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Pilot's Notes

PILOT'S NOTES
TOMAHAWK I
ALLISON V-1710-C15 ENGINE

SECOND EDITION
Oct. 1941

C.A.W. CORP.

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The Tomahawk I Airplane - Allison V-1710-C15 Engine

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TOMAHAWK I

ALLISON V-1710-C15 ENGINE

Second Edition
May, 1941

GENERAL CONTENTS LIST

Introduction

Section 1 - Pilot's Controls, and Equipment.
Details and Diagrams of Fuel, Oil,
Hydraulic and Coolant Systems.

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INTRODUCTION

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INTRODUCTION

1. The Tomahawk I is a single-seater, low wing, monoplane with retractable landing gear and enclosed cockpit, powered with an Allison V-1710-C15 engine, which drives a Curtiss electrically operated, tractor airscrew. The following are the main dimensions:

Span 37 ft., 3½ in., Overall length 31 ft. 8-9/16 in.

Overall height with tail down 9 ft., 7 in.

2. The Airscrew is a Curtiss multi-position and/or constant speed type. The pitch changing mechanism is operated electrically from the airplane electrical supply through brushes mounted in a housing, attached on the engine nose section, to slip rings mounted on the rear boss of the propeller hub, and thence to the pitch changing motor.

Automatic electric cutout switches limit the pitch range for ordinary operation and give high and low pitch settings.

Two types of control, manual selective and automatic, are available for selection by the pilot. The change from one to the other is made by a toggle switch located on the air screw control panel. (See Section 1, para 11)

3. The cockpit is totally enclosed. The windscreen is in three sections of laminated glass and behind the windscreen there is a section of 1 ½ inch glass for protection from gunfire. The transparent cabin cover slides fore and aft for entry and exit purposes. An emergency release is provided by which the entire sliding section has an emergency exit on the port side, for use in event of turnover. The structure behind the pilot is of sufficient strength to withstand a burnover landing. Three pieces of armor plate are provided; one piece 9 mm. thick ahead of the pilot from the windscreen line down to the top of the engine, a piece 7 mm. thick behind the pilot's back, and 9 mm. thick behind his head.

4. The main plane is a cantilever multi-spar, skin stressed type built in two pieces and joined at the centerline of the airplane. The wing tips are detachable. The joint where the two wing sections are connected will serve as a skid in case of an emergency landing with the wheel retracted.

The ailerons are both dynamically and aerodynamically balanced. They are operated by the conventional stick control. A fixed type trimming tab, adjustable on the ground is provided on each aileron. The ailerons have a stressed metal skin leading edge and are fabric covered.

The flaps are of the split trailing edge type, extending from the aileron to near the centerline of the airplane and are operated hydraulically by an electrically driven pump or by an emergency hand pump. An indicator on the instrument board shows the position of the flaps at all times when the battery switch is on.

5. Cooling System - Air passing through prestone radiators and oil cooler and exhausting into a common exit duct. Airflow through this duct is controlled by cowl flaps operated by a lever on the starboard side of the cockpit with a locking device incorporated.

6. Wing Guns - Two rifle caliber guns may be carried in each panel. Wing gun charging handles are located on the centerline of the airplane beneath the instrument panel. Ammunition boxes hold 490 rounds per gun. The trigger switch is located on the stick.

7. Fuel Tanks - The fuel is carried in three tanks, two in the center of the wing and one in the fuselage aft of the pilot. The total capacity of the three tanks is 132.6 imperial gallons. (See fuel system diagram.) On aircraft AH841 to AM519 the fuel tanks have "Superflexit" covering. On aircraft AN218 and subsequent, the fuel tanks have Goodrich #281 covering.

Oil Tank - Oil is carried in a tank in the fuselage behind and above the fuselage fuel tank. A dip stick is provided to read the oil level on the ground. When the oil in the system and tank is cold, the tank must not be refilled above the 7.5 gallon mark on the dip stick. The maximum effective capacity of the tank, when the oil in the system and tank is hot, is 9.6 gallons. On aircraft AK471 and subsequent the oil tank has Linatex covering.

Coolant Tank - The coolant expansion tank is forward of the firewall and has a capacity of two imperial gallons. Gun fire protection is provided for the expansion tank.

8. The fuselage is of semi-monocoque, skin stressed construction, and has a motor mount of welded steel tube and steel forged links. The fuselage access door is on the port side of the fuselage near the tail.

9. Fuselage Guns - Two synchronized guns are carried just ahead of the pilot. These are .50 caliber Colt guns, and are charged directly through an opening on each side of the instrument panel. Electrically operated rounds indicators are mounted near the instrument board on the upper longeron. The gun triggers are electrically operated by a selector switch located

above the port longeron, and trigger switch is located on the stick. A large divided ammunition box holds 380 rounds per gun.

10. Battery - A 34 ampere hour capacity, 24 volt battery is carried in the airplane and is accessible through the fuselage access door.

11. Landing Gear - The landing gear is equipped with oleo-pheumatic shock struts which are hydraulically retracted to rotate backward about a trunnion at the top of the strut. During retraction the strut is rotated 90° about its longitudinal axis by gears, so that the wheel lies flush in the wing. The gear is locked in both the up and down positions by hydraulically operated mechanical locks. The upper half of the strut has members attached to take side and drag loads and is attached to the lower half of strut through a scissors to take torque. On aircraft AH841 to AM519, the landing gear is equipped with 30 inch diameter smooth contour tires (6 ply) and wheels with 12 x 2¼ inch hydraulic brakes. On aircraft AN218 and subsequent the landing gear is equipped with 30 inch diameter smooth contour tires (8 ply) and wheels with 12 x 3¼ inch hydraulic brakes. For indicator see section 1 para 9.

12. Tail Wheel - The tail wheel assembly consists of a standard steerable knuckle unit and a 12½ inch wheel with earth conducting tire. The steering mechanism disengages at approximately 30° deflection from the longitudinal axis and when disengaged will swivel through 360°. The tail wheel is fully retractable and operates "clam shell" doors which enclose it completely after retraction. For indicator see section 1 para. 9

13. Fixed Tail Surface - The tail plane and fin are of all metal construction attached in fixed alighment to the fuselage.

14. Control Surfaces - The rudder and elevators are aluminum alloy construction, fabric covered. They are dynamically balanced and are equipped with trim tabs controlled from the cockpit. Rudder and elevators are controlled by the conventional pedals and stick.

15. Additional Equipment - In addition to the armament, the airplane is equipped with parachute flares, landing light, recognition device, oxygen, life preserver, radio, map case, engine and cockpit covers, navigation, formation, identification and cockpit lights, (See Section 1.)

16. Tie Down Rings are located inboard of the wing tips on the underside of the wing and marked "Tie Down."

17. Towing Rings - Towing rings and jack pads are provided on the landing gear.

18. Tool Box - A tool box for carrying the airplane and engine tool kit as an overload is provided in the fuselage and is accessible through the fuselage access door.

19. First Aid Kit is located on the port side of fuselage, being accessible through fuselage access door.

20. Desert Equipment - Supports and straps are provided for installing and securing desert equipment in the aft part of the fuselage accessible through fuselage access door.

SECTION 1

PILOT'S

CONTROLS AND EQUIPMENT

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FUEL, OIL, HYDRAULIC

AND COOLANT DIAGRAMS

-*-

COCKPIT PHOTOGRAPHS

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SECTION 1

Pilot's

Controls and Equipment

Introduction

This section gives the location and, where necessary, explains the function of the controls and equipment in the pilot's cockpit.

NOTE: On aircraft AH941 to AH970 inclusive, certain of the electrical switches are "On" when in the "Up" position. On aircraft AH971 and subsequent electrical switches are "On" in the "Down" position. Care should be taken to identify these. All switches are clearly marked "On" and "Off."

1. Cockpit - The cockpit is fully equipped and has the normal stick and rudder pedal controls which are dealt with individually in the following paragraphs. The sliding hood can be pushed right back from the cockpit and is operated by a crank mounted on the upper right longeron. A pin on the crank engages holes in the drum and locks the cabin in the full back, full forward and intermediate positions.

An emergency hood release is also fitted and is a lever painted red, located at the top forward frame of the cabin roof. In case of an emergency, while in flight, the entire enclosure may be released from the fuselage by pulling on this lever. In the event of turnover on the ground, pull the panel release handle and push open the emergency exit on the left hand side of the cabin enclosure. This emergency exit may be operated from the outside by means of a handle located on the lower rear left hand cabin frame.

An emergency release which, when pulled down, disengages the catches from the crank is located at the top of the windshield and consists of a turnbuckle and wire painted red. This eliminates winding the crank for rapid opening but the enclosure must then be pushed back by hand.

A ventilator for the cockpit is operated by a push-pull control located below the instrument board on the port side. When the control is pulled out (twist to lock) hot air is admitted to two vents,; one permitting hot air to enter directly into the cockpit, the other deflects the hot air between the windscreen and bulletproof safety glass, acting as a defroster, before passing into the cockpit.

NOTE: In the event of engine failure, to prevent cockpit from being filled with engine fumes and windscreen becoming misted on the inside, shut cabin heater "Off."

2. The seat is adjusted vertically by a lever on the starboard side of the seat. The lever is moved upward and to the rear permitting the seat to be raised manually. Rubber assist cords are attached to the back of the seat to assist the pilot in raising the seat. A release lever controlling the position of the Sutton harness is provided at the port side of the seat. To operate, push button on top of lever and move lever to rear locking position. This permits free movement of the pilot in a fore and aft direction. A pilot's relief tube is suspended from the bottom of the seat.

3. Control Column - The control column is of the conventional design. The control column hand grip has two switches; the one on the top of the grip is a push button and operates the landing gear and flaps; the other is a trigger switch and operates the firing of the guns.

4. Rudder Pedals - The rudder pedals are of conventional design and they are adjustable for leg reach by releasing a pin by means of the lever on the inboard side of the pedal, and moving forward or aft as required.

5. Brakes - Brakes are operated by toe pedals and the parking brake lever is located below the instrument board and may be engaged by being pulled back when the pedals are depressed. It is automatically disengaged when the pedals are depressed.

6. Trim Tabs - The adjustable trim tabs for the rudder and elevator controls are located at the port side of the cockpit near the pilot's seat, and work in the same plane as the controls concerned. The elevator wheel has a crank handle for rapid adjustment. Dials at the hand wheels indicate the positions of the tabs.

7. Retractable Landing Gear - The retractable landing gear is operated hydraulically by either the emergency hand pump, or the electric pump. An operating instructions plate is located on the left hand side of the cockpit. On aircraft Nos. AH741 to AH999 and AK100 to AK155 inclusive, a selector lever extends forward along the port side of the cockpit and has a push button on the end which must be depressed to move the handle from neutral. (The handle may be returned to neutral without depressing the button.) On aircraft AK156 and subsequent the push button on the undercarriage selector lever is replaced by a safety latch bolt which must be pulled forward before the lever can be moved.

To retract the landing gear depress the button on the end of the handle, (pull safety latch bolt forward), and raise the handle to the "Up" position. Then operate the electrical pump by pressing the switch button on the top of the control column. As a precaution the gun selector switch should be "Off" in case the trigger switch is squeezed by mistake. The switch must be held "On" during the period required for the retraction of the landing gear. To lower landing gear move handle to "Down" position and operate switch button as before.

To insure positive engagements of the locks, the switch should be held "On" for a few seconds after the indicator and the warning horn show that they are down. As a final check, the pilot should try and move the hand pump lever on the right hand side of the cockpit. If this lever cannot be moved, except by a high load which brings the hydraulic bypass valve into operation, the pilot can be sure that the landing gear is locked down. The selector lever should then be raised to its neutral position. This hydraulic valve control lever should be in neutral when taking off or landing.

An indicator on the instrument board indicates, the position of the landing gear whenever the battery switch is turned "On." A warning klaxon, which operates when the throttle is closed with the wheels retracted, is only connected to the locks and consequently will sound when the wheels are down, if the locks are not engaged.

This klaxon circuit is controlled through a toggle switch which is mounted just ahead of the throttle quadrant and is actuated by a cam mounted on the throttle rod. This cam may be pulled out to turn the klaxon off temporarily during a throttled dive with the wheels retracted. It engages automatically when the throttle is opened to the stop.

A light on the upper port side of the instrument board shows red if the wheels are down and not locked. The light has interchangeable heads for either day or night operation.

Emergency Operation: In the event of the electrical system failing, select the required position for the undercarriage on the selector lever and operate hand pump on right hand side of the cockpit.

Warning - Never operate pump with selector lever in "Up" position when airplane is resting on its wheels.

Before starting engine or taxiing, check landing gear lock by shifting selector to "Down" position and operating the hand pump until it is solid to fore and aft movement. Return valve lever to neutral position.

8. Wing Flaps - The wing flaps are operated hydraulically by either the hand pump or an electrically operated pump. The selector handle is located on the port side of the cockpit beside the pilot's seat and moves fore and aft: - forward for "Down," and aft for "Up," and neutral for "Off." The hand operated hydraulic pump (See para 7) may be worked back and forth to raise or lower the flaps after the "Up" or "Down" position has been selected on the handle. The flaps may be operated manually in order that partial setting may be obtained more easily. With air loads on the flaps they will close automatically as soon as the selector is moved to the "Up" position.

NOTE: - Flap selector lever cannot be set to "Up" position until undercarriage lever has been returned to neutral.

9. Undercarriage and Flap Position Indicator - The position indicator is located on the lower port side of the instrument board. The wheel and flap images simulate the actual position of the landing wheels, tail wheel and flaps. The images disappear from view when the electrical power is "Off," thereby indicating failure of the instrument, or open battery or generator circuit. The battery switch must be "On" to maintain operation of the indicator. The battery switch should be "Off" before leaving the airplane.

Engine Controls

10. Throttle Quadrant - The throttle, automatic mixture and propeller controls are located on the throttle quadrant. The mixture control locates the automatic rich and automatic lean positions. Approximately the last 10° movement of the "lean" mixture on the quadrant is the engine "idle cut-off" position. There is a spring stop included to prevent mixture control from entering the "idle cut-off" position when normal pressure is applied.

11. Airscrew Operation - This may be either "Automatic" or "Manual Selective." When on automatic control, a selected engine speed is held constant by an engine driven governor. Speed selection is accomplished by adjustment of the propeller control on the throttle quadrant, and the toggle switch on the propeller control panel is in the "down" or "on" position.

When on manual selective control, that is with switch in "Hand control" position, the propeller acts as a controllable pitch propeller by the operation of the "Increase RPM", or "Decrease RPM" switch. Circuits are independent of the governor so that if the governor fails the propeller can be used as a multi-position controllable propeller.

Since the markings on the propeller control are for approximate settings, the tachometer should be relied upon to obtain the desired RPM.

General Operation: Automatic Control - Set toggle safety switch, which is of the circuit breaker type, to "On" (Down) (automatic control) position for constant speed control by C.P. lever on throttle quadrant.

The desired RPM can then be obtained by moving the constant speed control lever on the throttle quadrant.

(If the switch throws out, it may be reset by turning to "Off" then to "On." Successive throwing out will probably be an indication of short circuit or overload, and the switch should be left off, in this event, the pitch should be changed only if absolutely necessary.)

Manual Control - Set switch from "On" (automatic control) to "Hand Control." The throttle quadrant lever is then cut out and any change in RPM must be made by operating the manual switch over to "Increase" or "Decrease" until the desired change in engine revs has been made.

12. The Fuel Cock is located on the port side of the cockpit below the hand fuel pump and marked to show the tanks and capacities.

13. Fuel Quantity Gauge for the auxiliary tank is located on the instrument board and the front and rear main tanks on the floor of the cockpit.

14. Carburetor Air Heat Control is a "push-pull" control located on the forward starboard side of the cockpit. The carburetor air intake is a scoop built into the top of the engine cowl. A butterfly valve, controlled from the cockpit is located immediately above the carburetor air screen and permits either cold or warm air or a mixture of both to enter. Warm air for the carburetor is taken from inside the engine compartment. The carburetor air screen is installed to prevent the passage of any foreign matter into the carburetor. The carburetor air control should always be in the cold position when starting the engine.

15. The Engine Primer is located on the starboard side of the cockpit, just below the instrument panel.

16. Starter - On aircraft AH741 to AH970, a foot operated electric inertia starter is provided. A foot treadle on the cockpit floor is pushed back to operate a starter switch, which allows a direct flow of current from the battery to the starter motor. When the starter has reached the desired speed,

the foot treadle is pushed forward actuating a starter meshing solenoid and a booster coil; also by the same movement of the foot treadle the starter switch contact is broken. The first few impulses of the engine in starting will automatically disengage the starter.

On aircraft AH971 and subsequent the foot operated starter is replaced by a two-way toggle switch located on the switch panel on the port side of the cockpit. This is pressed down to energize the starter and raised to engage it, and the switch automatically returns to the "Off" position when released.

In case of battery failure, the starter may be cranked by hand with crank and extension provided for this purpose, both being located in rear access compartment. The starter is operated by turning the crank handle which is inserted in the spiral slot provided in the end of the crank extension, on right hand side of enging cowl. Turn the crank with gradually increasing speed until a fairly good rate of speed is obtained. Remove the crank handle and extension. The engagement of the starter will then be accomplished by a pull on the hand starter button located immediately above the crank. Caution: Starter crank and extension must be removed immediately after cranking, and before actuating starter pull.

17. Oil Dilution Control is located on the switch panel on the port side of the cockpit.

(a) Before stopping the engine when a cold weather start is anticipated, hold the oil dilution control switch "On" for approximately four minutes at 800 RPM and stop the engine with the ignition switch, continuing to hold the dilution control switch "On" until the engine stops. Then, turn the standard fuel cock to the "Off" position.

(b) In starting the engine a normal start should be made. After starting the engine, if a heavy viscous oil is indicated by oil pressure that is too high or by oil pressure that fluctuates or falls back when the engine RPM is increased, the dilution valve should be held "On" to dilute the oil and correct this condition. Over dilution will result in a steady low oil pressure and should be avoided if possible.

(c) If the engine heat is excessive when operating the oil dilution control, the heat may evaporate the fuel out of the oil and leave the normal high viscosity oil in the engine. When this condition is encountered, the engine should first be shut off and allowed to cool for fifteen minutes, the restarted and the instructions outlined in paragraph "a" followed in preparing the engine for cold weather starting.

(d) Take-off may be made four minutes after starting the engine if there has been enough rise in oil temperature (40°C. minimum), or, if the engine holds its oil pressure and if the engine runs smoothly, the take-off may be made as soon after four minutes as these conditions are obtained.

18. Hand Fuel Pump Control is located on the port side of the cockpit forward of the throttle quadrant.

19. Radiator Flap Control is located on the starboard side of the cockpit near the floor. It consists of a long lever and a rack, the latter is provided with a stop at each end and may be set for "full open" (handle fully down), "full closed" (handle fully up), or any intermediate position.

NOTE: Filling points for:

Wing fuel tanks through left hand wing fillet.
Fuselage fuel tanks through rear vision glass, left hand side, forward.
Oil tank through rear vision glass, left hand side aft.
Coolant tank through inspection door, top of engine cowl.

Operational Equipment

20. Gun Firing Switch - See Section 1, para 3

21. Switches and Rheostats are located on panel on the left, below the throttle quadrant. Care must be taken to insure that all rheostats are in the extreme "Off" position when not in use, as they are equipped with integral switches.

22. Oxygen - The oxygen cylinders are carried in supports in the aft part of the fuselage, and accessible through fuselage access door. The oxygen regulator and bayonet outlet are located on the starboard side of the cockpit.

23. Aircraft Flares - Two forced landing flares are carried in flush type built-in wing flare racks. Flare release handles are located on the starboard side of the pilot's seat.

24. Recognition Device - A brakcet for mounting the damped rate control is provided on the starboard side of the cockpit which actuates the recognition device mounted on brackets near the top of fuselage accessible through fuselage access door.

25. Landing Lamp - A landing light is fitted to the underside of the port wing, and is operated by a switch on the main switch box.

26. Formation Lights for lighting the upper surface of the wings are located in the fuselage aft of the cockpit. These are controlled through a rheostat on the port side electrical boxes. (Aircraft AH971 onwards)

27. Identification Lights - Provisions are made in top of the fuselage aft of cockpit enclosure and starboard rear wing fillet for upward and downward identification lights. The identification light switch box is located on starboard side of cockpit.

28. Cockpit Lights - Cockpit spotlights are located on starboard and port sides of the cockpit. Spare bulbs are located on the port side, just above the trim tab controls.

29. Wireless Controls - Provisions have been made for the various radio units as follows:

Power Unit - aft part of fuselage
Transmitter and Receiver - aft part of fuselage
Receiver - forward of fuselage access door
Electric Controller - port side of cockpit
Control Unit - forward starboard side of cockpit
Remote Contactor - forward starboard side of cockpit

Provision is made for the installation of either TR9D or TR1133A, and R 3003.

30. Dalton Computor - On aircraft AN218 and subsequent, stowage for the Dalton Computor has been deleted.

31. Shield - An instrument light shield is provided to prevent reflections on the windshield.

32. Fire Extinguisher - is carried in brackets on the pilot's floor in aircraft AH741 to AM519. On aircraft AN218 and subsequent, the fire extinguisher has been deleted.

33. Map Case - is fastened to the starboard side of the cockpit.

34. Life Preserver - The back cushion of the pilot's seat may be used as a life preserver.

35. Rear View Mirror - A curved adjustable mirror is provided and installed at the top center of the windscreen, on AN218.

36. Camera Gun - On aircraft AN368 to AN517 inclusive, provision is made for the installation of a G-45 camera gun outboard of the landing gear, on the underside of the right wing. The camera control switch is located on the control panel on the port side of the cockpit. The footage and exposure indicator is mounted on an adapter plate on the starboard side of the cockpit above the radiator flap control handle.

37. Windscreen Defroster - is located below the center of the instrument board. A priming motion discharges a glycol spray upon the windshield, on aircraft AN218 and subsequent.

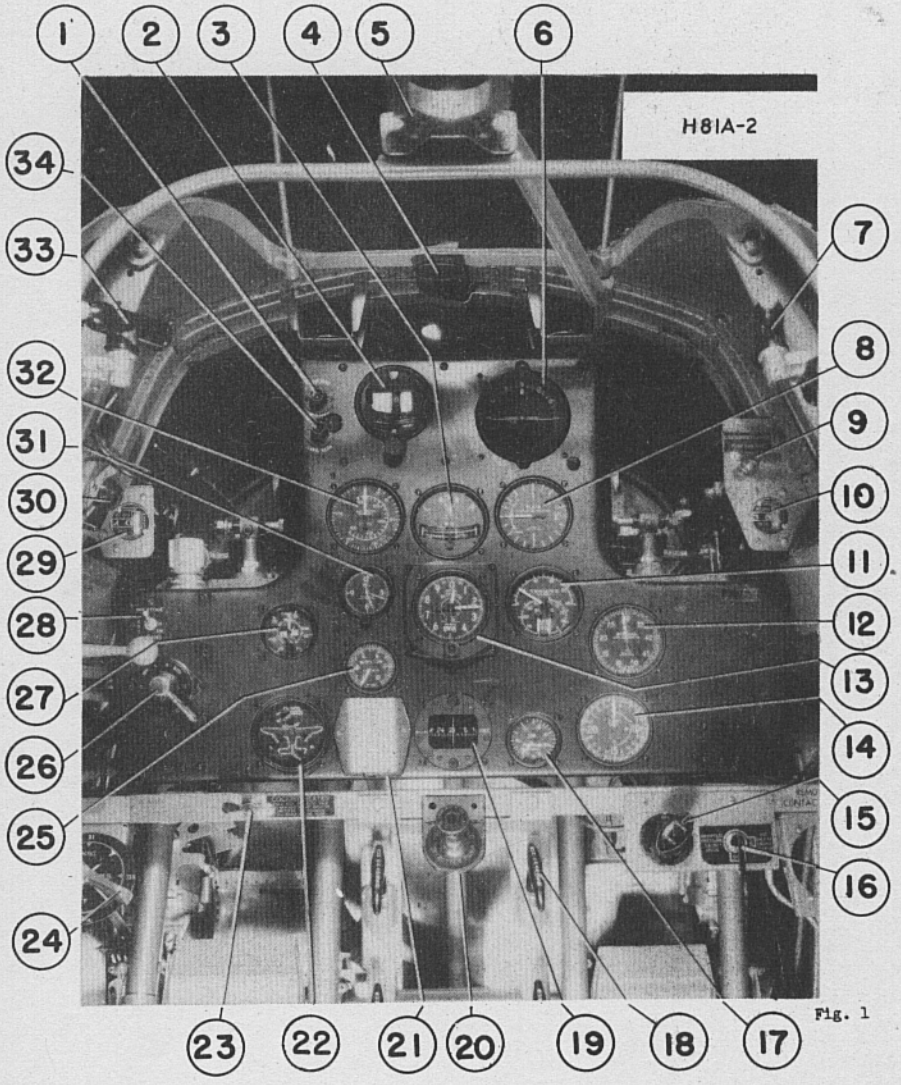
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Fig. 1

INDEX TO ITEMS ON INSTRUMENT BOARD

1. Prestone Warning Light
2. Turn Indicator
3. Bank and Turn Indicator
4. Windscreen Defroster
5. Optical Gun Sight
6. Flight Indicator
7. Cockpit Light
8. Climb Indicator
9. Carburetor Air Control
10. Rounds Indicator
11. Engine Gauge Unit (Oil Temperature, Fuel Pressure and Oil Pressure)
12. Manifold Pressure Gauge
13. Altimeter
14. Tachometer
15. Engine Primer
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28. Prestone Warning Test Switch
29. Rounds Indicator
30. Gun Selector Switch
31. Clock
32. Airspeed Indicator
33. Cockpit Light
34. Landing Gear Warning Light

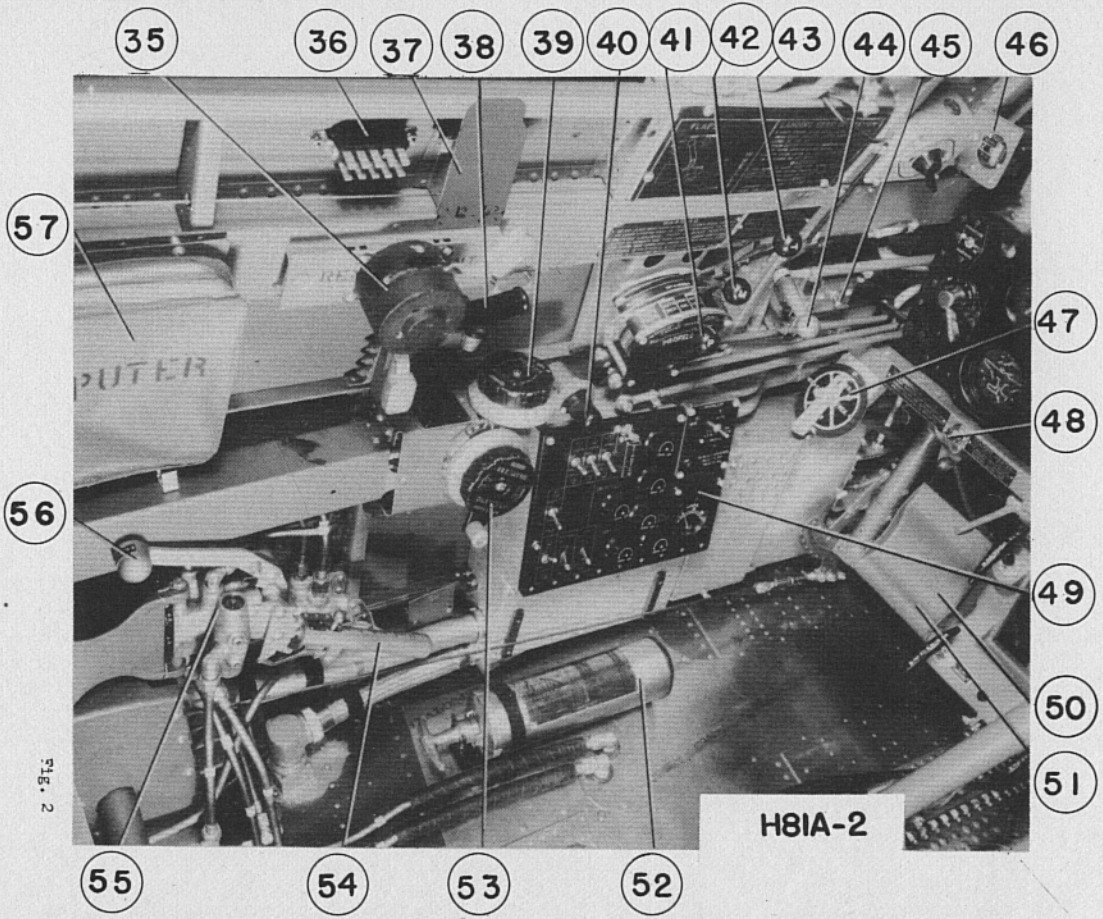
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Fig. 2

INDEX TO ITEMS ON PORT SIDE OF COCKPIT

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41. Propeller Control
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50. Wheel Brakes Treadle
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53. Elevator Trim Tab Control
54. Landing Gear Control
55. Hydraulic Control Valve
56. Flap Control Lever
57. Dalton Computor (Deleted on Aircraft AN218 and subsequent ships)

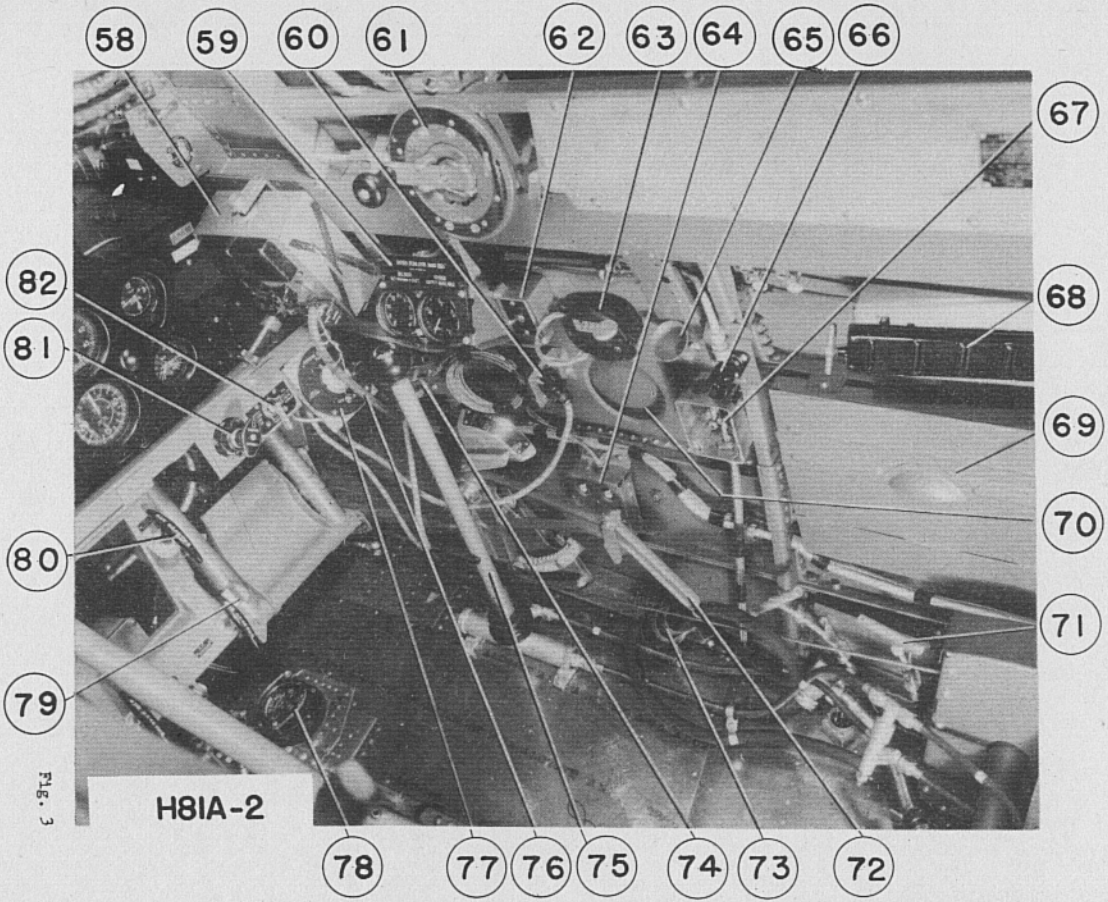
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Fig. 3

INDEX TO ITEMS ON STARBOARD SIDE OF COCKPIT

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63. Signal Key for Identification Lights
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66. Oxygen Bayonet Union
67. Junction Box for Radio Connector Plug
68. Recognition Device Control
69. Map Case
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71. Flare Release Handles
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74. Switch "ON" and "OFF" and plug for TR9D Radio Set
75. Emergency Hand Pump
76. Plug for Power Supply for Control Unit for R-3003 Radio Set
77. Remote Contactor
78. Wing Tank Fuel Gauge
79. Rudder Pedal Adjustment
80. Wing Gun Charging Handles
81. Engine Primer
82. Manifold Pressure Drain Gauge

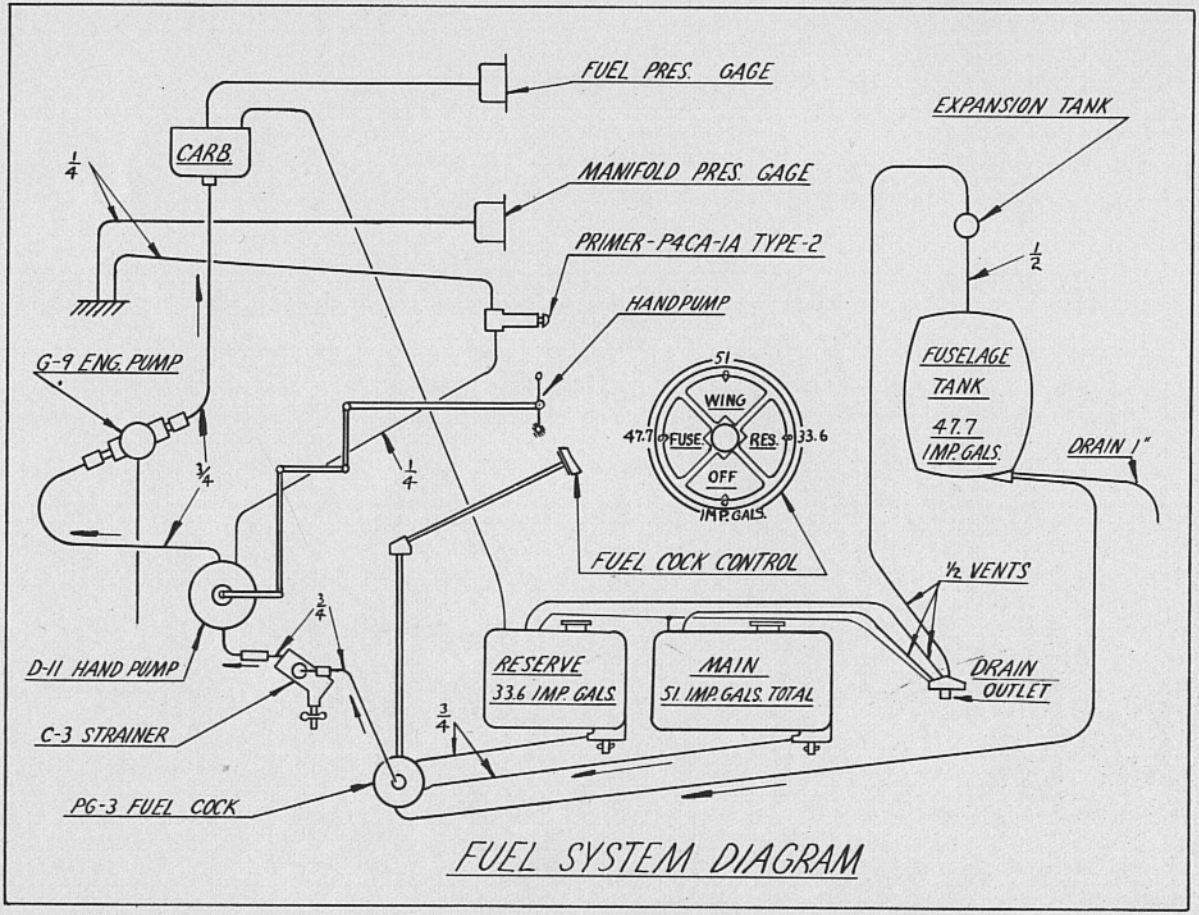
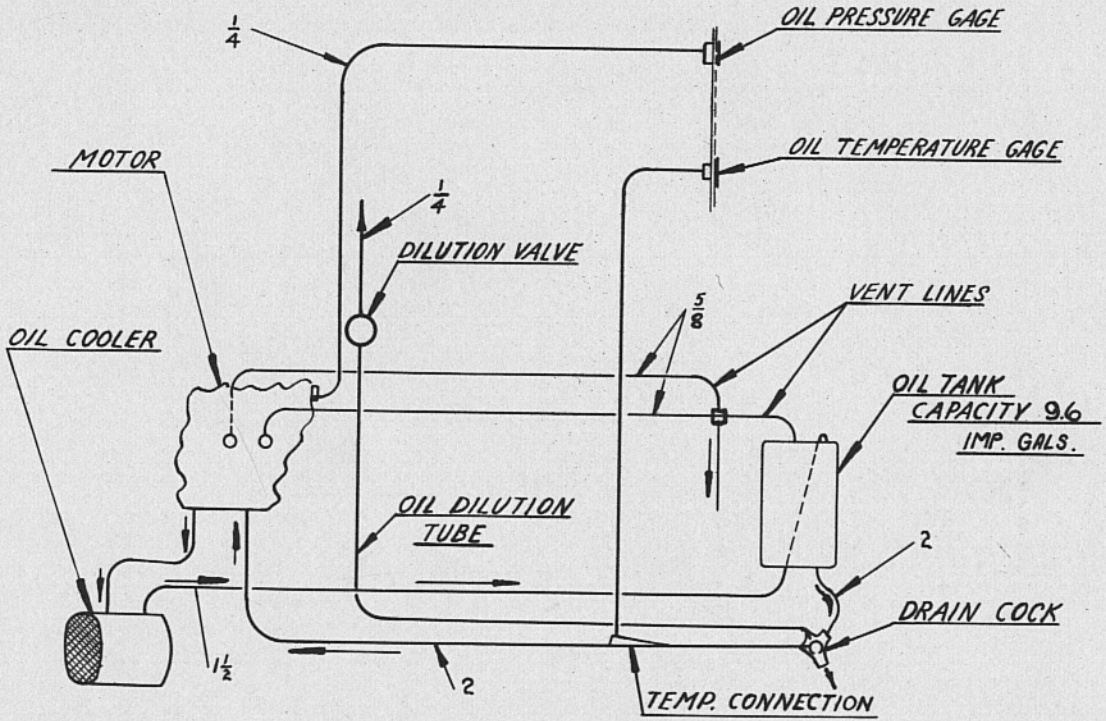

FUEL PRES. GAGE
EXPANSION TANK
CARB.
1/4
MANIFOLD PRES. GAGE
PRIMER-P4CA-1A TYPE-2
1/2
HANDPUMP
G-9 ENG. PUMP
51
WING
47.7 FUSE RES. 33.6
OFF
IMP. GALS.
FUSELAGE TANK 47.7 IMP. GALS.
DRAIN 1"
3/4
1/4
FUEL COCK CONTROL
1/2 VENTS
D-11 HAND PUMP
3/4
RESERVE 33.6 IMP. GALS.
MAIN 51 IMP. GALS. TOTAL
DRAIN OUTLET
C-3 STRAINER
3/4
PG-3 FUEL COCK
FUEL SYSTEM DIAGRAM

Fig. 4



OIL SYSTEM DIAGRAM

FIG. 5

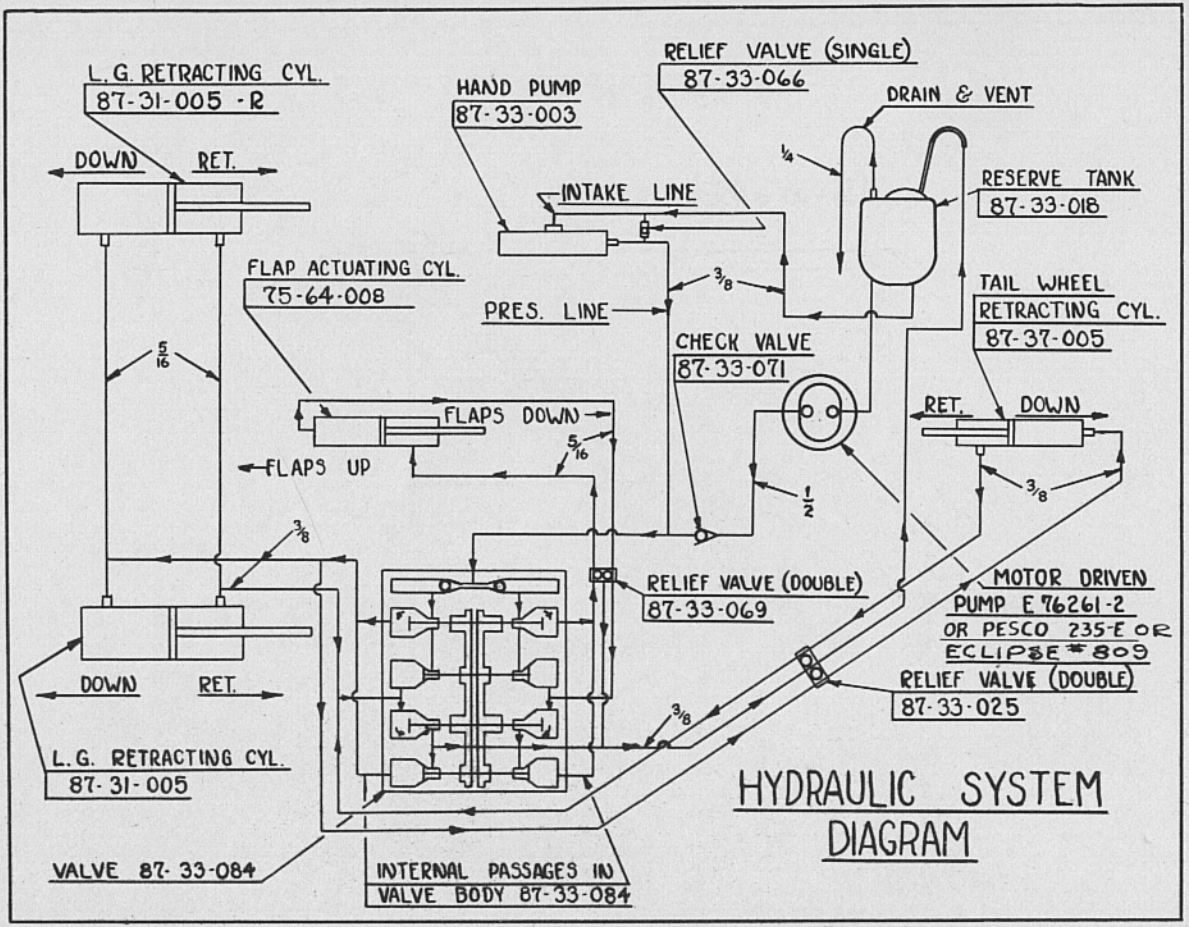

L. G. RETRACTING CYL.
87-31-005 -R
DOWN
RET.
HAND PUMP
87-33-003
RELIEF VALVE (SINGLE)
87-33-066
DRAIN & VENT
1/4
RESERVE TANK
87-33-018
INTAKE LINE
FLAP ACTUATING CYL.
75-64-008
3/8
PRES. LINE
TAIL WHEEL
RETRACTING CYL.
87-37-005
CHECK VALVE
87-33-071
5/16
FLAPS DOWN
FLAPS UP
RET.
DOWN
1/2
3/8
RELIEF VALVE (DOUBLE)
87-33-069
MOTOR DRIVEN
PUMP E 76261-2
OR PESCO 235-E OR
ECLIPSE #809
RELIEF VALVE (DOUBLE)
87-33-025
DOWN
RET.
L. G. RETRACTING CYL.
87-31-005
VALVE 87-33-084
INTERNAL PASSAGES IN
VALVE BODY 87-33-084
HYDRAULIC SYSTEM
DIAGRAM

Fig. 6

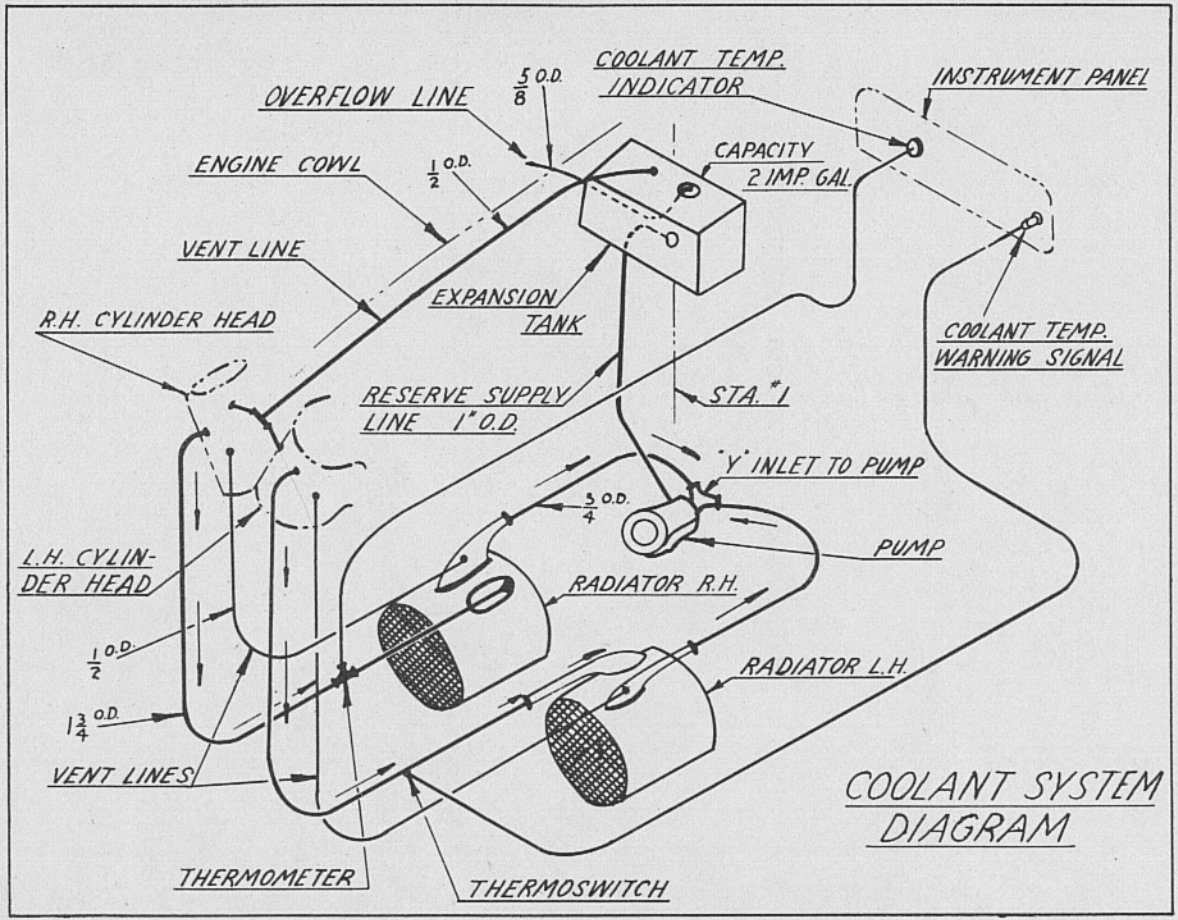

OVERFLOW LINE
5/8 O.D.
COOLANT TEMP. INDICATOR
INSTRUMENT PANEL
ENGINE COWL
1/2 O.D.
CAPACITY 2 IMP. GAL.
VENT LINE
EXPANSION TANK
R.H. CYLINDER HEAD
COOLANT TEMP. WARNING SIGNAL
RESERVE SUPPLY LINE 1" O.D.
STA. "I
"Y" INLET TO PUMP
3/4 O.D.
PUMP
L.H. CYLINDER HEAD
RADIATOR R.H.
1/2 O.D.
RADIATOR L.H.
1 3/4 O.D.
VENT LINES
THERMOMETER
THERMOSWITCH
COOLANT SYSTEM DIAGRAM

Fig. 7

SECTION 2

HANDLING and FLYING NOTES FOR PILOT

SECTION 2

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SECTION 2

HANDLING AND FLYING NOTES FOR PILOT

INTRODUCTORY NOTES

Note:- These notes should be read in conjunction with the Flying Training Manual, Part 1, Chapter III, which sets forth in detail the technique which is only outlined here.

1. Full details of the equipment of the aircraft are given in Section 1, and pilots should be acquainted with these details, which are only mentioned hereafter when there is some particular point to which attention should be drawn.

(i) Hydraulic system:- The hydraulic system operates the undercarriage, tail wheel and flaps, and a diagram of the complete system is given at the end of Section 1.

(ii) Undercarriage:- See Section 1.

(iii) Flaps:- The operation of the flaps is dealt with in Section 1. In the event of flaps being required for take-off, it is advisable to operate them manually in order to obtain more easily the partial setting required. This setting should be 20°. When flaps are down, caution should be exercised not to re-set the selector to the "up" position when there is any possibility that the resultant loss of lift might prove dangerous. Flaps should not be lowered at over 140 m.p.h. and should be raised for taxiing.

(iv) Wheel brakes:- These are toe-operated. They are satisfactory in operation and may be applied reasonably hard to restrict the landing run, but the good taxiing qualities of the aircraft do not necessitate their use under normal taxiing conditions.

INTRODUCTORY NOTES - Continued

(v) Gun firing system:- As the guns are fired electrically through a trigger switch on the stick, great care must be taken that this is not depressed accidently or when operating the undercarriage and flap switch.

(vi) Trimming tabs:- The elevator trimming tab is efficient and not unduly powerful for small movements of the trimmer wheel. The rudder trim is powerful and must be used at all times whenever speed of the aircraft is varied, particularly when the cockpit hood is open.

(vii) Air screw:- See Section 1, para. 11, for main operating instructions. When it is necessary to check the engine revs on the magneto switches, the propeller switch must first be put to the "Hand Control" position, when any fluctuations of revs will show on the rev counter. Care must be taken to see that the switch is returned to the "On" position, i.e., automatic position, so that C.P. lever on the throttle quadrant is again in operation, before taking off.

(viii) Cockpit hood emergency release: - See Section 1, para. 1.

(ix) Fuel, Oil and cooling systems: - Diagrams of these are given at the end of Section 1.

Note:- On aircraft Nos. A.H. 741 to A.H. 970 inclusive, certain of the electrical switches are "On" when in the "Up" position and care should be taken to identify these. All switches are clearly marked "Off" and "On".

FITNESS OF AIRCRAFT FOR FLIGHT

2. Ensure that the total weight and distribution of the load are in accordance with the weight sheet summary and ascertain that the aeroplane is in all other respects fit for flight.

PRELIMINARIES

3. Before starting the engine, check the following:

(i) That the ignition switches are OFF;
(ii) That undercarriage, tail wheel, and flap selectors are in NEUTRAL;
(iii) That constant speed toggle switch on control panel is ON; i.e., in "Automatic Control".
(iv) That wheel brakes are ON
(v) Switch on main battery switch and check undercarriage, tail wheel and flap indicator
(vi) Turn on fuel and check fuel tanks for contents
(vii) Check controls for free movement.

STARTING ENGINE AND WARMING UP

Note: For main engine details see Handbooks and paragraph 27 of these Notes.

4. (i) If engine has been standing, turn over by hand.
(ii) Turn carburetor air to "COLD", radiator shutters to "SHUT".
(iii) C.P. control to 2800 r.p.m.
(iv) Throttle to give approximately 800 r.p.m.
(v) Mixture control to idle cut-off. (See note)
(vi) Wobble pump to 4 lbs. pressure.
(vii) Prime engine with two to four strokes
(viii) Mixture control to FULL RICH
(ix) Switch - ON
(x) Push heel on starter pedal to energize starter.
(xi) When starter has reached sufficient speed, push down toe of starter pedal to engage.

Note:- Do not increase fuel pressure above 4 lbs. with the mixture control out of the idle cut-out position. If necessary, prime the engine to keep it from stalling, as pumping the throttle does not prime the engine.

TESTING ENGINE AND INSTALLATION

5. (i) Warm up at 800 to 1000 r.p.m.
(ii) Minimum oil temperature before running up over 40°C. - Maximum 85°C.
(iii) Oil pressure - 60 to 80 lbs.
(iv) Radiator temperature for running up - 80°C - Maximum 121°C
(v) Whilst warming up the engine, check the operation of the flaps.
(vi) Set propeller switch to "manual selective".
(vii) Check the functioning of the engine and magnetos at 2200 r.p.m. and 26 in. Hg. (65 Cm.Hg.)

Note:- Care must be taken to see that the tail does not lift when 1800 r.p.m. is exceeded, and it is advisable to have somebody holding this down whilst running up.

(viii) Reset propeller switch to "automatic" position and check C.P. control.

TAXIING

6. Owing to the steerable tail wheel, brakes are not necessary in normal circumstances. The view ahead is average and the machine is readily controllable.

If the engine is kept ticking over for any period of time, it should be cleared by being run up against the brakes prior to take-off.

ACTIONS PRIOR TO TAKE-OFF

7. Prior to actual take-off, check the following points by means of some suitable reminder, such as "T" - "M" - "P" "FLAPS" - "RADIATOR";

(i) "T" - trimming tab controls for rudder and elevator should both be in neutral as shown by the marks on the indicators.
(ii) "M" - mixture control should be at full rich.

Note:- It should be at auto-rich if aeroplane is above 3500 feet.

(iii) "P" - constant speed control should be set to give 3000 revs, and check that toggle switch is in the UP (automatic) position.

(iv) "FLAPS" - may be used up to 20° for take-off if required, although the advantage of so doing is very small. See paragraph 1 (iii).

(v) "RADIATOR" - position for this will be dependent on the outside air temperature.

TAKE-OFF

8. The aircraft is very easy to take-off and shows scarcely any inclination to swing, although a little right rudder may be needed. As the Allison engine has a particularly quick pick-up, the opening of the throttle must be done slowly and care must be taken to ensure that the specified maximum manifold pressure of 41 in. Hg. (104 Cm.Hg. on French instruments) is not exceeded. See para. 27 for full engine take-off limitations.

ACTIONS AFTER TAKE-OFF

9. (i) Once clear of the ground, raise the undercarriage and tail wheel by pressing the release knob on the end of the undercarriage selector lever, bringing the lever up to the undercarriage "UP" position, and pressing the thumb operating switch on the top of the control column. This operation is rather slow and whilst the undercarriage is going up -

(ii) reduce the boost pressure to 35 in. Hg. and reduce revs to 2600, and

(iii) maintain a flying speed of approximately 140 m.p.h.

(iv) When the indicator shows that the undercarriage and tail wheel are finally up, check that they are locked into position by operating the emergency hand pump, and if it is solid then the undercarriage and tail wheel are fully retracted. Return undercarriage selector lever to neutral position, and

(v) if lowered, raise the flaps by selecting the "Up" position on the flap selector lever, and press the thumb operating switch on the control column. When the flaps are up return the lever to neutral.

(vi) Set mixture control to automatic rich.

ENGINE FAILURE DURING TAKE-OFF

10. If the engine should fail during take-off, put the nose of
(i) the machine down and maintain flying speed. See that the undercarriage has commenced to come up and, if possible, select the "DOWN" position on the flap lever and give any possible assistance with the hand pump.

(ii) Switch off and land straight ahead.

CLIMBING

11. Whilst climbing away, check cockpit instruments systematically.

(i) Best climbing speed up to 14,000 feet is approximately 150 m.p.h.
(ii) R.P.M. and boost as given in para. 27.
(iii) Mixture in automatic rich
(iv) Radiator control adjusted to keep coolant temperatures between 85°C minimum and 125°C maximum

CRUISING

12. The absolute engine limitations for maximum cruising with the mixture control in either the Automatic Rich or in the Automatic Lean position are given in para. 27.

Recommended cruising conditions when less power is required are with the engine speed and manifold pressure at 2280 r.p.m. and 27.9 in. Hg. respectively, or 2190 r.p.m. and 25.2 in. Hg. respectively, with the mixture control in the Automatic Lean position. By adjusting the mixture control as described in para. 29 an improvement of about 5% in fuel consumption can be obtained on that given by using the Automatic Lean position.

GENERAL FLYING

13. Whilst this aircraft has a good view and is very manoeuvreable, it is directionally unstable, and this instability is most pronounced with the cockpit hood in the fully open position. It is necessary to use the rudder on all turns and it is also necessary to readjust the rudder bias for all changes of speed. As speed is increased the aircraft tends to yaw to the right, and left rudder bias must be applied. (See para. 14)

The control themselves are powerful at all speeds. It is possible to obtain high acceleration loadings by coarse use of the elevators. Trimmer tabs are effective.

INSTRUMENT FLYING

14. Owing to the directional instability of this aircraft with the hood open, it is essential that the hood be shut before any blind flying is attempted. It will be necessary to fly with the feet on the rudder bar, and particular care must be taken to avoid yaw. It would be advisable to lower the seat in order to obtain a better view of the instruments, which are somewhat masked by the reflector sight bracket.

STALLING

15. The stalling characteristics of this aircraft are good. At minimum speed the stall is gentle and there is some buffeting and pitching before the wing, generally the right, drops gently, followed by the nose.

At high speed the machine can be stalled as a result of coarse use of the elevators producing high acceleration loadings, but due warning is received, particularly on the high speed turn, by a shuddering of the aircraft, and loads of over 5g. can be applied to 180 to 200 m.p.h. without the aircraft stalling.

The stalling speeds of the aircraft at normal operational loads, were as follows:

Undercarriage up and flaps up	-	80	I.A.S.
Undercarriage down, flaps up	-	82	I.A.S.
Undercarriage up, flaps down	-	73	I.A.S.
Undercarriage down, flaps down	-	75	I.A.S.

SPINNING

16. This aircraft has been spun up to 5 turns and recovery was normal. The commencement of the spin is erratic and the aircraft tends to come out unless held in the spin. As soon as the standard actions for recovery are taken the spin ceases.

GLIDING

17. This machine handles quite normally on the glide both

with flaps up and flaps down.

(i) The glide with flaps up is flat and the view ahead is restricted.

(ii) With flaps and undercarriage down, the glide is steep and a good view is obtainable ahead. The lowering of the flaps makes the aircraft slightly nose heavy. Gliding turns with flaps and undercarriage down should be done at 105 to 110 m.p.h. at normal loadings.

(iii) The engine assisted glide is considerably flatter and should be done at 100 m.p.h., but the view forward is rather restricted by the high angle of the nose.

SIDE-SLIPPING

18. The aircraft can be side-slipped, although it is only just possible to hold the nose up and prevent the speed increasing unduly.

DIVING

19. The maximum permissible diving speed is 470 m.p.h. indicated.

(i) Before commencing a dive propeller should be put into coarse pitch to prevent over revving and the throttle should be left slightly open.

(ii) Flaps must never be used in an attempt to reduce diving speed.

(iii) As speed increases the aircraft tends to yaw to the right, this must be counteracted by the application of left rudder tab. With the hood open this tendency to yaw to the right is considerably worse than when the hood is shut.

(iv) As speed increases there is a tendency for the aircraft to become left wing low and roll to the left, which must be counteracted by the ailerons.

(v) Rate of descent is extremely rapid and speed is picked up very quickly.

(vi) Recovery is normal but elevators are powerful and considerable acceleration loads will result if too much force is used during recovery.

AEROBATICS

20. Subject to any current restrictions, normal aerobatics may be carried out on this aircraft. Due to the controls being powerful and moderately light the aerobatic qualities are good, but great care must be exercised to see that all aerobatics are carried out at sufficient height to enable the pilot to recover from a dive without exerting excessive loads on the aircraft. Care should also be taken to ensure that speed is maintained during aerobatics in the looping plane.

APPROACH AND LANDING (GENERAL)

21. This aircraft is very easy to land, but the following features should be noted:

(i) Landing must always be made with flaps down.
(ii) The angle of descent with flaps and wheels down and engine off is steep.
(iii) If an engine assisted approach is made with too much engine, the view ahead is apt to be restricted owing to the high position of the nose relative to the horizon.
(iv) When in the tail-down landing position this aircraft is at a considerable angle of attack so that if a 3-point landing is desired, some excess speed must be held in order to give sufficient elevator control to change the attitude of the machine from the steep gliding angle to the landing attitude, and to overcome any tendency to stall when making this change.

PRELIMINARY APPROACH

22. Reduce speed during the initial circuit of the aerodrome and -

(i) Open hood,
(ii) Ensure mixture control is in full rich,
(iii) Carry out the following vital actions in good time prior to the final approach, as the undercarriage takes some time to come down,
(iv) "U" - undercarriage and tail wheel down; depress button on the undercarriage selector lever and select "Down" position and press the operating

switch on the top of the control column. Check that the undercarriage and tail wheel are locked down by operating the emergency hand pump. Undercarriage and tail wheel are fully down when this is solid. When down, return selector lever to neutral.

Note:- Do not lower undercarriage above 175 m.p.h.

(v) "P" - pitch. Set constant speed control to give 3000 r.p.m., and check that the toggle switch on control panel is "ON" (in the down position).

(vi) "F" - flaps. When in the correct position for the final approach, select "flaps down" on the flap selector lever (lever forward), and press the thumb switch on the control column until flaps are fully down. Do not lower flaps at over 140 m.p.h.

Note:- In the event of failure of the electric motor, undercarriage and tail wheel and flaps may be operated by selecting the required position on the selector levers and operating the emergency hand pump.

(vii) Radiator closed as necessary.

FINAL APPROACH

23. The final approach should be done at the following speeds under normal load conditions:

(i) For the engine off approach, a speed of 95 to 100 m.p.h. should be maintained. This will give a steep angle of glide and a good view will be obtained of the landing area. Control at these speeds is good.

(ii) An engine assisted approach should be carried out at approximately 90 to 95 m.p.h. For this, very little engine is required and if too much engine is used, whilst serving to reduce the approach speed slightly, the angle of approach is too flat for the pilot to obtain a satisfactory view of the landing area.

LANDING

24. (i) The landing itself is easy, but if a 3-point landing is made, the angle of attack as the air-

craft settles on to the ground is high, and if the flattening out process has been commenced too soon it might be possible to stall the aircraft and drop a wing, and this point should be watched.

(ii) Normally there is no tendency for this aircraft either to drop a wing or to swing after landing.

(iii) Brakes may be applied to reduce the landing run.

(iv) Flaps should be raised as soon as the run is finished and before taxiing in, but care must be exercised to see that the undercarriage and tail wheel selector lever is not moved instead of the flap lever.

Note:- If this mistake is made, the tail wheel will retract first before the undercarriage, so that the pilot should have warning that he has made a mistake and should cease to press the thumb operating switch immediately.

FORCED LANDINGS

25. In the event of a forced landing, the pilot must decide whether or not it is advisable to lower the undercarriage or whether the landing should be carried out with the undercarriage retracted.

(i) If in doubt, decide to land with the undercarriage up;

(ii) Turn off the petrol and switch off engine; open hood.

(iii) Lower the flaps to reduce forward speed.

(iv) In the event of a forced landing on water, undercarriage, tail wheel and flaps should be UP. Hood must be open and harness done up.

NOTE:- FOR FURTHER DETAILS OF THE LATEST TECHNIQUE IN CONNECTION WITH ALL THE FOREGOING NOTES, PILOTS SHOULD REFER TO FLYING TRAINING MANUAL, PART 1, CHAPTER III.

POSITION ERROR TABLE

26. The corrections for position error are as follows:

At 60 mph I.A.S. reading subtract 3.5 mph
80 mph I.A.S. reading subtract 2.0 mph
100 mph I.A.S. reading subtract .5 mph

POSITION ERROR TABLE - Continued

120 mph I.A.S. reading add	1.0 mph
140 mph I.A.S. reading add	3.5 mph
160 mph I.A.S. reading add	5.0 mph
180 mph I.A.S. reading add	6.0 mph
200 mph I.A.S. reading add	8.0 mph
220 mph I.A.S. reading add	8.5 mph
240 mph I.A.S. reading add	9.0 mph
260 mph I.A.S. reading add	10.5 mph

NOTES ON THE ALLISON V-1710-C15 ENGINE
(Using 100 Octane Fuel)

27. The following should be carefully noted:

(i) Limiting operational conditions

Take-off *	Maximum r.p.m.	3000
	Maximum boost at S.L.	41.0 in.Hg.
	Maximum boost above 2600 ft.	38.9 in.Hg.
	Mixture control: below 3500 ft.	"Full-rich"
	above 3500 ft.	"Auto-rich"
Climb *	Maximum r.p.m.	2600
	Maximum boost	35.0 in.Hg.

* Note: - For take-off and climbs of short duration (not exceeding 5 min.) from sea level, the throttle should be adjusted to give 41 in. Hg. and left in this position until the boost falls to 38.9 in.Hg. This boost should then be maintained by adjustment of the throttle. For climbs of longer duration the boost should be adjust to 35 in. Hg.

Maximum cruising (mixture control "Auto-rich")	Maximum r.p.m.	2600
	Maximum boost	35 in.Hg.
Maximum cruising (mixture control "Auto-lean")	Maximum r.p.m.	2280
	Maximum boost	29.2 in. Hg.

NOTES ON THE ALLISON V-1710-C15 ENGINE
(Using 100 Octane Fuel) - Continued

Maximum level (5 minute limit)	Maximum r.p.m.	3000
	Maximum boost	38.9 in. Hg.
Maximum dive	Maximum r.p.m.	3120
	Maximum boost	38.9 in. Hg.

(ii) Oil Pressures

Normal	60-65 lb./sq.in
Minimum	50 lb./sq.in.

(iii) Oil inlet temperatures

Minimum for take-off	40°C
Normal	70-80°C
Maximum	85°C

(iv) Coolant temperatures

Maximum	125°C
Minimum for take-off or flight	85°C

FUEL CAPACITY AND CONSUMPTIONS

28. Note the following:

(i) Fuel capacity (in Imperial gallons):

Main tank	50 gallons
Fuselage tank	47 gallons
Reserve tank	33 gallons
Total	130 gallons

FUEL CAPACITY AND CONSUMPTIONS - Continued

(ii) Fuel consumptions (in Imperial gallons per hour):

Approximate consumptions at 12,000 ft. (except where otherwise stated) are as follows:

All out level (at 13,200 ft.)	at 3,000 r.p.m. and 38.9 in.Hg. boost	100
Climbing	at 2,600 r.p.m. and 35 in.Hg. boost	84
Cruising, (mixture control "Auto-rich)	at 2,600 r.p.m. and 35 in.Hg. boost	84
Cruising, (mixture control "Auto-Lean")	at 2,280 r.p.m. and 29.2 in.Hg. boost	49
	at 2,190 r.p.m. and 25.2 in.Hg. boost	39

Note: It is possible to obtain an improvement of about 5% on the "Auto-Lean" cruising consumptions by weakening the mixture as described in para. 29.

NOTES ON MIXTURE CONTROL

29. The engine is fitted with a Bendix-Stromberg injection type carburetor. Instead of the usual two-position mixture control as fitted to British engines, the mixture control has the following four main positions:-

(i) Full Rich. In this position there is no automatic compensation for altitude and temperature.

(ii) Automatic Rich. This is the position for the richest mixture which is automatically maintained by the compensating device.

(iii) Automatic Lean. This is the normal position for weak mixture. The automatic device maintains the mixture at this setting also.

(iv) Idle Cut-off. For stopping the engine and while priming during engine starting operations.

Furthermore, the mixture strength can be progressively

NOTES ON MIXTURE CONTROL - Continued

weakened by moving the lever from the Automatic Rich position towards the Idle-Cut-off position, the weakening being effective also in the region beyond the Automatic Lean position up to the point when the Idle Cut-off operates (at the extreme end of the travel). At any point in this range the automatic compensating device is in operation.

Although placing the mixture control in the "Automatic Lean" position gives a considerable reduction in fuel consumption, it is possible to obtain a consumption of about 5% lower by adjusting the mixture control as follows:

(i) Obtain the desired engine cruising conditions (provided that they do not exceed the limit for the mixture control in the "Automatic Lean" position as given in para. 27).

(ii) Change the propeller control from "Automatic" to "Manual".

(iii) Set the mixture control to the position determined by weakening the mixture until a drop of 40 to 50 r.p.m. is indicated. This position may be possibly between "Automatic Lean" and "Idle Cut-off".

(iv) Return the propeller control to "Automatic"

If changes in altitude or cruising conditions are made, this setting should be checked by repeating the above operations.