THE B-29

AIRPLANE COMMANDER TRAINING MANUAL
FOR THE SUPERFORTRESS

REVISED 1 FEBRUARY, 1945

PREPARED FOR HEADQUARTERS, AAF

OFFICE OF ASSISTANT CHIEF OF AIR STAFF TRAINING

BY HEADQUARTERS AAF, OFFICE OF FLYING SAFETY

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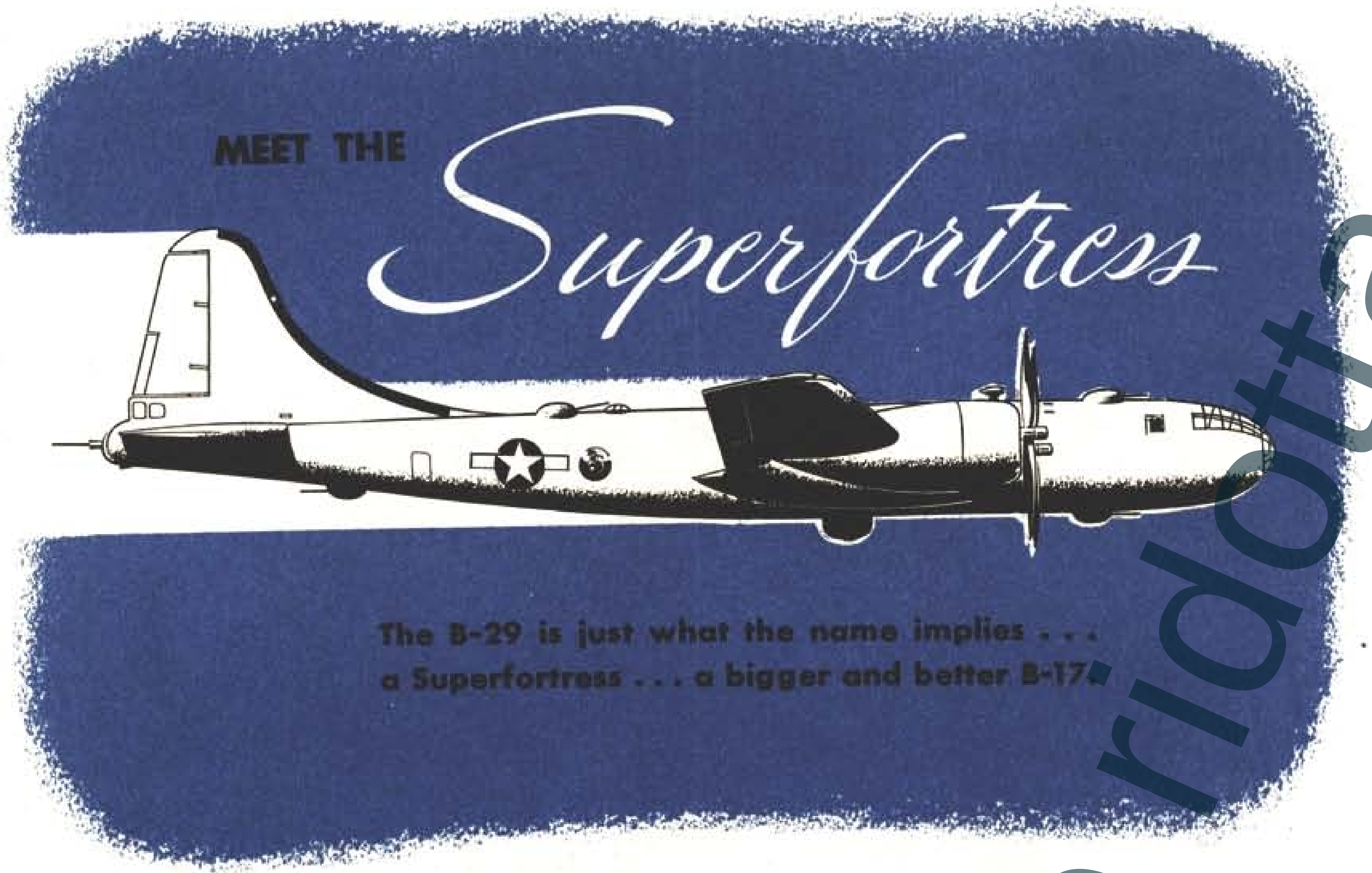
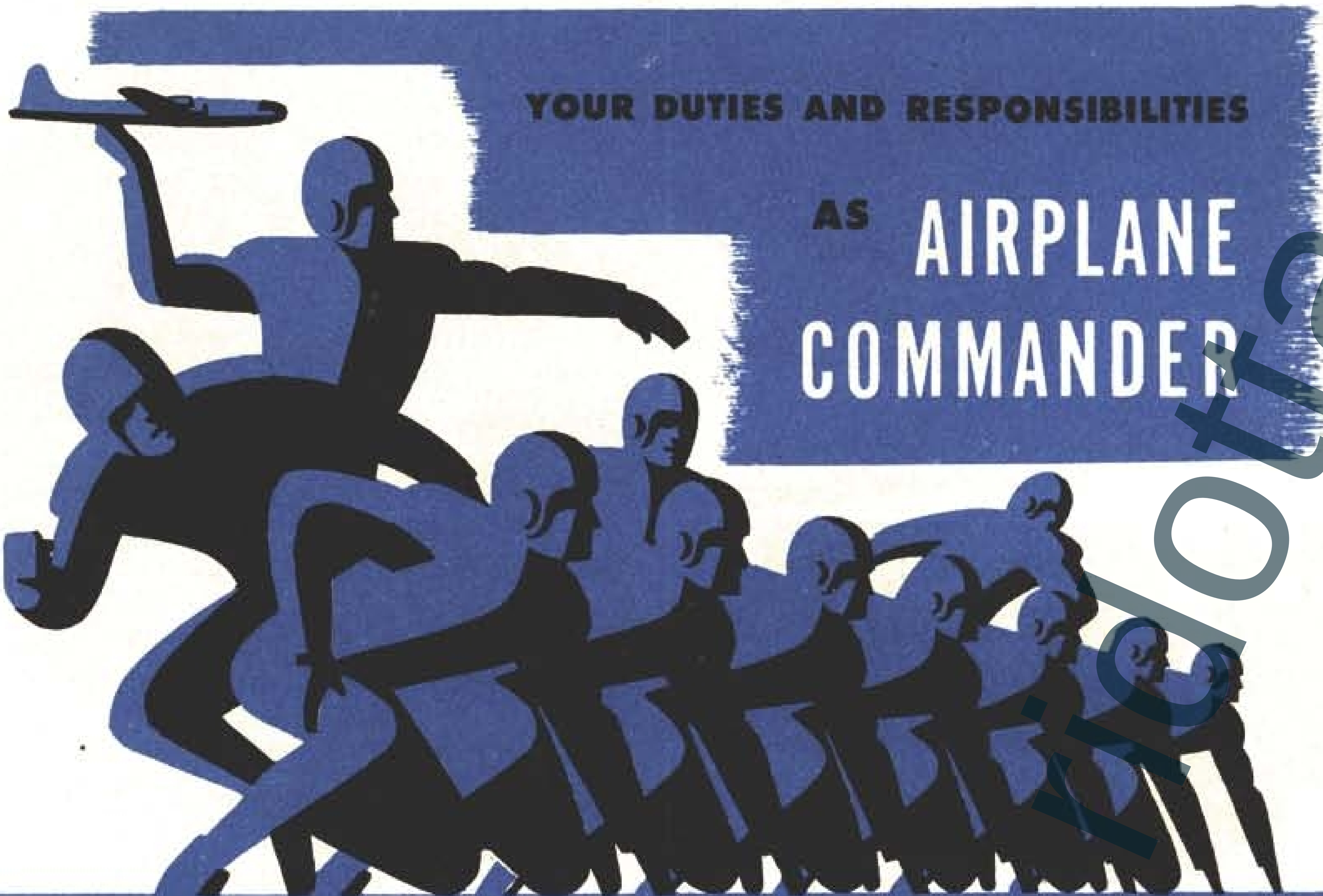


Early in 1939, when studies were started to determine just how to produce a bomber bigger and better than the B-17, the XB-29 came into being. Its basic design was determined in 1940. Three airplanes were built as prototypes for the actual production of the B-29, the first of these taking to the air in the fall of 1942.

Many qualities of the B-17 have been built into the B-29. The B-17 tail was one step in the development. In the early experimental stages, a B-17 was flown with dual turbos, the B-29 fin and rudder, the B-29 stabilizer and elevator, and even with the B-29 ailerons.

The B-29 is the first of the "very heavy bombers." Actually, in physical size it is not much larger than a B-17 or a B-24, but its weight and power are twice theirs and its speed is considerably greater. Loaded down with gas and oil for a long ferrying trip, it holds almost as much fuel as a railroad tank car. Under normal loads, it weighs 1/7 as much as a railroad locomotive and has four times the power. It is designed to carry heavy loads for long distances at high speeds and high altitudes.

THE **B-29** IS A YOUNG AIRPLANE, BUT IT IS FAST PROVING ITS CAPABILITIES . . .
AND YOU AS AN AIRPLANE COMMANDER WILL HAVE A HAND IN ITS FUTURE.



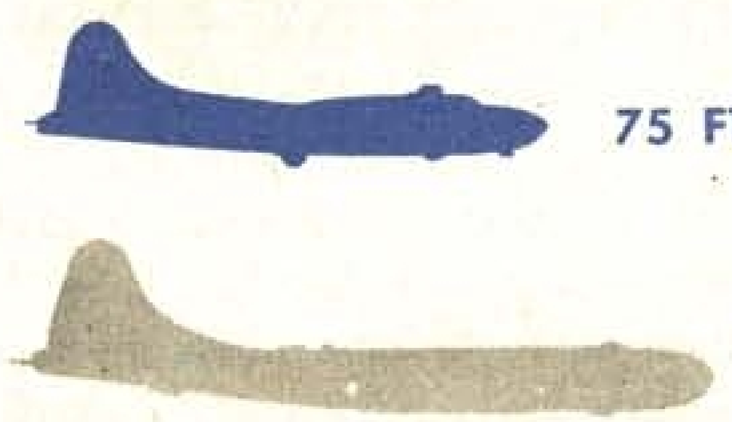
TRAINING ACCOMPLISHED

WEEKS	NUMBER OF EACH MISSION FLOWN	TOTAL NUMBER OF MISSIONS FLOWN	TOTAL NUMBER OF HOURS FLOWN
1st			
2nd			
3rd			
4th			
5th			
6th			
7th			
8th			
9th			
10th			
11th			
12th			

HOW BIG IS YOUR SUPERFORTRESS?

The B-29 is America's heaviest high-speed airplane . . . civilian as well as military. Here is how it compares with the B-17:

LENGTH



75 FT.

99 FT.

WING SPAN AND AREA

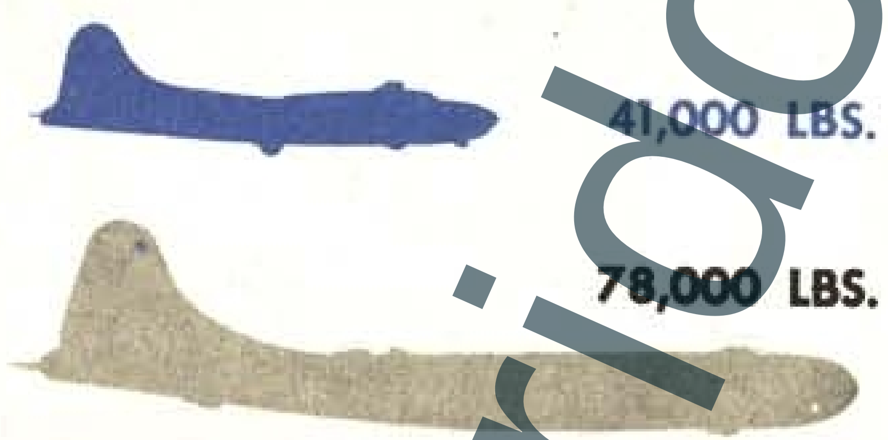
WING SPAN 104 FT.

WING AREA 1,420 SQ. FT.

WING SPAN 141 FT.

WING AREA 1,738 SQ. FT.

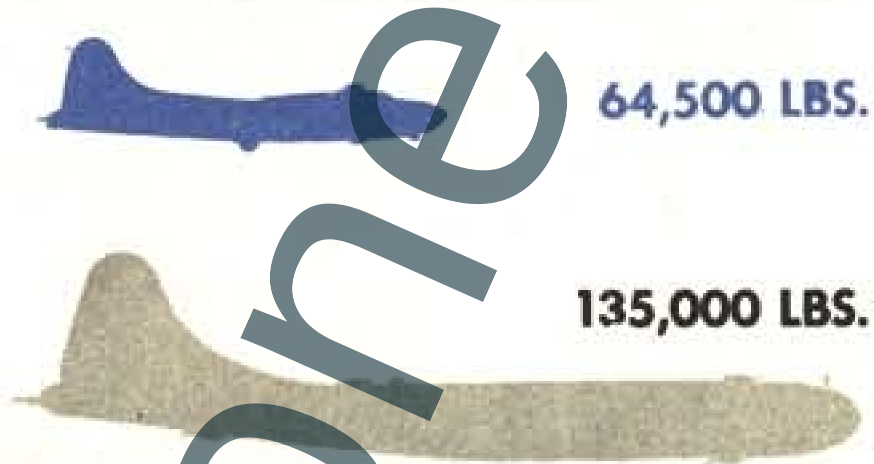
TACTICAL WEIGHT EMPTY



41,000 LBS.

78,000 LBS.

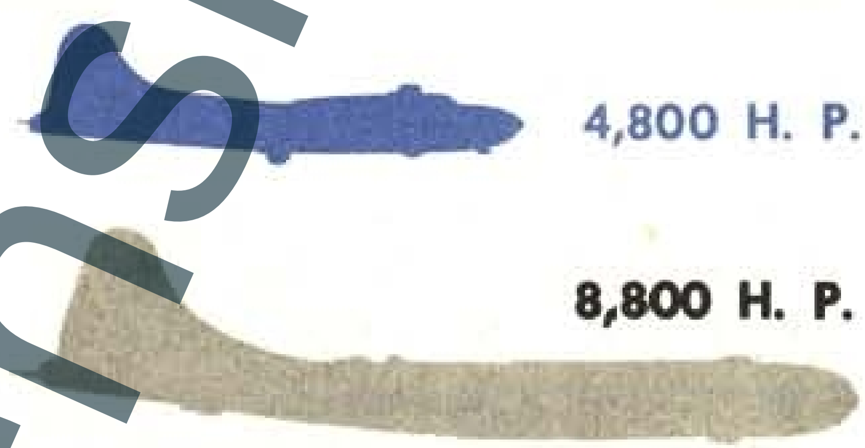
MAX. GROSS WEIGHT



64,500 LBS.

135,000 LBS.

RELATIVE POWER



4,800 H. P.

8,800 H. P.

Key

B-17= 

B-29= 

POWER PLANTS

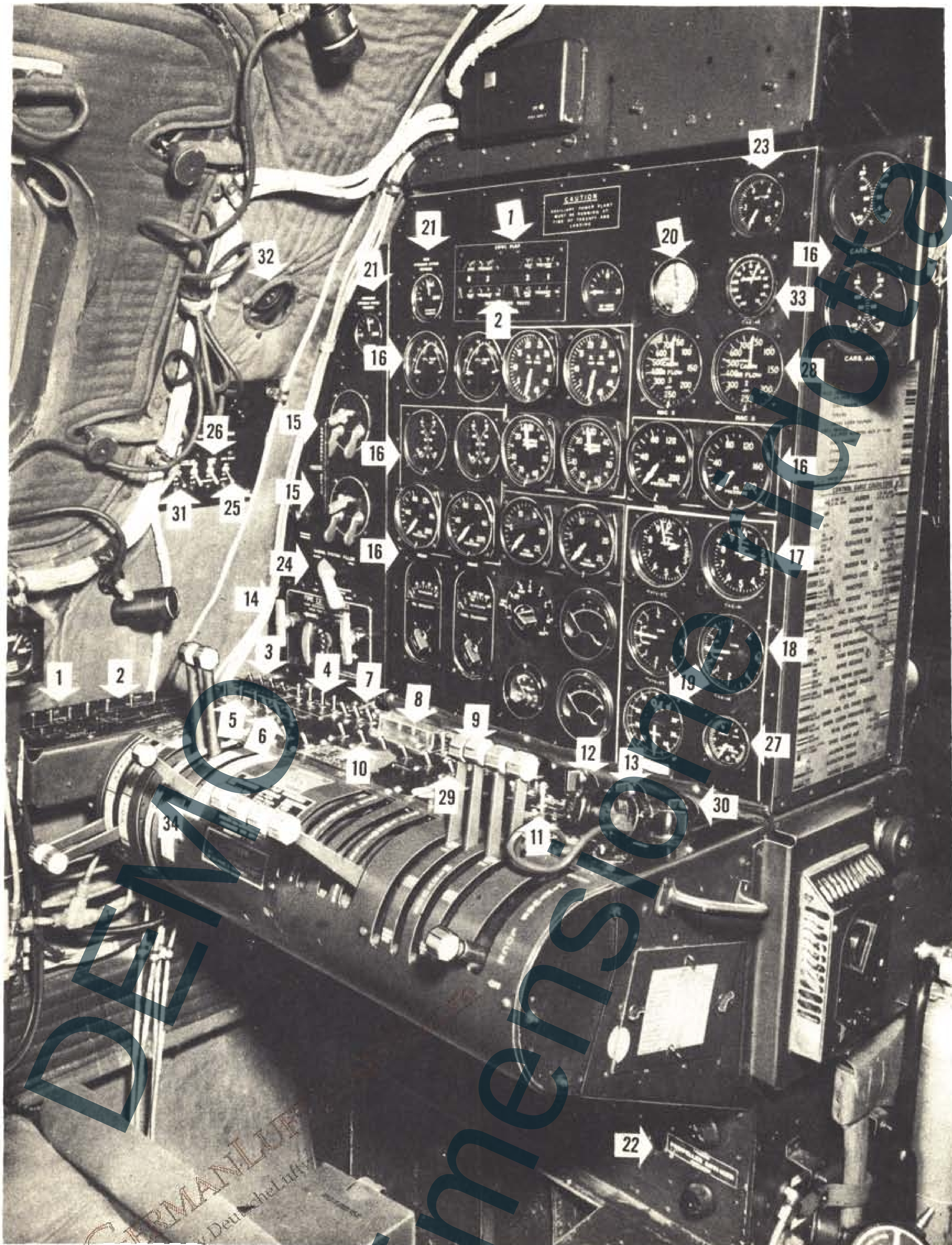
Your B-29 Superfortress has four 18-cylinder, twin-bank R-3350 Wright radial engines capable of delivering more than 2200 Hp each. The 4-bladed propellers, reduction geared (.35) to the crankshaft and rotating clockwise when viewed from the rear, are Hamilton Standard constant-speed, full-feathering, hydromatic. Constant-speed control is maintained by governors which are operated electrically by four momentary-contact toggle switches located on the airplane commander's aisle stand.

Each engine has two exhaust-driven turbosuperchargers mounted vertically on each side of the engine nacelle. The turbo boost on all four engines is controlled simultaneously by a Minneapolis-Honeywell electronic turbosupercharger control system operated by a single manual rheostat control knob on the copilot's aisle stand. Carburetors are Chandler-Evans automatic. Some late airplanes will have direct fuel injection systems of the Bosch or Bendix type. Vacuum pumps, one on each engine, provide vacuum for the cameras, de-icer boots, and instruments, and pressure for inflating the de-icer boots. Either inboard vacuum pump may be used for vacuum; the other three pumps provide pressure for the de-icer boots.

CONTROLS

FLIGHT ENGINEER'S STAND

From the airplane commander's and copilot's point of view the controls on the B-29 have been simplified—the majority of the power plant controls and most of the basic electrical and mechanical system controls are on the flight engineer's stand directly in back of the copilot. From his station he can visually check all engines and be in close communication at all times with the airplane commander and copilot.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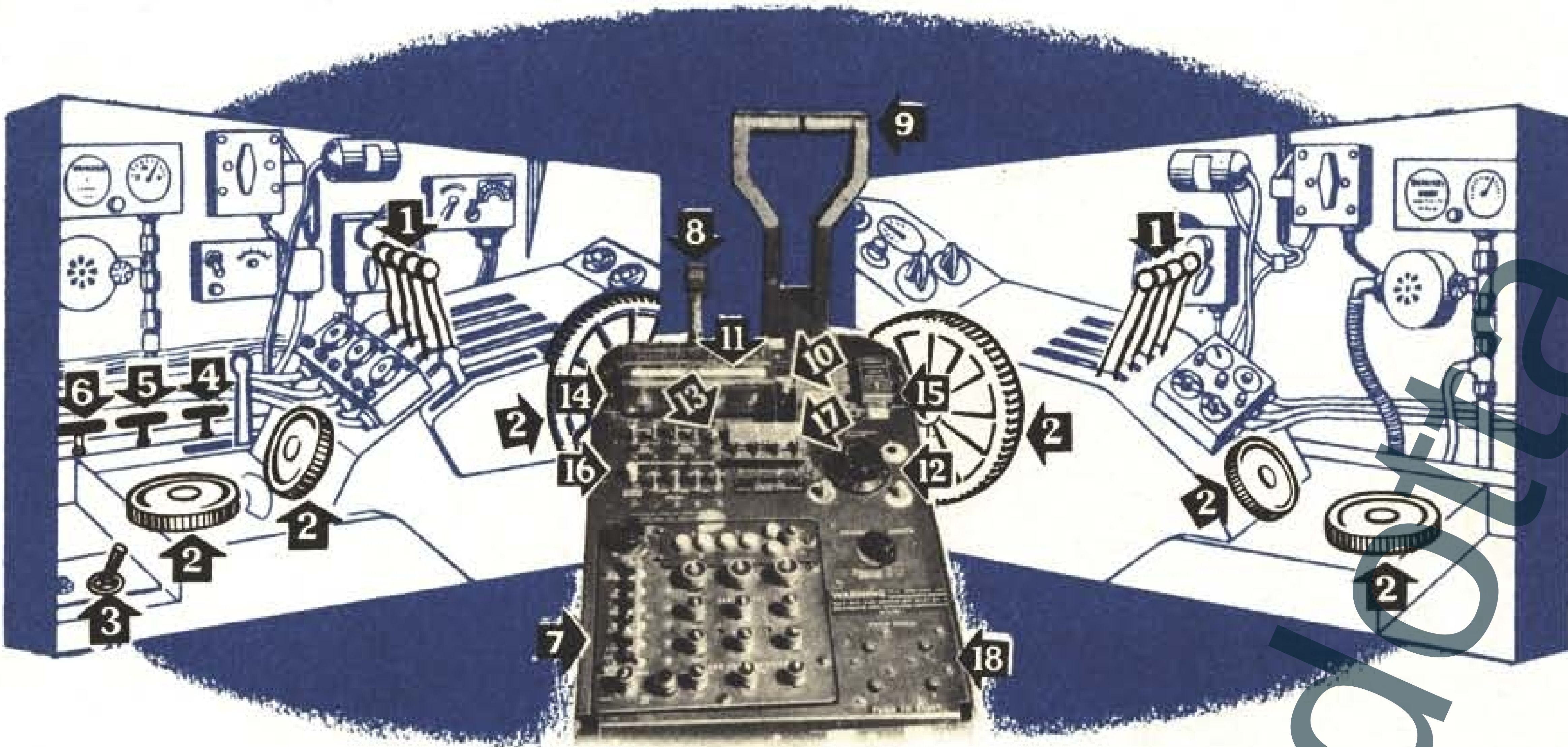
CAUTION



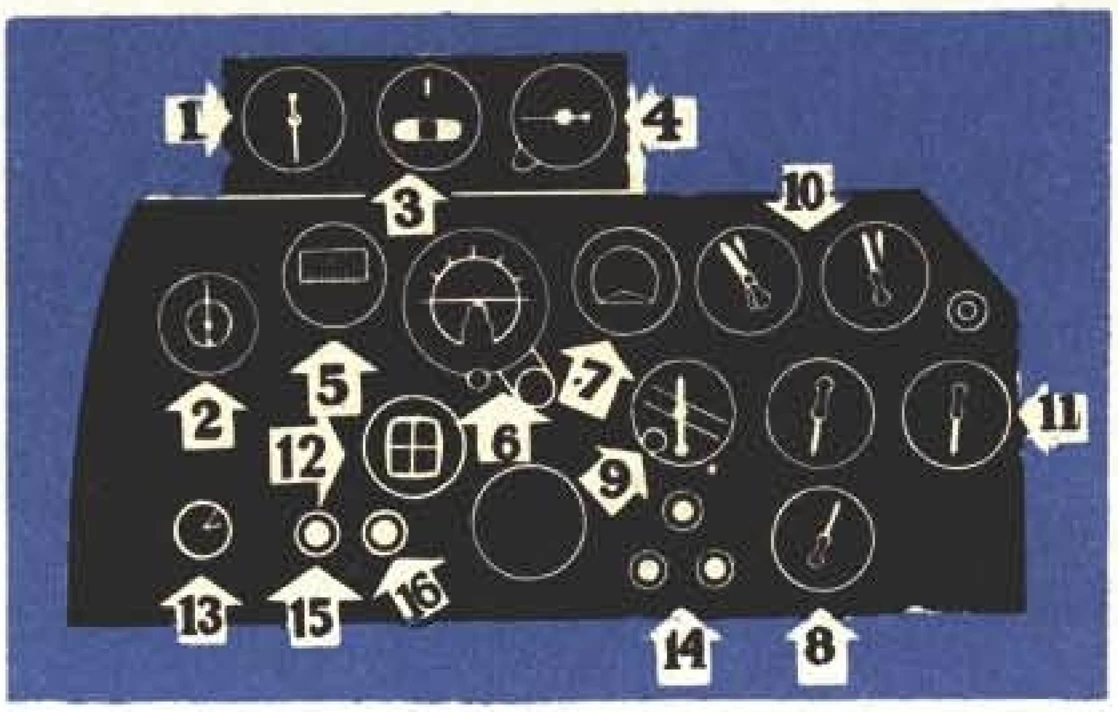
Both airplane commander and copilot have control stands on which throttles (1) and trim tab controls (2) are mounted. The landing gear transfer switch (3) and emergency cabin pressure (4) emergency bomb (5), and emergency landing gear door releases (6) are at the rear of the airplane commander's control stand.

The controls for the C-1 automatic pilot (7), the control surface lock (8), emergency brake levers (9), wing flap control switch (10), propeller feathering switches (11), turbo boost selector (12), phone-call signal light switch (13), alarm bell switch (14), landing gear switch (15), light switches (16), propeller increase and decrease rpm switches (17), and propeller pitch circuit breaker re-sets (18) are on the aisle stand to the right of the airplane commander's seat and within easy reach of the copilot.

Besides throttles, mixture controls, and fuel-tank selectors, the flight engineer's stand mounts the following engine controls and gages:

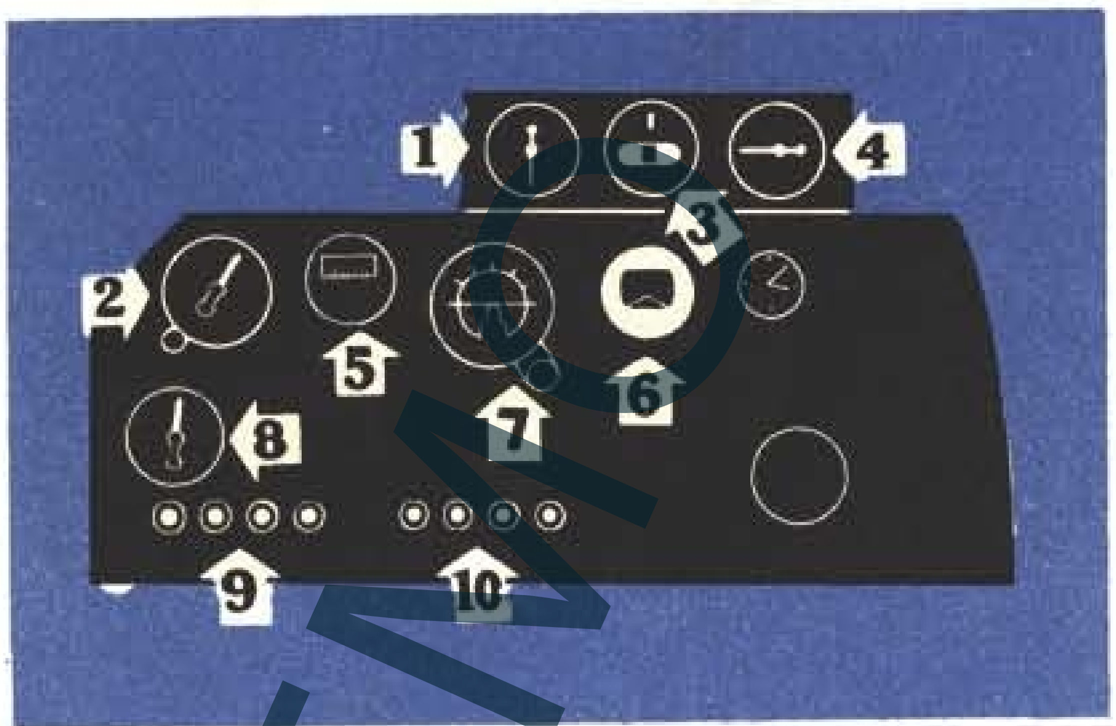
1. Cowl flap switches and indicators
2. Intercooler flap switches and indicators
3. Oil dilution switches
4. Starter switches
5. Oil cooler shutter switches
6. Pitot and prop anti-icer switches
7. Engine prime switches
8. Fuel shut-off valve switches
9. Fuel boost rheostats
10. Generator switches
11. Fuel transfer switches
12. Inverter switch
13. Hydraulic pump switch
14. Engine fire extinguisher controls and selector valve
15. Ignition switches
16. All engine, fuel, and oil gages
17. Two altimeters (outside and cabin)
18. Two rate-of-climb indicators (outside and cabin)
19. Airspeed indicator
20. Clock
21. Hydraulic pressure gages
22. Propeller anti-icer rheostats and switch
23. Suction gage
24. Emergency system filler valve
25. Landing gear spotlight switch
26. Cabin pressure warning horn switch
27. Cabin differential pressure gage
28. Cabin air rate-of-flow gages (2)
29. Battery switch
30. Fluorescent light rheostats
31. Cabin air conditioner switches
32. Free air temperature gage
33. Cabin air temperature gage
34. Vacuum selector lever

EXCEPT FOR MANIFOLD PRESSURE GAGES AND TACHOMETERS, THE INSTRUMENTS ON THE AIRPLANE COMMANDER'S PANEL ARE ALL FLIGHT INSTRUMENTS:



1. Airspeed indicator
2. Altimeter
3. Bank-and-turn indicator
4. Rate-of-climb indicator
5. Turn indicator
6. Gyro-horizon
7. Pilot direction indicator (PDI)
8. Radio compass
9. Flux gate compass
10. Manifold pressure gages
11. Tachometers
12. Blind-landing indicator
13. Clock
14. Turret warning lights
15. Bomb release indicator light
16. Vacuum warning light

THE INSTRUMENTS MOUNTED ON THE COPILOT'S INSTRUMENT PANEL ARE:



1. Airspeed indicator
2. Altimeter
3. Bank-and-turn indicator
4. Rate-of-climb indicator
5. Turn indicator
6. Magnetic compass
7. Gyro-horizon
8. Flap position indicator
9. Propeller rpm limit indicator lights
10. Landing gear indicator lights

The flight controls are conventional and the forces necessary to move them are light, even at high flying speeds—a surprising fact to most pilots the first time they fly the B-29. **The elevators** are similar to those on the B-17. **The ailerons,** although considerably larger than those on the B-17, are so rigged that they can be easily moved 18° up or down. **The rudder** gives maximum possible control and yet can be moved easily without the use of power boosts.

Wing flaps and **tricycle landing gear** are lowered and raised by reversible electric motors. The Fowler-type flaps, which provide lift and drag, travel on track and roller mechanisms in such a manner that they project beyond the trailing edge of the wing when they are extended. Under normal operation the landing gear can be lowered in 40 seconds.

INSPECTIONS AND CHECKS

With any airplane, inspections and checks are important factors in efficient operation. With the B-29, because of its size and complexity, they are more important than ever. Don't ignore them.

Go over your airplane before every mission and after every mission. Make sure each crew member inspects his own station. Check and double-check. As airplane commander you are responsible for all checks.

Before Entering Airplane

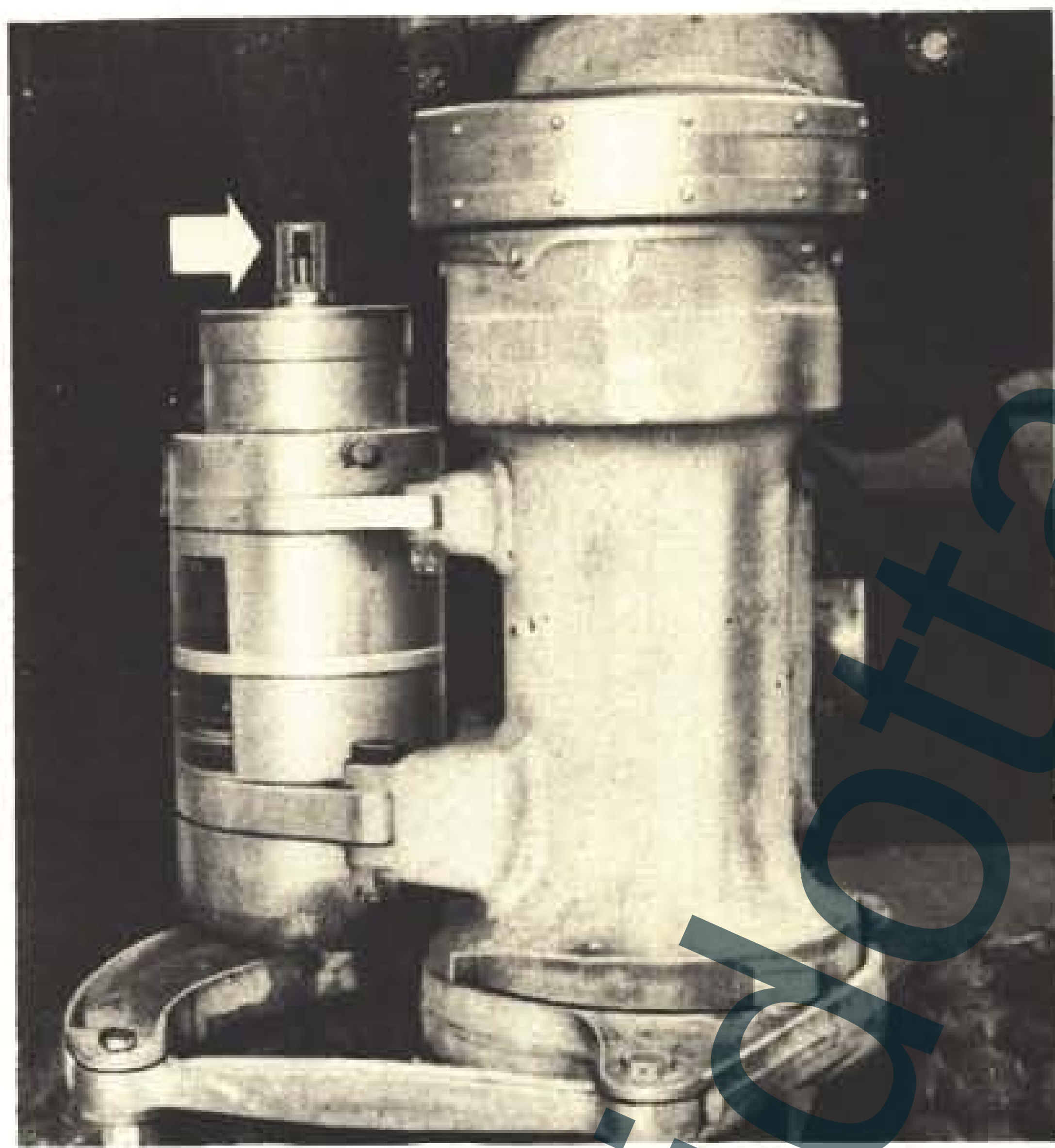
Before you climb into your airplane, go over the outside of it thoroughly. Have your copilot make the inspection with you, and pay particular attention to the following:

1. Condition of tires—examine carefully for cuts and slippage.

2. Wheel chocks—2 inches in front of inboard tires and 2 inches behind outboard tires.

3. Oleo struts—13¼ inches between pin centers on main gear, 10 inches on nose gear.

4. Hydraulic lines—check for leaks.



5. Shimmy dampener—check oil level. Top of pin should be even with groove.

6. Engine fire extinguishers—check red disk at end of line running down from each CO_2 bottle (nosewheel well). If the bottle has been accidentally discharged, the red disk is missing.

7. Gear motor and door motor cannon plugs—check each plug for looseness. If the rotating collar is not screwed tight, engine vibration can shake loose the cannon plug connection.

8. Cables on main wheel well doors—cables should be on pulleys and free of obstructions.

9. Pitot tube covers off.

10. All fastenings on inspection plates and engine cowlings should be tight.

11. See that engines and nacelles are free of oil and grease. Oil or grease is a fire hazard. Have it cleaned off before making the flight.

12. Inspect control surfaces and trim tabs for dents or damage.

13. Inspect all windows and blisters for cracks and dirt.

14. Check all seams and connections for fluid leaks.

After you have finished the visual outside check and before you perform your crew check, climb into the airplane, make sure that all switches are off, and instruct your crew to pull the propellers through preparatory to starting. If the airplane has been standing more than 30 minutes, each propeller should be pulled through at least 12 blades with no more than two men on each blade. If a propeller sticks, remove the plugs from the bottom cylinders, pull the propeller through to remove the excess oil from the cylinders, install clean plugs, and pull the propeller through again. NEVER attempt to relieve a liquid lock by applying pressure against the propeller or by pulling the propeller backwards.

Note

Prompt detection of liquid lock can prevent a late takeoff. As soon as the crew reaches the airplane they should check the ignition switches and pull each propeller through four blades.

After the propellers have been pulled through 12 blades each, you are ready to inspect your crew. Check each crew member for his physical condition, personal clothing, and equip-

8. EMERGENCY LANDING GEAR DOOR RELEASE IN PLACE

Airplane commander sees that the T-handle is in its proper position. Pulling this handle releases the nacelle doors only.

9. EMERGENCY BOMB RELEASE IN PLACE

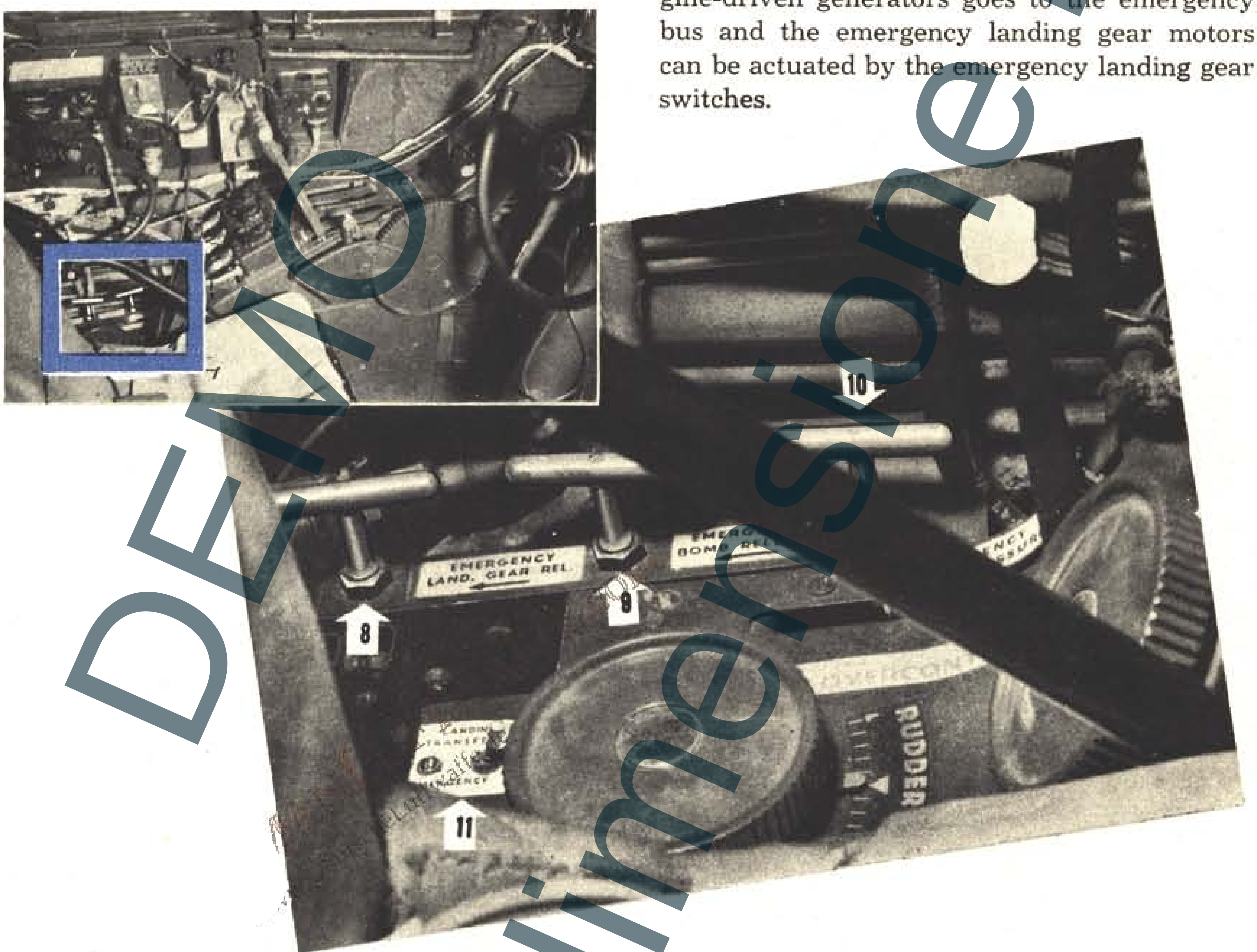
T-handle on airplane commander's control stand.

10. EMERGENCY CABIN PRESSURE RELEASE IN PLACE

T-handle on airplane commander's control stand.

11. LANDING GEAR TRANSFER SWITCH—NORMAL

Airplane commander sees that switch (airplane commander's control stand) is in the NORMAL position. In this position, the main landing gear and nosewheel are operated by the landing gear switch on the aisle stand. When the landing gear transfer switch is in the EMERGENCY position, power from the engine-driven generators goes to the emergency bus and the emergency landing gear motors can be actuated by the emergency landing gear switches.

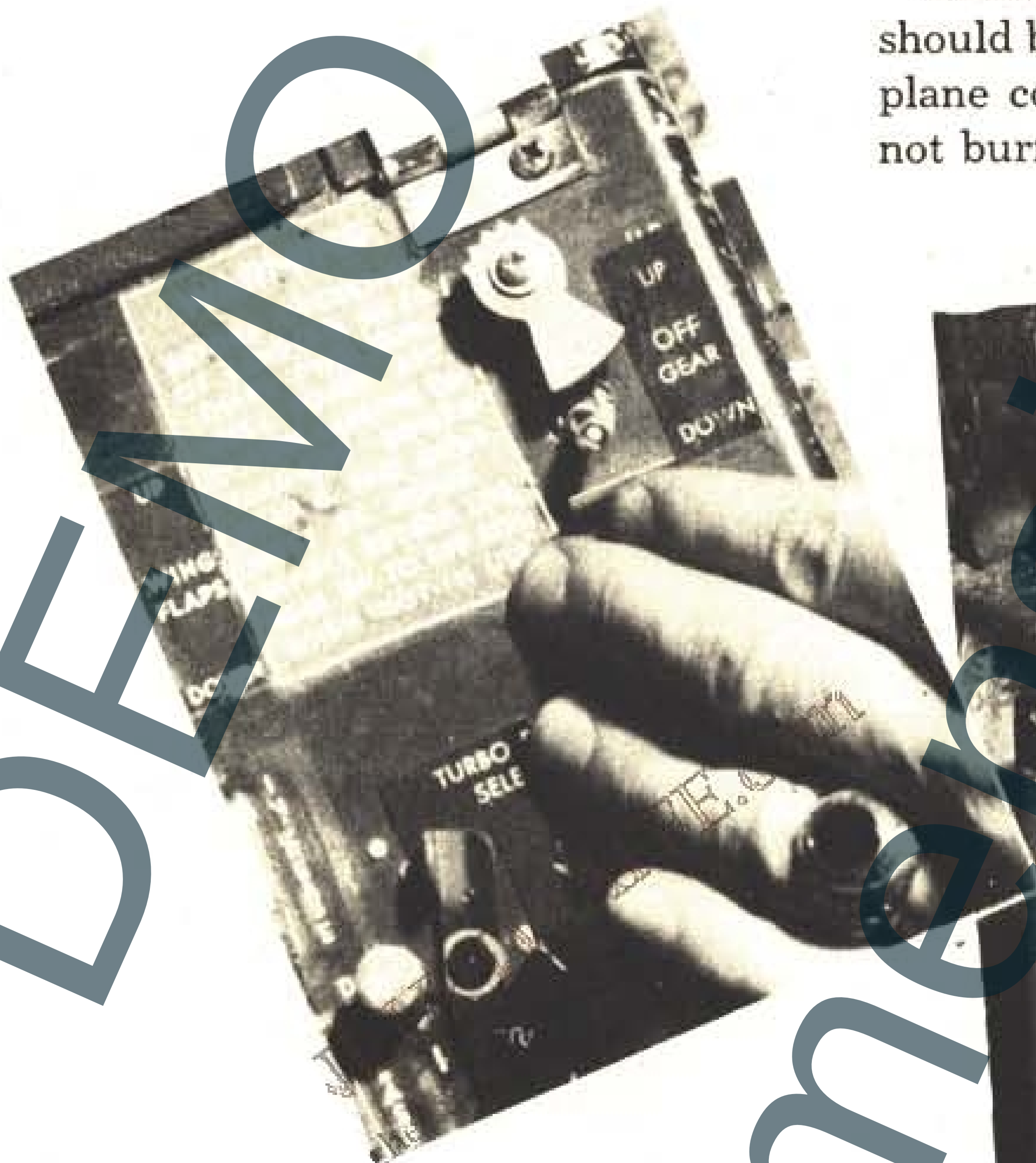


12. OVERCONTROL ENGAGED

Airplane commander sees that the lever (on airplane commander's control stand, but eliminated in later models) is in the ENGAGED position (full forward). This engages the flight engineer's throttles.

13. LANDING GEAR SWITCH NEUTRAL AND FUSE CHECK

Switch (airplane commander's aisle stand) should be neutral. Check to see that fuse in airplane commander's aisle stand is in place and not burned out.



14. BATTERY SWITCH ON

Flight engineer flips battery switch ON and notifies the airplane commander. All electrical circuits are energized by either the battery or the auxiliary power unit, or both. Both are used for normal ground operation on loads up to 200 amperes. For additional power, use an external power source or engine-driven generators.

15. PUTT-PUTT STARTED

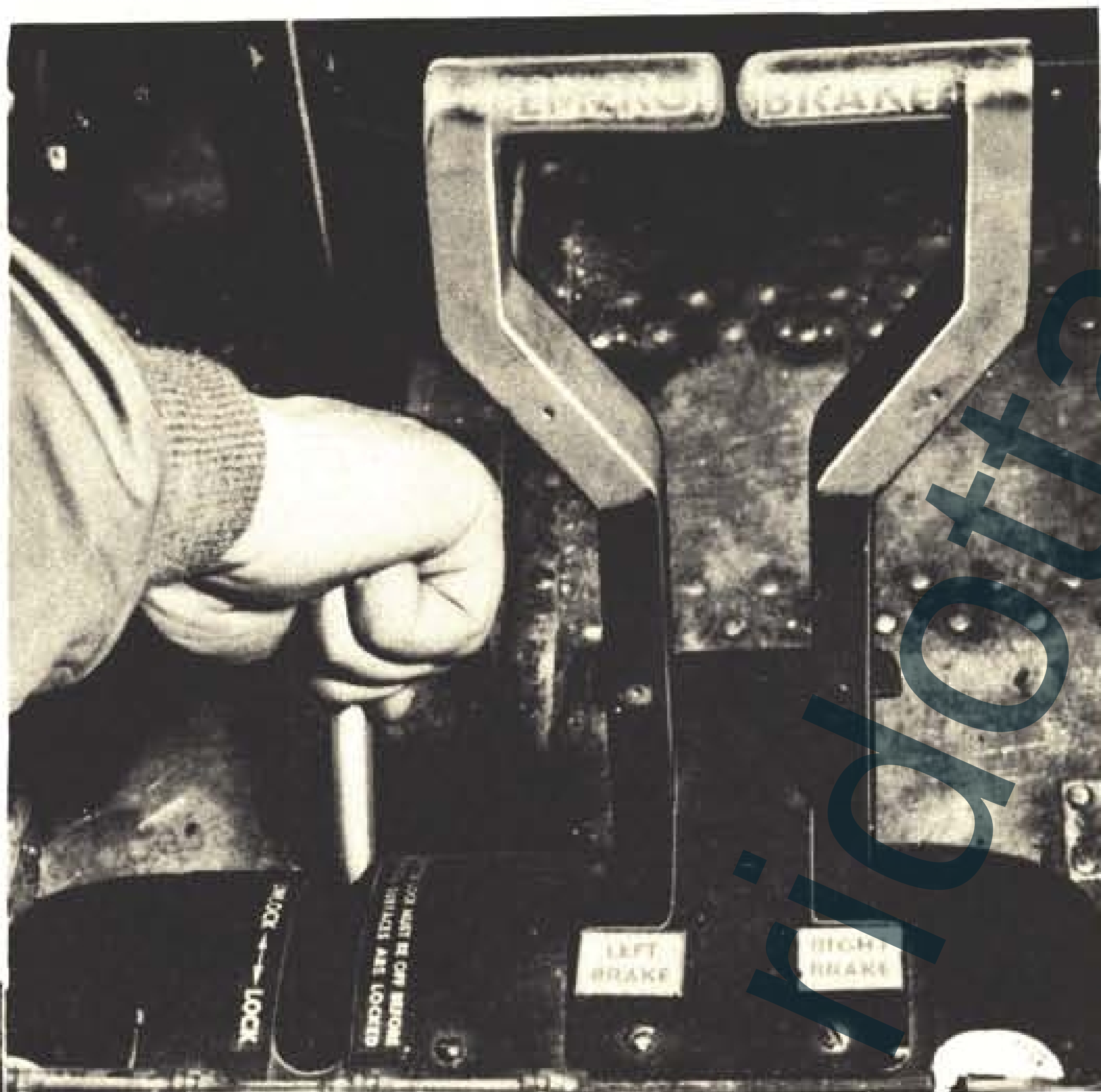
Copilot tells tail gunner to start the putt-putt.

16. HYDRAULIC PRESSURE O.K.

The copilot asks the flight engineer to check the emergency hydraulic pressure on engineer's panel (900-1075 psi) and checks the hydraulic pressure gage on his own instrument panel for a pressure of between 800 and 1000 psi. A fluctuating needle indicates a faulty pressure regulator. If the hydraulic pump overheats and smokes, remove the fuse on the flight engineer's aft fuse panel. To prevent overheating, make sure that pump stops when pressure reaches 1000 psi.

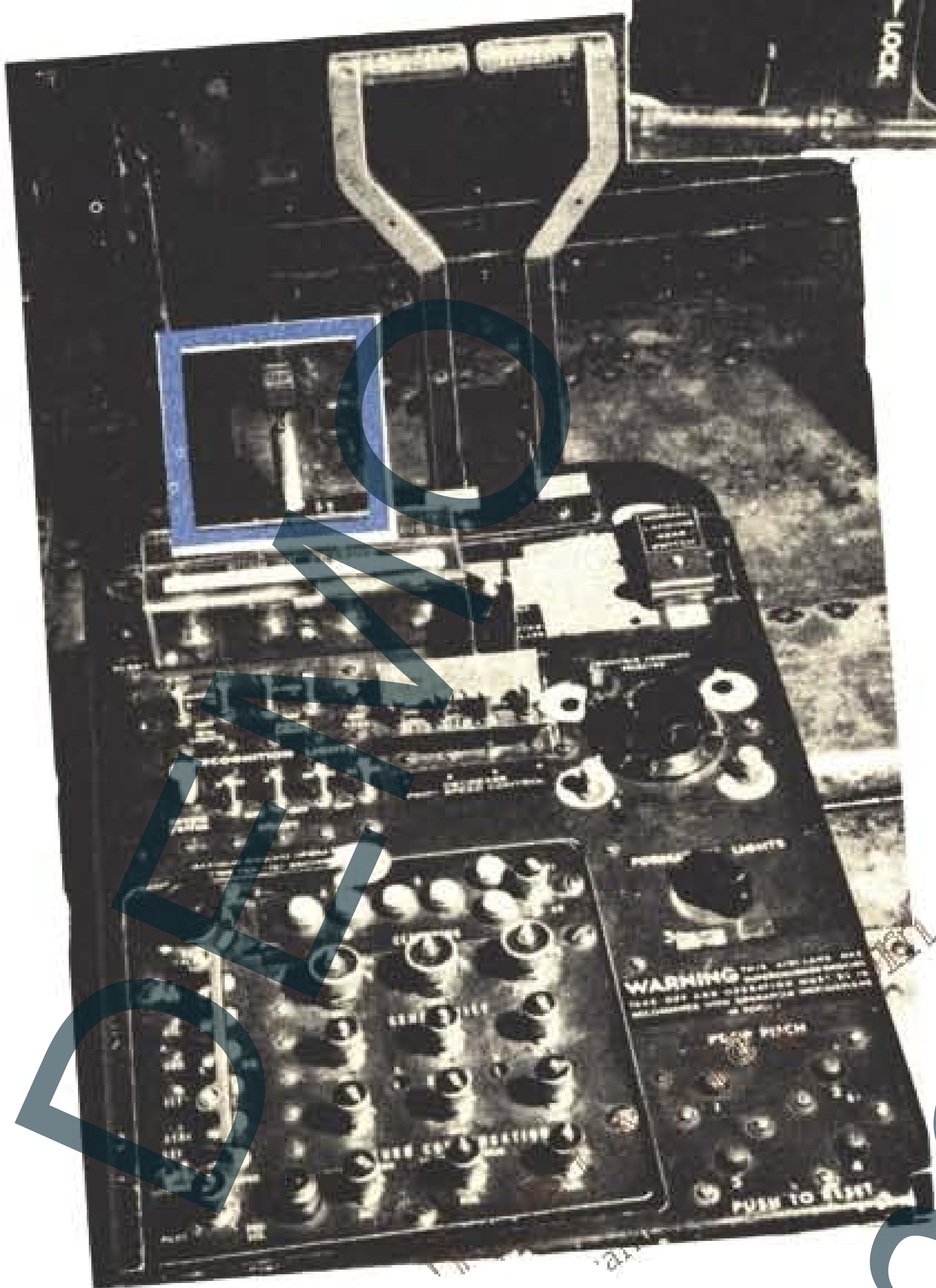
Warning

If an expander tube breaks while taxiing, use the emergency brakes only. Use of both normal brake pedals at the same time provides no braking on either side and allows all fluid and pressure in the normal system to drain through the broken tube. Use of both emergency brakes at the same time provides 100% braking on the good side (left gear, for example) and 50% braking on the bad side (right gear, for example). By switching the hydraulic servicing valve (flight engineer's panel) to emergency, you can maintain pressure and fluid indefinitely in both the normal and emergency systems. In those cases where you lose all fluid and pressure in the normal system, check valves prevent loss of fluid in the emergency lines, regardless of the position of the hydraulic servicing valve, and these lines hold enough fluid for approximately three applications of the emergency brakes.



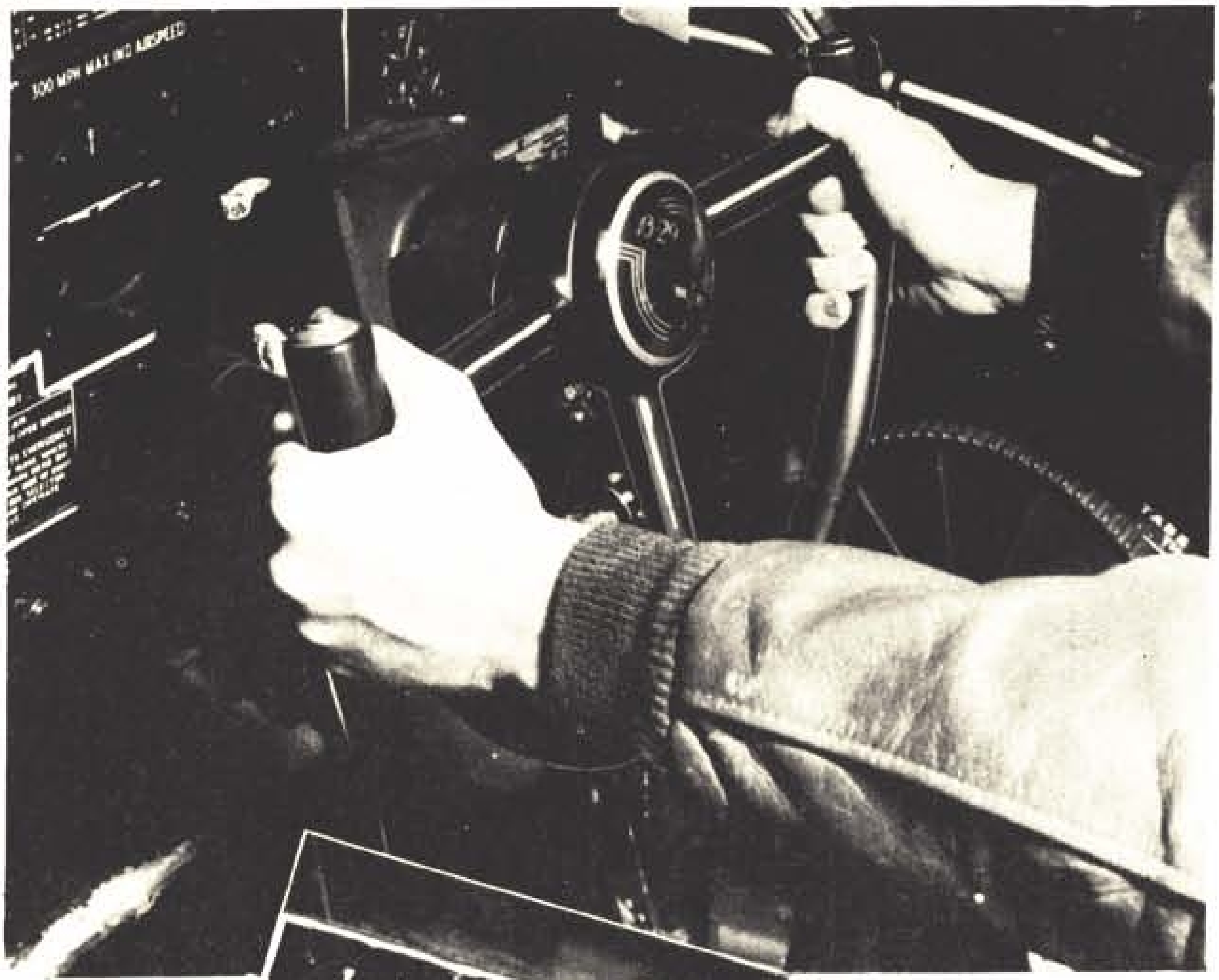
Note

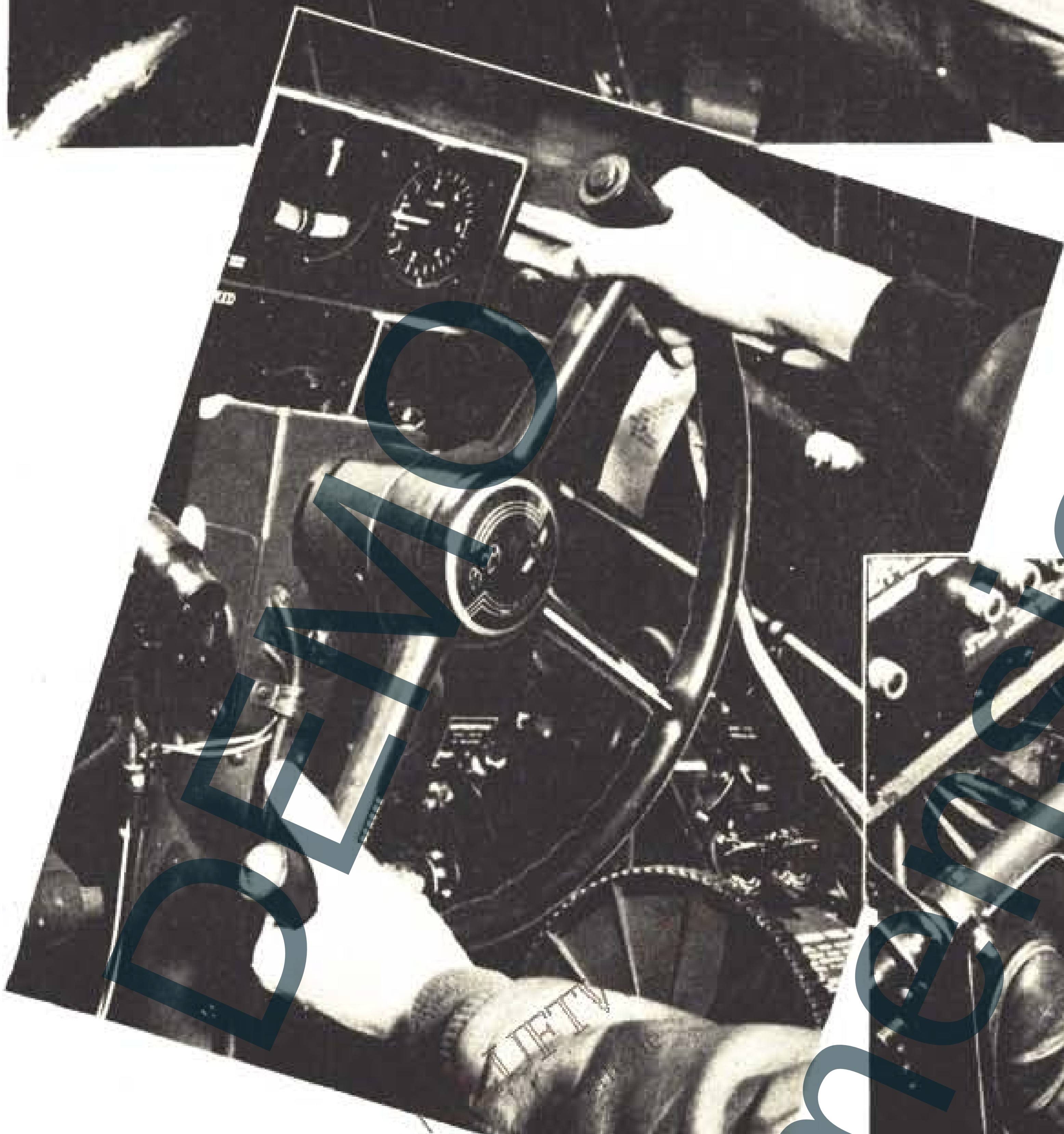
Make sure control lock is pushed all the way down and locked. Check to make sure it is locked.

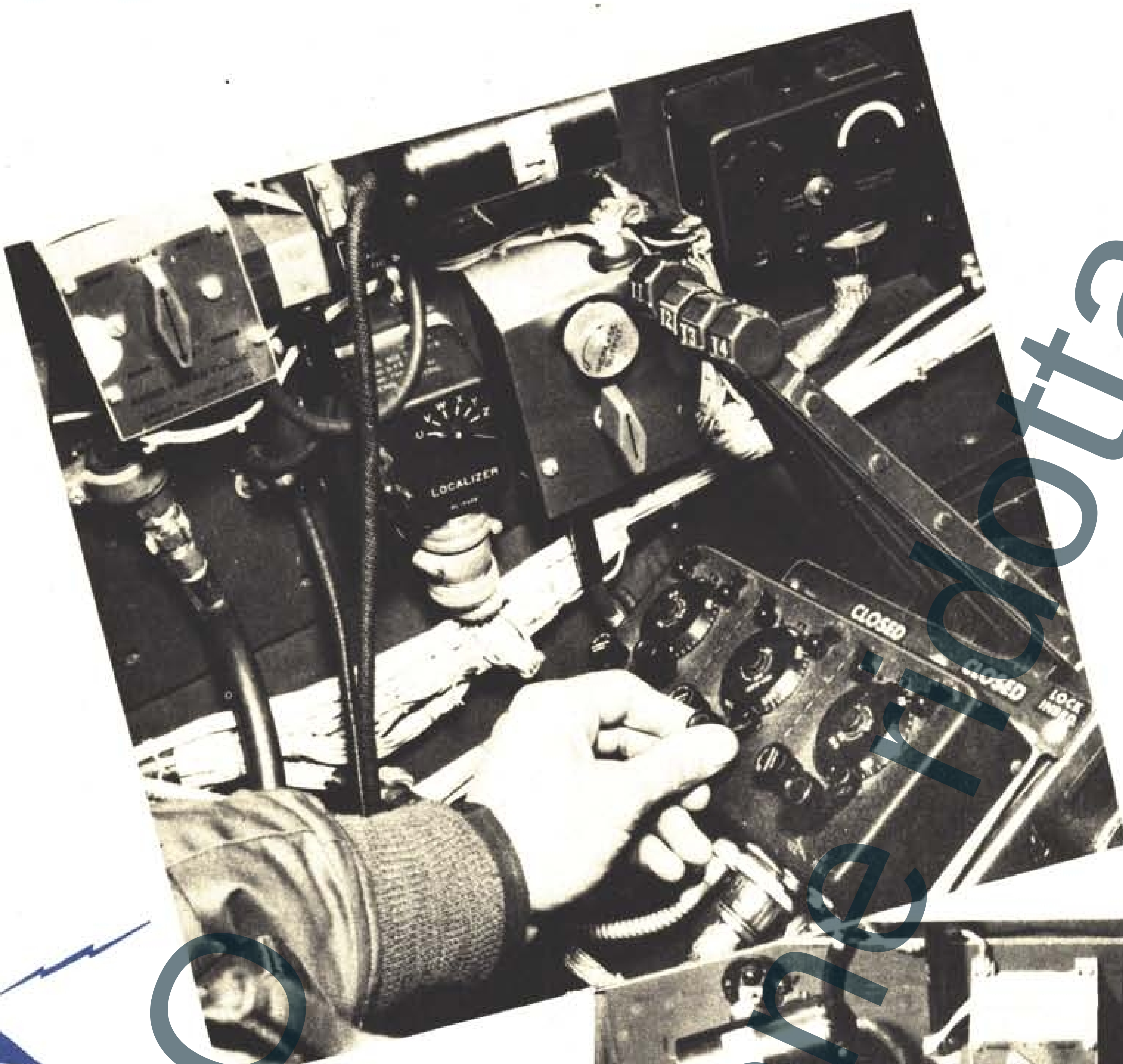


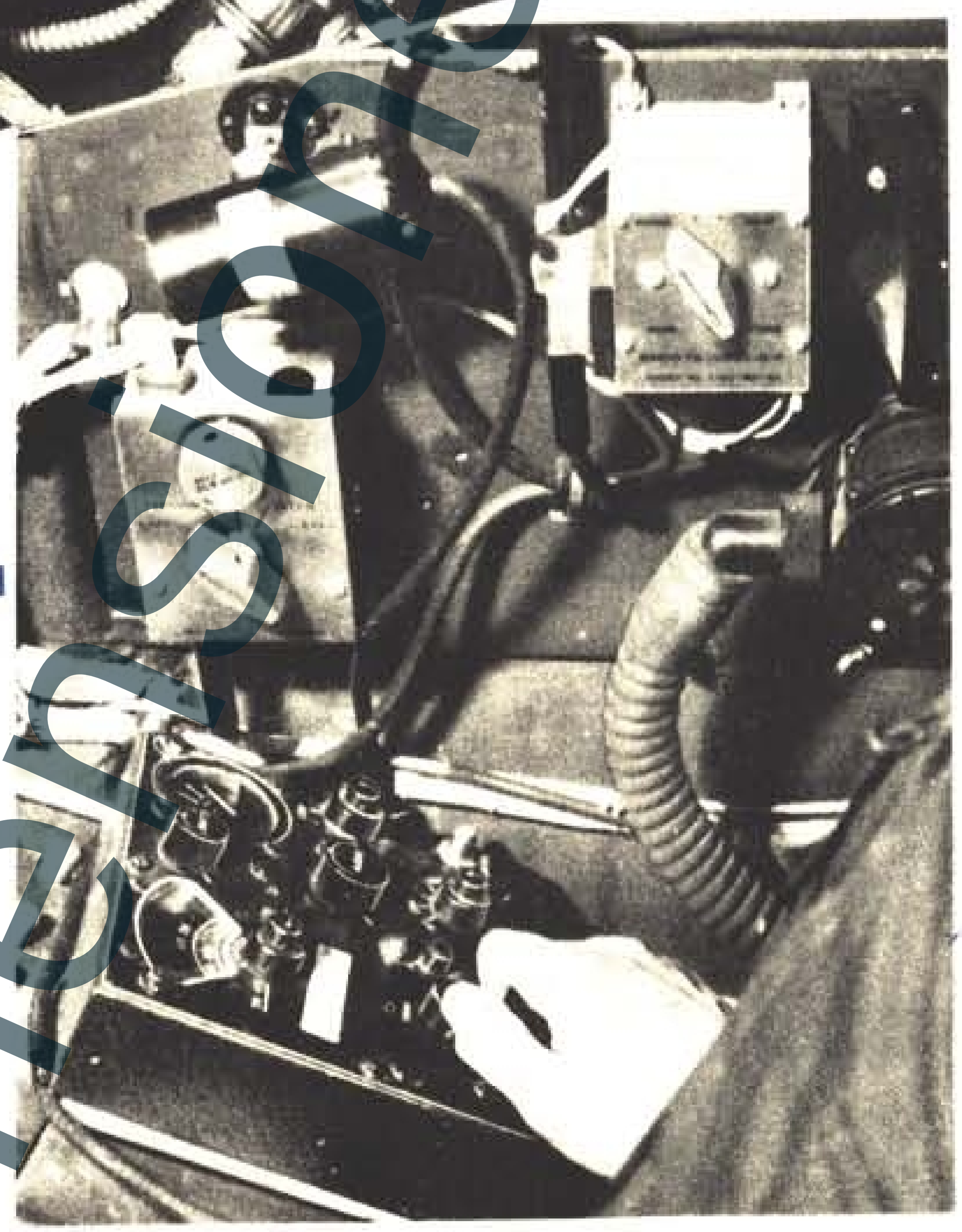
17. FLIGHT CONTROLS CHECKED

Airplane commander pushes down locking lever located at forward end of airplane commander's aisle stand. This also unlocks the throttles, which a lock bar holds in the closed position when the control lock is on. This lock bar is linked to the control lock in such a way that strong forward pressure on the throttles forces the control lock off and eliminates the possibility of locked controls on takeoff. The copilot makes the control check. In making the check, the copilot announces over the interphone, "Copilot to gunners, stand by to check controls." He then pulls the control column back and says on interphone, "Check elevators." Left gunner answers, "Left elevator up, sir." Right gunner answers, "Right elevator up, sir." The copilot then pushes the column forward and completes his check on the elevators. Ailerons and rudder are checked in the same manner.









18. RADIOS CHECKED

While the copilot is checking flight controls, the airplane commander turns on his command set and requests and receives taxi information. Copilot, after checking controls, turns on radio compass and checks for proper operation. He then turns radio compass off and stands by on the interphone so that he can be in continuous contact with the crew.

19. ALTIMETERS SET

Airplane commander and copilot set their altimeters by the tower altimeter setting. Check the altitude reading against the known field elevation. If the altimeter setting given by the tower indicates an altitude different from the known field elevation, check the setting again and note the difference in elevation so you can use it in correcting the reading when landing.

20. TURRETS STOWED

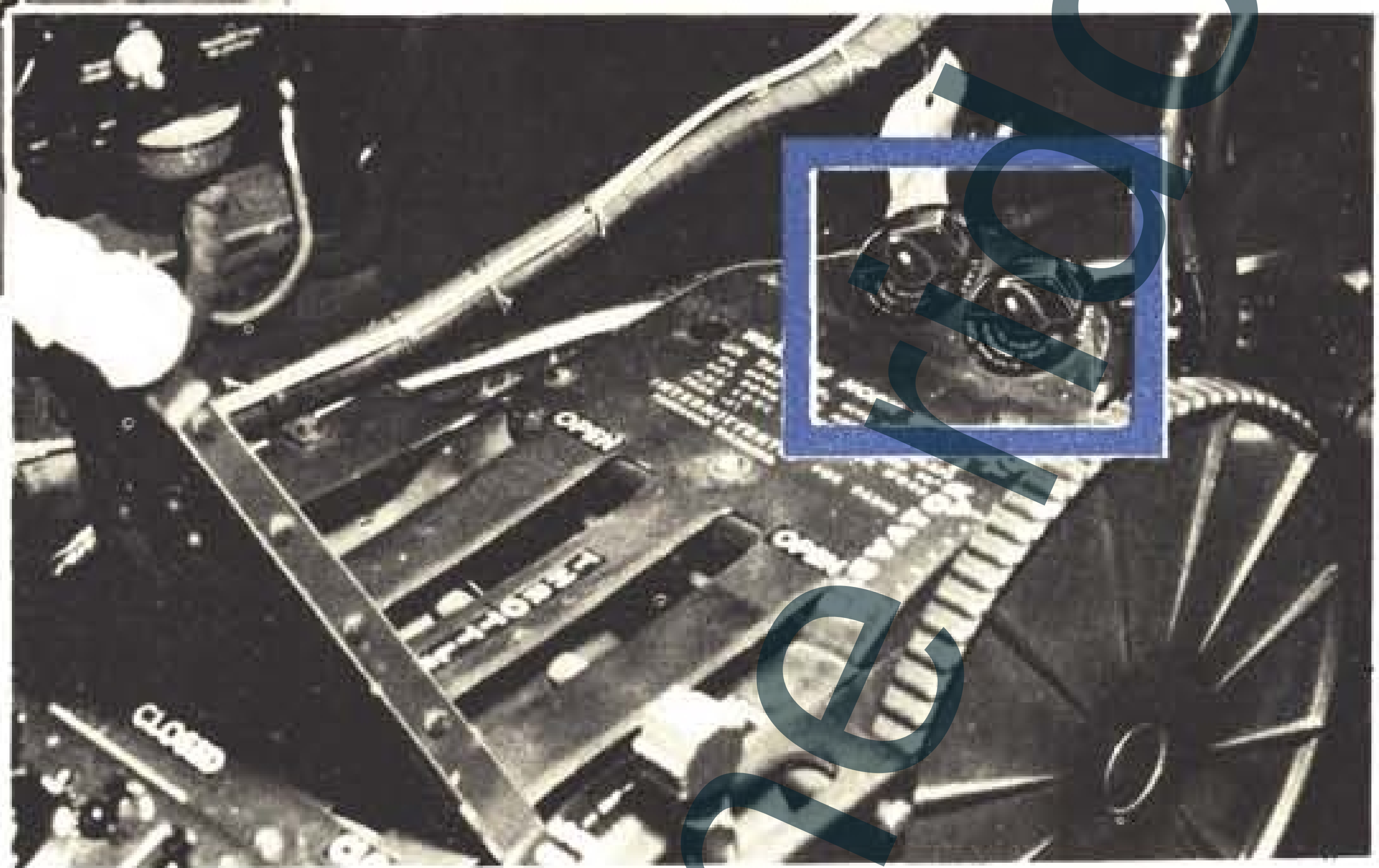
Airplane commander checks the three turret warning lights on his instrument panel to see that all turrets are properly stowed. Turret lights should be **out.**

21. ADJUST SEATS AND PEDALS

22. LIGHTS-CHECKED

If any night operation is contemplated on the flight, check all lights—fluorescent lights, identification lights, landing lights, and position lights (switches on control and aisle stands). A member of the ground crew should be instructed to check the landing lights and position lights. Wing position lights are not visible from the airplane in flight. They can be inspected at night from inside the airplane only by checking the reflection on the ground under the wing.

FLUORESCENT LIGHTS



23. OXYGEN O.K.

Airplane commander and copilot check their oxygen pressure gages for proper pressure (400 to 425 psi) and their walk-around bottles (should have same pressure as in system). Auto mix should be on ON, emergency valve OFF.

24. PROPELLERS HIGH RPM

Copilot pushes the propeller switches (aisle stand) to INCREASE RPM and holds them there until the propeller limit lights on his instrument panel flash on. The propellers then will be in high rpm.

25. TURBOS OFF

Airplane commander checks to see that the turbo selector dial is set at 0. Turbo-supercharger regulators are ready for instant operation at any time since amplifier tubes remain on even with selector dial at 0.

◀ TURBOS OFF

26. FLIGHT ENGINEER'S REPORT - CHECKLIST COMPLETE, READY TO START ENGINES

At this point, if the flight engineer has not completed his checklist, the airplane commander waits before giving the command to start engines.

27. STAND CLEAR - FIRE GUARD - CLEAR LEFT - CLEAR RIGHT

When ready to start the engines both the airplane commander and the copilot give the command "Stand clear" to the ground crew (clear right, clear left). When the fire guard is ready, copilot says on interphone, "Stand by to start engines."

Starting the Engines

The engines are started in 1, 2, 3, 4 order. The airplane commander tells the flight engineer to start No. 1 engine and signifies to the ground crew that No. 1 engine is ready to be started. The number of fingers held up by the airplane commander in case of engines 1 and 2 and the copilot in case of engines 3 and 4 signifies the number of the engine to be started. When the engine starts, the flight engineer ordinarily reports "Engine operating normally" and announces that he is "Ready to start No. 2 engine." Follow a similar procedure for the other engines.

In starting each engine, the flight engineer uses the following procedure:

a. Turns fire extinguisher to the engine being started.

b. Turns master ignition switch on.

c. Turns the boost pump on.

d. Energizes starter for from 12 to 16 seconds.

e. Moves starter switch to START position.

f. After propeller has made one revolution, turns ignition switch on and holds the primer down as needed to start and smooth out engine at 800-1000 rpm.

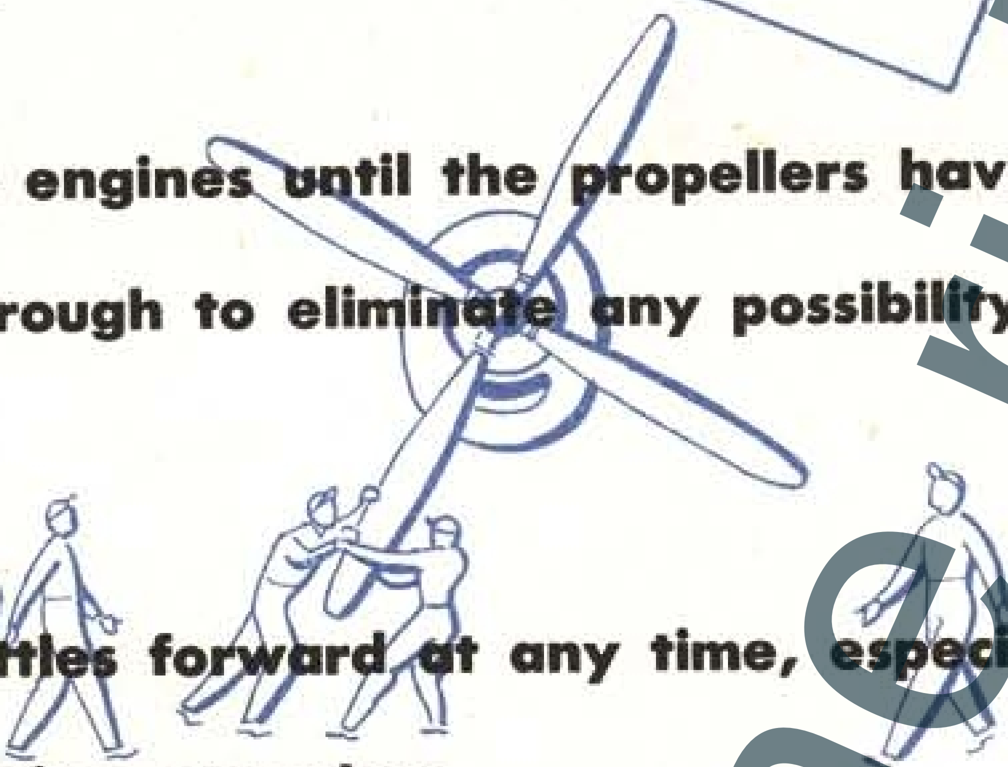
g. Moves mixture control to AUTO-RICH.

The flight engineer handles the throttles throughout the starting procedure, keeping the rpm between 1,000 and 1,200. When an engine is running, the flight engineer sets the throttle at 700 rpm (1,000 rpm if the cylinder-head temperature is below 150°C). Thereafter, the airplane commander will control the throttles except when asking for engine-driven generators and during the engine run-up. If either the copilot or the flight engineer sees that an engine is loading up (black smoke or rpm drop or both) he informs the airplane commander. Do not idle engines below 700 rpm.

STARTING DONT'S

1. Don't start the engines until the before-starting check has been covered item by item.

2. Don't start the engines until the propellers have been pulled through to eliminate any possibility of liquid locks.



3. Don't jam throttles forward at any time, especially during the starting procedure.

4. Don't start your engines until a fire guard is posted.

5. Don't continue to run an engine if the nose oil pressure and rear oil pressure do not build up within 30 seconds after starting.

Before Taxiing

CHECK GYRO INSTRUMENTS

1. VACUUM

The copilot asks the flight engineer to check vacuum reading. The flight engineer, after checking the vacuum reading for both pumps (gage on engineer's panel should read 3.8" to 4.2" Hg), reports this check to the copilot.

WARNING: Do not move the vacuum selector valve (engineer's control stand), except when making this check. Frequent use of the valve will cause unnecessary wear.

2. GYROS

Airplane commander and copilot check their gyro instruments to make sure that they are uncaged and operating correctly. At this time, set the directional gyros to agree with the magnetic compass reading.

3. INSTRUMENTS

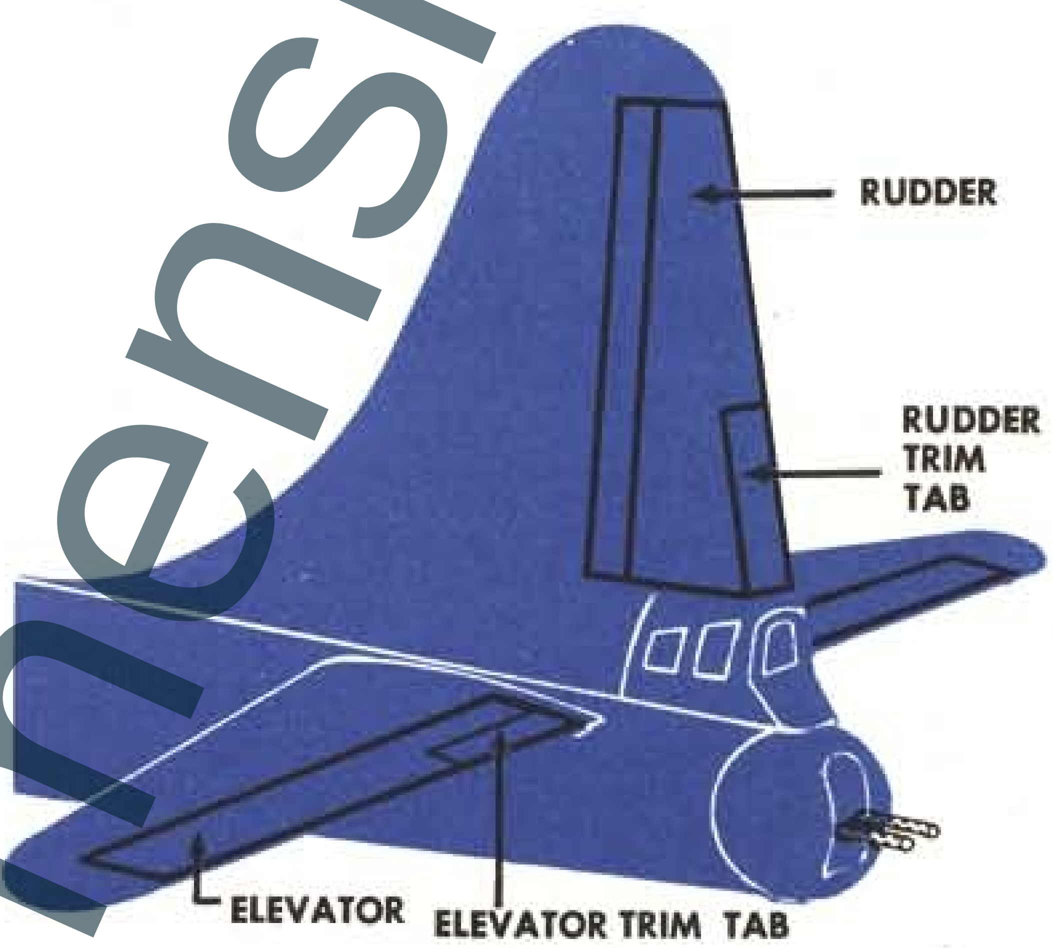
Airplane commander and copilot check their respective instrument panels for proper readings and operation of all instruments.

FLIGHT CHARACTERISTICS

Even with its large size and weight, the B-29 has just about the same flying qualities as smaller aircraft. Large aircraft are usually slower in responding to the pilot's controls because of their larger inertia. The control forces on the B-29 are light, and even at low flying speeds the combination of light forces with the high inertia of the airplane seldom gives the pilot any impression of sluggishness or lack of control. Just after taking off, and again during the short interval of time while landing, the rudder and the aileron control response is slow but it is still positive. The controls are as good and in many ways better than those of many small aircraft.

ELEVATORS

The elevator control is almost exactly like that on the B-17. The size of the horizontal tail is exactly the same except that the B-29 elevators have a little more balance and the nose of the tail airfoil section is turned up so that the tail does not stall when making a power-on approach to a landing with the flaps full down. Elevator trim tab is extremely sensitive in high-speed dives, and you must be careful not to over-control the airplane when flying with the trim tab. Overloading of the tail surfaces and other portions of the airplane may occur. Also, avoid diving in rough air.



AILERONS

The ailerons are large and can move the largest possible amount (18° up or down), so that the pilot has good control. The control wheel travel is greater than that now on the B-17. This extra control is valuable if an engine fails just after takeoff; or when, for some reason, fuel is used on one side of the airplane only and the other wing gets heavy. The effect of unbalanced amounts of fuel in the two sides is noticeable in the aileron control when flying straight and level. If you allow the speed to approach the stalling speed, the amount of aileron needed to offset uneven wing weights increases rapidly. Don't attempt a landing when this unevenness exists until you check the aileron control in flight at the landing speed.

The aileron trim tabs are geared to move when the ailerons move. The shape of the wing airfoil contour is such that the part covered by the ailerons has a hollow on top and is full on the bottom. If the control cables are cut during combat, the ailerons would ordinarily trim down because of this shape. To avoid this, the trim tabs are rigged down 1 inch at the trailing edge to trim the ailerons more nearly neutral if a cable is cut or broken.

RUDDER

The rudder gives the maximum possible control and stability, yet it can be moved without the help of power boosts. The diamond shape of the rudder is the result of studies made to find a rudder which behaves normally under all flight conditions. A good rudder is one that can be moved with a small amount of effort when an engine fails at any speed and does not become overbalanced or locked. Don't be confused by the light B-29 rudder forces—they do

PRACTICE STALLING AT NOT MORE THAN 15" HG.

ALTITUDE AND FLIGHT PATH OF A B-29 IN A STALL not tell you what the rudder is doing to the airplane. In landing approach conditions, it is possible to get an appreciable amount of skid with slight effort. Remember, it takes a certain amount of time to skid a large airplane and also to stop the skid.

When you trim the rudder, trim it to obtain equal pedal pressures.

STABILITY

The longitudinal stability of the B-29 is normal for all conditions. For good flying characteristics, however, the center of gravity (CG) must be kept within the allowable limits. The forward center of gravity limits are fixed by structural strength, and the elevator control for these forward limits is good for all normal operations. The most rearward center of gravity limit is determined by the longitudinal instability which occurs at climbing power. Going aft of this limit makes the airplane difficult to fly and decreases the safety of the airplane.

Make every possible effort to keep the center of gravity within the design limits and to keep the gross weight of the airplane to the absolute minimum for the mission to be performed. Use a weight-and-balance slide rule before and during every flight.

Stalls

The stall characteristics of the B-29 airplane are entirely normal. In practice, stall the airplane at not more than 15″ Hg. As it approaches the stall, a noticeable lightening of the elevator loads occurs. It is necessary to move the controls an appreciable amount to get a response from the airplane. There is rudder and elevator control during the actual stall, but no aileron control. Just before the full stall is reached, a shuddering and buffeting of the airplane occurs. The airplane recovers from the stall normally and has no excessive tendency to drop off on one wing when the stalls are properly controlled. Power reduces the stalling speed but, in general, has no great effect upon the stall.

Never fly below the power-off stalling speed, since any loss in power when flying below this speed is likely to put the airplane into a violent stall. On all landing approaches, be extremely careful not to allow the speed to fall below the power-off stalling speed. Try power-off approaches whenever possible in order to become familiar with the airplane under emergency conditions. Never use power to reduce your landing speed.

When the airplane stalls, always recover by **first nosing the airplane down** and then increasing the power. Never apply power at the stall without first dropping the nose. In most aircraft, it is possible to obtain a high rate of descent by applying power during the power-off stall without dropping the nose. **Avoid these conditions in the B-29.**

POWER-OFF STALLING SPEEDS

GROSS WEIGHT	INDICATED STALLING SPEEDS		
	FLAPS UP	FLAPS 25°	FLAPS FULL
140,000 POUNDS	145 mph	131 mph	119 mph
130,000	140	125	114
120,000	135	121	110
110,000	129	115	105
100,000	123	110	100
90,000	117	104	95
80,000	110	98	89
70,000	103	92	84

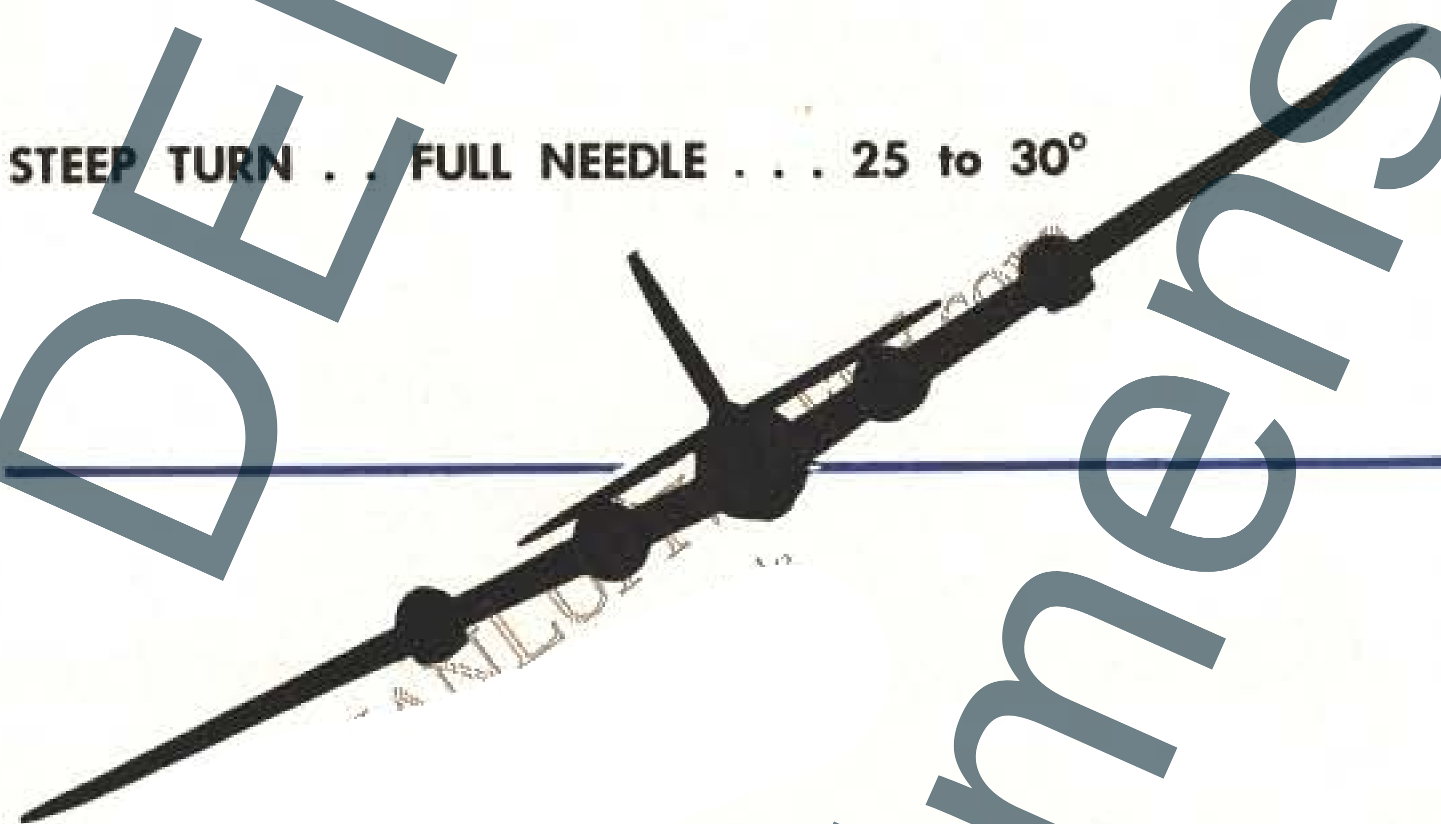
WARNING: DO NOT STALL THE AIRPLANE WITH THE COWL FLAPS OPEN MORE THAN 10°

Turns

In spite of its size and weight, the B-29 has good maneuverability. It controls easily and turns easily:

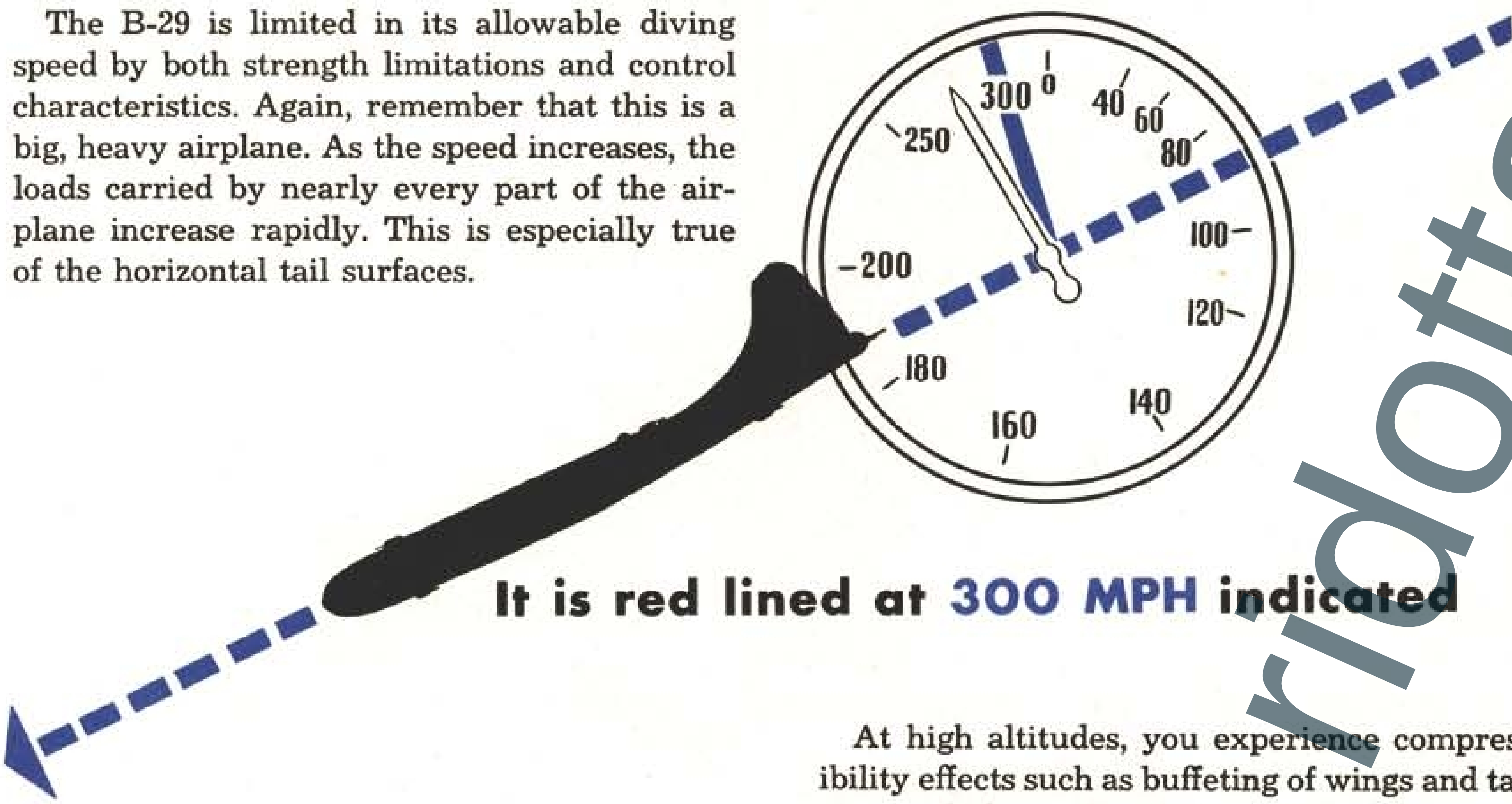
SHALLOW TURN . . ½ NEEDLE . . . 12 to 15°

STEEP TURN . . FULL NEEDLE . . . 25 to 30°



Dives

The B-29 is limited in its allowable diving speed by both strength limitations and control characteristics. Again, remember that this is a big, heavy airplane. As the speed increases, the loads carried by nearly every part of the airplane increase rapidly. This is especially true of the horizontal tail surfaces.



It is red-lined at . . . . . . 300 mph, indicated.

This speed is sufficiently above the level-flight, top speed of the airplane to cover most diving needs.

At high altitudes, you experience compressibility effects such as buffeting of wings and tail, extremely large elevator trim changes, and control ineffectiveness. For this reason, when flying at high altitude, reduce the red-line speed in accordance with the "altitude-in-thousands—maximum airspeed" table mounted beside the airspeed indicator.

Dead-Engine Characteristics

In straight and level flight, normal power, with one engine feathered and power balanced, the flight characteristics of the B-29 differ little from those of normal 4-engine operation. When turning into a dead engine to the extent of a 180° full needle-width turn, maintain a speed at least 20 to 25 mph, indicated, greater than the power-off stalling speed of the airplane. To avoid trouble, never turn into a dead engine at less than 150 mph, indicated.

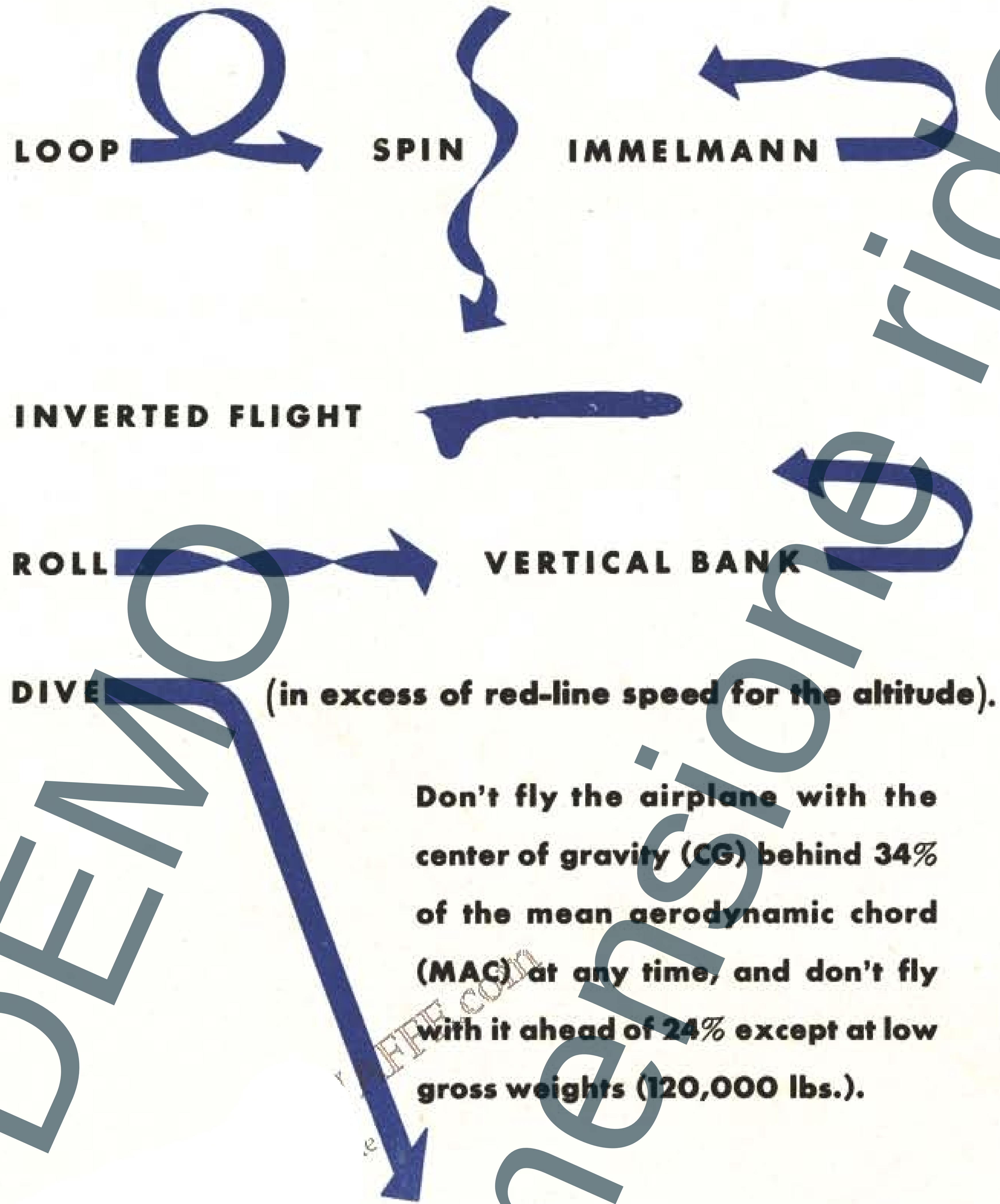
If two engines on the same side are out, the airplane has a tendency to roll and yaw. To keep lateral trim, apply aileron; the airplane then crabs, necessitating the use of rudder. It is possible to fly with two dead engines with good control at low weights at speeds down to 150

mph. However, at slower speeds full rudder is necessary to control the crab. In general, always stay at least 10 mph, indicated, above the power-off stalling speed. Keep the drag of the airplane as small as possible. At 100,000 lbs. gross weight it is just possible to maintain level flight on two engines with two propellers feathered and with the landing gear down and flaps in the approach position.

At 130,000 lb. a similar condition exists with three engines and one feathered.

RESTRICTED MANEUVERS

The following maneuvers are prohibited:



DIVE (in excess of red-line speed for the altitude).

Don't fly the airplane with the center of gravity (CG) behind 34% of the mean aerodynamic chord (MAC) at any time, and don't fly with it ahead of 24% except at low gross weights (120,000 lbs.).

LANDING

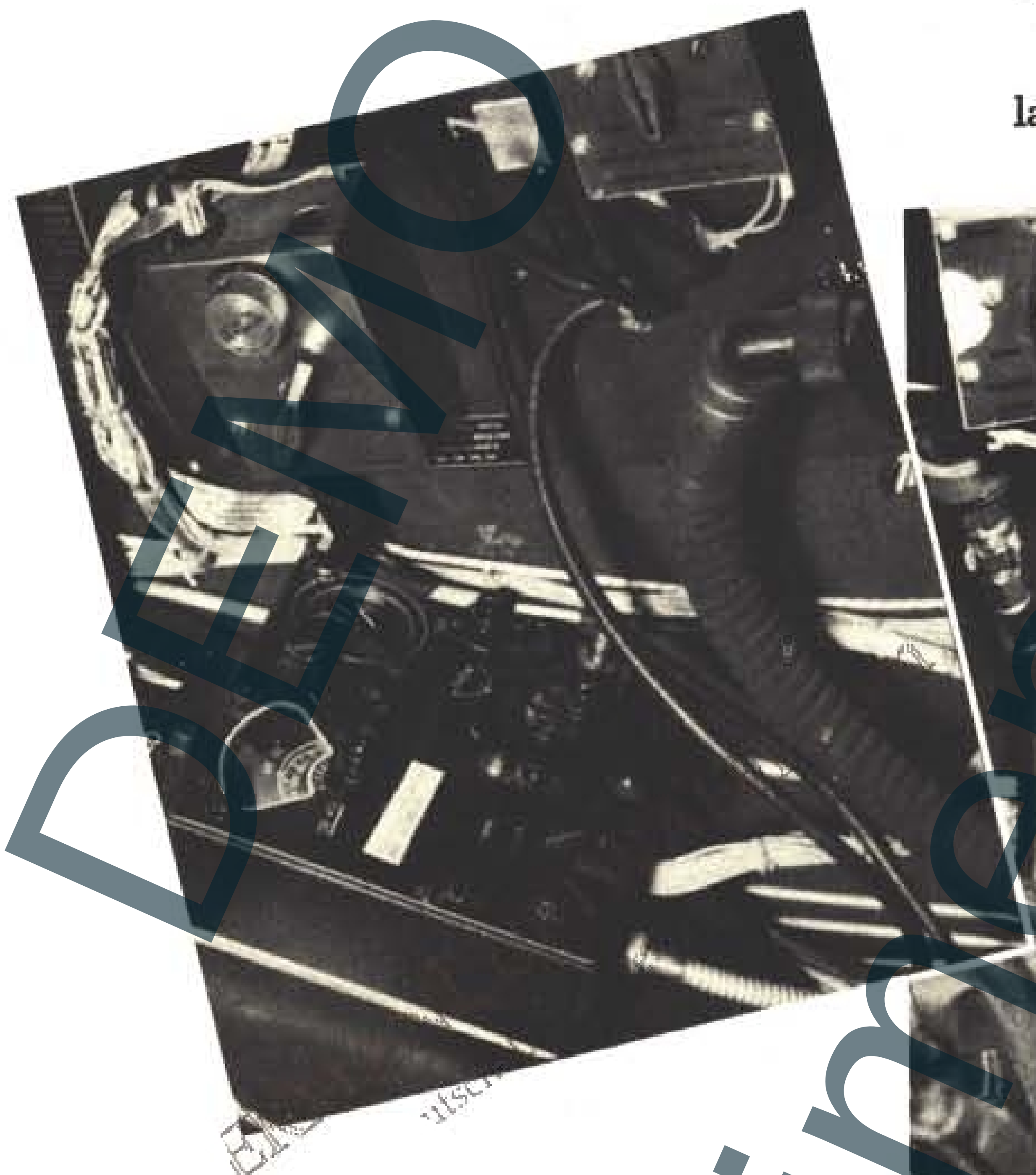
Before Landing Checklist

1. NOTIFY CREW—PREPARE FOR LANDING

The before-landing check starts on aircraft returning from a mission about 8 to 10 minutes before landing. For transition missions, take-offs can be spaced 10 minutes apart so that the airplane will not have to leave the traffic pattern. The airplane commander announces, "Prepare for landing." Copilot repeats the command over the interphone, at which time the tail gunner starts the putt-putt. Crew members acknowledge in the following order: Bombardier, navigator, flight engineer, radio operator, top gunner, left gunner, right gunner, and tail gunner.

2. RADIO CALL COMPLETED

The airplane commander calls the tower for landing information.

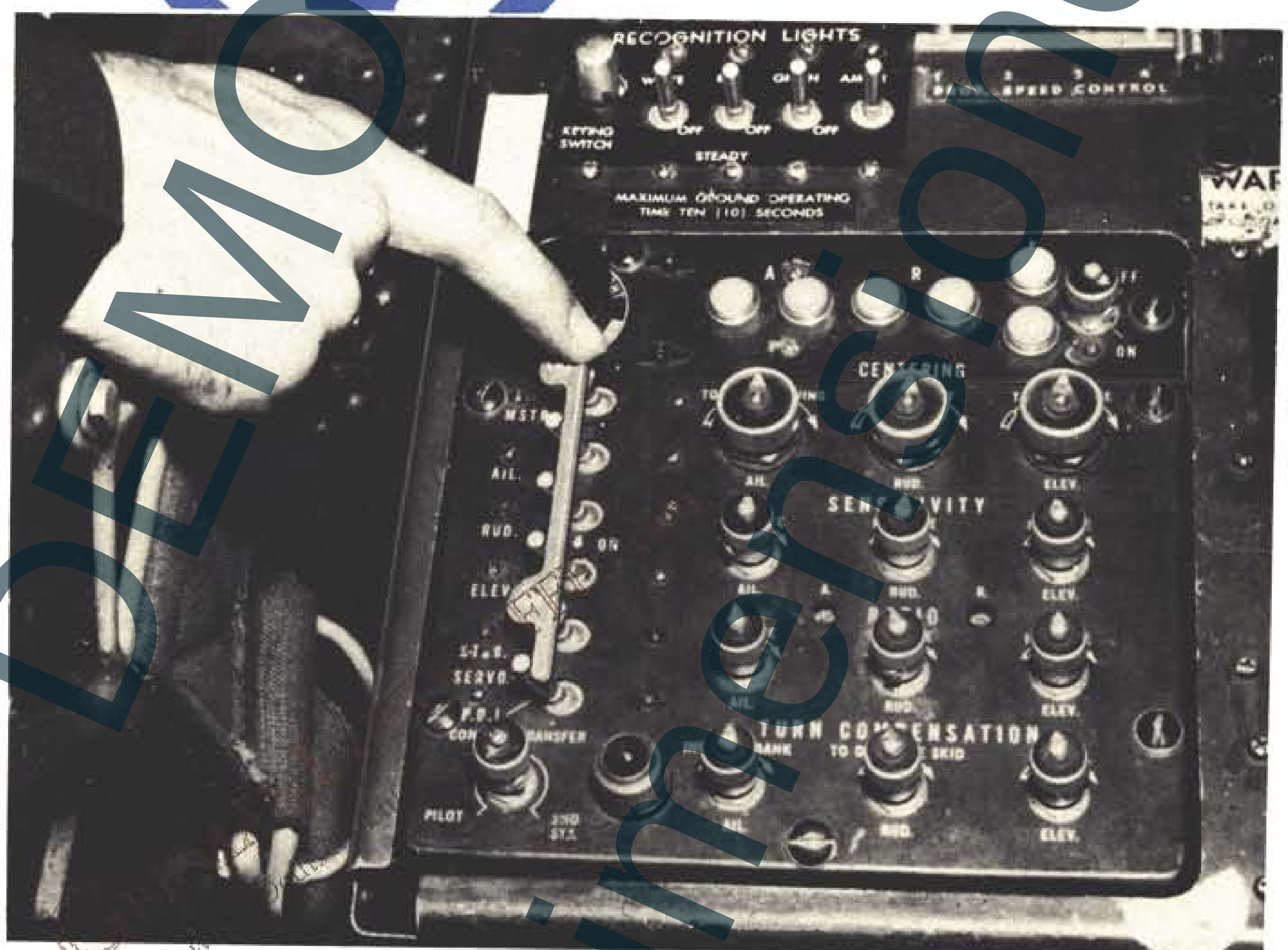


3. ALTIMETERS SET

Airplane commander and copilot set their altimeters to the altimeter setting given by the tower.

4. TRAILING ANTENNA IN

5. AUTOPILOT OFF



6. TURRETS STOWED

7. HYDRAULIC PRESSURE OK

The copilot meters the brake pedals until the pressure falls below 800 psi and checks to see that pressure returns to 1000 psi. Any difference in final pressure should be reported to the flight engineer, as copilot asks him to check emergency hydraulic pressure.

8. PUTT-PUTT ON THE LINE

The copilot checks with the tail gunner to make sure that the putt-putt is on the line.

9. PROPELLERS 2400 RPM

The copilot adjusts propellers to 2400 rpm before airplane commander reduces power.

10. LANDING GEAR DOWN AND LIGHTS ON

The copilot, on command of the airplane commander, lowers the landing gear. The side gunners check the main gear and announce in order, "Left gear down and locked," and, "Right gear down and locked." The copilot checks the nosewheel through the observation window in the floor of the cockpit and checks the landing gear warning lights on his instrument panel. Copilot announces, "Nosewheel down and locked."

Note: The IAS must be less than 180 mph before the gear is lowered.

The visual check by the gunners and the copilot is most important. The red warning light and the green down and locked lights (and the landing gear warning horn, on early models) all operate from the gear-motor limit switches. Remember this—the lights and the horn are not position indicators. They mean only that the limit switches have stopped the operation of the gear motors. If the switches open the circuits too soon, the gear is only partly down and warning of this danger can come only from the visual check. The gear supports the weight of the airplane if the retracting screw is not more than 4 inches from the full-down position (the screw itself retracts as the gear lowers). The gear is not designed to support the airplane if the screw is extended more than 4 inc

11. FLIGHT ENGINEER'S REPORT

The flight engineer gives the weight and center of gravity (CG) figures to the copilot.

12. STALL SPEED

The copilot finds the stalling speed based on the weight by referring to the table mounted on his instrument panel and informs the airplane commander.

13. WING FLAPS

At the airplane commander's command, the copilot extends the wing flaps 25° just before turning into the base leg. Later, on the final approach and at the airplane commander's command, he extends full flaps, at which point the airplane commander retrims the elevators. The side gunners check position of flaps and inform the copilot over the interphone.

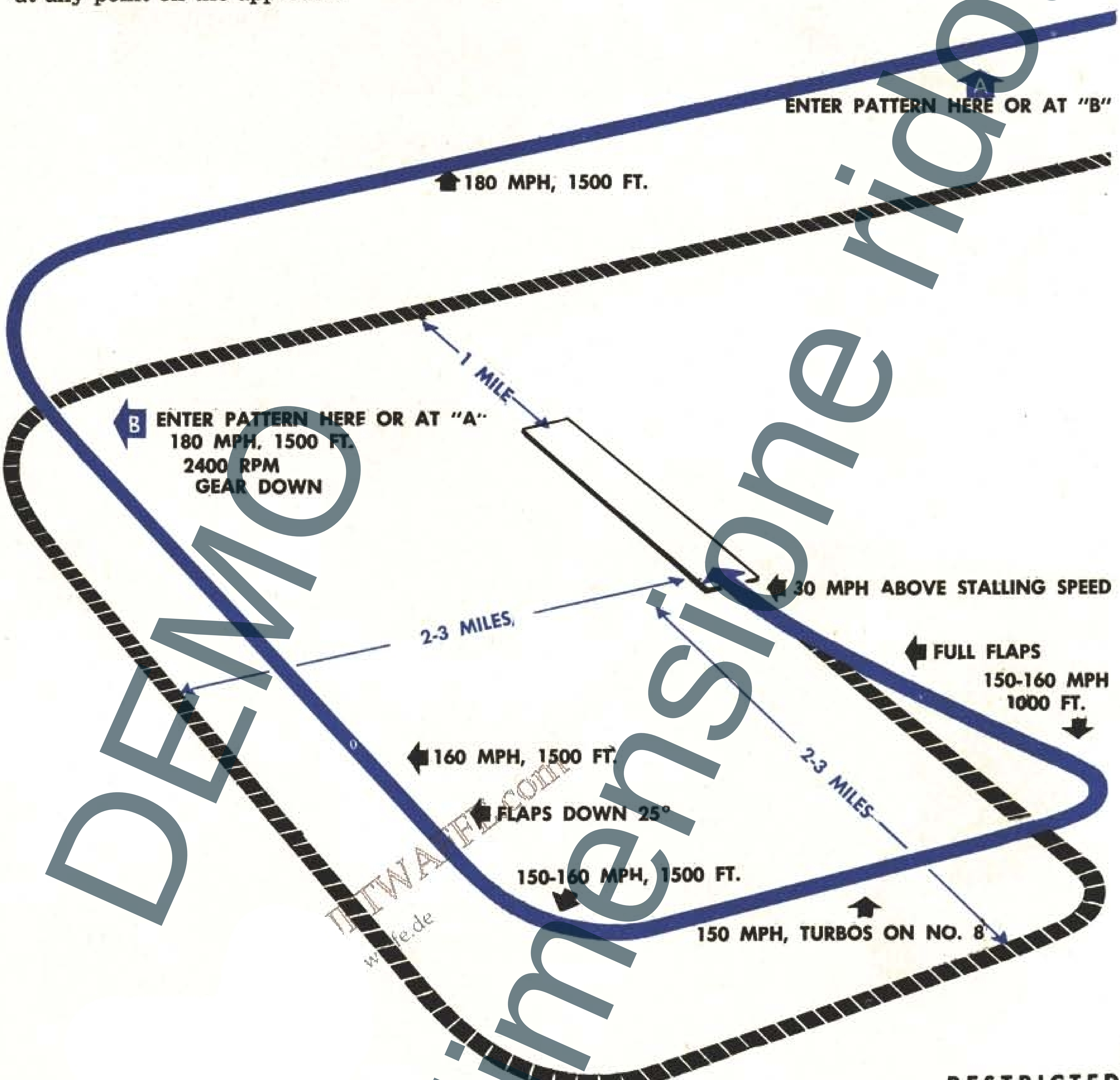
14. TURBOS ON NO. 8

Airplane commander calls for turbos on base leg. Copilot announces, "Turbos on," to flight engineer and turns selector dial to 8.

Landing Procedure

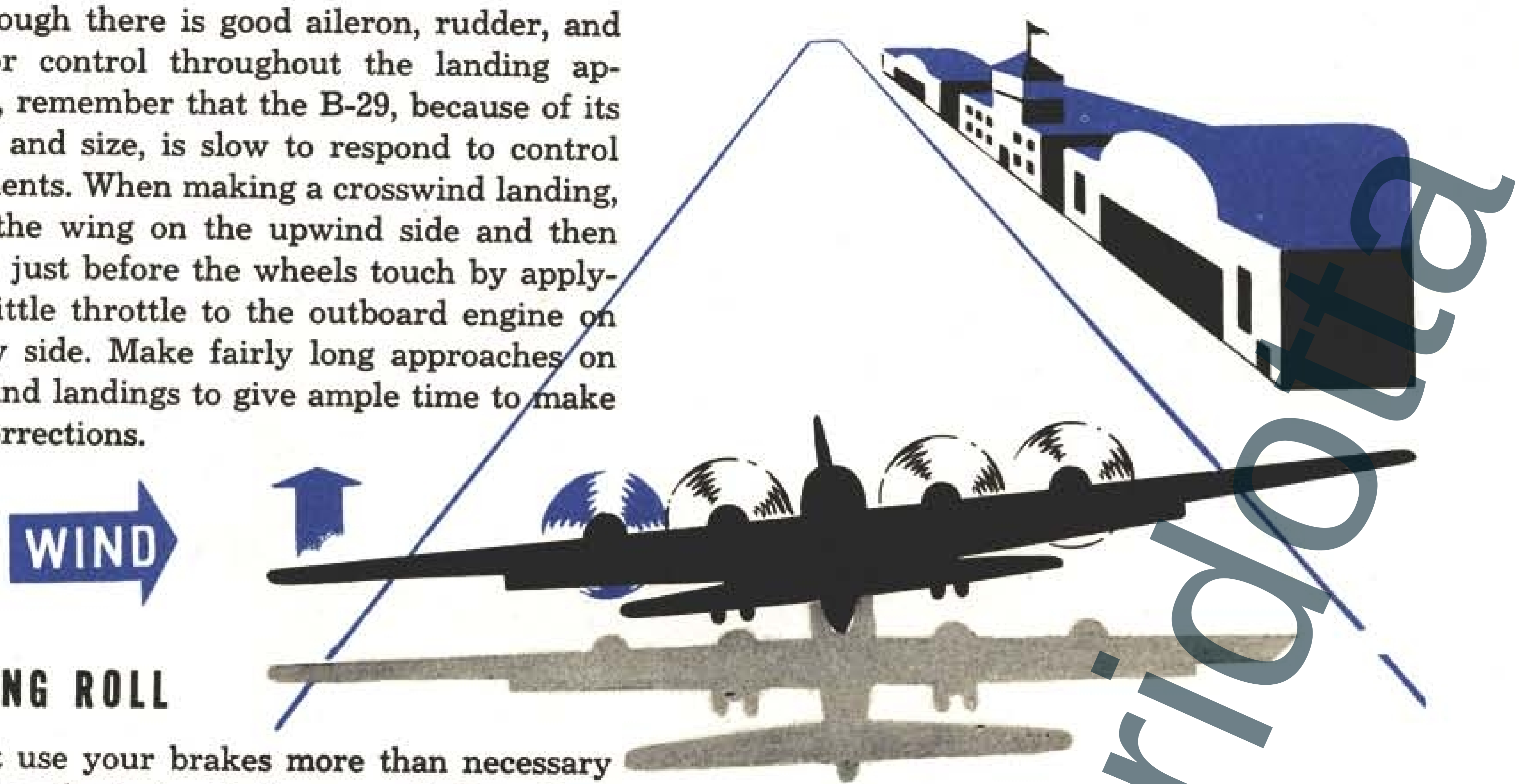
Don't put down full flaps until you are lined up with runway and sure of making the field. Go-arounds are difficult only when full flaps are down. After putting down full flaps, maintain an airspeed of 30 mph, indicated, above the power-off stalling speed. Don't chop the power at any point on the approach.

Long approaches are not necessary, even when landing on narrow runways, but the base leg is normally placed farther out than for a B-17 or a B-24.



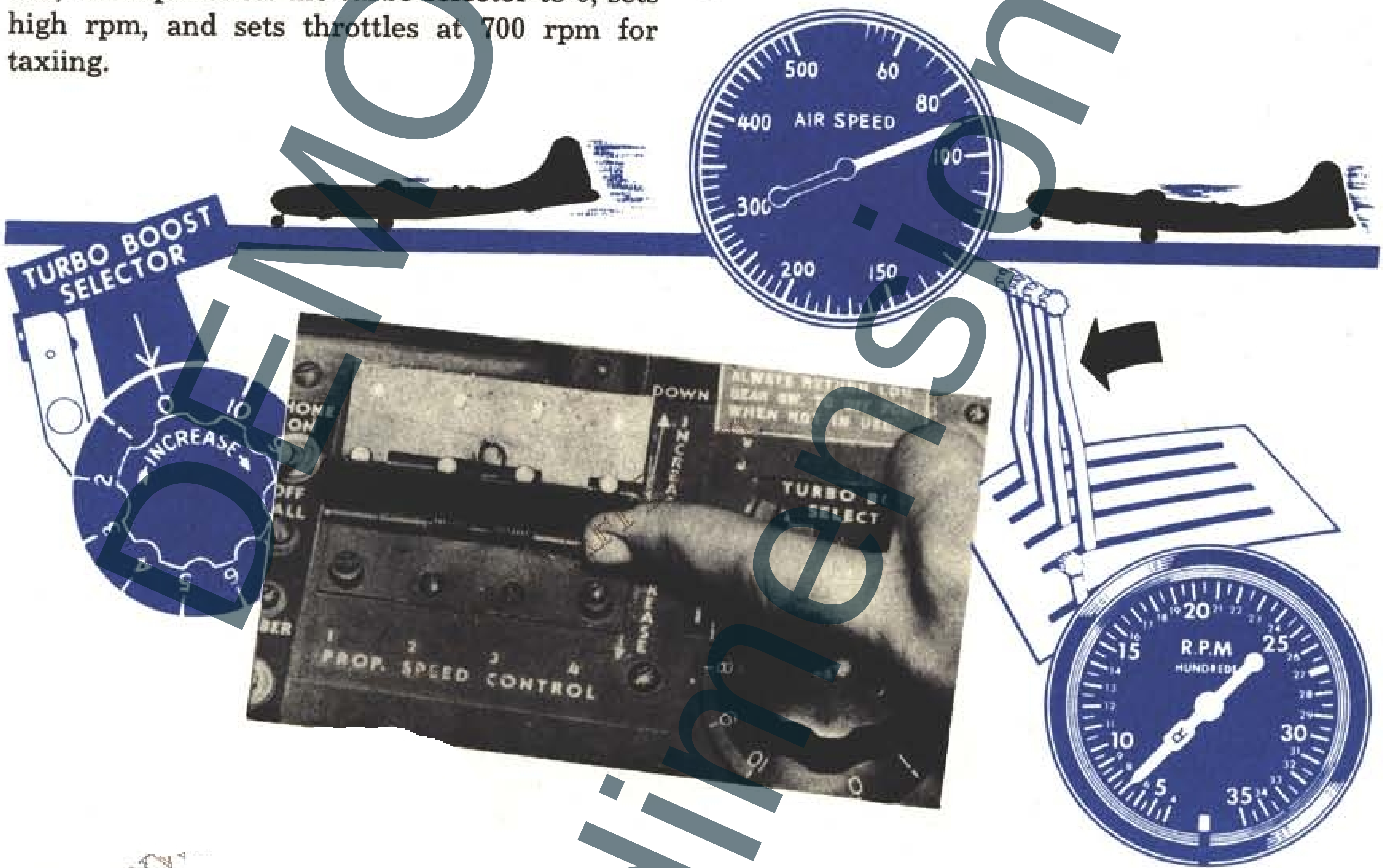
CROSSWIND LANDINGS

Although there is good aileron, rudder, and elevator control throughout the landing approach, remember that the B-29, because of its weight and size, is slow to respond to control movements. When making a crosswind landing, lower the wing on the upwind side and then raise it just before the wheels touch by applying a little throttle to the outboard engine on the low side. Make fairly long approaches on crosswind landings to give ample time to make drift corrections.



LANDING ROLL

Don't use your brakes more than necessary after the wheels touch the ground. On a long runway, let the airplane roll until it loses speed. Lower the nose gently at 90 mph, and when nearing end of runway, apply brakes evenly and smoothly. Toward the end of the landing roll, the copilot sets the turbo selector to 0, sets high rpm, and sets throttles at 700 rpm for taxiing.



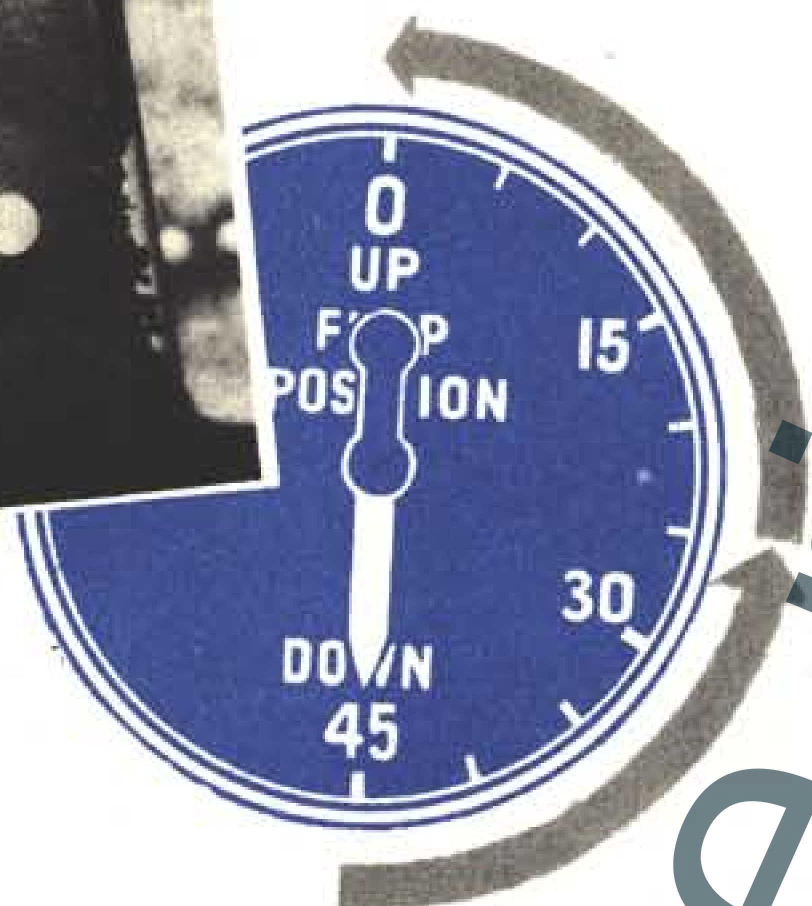
After Landing

1. HYDRAULIC PRESSURE

Copilot checks normal pressure gage for reading between 800 and 1000 psi.

2. TURBOS OFF

3. PROPELLERS IN HIGH RPM



4. WING FLAPS UP

At the airplane commander's command, near the end of the landing roll, copilot raises flaps (all the way, if this is the last landing; to 25° if planning to make another takeoff). Side gunners report on position of wing flaps.

5. PARKING BRAKES SET

6. BOMB BAY DOORS OPEN

Copilot calls for bomb bay doors open. Copilot says on interphone, "Open bomb bay doors." Flight engineer sets throttle on coolest engine to 1400 rpm. The radio operator and one of the gunners check through the pressure doors and report to pilot that doors are open. Flight engineer then returns throttle to 700 rpm and turns all generators off. (Generator procedure unnecessary with snap-opening bomb bay doors.)

7. MAGNETOS CHECKED

The flight engineer checks all magnetos at 2000 rpm.

8. ENGINES CUT

The airplane commander gives the order, "Cut engines," to the flight engineer, who cuts all engines simultaneously, using the following procedure:

a. Runs engines at 700 rpm until cylinder-head temperatures drop (190°C, if possible). While engines are cooling at 700 rpm, flight engineer flips master ignition switch to the OFF position momentarily to see that all magnetos are grounded out.

b. Increases throttle settings to 1200 rpm and runs each engine for at least 30 seconds at this speed.

c. Moves the mixture controls to IDLE CUT-OFF.

d. Cut switches after propellers stop turning.

e. Orders tail gunner to stop putt-putt.

9. RADIOS OFF

The airplane commander turns off the command set and the copilot switches off the radio compass.

10. CONTROLS LOCKED

11. WHEEL CHOCKS IN PLACE—BRAKES OFF

12. FORMS 1 AND 1A ACCOMPLISHED

The flight engineer completes Forms 1 and 1A and presents them to the airplane commander for check.

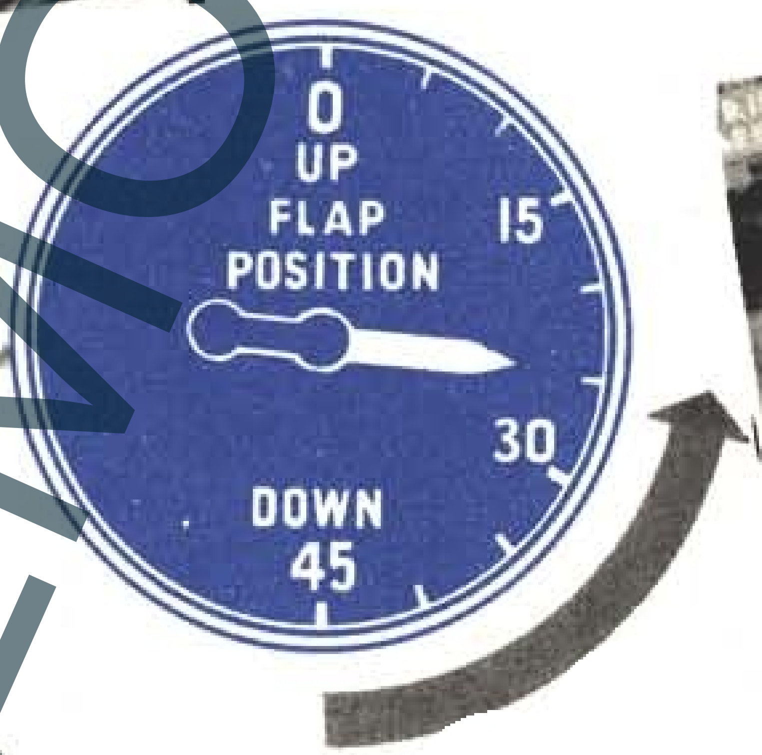
13. CREW INSPECTION

Crew members leave the airplane and line up as before to be checked by the airplane commander. At this time, defects in the airplane not already noted are reported to the flight engineer.

Go-Around

The procedure for a normal go-around is not complicated. Raise the flaps from the full-down position to 25° as power is applied and continue on the same approach angle until a safe flying speed is reached. Then raise the gear as soon as you are sure that the runway will not be touched, and ease the nose of the airplane up. Raising the flaps all in one movement to 25° is important. Don't wait for a safe flying speed—with the flaps full down, you cannot attain a safe flying speed because of the high full-flap drag and reduced acceleration. Follow this procedure:

1. Notify flight engineer that you are going around.
2. Apply throttle gradually as needed.
3. Raise flaps to 25°.
4. Set full high rpm.
5. Don't try to climb until reaching a safe flying speed.
6. Raise gear when safely clear of the ground.
7. Proceed as in a normal takeoff.
8. If needed, apply emergency power by advancing the turbo selector knob to No. 10.



TURBO-SUPERCHARGERS

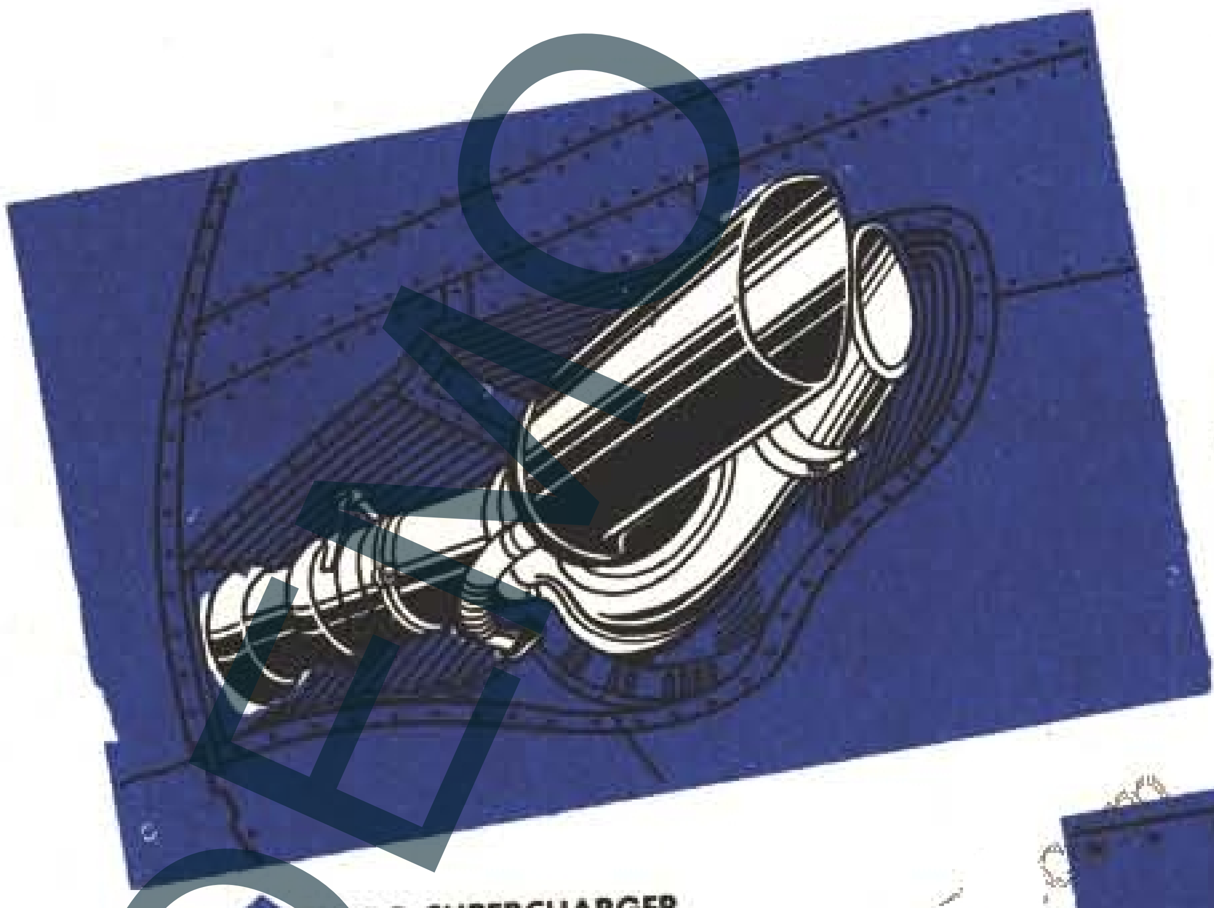
Each engine on the B-29 has two turbo-superchargers which boost the manifold pressure for takeoff and provide increased air pressure at high altitudes.

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.

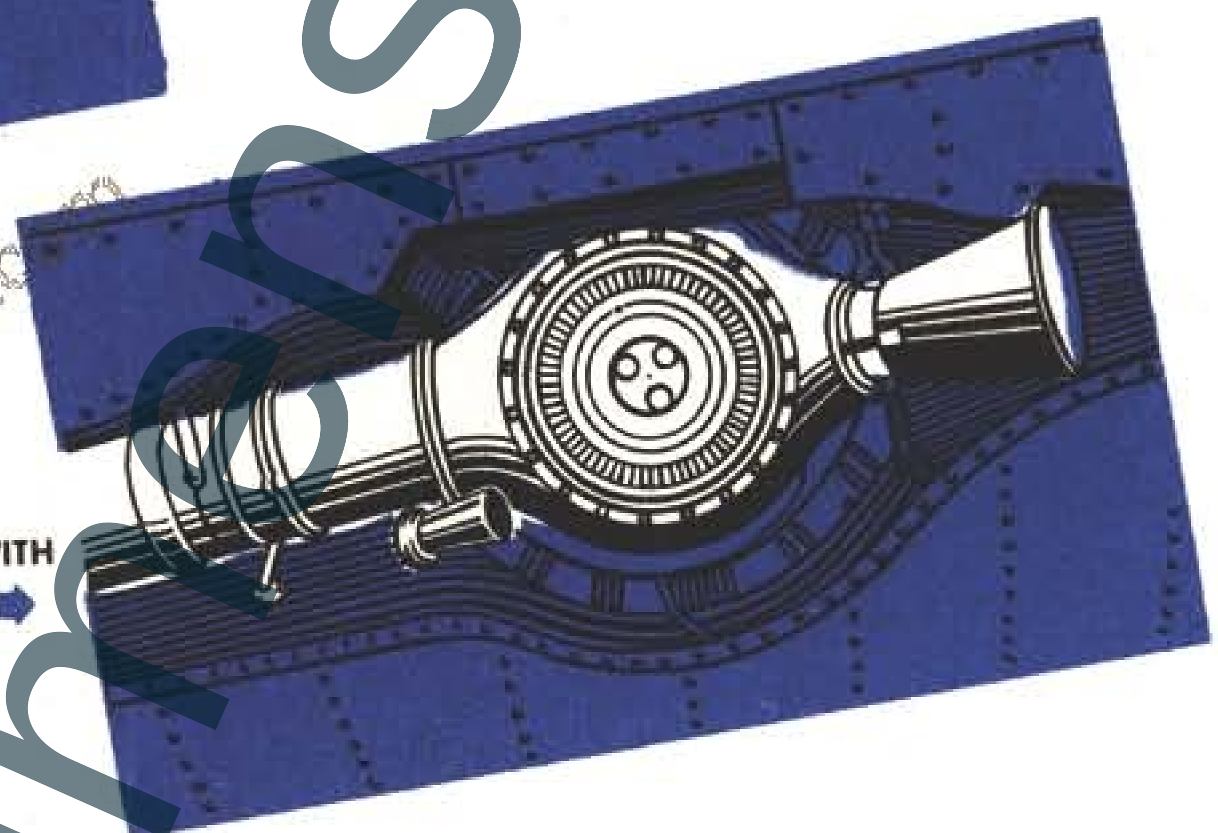
A ramming air inlet duct supplies air to the impeller which increases its pressure and temperature. However, in order to avoid detonation at the carburetor, the air supplied to the carburetor passes through the intercooler, where the temperature is reduced. The internal engine impeller, driven by the engine crankshaft, again increases air pressures 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 turbo 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.

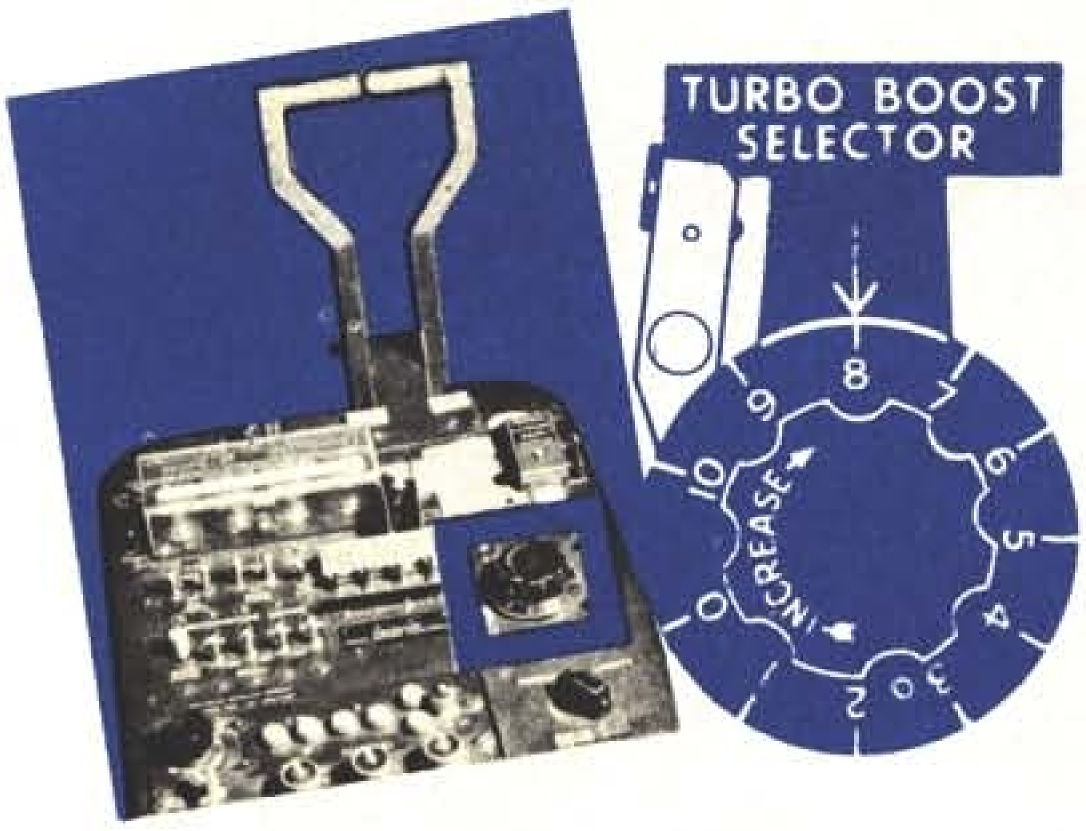


TURBO-SUPERCHARGER



URBO-SUPERCHARGER WITH FLIGHT HOOD REMOVED

Electronic Turbo-supercharger Control



The electronic turbo-supercharger control system on B-29s consists of separate regulator systems, all simultaneously adjusted by a single **turbo selector dial** located on the pilot's aisle stand. Each system controls the induction pressure of the particular engine through a Pressuretrol unit connected directly to the carburetor air intake.

Electrical power for the entire system comes from the airplane's 115-volt, 400-cycle inverter.

Each regulator includes a turbo governor which prevents turbo overspeeding both at high altitude and during rapid throttle changes.

Both exhaust waste gates on each engine are operated by a small reversible electric motor which automatically receives power from the regulator system when a change in waste gate setting becomes necessary to maintain the desired manifold pressure.

In case of a complete failure of the airplane electrical system, or failure of the inverter, the waste gates on all engines remain in the same position as when failure occurred, and approximately the same manifold pressure that was in use at time of failure is available.

If a failure occurs in any one of the electronic regulator systems, provision is made for the waste gate motor to drive the waste gate to the open position, and no supercharger boost is available on that **particular** engine.

Upon installation of the equipment, the system is adjusted so that a selector dial setting of 8 furnishes maximum desired takeoff power. A dial setting of 10 furnishes maximum emergency power.

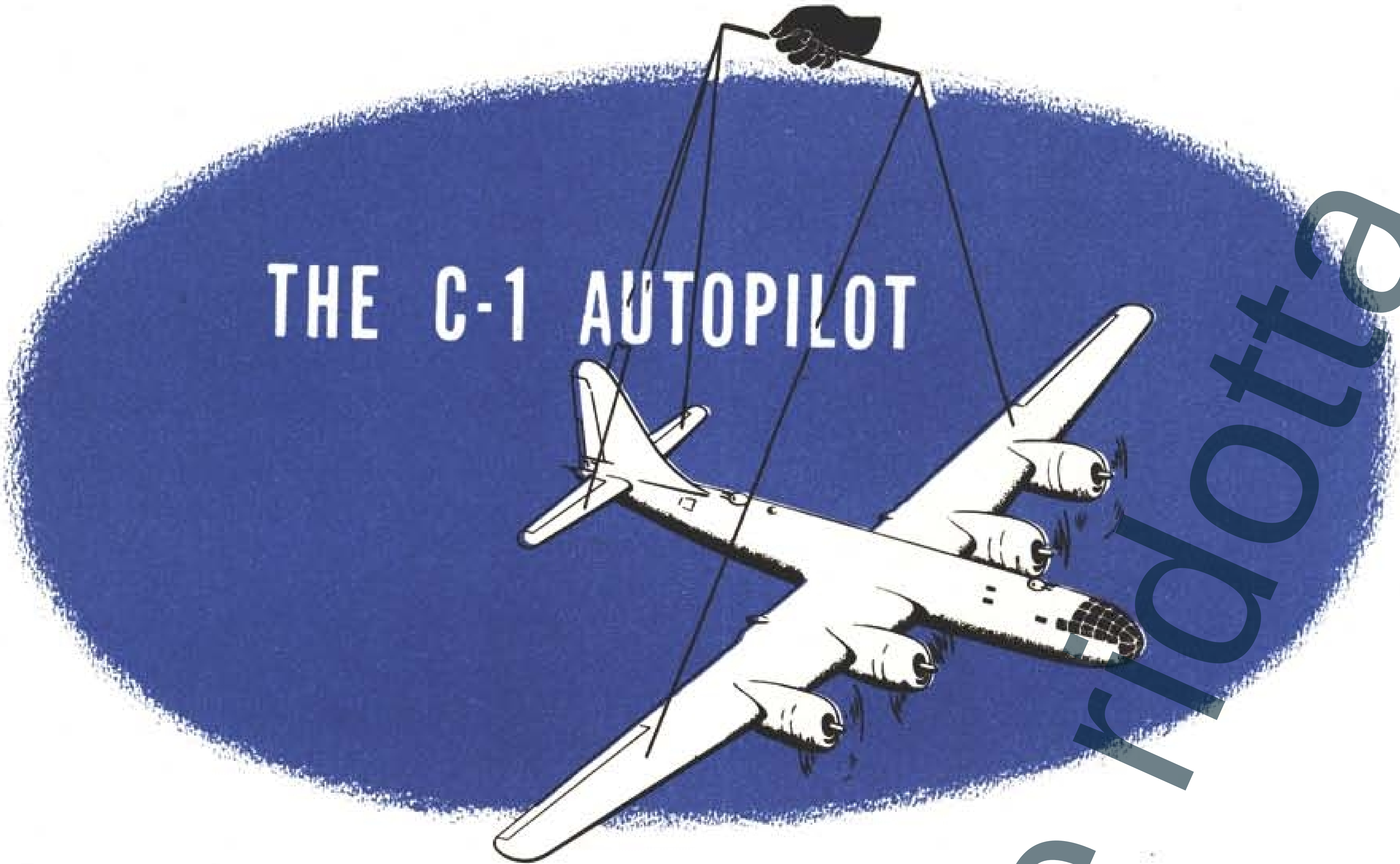
All engines should deliver the same power at a dial setting of 8. If it is necessary to adjust power on individual engines, use a screwdriver to turn the calibration screws located on the turbo selector dial unit.

HIGH ALTITUDE OPERATION

When flying at high altitude, you may reach a point where further turning of the selector dial fails to produce an increase in manifold pressure. This means that the overspeed portion of the turbo governor is limiting the turbo speed to safe rpm. When you encounter this condition, turn the manifold pressure selector dial counter-clockwise until it controls manifold pressure again. This prevents undue wear of the overspeed governor mechanism.

Emergency Power

You can obtain full emergency power (war power) at maximum engine rpm and full throttles by releasing the dial stop and turning the selector to setting 10. However, this setting places heavy strain on the engines and must be used only in emergencies and then only for periods not exceeding 2 minutes.



THE C-1 AUTOPILOT

The C-1 autopilot is an electromechanical robot which automatically flies the airplane in straight and level flight, or maneuvers the airplane in response to the fingertip control of the human pilot or bombardier.

Actually, the autopilot works in much the same way as the human pilot in maintaining straight and level flight, in making corrections necessary to hold a given course and altitude, and in applying the necessary pressure on the controls to make turns, banks, etc. The difference is that the autopilot acts instantaneously and with a precision that is not humanly possible.

The precision of even the most skillful human pilot is limited by his own reaction time, i.e., the interval between his perception of a certain condition and his action to correct or control it. Reaction time itself is governed by such human fallibilities as fatigue, inability to detect errors the instant they occur, errors in judgment, and muscle coordination.

The autopilot, on the other hand, detects flight deviations the instant they occur, and just as instantaneously operates the controls to correct the deviations. Properly adjusted, the autopilot neither overcontrols nor undercontrols the airplane, but keeps it flying straight and level with all three control surfaces operating in full coordination.

The C-1 autopilot consists of various separate units electrically interconnected to operate as a system. The operation of these units is explained in detail in AN-11-60AA-1. You can get a general over-all understanding of their functions and relation to each other by studying the accompanying illustration.

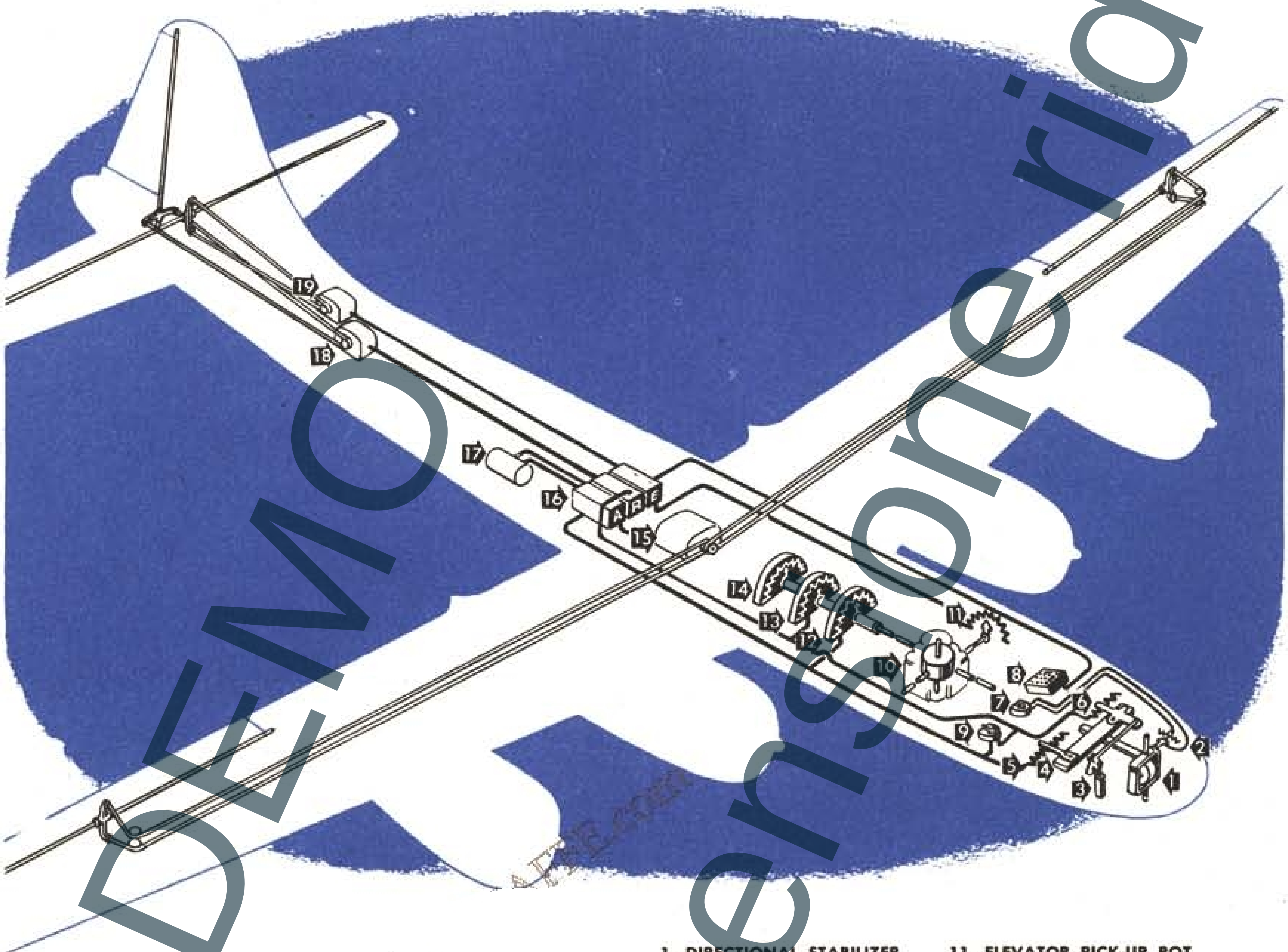
Assume that the airplane in the illustration is flying straight and level and that the autopilot is operating.

Suddenly a crosswind turns the airplane away from its established heading. The gyro-operated directional stabilizer (1) detects this deviation and moves the directional panel (4) to one side or the other, depending upon the direction of the deviation.

The directional panel contains two electrical devices, the banking pot (5) and the rudder pick-up pot (6), which send signals to the aileron and rudder section of the amplifier (16) whenever the directional panel is operated. These signals are amplified and converted (by means of magnetic switches or relays) into electrical impulses which cause the aileron and rudder Servo units (15 and 18) to operate the ailerons and rudder of the airplane in the proper direction and amount to turn the airplane back to its original heading.

Similarly, if the nose of the airplane drops, the vertical flight gyro (10) detects the vertical deviation and operates the elevator pick-up pot (11) which sends an electrical signal to the elevator section of the amplifier. The signal is amplified and relayed in the form of electrical impulses to the elevator Servo unit (19) which in turn raises the elevators the proper amount to bring the airplane to level flight.

If one wing drops appreciably, the vertical flight gyro operates the aileron pick-up pot (12), the skid pot (13), and the up-elevator pot (14). The signals caused by the operation of these units are transmitted to their respective



C-I AUTO PILOT

(SCHEMATIC DRAWING . . . DOES NOT SHOW CORRECT LOCATION OR PROPORTION OF UNITS)

1. DIRECTIONAL STABILIZER
2. P. D. I. POT
3. DASH POT
4. DIRECTIONAL PANEL
5. BANKING POT
6. RUDDER PICK-UP POT
7. P. D. I.
8. AUTOPILOT CONTROL PANEL
9. TURN CONTROL
10. VERTICAL FLIGHT GYRO
11. ELEVATOR PICK-UP POT
12. AILERON PICK-UP POT
13. SKID POT
14. UP-ELEVATOR POT
15. AILERON SERVO
16. AMPLIFIER
17. ROTARY INVERTER
18. RUDDER SERVO
19. ELEVATOR SERVO

(aileron, rudder, and elevator) sections of the amplifier. The resulting impulses to the aileron, rudder, and elevator Servo units cause each of these units to operate its respective control surface just enough to bank and turn the airplane back to an even keel or level-flight attitude.

When the human pilot wishes to make a turn, he merely sets the turn control knob (9) at the degree of bank and in the direction of turn desired. This control sends signals, through the aileron and rudder sections of the amplifier, to the aileron and rudder Servo units which operate ailerons and rudder in the proper manner to execute a perfectly coordinated (non-slipping, non-skidding) turn. As the airplane banks, the vertical flight gyro operates the aileron, skid, and up-elevator pots (12, 13, 14). The resulting signals from the aileron and skid pots cancel the signals to the aileron and rudder Servo units to streamline these controls during the turn.

The signals from the up-elevator pot cause the elevators to rise just enough to maintain altitude. When the desired turn is completed, the pilot turns the turn control back to zero and the airplane levels off on its new course. A switch in the turn control energizes the directional arm lock on the stabilizer, which prevents the stabilizer from interfering with the turn by performing its normal direction-correcting function.

The autopilot control panel (8) provides the pilot with fingertip controls by which he can conveniently engage or disengage the system, adjust the alertness or speed of its responses to flight deviations, or trim the system for varying load and flight conditions.

The pilot direction indicator, or PDI (7), is a remote indicating device operated by the PDI pot (2). When the autopilot is used, the PDI indicates to the pilot when the system and airplane are properly trimmed. Once the autopilot is engaged, with PDI centered, the autopilot makes the corrections automatically.

The rotary inverter (17) is a motor-generator unit which converts direct current from the airplane's battery into 105-cycle alternating current for operation of the autopilot.

HOW TO OPERATE THE C-1 AUTOPILOT

Before Takeoff

1. Turn control centered.

2. Make sure that all switches on the control panel are in the OFF position.

After Takeoff

1. Turn on the master switch.

2. Ten minutes later, turn on PDI switch (and Servo switch, if separate.)

3. Ten minutes after turning on the master switch, trim the airplane for level flight at cruising speed.

4. Have the bombardier disengage the autopilot clutch, center PDI and lock it in place by depressing the directional control lock. The PDI is held centered until the airplane commander has completed the engaging procedure. Then the autopilot clutch is re-engaged, and the directional arm lock released.

Alternate Method: The airplane commander centers PDI by turning the airplane in direction of the PDI needle. Then resume straight and level flight.

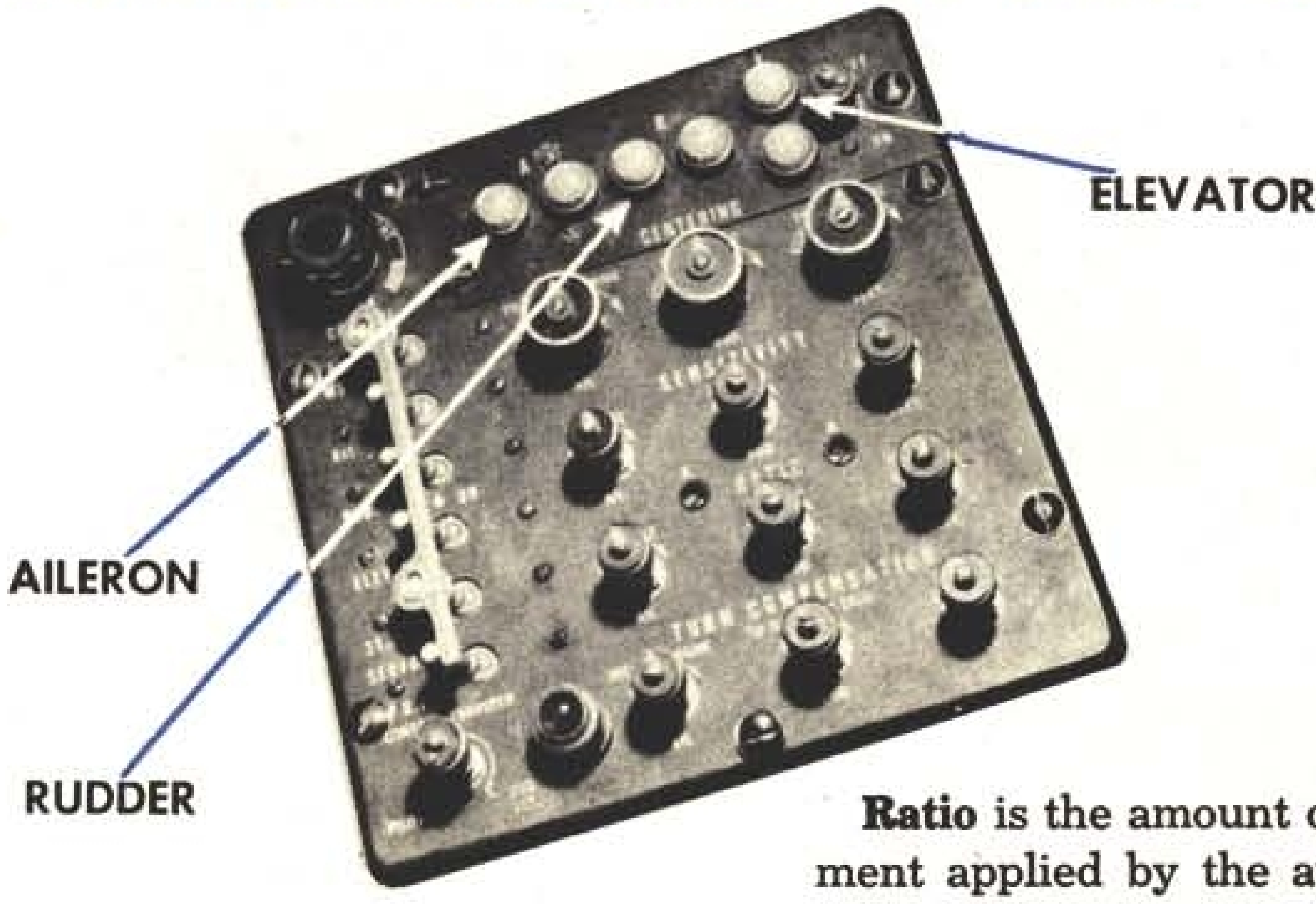
5. Engage the autopilot. Put out aileron telltale lights with the aileron centering knob, then throw on the aileron engaging switch. Repeat the operation for rudder, then for elevator.

6. Make final autopilot trim corrections. If necessary, use centering knobs to level wings and center PDI.

CAUTION

Never adjust mechanical trim tabs while the autopilot is engaged.

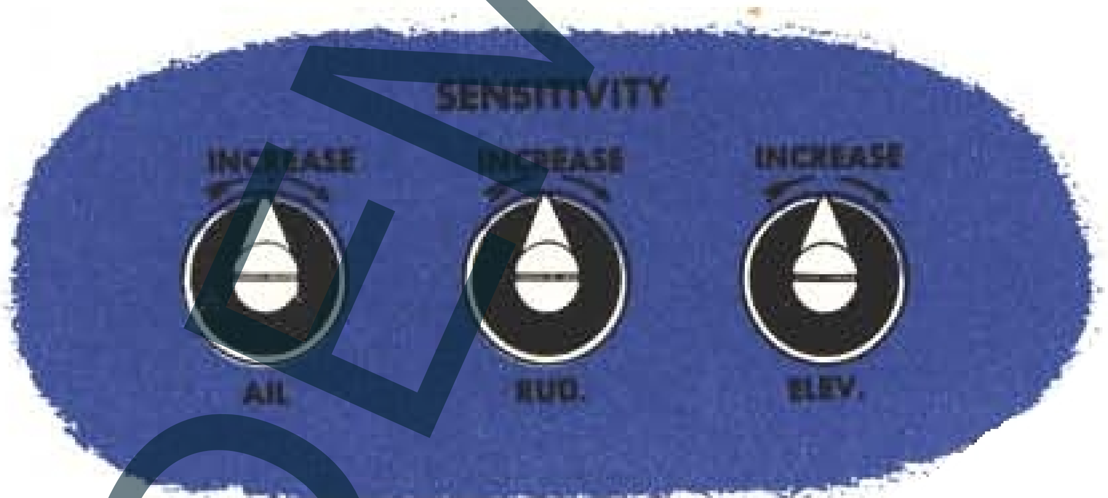
FLIGHT ADJUSTMENTS AND OPERATION



After the C-1 autopilot is in operation, the pilot should carefully analyze the action of the airplane to make sure all adjustments have been made properly for smooth, accurate flight control.

When both **tell-tale lights** in any axis are extinguished, it indicates the autopilot is ready for engaging in that axis.

Before engaging, use each **centering knob** to adjust the autopilot control reference point to the straight and level flight position of the corresponding control surface. After engaging, use the centering knobs to make small attitude adjustments.

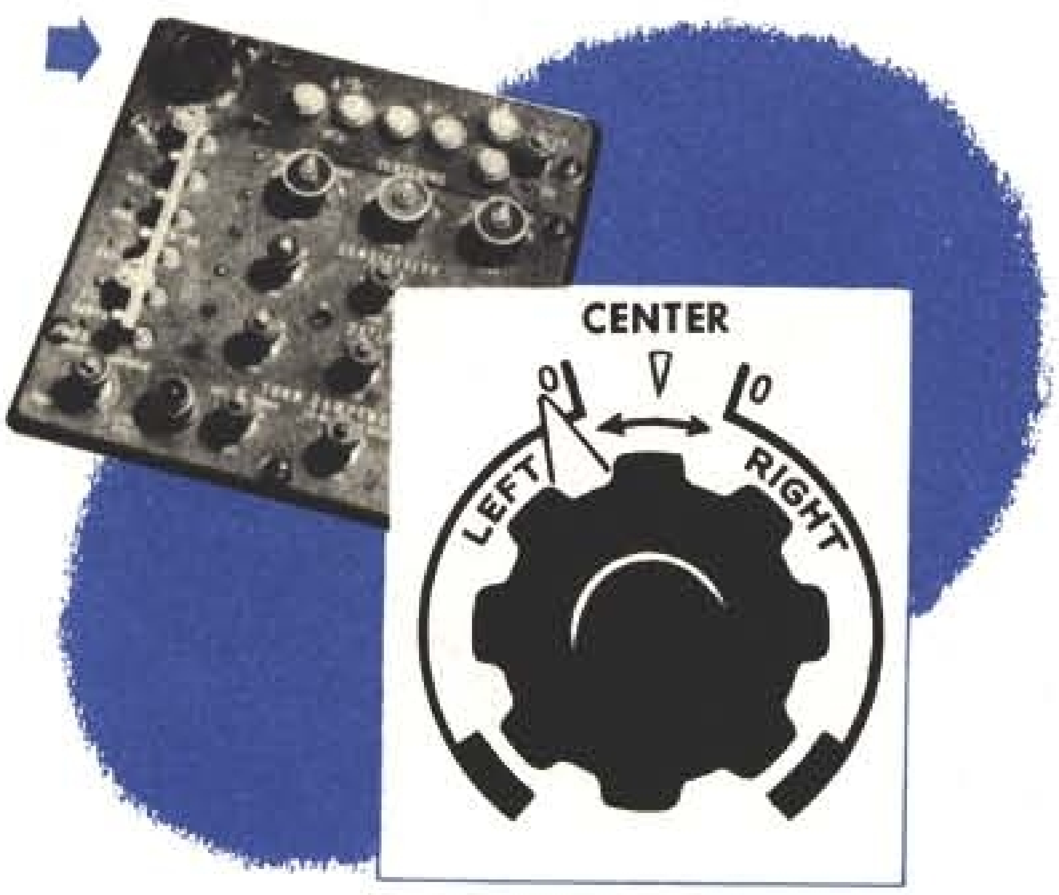


Sensitivity is comparable to a human pilot's reaction time. With sensitivity set high, the autopilot responds quickly to apply a correction for even the slightest deviation. If sensitivity is set low, flight deviations must be relatively large before the autopilot applies its corrective action.

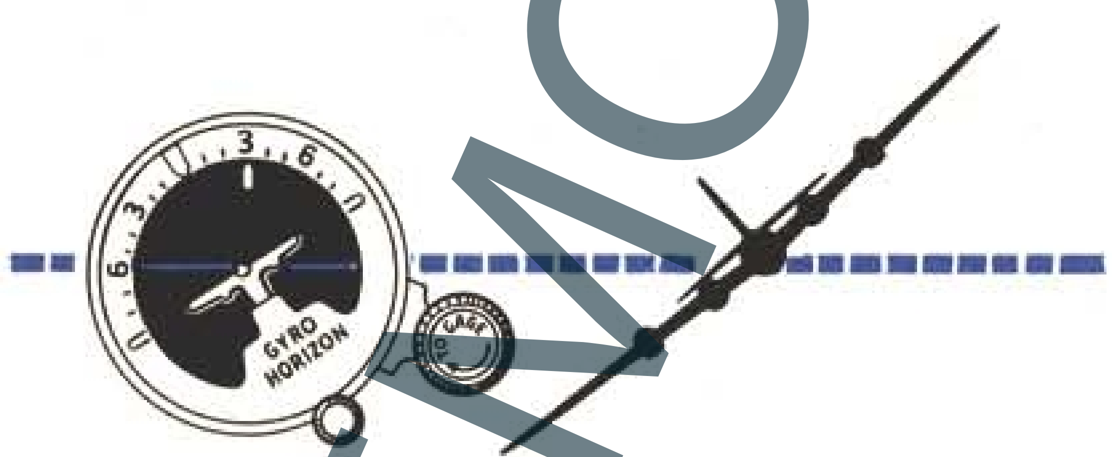
Ratio is the amount of control surface movement applied by the autopilot in correcting a given deviation. It governs the speed of the airplane's response to corrective autopilot ac-

tions. Proper ratio adjustment depends on airspeed. If ratio is too high, the autopilot overcontrols the airplane and produces a ship-hunt; if ratio is too low, the autopilot undercontrols, and flight corrections are too small. After ratio adjustments have been made, centering may require readjustment.

To adjust **turn compensation,** have bombardier disengage autopilot clutch and move engaging knob to extreme right or extreme left. Airplane should bank 18° as indicated by artificial horizon. If it does not, adjust aileron compensation (bank trimmer) to attain 18° bank. Then, if turn is not coordinated, adjust rudder compensation (skid trimmer) to center inclinometer ball. Do not use aileron or rudder compensation knobs to adjust coordination of turn-control turns. Recovery from a bombardiers turn must be coordinated. If the PDI returns to center before the wings are level, decrease the rudder ratio or increase the aileron ratio, depending on the speed of the recovery. If the wings are level before the PDI is centered, increase rudder ratio or decrease aileron ratio, **depending** on the speed of recovery.



The airplane commander uses the **turn control** to turn the airplane while flying under automatic control. To adjust turn control, first make sure turn compensation adjustments have been made properly, then set turn control pointer at beginning of trip-lined area on dial.

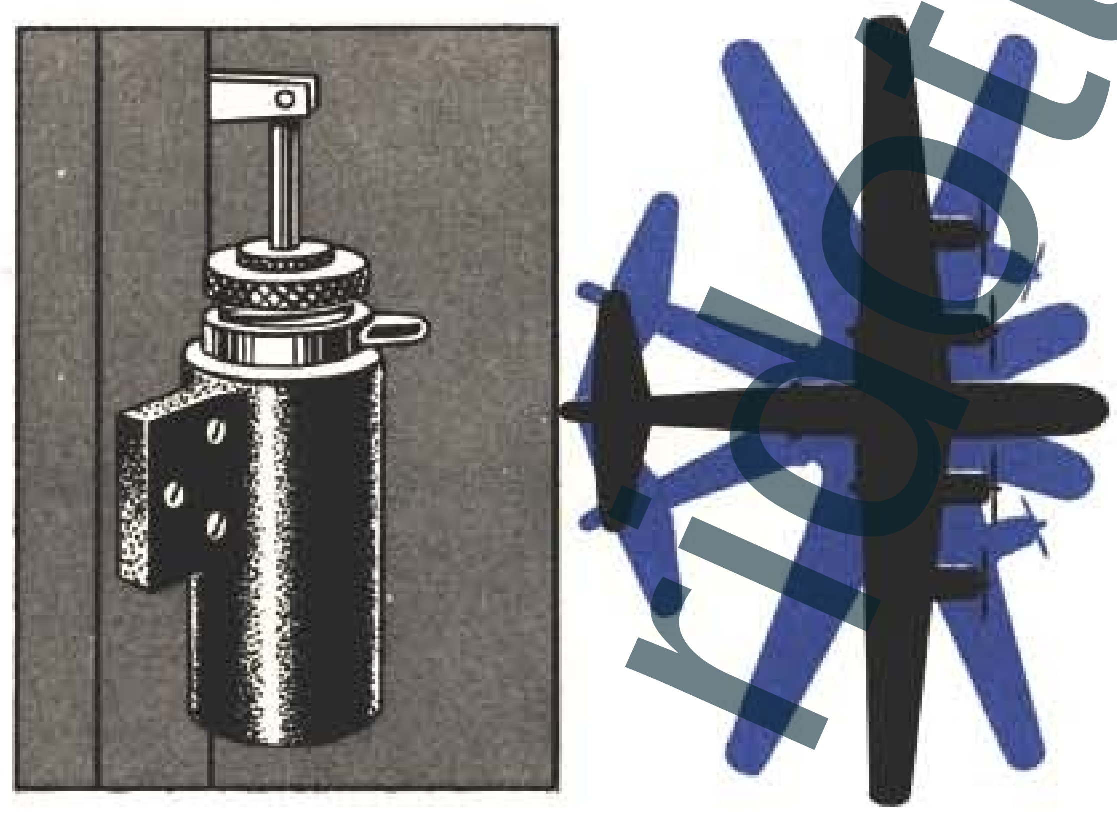


Never operate the Turn Control without first making sure the PDI is centered

trimmer to center ball. Make final adjustments with both trimmers and replace caps. Set turn control at zero to resume straight and level flight; then re-center.

The **turn control transfer** has no effect unless the installation includes a remote turn control.

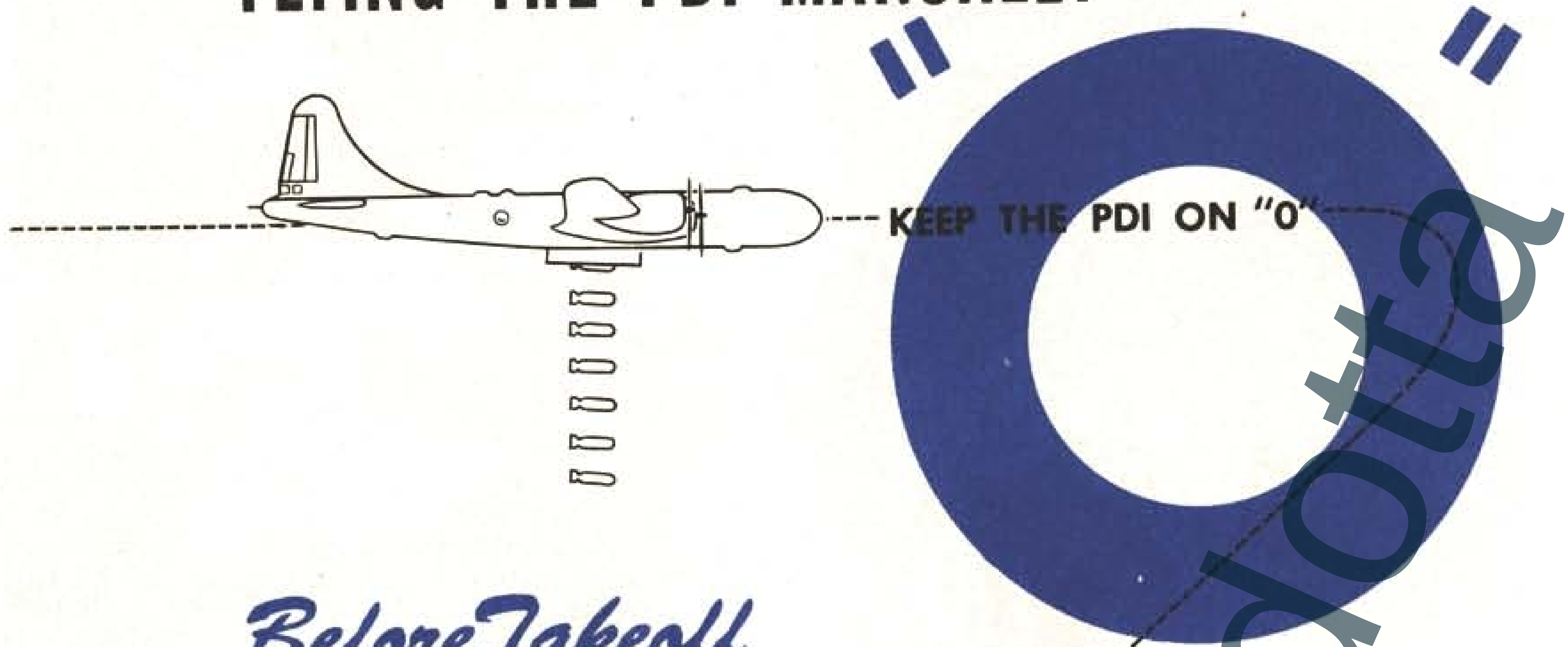
The **dashpot** on the stabilizer regulates the amount of rudder kick applied by the autopilot to correct rapid deviations in the turn axis. If



a rudder hunt develops which cannot be eliminated by adjustment of rudder ratio or sensitivity, the dashpot may require adjustment. To do this, loosen the locknut on the dashpot, turning the knurled ring up or down until hunting ceases, then tighten the locknut.

Cold-Weather Operation — When temperatures are between –12° and 0°C (10° and 32°F) autopilot units must be run for 30 minutes before engaging. If you desire accurate flight control immediately after takeoff, perform the autopilot warm-up before takeoff by turning on the master switch during the engine run-up, but make sure **autopilot is off during takeoff.** If warm-up is performed during flight, allow 30 minutes after turning on master switch before engaging. When temperatures are below –12°C (10°F) units must be preheated for 1 hour before takeoff. Use special heating covers or blankets with heating tubes.

FLYING THE PDI MANUALLY



Before Takeoff

1. Check the bombardier for proper position of PDI needle for a left turn, right turn and neutral or 0 position.

2. When bombardier's PDI is left, airplane commander's PDI is right, and vice versa.

On the Bombing Run

Note: Normally bombing is done using the autopilot; however, if the autopilot is out of order the airplane commander may use the PDI.

1. To center the PDI needle, turn the plane in the direction of the needle.

2. At the beginning of the bombing run, the airplane commander can usually expect maximum PDI corrections. Avoid tendency to over-correct by refraining from leading the needle.

3. No matter how slight the deviation of the PDI needle from 0, the needle must be immediately returned to 0.

4. Set turns must be coordinated; aileron and rudder turns, to effect more rapidly the desired degree of turn, and to avoid any excessive sliding of the bombsight lateral bubble and induced precession of the gyro.

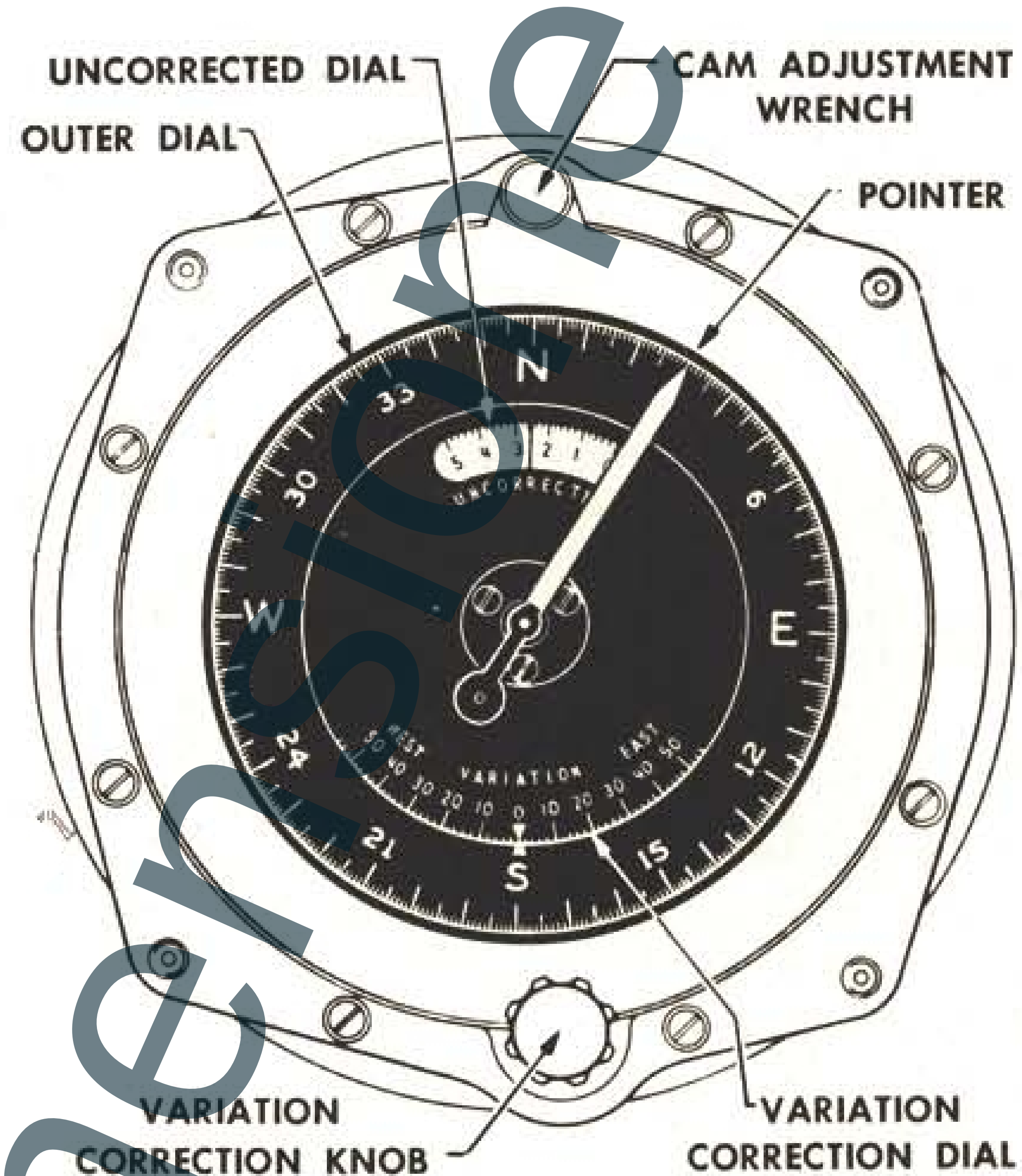
5. Banks must never exceed 18°, to avoid tumbling of the bombsight gyro.

6. Keep PDI on 0 until bombardier calls "Bombs away."

THE GYRO FLUX GATE COMPASS

The gyro flux gate compass, remotely located in the left wing of the airplane, converts the earth's magnetic forces into electrical impulses to produce precise directional readings that can be duplicated on instruments at all desired points in the airplane.

Unlike the magnetic needle, it does not go off its reading in a dive, overshoot in a turn, hang in rough weather, or go haywire in polar regions.



DEVELOPMENT OF THE GATE

The gyro flux gate compass was developed to fill the need for an accurate compass for long-range navigation. The presence of so many magnetic materials (armor, electrical circuits, etc.) in the navigator's compartment made it almost impossible to find a desirable location for the direct-reading magnetic compass.

To eliminate this difficulty, it became necessary to place the magnetic element of the navigator's compass outside the compartment, i.e., **to use a remote indicating compass.** The unit which is remotely located is called the **transmitter.** The unit used by the navigator is the **master indicator.** For the benefit of the airplane commander and such other crew members as may need compass readings, auxiliary instruments called **repeater indicators** may be installed in other parts of the airplane.

Units of the Flux Gate Compass

The gyro flux gate compass consists of three units which are analogous to the brain, heart, and muscles of the human body. The **transmitter,** located in the left wing of the airplane, is the brain of the instrument. The **amplifier** is the source of power for the compass and corresponds to the human heart. The **master indicator** does the work of turning a pointer and performs a function similar to that of the muscles in the human body.

1. THE BRAIN

Inside the remotely placed **transmitter** there is a magnetic sensitive element called the flux gate which picks up the direction signal by induction and transmits it to the **master indicator.** This element consists of three small coils, arranged in a triangle and held on a horizontal plane by a gyro. Each coil has a special soft iron core, and consists of a primary (or excitation) winding, and a secondary winding from which the signal is obtained.

Because each leg of the flux gate is at a different angle to the earth's magnetic field, and the induced voltage is relative to the angle, each leg produces a different voltage. When the angular relationship between the flux gate and the earth's magnetic field changes, there is a relative change in the voltages in the three legs of the secondary. These voltages are the motivating force for the gyro flux gate compass master indicator, which provides indications of the exact position of the flux gate in relation to the earth's magnetic field.

Each coil is a direction sensitive element, but one alone would provide an ambiguous reading because it could tell north from east, for instance, but not north from south. Therefore, it is necessary to employ three coils and combine their output to give the direction signal.

2. THE HEART

The amplifier furnishes the various excitation voltages at the proper frequency to the transmitter and master indicator. It amplifies the autosyn signal which controls the master indicator and serves as a junction box for the whole compass system.

Power for the amplifier comes from the airplane's inverter and is converted to usable forms for other units. The input of the amplifier is 400-cycle alternating current and various voltages may be used depending upon the source available.

3. THE MUSCLE

The master indicator is the muscle of the system because it furnishes the mechanical power to drive the pointer on the main instrument dial. The pointer is driven through a cam mechanism which automatically corrects the reading for compass deviation so that a corrected indication is obtained on all headings. The shaft of the pointer is geared to another small transmitting unit in the master indicator which can operate as many as six repeat indicators at other locations.

The amplifier, master indicators and repeaters all are unaffected by local magnetic disturbances.

How to Operate the Compass

1. Leave the toggle switch on the flux gate amplifier ON at all times so that the compass starts as soon as the airplane's inverter is turned ON.

2. Leave the caging switch in the UNCAGE position at all times except when running through the caging cycle.

3. About 5 minutes after starting engines, throw caging switch in CAGE position. Leave it there about 30 seconds and then throw to UNCAGE again.

4. With the new push-button type caging switch, depress it for a few seconds until a red signal light goes on. Then release the switch and the caging cycle is automatically completed, at which time the red light goes out.

5. Set in the local variation on the master indicator if you wish the pointer to read true heading.

6. If at any time during flight the compass indications lead you to suspect that the gyro is off vertical, run through the caging cycle when the airplane is in normal flight attitude, especially when leveling off after climb.

NOTE

For further details concerning functions, operation and flight instructions, see T. O. 05-15-27.

COLD-WEATHER OPERATION OF THE B-29

The following units in the B-29 are important in cold weather operation. Give them special attention and check when cold weather operation is anticipated.

Oil dilution is so arranged that all engines may be diluted simultaneously or individually by momentary-contact switches on the flight engineer's control panel. The oil dilution line runs from the Y-drain valves to the carburetor.

Each engine fuel-tank assembly has a drain cock reached through a small access door on the underside of the wing. Drain the bomb bay tanks by removing squareheaded pipe plugs.

To facilitate the draining of the oil, drain tubes can be attached to the drain cocks to carry oil overboard. Complete oil drainage is possible through the Y-drain cocks. Oil and fuel tank vent lines are designed so that moisture drains out of them and the engine breather lines end aft of the cowl flaps in a warm area. Oil cooler shutters play a vital part in cold weather operation and operate automatically.

The operation of the intercooler shutters is important in cold weather operations.

Supercharger boost control is sometimes useful in disposing of any accumulation of carburetor ice.

All B-29's have American Bosch induction vibrators for added starting boost. They are controlled by the starter switches.

Propeller anti-icing is used on all B-29's, and is controlled by a rheostat on the flight engineer's stand.

The external electric power receptacle is located in the No. 2 nacelle wheel well in older aircraft or in the nosewheel well in newer modified models. Use the external power cart in all winter ground operation to save the battery.

All oxygen valves should be opened and closed slowly during cold weather to prevent a surge of pressure which might result in an explosion.

When operating under extreme cold weather conditions, carefully check all safety latches and emergency exit latches for freedom of action prior to takeoff. Water and moisture may enter the latches, causing them to freeze and stick.

Batteries must have special attention in cold climates. At freezing temperatures, or below, the battery should be removed if portable generators are not available for engine starting, and stored in some suitable place where the temperature is above freezing, preferable around 20°C. Battery freezing temperatures are in proportion to the specific gravity of the electrolyte. The lower the specific gravity, the higher the freezing point.

NOTE **Remove all ice and snow from the airplane and control surfaces before takeoff.**

When parking an airplane on snow or ice, provide some sort of insulation under the tires to prevent them from freezing to the ground. Failure to adhere to this rule may result in tearing off large chunks of rubber when the airplane is moved.

STANDARD B-29 PILOT'S QUESTIONNAIRE

General Specification and Structure

1. The wing span of the B-29 is approximately (a) 107 feet, (b) 141 feet, (c) 103 feet.

2. The over-all length is approximately (a) 99 feet, (b) 110 feet, (c) 74 feet.

3. The maximum height is approximately (a) 16 feet, (b) 51 feet, (c) 29½ ft.

4. The wing airfoil section is a:

(a) Standard Boeing design similar to B-17.

(b) High-lift, high-speed Davis airfoil.

(c) Boeing 117.

5. Starting from the nose, name all the different compartments in the fuselage

6. Locate the exits from all the crew compartments.

(a) In flight.

(b) After crash landing.

7. Name the crew compartments which are accessible and those which are not accessible when cabins are pressurized.

8. The landing gear is not completely retractable inasmuch as the tail-skid is always extended. **True** or **False?**

Wing Flaps

9. The following type of flaps are used on the B-29:

(a) Split trailing edge flaps.

(b) Fowler flaps.

(c) Hinged, slotted flaps.

10. What are the flap settings for:

(a) Takeoff?

(b) Downwind leg?

(c) Final approach?

11. What is the maximum flap angle?

12. What is the maximum airspeed not to be exceeded with: (a) 45° flaps? (b) 25° flaps?

(a)

(b)

13. Explain in detail how you would put the flaps down, using the emergency system.

14. What is the minimum speed at which the flaps are retracted after takeoff?

Auxiliary Power Plant

15. Where is the auxiliary power plant located?

16. What is the voltage and amperage output of the auxiliary power plant generator?

17. Is the auxiliary power plant supercharged?

18. What type of fuel and oil must be used?

19. Describe normal starting procedure.

Landing Gear

20. In what ways can the landing gear be extended or retracted?

21. What is the direct function of the landing gear transfer switch?

22. What is the direct function of the bus selector switch on the battery solenoid shield?

23. Locate the emergency landing gear motor switches.

24. How can the landing gear and doors be retracted after an emergency operation?

25. What means has been provided for determining whether the landing gear has been extended? Day? Night?

26. Explain in detail the correct procedure in case landing gear fails to retract on normal system after takeoff.

27. What part of the landing gear mechanism causes the down and locked lights to burn.

28. Are 3-point (tailskid contact) landings normally expected on this plane?

29. What provision is made for emergency extension of the tailskid?

30. In your preflight inspection, how would you check the nose gear and main gear shock struts for proper extension?

31. How long is required to extend the landing gear on the normal system? On the emergency system?

Engine and Accessories

32. What type of engine is installed on the B-29?

33. Propeller rotation when viewed from the rear is in which direction?

34. What type of carburetor is used on the B-29?

35. Describe the type of starter that is used on the B-29?

36. What type of propeller is used?

37. What is the main difference between the propeller governor controls used on the B-29 and on the B-17?

38. What are the normal cowl flap positions for:
Ground Operations ....
Takeoff ....
Climb ....
Cruise ....

39. What is the maximum cylinder head temperature for the following:
Takeoff (max 5 min) ....
Climb (max 1 hour) ....
Auto Lean operation..................

40. Is a cowl flap position indicator provided?

41. What accessories are affected by failure of an inboard engine?

42. What accessories are affected by failure of an outboard engine?

Turbo-Supercharger, Induction and Exhaust System

43. How many turbos are used per engine on the B-29?

44. What type of turbo supercharger control is used?

45. What is the purpose of the exhaust supercharger?

46. What is the purpose of the supercharger pressuretrol?

47. How are the supercharger pressuretrols controlled by the pilot?

48. How many pressuretrols are used?

49. How are the cowl flaps and the intercooler flaps operated?

Oil System

50. What is the oil tank capacity on the B-29?

51. What are minimum and maximum limits for oil pressure?

52. What are minimum and maximum limits for oil temperature?

53. What is the minimum oil temperature to be reached before run-up?

54. What must be done to engine oil if emergency takeoff is necessary? (Before engine is completely warmed up?)

55. What means are used to control the engine oil cooler?

Fuel System

56. What is the fuel capacity for each engine?
Outboards:
Inboards:

57. What is the fuel capacity of the bomb bay tanks?

58. How are the tanks vented?

59. What is the function of the tank safety switches and where are they located?

60. The engine priming system injects fuel into what part of the engine?

61. What is the normal fuel consumption per engine at:
2200 Hp (takeoff)
2000 Hp (climb)
1170 Hp (cruise)

62. What position should the mixture control be set at for the following conditions:

Starting....................

Takeoff....................

Climb above 2200 rpm and 35″................

Cruise above 2200 rpm and 35″................

Cruise below 2200 rpm and 35″................

63. How are the fuel boost pumps operated?

64. How should the engine be primed?

65. Describe the procedure necessary to transfer fuel from number one fuel tank to number two fuel tank.

66. With fuel pressure at 17 lbs. and oil pressure at 40 lbs., how is it that fuel is injected into the oil system for dilution?

67. What is the hourly capacity of the fuel transfer system using both pumps?

Electrical System

68. How many generators are used on the B-29, and where are they located?

69. Where is the external power plug located?

70. What units are supplied with electrical power by the emergency bus?

71. In what two ways can the emergency bus be energized?

72. Can the normal bus and the emergency bus be energized at the same time?

73. What is the source of power for each bus if each bus is used separately?

74. How many amperes are required to operate:

(a) Wing flaps?

(b) Bomb bay doors?

(c) Landing gear (normal system)?

75. How many inverters are used on the B-29 to supply the AC system?

76. What instruments and pieces of equipment use AC from these inverters?

77. When the landing gear is not fully extended, under what conditions does it support the weight of the airplane?

78. If none of the landing gear would retract using the normal procedure. what would be the first thing to check and where?

79. What might make the warning horn blow

(a) steadily

(b) intermittently

80. If the main wheels retract, but the nosewheel does not, using the normal procedure, what should be checked first?

81. Explain in detail how you would open the bomb doors if the normal system failed.

82. Can the hydraulic pump be operated by the emergency bus?

83. Which of the door and gear motors are fused?

84. Name seven electric pumps which use 24 volt DC current.

85. Is the cowl flap operation automatic or manual?

86. If the propeller governors fail to operate, what should be checked first?

87. Do the fluorescent lights use AC or DC?

88. Name the five different systems of exterior lights.

89. Locate all fuse panels and indicate which are accessible in flight.

De-Icer and Vacuum Systems

90. When would you need all four vacuum pumps?

91. What does each pump do?

92. What should the vacuum pressure reading be?

93. Locate the anti-icer pumps and describe the function of each.

Cabin Heating and Supercharger System

94. What is the purpose of this system?

95. What provides pressure for the cabin?

96. Explain in detail how you would pressurize the cabin and how you can control the pressure manually.

97. In what ways can the cabin pressure be released?

98. Starting from sea-level, give the altitudes maintained in the cabin.

99. What check should you make on the cabin pressure regulators before pressurizing?

100. In case of failure of the cabin pressure regulator, what means are provided for keeping an excessive pressure from building up in the cabin? Where is this unit located?

101. How is the cabin heated?

102. Where is the cabin thermostat located?

Oxygen System

103. What type oxygen system is used?

104. What should the pressure gage read when the system is full?

105. How many oxygen systems are provided?

106. How many oxygen bottles are installed?

107. How many individual outlets (regulator panels) are provided?

108. Of what do these regulator panels consist?

109. What is the minimum pressure on which the system will operate?

110. Name the controls that may be used in the operation of the demand type regulator, and the difference of operation of the controls.

111. How long will one stationary cylinder last one man?

112. How long will the portable oxygen cylinder last a man?

113. Where are portable oxygen bottles located?

114. If a crew member is suffering from oxygen lack, in what position should his emergency valve be?

115. What precaution must be taken if the emergency valve is used?

Hydraulic System

116. What are the normal operating pressures of the normal and emergency systems?

117. Where is the hydraulic panel located?

118. How can the pressure of the normal and emergency systems be bled?

119. How is the emergency system serviced?

120. Is it safe to use normal brakes while servicing the emergency system?

121. Approximately how many brake applications may be made with the emergency system?

122. How many expander tubes per wheel?

123. After diligent application of brakes, it is proper to set the parking brakes. **True** or **False?** Why?

124. What power unit supplies the hydraulic pressure?

125. How is the proper hydraulic pressure maintained?

126. If you were using normal brakes on your landing roll and you broke an expander tube, what would you do?

Power Plant Performance

127. Give the following information:

T.O. Hp

Rated Hp

128. What is the proper engine rpm and mp for:

	MP	RPM
T.O.	....	....
Mil. Power	....	....
Rated Power	....	....
Auto Lean operation	....	....

129. Which should be reduced first, mp or rpm?

130. What causes detonation, how do you know when it occurs, and what would you do about it?

131. If all four engines were running hot (above 248°C) in a climb, what would you do and why?

132. Give stopping procedure.

133. Give procedure for checking prop governor system during engine warm-up.

134. What should be the intercooler flap position on T.O.?

135. In what order should the engines be started?

136. What are the minimum and maximum limits for carburetor air temperature

(a) Under conditions likely to produce ice?

(b) Under conditions unlikely to produce ice?

Radio Equipment

137. Name the radio sets that this plane is equipped with and what crew member has control of each.

138. Give the location of the jackboxes.

139. What switches must you turn on to operate the interphone system?

140. Give the five positions on the jack box.

141. If the interphone system fails, what is one of the first things to check, and where is it located?

Emergency Procedure

142. Why should airplane commander's, copilot's and flight engineer's escape windows and hatches be opened before an emergency landing?

143. What three emergency systems are provided for the airplane commander to communicate with the crew?

144. How is cabin pressure released in an emergency?

145. Why should airplane commander's, copilot's, and flight engineer's windows and upper escape hatch not be used as emergency exits during flight?

146. Why should lower turret areas be avoided by crew members during a crash landing?

147. Where should the crew members, with the exception of the airplane commander and copilot, station themselves for a crash landing on land?

148. What is location of life rafts?

149. How are life rafts released?

150. What is the proper procedure in case of engine fire in flight?

Cockpit Controls

151. Give the location of the following

a. Emergency landing gear door release.

b. Emergency brake control.

c. Engine fire extinguisher control.

d. Emergency hydraulic pressure gage.

e. Hydraulic servicing valve.

f. Hydraulic pressure gage.

g. Airplane commander's over-ride control (early models).

h. Airplane commander's bomb release handle.

i. Landing gear power transfer switch.

j. Surface control lock.

k. Emergency cabin pressure release.

l. Propeller anti-icer controls.

m. Surface de-icer valve.

n. Vacuum pump selector.

o. Warning horns.

p. Generator switches.

q. Position light switches.

r. Suction gage.

s. Prop feathering buttons.

t. Intercooler flap controls.

u. Engine primer controls.

v. Hydraulic hand pump.

w. Fuel shut-off valve switches.

x. Booster pump switches.

y. Landing gear switch (normal).

z. Landing light switch.

aa. Recognition light switches.

bb. Autopilot switches.