

SECTION 9

HYDRAULIC AND PNEUMATIC SYSTEMS

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HYDRAULIC SYSTEM

1. The Lockheed high-pressure hydraulic system operates the alighting gear, flaps and dive-brakes. A diagram of the system is given in fig. 1 of this Section, and four illustrations and the functional tests for the three circuits are given in Sect. 4, Chap. 3. Only the general principles of the system are described in the following paragraphs; details of the various hydraulic components will be found in A.P.1803B, Vol. 1.

RESERVOIR

2. The reservoir, containing fluid as specified in the Leading Particulars, is divided into two unequal compartments by a baffle plate, the upper part of which is perforated. The engine-driven pump receives its supply of fluid from the bottom of the larger compartment, while the hand-pump supply is from the smaller compartment. The fluid returning from the system enters the smaller compartment and, when this is full, passes through the holes in the baffle to the larger compartment. Consequently, a reserve of fluid is always available for the operation of the hand-pump. The instructions for filling the reservoir are given in Sect. 4, Chap. 2.

POWER CIRCUIT

3. An engine-driven pump supplies fluid under pressure to the selector valves, through an automatic cut-out valve and a hydraulic accumulator, at a pressure of 2,500 lb./sq. in. The accumulator is initially charged with air at a pressure of 1,250 lb./sq. in.; this air is further compressed by the pressure of fluid from the hydraulic pump acting upon a separator piston within the accumulator. It is thus possible to store a sufficient quantity of fluid at the required pressure to operate the services fully. Before dismantling any of the hydraulic components or disconnecting any of the pipes, it is necessary to release the pressure from the accumulator by manually operating the release valve situated adjacent to the selector valves. Two coupling points, located on the fire-wall, permit the use of a rig for ground test purposes.

EMERGENCY (HAND-PUMP) CIRCUIT

4. In the event of failure of the engine pump circuit, the flaps and alighting gear may be lowered by setting the respective selector levers to DOWN, and operating the

hand-pump. A manually-operated non-return valve, incorporated in the delivery line from the hand-pump, prevents pressure being applied to the dive-brake selector valve. When the non-return valve is manually overridden for ground test purposes, the dive-brakes can be operated by the hand-pump after the accumulator has been charged to the required pressure.

AUTOMATIC CUT-OUT AND RELIEF VALVE

5. Interposed between the engine-driven pump and the accumulator is an automatic cut-out valve. The purpose of this valve is to regulate the pressure of fluid delivered to the accumulator at 2,500 lb./sq. in. When this pressure has been attained, the accumulator is fully charged and the valve automatically closes, thereby directing the fluid from the pump back to the reservoir. A thermal relief valve which opens at 3,000 lb./sq. in., is also included in the system. This valve is a safeguard against excessive pressure being built up in the accumulator due to variations in atmospheric temperature, or against failure of the automatic cut-out.

SELECTOR VALVES

6. The three selector valves, which are mounted together on the aft face of bulk-head No. 2 at the lower port side, are operated by push rods from their respective levers on the control box. A special non-return valve is interposed on the pressure line between the alighting gear and the flap

selector valves. The flap selector valve is designed to include a neutral setting on the quadrant; the alighting gear and dive-brake selectors have two positions only.

ALIGHTING GEAR CIRCUIT

7. The alighting-gear jacks are controlled by the outboard of the three selector valves which has two settings; UP and DOWN. The circuit includes three hydraulic jacks, one for each main undercarriage leg and one for the nose wheel. The main undercarriage jacks are contracted and the nose wheel jack extended for alighting gear DOWN. The adjustment procedure for the jacks is given in Sect. 4, Chap. 3.

FLAP CIRCUIT

8. The flap circuit is controlled by the centre of the three selector valves. Each pair of flaps is operated by a single jack which is extended for flaps *down*. The flap selector lever is provided with the following three positions on the quadrant—FLAPS UP—NEUTRAL—*down*. The selector lever is returned manually to NEUTRAL when it is desired to set the flaps in any intermediate position suitable for take-off and in this position, the fluid passes to both sides of the jack ram.

DIVE-BRAKE CIRCUIT

9. Two settings only are provided by the dive-brake selector valve: OFF and ON. The dive-brakes cannot be operated by the hand-pump in the air (*para. 4*).

PNEUMATIC SYSTEM

10. The pneumatic system is used solely for providing pressure for operating the wheel brakes. A diagrammatic arrangement of the system is shown in fig. 2, and the pipe layout, together with details of the pneumatic panel, are illustrated in Sect. 4, Chap. 3. The servicing instructions for the brake differential unit and the pneumatic brakes are contained in A.P.2337, and instructions regarding the pneumatic components in A.P.1519.

SUPPLY SYSTEM

11. An engine-driven Hymatic compressor, mounted on the port top side of the engine wheel-case, supplies air to a reservoir at a pressure controlled by an air regulator. The reservoir may also be charged on the ground from a compressed air bottle, a

connection for which is provided on the pneumatic panel on the rear face of bulk-head No. 2. A relief valve is interposed in the pressure line, between the compressor and the oil-and-water trap, to safeguard the system in the event of failure of the air regulator. Access to the pneumatic panel is obtained by opening the gun-bay doors.

RESERVOIR

12. The reservoir, located immediately forward of the pneumatic panel, comprises a cylindrical shell with hemispherical ends. Integral with each end is a threaded adapter; from the forward end, pipes are led from a T-piece connection to the pressure regulator and filter; the pipe connection from the aft end leads directly to the brake pressure gauge in the cockpit.

OIL-AND-WATER TRAP

13. The oil-and-water trap, mounted on the pneumatic panel, is inserted in the pipe-line between the compressor and the pressure regulator and prevents oil or condensation reaching the regulator and air bottle. If there is air pressure available in the system, a turn of one flat of the hexagon nut at the base of the trap will allow the oil and water to drain away, and will be indicated by a noticeable rush of air. If there is no pressure, the nut and valve must be removed completely.

PRESSURE REGULATOR

14. The pressure regulator, situated on the starboard side of the reservoir, is interposed in the line from the oil-and-water trap to the reservoir. The output of the compressor is controlled by this regulator, which diverts the outlet of the compressor to atmosphere when the pressure in the reservoir exceeds 450 lb./sq. in.

FILTER

15. The air filter, located immediately behind the pneumatic panel, is connected to the system between the output side of the reservoir and a pressure-reducing valve. The purpose of the filter is to prevent any condensation from the air reservoir reaching the reducing valve or brake differential unit. The filter element is a thick felt pad sandwiched between perforated metal discs. The inlet pipe is connected to the side of the unit, and the outlet pipe to the top

cover, while the square-headed bolt, at the base of the filter, is for drainage purposes when the system is under pressure. The air filter should be drained at minor servicing operations.

PRESSURE-REDUCING VALVE

16. The pressure-reducing valve, located on the pneumatic panel, is a pressure-balanced valve interposed between the air filter and the brake control unit. The screwed inlet and outlet connections of the valve are marked to ensure correct assembly. Its purpose is to reduce the pressure from 450 lb./sq. in. to 200 lb./sq. in. for delivery to the brake differential unit. The adjusting screw which is wire-locked and sealed, should not be disturbed. A pressure relief valve, integral with the valve body, is set to 200 lb./sq. in. to safeguard the remainder of the system in the event of failure of the reducing valve.

BRAKE DIFFERENTIAL UNIT

17. The differential unit is mounted immediately forward of the lower central instrument panel, and access to the unit is gained by opening the armour plate door in No. 1 bulkhead. The rudder pedal layshaft and the brake lever on the control column are directly connected with the differential unit by a linkage and a Bowden cable respectively. The pressure applied to each brake should be as specified in the Leading Particulars when the rudder pedals are neutral.

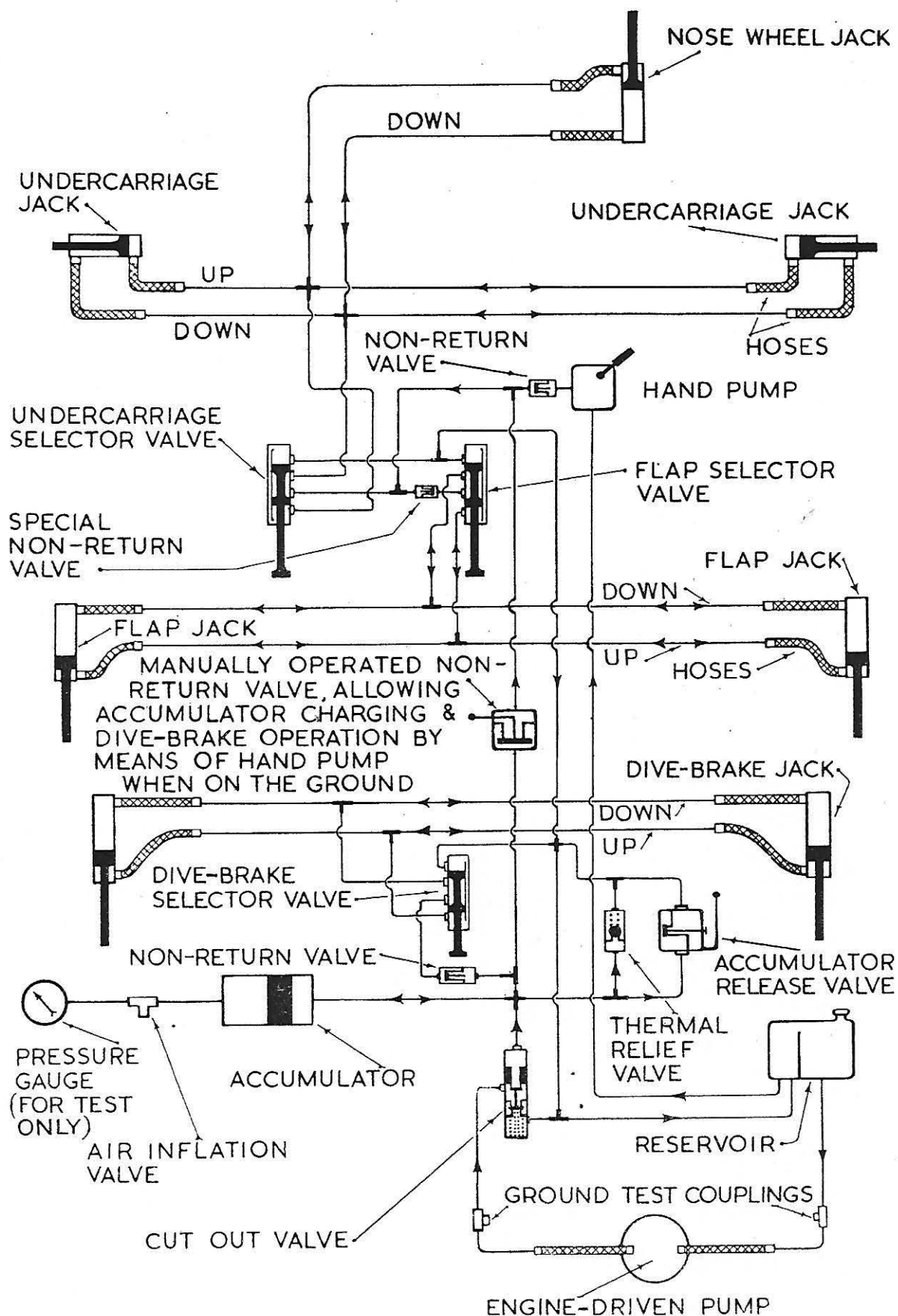


FIG. 1 HYDRAULIC SYSTEM DIAGRAM

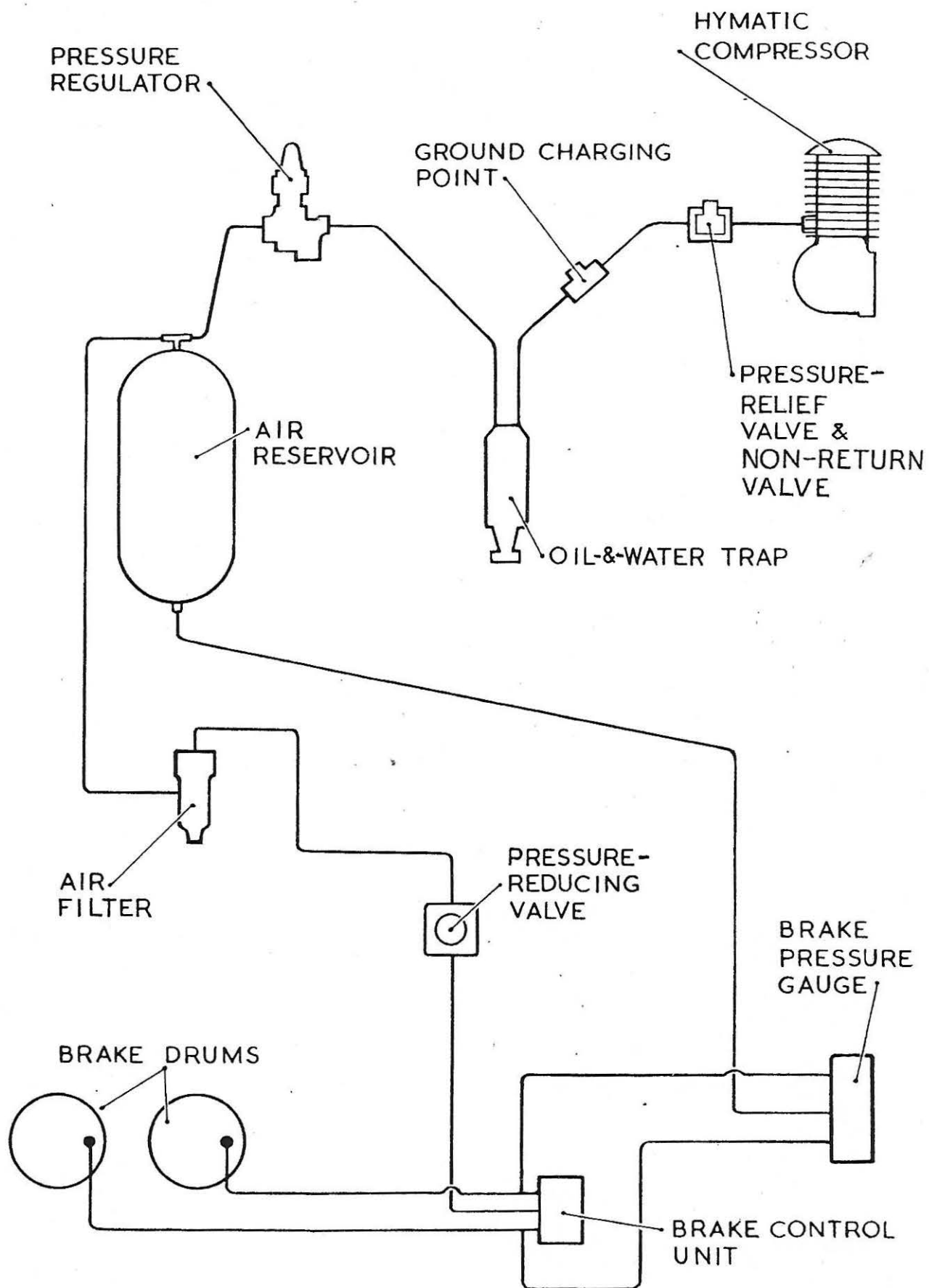


FIG. 2 PNEUMATIC SYSTEM DIAGRAM

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