PART I

DESCRIPTIVE

NOTE.—Throughout this publication the following conventions apply:—

(a) Words in capital letters indicate the actual markings on the controls concerned.

(b) The numbers quoted in brackets after items in the text refer to the illustrations in Part VI.

(c) Unless otherwise stated, all airspeeds and Mach numbers quoted are " Indicated."

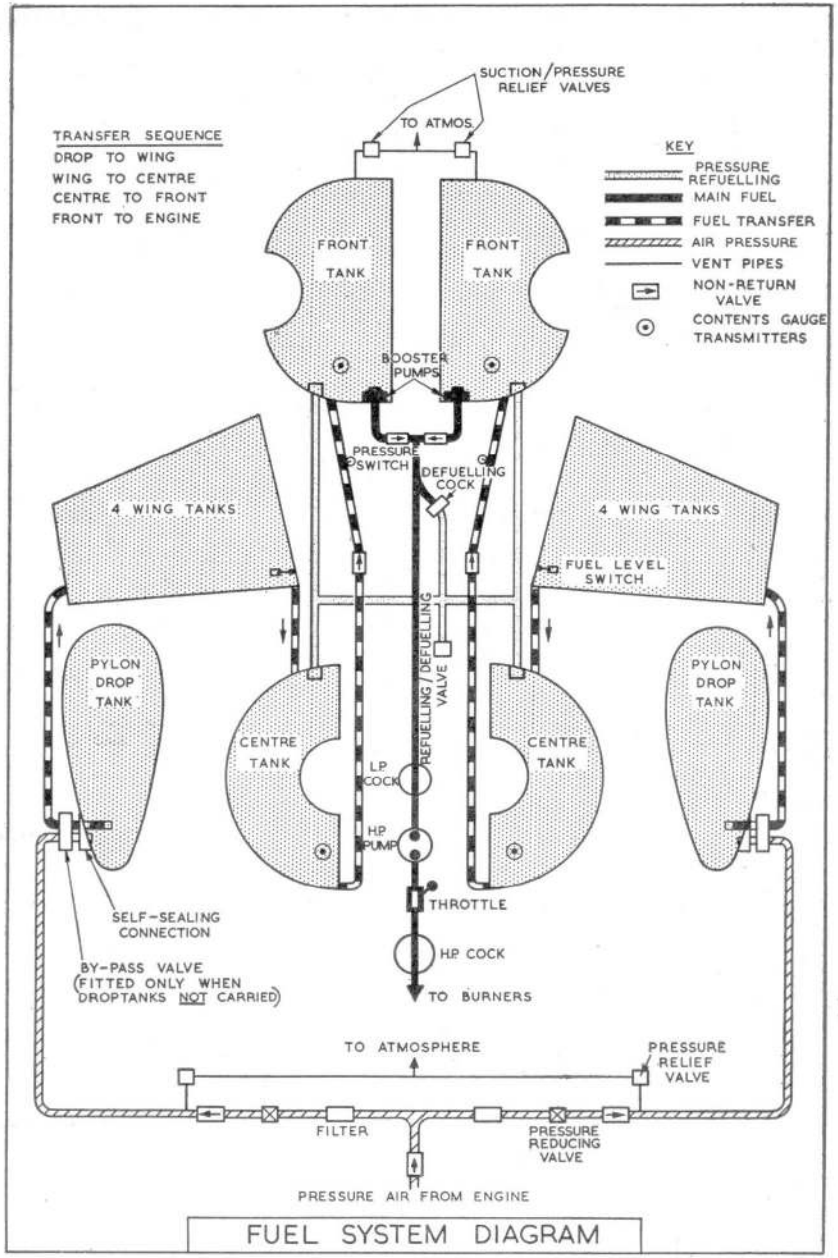
(d) All fuel poundage figures are calculated at 7.7 lb./gall. (Normal AVTAG).

1. Introduction

(a) The Hunter F.5 is a single-seat mid-wing fighter aircraft, with swept-back wings and a swept-back variable-incidence tailplane. Full-power ailerons and power-assisted elevators are fitted, both with manual reversion. When Mod. 365 is incorporated a full-power elevator replaces the power-assisted elevator. In such aircraft audio warning of hydraulic failure is provided by Mod. 327. The cockpit is pressurized and equipped with a Mk. 2H ejection seat.

(b) The power unit is a Sapphire Mk. 101, developing 8,000 lb. static thrust at sea level.

(c) Four Aden 30-mm. guns are installed in a detachable armament package in the fuselage undersurface.



FUEL SYSTEM DIAGRAM

FUEL AND OIL SYSTEMS

2. Fuel tanks and gauges

(a) Fuel is carried in four flexible bag-type tanks, in the centre fuselage, and in four interconnected tanks in the forward edge of each wing. Provision is made for carrying two 100-gallon pylon drop tanks.

(b) Each front tank contains an electrically-driven booster-pump fitted in a negative G fuel trap, the total contents of both permitting at least 15 seconds inverted flight.

(c) The tank capacities are:—

	Gallons	Weight (lb.) at 7.7 lb./gall.
Front tanks (2 × 101) ...	202	1,555
Centre tanks (2 × 23) ...	46	352
Wing tanks (2 × 70) ...	140	1,078
Total, internal ...	388	2,985
Pylon drop tanks (2 × 100)	200	1,540
Total, all tanks ...	588	4,525

(d) Two electrical contents gauges (73) on the starboard shelf indicate, in pounds, only the contents of the fuselage PORT TANKS and fuselage STBD. TANKS. There are no gauges for the wing tanks (on early aircraft) or for the drop tanks.* A CONTENTS CHECK switch (72), aft of the gauges, has two positions, ENGINE ON and ENGINE OFF. It is spring-loaded to the ENGINE ON position and is for use when it is required to check the contents with the engine stopped.

*Later aircraft will be fitted with gauges indicating the total contents of both wing and fuselage tanks.

3. Fuel transfer system

(a) Fuel from the drop and ~~rear~~ wing tanks is fed, by air pressure from the engine, to the centre tanks and then to the front tanks.

(b) The fuel transfer and the air pressure pipes are joined to each drop tank by means of a self-sealing connection, which automatically interconnects the air and fuel pipes when the drop tanks are jettisoned. When drop tanks are not carried, a bypass valve must be fitted to interconnect the two pipes.

(c) Two low level magnetic indicators (75), one for each set of wing tanks, show white when transfer from the wing (and drop) tanks is complete. The gauge readings should then begin to show a steady drop.

(d) Should the transfer system fail completely, no fuel will transfer from the wing and centre tanks. This is indicated by two indicators (71), one on each side of the contents gauges switch (72), showing white. At the same time the contents gauge transmitters in the centre tanks will become inoperative and the gauges will then only indicate the contents of the front tanks, i.e., the amount of fuel available to the engine. If only one side of the transfer system fails, the appropriate TRANSFER FAILURE indicator will come on and the associated gauge will indicate the available contents.

4. Main fuel feed system

The two booster-pumps deliver fuel from the front tank to a common pipe line, through the L.P. cock and thence to the engine-driven H.P. pumps. From the engine-driven H.P. pumps fuel is fed through the H.P. cock to the burners.

5. Booster-pumps control

NOTE.—Fuel balancing does not commence until the fuel gauge readings begin to fall from full indication, *i.e.*, on early aircraft when the wing and drop tanks are empty or, on later aircraft, when the drop tanks are empty.

(a) *Booster-pumps control (unmodified aircraft)*

(i) The contents of the port and starboard tanks which are gauged (*i.e.*, fuselage tanks early aircraft—wing and fuselage tanks later aircraft) are kept in balance by adjusting the rate of delivery from the front tanks booster-pumps. The pumps are electrically monitored by the fuel contents gauges so that should one side of the system tend to empty more quickly than the other, the delivery of the pump on that side is reduced until the levels are again approximately correct. (See para. 56 (c) (ii) and (iii).)

(ii) The fuel booster-pumps are controlled by two AUTO–OFF–MANL switches (78). The conditions obtained with the switches in various positions and both fuel gauges indicating less than full contents, are:—

Both switches at AUTO	Both pumps run under balance control conditions.
One switch at OFF One switch at AUTO or MANL	Pump controlled by switch at AUTO or MANL will run at full speed without balance control.
One switch at MANL One switch at AUTO or Both switches at MANL	Both pumps run at full speed without balance control.
Both switches OFF	Gravity feed only.

Only when *both* switches are at AUTO and when the ungauged tanks are *empty* will balance control conditions obtain. AUTO should be selected at all times except when either abnormal conditions obtain, or when fuel from ungauged tanks is being transferred. (See para. 56 (c) (ii) and (iii).)

(iii) Two circuit-breakers (84), one for each booster-pump, an ammeter socket (83) and a test switch (87) are on the starboard shelf.

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(b) *Fuel proportioner (later aircraft)*

(i) On later aircraft the fuel balancing equipment is replaced with a fuel proportioner. The booster-pumps are then controlled by two ON/OFF switches on the starboard shelf.

(ii) Fuel from each booster-pump is fed separately to the flow proportioner (a pair of gauged vane-type pumps on a common drive). Each proportioner pump delivers an equal amount of fuel to a single exit port;

thence it is fed through the L.P. cock to the engine. Unequal feeding should only occur if one booster-pump delivery pressure differs from the other by more than 2 lb./sq. in. If the proportioner fails, fuel bypasses it via spring-loaded non-return valves.

(iii) Management of the fuel system is similar to that given in para. 56. For AUTO or MANL, read ON.

(c) *Booster-pump failures*

(i) Should the contents gauges show more than 100 lb. difference in contents with both pumps at AUTO then either balance control or booster-pump failure has occurred.

(ii) Failure of a pump in AUTO will leave balance control on the remaining pump and since the fuel from the side on which failure has occurred will be fed by gravity only, the serviceable pump will go to minimum delivery. To check if a pump has failed, switch OFF the pump on the low contents side when the low pressure warning indicator should show white. If no such indication occurs then balance failure as opposed to pump failure has occurred and balance can only be obtained by controlling the pumps between the MANL and OFF positions.

NOTE.—Later aircraft will be fitted with two booster-pump failure red warning lights, one for each pump. In this case, the low pressure indicator will not show white if the test above is carried out.

(iii) If gauge failure occurs one or both gauges will read zero and it will be impossible to tell whether balance control is in operation or not.

6. H.P. pump

(a) A servo control system limits the pump output and a governor limits over-speeding of the engine.

(b) Control of the fuel flow is effected by:—

(i) The throttle, to meter fuel to the burners.

(ii) A barometric flow control (BFC), to vary the pump output in relation to intake pressure.

(iii) An air/fuel ratio control (AFC) to prevent an excess supply of fuel to the engine during periods of engine acceleration.

Both BFC and AFC are connected to the servo control system.

7. **H.P. fuel cock**

The H.P. fuel cock control (32) is mounted in a quadrant on the cockpit port shelf, and is moved forward from OFF to ON. A safety gate is provided to ensure that the H.P. cock cannot be moved unless it is first pressed downwards.

8. **L.P. fuel cock**

The L.P. fuel cock control (13) is adjacent to the H.P. cock control and also moves forward from OFF to ON.

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9. **Oil system**

Oil is carried in the engine sump, the capacity of which is 9 pints, with an additional 1½ pints in the engine. One pressure and one scavenge pump maintain a continuous circulation through a cooler and filter to the engine bearings and gears.

ENGINE CONTROLS

10. **Engine starting system**

(a) Starting is by means of a twin-breech cartridge starter which accelerates the engine until it becomes self-sustaining.

(b) Fuel for starting is delivered through a solenoid valve to six starting atomizers, where it is ignited by two high energy igniter plugs. Both the solenoid valve and the igniter plugs are energized when the starter button is pressed. During initial starting the throttle must be in the half-open position.

(c) The main control switches are:—

(i) The *battery master switch* (67).

(ii) The *ignition switch* (66) which controls the current to the igniter plugs. It should normally be locked in the ON position.

(iii) *The starter master switch* (63) *and circuit-breaker* (85). These complete the circuit through the starter button, ignition switch and relight switch. When the relight button is pressed, the starter button is isolated. The master switch also controls the electrical supply to the engine instruments, and completes the circuits to No. 1 inverter and the booster-pumps. The switch should be ON and the circuit-breaker in at all times when the engine is running.

(iv) The *starter pushbutton* (62), which initiates the starting sequence.

(d) When the battery master, engine master and ignition switches are all ON and the starter button is pressed, a cartridge is indexed and fired. The cartridge fires over a period of 4 seconds and causes the compressor to turn. At the same time full current is fed to the high energy igniter plugs which ignite the fuel spray. After 5 seconds a time switch de-energizes the ignition relay, closing the starting fuel solenoid valve and cutting out the igniters. After 11 seconds the engine should have accelerated to 3,000 r.p.m. Twenty-nine seconds after pressing the starter button the automatic time switch de-energizes the hold-in solenoid of the button allowing it to become operative once more.

11. **Restarting in flight system**

A relight button (33) is incorporated in the top of the H.P. cock control lever. It completes the circuit to the igniter plugs when relighting is required in flight.

12. **Throttle control**

The throttle control lever moves in a quadrant on the port shelf, the handle of the lever incorporating a twist-grip for

GGS manual ranging, a press-to-transmit pushbutton (19) and the airbrake control (20). A throttle damper (18) is aft of the lever.

13. Engine instruments

The engine instruments comprise a jet pipe temperature gauge, an oil pressure gauge and an r.p.m. indicator.

14. Engine fire-extinguisher equipment

(a) Two fire-extinguisher bottles, stowed between the air intakes just forward of the engine, are connected to the engine extinguisher inlet connection. Operation of the system is either by:—

(i) A manually-operated pushbutton (52) in the cockpit, on the starboard coaming, or

(ii) An automatically-operated inertia switch which operates if a crash landing occurs. When the inertia switch operates, the batteries are automatically isolated irrespective of the position of the battery master switch.

(b) Twelve resetting flame detector switches are situated around the engine and forward part of the jet pipe. Operation of any of the switches causes the ENGINE FIRE warning light (52) incorporated in the pushbutton to come on, provided electrical power is available. When the button is pressed the extinguishers discharge their contents through two spray rings, the forward of which encircles the engine compressor and the rear the turbine nozzle box. If the fire is extinguished, the light goes out as the flame switches cool.

(c) The warning light may be tested by pulling out the extinguisher pushbutton. Modified aircraft are provided with a test switch on the starboard coaming. On such aircraft the light should be tested by use of the switch.

(d) When the battery master switch is OFF the fire-extinguishers can be operated only by the inertia switch. The battery master switch must be ON to test the warning light or to operate the system by pushbutton.

MAIN SERVICES

15. Hydraulic system

(a) An engine-driven hydraulic pump maintains a live-line pressure of 3,000 ± 150 lb./sq. in. for the normal operation of the:—

Undercarriage and doors

Flaps

Wheel brakes

Aileron and elevator hydroboosters

Airbrake

The main pressure is indicated by the central needle of the triple pressure gauge (35) at the forward end of the port shelf.

(b) Five hydraulic accumulators are fitted in the circuit to provide a reserve of power in an emergency. The hydraulic side of the accumulators is connected to the wheel brakes (two), aileron hydroboosters (two), and elevator hydrobooster (one) respectively.

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(c) The pressure available in the wheel brakes accumulators is shown on a gauge (9) on the port shelf. The accumulators are charged with air to a pressure of 750 lb./sq. in. via a connection in the nosewheel bay. The aileron accumulators are charged to 1,575 lb./sq. in. (900 lb./sq. in. when Mod. 690 is embodied) via a connection in the starboard wheel bay and the elevator accumulator is charged to 1,575 lb./sq. in. via a panel in the port side of the fin. The pressure in the elevator accumulator is shown on a gauge visible through a transparent window on the fin; the pressure in the two aileron accumulators is shown on a gauge adjacent to the charging point.

(d) Indication that failure of the live-line system has occurred is given by the main needle of the triple pressure gauge and, when pressure has fallen to 600 lb./sq. in. the illumination of a red warning light on the port side of the instrument panel. When Mod. 327 is incorporated an audio warning also gives warning of hydraulic failure. This is the same audio warning, previously used for cock-pit pressure failure. When the audio warning cut-off switch (59) is operated the warning is discontinued.

(e) Two high pressure air bottles, which are charged to 1,800-2,000 lb./sq. in., are provided for the emergency lowering of undercarriage and flaps respectively. Air pressure gauges (9) (10) for the bottles are mounted on the port shelf.

(f) A hydraulic handpump, for ground test purposes, is fitted in the engine bay.

16. Electrical system (24 volt)

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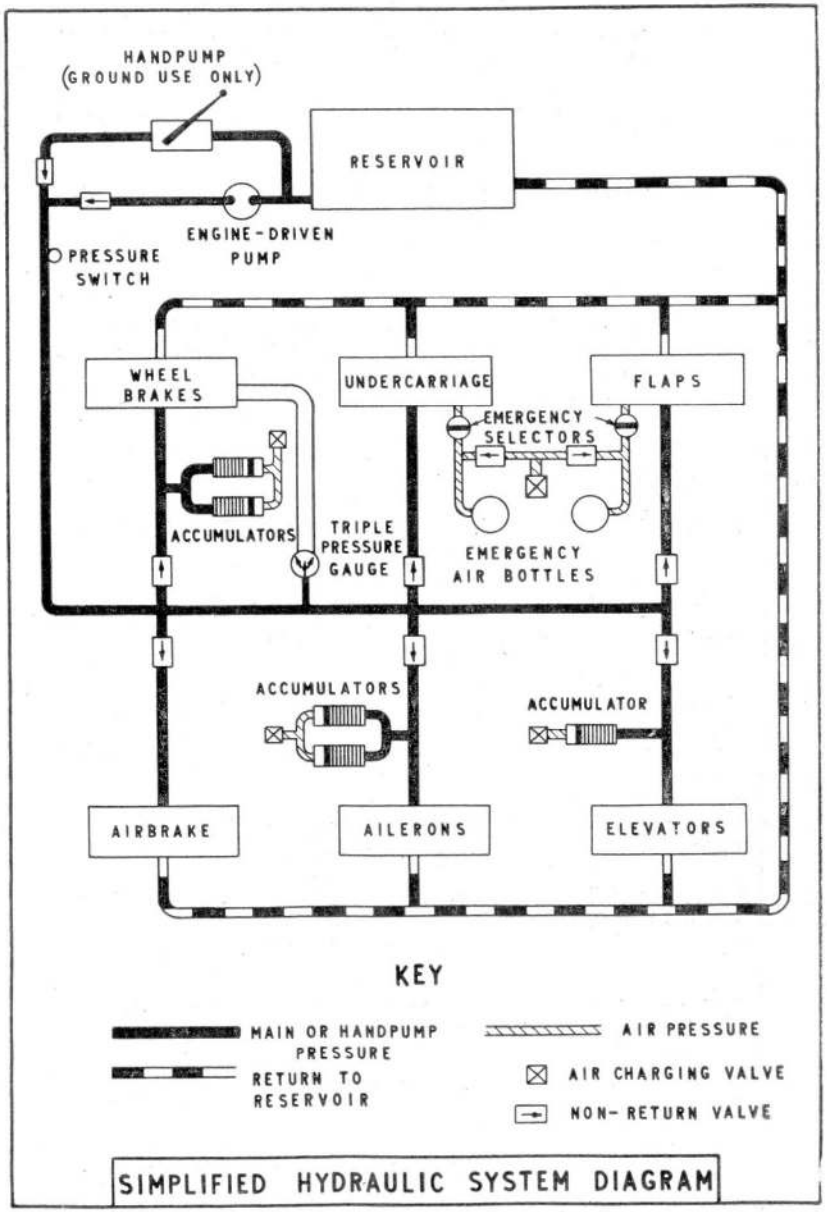
(a) *D.C. supply*

(i) Two 6,000-watt d.c. engine-driven generators supply the whole of the electrical system and charge two 12-volt aircraft batteries connected in series. When Mod. 386 is embodied two 24-volt batteries, connected in parallel, are fitted which double the available reserve if generator failure occurs. Two generator failure warning lights (61), situated below the centre of the instrument panel, come on only when their associated generator is not supplying power.

NOTE.—Minimum engine r.p.m. to keep the batteries fully charged are 3,700 (4,000 if one generator has failed). It must not be assumed that the generators are charging adequately if neither warning lamp is lit. The batteries can be taking an appreciable load with both lights out at low r.p.m.



SIMPLIFIED HYDRAULIC SYSTEM DIAGRAM

(ii) Control of the batteries is effected by a BATTERY MASTER switch (67) below the centre of the instrument panel. When set to OFF the switch isolates all electrical services from the batteries except the engine fire-extinguisher inertia switch.

(iii) An external ground supply socket is accessible via the radio bay door and is for use when a ground battery is necessary for servicing purposes.

(iv) The following table lists the various electrical warning lights and indicators in the cockpit. Failure in any circuit incorporating a magnetic indicator (with the exception of radar ranging) is shown by the indicator showing white.

Service	Indication	Function
Fire warning	1 red light (52)	Gives warning when temperature in engine bay exceeds 300 ± 30°C.
Fuel pressure warning	1 white magnetic indicator	Indicates fuel pressure low at engine inlet
Fuel transfer warning	2 white magnetic indicators (71)	Indicate failure of transfer system
Wing tank transfer	2 white magnetic indicators (75)	Indicate transfer from wing tanks complete
Booster pump warning	2 red lights (when fitted)	Indicate failure of associated booster pumps
Generator failure warning	2 red lights (61)	Indicate generator failure due to (1) Cut-out not closed (2) Fault in circuit
Radar ranging warning	1 white magnetic indicator (above 27)	Indicates radar ranging in use
Radar ranging operation	1 blue light (49)	Indicates radar ranging locked on target
Hydraulic failure warning	1 red light	Indicates hydraulic pressure below 600 lb./sq. in.

Service	Indication	Function
Undercarriage position	3 red or green lights (37)	Indicate position of each U/C unit separately No light—unit locked up Red light—unit between locks Green light—unit locked down.
Undercarriage warning	1 red light (36)	Indicates when throttle closed and U/C ~~locked up~~ NOT LOCKED UP A.L.1.
Powered controls	2 white magnetic indicators (42)	Indicate separately disengagement of aileron or elevator hydroboosters, or fault in electrical circuit
Airbrake	1 white magnetic indicator (33)	Indicates airbrakes not fully retracted
Cockpit pressure warning	1 red light (56)	Indicates drop of ½ lb./sq. in. in cabin pressure differential.
Telebriefing	1 amber light (23)	Indicates telebriefing in use

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(v) *Emergency battery*
An emergency battery is provided to supply the emergency lamps, the Manual emergency selector circuit (Mod. 502) and, when Mod. 488 is embodied, the turn and slip indicator. If fully charged the battery will provide between 7 and 20 hours' continuous use, depending on the load imposed on it.

(b) *A.C. Supply*

(i) A.C. for the Mk. 4F compass, artificial horizon and oil pressure gauge is supplied by No. 1 Type 100A inverter, with No. 2 Type 100A inverter acting as a standby. The engine starter master switch normally controls the circuit to the inverters but No. 2 inverter does not come into circuit until micro-switches, attached to the undercarriage, are operated when the weight is taken from the undercarriage as the aircraft becomes airborne. If No. 1 inverter fails, automatic changeover to No. 2 inverter occurs, which causes a magnetic indicator on top of the A.C. junction box to show white.

(ii) When No. 2 inverter is in circuit it also acts as a feed to the radar ranging. When the latter is switched on, No. 2 inverter operates a torque switch to bring into operation a Type 200 inverter which supplies the radar ranging. If auto-changeover occurs, the torque switch trips and the radar ranging is inoperative.

(iii) A.C. for gun firing is supplied by a Type 300 inverter which is brought into operation when the gun firing safety flap is raised, provided that the gun firing circuit is in operation (see para. 52(a)).

(iv) Located on top of the A.C. junction box at the aft end of the port shelf, in addition to the changeover indicator, are two circuit breakers, for the Type 100A inverters, and

a TEST/NORMAL switch (for servicing purposes). The latter switch should be set to NORMAL (inboard) for flight conditions. In flight none of these is visible or accessible.

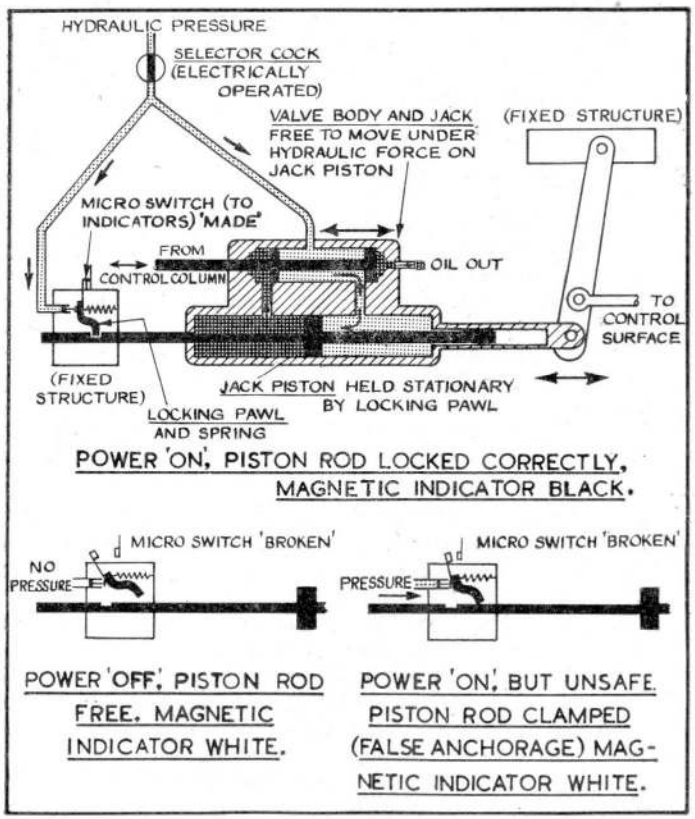
(iv) To test the standby inverter, first check that the engine master switch is OFF and then set the battery master switch ON, the inverter test switch to NORMAL (inboard) the inverter circuit-breakers in and then move the RADAR TEST switch (8) to TEST. The inverter can then be heard to operate and the artificial horizon can be seen to erect. When the test is complete return the radar test switch to OFF.

POWERED FLYING CONTROLS AND TRIMMERS

17. Flying controls operation

(a) *In Power*

The ailerons and elevator are power-operated, the power being supplied by hydraulic oil under pressure from the aircraft hydraulic system. A hydrobooster consisting of a valve and jack body and a piston rod is fitted close to each control surface. The control column is connected direct to the valve control rod so that depending on the direction of movement of the control column, the valve opens to admit pressure oil to one side of the jack piston and at the same time the other side is opened to return. The piston rod is anchored to the aircraft structure (ailerons and full power elevator) or to the control circuit (power-assisted elevator) by means of a spring-loaded hydraulically-operated pawl. The jack body is directly connected to one end of the control surface. When the pawl is in position and hydraulic pressure is fed from the valve to one side of the jack piston, the jack body moves relative to the piston and deflects the control surface. When control column movement ceases, the valve closes causing a hydraulic lock which prohibits further movement of the jack body and control surface.



TYPICAL HYDROBOOSTER

(b) *In Manual*

(i) Manual operation of the controls may be selected deliberately by operating a switch in the cockpit (see para. 18) provided that electrical power is available, or will happen automatically if hydraulic pressure drops below 200 lb./sq. in.

(ii) When operating in Manual, control surface movements are achieved through a mechanical linkage. The spring-loaded hydraulically-operated pawls automatically disengage and release the anchored jack piston rods, allowing them and the jack bodies to move freely with the control surfaces. The controls are heavy in Manual, especially the ailerons,

but to avoid excessively high stick forces the spring-loaded hydraulically-operated pawls automatically disengage and release the anchored jack piston rod, allowing it to slide freely with the movement of the jack body.

(c) *Hydraulic power reserve*

Accumulators are fitted in the powered control circuits to provide a reserve of power if the main hydraulic supply fails. This reserve may be sufficient for a maximum of 3 complete cycles of aileron and elevator operation before the controls revert automatically to Manual, but even if no control movement is made, accumulator pressure will not be maintained for a long period due to seepage through the hydraulic components. With some types of hydraulic failure immediate reversion to Manual will result.

18. Controls and indicators

(a) *Pre-mod. 452*

Two ON/OFF switches (43) are on the instrument panel and control electrically the hydraulic cocks, one for the aileron circuit and the other for the elevator circuit. When the engine is running and a switch is selected ON hydraulic pressure is fed to that circuit and to the pawl which engages in the jack piston rod.

(b) *Post-mod. 452*

When mod. 452 is embodied a revised wiring and switching arrangement is applied to the aileron and elevator pawl release units so that Manual is automatically selected if any pawl disengages, even though momentarily. The aircraft can therefore be flown only with Power correctly engaged or in Manual. The two ON/OFF switches of unmodified aircraft are replaced by two ganged MANUAL-off-POWER selector switches which are spring-loaded to the central (off) position. Deflection upwards to POWER isolates the fail-safe circuit to allow initial engagement or re-engagement. Deflection downwards immediately selects Manual.

(c) Two magnetic indicators (42), one for the aileron circuit and the other for the elevator, are mounted beside the switches and show black when the piston rod locking pawls are correctly engaged and white when the appropriate pawl is disengaged or incorrectly engaged, or alternatively when electric power to the indicator is not available.

(d) A hydraulic pressure gauge (35) and a red warning light are fitted in the cockpit to warn the pilot if the pump is losing pressure.

(e) *Manual emergency selector buttons* (*Mod. 502*)

When Mod. 502 is embodied two yellow and black striped pushbuttons are fitted at the bottom left-hand corner of the instrument panel to permit the emergency selection of Manual of either ailerons or elevators or both, should the aircraft electrical system have failed. When either button is pressed an electrical supply from an independent dry battery is connected to the appropriate selector cock and the associated controls then revert immediately to Manual.

NOTE.—These buttons must not be pressed if normal electrical power is available as in this event it is likely that the control circuit fuse will be blown.

19. Aileron feel and trim

(a) On the ailerons, the piston rod is anchored to the aircraft structure, the air loads are resisted entirely by the hydraulic jack effort and no load is fed back to the control column. To provide control feel, a spring is fitted in the control circuit and gives an artificial stick force which is proportional only to aileron deflection but not to airspeed. When Mod. 188 is embodied a handwheel is fitted on the left-hand side of the control column to provide spring feel adjustment and should be used to counteract any out-of-trim forces which may occur when flying in Power. A white line is inscribed on the handwheel. When the trimmer is neutral the line points forward and the trimmer engages in a spring-loaded detent. Movement from this position is through 300° either to the left or to the right thereby adjusting the zero force position of the stick. Its use when flying in Manual is not recommended because its assistance is almost negligible and unless reset to its original position when reverting to Power it reduces the likelihood of a successful re-engagement.

(b) A trim tab is fitted on the port aileron. It is only intended for use in Manual and a guard (31) is placed round the trim control to prevent its inadvertent use when in Power.

(c) *Aileron gear change* (*Mod. 457*)

(i) With Mod. 457 embodied, the control column/aileron gearing is automatically changed when a reversion to Manual control is made, so that for the same stick movement aileron travel in Manual is approximately two-thirds of that obtained in Power.

(ii) This automatic changeover is provided for by the insertion of a hydraulic jack in the aileron control linkage. When hydraulic pressure is fed to the jack (via the aileron Power selector cock) the jack extends to alter the linkage effective arm. When hydraulic pressure is lacking the jack retracts under spring pressure.

20. Elevator feel and trim

(a) (i) *Power-assisted elevator*

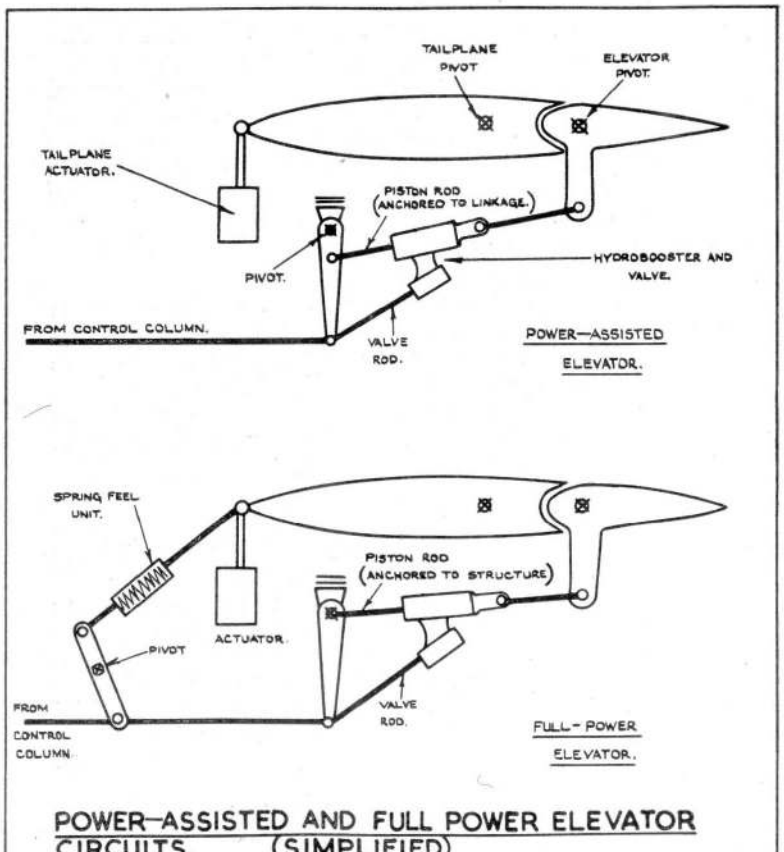
On the power-assisted elevator the piston rod is anchored to the control circuit itself, so that approximately $\frac{1}{4}$ of the air loads on the control surface are fed back to the stick, and changes of air load on the elevator will be felt by the pilot as changes of stick force, this providing a feel similar to that obtained from a normal manual control.

(ii) *Full-power elevator* (*Mod. 365*)

In aircraft fitted with the full-power elevator the feed-back previously built into the control circuit is eliminated by fixing the locking pawl to the aircraft structure and the air loads on the elevator are resisted entirely by hydraulic jack effort. To provide control feel, a spring is fitted in the control circuit between the control column and the variable-incidence tailplane. The spring gives an artificial feel to the elevator control circuit by imposing a force proportional to stick deflection but not to airspeed (i.e. air loads).

(b) (i) An electrically-operated variable-incidence tailplane is provided. It is hinged at the rear end, while a projection on the leading edge is connected to an electrically-operated actuator mounted in the dorsal fin below the tailplane. The actuator is operated by one of two electric motors, the main and the standby. The main motor is controlled by a thumb switch (60) on top of the stick and the tailplane operates in the

same way as a conventional trimming tab. After selecting by feel the required tailplane angle to give zero stick force for a given flight condition, the elevator is trailing with no air load imposed on it. The tailplane main motor circuit is protected by a circuit breaker (6) on the port shelf.



POWER-ASSISTED AND FULL POWER ELEVATOR CIRCUITS. (SIMPLIFIED)

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(ii) The standby motor, which is fitted to meet the case of failure, of the main motor, or its electrical supply, is controlled by a switch (28) under a cover on the port shelf. When the cover is raised to enable operation of the standby switch, the main motor circuit is isolated. The standby motor operates at about one-third the rate of the main motor.

(iii) The setting of the tailplane is shown on an indicator (45) on the port side of the instrument panel.

21. Engaging power controls on the ground

(a) *Pre-mod. 452*

When hydraulic and electrical power are available the power selector switches should be switched ON and the control column moved to engage the power controls locking pawls. If, as is likely, the locking pawls are not opposite their slots, they clamp on the side of the piston rods; considerable force is then required to slide the piston rods and engage the pawls in the slots. When all pawls are correctly engaged the control column can be moved freely over its full travel in all directions, and is felt to come up against positive stops at the extremes of its movement. The indicators (42) will then show black.

(b) *Post-mod. 452*

To engage Power hold the appropriate selector switch to POWER with the left hand and move the stick with the right hand, laterally when engaging aileron and fore-and-aft when engaging elevator, until the corresponding magnetic indicator goes black. The switch can then be released. To engage aileron power more easily it is advisable either to:—

(i) Select POWER with the stick held hard over to starboard and then move it to port.

or (ii) Attempt the engagement immediately after light-up before hydraulic pressure builds up.

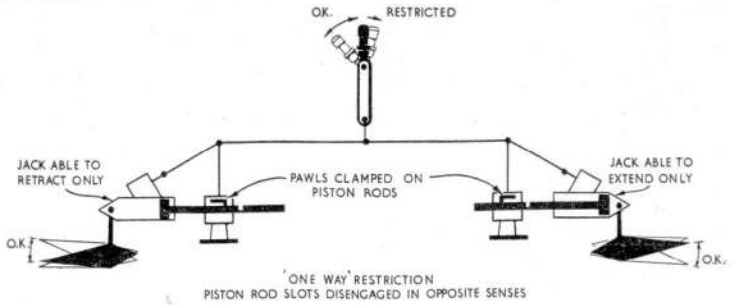
If Power has not been correctly engaged the controls will revert to Manual when the switch is released.

22. Re-engaging power controls in the air

NOTE.—The information concerning false anchorages applies mainly to aircraft without Mod. 452. When this mod. is embodied false anchorages can still occur when re-engaging Power in the air only so long as the selector switch is held at POWER.

When a reselection to Power is made in the air, it is possible that the locking pawls will not engage in the slots on the piston rods, but merely clamp on the side of the rods giving a false anchorage; the magnetic indicators remain white. False anchorages can be caused by the pistons "creeping" to full travel during a lengthy period of manual flying or when the ailerons are deflected appreciably either by the control column or by the presence of aileron up or down float when selecting Power ON or OFF. False anchorages can give two types of restriction.

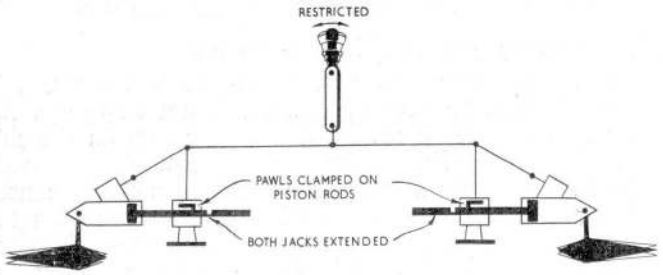
(a) *One-way restriction (See para. 86 (a))*



'ONE WAY' RESTRICTION
PISTON ROD SLOTS DISENGAGED IN OPPOSITE SENSES

This usually occurs as a result of reselecting power with the ailerons deflected, e.g. when initiating a turn. The locking pawls clamp on the side of the piston rods in opposite senses relative to the slots, e.g. one rod extended the other retracted. There will be apparent power-operated movement in one direction due to the clamping of the pawls on the rods. Movement of the control column in the other direction is restricted since power assistance is not available and not only has the friction clamp of both pawls to be overcome but the ailerons have to be deflected manually. This type of restriction can also occur as a result of having one pawl correctly engaged and one pawl out of engagement. Correct engagement of the pawls can be obtained by demanding a force greater than that which can be held by pawl friction, thus causing the piston rods to slide.

(b) *Both-ways restriction* (*See para. 86 (b)*)



'BOTH WAYS' RESTRICTION
PISTON ROD SLOTS DISENGAGED IN THE SAME SENSE

This usually occurs as a result of reselecting power ON with the ailerons floating up or down, e.g. when easing out of a dive. The pawls will grip the piston rods in the same sense relative to their slots, e.g. both rods extended or both retracted, giving complete jamming of the control column in the neutral position. Movement of the control column in either direction is restricted by the friction clamp of one pawl and the ailerons having to be deflected manually.

OTHER AIRCRAFT CONTROLS

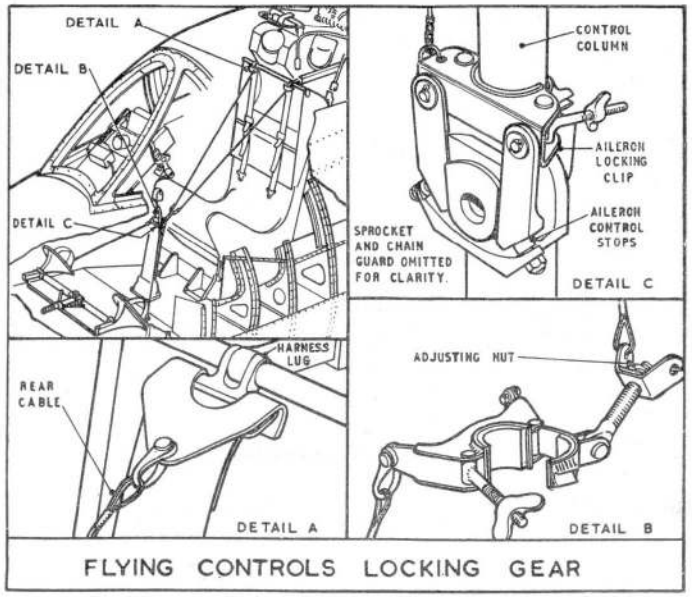
23. Rudder bar adjustment

The rudder bar is adjustable for leg reach by means of a control toggle (68) at the bottom centre of the instrument

panel. When the control is pulled out, a plunger is disengaged from a hole in the adjusting shaft, thus allowing the rudder bar arms to be pushed forward against the pressure of a spring, or to swing aft by spring pressure. When adjustment is complete, releasing the control to allow the plunger to engage in the nearest hole will fix the rudder bar in the desired position.

24. Flying controls locking gear

(a) *Internal locking*



FLYING CONTROLS LOCKING GEAR

The internal locking device consists of four cables which are joined to a clip, designed to attach to the control column. The other ends of the cables incorporate hooks which should be attached to the safety harness lugs on the ejector seat and to the outboard edges of the rudder pedals. When fitting the cables the rudder pedals should be in the central position and the cables tensioned by movement of the seat backrest pan.

(b) *External locking*
Locking clamps are provided for all flying control surfaces.

25. **Trimming tab controls**

The rudder and port aileron incorporate electrically-operated trimming tabs. A combined aileron and rudder trim control (31) is situated on the port shelf with a combined tab position indicator (30) just forward of it. The aileron trim tab must be set to neutral before take-off and must remain so at all times when power is engaged. A locking guard is provided to prevent inadvertent operation of the aileron trim when in Power. It must be engaged at all times when flying with ailerons in Power.

26. **Undercarriage control and position indicator**

(a) The tricycle undercarriage is operated hydraulically after electrical selection by either the UP or DOWN push-button (39), on the port side of the instrument panel.

(b) A standard position indicator (37) is fitted to the left of the pushbuttons. A warning light (36) below the push-buttons comes on if, with the undercarriage NOT locked up, the throttle is closed. AL.1

27. **Undercarriage emergency operation**

(a) Should electrical or hydraulic failure occur, the undercarriage may be lowered irrespective of the setting of the normal selectors by pulling the U/C emergency release (25), on the port shelf, while holding in the central knob. This admits air from an emergency bottle direct to the lowering jacks, forcing them to lower and lock. The available air pressure is shown on a gauge (9) at the rear end of the port shelf.

(b) If it is required to retract the undercarriage on the *ground only* the UP selector pushbutton should be twisted clockwise and then pressed. This is inoperative if the undercarriage emergency system has been used.

28. **Flaps control and position indicator**

(a) The flaps are selected electrically and operated hydraulically. Selection is by means of a switch (40), on the port side of the instrument panel, which provides UP, DOWN (80°) and six intermediate positions (15°, 23°, 30°, 38°, 45°, 60°).

(b) The flaps may be selected to any position but the extent to which they will lower depends upon the air loads. If speed is increased with the flaps extended, the angle will be adjusted to suit the air loads. (But see paras 55 (b) and 67 (d)).

(c) A flap position indicator is fitted adjacent to the selector switch.

29. **Flaps emergency operation**

Should electrical or hydraulic failure occur, the flaps may be lowered fully down only irrespective of the setting of the normal selector by pulling the emergency release (41), on the instrument panel, while holding in the central knob. This admits air from an emergency air bottle direct to the lowering jacks. The available air pressure is shown on a gauge (10) at the rear end of the port shelf.

30. **Airbrake control**

(a) An under-fuselage airbrake is provided. It is electrically selected and hydraulically operated and will extend fully at any speed.

(b) Control of the airbrake is by means of a three-position switch (20), spring-loaded to the central off position, on the throttle lever. No position other than fully in or fully out can be selected. A magnetic indicator (38) on the instrument panel shows black only when the airbrake is fully in.

(c) The airbrake is automatically inoperative when the undercarriage is lowered. If the undercarriage is lowered

when the airbrake is out, the airbrake will automatically retract. *Airbrake IN must not normally be obtained by selecting undercarriage DOWN.*

(d) A spring-loaded switch (14) on the port wall enables the airbrake to be tested on the ground. When the switch is held to TEST, the airbrake extends through 10° only and then retracts with a slight bump. The indicator shows white momentarily while the airbrake is out.

31. **Wheel brakes control**

(a) The wheel brakes are operated hydraulically by means of a lever attached to the forward face of the control column and a differential relay controlled by the rudder bar.

(b) The main hydraulic pressure (3,000 ± 150 lb./sq. in.) is shown on the triple pressure gauge (35) together with the pressure at each main wheel (1,500—1,650 lb./sq. in.).

(c) Should the hydraulic system fail, the pressure in the wheel brakes accumulators will be sufficient for landing but will leave little in hand for subsequent taxying. The available accumulator pressure is shown on a gauge (11) at the aft end of the port shelf.

(d) (i) Maxaret brake units are fitted and permit the use of full braking when essential without the danger of wheel locking and tyre damage. The units come into operation only if the wheels are rotating and in no circumstances should the brakes be applied before touchdown.

(ii) Should hydraulic pump failure occur, the brakes accumulators, if fully charged, should provide sufficient pressure for about 40 operations of the units. The brakes will remain effective until accumulator pressure drops to 750 lb./sq. in.

32. **Electrically-operated flight instruments**

(a) The turn and slip indicator is operated by D.C. whenever electrical supply is available. If electrical supply is lacking, the word OFF appears in the face of the instrument.

(b) The Mk. 3B or Mk. 4 artificial horizon is operated by A.C. (see para 16 (b)). In the Mk. 4 artificial horizon is incorporated a power failure indicator that shows the word OFF when electrical supply is lacking. If the fast erection button (47) is used before flight to erect the horizon, it must not be kept depressed after satisfactory erection is achieved. In flight the button should only be used in unaccelerated level flight.

(c) The Mk. 4F compass is also operated by A.C. (See para 16 (b)). A test panel (86) is fitted at the rear end of the starboard shelf.

COCKPIT EQUIPMENT

33. **Entry to aircraft**

(a) Access to the cockpit is normally gained via a special ladder, supplied as ground equipment.

(b) A single emergency footstep is located in the port side of the fuselage, below the cockpit.

34. **Hood operation**

(a) The hood is opened or closed electrically after selection by a three-positioned OPEN-OFF-SHUT switch (22) on the port wall. The hood may be stopped at any position by selecting OFF but in flight the switch must be SHUT, otherwise partial depressurization may occur. There is a delay of about 5 seconds between selection and operation when the switch is set to OPEN. Above the switch is a clutch lever which when set to FREE declutches the actuator, locks the switch at OFF and enables the hood to be moved by hand. A circuit breaker (7) for the hood motor is fitted at the rear end of the port shelf.

(b) The hood seal is automatically inflated when the hood is fully closed, and deflated when either OPEN is selected or the clutch release is set to FREE.

(c) Four pointers (15) are provided, one at each end of the hood rails. Alignment of the pointers with their associated spigots indicates that the hood rails are locked and are safe for flight.

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35. Hood jettisoning

(a) *Pre-mod.* 281
The hood may be jettisoned mechanically by pulling the handle (34) on the port shelf. This action also operates a micro switch which, if electrical power is available, automatically lowers the gunsight.

(b) *Post-mod.* 281
The hood is jettisoned by gas pressure from a jettison gun acting on two pistons which release the hood rails and then push the hood upwards. This action may be initiated by pulling the hood jettison handle or will occur when either ejection seat handle is pulled. In the former case the G.G.S. is automatically lowered if electrical power is available, but in the latter case it will be necessary first to lower the G.G.S. manually.

(c) *External emergency release*
An external emergency release ring is inside a break panel on the port side of the fuselage. When the release ring is pulled the hood rails are released; in the case of aircraft fitted with Mod. 281 the jettison gun is not fired. The hood may then be lifted clear manually.

36. Cockpit pressurization, heating and demisting

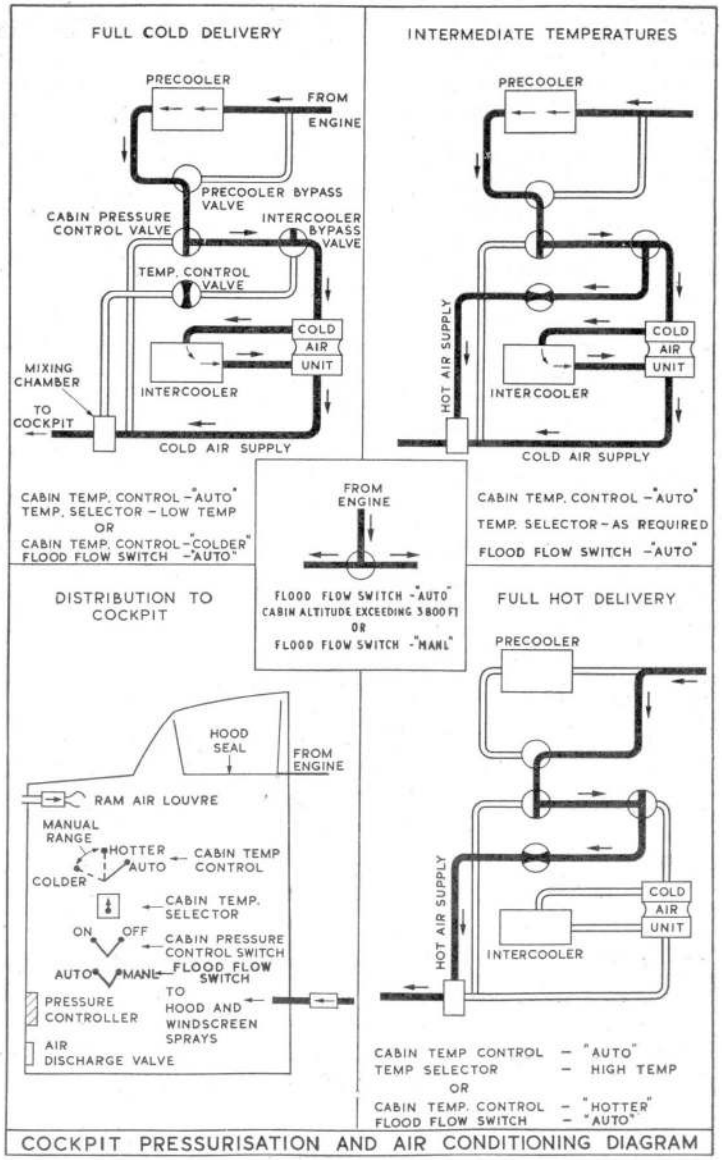
NOTE.—The system is inoperative whenever the hood is open.

(a) Hot air under pressure is bled from the engine compressor to supply the heating, pressurization and demisting system. The air supply to the cockpit terminates in spray pipes which provide for windscreen side panels and hood demisting.

(b) The master ON/OFF switch (3) controls the flow to the cockpit. The temperature control lever (2) permits the selection of AUTO or manual HOTTER-COLDER. The temperature selector (1) is for use in AUTO to pre-select the desired temperature, which is then maintained by a thermostat. In the manual range, temperature is controlled by first setting the lever to HOTTER or COLDER and then, when the desired temperature is reached, engaging the lever in the central gate.

(c) The cockpit altimeter (55) should indicate in accordance with the following table. Should the cockpit pressure drop below a pre-determined minimum, a red light (56) on the right of the instrument panel comes on.

Actual altitude	Cockpit altitude	Cockpit altitude at which warning light comes on
20,000 ft.	13,000 ft.	13,750 ft.
30,000 ft.	16,500 ft.	18,000 ft.
40,000 ft.	22,500 ft.	24,000 ft.



COCKPIT PRESSURISATION AND AIR CONDITIONING DIAGRAM

(d) (i) A "flood flow" valve is incorporated in the system, which may be controlled in AUTO or MANL according to the setting of the FLOOD AIR FLOW control switch (4).

(ii) When the switch is set to MANUAL, "flood flow" is brought into operation and is used primarily for clearing any transparency misting.

(iii) When the switch is at AUTO, should loss of cockpit pressure cause the cockpit altitude to exceed 38,000 ft., an altitude switch operates to supply "flood" air to the cockpit. In addition, an audio warning is transmitted over the pilot's head set. This warning may be silenced by the operation of the switch (59) on the instrument panel. When Mod. 327 is incorporated, the audio warning is connected to the hydraulic system and its use here is discontinued.

(iv) A switch (5) for *ground testing* the aural and visual warning circuits and flood air supply is to the rear of the normal controls. It must not be used in flight.

37. Windscreen de-icing system

The system consists of a tank containing the fluid, an electrical pump, a spray unit forward of the windscreen and an ON/OFF control switch (51) on the starboard coaming. When the switch is ON the pump operates to force de-icing fluid to the spray unit. When Mod. 581 is incorporated the system is deleted.

38. Anti-G suit system

(a) The purpose of the system is to provide air at low pressure for the pilot's anti-G suit, the connection for which is on the port side of the ejection seat.

(b) Air under pressure is stored in two air bottles, the contents of which are indicated by a pressure gauge (82) on the starboard wall. When the cock (80) below the

gauge is ON and G in excess of approximately $1\frac{1}{2}$ is applied, a spring-loaded valve operates and allows air to pass to and inflate the anti-G suit. The amount of inflation depends on the amount of G applied.

(c) The system may be tested, with the cock ON, by pressing the ANTI-G TEST button (81) adjacent to the on/off cock, as gently as possible to avoid severe discomfort due to too rapid inflation.

39. Ejection seat—Mk. 2H

(a) A Mk. 2H pilot ejection seat is fitted incorporating a type ZF harness, headrest, footrests, parachute container and a seat well for the dinghy and emergency oxygen supply.

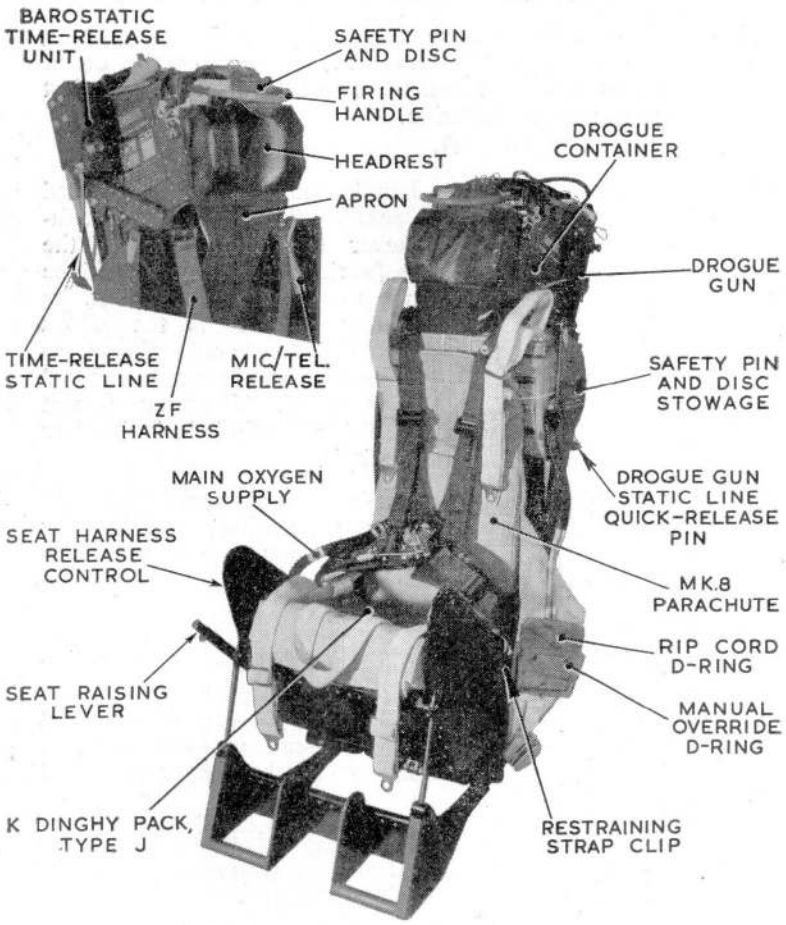
(b) The height may be adjusted by a lever on the starboard side of the seat; the harness release is also on the starboard side.

(c) The ejection gun is fired by pulling the handle above the headrest. When Martin Baker Mod. 423 (which supersedes Mod. 273) or Martin Baker Mod. 488 (on aircraft embodying Hunter Mod. 281, see (h) below) is embodied a secondary firing handle is fitted to the forward edge of the seat pan. This handle is intended for use when ejecting under positive G conditions. When either handle is pulled the ejection gun is fired and ejection follows. A stowage for the secondary firing handle safety pin may be provided on the outer face of the starboard thigh guard.

(d) All leads incorporate quick releases which are automatically broken on ejection.

(e) After ejection, at heights of 10,000 ft. and below, a barostat causes an automatic cycle to commence. After 3 seconds the safety harness is released as are the face screen, firing handle and headrest pad. An apron attached to the seat drogue then pitches the pilot head first out of the seat, at the same time opening his parachute.

(f) A manual override D-ring is fitted over the rip-cord D-ring and should be operated to isolate the automatic device if the system has failed.



EJECTION SEAT MK 2H.

(g) (i) When Martin Baker Mod. 272 is embodied the foot-rests are removed and leg restraining cords are fitted in lieu; the thigh guards are retained.

(ii) The leg restraining cords ensure that the occupant's legs are drawn back automatically and restrained close to the seat pan during ejection, thus providing leg clearance and preventing the legs being blown apart after ejection. The cords should be fitted as follows:—

1. Secure the leg straps below the knees with the D-rings to the rear.

2. Pass the left nylon cord through the right-leg D-ring under the safety harness lap straps and insert the right shoulder harness eye-piece through the loop on the cord. Secure the shoulder harness in the quick release box.

3. Repeat for the other cord, passing the right cord through the left-leg D-ring and attach the loop to the left shoulder harness. Secure the harness.

(iii) The restraining cords are fastened to the floor in brackets, the rivets of which shear at 400 lb. force. The cords pass through snubbing units at the front of the seat pan. These units allow the cords to pass freely *down* through the unit, but prevent them passing *upwards*. Thus on ejection the cords are pulled downwards through the units pulling the legs close to the seat pan. The legs are held there until the safety harness is released. The cords are then pulled through the calf-strap D-rings and free the legs. A release button is provided under each snubbing unit to allow the occupant to adjust the cords to give comfortable leg movement in the aircraft.

(h) *Single lever ejection* (*Mod.* 281)

With Mod. 281 embodied, when either ejection seat firing handle is pulled the hood is jettisoned immediately by gas pressure from a hood jettison cartridge; at the same time a delay unit at the back of the headrest is started. This unit withdraws the sear from the seat one second after the handle is pulled. The seat is then ejected.

40. **Oxygen system**

(a) Oxygen is carried in two Mk. 5D cylinders. A Mk. 17 demand regulator controls the supply to the pilot.

(b) A contents gauge (57) is mounted on the right of the instrument panel. The regulator (74) is at the forward end of the starboard shelf. The regulator consists of an ON/OFF valve which controls the flow of oxygen, an air inlet NORMAL-100% OXYGEN switch, an emergency three-position switch and a combined flow and blinker unit.

(c) When the ON/OFF valve is on and the inlet switch is at NORMAL, an air/oxygen mixture is fed to the pilot's mask up to a height at which 100% oxygen is automatically delivered. When the inlet switch is at 100% OXYGEN, no air is added irrespective of the height. This position should be selected if any symptoms of anoxia or fumes are present. The emergency switch, when moved to either right or left, admits oxygen under greater pressure. Normally it should be central, but should be offset if cabin pressure failure occurs.

(d) The mask may be tested before flight by firmly pressing in the emergency switch, when in the central position. Oxygen is then supplied under pressure, the firmer the switch is pressed the greater the pressure (up to 5 times that obtained with the switch in either side position). The mask can then be adjusted until no leaks are present.

(e) *Emergency system*

A manual control (69) inboard of the starboard shelf is pulled up to turn on the emergency bottle, provided the safety pin on the bottle is withdrawn. Operation of the emergency system is automatic on use of the ejection seat.

41. **Internal lighting**

Three ON/OFF dimmer switches (77) are provided on the starboard wall for the control of the internal lighting. An emergency lamp switch (76) is on the starboard wall above the oxygen regulator.

42. **External lighting**

The navigation lights are controlled by an on/off switch (70) on the starboard shelf.

43. **Accelerometer**

The accelerometer (44) indicates all normal accelerations imposed on the aircraft by means of three concentrically mounted pointers. One pointer indicates instantaneous G, the other two register the maximum positive and negative G readings respectively until reset.

44. **Pressure head heater**

The heater element in the pressure head is controlled by a switch (64) below the centre of the instrument panel.

45. **Emergency equipment**

(a) *Crowbar*

This (12) is clipped to the cockpit port wall.

(b) *E.2 compass*

This (50) is mounted below and to the right of the GGS. Deviations of up to 12° must be expected when the GGS is in the combat position.

(c) *Aircraft destructor stowage*

Access to this is gained through a quick-release panel on the fuselage port side, level with the cockpit.

OPERATIONAL CONTROLS

46. **Gyro gunsight Mk. 5**

(a) The GGS is housed in a retractable mounting above the instrument panel. Retraction is controlled by an electric motor in circuit with the GGS on/off switch (48) on the right of the sight. An emergency lowering manual control (46) is on the left of the sight.

(b) The sight automatically provides for both manual and radar ranging. Altitude and ballistics units automatically compensate for the time of flight and gravity drop of the particular ammunition in use. The altitude unit is fully automatic but the ballistics unit must be pre-set for the particular ammunition before flight.

(c) The selector-dimmer control (26) on the port shelf contains a dimmer switch and a 5-position selector switch. The five positions are:—

G (gyro)	Moving graticule only is visible
F and G (fixed and gyro)	Both graticules are visible
F (fixed)	Fixed graticule only is visible. The sight may only be used as a reflector sight. Radar ranging not possible.
MRP (Medium RP) / SRP (Steep RP)	The sight is set for use with RP's.

47. **Radar ranging (ARI. 5820)**

(a) The radar ranging ON/OFF switch (27) is on the forward end of the port shelf. An adjacent magnetic indicator shows white when radar ranging is in use and black when its use is discontinued.

(b) Radar ranging automatically provides the GGS with target range information within the limits of 200-800 yards. The radar searches from maximum range down to minimum range until a target is found. If no target is found within the search area the search is automatically repeated. When a target is found the radar locks on to it, and a blue light (49) on the right of the GGS lights up to indicate this.

(c) A spring-loaded TARGET REJECT IN-OUT switch (24) is on the port wall. Its function is to unlock the radar from an unwanted target or to check that it is locked on to the correct target.

When IN is selected, the radar unlocks from the target and searches inwards to minimum range. If no fresh target is found the normal search cycle commences whether the switch is retained at IN or not. When OUT is selected the radar unlocks from the target and searches outwards to maximum range. It will remain at maximum range if the switch is retained at OUT, but when released the normal search cycle is commenced.

(d) To check that the radar is locked on the correct target set the span knob of the GGS to that of the target type. If the correct target is being ranged the GGS graticule should just encompass the target span. If the target span extends beyond the graticule (over ranging) or does not extend to the graticule (under ranging), the wrong target is being ranged and REJECT IN or REJECT OUT respectively should be selected.

NOTE.—1. When the manual twist-grip is set at a shorter range than that of the target, the radar cannot control the graticule until the target comes within the range set by the twist-grip, when the radar takes over the ranging.

2. When the twist-grip is set to minimum range, the radar is overridden. This is to enable the pilot partially to cage the GGS gyro during violent manœuvres.

3. When the desired target is near the ground (below 5,000 ft.) and the radar has locked on to the ground it is better to select REJECT IN than REJECT OUT to lock on to the target.

48. **VHF equipment**

(a) *ARI. 18064*

The two 10-channel VHF controllers (16), with an adjacent changeover switch (17), are on the port shelf. A press-to-transmit switch (19) is in the end of the throttle lever handle. The sets are stowed in the radio bay.

(b) *ARI. 18012*

The telebriefing land-line plug is at the underside of the rear fuselage, forward of the tail bumper. When the plug is connected the VHF circuit is de-energized and an amber warning light (23) on the port shelf indicates that telebriefing is in use. The pilot's press-to-speak button is adjacent.

(c) *ARI. 18044*

The control switches (21) are on the port wall. The indicator is positioned at (54).

49. IFF Mk. 3 GR (ARI. 5131)

(a) The G, G/D, F and D switches (79) are grouped on the starboard shelf.

(b) A suppressed aerial is mounted in the leading edge of the fin.

50. DME—Rebecca Mk. 7 (ARI. 5849)

(a) The control unit (89) is on the starboard shelf. A range and heading meter (53), which indicates range and left/right heading from the homing beacon, is on the instrument panel.

(b) Two suppressed aerials are fitted, one in the engine starter door and one in the engine access door.

51. G45 and recorder cameras

(a) The cine and recorder cameras are operated automatically whenever the gun or camera firing switch on the control column is energized, with the camera master switch ON.

(b) The camera master switch (65) is on the switch panel below the instrument panel. The aperture switch (58) is on the starboard side of the instrument panel.

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52. Gun firing

(a) The gun firing switch is on the forward face of the control column handgrip. The circuit is automatically isolated when the undercarriage is locked down. A butt test switch (88) is mounted on the starboard shelf and provides an override of the automatic isolation of the gun firing circuit.

(b) When the gun firing safety flap is raised an A.C. inverter is started up to provide electrical power for firing the guns.

(c) When the guns are fired, an electrically-operated selector is energized to open the gun bay scavenging flap. This causes air to clear the gases from the gun bay through the link and empty case chutes. When the trigger is released the scoop closes and the air flow is cut off.

53. Bomb release and drop tank jettisoning

(a) *Bomb release and jettison*

(i) The armament control panel (33) is on the port shelf. When the FUSING switch is set to NOSE or TAIL (as required), the BOMBS/RP switch set to BOMBS and the NORMAL/PRACTICE switch set as required, the bombs are released by pressing the bomb release pushbutton on top of the control column.

(ii) The bombs may be jettisoned in a safe condition by pressing the CLEAR A/C switch. (See (c) below.)

(b) *Drop tank jettisoning*

When the bomb fusing switch is set OFF, both inboard drop tanks are jettisoned by pressing the bombs release pushbutton.

(c) *'Clear aircraft' switch*

When the bomb fusing switch is OFF, all stores, drop tanks or bombs, carried on the pylons are simultaneously jettisoned by pressing the CLEAR A/C switch (50), on the left on the GGS.