restrictor which prevents too rapid retraction of the gear. The actuating cylinder unlatches the down-latch and retracts the nose gear. Fluid then flows to the main gear down-lock unlatching jacks, disengaging the shock strut latch, and then to the main actuating cylinder. The initial travel of the main actuating cylinder disengages the drag link latch and the gear retracts. When the gear is up, spring-loaded hook latches engage a roller on each gear to lock the gear. Up-lock limit switches stop the action when all gear is fully retracted and locked.

With the switch in the GEAR DOWN position the action is repeated through the down lines with the fluid first actuating the double unlatching jack and sequence valve to disengage the up-latch on the main and nose gear. Fluid then goes to the actuating cylinders and the gear extends. Fluid enters the actuating cylinders through shuttle valves which block off the main system when the emergency system is in operation.

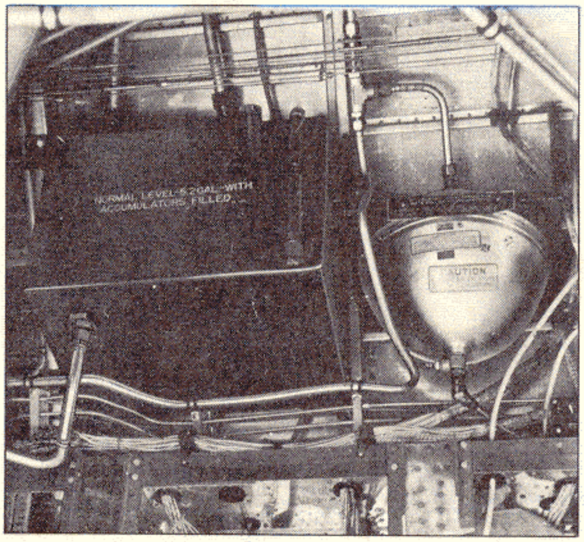
If the electrical system fails, you can operate landing gear by the procedure outlined under paragraph 4 of this section. In case of complete failure of the open center system, you can **lower** the gear by use of the emergency system described under the heading **Emergency Hydraulic System** in this section. There is no way to retract the gear if the normal system fails, however.

Brake Hydraulic System

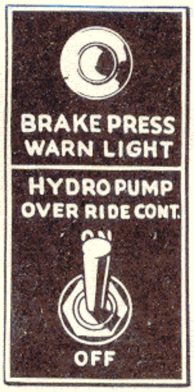
The brake hydraulic system operates the brakes on the main gear wheels and under certain conditions also furnishes pressure for the fluid in the emergency system. The brake system is actually two separate accumulator systems, so that failure of one system does not mean total brake failure. The accumulators are located on the right and left sides of the forward bomb bay. The left accumulator supplies fluid to the forward brake valve (underside of flight deck floor) which controls the inboard brakes of the main landing gear wheels. The


PRESSURE
BRAKES
RETURN AND SUCTION
DRAIN AND VENT

right accumulator supplies pressure to the aft valve, controlling the outboard brakes. Each wheel contains two expander tube assemblies operated by control units in these brake valves. The valves are interconnected by cables to the pedals so that either airplane commander's or copilot's right pedal operates all brake assemblies for the right landing gear. Two pressure gages on the right side of the instrument panel indicate available accumulator pressure for brake operation. The inboard brake pressure gage indicates fluid pressure in the left accumulator and the outboard pressure gage indicates pressure in the right accumulator. Hydraulic fuses in the accumulator pressure gage lines prevent total loss of pressure in the case of line failure between fuses and gages.

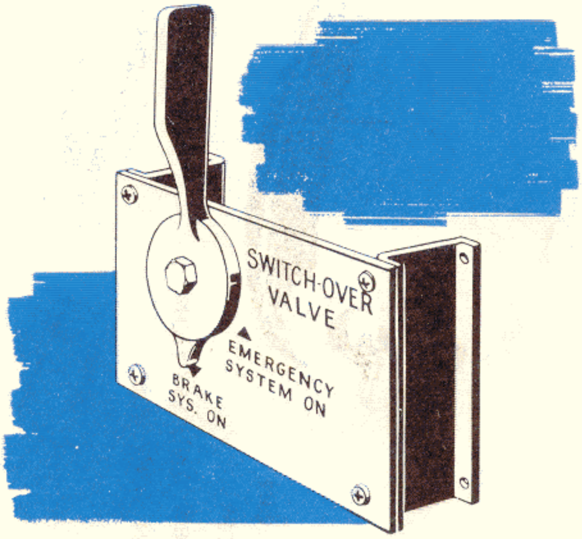


Fluid for the accumulators comes from the brake reservoir, capacity 5.2 gallons, located on the upper right hand side of the forward bomb bay. The electric pump which supplies brake fluid pressure is mounted on the right side of the forward bomb bay. A pressure switch controls the operation of the pump, kicking it in at 850 plus 50 minus 0 psi and kicking it out at 1030 plus 50 minus 0 psi. A warning light on the right side of the instrument panel lights when the pressure in the accumulator system drops to between 600 and 625 psi. The light goes out at 750 psi. When the pressure falls too low you can turn on an over-ride switch adjacent to the warning light which operates the motor continuously, over-riding all electric pump switches except the circuit breaker and the main hydraulic switch at station 4.0.



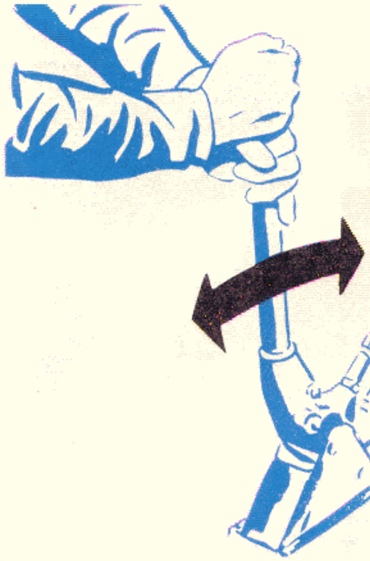
Caution: The brake over-ride switch is a momentary contact switch. Hold it ON only until pressure rises to the normal operating range; then turn it OFF.

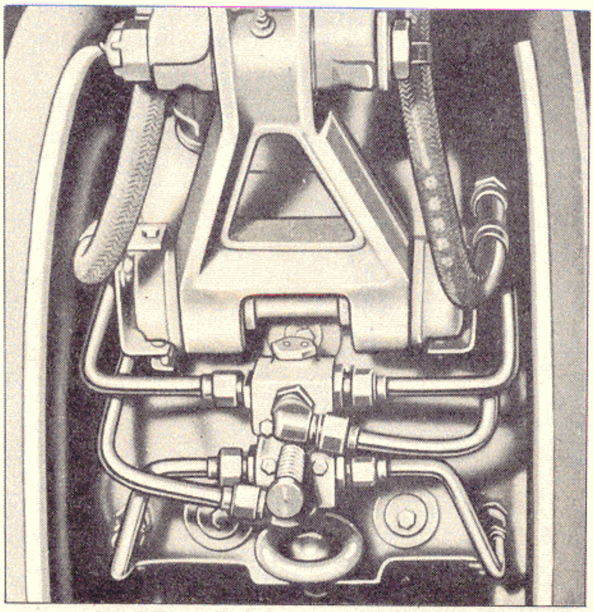
After flight, turn off the electrically-operated pump with the switch mounted on the aft wall of the flight compartment.



A switchover valve on the aft side of the forward bomb bay bulkhead functions normally to direct suction fluid from the brake reservoir to the electric-driven pump and to direct pressure fluid from the pump to the accumulators. The control handle for the valve is located on the aft wall of the flight compartment. The normal position of the valve control is BRAKE SYSTEM ON; the other position is EMERGENCY SYSTEM ON.

In normal operation, fluid from the brake reservoir passes through the switchover valve (in BRAKE SYSTEM ON position) to the electric hydraulic pump, through a purolator, a check valve, and past the emergency relief valve (1500 psi setting). Fluid pressure then comes back through the switchover valve, through another check valve, past the brake system relief valve (1250 psi setting) to a T. One line of the T leads through a surge check valve to the left accumulator and the other past the pressure switch through a regular check valve to the right accumulator. Fluid from the accumulators goes past the brake pressure gage lines to the brake control valves.



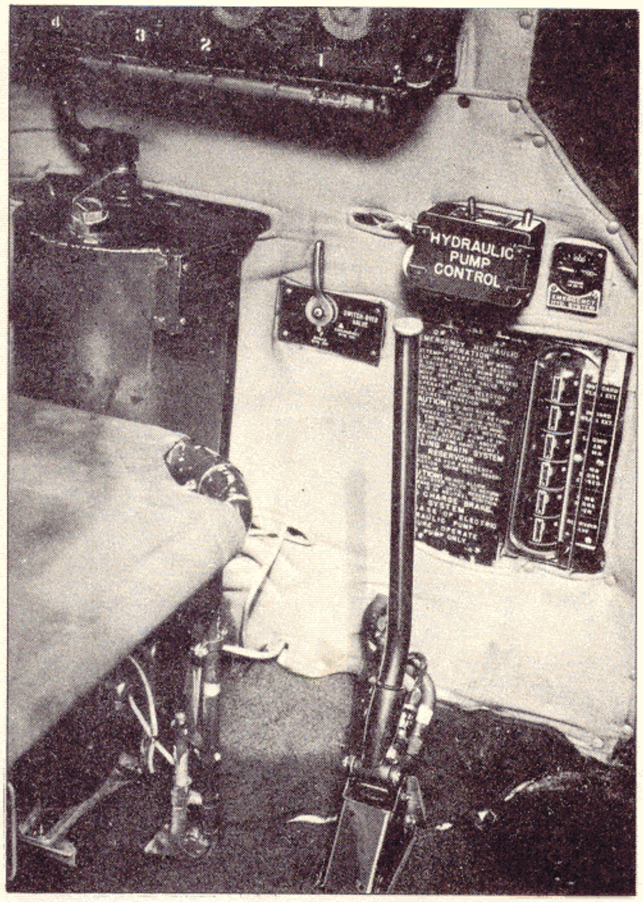


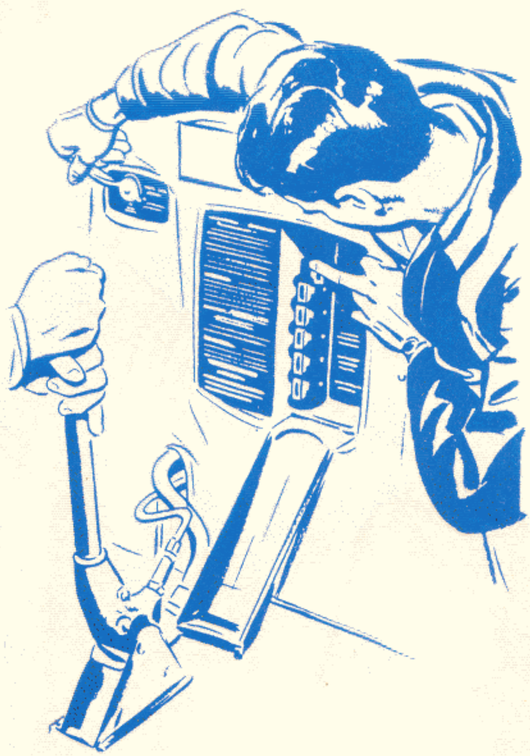
You can bleed the brakes in much the same manner as you do on the B-24, by bleeder valves on the landing gear, except that you depress a plunger on the B-32 bleeder valves instead of backing out a screw as on the B-24.

You cannot charge the accumulators from the engine-driven pumps. You can, however, charge them by the hand pump located at the aft right corner of the flight deck in case of hydraulic pump failure. To charge the accumulators by the hand pump, just work the pump, leaving the switchover valve where it normally is: BRAKE SYSTEM ON position. You can't get normal brake operation with the hand pump, but a good stiff workout on the pump gives you several applications of the brakes. Try it when you have an opportunity so that you know what to expect. Don't attempt to taxi when the hand pump is your only source of accumulator pressure. Stop and get towed in.

Emergency Hydraulic System

In case of main hydraulic system failure, the emergency hydraulic system furnishes pressure for lowering the gear (except tailskid), opening and closing the bomb bay doors, extending the inboard and outboard flaps, and filling the main reservoir from the emergency reservoir. The emergency system has a separate tank, capacity 5.8 gallons, located at the aft right corner of the flight deck. Pressure is supplied by the brake electric pump through the switchover valve. The switchover valve control is spring loaded and must be held over to EMERGENCY SYSTEM ON position. In this position a microswitch energizes the electric pump and keeps it running continuously until the switchover valve is released. Pressure fluid flows to the pump, then through a filter, check valve, and past the pressure relief valve to the emergency selector





valve manifold, with a connection to the pressure gage mounted on the wall close to the switchover valve. The emergency selector valve has separate lines to each unit which by-pass the main system through shuttle valves and double unlatching and sequence valves.

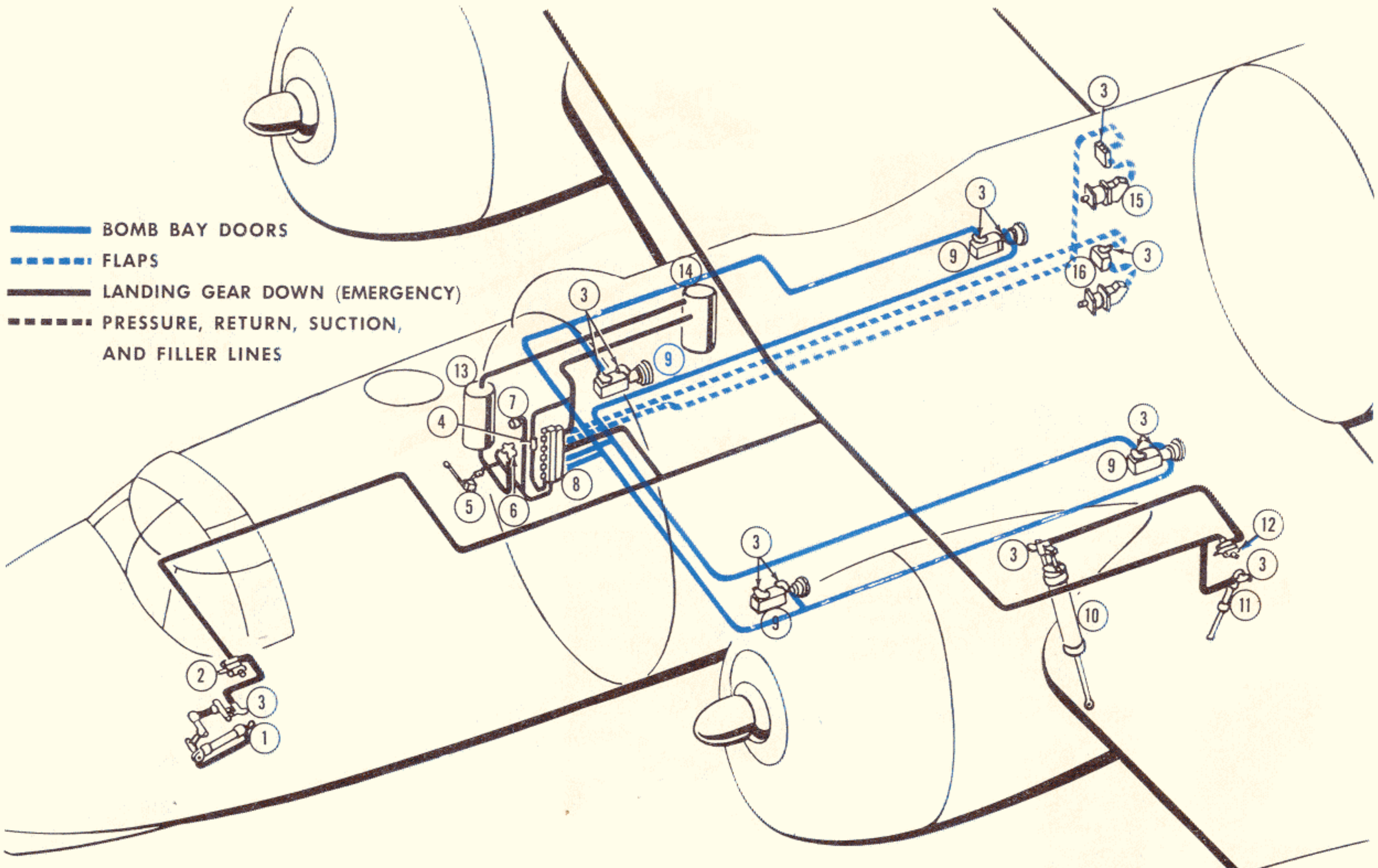
To operate the emergency system:

1. Hold switchover valve over to EMERGENCY SYSTEM ON position.
2. Immediately set emergency selector valve control ON for unit desired.
3. When operation of unit is complete, return selector valve control to NEUTRAL.
4. Return switchover valve to BRAKE SYSTEM ON.

Although main reservoir filling is part of the emergency hydraulic system, it is the normal procedure for filling the main reservoir. When the main reservoir is full, it overflows into the emergency tank. When you hear this overflow, return valves to NEUTRAL and BRAKE SYSTEN ON. In the air when you can't hear overflow, watch sight gages.

Precautions:

1. When you move switchover valve to EMERGENCY SYSTEM ON position, set de-



EMERGENCY SYSTEM

1. Nose Gear Cylinder
2. Nose Gear Unlatching Jack
3. Shuttle Valves
4. Check Valves
5. Hand Pump
6. Switchover Valve
7. Emergency System Gage
8. Emergency Selector Valve
9. Bomb Door Hydraulic Motor
10. Main Gear Cylinder
11. Main Gear Auxiliary Cylinder
12. Main Gear Unlatching Jack
13. Emergency Reservoir
14. Main Reservoir
15. Flap Hydraulic Motor
16. Flap Lock Valve

sired emergency selector valve control at once to avoid building up excessive pressure.

2. Always return selector valves to NEUTRAL and switchover valve to BRAKE SYSTEM ON immediately after the operation of the unit is complete to avoid overload of the electric pump.

3. Don't let switchover valve return to BRAKE SYSTEM ON until selector valve is back to NEUTRAL.

4. Emergency system operation of flaps involves using two separate emergency selector valve controls, one for inboard and one for outboard flaps. Fluid in this system does not flow through the proportional flow dividers which synchronize inboard and outboard flap travel. Therefore, you must check the flap indicators throughout the operation, turning one emergency selector valve to NEUTRAL momentarily if one set of flaps gets ahead of the other.

5. In the event of a leak, be careful not to pump emergency tank fluid through the leak from the main tank by use of the reservoir filling procedure.

6. Although you can operate all units of the selector valve at once, it is not practical to do so. Don't depend on it.

Note: If the electric hydraulic pump fails, you can operate the emergency system by setting the valves as described and using the hand pump. This is difficult and you may not get required pressure. At best it is a two-man job because both holding the switchover valve and working the hand pump are tough operations.

Turret Hydraulic System

The turret hydraulic system serves to extend and retract the belly turret. It is a completely separate system consisting of a reservoir with a capacity of .215 gallons, a shut-off valve, hand pump, and an actuating cylinder.

To extend turret:

1. Close shut-off valve.
2. Work hand pump until weight of turret is lifted from mechanical uplatch.
3. Release latch.
4. Open shut-off valve. The degree of opening of shut-off valve governs speed of extension.

To retract turret:

1. Close shut-off valve.
2. Operate hand pump until turret is latched up.

Emergency Operations

The following are examples of possible hydraulic emergencies not covered in preceding paragraphs, with procedures for handling them.

Limit switch failure:

1. Watch main system pressure gage.
2. If pressure continues to register after unit operation is complete, limit switch has not released main selector valve. In that case return control toggle switch to NEUTRAL.
3. If pressure gage registers 0 before units have fully operated, limit switches have released selector valve prematurely. In this case over-ride limit switches by manual operation of main selector valves.

Units do not operate or operate only slightly:

1. Check gage. If pressure is 1500 psi (relief valve setting), suspect air in lines. If practicable, operate units through both directions of travel until they work properly.
2. If down landing gear does not unlock at all, it may be because the latch is not properly adjusted. Further attempts to raise it may break latch. Leave gear down and come back if possible.

Failure of hydraulic pumps:

1. If one engine-driven pump fails the other operates units, but more slowly.
2. If both engine-driven pumps fail, use emergency system.
3. If electric pump fails, charge accumulators with hand pump.
4. If both engine-driven and electric pumps fail, operate units by emergency system operation and hand pump.

Electric pump kicks in and out:

1. Probable cause: internal leak in pressure switch.
2. Turn off electric pump at main switch on bulkhead.
3. Turn on switch only when accumulators are to be charged.
4. Leave switch on during landing and taxiing.

Failure of landing gear down latch mechanism:

1. Before landing, depress and lock pressure control plunger on main selector valve.

2. Hold in landing gear down-button on main selector valve during landing.

Tailskid fails to extend:

The emergency system does not extend the tailskid along with the gear. Following is procedure for manual extension when tailskid fails to come down with gear:

1. Disconnect aft tube from hydraulic lock valve.

2. Remove plug from hydraulic lock valve.

3. Insert lower turret hydraulic jack handle through this port and push jack piston rod to rear to extend skid.

4. Connect tube on lock valve.

Failure of main and emergency reservoirs or lines:

If all fluid is lost from the main and emergency reservoirs, in extreme emergency you can lower gear and flaps by the brake reservoir fluid and electric pump:

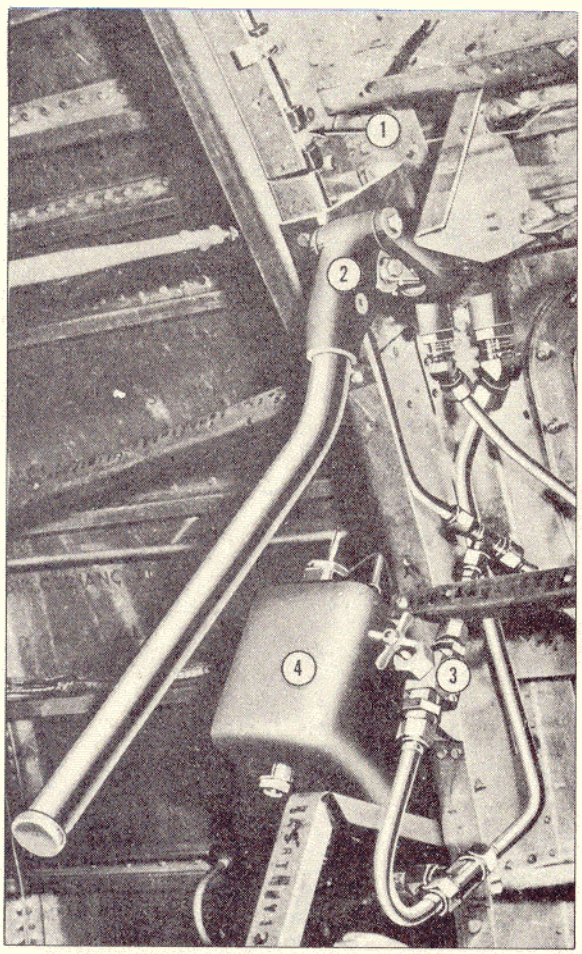
1. Make sure accumulators are fully charged.

2. Turn on emergency selector valve control of gear or flaps.

3. Leave switchover valve in BRAKE SYSTEM ON position.

4. Hold on copilot's over-ride switch of the electric hydraulic pump. This procedure takes brake reservoir fluid from the pump and diverts it into the emergency system.

5. After operation is complete, set gear or flap emergency selector valve to NEUTRAL and turn copilot's over-ride switch off.



TURRET SYSTEM INSTALLATION

1. Restrictor
2. Hand Pump
3. Shut-off Valve
4. Reservoir

Electrical System

The electrical system of the B-32 is a 24-volt, direct current system which uses a grounded negative return through the metallic structure of the airplane. The fuselage electrical power network is a continuous circuit which forms a complete circle around the fuselage. The network comprises three conductors in parallel, interconnected by three conductors just aft of the flight compartment. The interconnection makes two 3-conductor loops, one supplying power to the forward section, and the other supplying power to the aft section. The conductors are spaced at least 3 inches apart to reduce vulnerability to battle damage. Each conductor is capable of supplying power in an emergency.

Note: The switches and wiring for the control and indicating circuits of this airplane are so arranged by isolation that damage to the right side of the fuselage can only affect outboard engines, and damage to the left side of fuselage can only affect inboard engines.

Current limiters are used throughout the system to prevent the spread of faults and limit their duration. The limiters are arranged so that the one closest to the fault blows, isolating that part of the circuit. Sixty spare limiter links are contained in each of two bags, one hung on the right wall of the flight deck and the other on the forward wall of the aft compartment. At least one limiter link of each rating is provided in each bag. When you replace a link, be sure you use a link of exactly the same current rating as the one replaced.

Generators

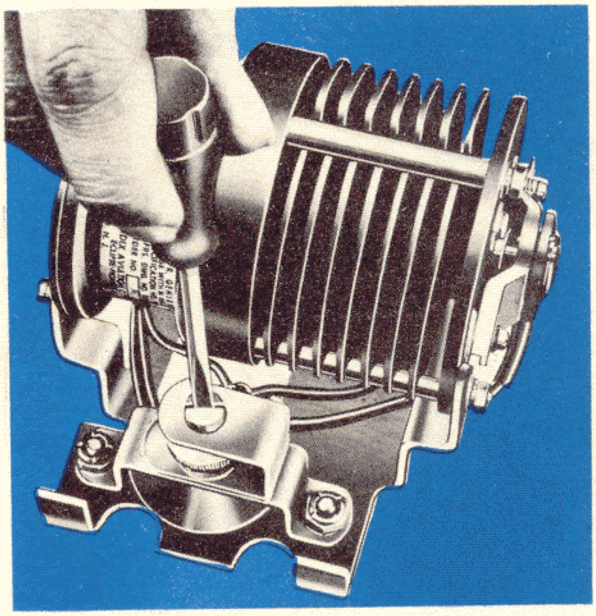
Engines 2 and 3 each operate one 300-ampere, 24-volt DC generator and engines 1 and 4 each operate two 200-ampere, 24-volt DC generators. Training airplanes have only one generator on each outboard engine. Two power cables in parallel connect the generators to each nacelle junction box. Three parallel power cables carry the current from the junction box to the fuselage power network. Each cable can supply necessary power to the system in case of emergency. A 200-ampere, DC generator is mounted with and operated by the APP.

Each 200-ampere generator on engines 1 and 4 contains a 2-speed gear box which comes into operation when engine speed drops to 1475 rpm and disengages at 1625 rpm. The generators deliver rated output at engine speed as low as 800 rpm. All generators are cooled by forced air from the intercooler inlet ducts.

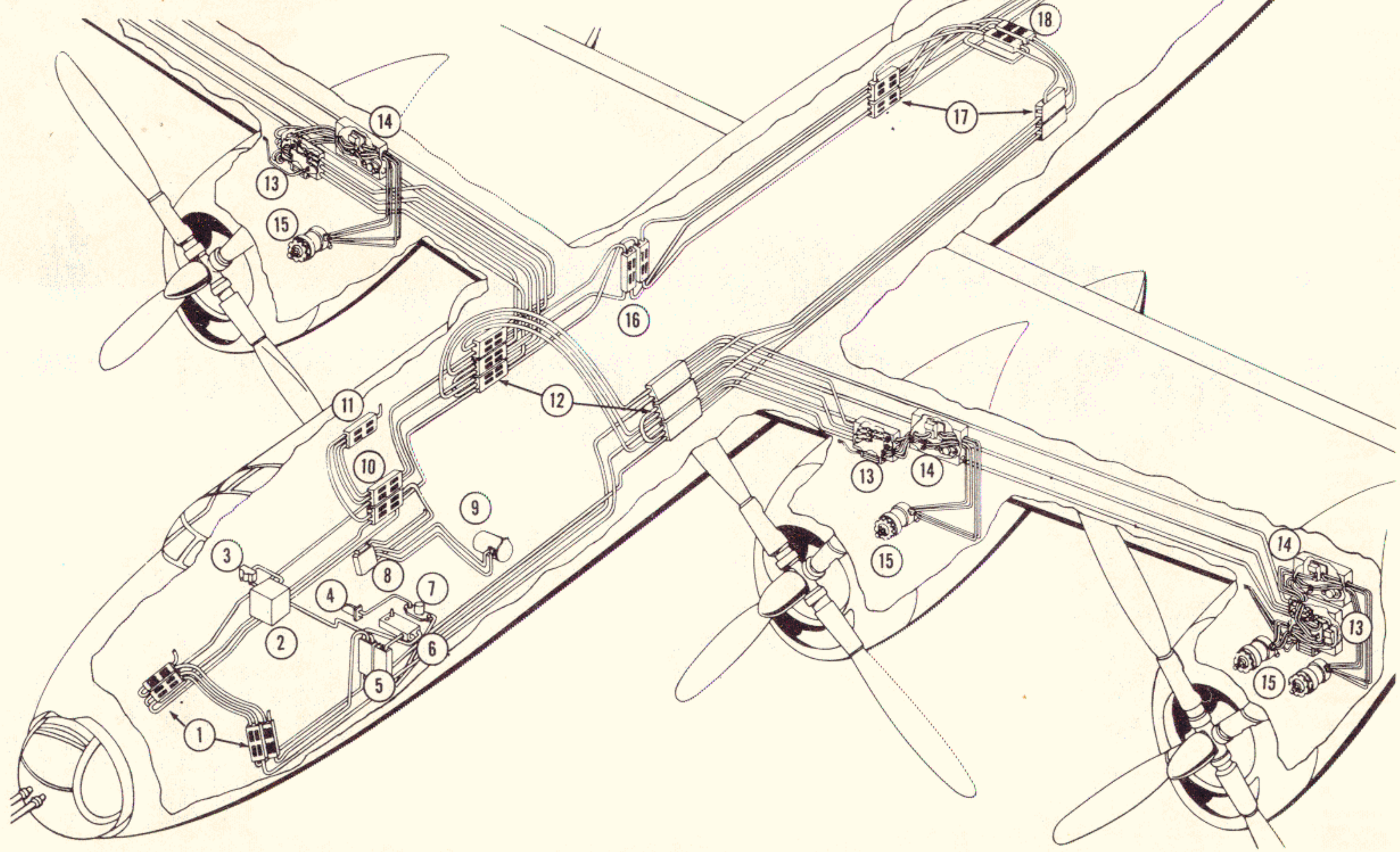
The generator panel includes an AC voltmeter for checking inverter voltage. You can check APP voltage on the DC voltmeter by turning the generator selector control to APP.

Voltage Regulators

Six voltage regulators (four on training airplanes) for the engine generators, are located on the aft right wall of the flight compartment, under the generator panel. The APP voltage regulator is near the APP under the flight deck. They are standard regulators, and must be adjusted in flight periodically. Check with your engineer to be sure he understands the paralleling procedure.



1. Limiter Blocks, Sta. 2.0
2. Battery
3. Battery Relay
4. Outside Power Receptacle
5. Limiter Blocks, Sta. 3.0 L.H.
6. Inverter Automatic Changeover Relay
7. Outside Power Receptacle Relay
8. APP Junction Box
9. APP Generator
10. Limiter Blocks, Sta. 4.0 R.H.
11. Limiter Blocks, Sta. 3.3 Top
12. Limiter Blocks, Sta. 4.3
13. Spar Junction Box
14. Nacelle Junction Box
15. Generators
16. Limiter Blocks, Sta. 5.0
17. Limiter Blocks, Sta. 6.1
18. Limiter Blocks, Sta. 6.3 Top
19. Limiter Blocks, Sta. 10.3 R.H.



Reverse Current Relays

Reverse current relays are located in each nacelle junction box, and another one is mounted alongside the APP unit under the flight deck. The reverse current relays connect the generators to the electrical system when the generator voltage is high enough. The relays close only when the generator switches on the generator panel are closed. They open automatically if the generator voltage becomes lower than the rest of the system causing a reverse current to flow, as happens when the engines are idling or stopped.

Battery

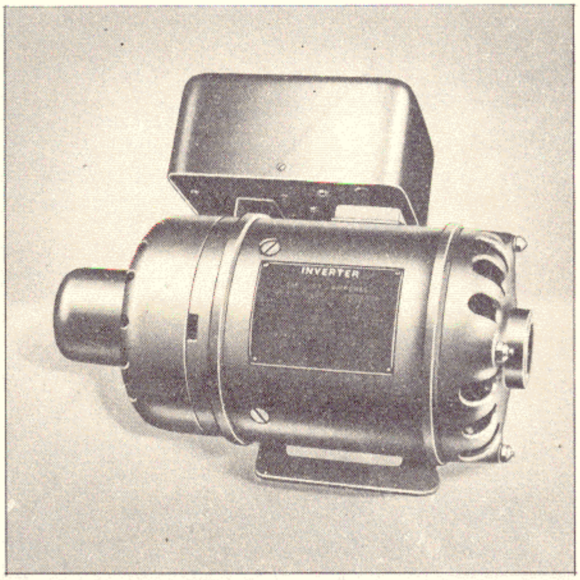
The airplane has only one 24-volt, 17-ampere hour battery, connected to the power network through a solenoid. The master ignition switch does not operate the battery solenoid. Battery switch is on the copilot's auxiliary panel. This single battery capacity is so small that it is easy to discharge it completely by even short operation of any electrical equipment. Therefore it is necessary to have the APP running or to connect to an outside power source for ground operation of any electrical equipment. **The sole purpose of the battery in the B-32 is to start the APP.**

The outside power receptacle is located in the forward accessory compartment aft of the nosewheel well. It connects to the power network through a solenoid.

Inverters

Two 750-volt-ampere, 400-cycle inverters suspended below the flight deck floor just aft of the nosewheel well furnish alternating current power. They are referred to as the main and spare inverters. They have two voltages, 26 volts for the flux gate compass, and 115 volts for the TBS regulator, radio altimeter, radio compass, fluorescent lighting on the main instrument panel, and the drift meter.

A toggle switch on the copilot's auxiliary panel controls the inverters. The down position is for starting and stopping the main inverter and the up position for testing the spare inverter. A toggle switch on the generator panel



permits checking both AC voltages on the single voltmeter mounted adjacent to the switch.

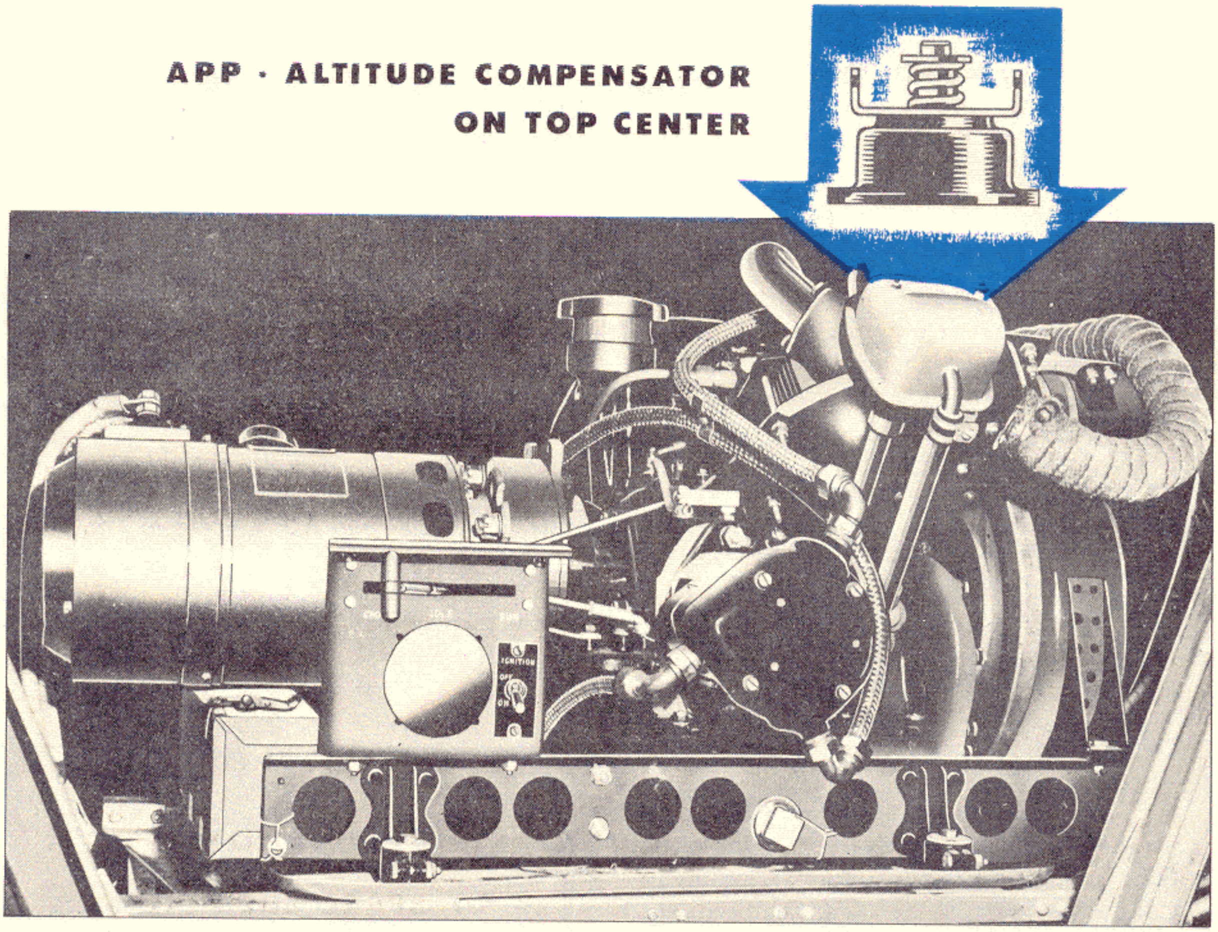
The inverter system has an automatic changeover relay to change over to the spare inverter in case of failure of the main inverter. You can over-ride the changeover relay by leaving the inverter switch in SPARE TEST position. A red light on the copilot's auxiliary panel, adjacent to the inverter switch, lights up when the main inverter fails. Another red light on the main instrument panel adjacent to the manifold pressure gages lights when both inverters fail.

Auxiliary Power Plant

The APP is a 2-cylinder, 4-cycle gasoline engine which drives a 200-ampere generator. The unit is mounted under the flight deck just forward of the bomb bay. The APP gets fuel from the inboard fuel cells of No. 3 tank through a solenoid-operated valve. The fuel valve goes on with the APP switch, current from the APP holding it on even when the generator switch is off.

The engine delivers about 10 hp at sea level. Above 8000 feet its output drops off rapidly, since it is not a supercharged engine. It has an altitude compensator adjustable for sea level, 5000 feet, and 10,000 feet operation. Set the pointer on the compensator to point exactly to the altitude closest to that at which you are

APP · ALTITUDE COMPENSATOR ON TOP CENTER



flying. The pointer must be exactly opposite one of the altitude settings or it won't work.

The APP is started from the battery, either electrically or manually. You normally connect it with the main DC power system and operate it in parallel with the generators by moving the APP equalizer switch on the copilot's auxiliary panel to ON.

Note: Recommended procedure for the B-32 is to use an external power source for ground checks and starting, saving the APP for taxiing, takeoff, landing, and emergency power. When you don't have external power, however, run the APP during all ground operation of airplane and its equipment. Start it at least 10 minutes before takeoff or landing so that it has time to warm up before picking up the load required. **The APP must always be running during taxiing to provide sufficient power for the electric motor which charges brake accumulators.**

Normal starting of the APP is covered under **Before Starting Engines, Amplified Checklist.** The following is the procedure for manual starting:

1. Turn battery switch on.
2. Turn on APP ignition switches, at the APP and on the copilot's auxiliary panel.
3. Turn equalizer switch off.
4. Set APP throttle lever to IDLE position.
5. Wind the starting rope around the pulley, and yank to spin the engine. As you pull the rope, have the APP generator switch held over to START position.
6. Repeat until engine starts. In low temperatures you have to choke it by use of the throttle lever.
7. Idle the engine for approximately 5 min-

utes, or until the oil temperature is at least 21°C.

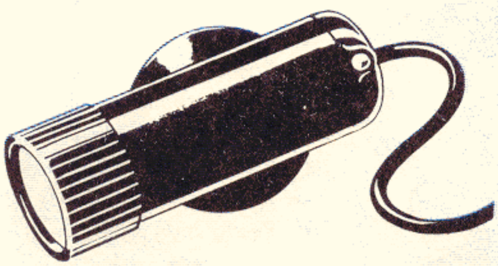
8. Put throttle lever in RUN position and operate the engine two or three minutes before applying any electrical load.

9. Place APP generator switch to LOAD position.

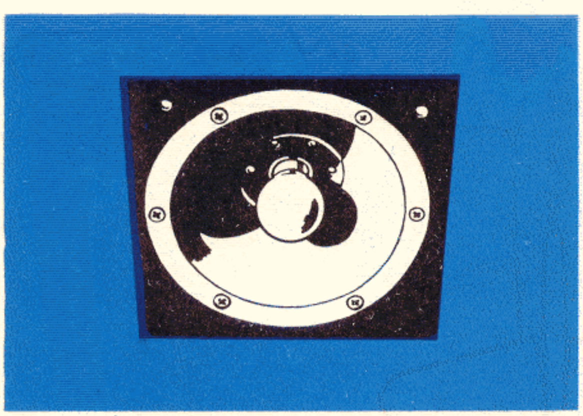
10. Place equalizer switch at ON position.

Interior Lighting

1. **Bomb bay lighting.** Bomb bays have ten dome lights with switches located at the radio operator's equipment panel or at the rear compartment switch and circuit breaker panel.



2. **Extension lights.** Each of the following stations is provided with an extension light: airplane commander's, copilot's, bombardier's, navigator's, radio operator's, and forward cabin settee. Each light has a circuit breaker mounted adjacent to it. Switches are on the lights.



3. **Compartment dome lights.** Flight compartment, accessory compartment under the flight deck, and the rear compartment have one dome light each. The two switches for the flight compartment light are in the nosewheel well and adjacent to the light. The two accessory compartment switches are in the nosewheel well and at station 4.0 switch panel, just forward of the bomb bay. The two rear compartment switches are at the entrance to the compartment and at the rear compartment panel.

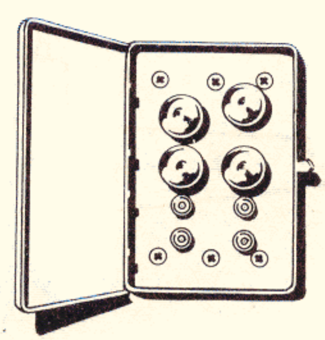
4. **Navigator's table light.** The navigator's station has a table light with a variable rheostat for dimming the light.

5. **Fluorescent lights.** Airplane commander's, copilot's, and bombardier's station have DC fluorescent lights. The bombardier's light is equipped with a head band. The main instrument panel has two AC fluorescent lights, one at each end of the panel.

6. **Compass light.** A light is mounted on the magnetic compass, with a rheostat for dimming. The rheostat control is directly below the compass.

LOCATION

OF SPARE BULB BOXES

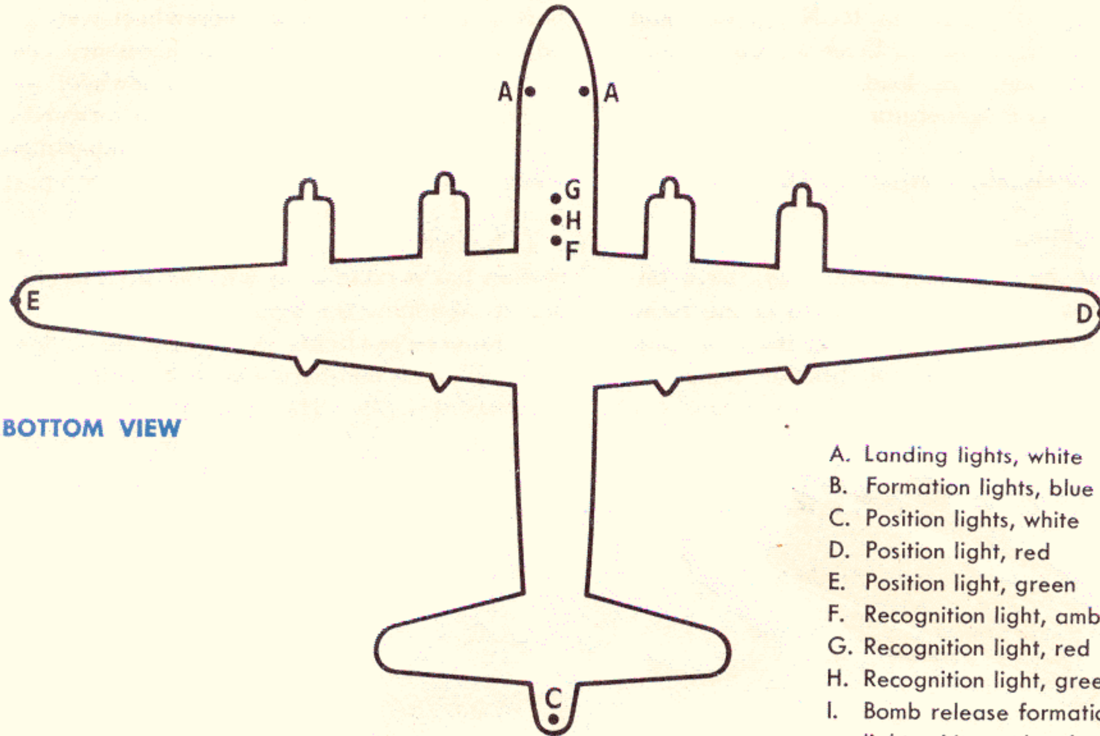


FLIGHT DECK, RIGHT SIDE, STATION 3.0.

•

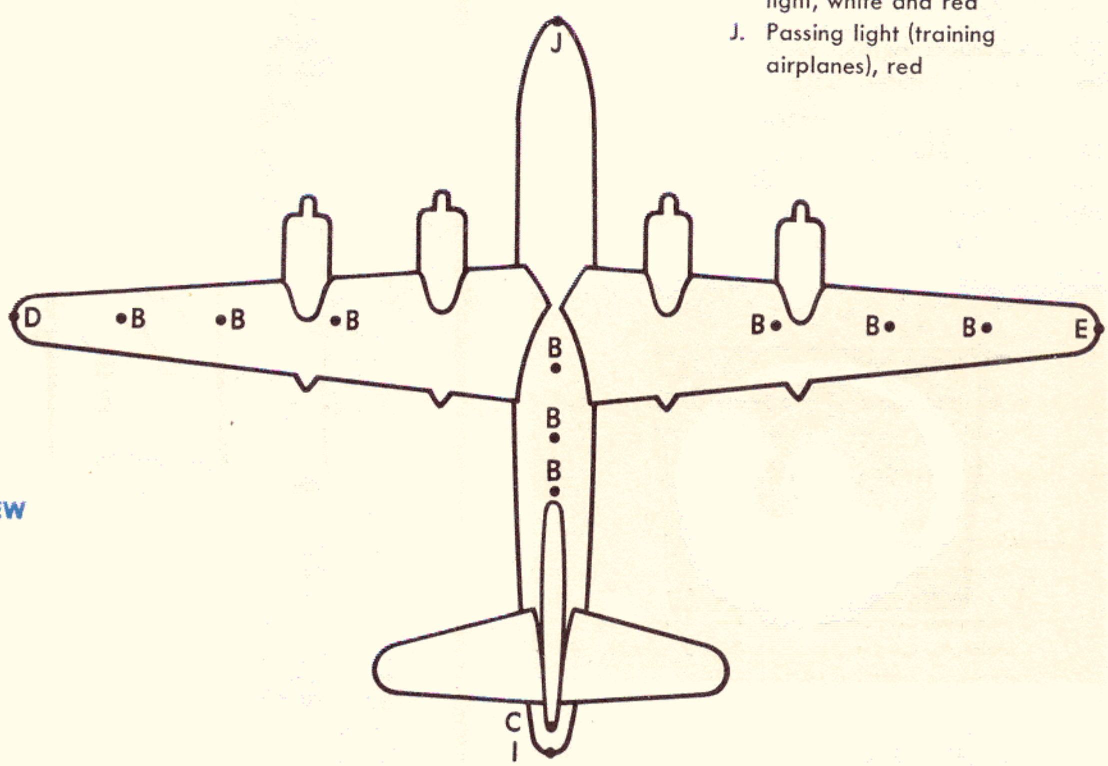
FORWARD WALL, REAR COMPARTMENT, RIGHT SIDE.

Exterior Lighting



BOTTOM VIEW

- A. Landing lights, white
- B. Formation lights, blue
- C. Position lights, white
- D. Position light, red
- E. Position light, green
- F. Recognition light, amber
- G. Recognition light, red
- H. Recognition light, green
- I. Bomb release formation signal light, white and red
- J. Passing light (training airplanes), red



TOP VIEW

The landing lights are fully retractable, controlled by a 3-position switch for each light mounted on the copilot's control pedestal. The switch positions are EXTEND, OFF, RETRACT. The lights go on automatically as they extend. You can turn them off when extended by putting the switch in OFF position.

You control the formation lights and the position lights from 3-position switches on the airplane commander's auxiliary panel. The switch positions are BRIGHT, OFF and DIM.

The control box for the recognition lights is on the airplane commander's equipment panel next to his circuit breaker panel. A keying switch for signalling is provided, and each light has a 3-position switch: STEADY, OFF, and KEY.

The bomb release light warns your formation of bomb release. It is controlled from a switch on the bombardier's panel. The white light goes on when bomb doors are fully open. Then the red light comes on during bomb release period, going out after the last bomb drops.

Circuit Breakers

Most of the electrical circuits on the airplane incorporate circuit breakers which kick out in case of overload. The accompanying diagram shows the location of the circuit breaker panels, and the legend gives the units on each panel.

CIRCUIT BREAKER LOCATIONS

1. Airplane commander's circuit breaker panel
- Aileron tab control
- Aileron tab position indicator
- Flap warning horn
- Flap position indicator
- Flap control
- Landing gear control
- Position lights
- Formation lights
- Autopilot
- Side fluorescent lights
- Airplane commander's indicator lights
- Panel fluorescent lights
- Propeller booster, right
- Propeller booster, left

2. Airplane commander's oxygen panel
- Recognition lights
- Cockpit lights
- Flying suit heater

3. Airplane commander's instrument panel
- Windshield wiper

4. Propeller control panel
- Propeller

5. Copilot's main panel
- Oil temperature, No. 1 and No. 2
- Oil temperature, No. 3 and No. 4
- Carburetor air temperature, No. 1 and No. 2
- Carburetor air temperature, No. 3 and No. 4
- Fuel gage, right tanks
- Fuel gage, left tanks
- Fuel valve, left inboard
- Fuel valve, right inboard
- Fuel booster, left inboard
- Fuel booster, right inboard
- Propeller anti-icer, inboard
- Oil cooler, No. 2 engine
- Oil cooler, No. 3 engine
- Intercooler, No. 2 engine
- Intercooler, No. 3 engine

6. Copilot's oxygen panel
- Cockpit light
- Flying suit heater

7. Heat exchanger panel
(Panel is present but not in use: heat exchanger dump flaps are bolted in 20° open position.)

8. Copilot's auxiliary panel
- Intercooler, No. 1 engine
- Intercooler, No. 4 engine
- Oil cooler, No. 1 engine
- Oil cooler, No. 4 engine
- Cowl flaps
- Carburetor pre-heat
- Fuel booster, left outboard
- Fuel booster, right outboard
- Fuel valve, left outboard
- Fuel valve, right outboard
- Fuel valve drain
- Wing anti-icer
- Tail anti-icer
- Flight deck heat
- Propeller anti-icer, outboard
- Landing lights
- Engine starters
- Oil dilute
- Engine primer
- Inverter control
- Brake pressure warning

9. Navigator's panel
- Radio compass DC
- Remote compass DC
- Table light
- Outside air temperature
- Flying suit heater
- Cockpit light

10. Radio operator's panel
- Cockpit light
- Forward bomb bay light
- Interphone
- Flying suit heater
- Trail antenna control

11. Station 4.0 forward right side
- Hydraulic pump control

12. Station 3.1 right panel
- Interphone
- Flying suit heater
- Cockpit lights

13. Bombardier's panel, left side
- Fluorescent lights
- Nose fusing
- Bomb release
- Bomb door control
- Light testing power
- Bomb formation light
- Interphone control
- Bomb salvo
- Glide bombing attachment
- Rack selector

14. Bombardier's panel, right side
- Camera
- Cockpit lights
- Flying suit heater
- Windshield wiper

15. Station 1.1, right side
- Ammunition booster test

16. Under flight deck, station 3.0
- (First seven located on flight deck, station 3.1, on combat-equipped airplanes.)
- Radio compass, AC
- Radio altimeter
- Detonator
- Radio blind approach
- Radio identification
- Command modulator
- Command receiver
- Flight deck dome light
- Accessory compartment dome light
- Landing light, right
- Landing light, left

17. Inverter relay box
- Main inverter
- Spare inverter

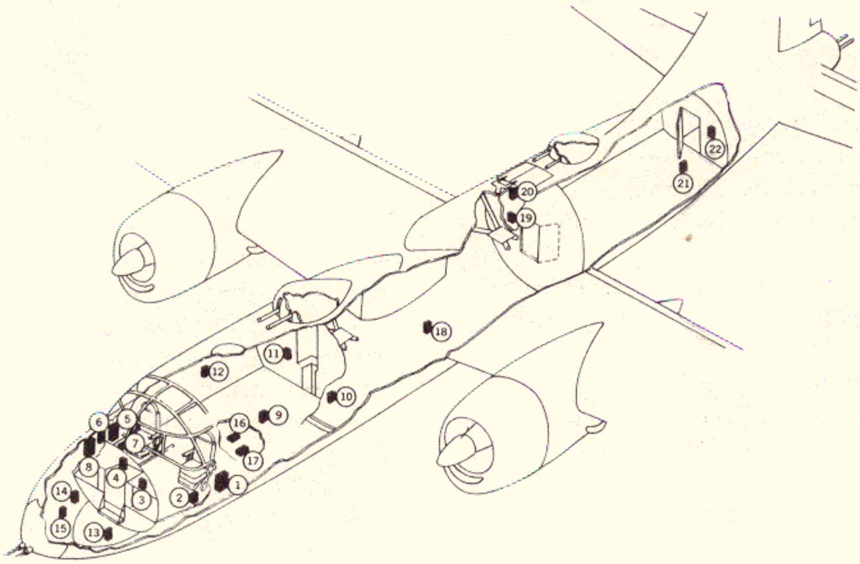
18. Bomb bay, station 5.0, right side
- Bomb salvo
- Bomb release
- Radio marker beacon

19. Rear compartment, station 6.0
- Rear compartment dome light
- Rear compartment dome light

20. Rear compartment, station 6.0
- Flying suit heater

21. Rear compartment oxygen panel
- Flying suit heater

22. Tail compartment, left side
- De-icer pumps



11

Emergency Operations

The following are examples of possible electrical system emergencies, with the procedures for handling them.

Failure of any electrically operated unit:

1. If any electrically operated unit fails, always check circuit breaker first. It is the most likely place to find trouble and the easiest to check.

No current to start APP on ground:

1. Use outside power source to start APP.
2. If battery solenoid has not closed, APP does not charge battery. This may be because of low battery voltage.
3. With outside power source disconnected and APP running, install a jumper wire between terminals of battery solenoid. This closes solenoid and allows battery to charge.

Note: If battery is completely dead, operate battery switch for a short period; then turn off, allowing battery to cool before turning on switch again. This prevents battery from boiling over because of high charging rate.

No current to units to be operated:

1. Check power supply: generator, battery, or APP on.
2. Check circuit breaker.
3. Check power current limiters.

Faulty generator—no voltage or amperage:

This situation may arise from loss of residual magnetism of generator magnets. You may be able to restore it by flashing the fields.

1. With engine speed at 1800 rpm, connect a jumper wire to battery connection, or to a hot lead.
2. Touch the other end of the wire to "A" terminal of voltage regulator socket momentarily until voltage registers on voltmeter.
3. Remove wire and replace voltage regulator.

Faulty generator—excessive voltage:

1. Possible cause: faulty or maladjusted regulator.
2. Turn generator switch OFF.

Note: Whenever it is necessary to turn a generator off, reduce rpm to 1200 or below to prevent arcing or pitting of relay points.

3. Try lowering voltage with adjustment screw.
4. If high voltage persists, remove voltage regulator from socket.

Inverter failure:

1. If inverter fails, and automatic switchover does not operate, turn inverter switch on copilot's auxiliary panel to SPARE TEST position and leave it there.

Failure of primer solenoid:

1. Prime with mixture control, being careful not to load lower cylinders and cause a liquid lock.

Failure of automatic control on intercooler and oil cooler flaps:

1. Indication of this situation is excessively high or low oil temperatures or carburetor air temperatures.
2. Remove switch from AUTOMATIC and maintain proper temperature with selective manual setting.

Vacuum System

The B-32 vacuum system operates the turn and bank indicator, the directional gyro, and the artificial horizon. Two engine-driven pumps on No. 2 and No. 3 engines provide the vacuum pressure. Suction relief valves in the lines, set to approximately 5 inches Hg., protect the system from excessive pressure. Check valves near the junction of the two lines protect the instruments from a compressed air charge in case of engine backfire. A vacuum control valve on the airplane commander's auxiliary panel reduces vacuum from 5 to 2 inches for operating the turn and bank indicator. The vacuum pressure gage is mounted on the airplane commander's panel just above the control valve. A screen type air filter in the nose behind the bombardier's panel protects the system from dust and dirt.

The system automatically comes into operation with the starting of either No. 2 or No. 3 engine. Normally both pumps supply suction pressure, but either one alone operates the system.

There is no selector valve by which you switch pumps in case of pump or engine failure because in such a situation the check valves act as automatic cross-over valves to utilize pressure from the good pump.

Note: With no vacuum selector valve on the airplane it is necessary to check individual vacuum pump operation by watching the gage when you start No. 3 engine as a check on that pump. Then after flight, leave No. 2 engine running and shut down No. 3, watching the gage as a check on No. 2 pump.

Emergency Vacuum System Operation

Failure of one pump or engine:

1. System continues to operate on other pump.

2. As a precaution set up autopilot so that you can use tell-tale lights as a flight indicator check, in case other pump fails.

Sluggish turn and bank indicator:

1. In emergency correct by adjusting vacuum control valve.

One flight instrument fails, but the rest operate:

1. Possible cause: dirt on filter of individual instrument.

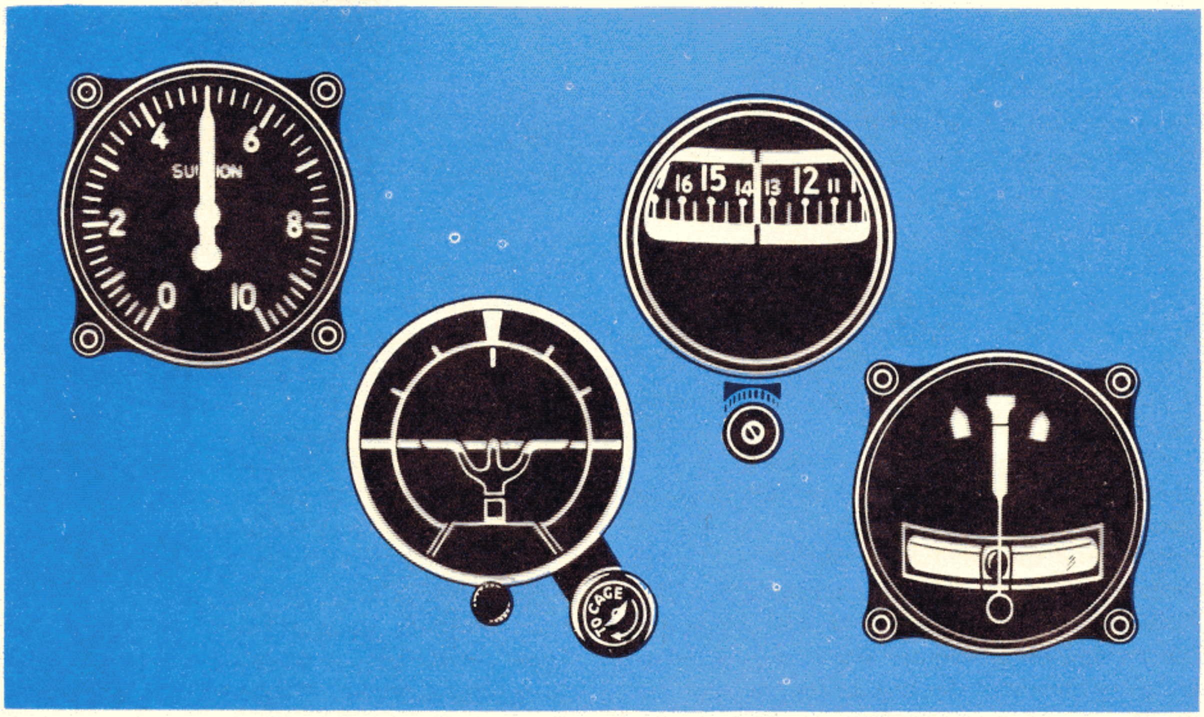
2. Remove filter; clean and replace it.

3. If you can't clean filter in flight, leave it off until you land. This is a procedure for emergencies only as it allows dirt to enter the system.

Low suction at gage:

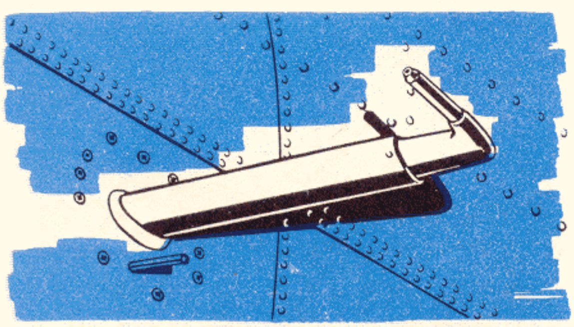
1. Possible cause: dirt on vacuum system filter.

2. Remove filter; then check gage. If vacuum pressure comes up, filter is dirty. Remove filter; clean and replace it or leave it off if necessary.

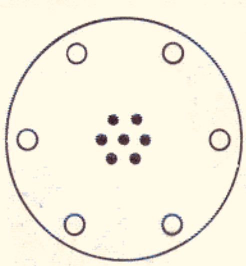


Pitot-Static System

Pitot masts on the lower side of the fuselage between stations 2.0 and 2.1 supply dynamic air pressure for copilot's, bombardier's, and navigator's airspeed indicators. Some early B-32's have only one set of flight instruments and those airplanes have only the left pitot mast installed. An electrical heat element, controlled by a switch on the copilot's auxiliary panel, prevents ice formation in the pitot tube. Drain holes conduct water away from the lines when ice melts in the tube.



Static pressure for the static side of the airspeed indicators, and for the operation of the altimeters and rate of climb indicators, comes from two sources in the airplane. There are two



selector valve switches, one on the airplane commander's auxiliary panel and one on the right side of the bombardier's station. The up position of these switches, labeled STATIC TUBE, is the normal source of static pressure. The normal source comes from two openings, one on each side of the fuselage forward of the wing, an arrangement which gives accurate

static pressure in spite of yawing action of the airplane. The down position of the switch, labeled ALTERNATE SOURCE, opens the line to a pressure source inside the cockpit in the event of failure of the normal source. An ON-OFF shut-off valve adjacent to the bombardier's static selector switch provides static pressure for the bomb glide attachment.

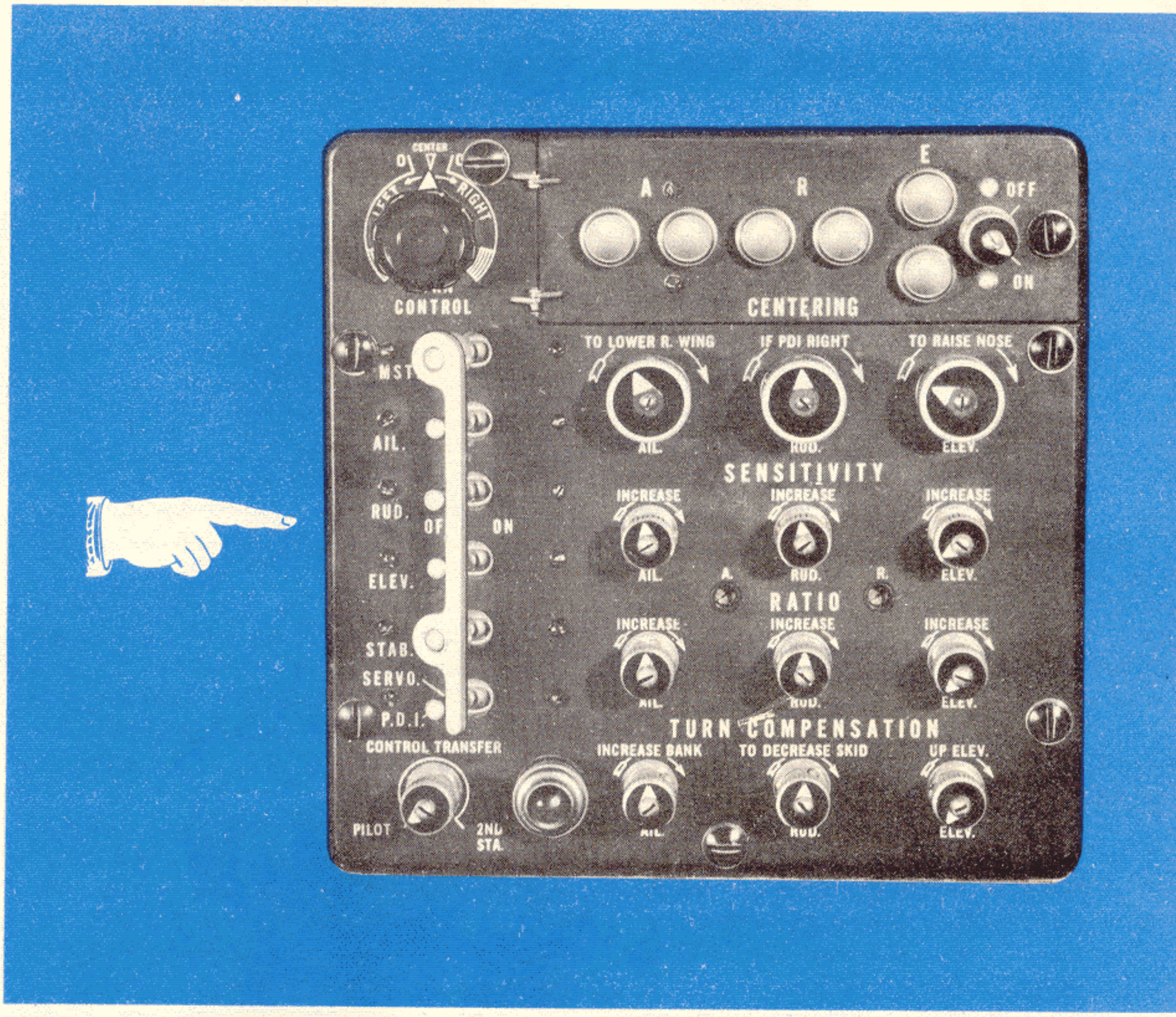
Emergency Pitot-Static System Operation

Icing conditions:

1. Turn on pitot heat and leave it on whenever icing conditions are anticipated.

Failure of normal static source:

1. Switch both selector valves to ALTERNATE SOURCE.
2. Alternate source of static pressure may affect flight instrument accuracy. Test it some time during normal flight to check instrument reaction on your airplane.



The C-1 Automatic Pilot

The C-1 autopilot in the B-32 is an electromechanical robot which automatically controls the airplane to maintain straight and level flight or turns the airplane in response to fingertip control of the human pilot, navigator, or bombardier. If you have used the C-1 autopilot in other airplanes, check to see that you are familiar with the slight modifications which have been added to the model installed in your B-32.

You must thoroughly understand the operation of the separate units of the autopilot and their relation to each other. If you don't understand the function of each unit, read it in detail in AN11-60AA-1. Check with your navigator and bombardier to be sure that they are qualified to operate the autopilot. On long flights of the kind for which the B-32 is designed and for precision bombing the autopilot is an indispensable part of your equipment. See that it is correctly checked, serviced, and maintained.

Autopilot Control Panel

The following paragraphs describe the main autopilot control panel units and explain their operation:

1. **Master switch.** The master switch consists of two toggle switches connected by a bar. In the ON position this switch starts all electric motors of the autopilot except the torque motor in the stabilizer. In the OFF position it completely disengages all autopilot switches.

2. **Servo-PDI switch.** This switch controls two circuits: it connects the PDI meter on the instrument panel to the PDI meter on the directional stabilizer, and it starts the torque motor which opposes any force tending to precess the stabilizer gyro.

3. **Aileron, rudder, and elevator switches.** These switches engage and disengage ailerons, rudder, and elevators from control by the autopilot.

4. **Tell-tale lights.** Two tell-tale lights for each control surface are located on the top of the panel. When the tell-tale lights go out, the control surfaces are in the correct attitude to produce the condition of flight for which the autopilot has been set up.

5. **Tell-tale light shutter knob.** Located to the right of the lights, this knob provides a means of turning out the tell-tale lights when flying on instruments or at night when you want to reduce cockpit light to a minimum.

6. **Centering knobs.** The centering knobs are electrical trim tabs. They serve two purposes: when you engage the autopilot you use them to coordinate the tell-tale lights with the manual trim tab setting so that all lights are out when the airplane is in the desired attitude; and when the autopilot controls the airplane, you use the knobs to compensate for small changes in flight conditions.

Note: Never trim the airplane by use of the manual trim tabs while flying on the autopilot. If you do, the result may be a violent maneuver when you turn the autopilot off.

7. **Sensitivity knobs.** These knobs regulate the amount of airplane deviation the autopilot allows before it applies correction, i.e., **speed of correction.** The action produced by the knobs is comparable to the reaction time of a human pilot. If sensitivity is too low, the autopilot allows the airplane to wander as if a sleepy pilot were at the controls. If sensitivity is too high, the controls chatter like those on an airplane flown by a pilot with the D.T.'s.

8. **Ratio knobs.** These knobs regulate the amount of control movement applied by the autopilot to correct for a given deviation, i.e., **amount of correction.** Too low ratio produces a reaction like that from a human pilot who never applies quite enough correction. Too high ratio produces a reaction like that from a human pilot who jumps on every deviation with twice the control necessary.

9. **Turn compensation knobs.** These controls are electrical trim tabs for coordinating bombardier's turns. Their adjustment has no effect on level flight. You can use the up-elevator trimmer while using the pilots' turn control knob, but the skid and bank trimmers are only effective for bombardier's turns.

Note: When the bombardier is turning the airplane, don't adjust centering knobs; they leave your airplane out of trim when you return to level flight.

10. **Turn control knob.** The turn control knob is used by the airplane commander to make coordinated turns while flying on the autopilot. The navigator's instrument panel and the stabilizer in the bombardier's compartment also have turn control knobs.

11. **Control transfer knob.** By use of this knob located in the lower left corner of the panel you transfer control of the autopilot from the airplane commander to the navigator. The knob has two settings: PILOT and 2ND STATION. Be sure transfer knob is turned fully to desired setting. Although the light goes on at the first click, control does not transfer until pointer is full on 2ND STATION setting.

12. **Control indicator light.** The light next to the transfer knob indicates who has control of the autopilot. When the light is on, control is at the navigator's station; when it is off, control is at the airplane commander's panel.

13. **Aileron turn control trimmer.** This control is an electrical bank trimmer located between the sensitivity and ratio control knobs on

the left side. You adjust it with a screwdriver to give a 30° bank when the airplane commander's or navigator's turn control knob is turned to the first stop. Check the degree of bank on the gyro horizon.

14. **Rudder turn control trimmer.** This control is an electrical skid trimmer for airplane commander's and navigator's turns. It is located between the sensitivity and ratio knobs on the right side. Adjust it with a screwdriver to eliminate slip or skid in a turn, checking the coordination of the turn on the turn indicator.

Bombardier's Controls

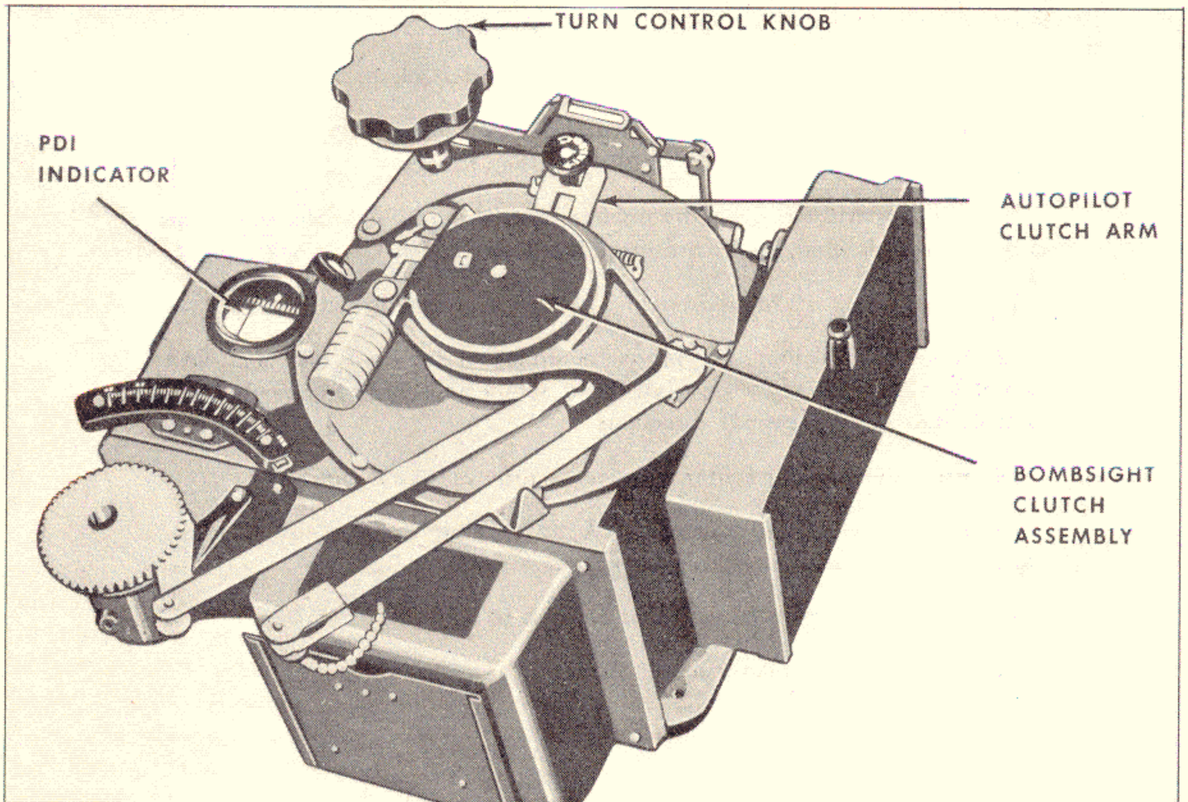
1. **Dashpot.** The dashpot, on the directional gyro housing in the bombardier's compartment, simulates the increase in rudder pressure used by a human pilot to coordinate control on entering and leaving turns. If the dashpot is set too loose, PDI wavers with irregular movements. If it is too tight, the airplane hunts in the turn axis, as indicated by a periodic oscillation of the PDI. Adjust the dashpot by turning the lock ring counter-clockwise to unlock, then turning the adjusting nut up to loosen or down to tighten, re-locking the ring afterward.

2. **Autopilot clutch.** The clutch is located on the directional gyro in the bombardier's compartment and is used to disengage the directional stabilizer. When the clutch is engaged, airplane commander, navigator, or bombardier steers the airplane. When it is disengaged, only the bombardier can steer the airplane by his turn control knob or by the bombsight.

Note: When the bombardier steers the airplane, he normally has the autopilot clutch disengaged. It is possible for him to over-ride the engaged clutch with his turn control knob, but it puts excessive wear on the clutch.

3. **Bombsight clutch.** The bombsight clutch on the directional stabilizer engages bombsight and the autopilot, permitting the bombardier to steer the airplane by turning the bombsight. When the bombsight clutch is engaged, the autopilot clutch should be disengaged.

4. **Bombardier's turn control knob.** The bombardier uses this control knob to turn the airplane when he has control.



DIRECTIONAL STABILIZER

AIRPLANE COMMANDER'S AUTOPILOT GROUND CHECKLIST

1. Center turn control.

2. Turn autopilot master switch bar to ON.

3. Set control transfer knob to PILOT.

4. Turn tell-tale light shutter switch to ON.

5. Set all adjustment knobs to up position, making sure pointers are not loose.

6. Have bombardier center PDI and engage autopilot clutch.

7. Turn servo-PDI switch to ON.

8. Operate controls through complete range several times, checking to see that tell-tale lights flicker and go out as the streamline position is reached from either direction.

9. Turn aileron, rudder, and elevator switches to ON.

10. Turn aileron centering knob clockwise, then counter-clockwise, checking to see that control wheel turns to right, then to left.

Note: If properly adjusted, the pointers of all centering knobs should be at 5 or 7 o'clock when knobs are turned to their extreme positions.

11. Repeat item 10 for rudder and elevator, observing action.

12. Have bombardier disengage autopilot clutch and turn his turn control knob for full right and left turns, while you check to see that the controls move in the proper directions.

13. Have bombardier center PDI and engage autopilot clutch.

14. Rotate main panel turn control knob for right and left turns, checking aileron and rudder controls for proper movement.

15. Repeat item 14 with turn control knob at navigator's station.

16. If all checks are satisfactory, turn master switch OFF.

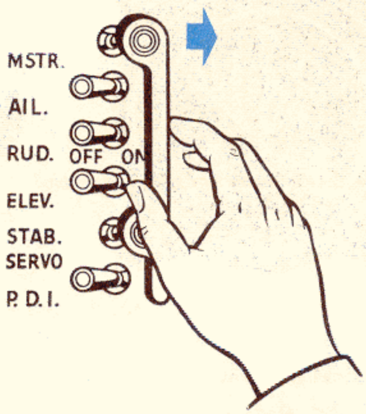
Before Takeoff

1. Set all pointers on control panel in up position.

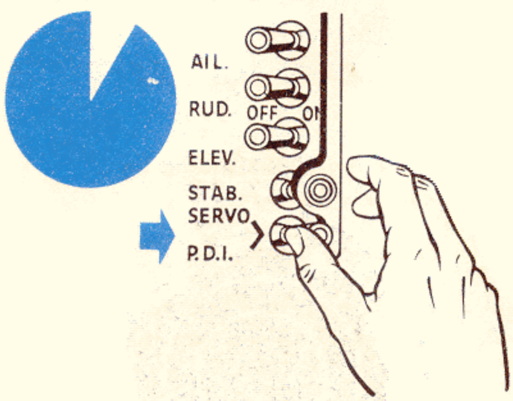
2. Make sure that all switches on control panel are in OFF position.

3. Check with bombardier for proper position of PDI needle for a left turn, right turn, and for neutral or zero position.

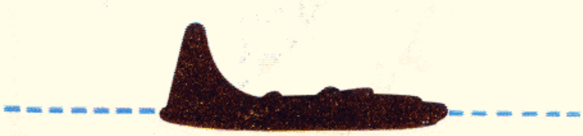
After Takeoff—Engaging Autopilot



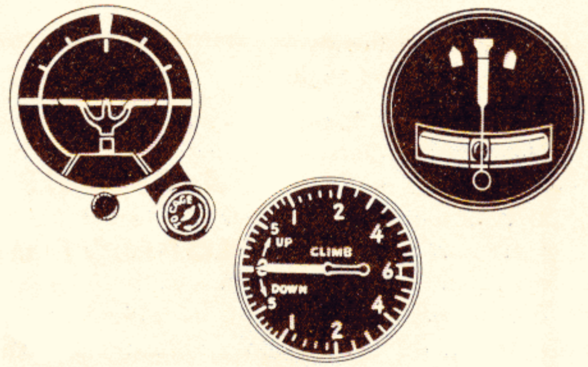
1. Turn master switch ON.



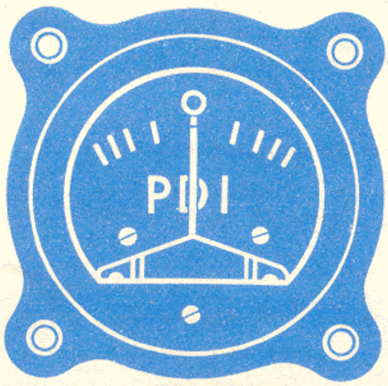
2. Five minutes later turn servo-PDI switch ON.



3. Ten minutes after turning on master switch trim airplane for straight and level flight



at cruising speed by reference to flight instruments.



4. Have the bombardier disengage autopilot clutch, center PDI, and lock it in place by depressing the directional arm lock. This procedure holds PDI centered until you have completed the following engaging procedure. Then bombardier re-engages autopilot clutch and releases directional arm lock.

Alternate method: center PDI by turning airplane in direction of PDI needle, holding a zero PDI course while engaging autopilot.

5. Engage autopilot by putting aileron telltale lights out with aileron centering knob, then throwing aileron engaging switch to ON. Repeat the operation for rudder, then for elevator.

6. Make final autopilot trim corrections, if necessary. Use centering knobs to level wings and center PDI.

Caution **NEVER ADJUST MECHANICAL TRIM TABS WHILE AUTOPILOT IS ENGAGED.**

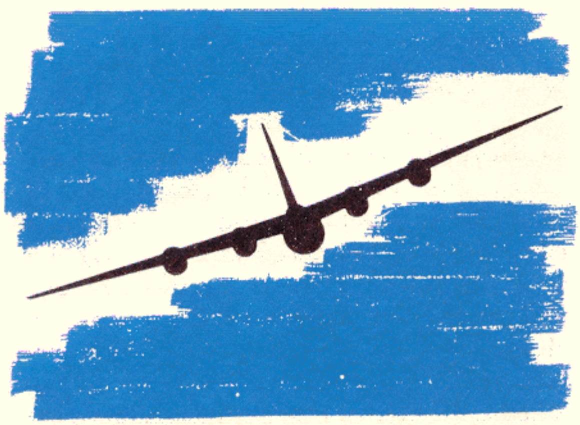
Autopilot Adjustment— Straight and Level Flight

Note: On long flights disengage autopilot periodically and retrim manually for weight changes; then re-engage.

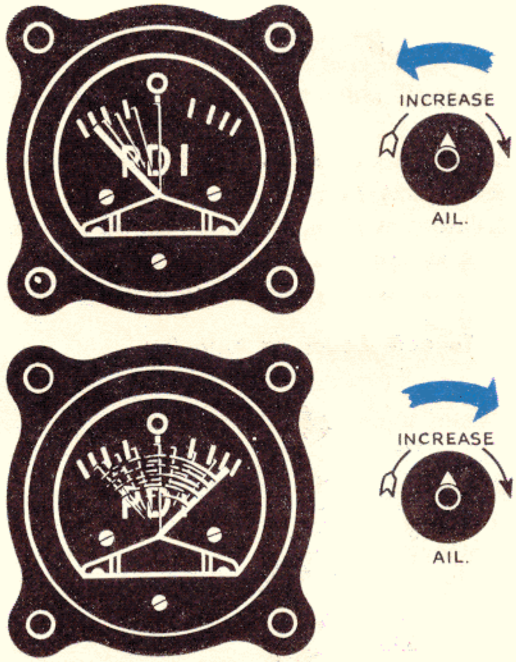
1. If autopilot is too slow to correct for a deviation in any one of the three axes of flight, make proper adjustment with sensitivity knobs.
2. If autopilot overcorrects or undercorrects for deviations, make proper adjustment with ratio knobs.
3. If airplane gains or loses altitude, use elevator centering knobs to trim out error.
4. In general, use centering knobs only for slight changes in attitude after you engage autopilot.

Coordinating Bombardier's Turns

1. Be sure airplane is flying straight and level, with PDI on 0.



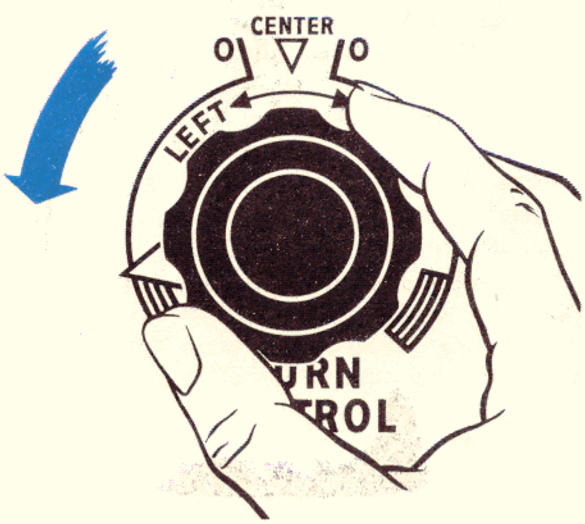
2. Have bombardier disengage autopilot clutch.
3. Have bombardier move his turn control knob to extreme right or left. Bombardier must be sure 12° stops are not in use when he does this.
4. Adjust turn compensation knobs. Set bank trimmer to give an 18° bank. Set skid trimmer to center ball. Set up-elevator trimmer to maintain altitude.
5. Have bombardier re-engage autopilot clutch, allowing stabilizer to re-center PDI. Speed of PDI recovery gives you a check on



aileron ratio setting. If PDI recovery is slow, **decrease** aileron ratio setting. If PDI recovery is so fast it overshoots, **increase** aileron ratio setting.

Coordinating Turn Control Turns

1. Fly straight and level, PDI on 0. Check instruments and correct with centering knobs if necessary.



2. Move turn control to first stop at edge of shaded area on knob dial.

3. Adjust aileron turn control trimmer with screwdriver to give 30° bank.

4. Adjust rudder turn control trimmer with screwdriver to stop skid.

5. Adjust up-elevator turn compensator to correct gain or loss of altitude. **Note:** You use up-elevator trimmer instead of elevator centering knob to adjust altitude, because if you use the centering knob you have to re-trim for level flight after turn.

6. As you come out of turn, stop turn control pointer at 0.

7. When wings are level, return pointer to center.

Caution: In rough air, don't use shaded area at lower range of turn control knob. It produces banks steeper than 30°, and in rough air these banks can suddenly increase to an angle which spills the autopilot gyro.

Use of Autopilot at High Altitudes

In normal low altitude flying your autopilot reacts efficiently if you set it up properly and keep it adjusted. At high altitudes—above 30,000 feet—several factors affect the operation of the autopilot, and to get efficient operation you must take these factors into consideration:

1. **Change in flight characteristics.** The performance of the autopilot is never any better than the performance of your airplane. Note the changes in technique which you use to fly the airplane manually at high altitude and remember that you have to adjust the autopilot controls to achieve the same changes in technique.

2. **Low temperature.** Your autopilot must be properly warmed up in order to operate correctly. If you plan to use it at high altitude, turn it on and set it up as soon after takeoff as practicable. Use your autopilot to climb with, making the necessary changes in the control knobs as you go up.

3. **Loss of electrical efficiency.** At high altitudes insulation of electrical wiring tends to break down to a certain extent, and while you won't lose all power at the altitudes you fly, the loss of electrical efficiency may have some effect on the electrical system which operates your autopilot. Never turn off a generator in normal flight and check periodically to see that all generators are operating properly and putting out sufficient power.

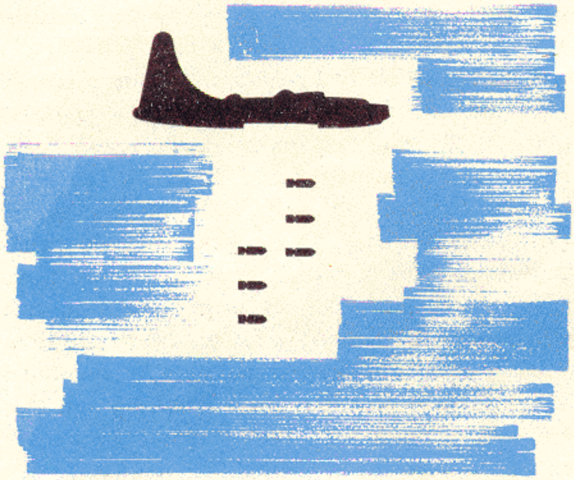
4. **Sluggish control reaction.** As you increase your altitude there is a tendency for the airplane to fly tail low, particularly under fully loaded combat conditions. Also the controls become increasingly soft, and the reaction of the airplane is sluggish compared with low altitude operation. Control errors show up more slowly, but take a longer time to correct, and you may be far out of the formation by the time you are able to make the necessary corrections and return to position. On a bombing run this may mean missing the target, or during fighter action it may mean losing the formation. To minimize these conditions be sure that your autopilot is correctly set up, and anticipate corrections as you do when flying manually at high altitude.

At high altitude you have to increase sensitivity and ratio. You must also loosen the dashpot adjustment as you go up. It is impossible to specify arbitrary settings for the various controls, since the corrections vary with the loading and altitude. Just be sure that you know the characteristics of your airplane under various conditions and are thoroughly familiar with the operation of the autopilot. Then stay alert for trouble and you probably won't have any.

Use of Autopilot in Formation and Bombing Run

It has been demonstrated by combat results that when practicable, use of the autopilot on the bomb run improves the efficiency of even excellent pilot-bombardier teams by as much as 50%. Improved efficiency means risking fewer lives and airplanes. Using smaller bomb loads with greater accuracy increases range. With the autopilot much shorter bomb runs are possible, which means less loss from enemy action. Along with those advantages use of the autopilot on long missions relieves you of many hours of tiresome flying.

Until such time as formation sticks are installed on all B-32's, however, there may be occasions when the autopilot can't achieve the maneuver you need. Therefore it is necessary



that you and your bombardier be able to disengage and engage the autopilot rapidly if the necessity arises. Practice rapid disengaging and engaging whenever you get the opportunity. The following situations illustrate conditions in which such action is required.

1. **Inaccurate initial turns.** While flying on autopilot if you use poor technique in the initial turn onto the bombing run, you may be so far out of line that the bombardier cannot bring you back with his 18° turn control bank. You have to clutch the bombsight and disengage the autopilot so that you can fly the corrections manually. Be sure that you can do this rapidly enough to correct in time to hit the target.

2. **Improperly set up autopilot.** If you have not set up your autopilot correctly, it does not react the way you want it to, particularly when changing altitude and airspeed on your turns into the target. You have to disengage the autopilot in this case and fly the PDI manually, which means loss of accuracy. To prevent the situation set up your autopilot correctly and, if possible, check it against the conditions of flight which prevail over the target.

3. **Prop wash in formation.** If you have the autopilot sensitivity and ratio set up for smooth air conditions and then run into prop wash going into the target, the autopilot makes unsatisfactory corrections. You have to disengage it and as soon as possible re-engage it for the rest of the bombing run. Naturally if the formation is flown correctly you don't run into prop wash, but many factors can interfere with the proper flying of the formation.

4. **Poor position in formation.** Other things being equal, it is more difficult for the tail-end elements of the formation to turn into the target. Poor leadership or planning may make it necessary for these elements to disengage their autopilots so that they can maneuver sufficiently to line up on the target. Even with good planning and leadership, enemy action or poor weather may throw the last elements off.

Use of Autopilot in Emergencies

1. **Control cable damage.** Manual control cables are long; autopilot control cables are comparatively short and less vulnerable to damage by enemy action. In one Air Force alone, close to 100 airplanes returned to base on autopilot with manual controls out of commission. Therefore, on all missions, even though you don't plan to fly on autopilot, set it up as soon as possible; adjust it, then turn off aileron, rudder, and elevator switches, leaving master switch on. If you suddenly lose your manual controls, flip the three control surface switches to ON position, immediately and together, even though you normally turn them on one at a time.

2. **Abandoning ship.** The autopilot doesn't bail out. Let it hold the airplane in straight and level flight, if possible, when you have to abandon ship.

3. **Emergency disengaging.** Remember that in case of emergency you can disengage the autopilot with a single flip of the master switch bar, or you can overpower it if you use enough force.

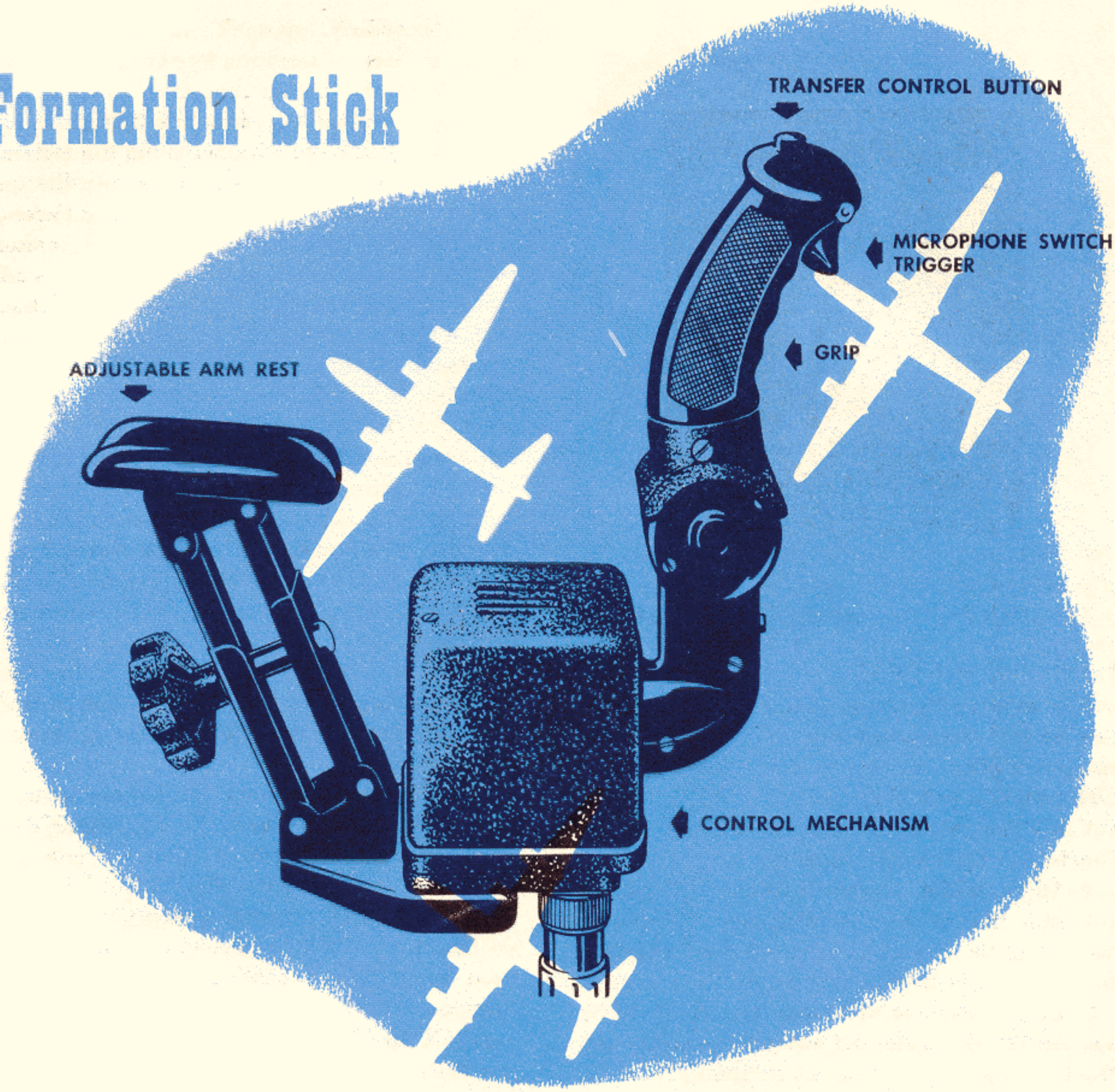
Faulty Operation of Autopilot

1. Check circuit breakers.

2. If flight characteristics are faulty, make adjustments on airplane commander's control panel, stabilizer, or servo motors.

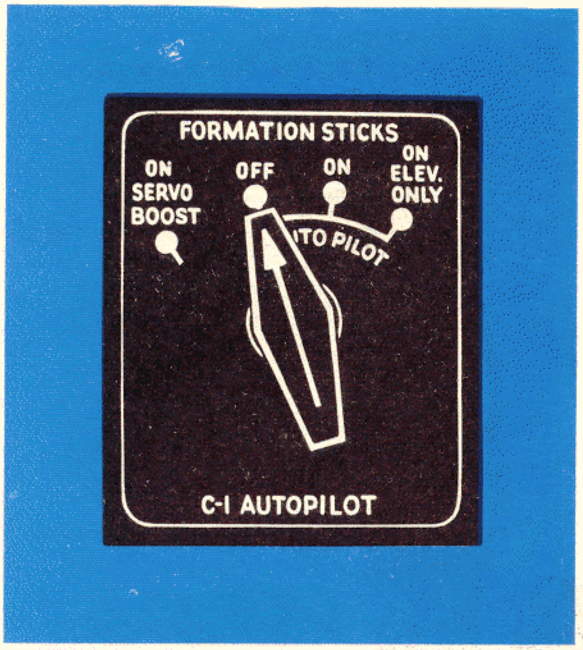
3. In extreme emergency, if autopilot does not operate, you can try replacing a rectifier or amplifier tube in autopilot amplifier unit with 7Y4 rectifier tube or 7F7 duotriode voltage amplifier from spare turbo regulator amplifier.

Formation Stick



The formation stick provides a means by which you can maneuver your B-32 through the autopilot, with easier, faster, and more efficient control. The system consists of two sticks and pedestal assemblies, two release switches and one function selector switch. At the present writing the exact location of the stick assemblies in the B-32 is not determined, but it will be adjacent to the two pilots' seats.

The formation stick assembly consists of a fighter stick grip, a control transfer switch button, and a trigger microphone switch. Two potentiometers pick up signals from the movements of the stick and transfer them to the autopilot amplifier. You use the control transfer button on top of the grip to transfer control of the airplane from one stick to the other. Only one stick has control at a time, and the airplane commander can over-ride the copilot's transfer button and keep control by holding his own control transfer button down continuously. The release switches permit instantaneous disengaging of stick and autopilot. The trigger microphone button operates conventionally.



Function Selector Switch

The function selector switch is a four-position control with which you engage the formation stick. The switch positions are OFF, ON, ON SERVO BOOST, and ON ELEVATORS ONLY. The following paragraphs describe the function of the various settings.

1. **OFF position.** In this position of the switch the stick has no control. With the autopilot in operation, the release and transfer switches are the only units of the formation stick system which are effective. You can use the release switches to disengage the autopilot even though the formation sticks are not in operation.

2. **ON position.** With the switch in ON position, the stick functions the same as the airplane commander's turn control knob on the autopilot except that the stick provides pitch axis control as well as bank control. In other words, you fly the airplane with the formation stick in the same way you manually fly an airplane equipped with a control stick except that with the formation stick you don't use the rudder pedals. Control is through the autopilot, and turns with the stick are coordinated with the turn control trimmers. You can use the ON position of the selector switch when flying loose formation or when flying singly.

3. **ON SERVO BOOST position.** With the switch in this position you fly the airplane with the formation stick as though it had no autopilot. The autopilot is now not flying the airplane, but you have what amounts to electrical operation of the control surfaces in all three axes through the servos. The only difference between this procedure and normal manual control, as far as operation is concerned, is that you are operating all three control surfaces with a single control. Only slight pressures are necessary to turn the airplane. Although the autopilot is not flying the airplane when the selector switch is in this position, your autopilot centering, sensitivity, and ratio knobs are still effective. Turn compensation, however, is not effective. In this position of the switch the stick system cannot make any rudder correction in turns, so you have to hold considerable up-elevator to maintain altitude. Don't expect perfect coordination in turns when you are using the stick in ON SERVO BOOST position. You use the system with the switch in ON SERVO BOOST for flying tight formation and for evasive action.

Note: Rapid and steep banks are possible with the stick operating in ON SERVO BOOST position. If you exceed 40° banks, however, leave the switch in ON SERVO BOOST position for at least 10 minutes thereafter. You must do this, if possible, to give the autopilot gyros time to right in case the excessive bank tumbled them.

4. **ON ELEVATORS ONLY position.** With the selector switch in this position you have control over the pitch axis only. Moving the stick to either side has no effect on ailerons or rudder which remain under full autopilot control. You use this selector switch position on the bombing run so that while the bombardier flies the airplane with the bombsight you can still control altitude and airspeed with elevators.

Preflight Check of Formation Stick System

1. Perform regular preflight inspection of C-1 autopilot. Remember that functioning of the formation stick depends directly on proper operation of your autopilot.

2. Set function selector switch to ON.

3. Move airplane commander's stick to extreme right, checking to see that control wheel turns clockwise and right rudder pedal moves forward.

4. Hold formation stick off center and check directional arm lock on autopilot stabilizer to make sure that it is held securely.

5. Release stick and check to see that control wheel, rudder pedals, and formation stick return to neutral and that directional arm lock releases.

6. Move airplane commander's stick to extreme left, then release, checking to see that control wheel turns counter-clockwise and left rudder pedal moves forward and that controls and stick return to neutral on release.

7. Pull stick back, then release, checking to see that control column moves to rear and that stick and column return to neutral on release.

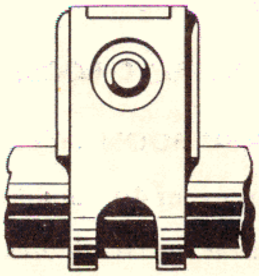
8. Push stick forward, then release, checking for forward movement of column and return of column and stick to neutral on release.

9. Press control transfer button on top of copilot's stick and repeat steps 3 to 8 using copilot's instead of airplane commander's stick.

10. Check operation of controls with function selector switch in ON SERVO BOOST position.

11. Check operation of elevators with function selector switch in ON ELEVATORS ONLY position.

12. Press control transfer button on airplane commander's stick and make sure that it regains control.



13. Press one release switch, then try manual controls for free and full movement to be sure that switch disengages autopilot.

14. Snap autopilot master switch to OFF position, then ON again, re-engaging other autopilot switches and checking to see that autopilot again has control.

15. Repeat steps 13 and 14 using the other release switch.

16. Check microphone switch on formation stick by interphone operation.

17. Turn function selector switch to OFF position.

Formation Stick Operating Instructions

Before takeoff:

1. Check to see that both autopilot master switch and formation stick function selector switch are in OFF position.

After takeoff:

1. Engage autopilot by normal procedure.

2. Coordinate bombardier's turns by normal procedure.

3. Coordinate airplane commander's turn control turns by normal procedure.

4. Engage formation stick by setting function selector switch for operation desired.

5. Use ON SERVO BOOST position for flying wing position in tight formation or when quick maneuvering is necessary. Move stick as though operating manual controls.

6. Use ON position for leading formation, flying wing position in loose formation, or for flying singly, as on X-C. For straight and level flight leave stick at neutral and autopilot retains complete control. For changes of flight attitude, use stick as though operating manual controls, coordinating with throttles for changes of altitude.

7. Use ON ELEVATORS ONLY position when bombardier has control of the airplane. Move stick forward and back for control of altitude and airspeed.

8. Use OFF position when flying on autopilot without the use of the formation stick and when the autopilot is turned off.

During flight:

1. To change function selector switch from ON SERVO BOOST to any other position, hold airplane level and turn switch.

2. To change function selector switch from any position to ON SERVO BOOST, make sure that PDI is centered before turning switch.

3. To change from ON SERVO BOOST to any other position after gyros have been tumbled, hold airplane level for 10 minutes before turning switch.

4. To transfer control from other stick to your stick, momentarily press transfer button on top of your stick. If airplane commander and copilot press transfer buttons at same time, airplane commander's stick gets control. Changes of settings on function selector switch have no effect on control transfer. If one stick fails, transfer control to the other. If both sticks fail, turn function selector switch to OFF position.

5. To release control by both formation sticks and autopilot, momentarily press release button.

6. To re-engage following operation of release switch, turn autopilot master switch OFF and re-engage autopilot in normal way.

Note: If you do not move formation stick after pressing release switch, you can re-engage by turning autopilot master switch OFF and ON, then immediately re-engaging other autopilot switches. This procedure is useful in case of accidental operation of release switches.

FORMATION STICK OPERATING Precautions

1. Don't try to land airplane by use of formation stick except in emergency when manual controls are shot out.

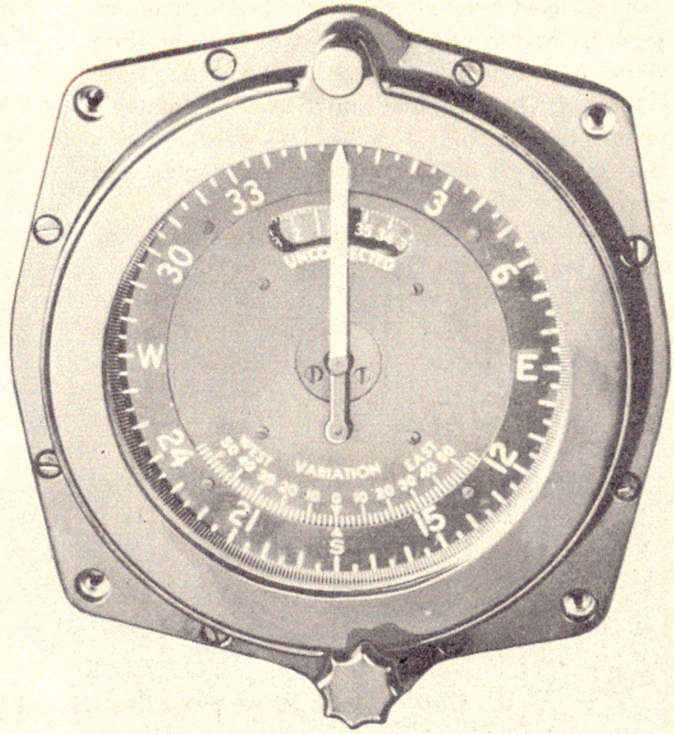
2. Be sure PDI is centered before turning function selector switch to ON SERVO BOOST position.

3. Remember that autopilot has no control over airplane when function selector switch is in ON SERVO BOOST position.

4. Don't use autopilot turn control when flying ON SERVO BOOST.

5. Don't exceed 40° bank while flying ON SERVO BOOST unless emergencies make it necessary. Banks much in excess of 40° tumble autopilot gyros, in which case you have to fly level for 10 minutes before moving switch out of ON SERVO BOOST position.

Flux Gate Compass



MASTER INDICATOR

The gyro flux gate compass is a remote indicating earth induction compass. It consists of a gyro-stabilized flux gate transmitter, an amplifier, a master indicator, two repeater indicators, remote erecting unit, and a control box. The system provides an accurate direction reading up to 65° with horizontal. Within this angular limitation, the indications of the compass are accurate because an electrically-driven gyro maintains the operation of the flux gate in a horizontal plane. The amplifier, master indicator and repeaters are all unaffected by local magnetic disturbances. The airplane inverter supplies 26 volt AC power to operate system.

The transmitter is located in the left wing outer panel in order to get it away from the magnetic materials in the compartment. The master indicator is on the navigator's panel. It incorporates an adjustment dial by which the navigator may insert magnetic variations for all the indicators. One repeater compass is located on the airplane commander's instrument panel and the other on the bombardier's instrument panel.

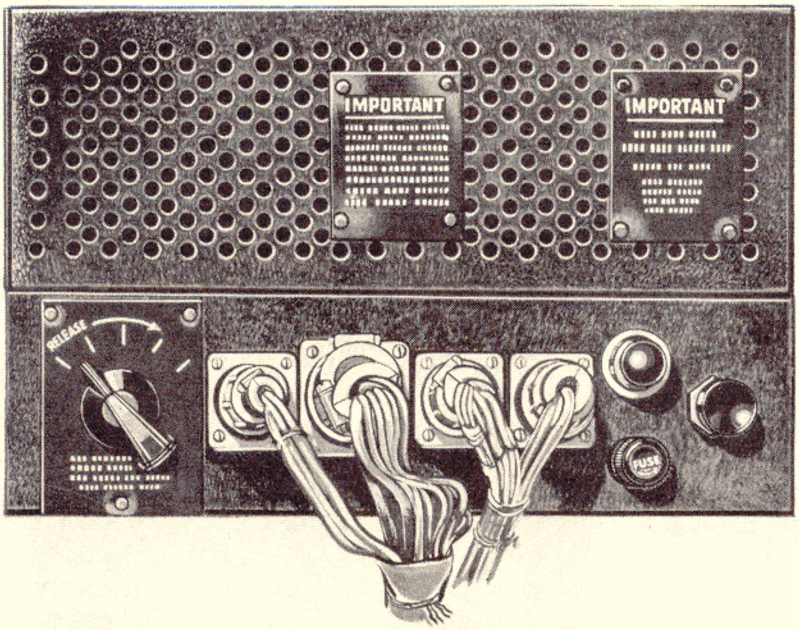
The amplifier is mounted underneath the aft end of the navigator's table. At the right on the face of the amplifier is a green pilot light which is on when the amplifier is operating. On some models of the amplifier a push button is located next to the pilot light, placarded with instructions for starting in cold weather. For practical purposes you can disregard this button; it was intended for a different installation.

At the left side of the amplifier face is a rheostat for adjusting amplifier sensitivity. Normally it is set just below the point at which the master indicator begins to oscillate. On long missions when you fly north into increasingly high magnetic latitudes, you may have to turn up the rheostat. Turn it up until the master indicator oscillates, then bring it back just below that point.

How to Operate the Compass

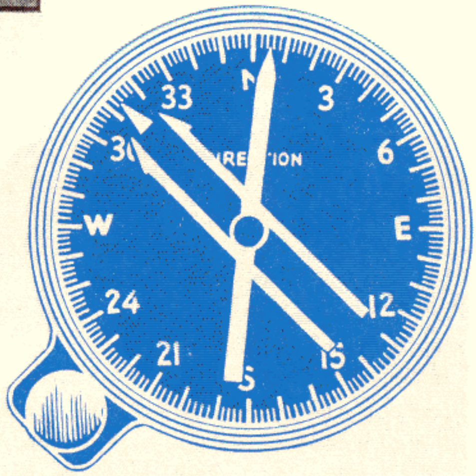
1. Compass is on at all times; it starts when airplane's inverter is turned on.
2. At least five minutes after starting engines push in button on caging control unit, holding it in until red light above it comes on, then release it. This action automatically completes a caging and uncaging cycle. The gyro remains uncaged at all times except during caging and uncaging cycle.
3. Set in local variation on master indicator if you want pointer to read true heading.
4. If at any time during flight indications lead you to believe that the compass operation is faulty, run through caging operation with airplane in normal flight attitude.

CAGING CONTROL UNIT



AMPLIFIER

REPEATER



Radio Equipment

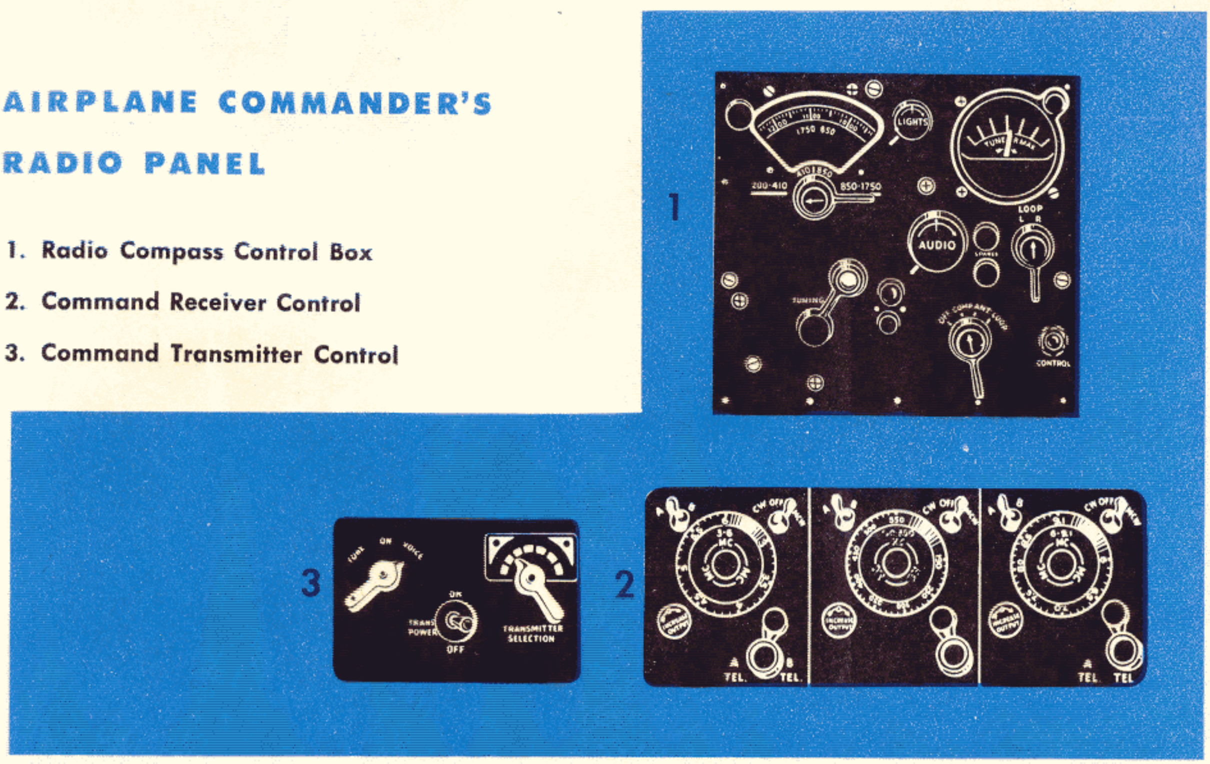
The general communications facilities in the B-32 consist of standard radio and interphone equipment to provide 2-way communication with ground stations and other airplanes, interphone communication between crew members, and the reception of radio range and marker beacon signals.

In addition, the B-32 may also carry specialized equipment for automatic radio direction finding, and the recognition and identification of friendly aircraft. This specialized and classified equipment is not covered in this manual, but special publications are available covering its use.

The general communications equipment consists of the following units:

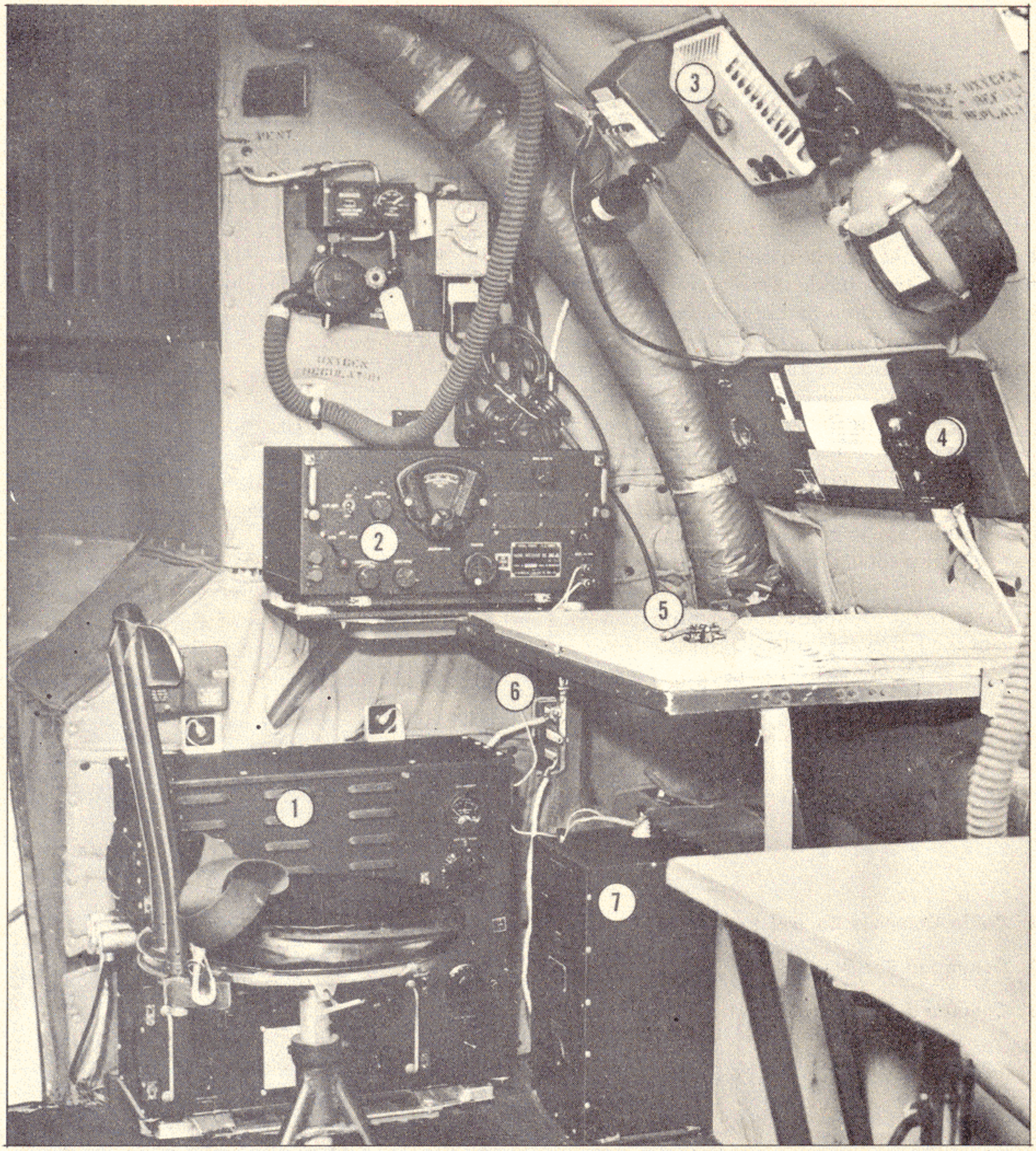
1. **Liaison radio set.** The receiver, located on the bulkhead next to the radio operator's station, has six or seven frequency bands, depending on the model of set, covering frequencies from 200 to 500 Kc and from 1.5 to 18.0 Mc. The transmitter equipment consists of a medium-range transmitter, located on the bulkhead below the receiver, a dynamotor, antenna, antenna variometer, and seven tuning units which lock into the bottom of the transmitter. All of the equipment is under the control of the radio operator although the airplane commander and copilot can operate the transmitter remotely through their interphone switch boxes. The transmitter operates on the fixed antenna or on the 250 foot reel antenna. The radio operator selects the desired antenna by a switch on the bulkhead just below his table. The switch for operating the antenna reel is located at the radio operator's right, just above the table.

2. **Command radio set.** The command set consists of a 2 or 4-channel transmitter, located on the forward right side of the flight compartment. The frequencies are 4495, 6210, 3105 and 4540 Kc, the 2-channel set operating on the first



AIRPLANE COMMANDER'S RADIO PANEL

1. Radio Compass Control Box
2. Command Receiver Control
3. Command Transmitter Control



RADIO OPERATOR'S STATION

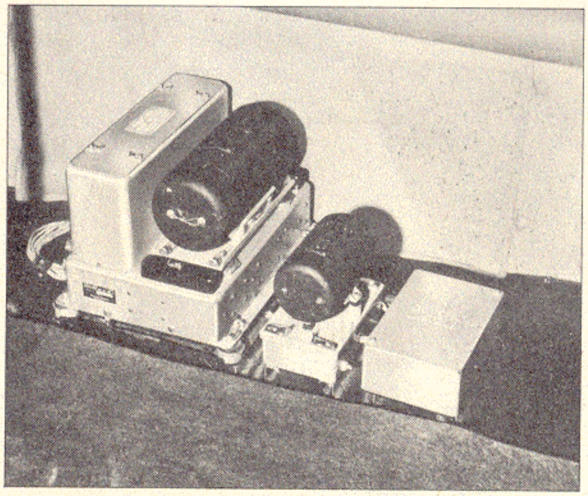
1. Liaison Transmitter
2. Liaison Receiver
3. Interphone Jackbox
4. Reel Control Box
5. Code Key
6. Antenna Switch
7. Antenna Variometer

two frequencies. One receiver located on the rack with the transmitter and operating in a frequency range of 200-500 Kc and 3 to 9 Mc is controlled from the panel above the airplane commander's head.

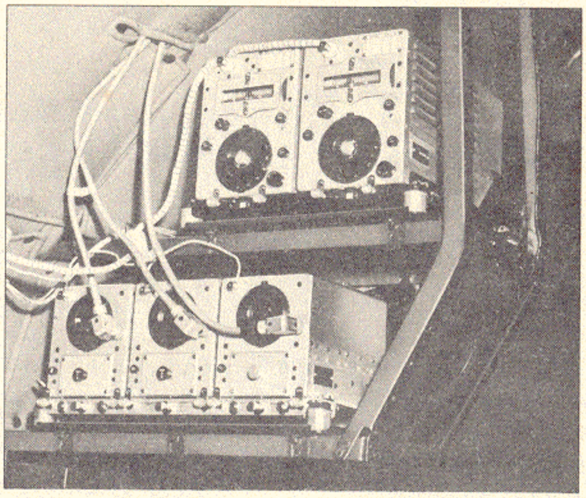
3. **Radio compass.** This set consists of a receiver at the left side of station 4.0 under the flight deck, control boxes on the radio panel and at the navigator's position, loop antenna mounted on the under side of the fuselage at the forward bomb bay, and indicators on the main and navigator's instrument panels. The compass operates on a frequency range of 100 to 1750 Kc.

4. **Marker beacon.** The marker beacon receiver, located at the left side of station 5.0, midway of the bomb bays, operates on an ultra high frequency of 75 Mc. In use, it indicates signals received from instrument landing markers, cones of silence, and other ground facilities which employ 75 Mc horizontally polarized radiation. The antenna is mounted below the fuselage between the bomb bays.

5. **Interphone.** The complete interphone system provides communications facilities for crew members at 14 stations: nose turret, bombardier, airplane commander, copilot, navigator, radar, radio operator, top forward turret, midway of bomb bays, top aft turret, lower ball turret, two positions at aft bunk, and tail turret. Besides interphone facilities, the system also permits limited use of radio facilities. On airplanes with VHF sets the interphone boxes at the airplane commander's and copilot's stations receive VHF only at both VHF and LIAISON positions of the switch on the jackbox. The radio operator's jackbox receives liaison only at both the VHF and LIAISON positions of the switch. The boxes are wired in that way to prevent interference between radio operator and airplane commander and copilot.



Command Dynamotor and Modulator Unit



Command Receiver and Transmitter

6. **IFF radio set.** The operation of this equipment is automatic and controlled by switches on the airplane commander's radio panel and at the IFF control box. Two detonator switches are provided next to the airplane commander's control switch. Their purpose is to set off a charge which destroys the equipment if it becomes necessary to abandon the airplane. When you push both buttons together, a small charge explodes in the receiver. There is also an automatic detonator switch which can be set to destroy the equipment when it is subjected to any severe shock. The IFF antenna is mounted on the under side of the fuselage at the aft bomb bay.

7. **VHF radio set.** As installed in combat-equipped B-32's, this equipment includes a receiver located at the right side of station 6.0, operating on four channels: A, B, C, and D. The use to which the various channels are put is dictated by local operations. The control box is located on the aft face of the airplane commander's control pedestal.

Heating, Ventilating, Anti-icing, and De-icing Systems

Each engine exhaust system on your B-32 incorporates a primary heat exchanger which transfers heat from exhaust gases to outside air taken in through the nacelle scoops. The heat exchangers in No. 1 and No. 4 nacelles furnish heated air for anti-icing the wings. Primary heat exchangers in No. 2 and No. 3 nacelles furnish heated air to secondary heat exchangers in the fuselage, which in turn supply heat to the forward and aft cabins, and in later B-32's, also supply heat for anti-icing the empennage. In earlier B-32's the empennage incorporates conventional de-icer boots. A conventional slinger ring arrangement on the propeller hubs anti-ices the props by distributing alcohol over the blades.

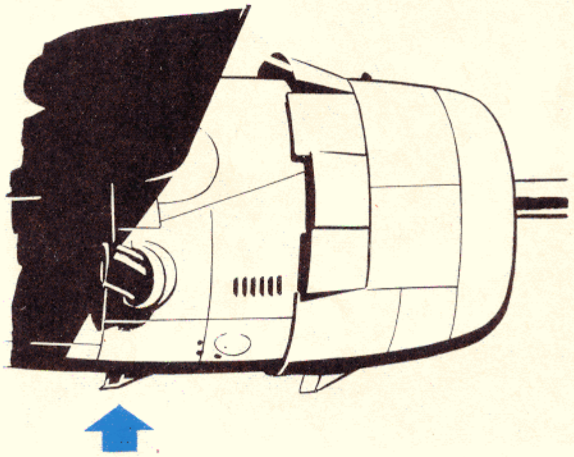
For the ventilating system, you use the same controls and ducts which furnish heat to the cabins. By dumping heated air from the primary heat exchangers overboard and opening the air vents you get circulation of unheated fresh air.

In studying your heating and ventilating system, remember that it depends on ram air pressure. You can't get heat or ventilation from the system for ground operation. Remember also that safety valves operate automatically to dump the heated air overboard when it gets too hot during long periods at high power output. When this happens there is no heated air available for the cabin or for anti-icing the wings, until the temperature in the exchangers drops below the pre-set limit.

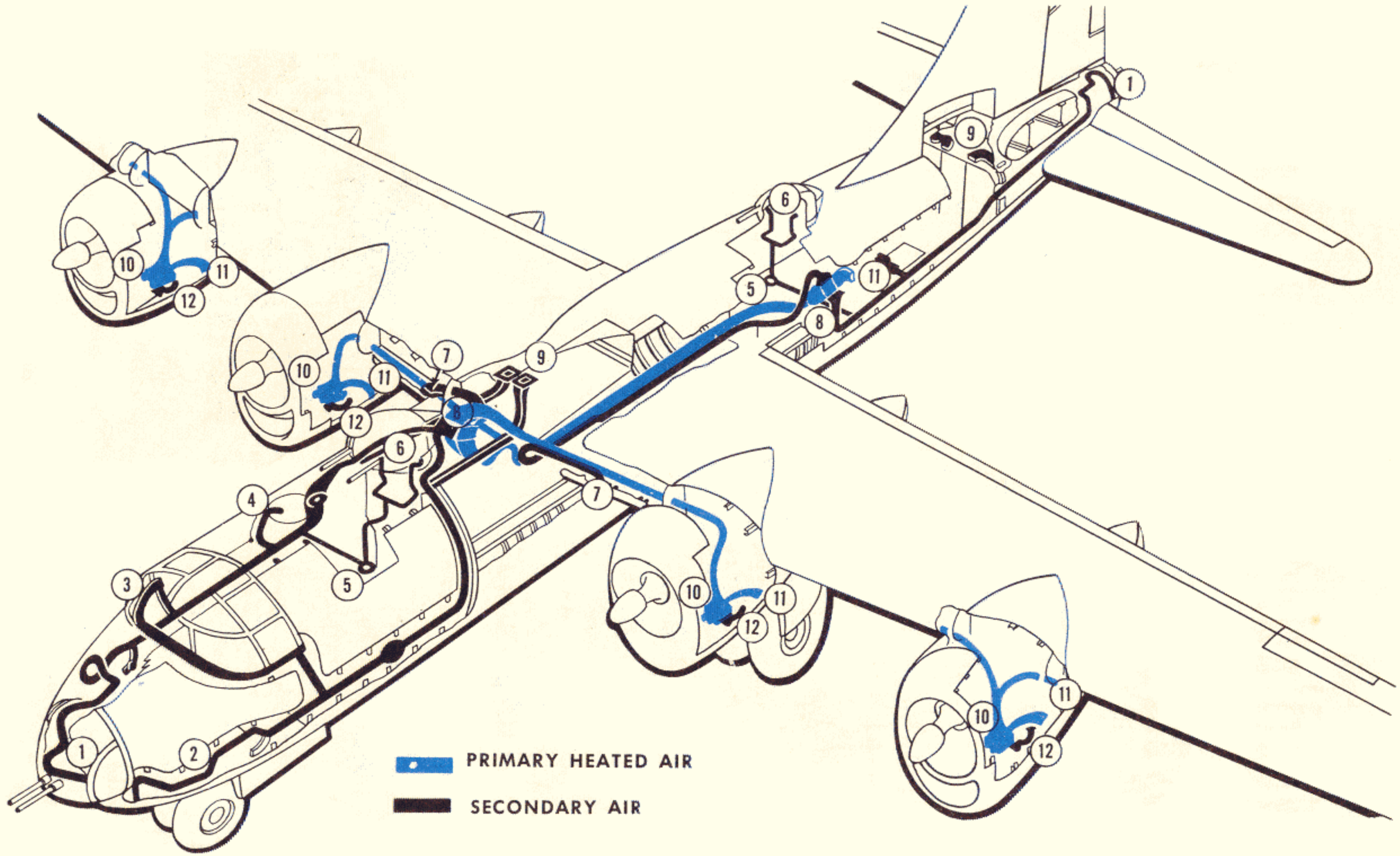
Cabin Heating and Ventilating

1. **Primary heat exchangers.** The primary heat exchangers which supply primary heated air for cabin heating are located in No. 2 and No. 3 nacelles. These exchangers produce heated air by transferring heat from hot exhaust gases to cold ram air. The hot exhaust gases pass through closed passages in the exchangers, and the cold ram air from the nacelle scoops circulates around these passages. The outlet flow of exhaust gases from the heat exchangers goes to the superchargers.

Just aft of the primary heat exchanger is a Y duct, of which one outlet leads to the secondary heat exchangers in the fuselage and the other outlet leads to an overboard dump door on the lower side of the nacelle. Another outlet just ahead of the nacelle Y duct provides heat from the exchanger for carburetor air preheating. A flow control gate in the nacelle Y duct directs heated air to the secondary heat exchangers when the system is turned off. As a safety feature, a temperature control unit and an actuator operate the flow control gate to dump the heated air overboard when its temperature rises above a pre-set limit or when a leak allows exhaust gas to enter the heated air duct. When the temperature drops below the



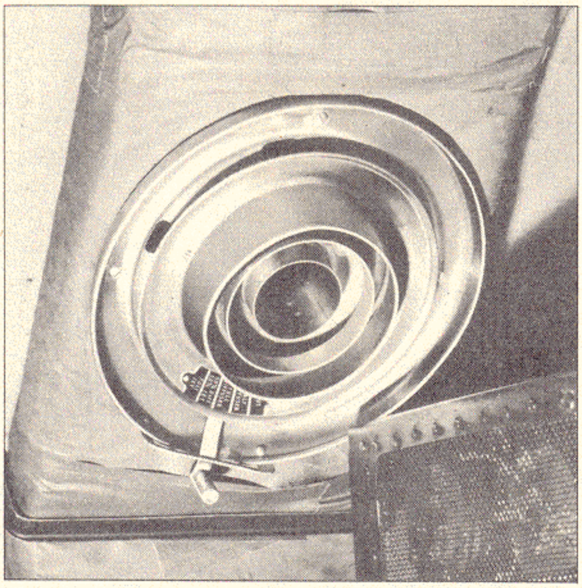
Nacelle Dump Duct



1. Turret Ducts
2. Bombardier's Window Duct
3. Windshield Defroster and Anti-icer
4. Astro Glass Defroster Duct
5. Turret Heater Rings
6. Turret Defrosters
7. Air Intakes
8. Secondary Heat Exchangers
9. Air Exhaust Vents
10. Primary Heat Exchangers
11. Overboard Dump Duct
12. Primary Heat Exchanger Shroud Cooling Air Duct

limit, the control gate closes the dump duct, re-routing heated air to the system.

2. **Secondary heat exchangers.** Primary heated air flows to one secondary heat exchanger in the forward bomb bay and another in the aft cabin. The primary heated air from No. 2 nacelle flows through closed passages on the forward secondary heat exchanger. There it transfers heat to fresh air which enters through a scoop in the leading edge of the wing between No. 3 nacelle and the fuselage and flows through a duct around the closed passages in the secondary heat exchanger. This heated outside air



Cabin Heat Duct

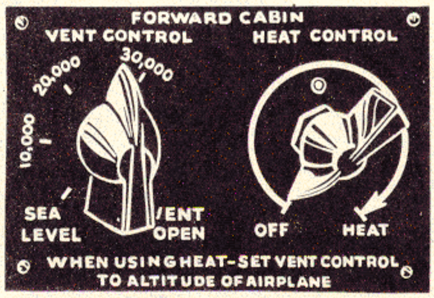
then goes through ducts to the forward cabin, top turret, navigator's astro glass, nose turret, bombardier's compartment, and to the pilots' windshields for anti-icing.

The outflow of primary heated air from the forward secondary heat exchanger then joins the flow of primary heated air from No. 3 nacelle going to the aft secondary heat exchanger. This primary air transfers heat to fresh air which enters the aft exchanger through a duct from a scoop in the leading edge between No. 2 nacelle and the fuselage. Then the primary heated air flows out of the system through an overboard dump at station 6.3. The heated fresh air from the aft heat exchanger goes to the rear cabin, upper and lower turrets, and the tail turret. Water separators and traps prevent moisture entering the ducts from the wing scoops.

A valve at the Y ducts of the forward and aft secondary heat exchangers makes it possible to control the amount of primary heated air flowing through the heat exchangers or to by-pass the exchangers completely, routing the primary heated air on out through the overboard dump outlet. Thermal switches on the actuator of this valve and the fuselage dump valve operate as a safety feature to by-pass the secondary heat exchangers and dump the primary heated air overboard if its temperature rises above a preset limit. When the air temperature drops below the limit, the valves again route the air through the heat exchangers.

Exhaust vents on the aft bulkhead of the forward cabin allow the used air in the cabin to flow overboard through outlets on top of the wing. Similar exhaust vents in the aft cabin route aft cabin used air overboard through outlets in the fuselage just forward of the horizontal stabilizer leading edge.

You provide ventilation through the same system by controlling the valves in the Y ducts of the primary heat exchangers so that primary heated air is dumped overboard through the nacelle dump duct. In that case, the flow into the cabins is unheated fresh air taken in through the scoops in the wing leading edge.



3. **Heating system controls.** The forward and aft secondary heat exchanger systems are independent. Control of the forward heat exchanger is by two rheostats on the copilot's auxiliary panel. Duplicate rheostats on the oxygen panel of the aft cabin control the aft heat exchanger.

The right rheostat in each case controls the opening of the valve at the Y ducts of the secondary heat exchangers and thus regulates the amount of primary heated air passing through the heat exchangers. With the rheostat in OFF position primary heated air goes out the nacelle overboard dump. These rheostats are in OFF position at full counter-clockwise and increase the heat as you turn them clockwise toward the HEAT position.

The left rheostat in each case controls the opening of the cabin air exhaust vents outlets and thus regulates the rate of flow of heat or ventilation through the cabins. These rheostats have an OFF or CLOSED position at full counter-clockwise and are calibrated in altitude settings up to the OPEN position at full clockwise.

Note: Some early B-32's have CLOSED position at full clockwise, but the placard has been corrected on later airplanes to read OPEN.

As you ascend you place this rheostat at the altitude figure at which you are flying. The higher the altitude setting the farther open the exhaust vent door, thereby maintaining an approximately constant pounds-per-minute air flow for efficient operation of the heat system.

For ventilation without heat you turn the right hand rheostat to OFF position and regulate the left hand rheostat to give you the desired rate of flow of ventilating air, regardless of altitude.

In addition to these controls, manually operated valves at various positions along the ducts permit you to control the heat at the various outlets.

Note: In early B-32's a permanent setting for the dump flaps in the nacelles had not been determined, and four toggle switches for the operation of these flaps are provided at floor level on the copilot's right side. The dump flaps are bolted in permanent position 20 degrees open on later airplanes, and the switches are safetied or removed.

4. **Flight operation of cabin heating system.** After takeoff, turn heat control knob (right rheostat) approximately ¼ on. Set vent control (left rheostat) at flight altitude. When heat exchangers reach operating temperatures readjust both rheostats for desired temperature. Turn all rheostats to OFF position after landing.

Note: Remember that the operation of forward and aft heating systems is independent. Brief scanners or gunners in the operation of the system because they have to regulate their own heat and ventilation. Advise them by interphone of large changes of altitude so that they can change their vent controls accordingly.

Wing Anti-icing

The primary heat exchangers in No. 1 and No. 4 nacelles provide heated air for wing anti-icing. They function the same as do the inboard primary heat exchangers with the same thermal

switch unit for dumping primary heated air if it exceeds a temperature limit.

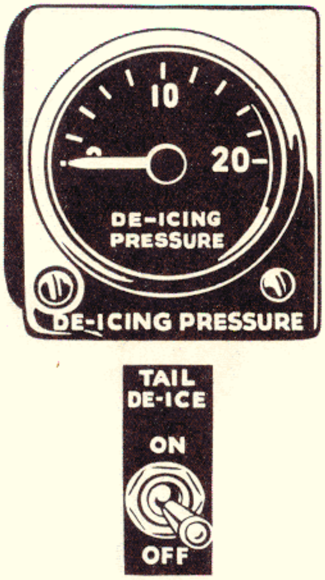
You actuate the wing anti-icing system by a toggle switch on the copilot's auxiliary panel. Use the anti-icing system whenever you anticipate icing conditions. With the switch in ON position the valve at the nacelle Y ducts directs primary heated air through an interspace formed by inner and outer leading edge skins. The air then goes into the wing section proper through holes in the front spar web and then overboard to the outside through holes in the rear spar web. Between the inboard and outboard nacelles where fuel and oil cells are aft of the front spar the used air goes into the nacelle area instead of through the spar web. In the wing tips the heated air enters the space between skins at the bottom of the wing and goes outside through holes in the outer skin on top of the wing tip.

With the switch in OFF position the Y duct valves route the heated air out through the nacelle overboard dump flap.

Caution: If you lose engine No. 1 or No. 4, shut off the wing anti-icing system, so that you won't get ice on one wing and not on the other.

Empennage De-icers and Anti-icers

The first 200 B-32's have conventional de-icer boots on the leading edges of the horizontal stabilizer and the fin. Subsequent airplanes have thermal anti-icers in the tail, like those in the wing. The following paragraphs describe the operation of both systems.



1. **Empennage de-icer system.** The de-icer system consists of de-icer boots, a pump in the aft accessory compartment, distributor valve, control and pressure gage on the copilot's auxiliary panel and another switch on the forward side of the pump. To operate the system turn either toggle switch to ON position. This starts the air pump and distributor valve. A complete cycle of the de-icer boot operation then takes place approximately every 37 seconds. If the pump fails to work or stops, check the pump circuit breaker on the forward left wall of the aft accessory compartment.

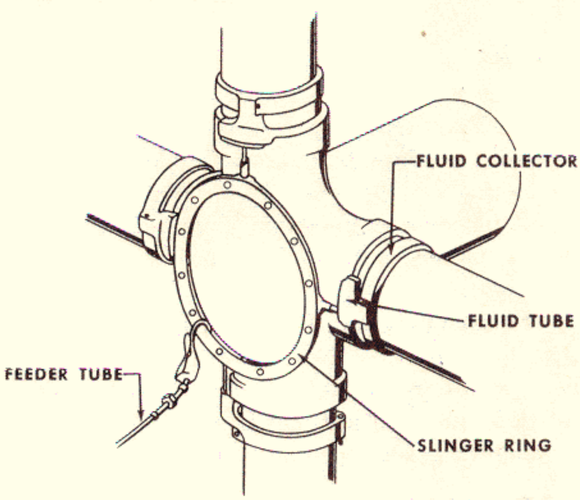
2. **Empennage anti-icer system.** In airplanes equipped with empennage thermal anti-icers an alternate duct leads off the primary heat overboard dump in the aft compartment to conduct primary heat to the tail. A toggle switch, just above the wing anti-icing switch on the copilot's auxiliary panel, actuates a valve which directs the heated air to the tail or overboard. An overheat protective thermostat in the primary heat ducts to the empennage, just aft of the dump valve, opens the dump valve and dumps the heated air overboard if it exceeds a pre-set temperature limit. When the primary heated air returns to normal temperature the dump valve closes and the heated air again goes to the empennage if the empennage anti-icing switch is in ON position.

The switch is a 3-position toggle switch with OFF, ON, and MAXIMUM positions. This switch over-rides any position of the heat control rheostat. In the OFF position the primary heated air goes out through the overboard dump outlet. In ON position the primary heated air by-passes the aft secondary heat exchanger and then goes through the ducts to the empennage, rather than out the dump. **Note that the aft cabin can get no heat with the empennage anti-icing switch in ON position.**

In MAX position, the primary heated air by-passes both secondary heat exchangers and goes to the tail. **With the switch in MAX position neither cabin can get any heat.**

Always carry heated clothing, if possible, when you expect to fly in low temperatures. The heating system can fail. If you plan to use your tail anti-icers, be sure to advise your crew to wear their heated clothing because the heating system is definitely unavailable in that case.

Propeller Anti-icing



The propeller anti-icing system prevents ice accumulation on propellers by pumping isopropyl alcohol to slinger rings and collectors on the props from which the alcohol spreads over the props by centrifugal force. The 8-gallon alcohol tank is on the aft bomb bay bulkhead with the filler neck protruding through to the aft cabin. Two rheostats on the copilot's auxiliary panel, one for the inboard and one for the outboard props, control the output of the pumps to maintain desired flow of alcohol.

Heating and Icing Emergencies

1. Don't operate cabin heaters if both primary and secondary heaters are damaged because heaters may be admitting carbon monoxide to cabins.

2. If you suspect presence of carbon monoxide, have everybody aboard use oxygen masks with auto-mix lever at 100% OXYGEN position. Turn off heaters; turn on ventilating system.

Wing and tail icing:

1. Operate wing anti-icers and tail de-icers.
2. If No. 1 or No. 4 engine fails, turn off wing anti-icing system so that you don't get the dangerous situation of ice building up on one wing and not on the other.

Windshield icing:

1. Turn on cabin heat.
2. Turn off manual controls to all heater outlets except windshield defroster. This forces full cabin heat supply through double pane windshield.

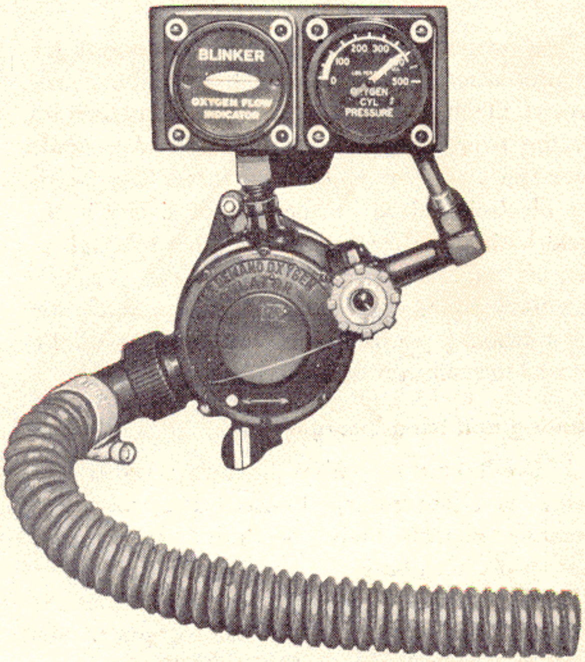
Carburetor icing:

1. Operate carburetor pre-heat switch.
2. If icing is severe, increase power.
3. See that intercooler shutters are closed. If AUTOMATIC operation fails, operate selector switch in MANUAL CLOSED.

Prop anti-icer pump failure:

1. Determine which pump is out: if No. 1 or No. 4 prop is not receiving fluid, left pump is faulty; if No. 2 or No. 3 prop is not receiving fluid, right pump is faulty.
2. Check circuit breaker.
3. Tap pump lightly with soft hammer.
4. In extreme emergency, remove one motor brush plug and rotate armature with small screwdriver.

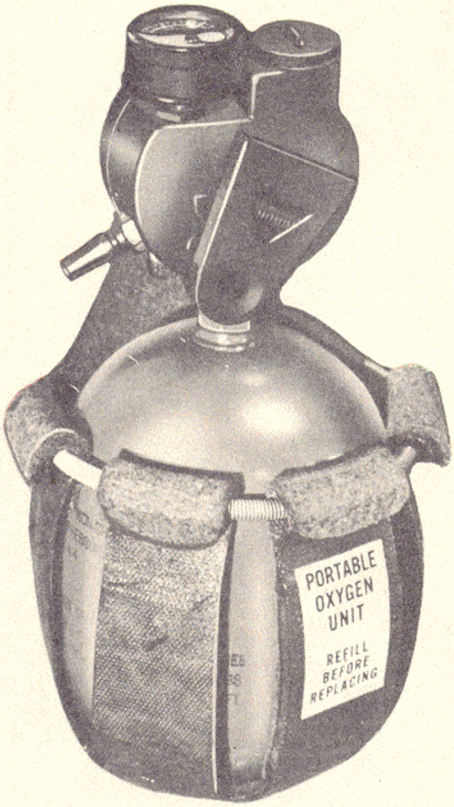
Oxygen System



Oxygen Panel

USE OXYGEN

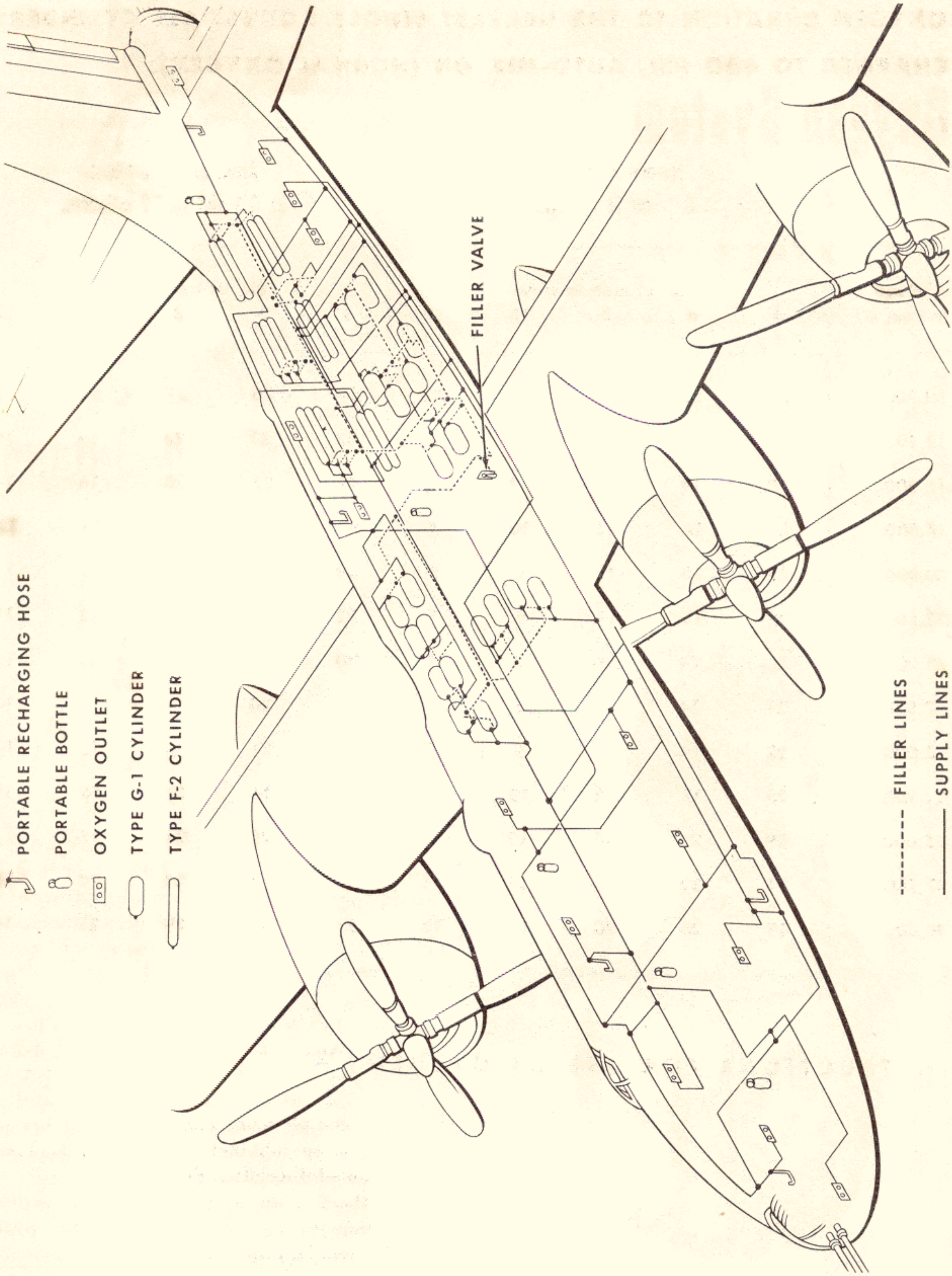
1. At 10,000 feet and above on all flights.
2. From the ground up on all combat and tactical flights at night.
3. Between 8000 and 10,000 feet on all flights of 4 hours or greater duration.



The B-32 oxygen system is a low-pressure demand type supplied by an installation of 13 G-1 cylinders and 14 F-2 cylinders with provisions for an additional nine G-1 cylinders. The cylinders are installed in the bomb bay and aft compartments.

There are 14 oxygen stations in the airplane, each equipped with an A-12 regulator, a pressure gage, and a flow indicator. Five or more portable A-4 walk-around bottles are provided. You can recharge the walk-around bottles from the five recharger hoses located as shown in the oxygen system diagram. You use the A-14 or A-10A demand mask with this installation.

The duration of the oxygen supply varies with individual requirements of the crew, with their activity, the altitude, and the equipment.


PORTABLE RECHARGING HOSE
PORTABLE BOTTLE
OXYGEN OUTLET
TYPE G-1 CYLINDER
TYPE F-2 CYLINDER
FILLER VALVE
FILLER LINES
SUPPLY LINES

OXYGEN DURATION TO THE NEAREST WHOLE HOURS, ALL CYLINDERS CHARGED TO 400 PSI, AUTO-MIX ON (NORMAL OXYGEN):

	Normal installation: 13 G-1 and 14 F-2 cylinders.					Alternate Installation: 22 G-1 and 14 F-2 cylinders.				
Altitude in Feet	No. of men in crew 4	6	8	10	12	No. of men in crew 4	6	8	10	12
10,000	37	25	19	15	12	54	36	27	22	18
12,500	32	21	16	13	11	47	31	23	19	16
15,000	28	19	14	11	9	41	27	20	16	14
17,500	25	17	13	10	8	37	25	19	15	12
20,000	23	15	12	9	8	34	22	17	14	11
22,500	22	15	11	9	7	32	21	16	13	11
25,000	20	14	10	8	7	30	20	15	12	10
27,500	21	14	11	8	7	31	20	15	12	10
30,000	22	14	11	9	7	32	21	16	13	11
32,500	25	17	12	10	8	36	24	18	15	12
35,000	29	20	15	12	10	43	28	21	17	14
37,500	34	23	17	13	11	49	32	24	20	16
40,000	39	26	20	16	13	57	38	29	23	19

INSTRUCTIONS FOR USE OF OXYGEN

1. For complete instructions on the use of oxygen and operation of oxygen equipment see your **Pilot's Information File.**

2. If there is anything you are not sure of concerning the use of oxygen, be sure to ask your Personal Equipment Officer.

INDEX