RESTRICTED

PILOT'S HANDBOOK

MODEL OS2U-1

VOUGHT SIKORSKY

Released by the
BUREAU OF AERONAUTICS
NAVY DEPARTMENT

VOUGHT-SIKORSKY AIRCRAFT
STRATFORD, CONNECTICUT
DIVISION OF
UNITED AIRCRAFT CORPORATION

RESTRICTED

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FOREWORD

The ground covered herein is only that which is the concern of the pilot who is flying the OS2U-1 for the first time. More detailed information on the airplane in general and on all controls and installations is contained in the "Erection and Maintenance Instructions," which is also furnished with the airplane.

COCKPIT ARRANGEMENT AND CONTROLS

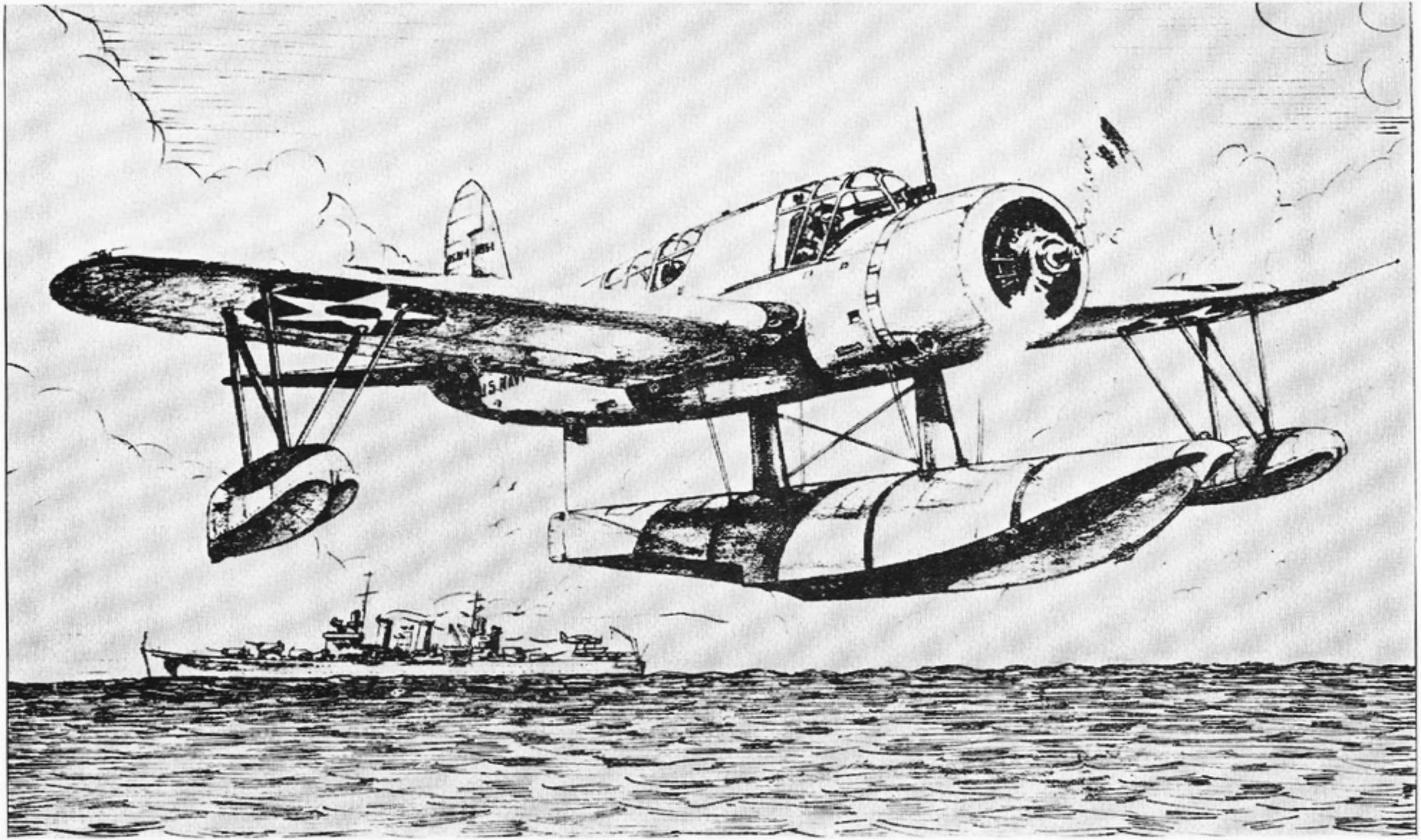
A. The photographs which follow show the location of the more important controls in the pilot's cockpit.

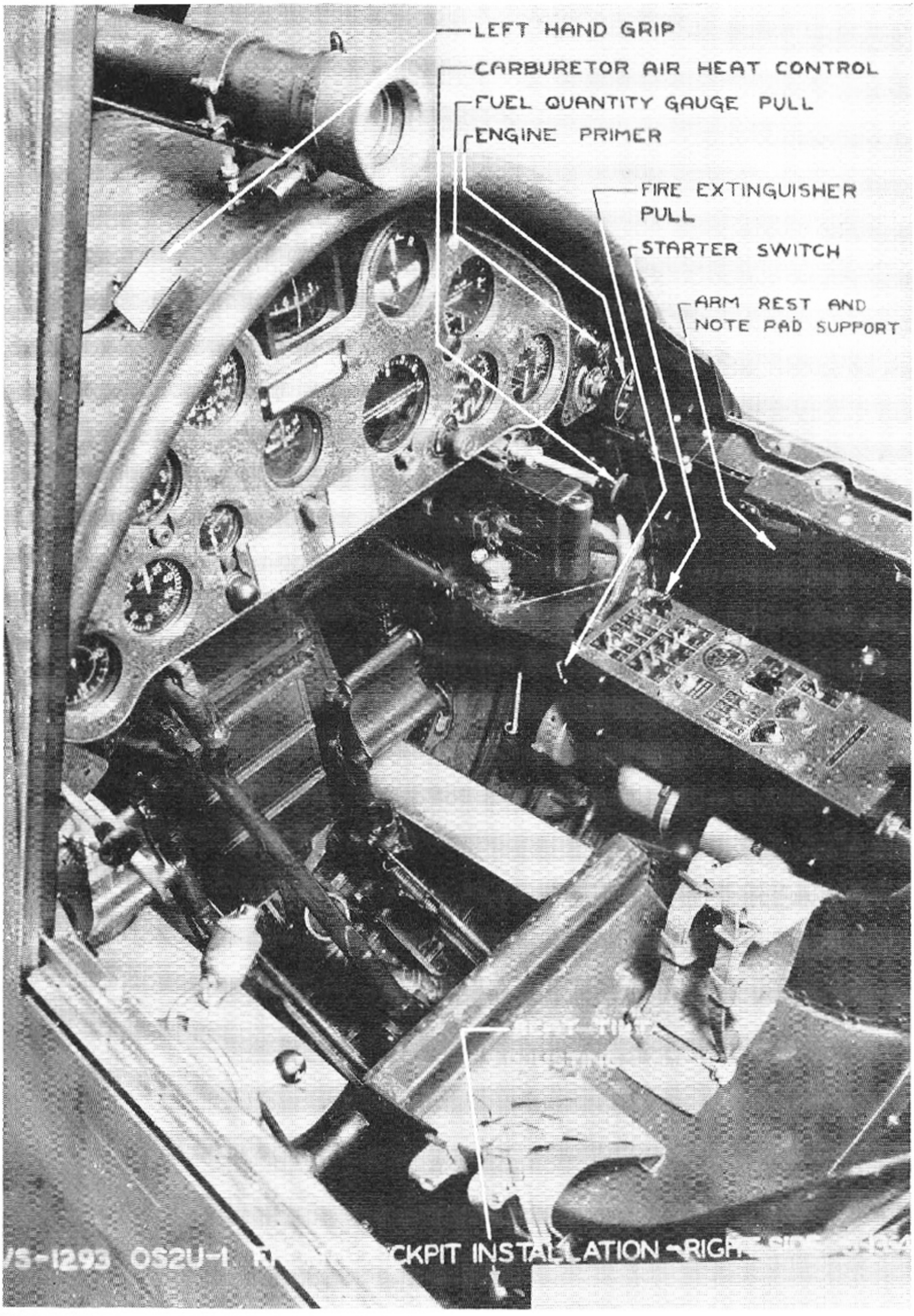
VS-1293 — FRONT COCKPIT INSTALLATION — RIGHT SIDE

VS-1295 — FRONT COCKPIT INSTALLATION — LEFT SIDE

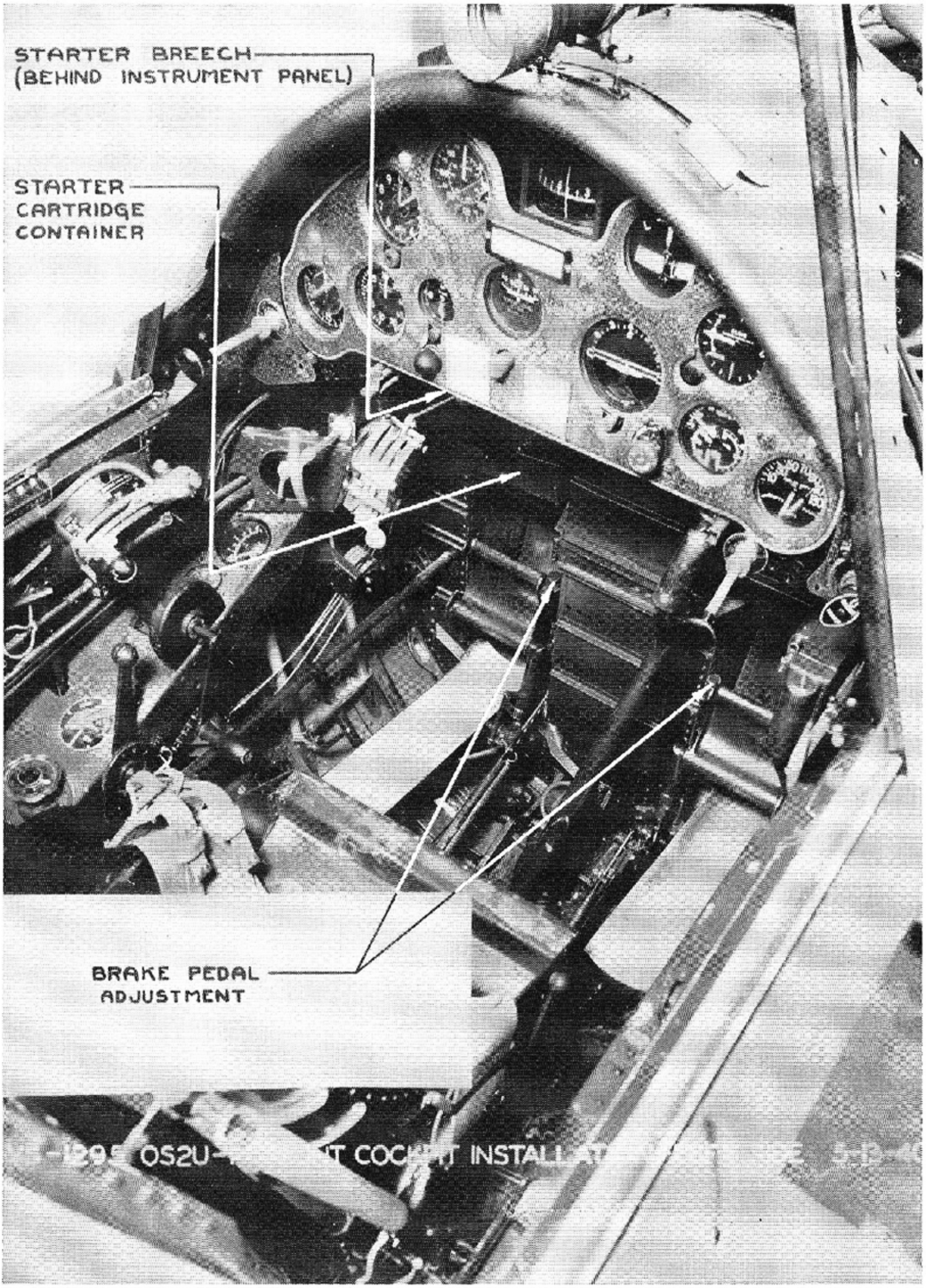
VS-1296 — FRONT COCKPIT INSTALLATION — LEFT SIDE

VS-1299 — HOIST SLING (STOWED)

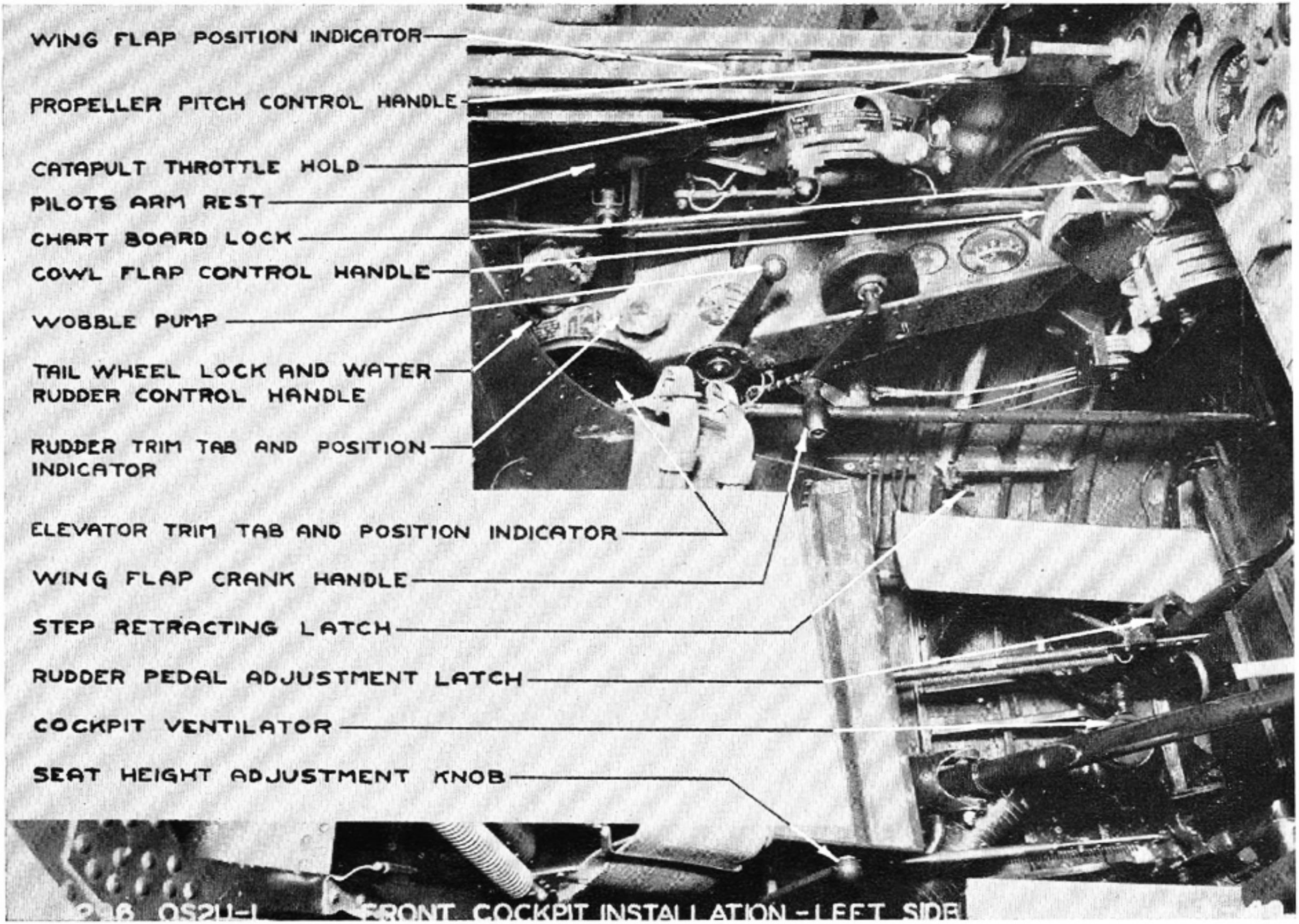

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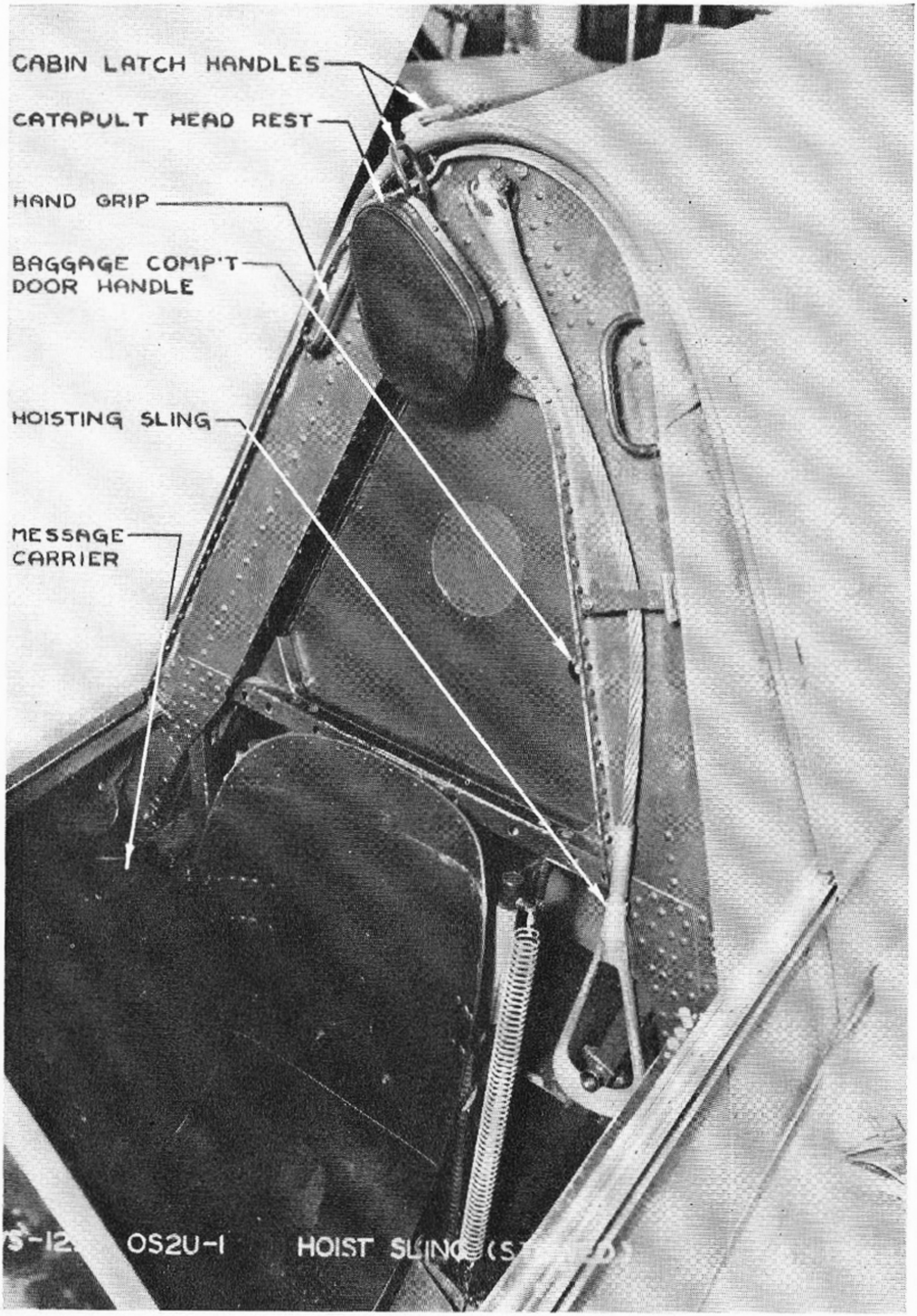
FRONT COCKPIT --- RIGHT SIDE



FRONT COCKPIT --- LEFT SIDE



2-6 OS2U-1 FRONT COCKPIT INSTALLATION - LEFT SIDE



HOIST SLING (STOWED)

POWER PLANT

A. Engine

Designation	—Pratt and Whitney R-985-48 Wasp Jr.
Rating-Take-Off	—450 BHP at 2300 rpm and 35.5 in.Hg. for take-off at sea level.
Normal	—400 BHP at 2200 rpm at sea level and at 5500 feet.
Gear Ratio	—Direct drive.
Carburetor	—Bendix-Stromberg, automatic mixture control, Type NA-R9C2.
Fuel	—92 Octane (see T.N. 27-39) ("87 octane" by old spec.)
Oil	—Symbol 1100 (see T.O. 35-38).
Max. R.P.M. Limit	—2900

B. Engine Operation

1. Starting

Starter (Cartridge)	—Insert live cartridge, close breech fully and lock.
Fuel	—Reserve on.
Mixture Control	—AUTOMATIC RICH.
Wobble Pump	—About 12 strokes, 3 lbs. on Fuel Pressure Gauge.
Primer	—5 strokes for cold starting. 2 strokes for warm starting.
Throttle	—Set about ½ inch open. Do not pump to keep engine running.
Propeller Control	—Pulled out (positive high pitch).
Cowl Flaps	—Open
Carburetor Air Heat	—Cold (control in).
Ignition Switch	—On
Generator Switch	—On
Battery Switch	—On
Starter Switch	—On (momentarily).

*Remove cartridge and close breech after starting.

*In opening the breech immediately after firing, raise the lever only halfway and allow any pressure in the starter to escape through the relief valve before raising the lever and fully unlocking the breech.

In case of failure of a cartridge to fire on first attempt, additional attempts should be made by closing the Momentary Toggle Switch at least three times. If the cartridge still fails to fire, it shall not be removed from the breech for at least five minutes.

A Type B (17 gram) cartridge is the maximum size that may be used with this starter.

2. Warming Up

Cowl Flaps	—Open.
Oil Pressure	—Must come up to normal in 30 seconds, otherwise stop engine.
Propeller Control	—Pushed in as soon as oil pressure is up to normal and engine is running smoothly.
R.P.M.	—1000 (Do not exceed 1200 r.p.m. except for short periods.)
Cylinder Temp.	—204°C (400°F) is maximum permissible except during short bursts—then 260°C (500°F).

NOTE: Do not operate engine on one (1) magneto above 1550 R.P.M. (see T.O. 55-39).

3. Stopping

Carburetor is equipped with "Idle Cut-Off," last 10° of mixture quadrant marked in "RED."

Cowl Flaps	—Open to cool engine while idling.
Propeller Cont.	—Pull out (positive high pitch) if practicable.
Throttle	—Closed when engine has cooled.
Mixture Control	—Pull back to limit of movement.
Ignition Switch	—"OFF" WHEN ENGINE HAS STOPPED.
Battery and Generator Switches	—Off.

4. Maximum Permissible Power Operation

Condition	*Altitude*	*Max. Manifold Pressure*	*Max. R.P.M.*	*Mixture Control*	*BHP*
Take-off	Sea Level	35.5 in.Hg.*	2300**	Automatic Rich	450
Climb and Level Flight	S.L. to 3000 ft.	33.5 in.Hg.	2200	Automatic Rich	400
Climb and Level Flight	3000 ft. to 5500 ft.	32.5 in.Hg.	2200	Automatic Rich	400
Normal Altitude Rating	5500 ft.****	32.0 in.Hg.	2200	Automatic Rich	400
Climb and Level Flight	Above 5500 ft.	FULL THROTTLE***		Automatic Rich	

*Duration of take-off only, set throttle stop for this condition throughout take-off run.

**Duration of take-off only, set stop on Constant Speed Unit for this R.P.M.

***Do not exceed 32 in.Hg. above 5500 feet altitude.

****NOTE: Due to the effect of ram, 32.0 in.Hg. manifold pressure can be obtained up to approximately 6250 feet altitude in level flight and 6000 feet in climb, the critical altitude thus differs from the rated altitude.

5. Mixture Control

This airplane is equipped with a NA-R9C2 Automatic Carburetor. The mixture quadrant is marked with two additional positions, "AUTOMATIC RICH," and "AUTOMATIC LEAN," with corresponding locating depressions in the mixture ratchet, in addition to the usual idle cut-off position and manual mixture control range.

For take-off, landing, climb, maneuvers, diving, and all flight operation (except if better fuel economy is desired in level flight cruising), the control should be set for AUTOMATIC RICH. This setting is satisfactory for all flight operation.

For *level flight* cruising operation below 70% normal rated power at any altitude the control may be set to AUTOMATIC LEAN. This setting is for *level flight* cruising *only*, and gives approximately best economy operation from 37% to 57% normal rated power. If it is desired to climb from a steady cruising condition, the control should be shifted to AUTOMATIC RICH. The use of AUTOMATIC LEAN at any time is contingent upon satisfactory engine cooling as defined by the maximum allowable cylinder temperatures specified herein.

Manual Operation:

Normally there is no reason for manual operation of the mixture control, but it is available for test purposes or emergency operation where the automatic unit is found to have failed. If the manual mixture control is used in service operation for any reason, it should be set to FULL RICH for take-off, landing, and climb or level flight at or near maximum power at all altitudes. For level flight operation between 70% and 85% rated power out-put the mixture may be leaned manually to rich best power (slightly richer than the point giving maximum r.p.m. with the propeller in positive high pitch). For cruising operation at or below 70% normal rated power at any altitude the mixture may be leaned manually sufficient to give a drop of 20 r.p.m. in engine speed (propeller must be in positive high pitch). Leaning by the manual mixture control from Full Rich at any time is contingent upon satisfactory engine cooling as defined by the maximum allowable cylinder temperatures specified herein.

6. High Speed Level Flight

Set propeller to govern at 2200 r.p.m.

Mixture control to AUTOMATIC RICH, Manifold Pressure, see page 4.

7. Maximum Climb

Set propeller to govern at 2200 r.p.m. Set Mixture Control to AUTOMATIC RICH.

Cowl Flaps —Open as required.

Best Airspeed —90 knots, sea level to 6000 feet, then decreasing about 1½ knots per thousand feet to 75 knots at 16,000 feet.

8. Cruising

Set propeller in positive high pitch, Propeller Control pulled out, for best operation.

Mixture Control —AUTOMATIC LEAN, for operation below 70% power. AUTOMATIC RICH for operation above 70% power.

Cowl Flaps —Closed, cylinder temperature not over 232°C (450°F).

Carb. Air Heat —Set control for 32°C on temperature gauge. See T.O. 19-38.

A Power Control Chart for the R-985-48 engine is included on page 10 of this book. It shows values of Manifold Pressure and R.P.M. required for various percentages of rated power out-put versus altitude, and is to be used as a guide in controlling engine operation. The Chart is used by entering on the altitude scale and proceeding as indicated by the dotted lines to the observed Manifold Pressure and R.P.M., and then reading the percent of rated power. This power then can be corrected as indicated for the difference between the actual carburetor air temperature and the standard air temperature obtained from the plot in the upper left corner of the Chart.

It is recommended that cruising operations be carried out at conditions not exceeding those shown on Power Control Chart labeled "Maximum Recommended for Cruising."

9. Cylinder Temperature

Normal Max. Cylinder Temp. Limit —260°C (500°F)
Maximum for 5 minutes —288°C (550°F)
Max. Continuous Cruising Limit —232°C (450°F)

Do not lean mixture if temperature exceeds cruising limit.

10. Cowl Flaps

Operation: Pull control to open, handle vertical to lock, turn handle about 60° left or right to unlock. Maximum opening is for ground operation only.

All ground and water operation	—Wide open.
Before take-off	—Open as required.
All climbing operations	—Open as required.
Level flight operation	—Closed.
Diving	—Closed.
Landing	—Closed.

General: Adjust opening to suit flight and air temperature conditions so that maximum cylinder temperature does not exceed 260°C (500°F).

C. Propeller and Constant Speed Unit

Two-blade, constant speed, Hamilton-Standard Design No. 6167A-12, 8.5 feet diameter, Hub No. 2D30, Governor Unit No. 1C2-A5.

Maximum blade angle range	—10.0°
Index setting	—21.0° at 42 inch station.
High pitch stop	—21.0° at 42 inch station.
Low pitch stop	—11.0° at 42 inch station.

Constant speed unit low r.p.m. unit setting—Positive high pitch.

Constant speed unit high r.p.m. unit setting—2300* r.p.m.

*Set stop on Constant Speed Unit for this r.p.m.

The propeller high pitch (21.0°) is set to favor cruising operation. It is 1.0° higher than the setting of 20.0° required to hold the engine to rated r.p.m. (2200) in level flight at critical altitude at full throttle, AUTOMATIC RICH (approximately 6250 feet altitude at 32 in.Hg. manifold pressure) with full observation load and equipment.

The propeller low pitch (11.0°) is set to allow 2300 r.p.m. 35.5 in.Hg. manifold pressure, AUTOMATIC RICH, throughout the take-off run for maximum take-off and low speed climb performance at sea level. No positive low pitch is provided.

Constant Speed Unit low r.p.m. limit setting is positive high pitch as is customary. With the Constant Speed (propeller) control set here (handle pulled out to limit), conditions are exactly the same as with a two-position controllable propeller set for high pitch.

The high r.p.m. limit (control pushed fully in) is used for take-off only. The control has a vernier adjustment obtained by rotating the knob (right hand screw) for close adjustment of the r.p.m. A collar on the control permits increasing the friction to lock it as desired.

Control Setting

Take-off	—Maximum r.p.m. (control pushed in to limit—2300 r.p.m.).
Climbing Operation	—Set to not over 2200 r.p.m.
Cruising Operation	—Positive High Pitch (control pulled out).
*Diving	—Positive High Pitch (control pulled out).
Gliding	—Positive High Pitch (control pulled out).
Landing	—Set to not over 2200r.p.m.

*Under cold operating conditions an appreciable time interval is required for the propeller to be shifted from a moderately low pitch setting to positive high pitch. Overspeeding of the engine in a dive will result if propeller has not been set to high pitch.

D. Carburetor Air Heat Control

Location	—Knob at right side of instrument board.
Operation	—Pull out for hot air, push in for cold. Fine adjustment by rotating knob; to left to increase temperature.
Take-off	—Set at full cold (control in) unless extremely humid.
All other Flight	—Set for 32°C (90°F). (See T.O. 19-38).

Carburetor Air Temperature will vary with throttle setting—re-set as required.

Likely Carburetor Icing Conditions—Any strut temperature from 0°C (32°F) to 25°C (77°F) with hazy humid weather particularly at part throttle (see T.O. 19-38). At constant altitude with fixed throttle position, positive high pitch, and fixed carburetor air heat control position, gradual decrease in manifold pressure (and r.p.m.) indicates ice is forming in carburetor.

(NOTE: Position of Carburetor Heat Control will effect manifold pressure due to effect on ram).

E. Fuel System

One Main Tank, total capacity	—144 gals.
Reserve (standpipe)	— 30 gals.
Fuel Available on "Main" (with full tank)	—114 gals.
Fuel Available on "Reserve" (with full tank)	—144 gals.

Set Fuel Valve on "Reserve" for Take-off, Landing, Diving, and Maneuvers, see T.O. 38-38.

Normal Fuel Pressure at Carburetor—3 to 4 lbs./sq. in. (T.O. 13-40).

Normal Fuel Pressure Indicated on Gauge and Gauge Line Full of Fuel—2½ to 3½ lbs./sq. in. (3½ lbs. preferred) (see T.C. 13-40).

Total Fuel Load, Osbervation Landplane	—141 gals.
Total Fuel Load, 116-lb. Bomber Landplane	— 80 gals.
Total Fuel Load, Observation Seaplane	120 gals.
Total Fuel Load, 116-lb. Bomber Seaplane	— 80 gals.
Total Fuel Load, Observation Seaplane (Rough Water Test)	— 90 gals.
Total Fuel Load, Smoke Screen Layer Seaplane (Catapult only)	— 80 gals.
Total Fuel Load, Long Range Observation Seaplane (Catapult only)	—144 gals.

F. Oil System

Oil	(See T.O. 35-38)	—Symbol 1100
Quantity	—Landplane Observation	— 10 gals.
	Landplane 116-lb. Bomber	— 7 gals.
	Seaplane Observation	— 9 gals.
	Seaplane 116-lb. Bomber	— 7 gals.
	Seaplane Observation (Rough Water Test)	— 8 gals.
	Seaplane Smoke Screen Layer	— 7 gals
	Seaplane Long Range Observation	— 10 gals.

Pressure —70 to 90 lbs./sq. in. Normal
50 lbs./sq. in. Minimum

Temperature (See T.O. 35-38)
25°C (77°F) Minimum for Take-off
95°C (203°F) Maximum

This airplane is equipped with a thermostatic oil temperature regulator.

OPERATION CHARTS

A. The use of the Power Control Chart on the following page is explained under Section III-B(8) Cruising Operation, page 6.

ALTITUDE – 1000 FT.
0 2 4 6 8 10 12 14 16 18 20
ST'D. TEMP. °C.
15 10 5 0 -5 -10 -15 -20 -25
ALTITUDE - FT.
20000 18000 16000 14000 12000 10000 8000 6000 4000 2000 S.L.
R-985-48 ENGINE
RATING:
TAKE OFF 450 BHP @ 2300 RPM @ 35.5" HG MP
NORMAL 400 BHP @ 2200 RPM @ S.L. TO
5500 FT. ALT.
FULL THROTTLE 2200 R.P.M. (NO RAM)
20" HG
21"
22
23
24
25
26
27
28
29
30
31
32
33
34
MAX. ALLOW FOR CONTINUOUS OPERATION
A
B
PERCENT RATED POWER
100 90 80 70 60 50 40
F E D C
40 20 0
CARB.-ST'D. TEMP. °C.
2200 R.P.M.
2000
1800
1600
1400
1200
MAX. RECOMMENDED CRUISING LIMITS

NORMAL INSTRUMENT READINGS

Landplane Observation

Condition	—Steady cruising.
Cowl Flaps	—Closed.
Mixture	—AUTOMATIC LEAN
Carburetor Heat	—Part on.
Propeller Control	—Pulled out (positive high pitch).
Altitude	—1500 feet
Strut Temperature	—10°C
Indicated Airspeed	—110 knots
Manifold Pressure	—28.4 in.Hg.
R.P.M.	—1780
Carburetor Air Temperature	—32°C
Maximum Head Temperature	—185°C
Maximum Base Temperature	—115°C
Oil Pressure	—83 lbs./sq. in.
Fuel Pressure	—3½ lbs./sq. in.
Oil-in Temperature	—70°C
Oil-out Temperature	—80°C
Fuel Consumption	—18-19 gals./hr.

FLIGHT CHARACTERISTICS

A. Balance

If no useful load (no radio, armament, or passenger) is carried in the rear cockpit, secure not less than 200 pounds of ballast in the rear seat and 50 pounds on the floor aft of the rear set. See Erection and Maintenance Instructions for permissible useful loads.

B. Take-Off

Landplane (Seaplane)

CHECK-OFF PROCEDURE

Control Tabs	—Set
Wing Flaps	—2/3 down or up.
Cowl Flaps	—Open (3 notches).
Propeller	—Max. RPM (low pitch).
Carb. Air	—Cold.
Mixture	—Automatic Rich.
Fuel	—Reserve on.
Tail Wheel (Water Rudder)	—Engaged.
Landing	—Reverse above procedure.

WARNING: Do not begin to lower flaps above 110 knots.
Do not exceed 100 knots with flaps 2/3 down.
Do not exceed 85 knots with flaps full down.

Stalling Speed—Loaded as Observation Landplane or Seaplane.

Flaps full down	—53-52 knots indicated airspeed.
Flaps 2/3 down	—56-55 knots indicated airspeed.
Flaps up	—62-61 knots indicated airspeed.

C. Catapulting

Elevator control tabs	—7° up tab.
Wing flaps	—2/3 down or full down.
Cowl flaps	—Open.
Propeller	—Max. RPM (low pitch).
Carb. air	—Cold.
Mixture	—Automatic Rich.
Fuel	—Reserve.
Stick (Top)	—5″ aft of Instrument Panel.
Manifold Pressure	—35.5″ (Max.)

D. Power Operating Tables

(to be posted in cockpit)

	Max. M.P. (in.Hg.)	*Max. RPM*
Take-off	35.5	2300
Diving	(215 knots IAS)	2900
Level Flight		
Sea Level	33.5	2200
3000 feet	32.5	2200
5500 feet	32	2200
Above 5500 feet	Full Throttle	Maximum

E. Check-Off List

(to be posted in Cockpit)

Landplane (seaplane)
Catapulting (seaplane)
Control tabs
Wing flaps
Cowl flaps
Propeller
Carb. Air
Mixture
Fuel
Tail Wheel (water rudder)

For landing reverse above procedure.

NOTE: The various restrictions and characteristics contained in this section were applicable when the airplanes were first delivered to the Navy. However, constant reference must be had to Technical Orders, Bulletins, etc., for such modifications as may be issued by the Bureau of Aeronautics.

TAXIING CHARACTERISTICS

As a landplane, the taxiing characteristics are normal. The airplane is provided with a tail wheel lock (control adjacent to the left side of the seat), which should be engaged before take-off and released after completing the landing roll. No ground looping tendencies have ever been noticed. To avoid excessive use of the brakes, some assistance may be obtained by locking the tail wheel when taxiing across a strong wind.

As a seaplane, a water rudder is provided, the engaging control being the same as used for the tail wheel lock on the landplane. The rudder should be engaged for take-off, landing, and taxiing. For prolonged taxiing the cowl flaps should be wide open.

TAKE-OFF AND LANDING DISTANCES

The following distances are based on calculated results and show ground run distances.

Altitude, Feet	Take-off Distance Feet	Landing Distance Feet
Sea Level	540	550
2000 feet	600	584
4000 feet	663	620
6000 feet	767	658
8000 feet	905	700

CONTROL SYSTEM

A. Lateral Control System.

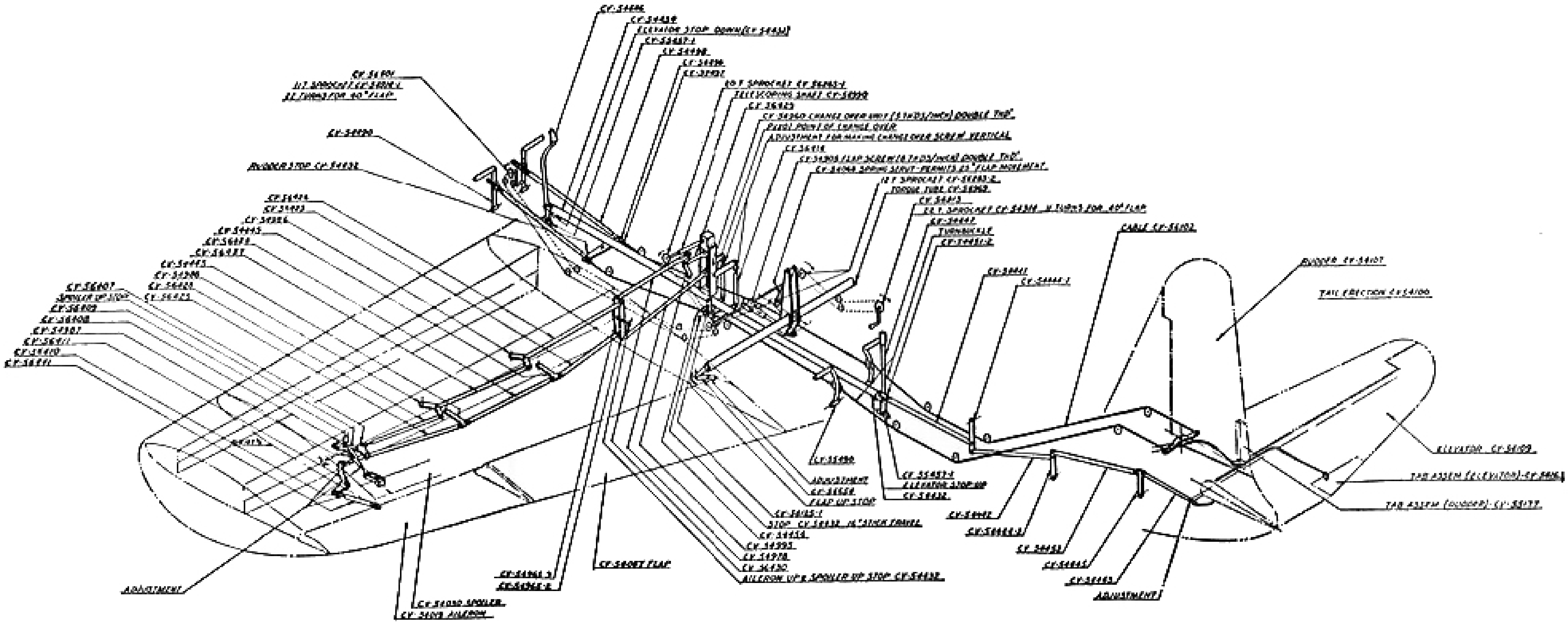
This airplane is provided with a lateral control system which is designed to permit the use of the normal ailerons drooped to high angles as a high lift device in addition to the wing flaps, the control function of the ailerons being shifted to the spoilers. Drawing CV-54403 shows the control system schematically. In normal cruising flight with the flaps up, the lateral control is obtained with the ailerons, the "Change-over" unit being in the up position so that on movement of the stick laterally, only the aileron control push-rods are moved, the spoiler push-rods being opposite the axis of rotation of the "Change-over" unit. As the cockpit crank is operated to lower the flaps, the "Change-over" unit screw is operated to lower the ends of the aileron and spoiler control push-rods, drooping the ailerons proportionately at the same time. When the cockpit crank has made 22 turns, the flaps are fully deflected (40°), the ailerons are fully drooped (30°), and the "Change-over" unit has lowered the ends of the aileron controls and the spoiler control push-rods to the lowest position, so that the ends of the aileron push-rods are opposite the axis of rotation of the "Change-over" unit, thus fixing the ailerons so they cannot move, while the spoiler control is fully operative.

B. Spring-Loaded Flaps

The wing flaps on the airplane are spring-loaded and inter-connected across the fuselage. The mechanism allows the flaps to retract 25° from the initial setting given by the hand-crank depending on the airspeed and throttle opening. The springs are set so that with full flap deflection by the crank and throttle closed, they begin to retract at about 63 knots indicated airspeed and are at 25° at about 85 knots. With the throttle open at a given speed, the flaps come up about 10° further due to slipstream action. The spring mechanism is designed so that, within the limits of the spring action, the flap angle is determined by the airspeed (and throttle opening) regardless of the flap setting given by the crank. (A stop operating directly on the flap is provided so that the flap itself is positively locked in the UP position when the cockpit control is so set). An indicator (located at the left side of the cockpit) shows the actual position of the flap. It should be noted that the spring loading applies only to the flaps, not the aileron droop, so that the latter maintains the angle appropriate to the crank setting regardless of airspeed.

C. Flap Operating Controls

Flap operating cranks are provided in both the front and rear cockpits—located on the left in the front cockpit and on the right in the rear cockpit. By means of a spring-loaded pin the rear cockpit crank may be disengaged when not being used. To disengage—raise the spring-loaded pin by means of the knob and turn to lock.



MOVEMENTS

AILERON 30° UP - 20° DOWN FLAP UP
FLAP DOWN 40° - UP TO 15° AGAINST SPRING
AILERON DROOP 30°
SPOILER 45° UP 3° DOWN FLAP DOWN
ELEVATOR 30° UP - 20° DOWN
RUDDER 25° R - 25° L
ELEVATOR TAB 13 1/4° DOWN - 10 3/4° UP (8 TURNS OF WHEEL)
RUDDER TAB 20° LEFT - 20° RIGHT (8 TURNS OF WHEEL)

REFERENCE DRAWINGS

CY-54404 SURFACE CONTROLS
CY-54402 ELEVATOR CONTROLS
CY-54430 FLAP AILERON & SPOILER CONTROL
CY-54988 CHANGE OVER INSTALL.
CY-54475 AILERON & SPOILER CONTROL OUTER PANEL
CY-56451 FLAP POSITION INDICATOR

ISOMETRIC OF SURFACE CONTROLS