RESTRICTED

PILOT'S HANDBOOK

MODEL J4F-2 AIRPLANE

CONTRACT NO. NXs-5229

RANGER ENGINE NO. 6-440C-5

WIDGEON

RELEASED BY THE BUREAU OF AERONAUTICS NAVY DEPARTMENT

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
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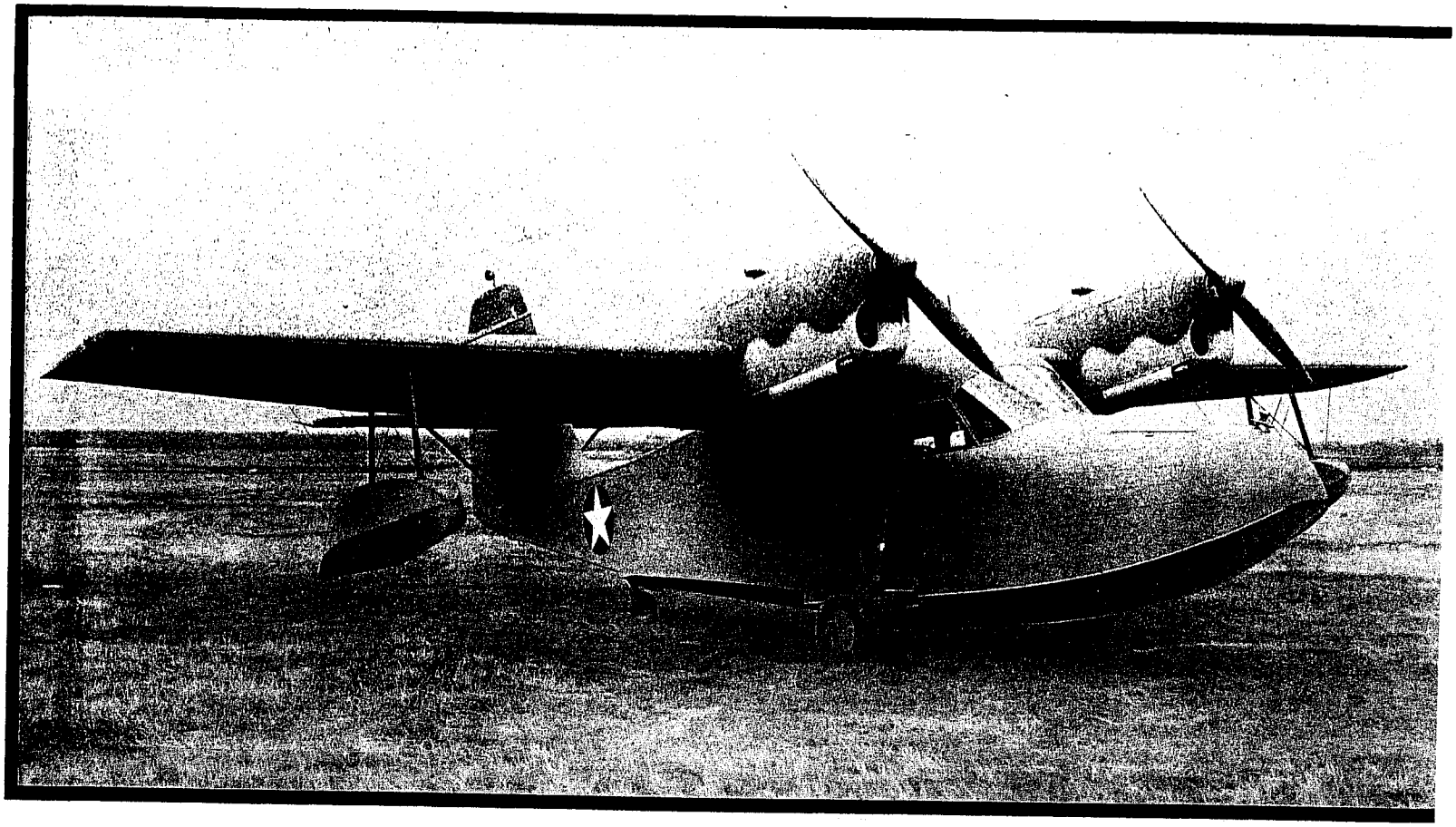

FOREWORD

This handbook is prepared for the purpose of familiarizing flying personnel with the take-off flying and landing characteristics of this airplane; the functions of particular systems and installations, and the operation of the various automatic and manual controls.

For service and overhaul instructions, refer to the Erection and Maintenance Instructions Manual for this airplane.

The airplane is a twin engine, five place, amphibian monoplane. It is designed for utility and observation use.

The main wheels are extended and retracted hydraulically and locked mechanically in the UP and DOWN positions. The tail wheel is also hydraulically operated, extending or retracting simultaneously with the main wheels.

The power plants are Ranger 6-440C-5, 6 cylinder in-line, inverted aircooled, direct drive engines; designed to operate on 91 octane fuel. The rating of the combined engines is 400 BHP at 2450 RPM at sea level.

The two integral wing fuel tanks have a total combined capacity of 108 gallons; left 54 gallons and right 54 gallons. Each oil tank has a capacity of $3\frac{1}{2}$ gallons, with one gallon foaming space.

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LIST OF ILLUSTRATIONS

SECTION I

COCKPIT ARRANGEMENT

AND

CONTROLS

The arrangement of the cockpit and cabin and the locations of the various controls are shown on the accompanying photographic illustrations.

In general, the controls and their operation are indicated by adjacent nameplates.

1. FLYING CONTROLS

Aileron & Elevator

Standard column and throw-over wheel.

Rudder

Standard overhung pedals. Removable rudder bar for co-pilot.

Elevator Trimming Tab

Handcrank on left hand side of Upper Control Panel. Tab position indicator above crank.

ROTATE CLOCKWISE - NOSE UP

Elevator Balance Tab

The tab, on the right elevator, is designed for downward movement only. It is actuated by a direct cable from the Wing Flap Controls and is not adjustable in flight. This tab automatically compensates for changes in trim produced by

lowering the flaps.

It is important that the static balance tube on the upper surface is always firmly attached.

Rudder Trimming Tab

Handcrank on right hand side of Upper Control Panel. Tab position indicator above crank.

ROTATE CLOCKWISE - NOSE RIGHT

Wing Flaps

Three position Hydraulic Control Lever on the right hand side of the Upper Control Panel. Flap position indicator adjacent to Control Lever.

LEVER UP - FLAPS UP
LEVER CENTER - NEUTRAL
LEVER DOWN - FLAPS DOWN

Normal Operation

Operated hydraulically by Flap Control Lever - controllable downward from 0° to 40°. Movement may be stopped at desired degree of droop by returning the lever to NEUTRAL position.

Emergency Operation

Thumb Latches are provided to lock the Flap Control Lever in the operating positions to permit the pilot to have one hand free if emergency hand pump operation is needed. About seven strokes are required to lower flaps. White Up Latch located to the left of the control lever slot at the UP position and Red Down Latch at the DOWN

position. The White Up Latch may be left locked since the flap is returned to the UP position by the action of a tension spring.

CAUTION: THE RED DOWN LATCH SHOULD BE USED ONLY WHEN OPERATING THE HAND-PUMP AND RELEASED IMMEDIATELY AFTER PUMPING, OTHERWISE, THERE IS NO FLOW THROUGH THE VALVES AND UNRELIABLE OPERATION OCCURS.

2. LANDING GEAR CONTROLS

The Hydraulically operated Main and Tail Wheels are extended or retracted simultaneously by double-acting hydraulic cylinders. The operating pressure is supplied by the engine driven hydraulic pump or, in emergency, by the hydraulic hand pump.

Normal Operation

Landing Gear movement is controlled by a lever on the left center of the Upper Control Panel which has the DOWN and UP positions plainly marked thereon.

LEVER UP - LANDING GEAR RETRACTED
LEVER CENTER - NEUTRAL
LEVER DOWN - LANDING GEAR EXTENDED

Emergency Operation

In case of failure of the engine driven pump (installed on left engine), the Emergency Hand Pump on the left side of the pilot's seat should be used. Approximately 24 strokes are required to retract or extend the Landing Gear. Two Red Thumb Latches are provided at the right of the lever slot to lock the Landing Gear Control Lever in the desired operating position enabling the pilot to have one hand free if hand pump operation is needed.

CAUTION: THE RED LATCHES SHOULD BE USED ONLY WHEN USING THE HAND PUMP AND SHOULD BE RELEASED IMMEDIATELY AFTER PUMPING, OTHERWISE, THERE IS NO FLOW THROUGH THE VALVES AND UNRELIABLE OPERATION OCCURS.

Wheel Position Checks

Inspection Windows

Located at the top of each wheel pocket. The hinged covers of the wheel pockets may be raised for complete inspection.

Warning Instrument

This instrument, designed to help prevent inadvertent landings with the Landing Gear in the incorrect position, is located on the top center of the Main Instrument Panel. The signal lights when the right engine is throttled below 1550 RPM. In the event that the wheels are neither completely UP or DOWN - DANGER WHEELS is lighted, if the wheels are in the retracted position - WHEELS UP is lighted and if they are DOWN - WHEELS DOWN is lighted.

Hydraulic System Pressure Gage

Located on the right hand side of the Upper Control Panel. When the Landing Gear and Flap Selector Valves are not in use, the gage reads zero. As the landing gear is operated the pressure should read about 100 p.s.i., and when the gear is completely retracted, the gage shows a relief pressure of 900 p.s.i.

Tail Wheel Caster Lock

The 360° swivel type tail wheel drag link is equipped with a lock-pin which locks the caster in the trailing position. The lock-pin is controlled by cable from Lock Lever on the Upper Control Panel.

LEVER UP - UNLOCKED
LEVER DOWN - LOCKED

The primary purpose of the lock is to reduce the possibility of ground looping in landing under unfavorable ground conditions. Lock the tail wheel immediately after taxiing into position for take-off. The wheel will then remain locked during flight and landing. Unlock after the landing run has been completed in order to facilitate taxiing.

The tail wheel lock assists taxiing up and down steep ramps.

Brake Controls

The hydraulic brakes for each landing gear wheel may be operated individually by means of toe-bars attached to the rudder pedals.

It must be remembered that wet brakes may be ineffective; therefore, it is wise to taxi cautiously immediately after leaving the water. If an immediate land landing is to be made after a water take-off, the brakes will dry more rapidly with the landing gear in the down position.

For parking, either brake or both can be locked ON by lifting the knob located between the rudder pedals, then operating the brakes. Brakes may be adjusted by varying the length of the adjustable rods attached to the toe-bars.

3. POWER PLANT CONTROLS

Carburetor Air Preheat

Two push-pull "T" Handles on the left hand side of the Upper Rear Control Panel.

PULL FOR HEAT THEN ROTATE TO LOCK

Fuel Valves

The three control levers are at the right hand side of the Upper Rear Control Panel.

RIGHT TANK
TANK CROSS FLOW
LEFT TANK

LEVERS UP - OFF
LEVERS DOWN - ON

CAUTION: VALVE MUST BE CLOSED ON EMPTY TANK. AT LEAST TWO VALVES MUST BE ON SIMULTANEOUSLY TO OPERATE BOTH ENGINES.

Ignition

Single unit, double switch at the center of the Upper Control Panel.

Master Switch

Lever at center of the Upper Rear Control Panel.

LEVER RIGHT - SWITCH ON
LEVER LEFT - SWITCH OFF

Throttles

Levers located at lower edge of the Upper Control Panel.

LEVER FORWARD - THROTTLE OPEN
LEVER AFT - THROTTLE CLOSED

Mixture

Two levers at center of the Upper Rear Control Panel. IDLE FUEL CUT-OFF sectors painted red.

LEVERS UP - LEAN POSITION
LEVERS DOWN - RICH POSITION
LEVERS FULL UP- IDLE FUEL CUT-OFF

Starter

Two push buttons on lower left hand side of the Main Instrument Panel.

PUSH TO START ENGINE

Wobble Pumps

Lever at right and left hand side of the Upper Rear Control Panel.

RIGHT LEVER - RIGHT PUMP
LEFT LEVER - LEFT PUMP

Primer Pump

The primer pump is located on left hand side of the Main Instrument Panel. Primer supplied by operating the left wobble pump lever.

4. AUXILIARY CONTROLS

Cabin Heat

Two mixing control handles; cockpit control to right and above the co-pilot and cabin control to the left and above the pilot.

PUSH FORWARD - HOT AIR
PUSH AFT - COLD AIR

The adjustable ventilator in the cabin ceiling should normally be open except in very cold weather.

Electrical Switches & Rheostats

The following switches are on the lower left of the Main Instrument Panel:

Anchor Light
Navigation Light
Pitot Heat Switch
*Compass Light
*Cockpit Light
Generator Switch
Fuel Gage Switch
Landing Light

*These switches are combined with rheostats.

5. USEFUL LOAD CONTROLS

Radio

Control panel located on the forward right hand side of the cabin.

Armament

Bomb rack located on the underside of the right wing between the engine nacelle and the hull.

Bomb release control located at the left hand side of the co-pilot's seat.

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Control panel located on the forward right hand side of the cabin.

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Bomb rack located on the underside of the right wing between the engine nacelle and the hull.

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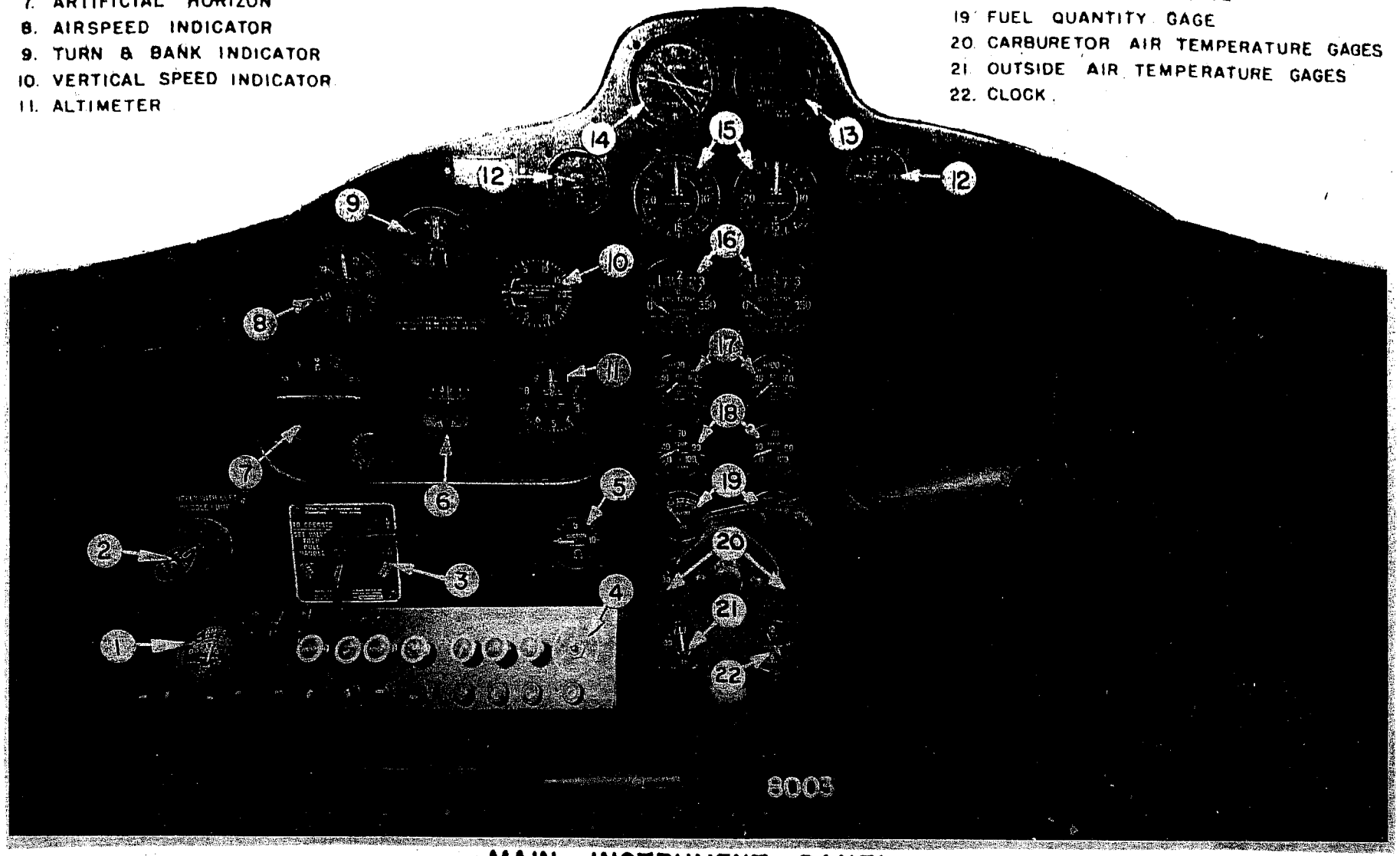
1. VOLT AMMETER
2. PRIMER PUMP
3. FIRE EXTINGUISHER CONTROL
4. LANDING LIGHT SWITCH
5. VACUUM GAGE
6. DIRECTIONAL GYRO
7. ARTIFICIAL HORIZON
8. AIRSPEED INDICATOR
9. TURN & BANK INDICATOR
10. VERTICAL SPEED INDICATOR
11. ALTIMETER
12. FUEL PRESSURE GAGES
13. LANDING GEAR INDICATOR LIGHT
14. COMPASS
15. TACHOMETERS
16. CYLINDER HEAD TEMPERATURE GAGES
17. OIL PRESSURE GAGE
18. OIL TEMPERATURE GAGE
19. FUEL QUANTITY GAGE
20. CARBURETOR AIR TEMPERATURE GAGES
21. OUTSIDE AIR TEMPERATURE GAGES
22. CLOCK

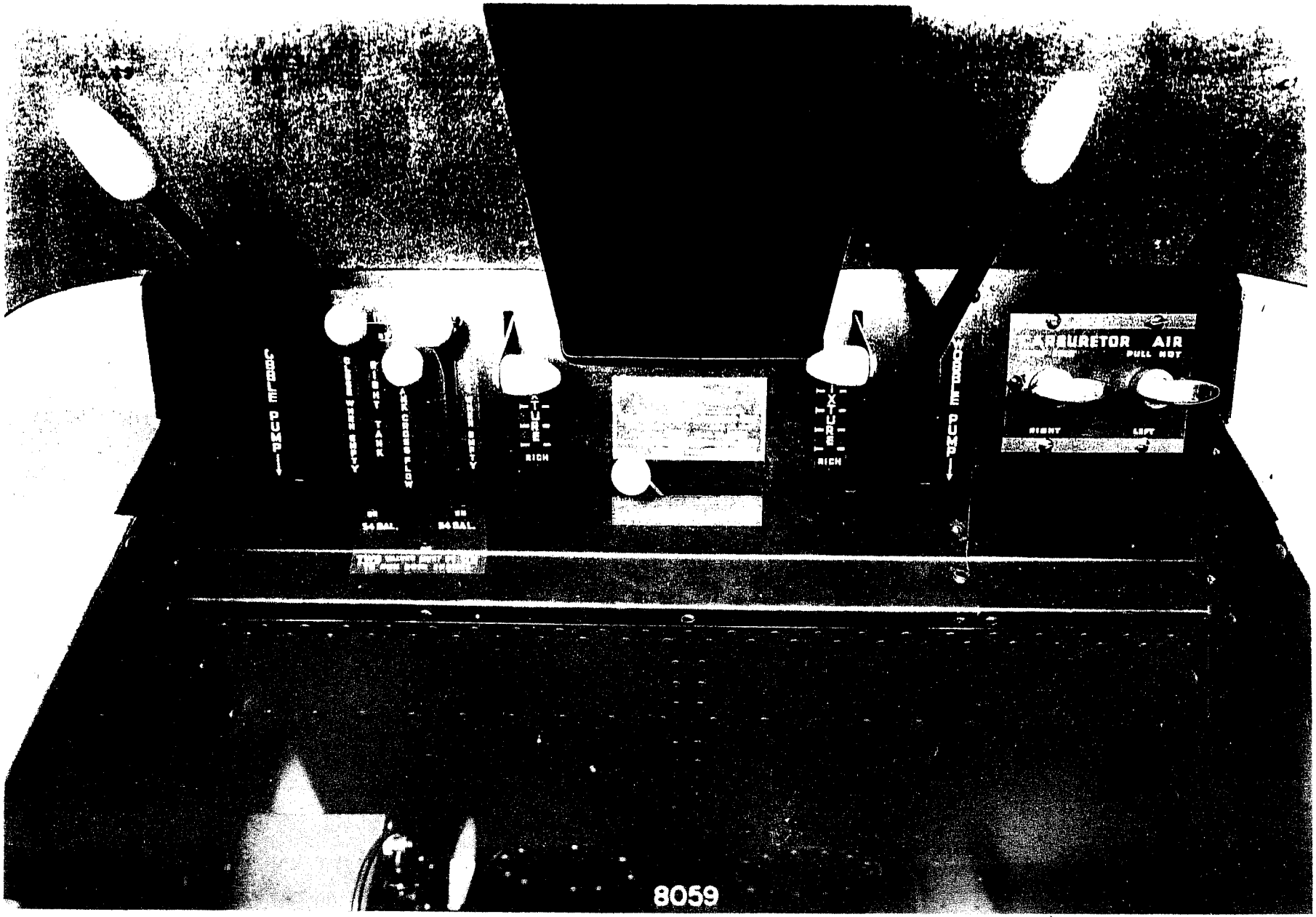


MAIN INSTRUMENT PANEL

FIG. 1

UPPER CONTROL PANEL

FIG. 2



UPPER REAR CONTROL PANEL

FIG. 3

SECTION II

OPERATION INSTRUCTIONS

1. POWER PLANT

(a) Engine

This airplane is powered with two Ranger Model 6-440C-5, 6 cylinder in line, inverted air cooled, direct drive engines which may be operated on either 87 or 91 octane fuel. These engines are not supercharged. The combined engines are rated;

400 HP at 2450 RPM, with 28" Hg.
300 HP at 2300 RPM, with 22" Hg.
300 HP at 2350 RPM, with 21.5" Hg.

Fuel Spec. - 87 octane AN-F-25
91 octane AN-VV-F-776
Oil Spec. - AN-VV-O-446 Grade 1100

(b) Propellers

This airplane is equipped with Sensenich wooden, two blade, fixed pitch propellers.

Diameter	82"
Pitch (at 3/4 Radius)	72"

Under standard sea-level atmospheric conditions, the static ground RPM is approximately 2100.

It should be remembered that temperature and humidity conditions affect wooden propellers, even after short periods without use. They sometimes warp slightly and not alike on either side; thereby changing the speed characteristics of their respective engines. This is the usual explanation if one engine does not turn-up as fast as the

other and does not normally indicate a power loss. Several hours of running may bring the propellers back to their former speed.

It is usual practice on twin-engine airplanes to synchronize the speed of the engines by their sound, even though the tachometer readings may be slightly different.

(c) Carburetor Air Controls

The carburetor air pre-heat duct, mounted below the carburetor, is fitted with a mixing valve arrangement which is controlled by "T" Handles on the Upper Rear Control Panel.

PULL FOR HEAT THEN ROTATE TO LOCK

Hot or cold air, or any desired mixture of both, may be supplied to the carburetors. Temperatures of intake air at the carburetor are indicated on the Main Instrument Panel. A total heat rise of 60° is available at an outside air temperature of 30°F.

(d) Mixture Control

The following expressions are used in manual adjustment of the Mixture Control.

FULL RICH - Setting of the Mixture Control Lever in the position which gives the maximum fuel flow.

BEST POWER - Setting of the Mixture Control Lever which, with a given fixed throttle setting, results in maximum engine RPM. At leanest fuel flow, further leaning of the mixture would cause a decrease in engine RPM.

SMOOTH OPERATION - The setting for BEST POWER is obtained and then the mixture enriched until the engine speed drops 20 to 30 RPM.

MAXIMUM ECONOMY - Obtained by adjusting to BEST POWER and then leaning to obtain a decrease of 40 to 50 RPM.

The carburetors are fitted with IDLE FUEL CUT-OFFS which provide for stopping the flow of fuel to the carburetor jets when the Mixture Control Levers are in the FULL AFT position on the mixture segment. This portion of the control unit is painted RED.

(e) Engine Starting

It is recommended that the engines, after standing as long as over night, be pulled through three complete revolutions by hand before starting.

The engines are equipped with Eclipse Type E-80 starters. Starter buttons are located on the lower left hand side of the Main Instrument Panel.

The Right Engine should be started first in order to avoid voltage drop (with generator in-operative), which is caused by the longer starter cable leading to the left engine.

The best combination of fuel valves shall be turned on. At least two (2) valves must be on. Valve must be closed on empty tank. Proceed as follows:

Place the Master Switch to the ON position.

Set the mixture control to FULL RICH position and operate the left wobble pump lever to obtain a fuel pressure of 2-1/2 to 3-1/2 pounds.

Prime the engine by pumping the throttle approximately 3 or 4 times, dependent on outside temperature. Use of the priming pump is usually necessary only in cold weather as there is a tendency to overprime when operating this unit.

The selective primer is connected to the left fuel system. To assure filling the primer, operate the left wobble pump until pressure shows on the fuel pressure gage. The primer is more effective if the motor is being turned over while priming as the charge is immediately sucked into the cylinders.

With the throttle in the CLOSED position, PUSH-IN master ignition switch marked PULL-OFF, turn the individual switch on to the LEFT position as this magneto is equipped with an impulse unit.

Press the starter button and as soon as the engine starts, turn the individual ignition switch to the BOTH position and advance the throttle to about 800 RPM.

If the engine, after starting, shows any indication of missing or lean running, it will be necessary to pump the throttle at the closed position, using very short strokes.

If the engine is overprimed, as indicated by dripping of an excessive quantity of gasoline from the carburetor drain, the throttle should be opened wide and the engine turned backward several revolutions by hand with the ignition switch OFF.

In extremely cold weather both engine and oil should be preheated.

If the engine fails to start after a reasonable number of attempts, consult the chapter on Engine Troubles in the INSTRUCTION BOOK for RANGER AIRCRAFT ENGINES.

(f) Warming Up Engines

As soon as the engine starts, check the oil pressure gage. If no pressure is indicated after 30 seconds running, the engine should be stopped and an investigation made.

Always be sure that the primer pump is shut off after starting.

In cold weather, when the oil has not been preheated, keep the engine throttled as low as possible until some temperature is registered.

The warming-up period is important and should be carried out as follows:

After the oil gage indicates pressure, run the engine at 800 to 1000 RPM until the pressure is normal for this speed which will be between 50 and 70 lbs. This warm-up period should be extended for at least 5 minutes at which time the RPM should be increased to 1000. It is recommended that these speeds not be exceeded until the oil temperature registers 100°F. (38°C). A FULL RICH mixture should be used for all speeds when running on the ground near sea level.

The RPM check is made as follows:

These engines are rated at sea level, and therefore, should be checked at full throttle. As cooling of the engine is insufficient while on the ground, any prolonged running at or near full throttle should be avoided. Check oil pressure and temperature. Note drop in RPM when switching to one magneto at a time. Drop in RPM when operating on either magneto alone should not exceed 75 RPM.

Check for acceleration being sure that the mixture control is in the FULL RICH position.

(g) Take-Off

Set mixture control to FULL RICH position, manifold pressure 29" Hg. and 2100 RPM (approx.).

(h) Climb

At full throttle, the engines operate at special rich settings. At slightly less than Full Throttle, the fuel consumption drops to the normal curve. Therefore, in order to avoid excess heating and engine wear, climbing should be done at Full Throttle or with power reduced to 75%.

	Manifold Pressure 75% Power
S.L.	23.5" Hg.
2000 Ft.	23.0" Hg.
4000 Ft.	22.5" Hg.
6000 Ft.	22.0" Hg.
8000 Ft.	21.5" Hg.

(i) High Speed Level Flight

Recommended cruising power is 75% or less at all altitudes.

Mixture control is set at FULL RICH below 4000 ft. and at SMOOTH OPERATION above 4000 ft.

Maximum allowable RPM 2550.

(j) Cruising

Cruising economy will be obtained by conducting cruising operations in a range not to exceed 60% of the normal sea level H.P. See Figs. 4, 5 and 6 herein, for values for manifold pressure and engine speed for various altitudes and fuel consumption, which may be used as a guide in controlling engine operation. Maximum economy will be about 90 knots indicated air speed at full load - #4500. The minimum cruising speed should not be less than 90 knots true indicated air speed at all altitudes.

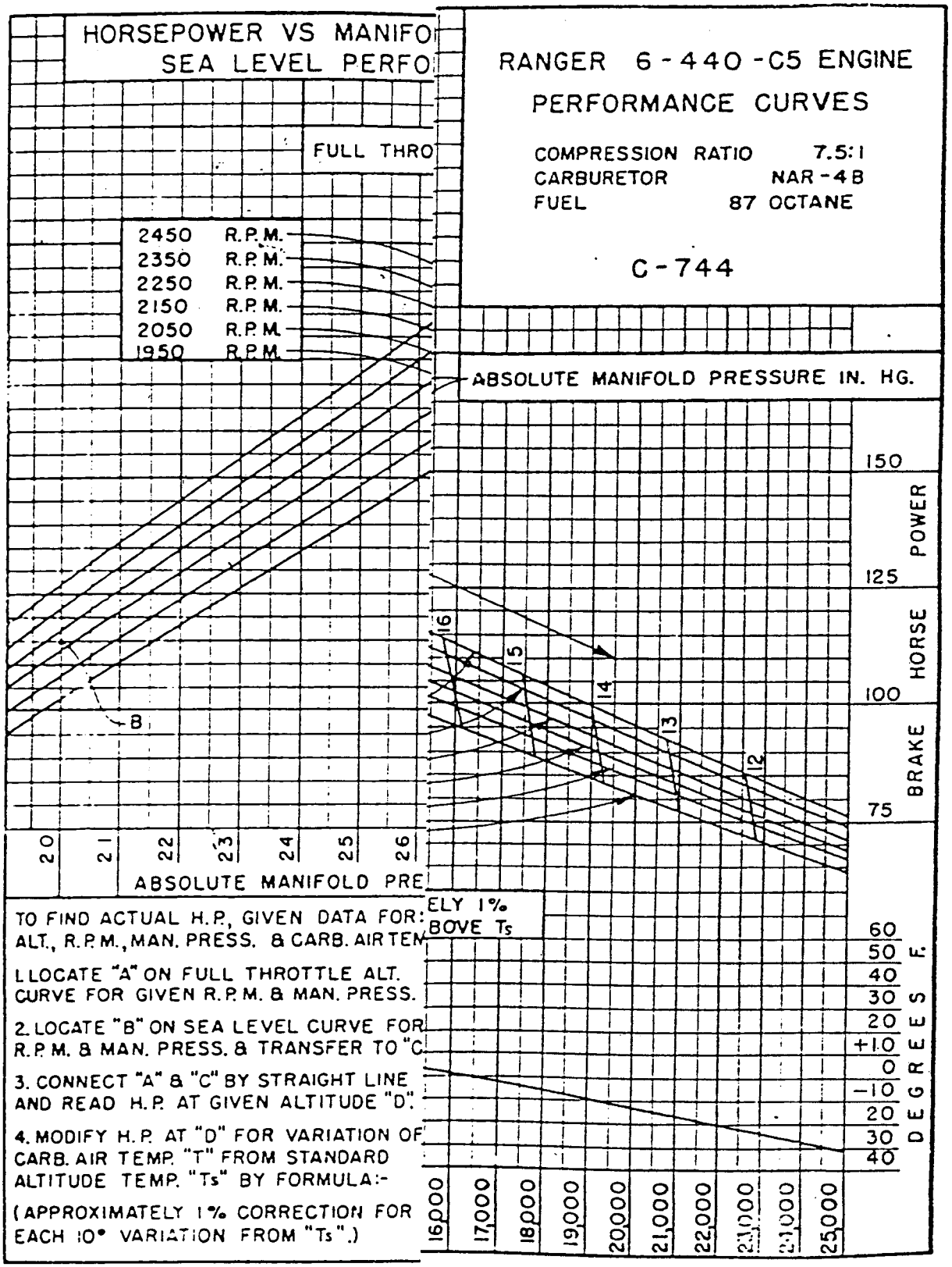
If roughness is experienced at high altitudes, the mixture control should be leaned out, the amount depending on the altitude and RPM.

ENGINE OPERATING CHART

Operating Conditions	Altitude Feet	Permissible R.P.M.	% Rated Power	Max. Abs. Man. Press.	Max. Cyl. Head Temp.	Mixture Control
Starting	S.L.	800 to 1000	---	---	---	Full Rich
Take-Off (Full Throttle)	S.L.	2050 to 2150	100	29.0" Hg.	500°F(260°C)	Full Rich
Cruising Max. Power	S.L.	2260	75	23.5" Hg.	465°F(240°C)	Best Power
	4000	2330	75	22.5" Hg.	465°F(240°C)	Best Power
	8000	2370	75	21.5" Hg.	465°F(240°C)	Best Power
Cruising Recommended	S.L.	2150	62½	22.0" Hg.	465°F(240°C)	Smooth Oper.
	4000	2200	62½	21.0" Hg.	465°F(240°C)	Smooth Oper.
	8000	2250	62½	20.0" Hg.	465°F(240°C)	Smooth Oper.
Cruising Economical	S.L.	1975	50	19.5" Hg.	465°F(240°C)	Max. Economy
	4000	2025	50	18.5" Hg.	465°F(240°C)	Max. Economy
	8000	2075	50	17.5" Hg.	465°F(240°C)	Max. Economy
Stopping	S.L.	800 to 1000	---	---	---	Idle Cut-Off

Oil Pressure: 50 to 70 p.s.i. except idling 15 p.s.i.
Oil Temperature: 140°F (60°C) to 170°F (77°C); Maximum 200°F (93°C)
Fuel Pressure: 2.5 to 3.5 p.s.i. Maximum Allowable R.P.M. 2550

FIG. 4


HORSEPOWER VS MANIFO
SEA LEVEL PERFO
FULL THRO
2450 R.P.M.
2350 R.P.M.
2250 R.P.M.
2150 R.P.M.
2050 R.P.M.
1950 R.P.M.
8
20
21
22
23
24
25
26
ABSOLUTE MANIFOLD PRE
RANGER 6-440-C5 ENGINE
PERFORMANCE CURVES
COMPRESSION RATIO 7.5:1
CARBURETOR NAR-4B
FUEL 87 OCTANE
C-744
ABSOLUTE MANIFOLD PRESSURE IN. HG.
16
15
14
13
12
150
125
100
75
POWER
HORSE
BRAKE
ELY 1%
BOVE Ts
60
50
40
30
20
+10
0
-10
20
30
40
DEGREES F.
16,000
17,000
18,000
19,000
20,000
21,000
22,000
23,000
24,000
25,000
TO FIND ACTUAL H.P. GIVEN DATA FOR:
ALT., R.P.M., MAN. PRESS. & CARB. AIR TEM
1. LOCATE "A" ON FULL THROTTLE ALT.
CURVE FOR GIVEN R.P.M. & MAN. PRESS.
2. LOCATE "B" ON SEA LEVEL CURVE FOR
R.P.M. & MAN. PRESS. & TRANSFER TO "C
3. CONNECT "A" & "C" BY STRAIGHT LINE
AND READ H.P. AT GIVEN ALTITUDE "D".
4. MODIFY H.P. AT "D" FOR VARIATION OF
CARB. AIR TEMP. "T" FROM STANDARD
ALTITUDE TEMP. "Ts" BY FORMULA:-
(APPROXIMATELY 1% CORRECTION FOR
EACH 10° VARIATION FROM "Ts".)

FUEL CONSUMPTION AND RANGE TABLE WITH SENSENICH 82RS72 PROPELLERS

% HP	Alt	Approx. Average RPM	Approx. Average M.P.	Approx. Speed Kts. *1.	Normal Consumption Full Rich	Range in Naut.Miles *2.	Minimum Consumption Max. Lean	Range in Naut.Miles *2.
75%	S.L. 6000	2250 2350	25.0 22.0	118 125	23.5 23.5	500 530	20.2 20.2	580 620
62½%	S.L. 6000	2125 2200	23.0 20.0	108 115	19.6 19.6	550 580	16.5 16.5	650 700
50%	S.L. 6000	1975 2050	21.0 18.0	98 103	16.5 16.5	590 620	13.5 13.5	720 740
43%	S.L.	1900	20.0	93	15.5	600	12.6	740

*1. Actual Speed. Indicated speed will be less.
*2. Based on 100 gallons - 8 gallons allowed for warm-up, taxi. etc. - No wind.
3. These figures are approximate; subject to variations in the propeller characteristics and atmospheric conditions.

FIG. 6

(1) Normal Instrument Readings

The following instrument readings were taken on a cruising flight at 500 ft. altitude.

Engine Speed	2150 RPM
Mixture	Smooth Operation
Fuel Pressure	3.2 p.s.i.
Oil Pressure	52 p.s.i.
Oil Temp.	122°F
Cylinder Temp.	338°F
Carburetor Air Temp.	77°F
Airspeed	112 Knots
Outside Air Temp.	68°F

2. FUEL SYSTEM

Tanks

The fuel is carried in two integral wing tanks.

LEFT WING TANK - 54 U.S. GAL.
RIGHT WING TANK - 54 U.S. GAL.

TOTAL 108 U.S. GAL.

Quantity Gage

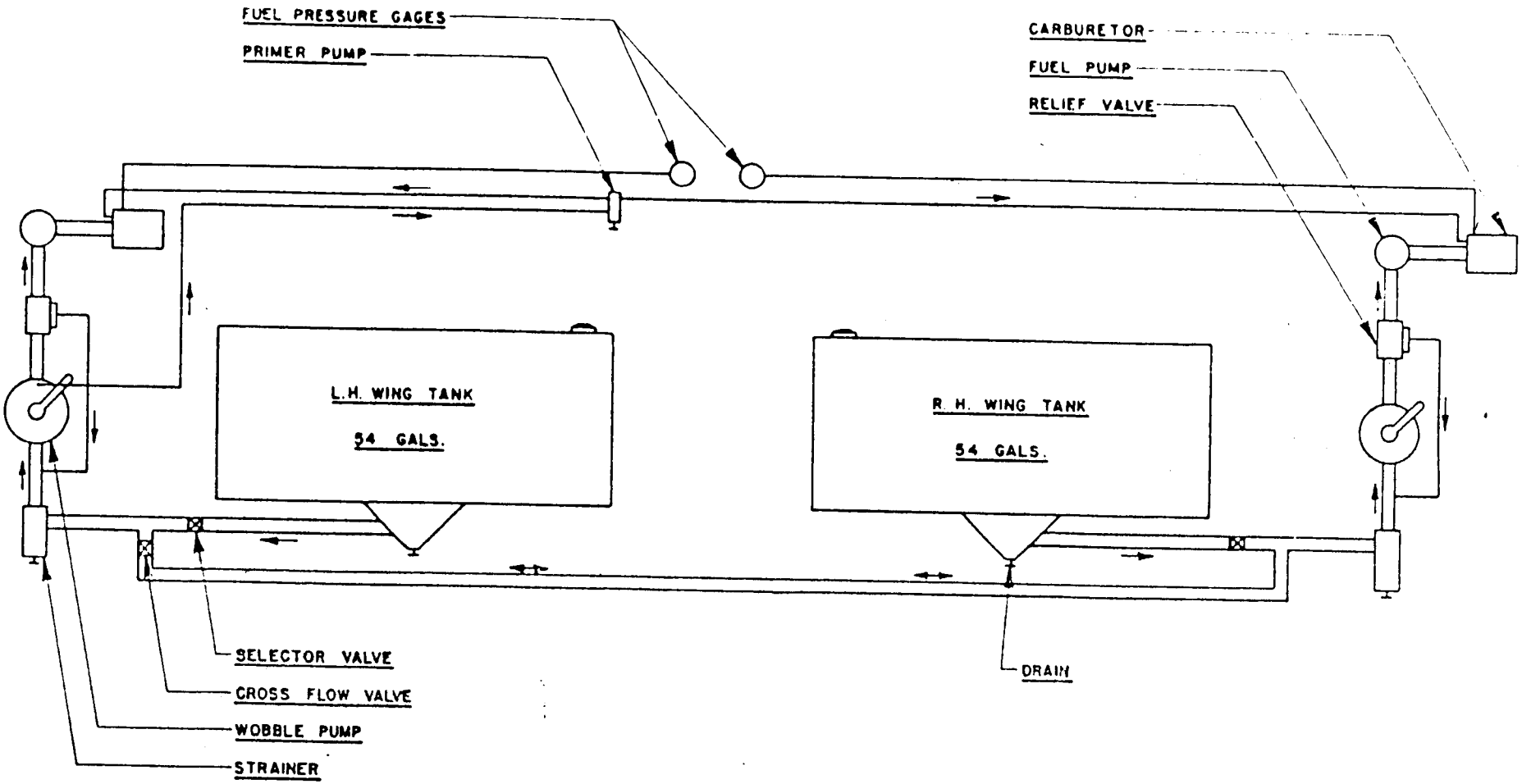
An electric fuel quantity gage, for each wing tank, is located on the Main Instrument Panel. They are controlled by a switch on the Electrical Panel.

A Fuel Strainer, Wobble Pump and Relief Valve are mounted in each nacelle.

As shown by the fuel system diagram, herein, the system is essentially a complete separate unit for each engine; and is normally used as such with each tank feeding its own engine directly. There is, however, a cross-flow connection with a shut-off valve, enabling both engines to be run simultaneously from either tank.

CAUTION: WHEN USING THE SHUT-OFF VALVE, THE VALVE ON THE TANK NOT BEING USED SHOULD BE CLOSED. IF A TANK SHOULD RUN DRY WHEN ALL THREE VALVES WERE OPEN, AIR WOULD ENTER BOTH SYSTEMS RESULTING IN ENGINE FAILURE.

IT SHOULD BE REMEMBERED THAT FOR BOTH ENGINES TO RUN, TWO VALVES MUST BE ON AND THAT THREE VALVES SHOULD NOT BE ON AT ONCE IF THE FUEL IS VERY LOW.



FUEL SYSTEM DIAGRAM

3. OIL SYSTEM

Tanks

The oil for each engine is carried in a single tank, one in each engine nacelle, aft of the firewall.

TANK CAPACITY - $3\frac{1}{2}$ U.S. GAL.
FOAMING SPACE - 1 U.S. GAL.

Situated at the left side of each engine is a 5" dia. oil cooler with thermostatic oil temperature control. It maintains the Oil-In temperature at approximately 140°F. (60°C) to 170°F. (77°C). The thermostatic control valve causes the oil to by-pass the cooler when the Oil-In temperature is below approximately 120°F. (49°C), returning the oil to the upper section of the tank.

The vent line is provided between the top of the oil tank and the rear of the crankcase. The oil drain valve is installed at the bottom of the tank.

Temperatures:	Maximum 200°F Desired 140°F to 170°F
Pressures:	Maximum 70 p.s.i. Desired 60 p.s.i. Minimum 50 p.s.i. Cruising Minimum 15 p.s.i. Idling

SECTION III

FLYING CHARACTERISTICS

I. LOADING SCHEDULE

This schedule has been prepared to permit a relatively simple and rapid check on balance by operating personnel for any combination of Useful Load and Special Equipment, or with Weight Empty Equipment removed for some particular mission.

The definition of terms used in this schedule are listed below:

1. Basic Weight

   This weight represents the actual weight empty plus non-expendable useful load items (Radio Equipment, etc.)

2. Index Unit

   An index unit is the moment (weight x distance of any item in the airplane about the horizontal reference line divided by 1000 to allow greater ease of handling.

3. Limiting C.G. Lines (See Fig. 10)

   The diagonal lines represent the recommended balance limits between which the center of gravity should be maintained.

4. A sample calculation showing how these data are used has been included on page 35.

Crew, Passengers & Variable Items of Equipment

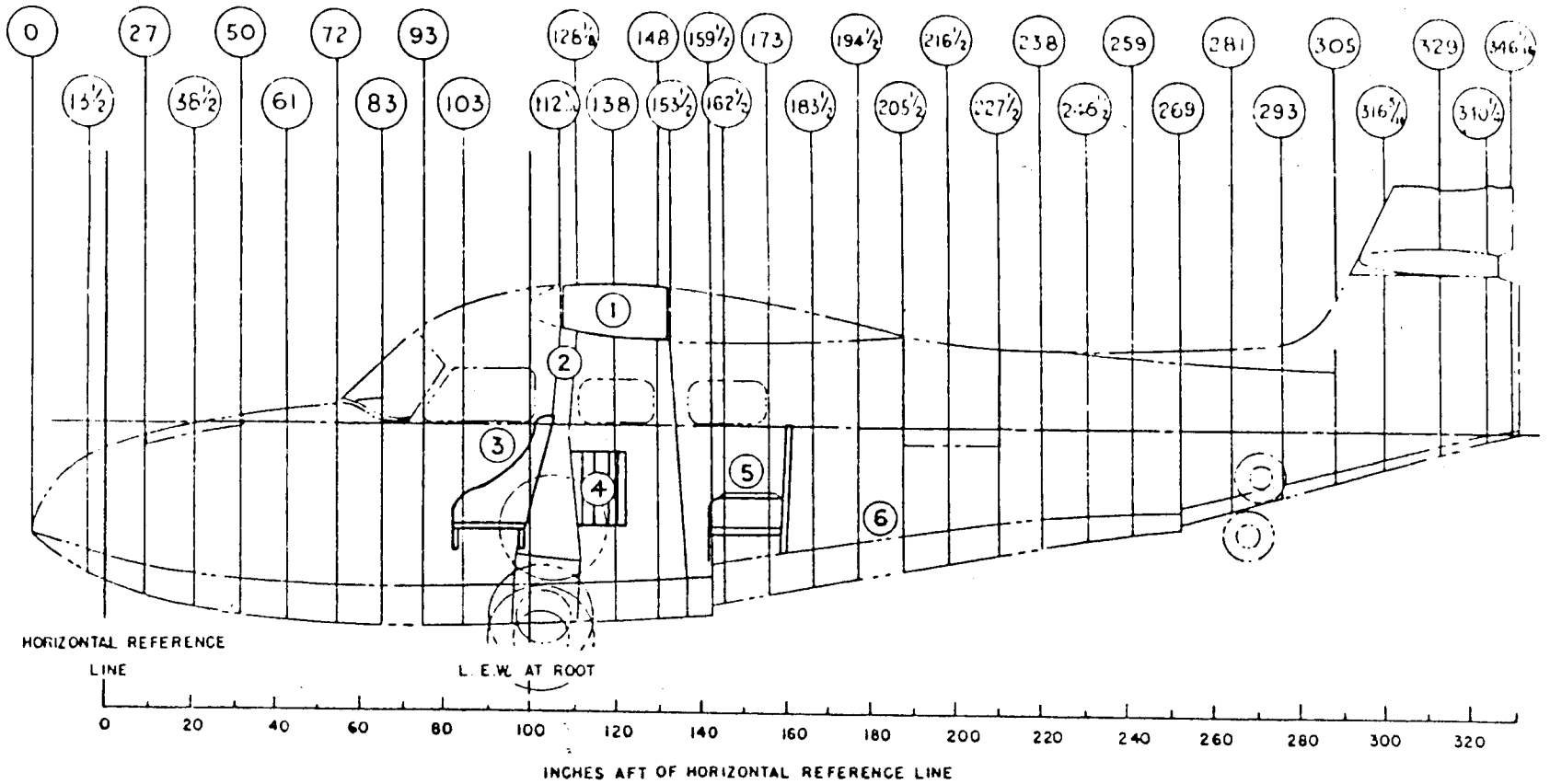
Item	Weight	Index Unit
Basic Weight	3210	376.69
Pilot	170	15.98
Co-Pilot	170	15.98
1 Passenger (Aux. Seat)	170	20.23
1 Passenger (Aft)	170	25.84
1 Passenger (Aft)	170	25.84
Oil (8.3 Gals. Approx.)	62	6.82
Fuel	See Fig. 9	
*Baggage in Rear	See Fig. 9	
Baggage in Bow Compartment	20	1.00

*Maximum 400# Subject to C.G. Check.

Sample Calculation

Basic Weight	3210	376.69
Pilot	170	15.98
Co-Pilot	170	15.98
Oil (8.3 Gals.)	62	6.82
Fuel (108 Gals.)	648	78.70
Baggage in Bow Compartment	20	1.00
Baggage in Rear	220	41.80
	4500	536.97

Plotting these coordinates on Fig. 10 shows the C.G. within the allowable limits.



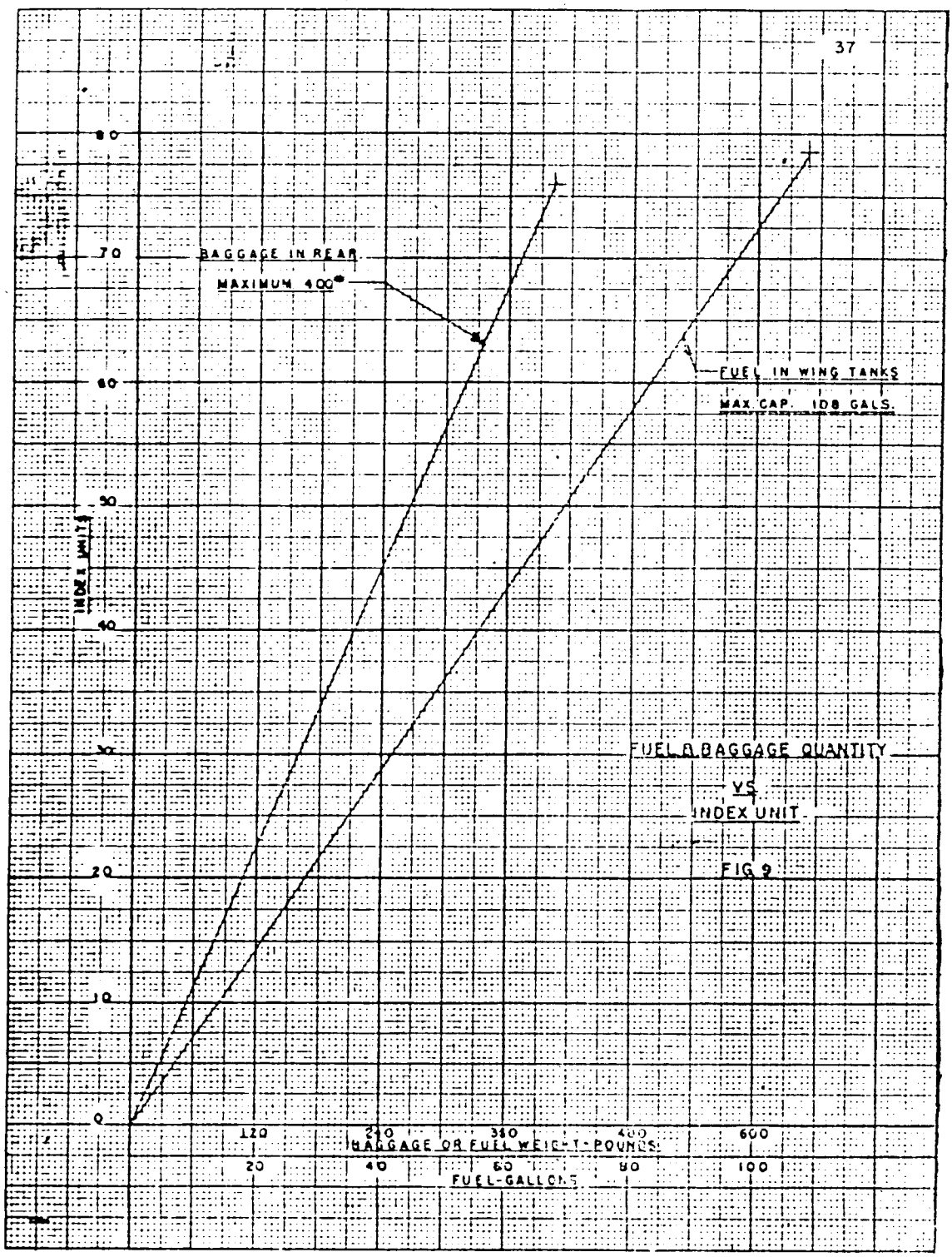
1 FUEL
2 RADIO
3 PILOT AND CO-PILOT
4. AUXILIARY SEAT
5. PASSENGERS (2)
6. BAGGAGE

NOTE:

TO DETERMINE THE INDEX UNIT FOR ANY ITEM OF WEIGHT MULTIPLY THE WEIGHT IN POUNDS BY THE DISTANCE IN INCHES THAT THE WEIGHT IS LOCATED AFT OF THE HORIZONTAL REFERENCE LINE (OR 100 PLUS THE DISTANCE IN INCHES THAT THE WEIGHT IS LOCATED AFT OF THE L.E.W. AT ROOT) AND DIVIDE THE PRODUCT BY 1000.

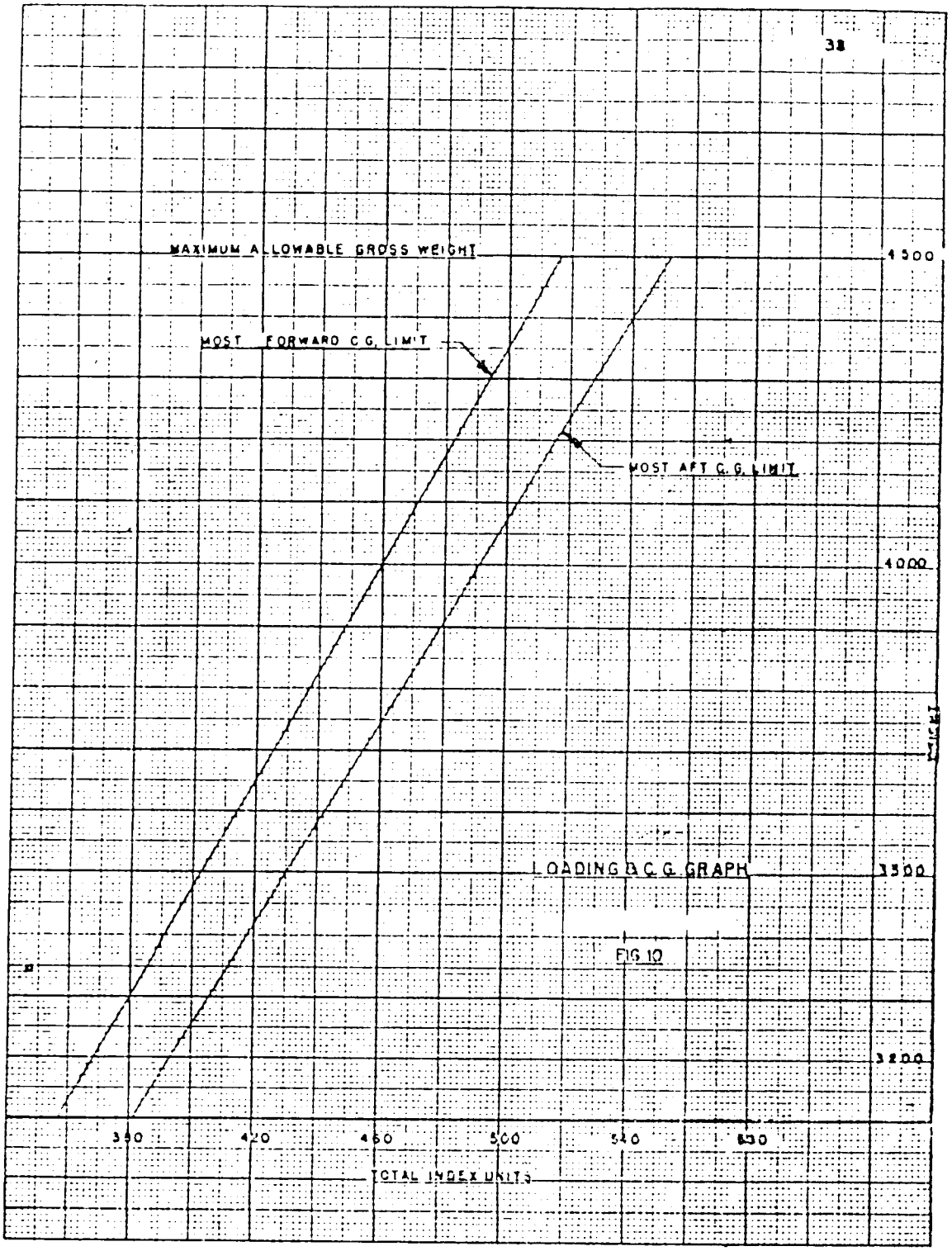
LOADING DIAGRAM

FIG. 8



FUEL & BAGGAGE QUANTITY
VS
INDEX UNIT

FIG 9



LOADING & C.G. GRAPH

FIG 10

2. MANEUVERS

Land Take-Off

The land take-off run is approximately 900 feet at sea level with gross load and no wind. Both wheels should be braked after take-off and before retraction of landing gear to prevent excessive tire wear caused by their rotation against the wheel pocket bumper pads.

Water Take-Off

A water take-off with full load under no wind conditions can be made in 27 seconds.

Spray Reduction

The durability of the propellers is greatly reduced if they are subjected to severe spray conditions. A little thought and attention by the pilot will eliminate a great deal of the spray thrown outward from the hull.

It will be noted that at all normal taxiing speeds, the bow wave lies flat and passes well below the propellers. As the speed increases, the point at which the bow wave leaves the chine moves rapidly rearward until it is soon entirely behind the propellers. However, the speed creates a feather of spray that strikes the tips for a moment before this point is reached. This can be clearly observed when the water is calm, though the pattern is distorted in rough water.

The pilot should reduce the spray-beating period by getting through it rapidly and by holding the bow as high as possible to get the spray well aft early in the run.

It is suggested that power be applied moderately as the plane accelerates to the spray point at which time the throttles should be fully advanced smartly and the wheel held full back.

Spray conditions are frequently less in rough or choppy waters because the stronger wind reduces the critical period. However, a little care in choice of time and position of take-off will avoid passing through higher than average waves at the critical conditions. For example, the pilot should clear his own waves after a downwind taxi before starting the take-off.

Adherence to these suggestions will decrease propeller deterioration.

As on any flying boat, the torque during take-off will cause a list to the left which may be disregarded. It is more noticeable under no-wind conditions. A very slight turn to the left during the start of the take-off will assist in raising the left float early.

Use of Flaps

Deflection of the trailing edge flaps opens slots at their leading edge, thus obtaining the advantage of a relatively high lift and low drag at small angles. They are, therefore, much more effective than split flaps during such low speed operations as take-off, climb and single engine performance.

Best flap position for Take-Off:

Take-Off	20°
Climb	0° to 12°

Single Engine Flight

In the event of failure of one engine, the operating engine should be opened to full power and the plane retrimmed. The indicated air speed should be held to 90 MPH at 4000 ft. or 95 MPH near sea level in order to best maintain altitude or achieve minimum rate of descent.

The ability to fly well on one engine improves rapidly as the load is decreased. At full gross load of 4500 pounds, single engine flight is seriously affected by turbulence, ragged flying, rain on the wings, etc. Unless the in-operative engine is rough. as from a mechanical failure, the throttle should be opened to permit maximum wind-milling rpm. However, in very cold weather, the congealing of the oil will eventually stop the engine.

Procedure for Single Engine Flight

1. Operating Engine
   - Full Rich Mixture
   - Full Throttle
   - Zero or minimum carburetor heat

2. Inoperative Engine
   - If turning smoothly - Cut Switch - Full Throttle
   - If rough - Close Throttle - Cut Switch
   - If desired to decrease load - Leave fuel valve ON, unless danger of fire from spitting.

3. Trim with rudder tab

4. Assume 90 mph - 4000 ft. or above.
   Assume 95 mph - 1000 ft. or below.

Taxiing

By extending the landing gear wheels when taxiing on water, the maneuvering characteristics are improved; forward speed is reduced and sharper turns can be made - however, wheels should not be lowered in water less than 3 feet deep.

Following water maneuvering with wheels down, the use of the emergency hand hydraulic pump will be found convenient for retracting the gear after the engines are stopped.

When approaching a beach with the intention of taxiing out - it is considered good practice to come in slowly and at an oblique angle (not straight on) in order to determine if the surface is sufficiently firm to support the wheels.

3. CHECK-OFF LISTS

Take-Off

1. Fuel ——— ON BEST TANK
2. Mixture ——— FULL RICH
3. Manifold Pressure ——— 29" Hg.
4. Engine Speed ——— 2100 RPM (Approx.)
5. Carburetor Heat ——— ON COLD
6. Elevator Tab ——— NEUTRAL
7. Rudder Tab ——— NEUTRAL
8. Tail Wheel ——— LOCKED
9. Flaps ——— 20° OR AS DESIRED

Flight Cruising

1. Wheels ——— RETRACTED
2. Oil Pressure ——— 50 p.s.i. MIN.
3. Oil Temperature ——— 200° F Max.
4. Fuel Pressure ——— 2.5 to 3.5 p.s.i.
5. Carburetor Heat ——— COLD UNLESS NEEDED

Landing

1. Landing Gear ——— DOWN-LAND, UP-WATER
2. Mixture ——— FULL RICH
3. Fuel ——— BEST TANK COMBINATION
4. Tail Wheel ——— LOCKED
5. Flaps ——— 40° OR AS DESIRED