

HYDRAULIC GROUND EQUIPMENT

List of Contents

	Para.		Para.
Introduction	1	Bipod Jacks	26
PILLAR HYDRAULIC JACKS		Four-Legged Jacks	27
General	3	HYDRAULIC SERVICING	
Hydraulic System	5	TROLLEY Mk. 1	
Air Locks	7	Introduction	28
Precautions	8	Engine	32
Care	10	Control Box	33
4 Ton Pillar Hydraulic Jack	13	Oil Filter	36
TRIPOD, BIPOD AND		Oil Tank	37
FOUR-LEGGED JACKS		Hydraulic Circuits	38
Introduction	22	Operating Instructions	42
Tripod Jacks	23	Starting the Engine	46

List of Illustrations

	Fig.		Fig.
4 Ton Pillar Hydraulic Jack	1	Engine	7
Construction of Jack	2	Control Box	8
Tripod Jack	3	Oil Filter	9
Bipod Jack	4	Open or Priming Circuit	10
Four-Legged Jack	5	Closed or Testing Circuit	11
Hydraulic Servicing Trolley Mk. 1	6	Square Section Spring	12

Introduction

1. The principles of hydraulics have been dealt with in Section 1, Chapter 10 of this publication, and the purpose of this chapter is to deal with some of the applications of these principles to ground equipment. The examples of hydraulic jacks and hydraulic servicing trolleys dealt with are given as being typical of the types forming the wide range that is available. More detailed information regarding all types can be obtained from A.P. 2817A, Vol. 1 and Vol. 6, and A.P. 2306B, Vol. 1 and Vol. 6, as appropriate.

2. Serious accidents have occurred as the result of the misuse of hydraulic equipment and/or incorrect method of operation. Consequently, personnel who are required to use such equipment should study the more

detailed information available. This will help them to understand and use the equipment to the greatest advantage and also to eliminate accidents. It is also important that the correct fluid is used or, if this is not available, an alternative fluid as quoted in the relevant A.P.

PILLAR HYDRAULIC JACKS

General

3. Hydraulically operated jacks having telescopic rams provide high lift jacking equipment for such applications as raising an aircraft's fuselage or undercarriage and for similar operations. The advantages of a jack raised by fluid pressure from a small force pump are twofold. The load is raised with the minimum of effort and is under sensitive control at all stages of raising and lowering.

(A.L. 21, Oct. 65)

4. Most of the work entails the load being sustained for varying periods according to the job in hand. Thus it is necessary for a hydraulic jack to have mechanical means of locking, otherwise seepage of fluid past the valves would cause hydraulic failure. The type of lock that is commonly used consists of a collar or sleeve surrounding the rams and placed between the body of the jack and the jack head adapter. When such a device is used the jack release valve should remain closed. To lower the jack first raise the load slightly, then release the locking device and slowly open the release valve.

Hydraulic System

5. The main features of all pillar type hydraulic jacks are similar although their construction may vary. In principle, each jack consists of single, double or triple rams assembled in the jack body. The rams are raised in their cylinders by fluid pressure from a small force pump. The plunger of the pump slides in the pump cylinder which receives and discharges the hydraulic fluid via the inlet and delivery valves.

6. Provision is made to prevent damage to the jack by overloading. This may be in the form of an overflow orifice or an overload release valve set to discharge at 25 per cent overload.

WARNING . . .

The setting of the overload release valve of any hydraulic jack must not be altered.

Air Locks

7. Attention has already been drawn to the need for the use of the correct fluid. Air-locks in hydraulic jacks are caused by lack of fluid, and they can be prevented by periodically topping-up the fluid container to the correct level. If the jack rams tend to hesitate when being raised it indicates an air-lock. It can be cleared by raising the rams, free from load, and pumping until the trapped air is expelled through the overload release valve or other overload safety device.

Precautions

8. Good foundations are essential for supporting a jack. Concrete is suitable provided that it is of sufficient thickness. When any doubt exists, strong wood packing

should be placed under the base of the jack before any lift is attempted. Because the rams of the jack are raised through a straight lifting axis, at right-angles to the base of the jack, it is essential that only a straight lift is taken when using this type of jack.

9. Before raising a load, ensure that lateral movement of the load cannot occur whilst the load is being raised. If such movement should occur when the rams are well extended, the load may slip off the jack head, the rams may bend, or the jack may fall over. It is advisable to pack the jack upwards as much as possible before raising the rams. This helps to keep the jack stable besides reducing the movement of the rams. It is stressed that strong secure packing must always be used.

Care

10. Jacks should be kept clean, the rams being cleaned before being lowered. The hydraulic fluid lubricates the rams and keeps them in a slightly oily condition. Where mechanical parts, such as levers, swivel upon fulcrum pins on the outside of the jack, periodic lubrication will prevent excessive wear of the pins and also ensure ease of operation.

11. Slight leakage of fluid from the glands can usually be stopped by screwing down the appropriate gland nuts about half a turn. Care should be taken to avoid overtightening which makes the movement of the rams or pump plunger stiff.

12. The pump operating handle must be kept with the jack. Damage to the rams can be prevented by keeping them fully retracted and the air valve and release valve closed when the jack is not in use. Only light effort should be used to close the release valve; the use of excessive force will damage the valve seating.

4 Ton Pillar Hydraulic Jack

13. This jack (Fig. 1) is a typical example of the double ram type. The operating handle also serves to regulate the release valve, which is closed by turning the handle in a clockwise direction.

14. The jack has a closed height of $8\frac{1}{2}$ inches and a lift of $9\frac{7}{8}$ inches plus a screwed extension adjustment of $3\frac{1}{4}$ inches. It can be

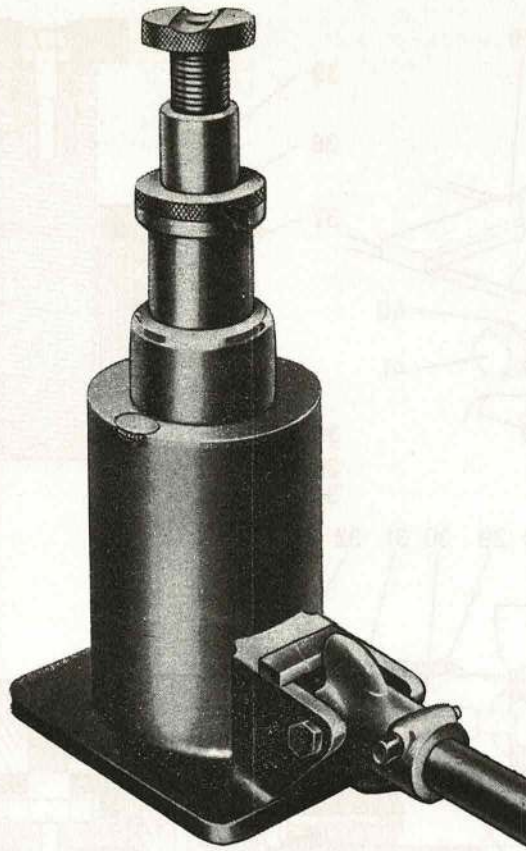


Fig. 1. 4 TON PILLAR HYDRAULIC JACK

used for general purpose jacking where the available headroom is low and the movement of the operating handle is restricted, e.g. for undercarriage and tail wheel jacking.

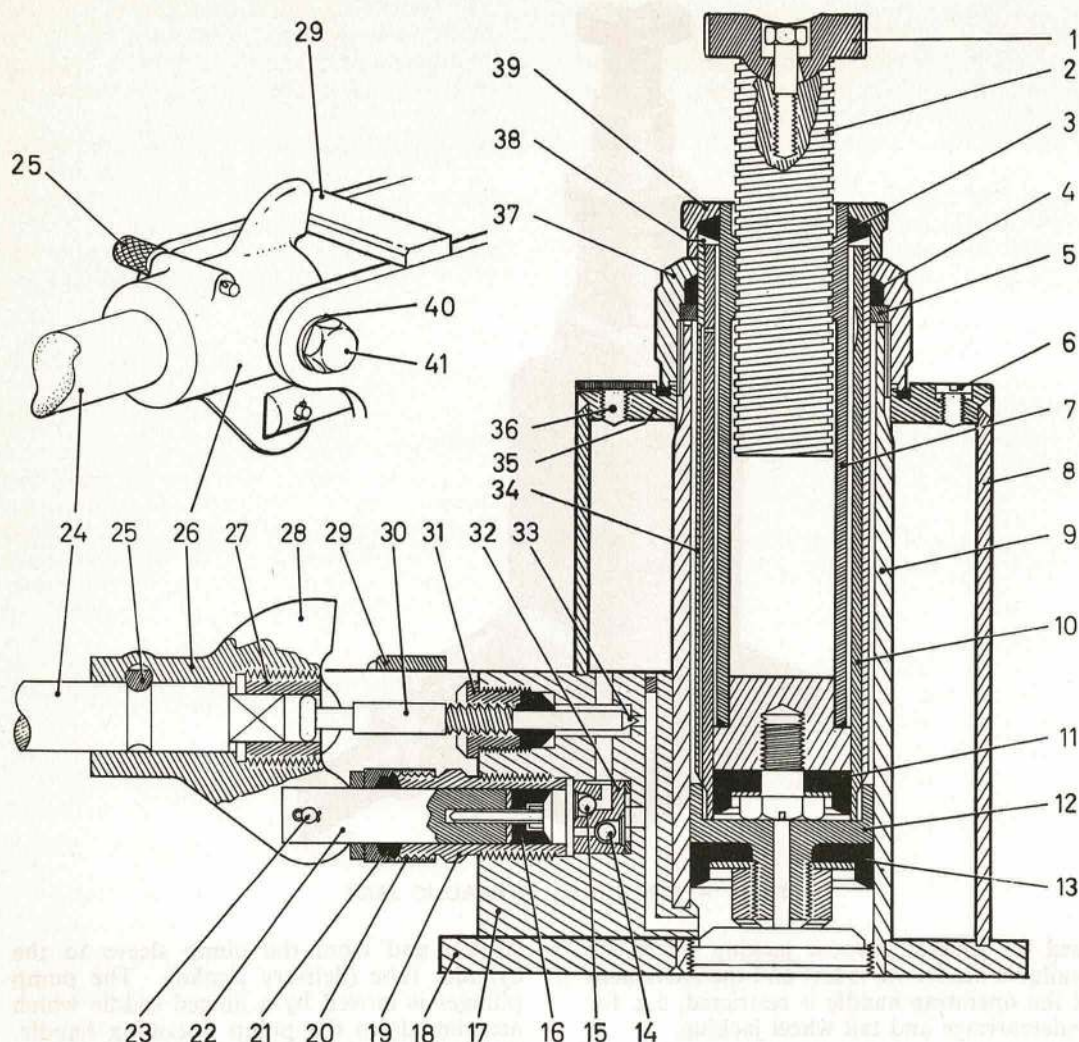
15. Alternative jack head adapters are available for use with the jack and the position of the adapter can be varied by screwing the extension into or out of the top ram. One adapter is free to swivel and is grooved to fit against an undercarriage jacking point.

16. **Construction.** Fig. 2 illustrates the construction of the jack.

17. **Operation.** A single-acting force pump provides hydraulic pressure. Inlet and delivery valves which are incorporated in the valve cage control the passage of fluid from the container to the pump sleeve (inlet

stroke) and from the pump sleeve to the cylinder tube (delivery stroke). The pump plunger is moved by a hinged saddle which accommodates the pump operating handle. Hydraulic fluid is forced by the pump into the cylinder tube and acts against the bottom ram and, through the holes in the bottom ram end, against the top ram. The extension of the bottom ram is limited by a stop washer. The travel of the top ram is limited by a gland packing washer, secured by the gland collar which also retains the top ram packing. The air valve screwed into the top of the fluid container must remain open when the jack is in use; this allows air to replace the fluid which is pumped from the reservoir. There is no overload release valve incorporated but an overflow tube allows fluid to return to the container when the rams become fully extended. The release valve,

(A.L. 21, Oct. 65)



- | | | | |
|---------------------------------|---------------------------|---------------------------|----------------------------|
| 1. Swivelling Jack Head Adapter | 11. Leather Bucket Washer | 22. Pump Plunger | 32. Valve Cage |
| 2. Screwed Extension | 12. Bottom Ram End | 23. Plunger Pin | 33. Release Valve |
| 3. Top Ram Packing | 13. Leather Bucket Washer | 24. Pump Operating Handle | 34. Overflow Tube |
| 4. Bottom Ram Packing | 14. Delivery Valve | 25. Handle Lock Pin | 35. Container Cover |
| 5. Stop Washer | 15. Inlet Valve | 26. Pump Saddle | 36. Air-Valve Screw |
| 6. Filler Screw | 16. Leather Bucket Washer | 27. Turnscrow | 37. Stop Collar |
| 7. Top Ram | 17. Pump Block | 28. Pump Saddle Stop | 38. Top Ram Packing Washer |
| 8. Fluid Container | 18. Jack Baseplate | 29. Stop Flange | 39. Gland Collar |
| 9. Cylinder Tube | 19. Pump Sleeve | 30. Release Valve Plunger | 40. Lock Washer |
| 10. Bottom Ram | 20. Gland Nut | 31. Release Nut | 41. Trunnion Screw |
| | 21. Packing | | |

Fig. 2. CONSTRUCTION OF JACK

opened by turning the pump handle anticlockwise, controls the return of the hydraulic fluid from the cylinder tube to the fluid container and thus controls the lowering of the rams.

18. Changing Adapters. To substitute a Mk. II for a Mk. I adapter, proceed as follows:—

(a) Turn the knurled adapter anticlockwise and raise the screwed extension to its highest position.

(b) Continue turning the adapter until the hexagonal-headed screw is withdrawn from the extension.

(c) Screw the alternative adapter into the extension until it is located against the spherical seating.

19. Lifting. A good foundation must be provided to support the jack. Use the jack head adapter to suit the correct jacking point. Adjust the jack to its closed position, and use packing to raise it so that the lift is obtained with the minimum of ram extension.

The procedure for lifting is as follows:—

- (a) Turn the handle lock pin until the flat side of the pin is across the pump saddle bore.
- (b) Insert the pump operating handle with its square end engaging in the release valve turncrew.
- (c) Turn the lock pin to secure the handle in the saddle.
- (d) Place the jack directly under the jacking point of the load to be raised and adjust the screwed extension.
- (e) Close the release valve and open the air valve.
- (f) Operate the handle and raise the rams until the head adapter is tight against the load.
- (g) Examine the packing and the position of the head adapter. Ensure that the jack is prepared for a straight lift and that the load will rise clear of all obstructions.
- (h) Slowly operate the pump and raise the load to the desired height.
- (j) If the load has to remain elevated, place supports in position and lower the load on to the supports.

20. Lowering. The load should be lowered as follows:—

- (a) Raise the load slightly to clear the supports.
- (b) Remove the supports.
- (c) Open the release valve slowly at first and then regulate it to control the rate of descent.
- (d) Remove the jack and close the rams.
- (e) Remove the operating handle and keep the jack in a vertical position with the release valve and air valve screw closed.

21. Fluid Level. It is essential that the fluid level is about half an inch from the container cover when the rams are down and the jack base is level. The jack should be topped up when necessary with the correct hydraulic fluid. To top up or fill the jack proceed as follows:—

- (a) Remove the filler screw and the air valve screw.

- (b) With the aid of a small funnel pour the fluid into the container until, with the rams fully retracted there is an air space of half an inch depth above the level of the fluid.

- (c) Slowly operate the pump during the filling operation, keeping the release valve open to allow free circulation of the fluid.

- (d) Ensure that the air valve and filler screws are replaced in the container cover after the filling operation is complete.

TRIPOD, BIPOD, AND FOUR-LEGGED JACKS

Introduction

22. Tripod, bipod and four-legged jacks are used to raise an aircraft for various servicing and repair operations. They consist of a hydraulic unit or body supported by a number of legs; the hydraulic unit is sometimes termed the heart or jacking unit. All types are similar in construction except for the arrangement of the legs, the layout of which is determined by the specific applications for which the jack will be used.

Tripod Jacks

23. Tubular legs are attached to a hydraulic body to form a tripod jack (Fig. 3), thus forming a three-legged trestle with the feet equally disposed around the axis of lift. The centre line of the hydraulic body coincides with the lifting axis. The use of the tripod jack is limited because only a straight lift can be taken and no allowance can be made for any lateral movement of the jack head.

24. The smaller tripod jacks have a lifting capacity up to five tons and have fixed legs that are welded to the ram cylinder; the fluid container may be separate or formed by the jack legs. The jack feet are usually fixed, although some have swivelling feet to provide a firm foundation on irregular ground. Jack head adapters suitable for the aircraft being serviced are easily fitted to the jack ram. The hydraulic mechanism consists of a small force pump which provides the pressure below the ram that causes it to rise; a release valve controls the descent of the ram.

25. The larger tripod jacks with a lifting capacity greater than five tons have the

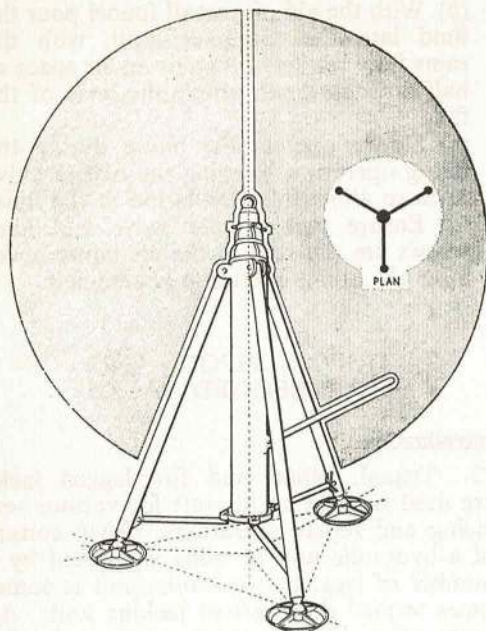


Fig. 3. TRIPOD JACK

hydraulic system incorporated in the hydraulic body which also forms the fluid container. The hydraulic mechanism consists of a force pump and a release valve arranged in a similar way to the smaller jacks. Some jacks have an air valve which is opened by assembling the jack legs, whilst on others it must be un-screwed; the air valve must be open and the release valve closed before the action of the pump can raise the ram. For convenience of transport, these larger jacks are built up with three trestle legs pinned to the hydraulic body and held rigidly by tie bars from the lower part of each leg to the hydraulic body.

Bipod Jacks

26. A bipod jack (Fig. 4) has two legs in the same vertical plane as the lifting axis. These two legs, which rest upon swivelling feet and support the load, are the bipod or load legs and they are free to tilt through a small angle. The third or trailing leg can be adjusted to steady the bipod legs as they tilt during a lifting operation. This type of jack can thus be used where the jacking point moves laterally as the lift is taken, for example when raising one side of an aircraft for the purpose of changing a wheel. The hydraulic mechanism is similar to that of the tripod jacks.

Four-Legged Jacks

27. A four-legged jack (Fig. 5) is obtained by attaching an additional leg to the hydrau-

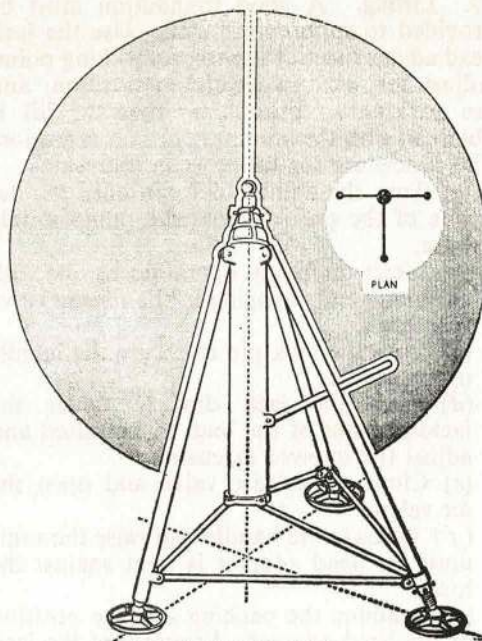


Fig. 4. BIPOD JACK

lic body of the bipod jack at the side opposite to the trailing leg. The use of this leg gives increased stability. This fourth leg is telescopic and it can be reduced in length by closing, and then pinning to the hydraulic body in a stowed position. Mechanical methods of locking the rams are provided for use when the jacks are trestling an aircraft.

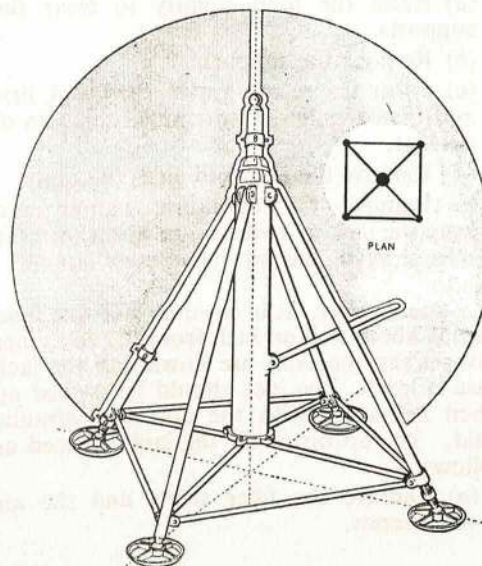


Fig. 5. FOUR LEGGED JACK

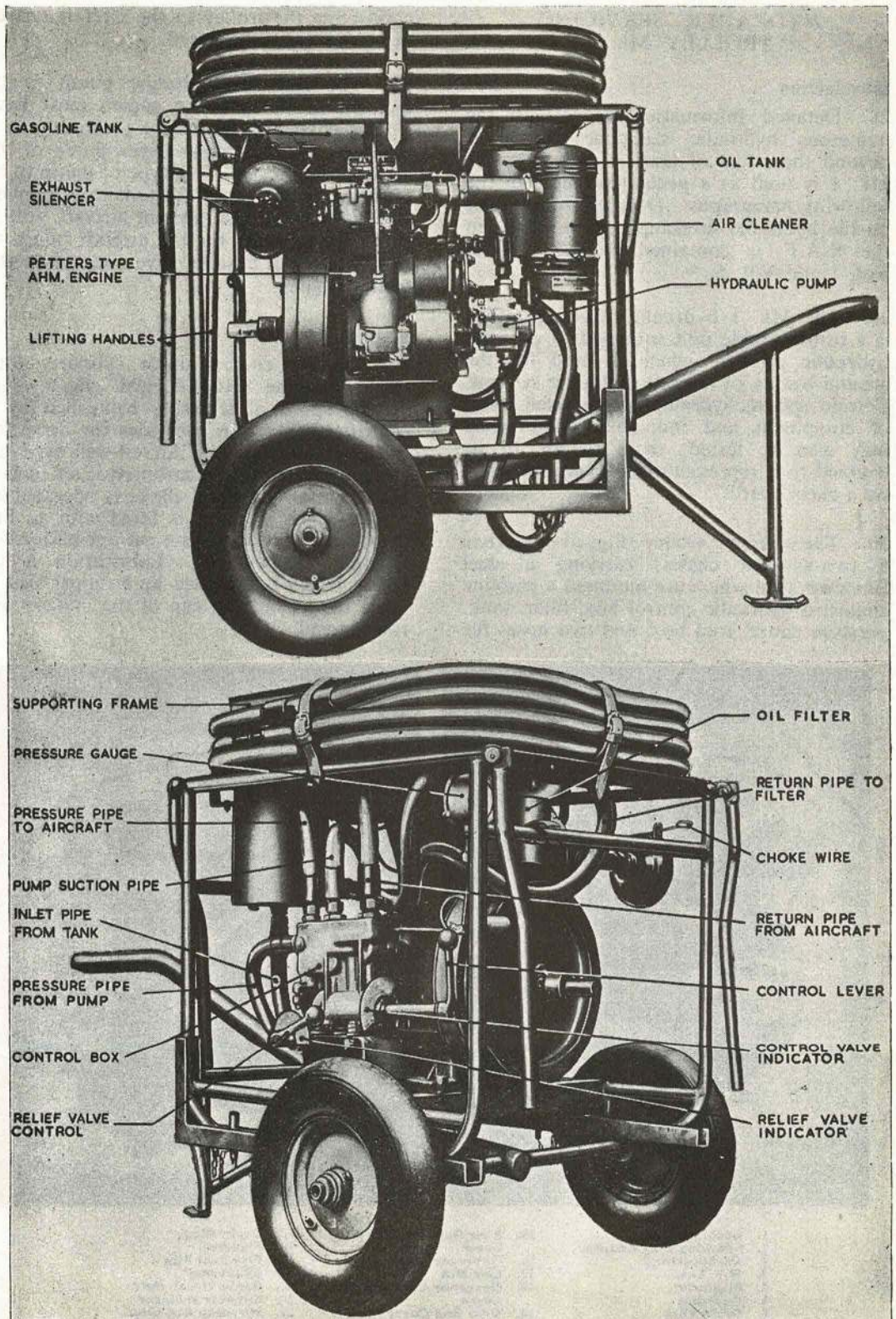


Fig. 6. HYDRAULIC SERVICING TROLLEY Mk. I

HYDRAULIC SERVICING TROLLEY Mk. 1

Introduction

28. Detailed information concerning the numerous hydraulic servicing trolleys is beyond the scope of these notes; thus, the Mk. 1 is used as a general example in the following paragraphs. Detailed information on the hydraulic servicing trolleys in use in the R.A.F. is contained in A.P. 2306B, Vol. 1 and Vol. 6.

29. The Mk. 1 hydraulic servicing trolley is a transportable unit equipped to generate hydraulic pressure which is used for the ground testing of aircraft hydraulic systems. Certain special hydraulically-operated items of equipment and individual components may also be tested; these require to be coupled to a representative system mounted on a checkboard.

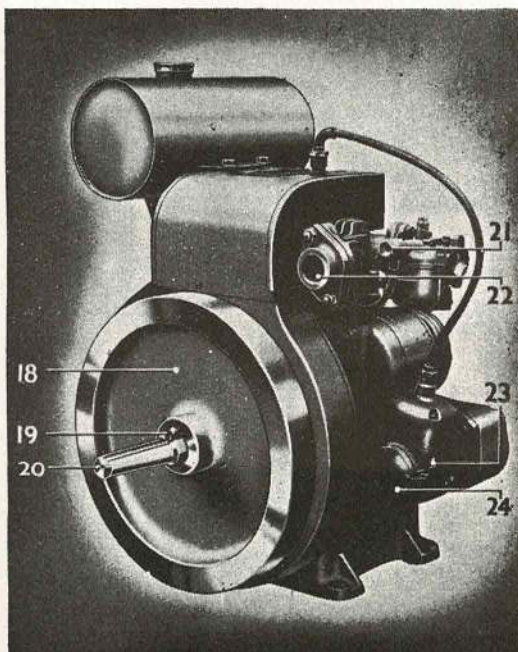
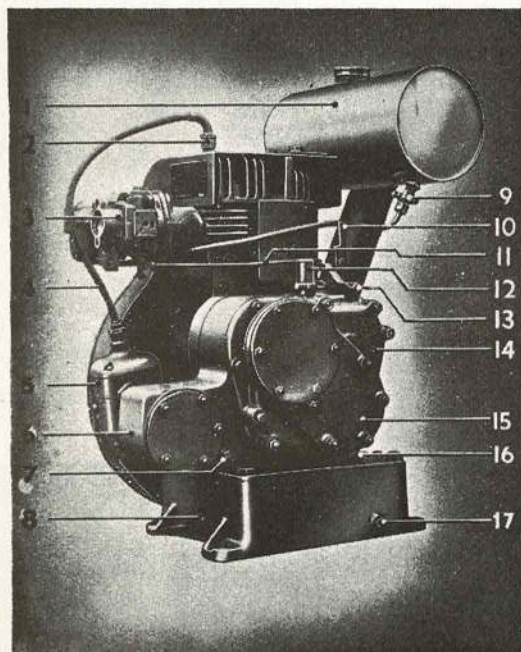
30. The servicing trolley (Fig. 6) comprises a two-wheeled chassis carrying a steel framework on which are mounted a gasoline engine, a hydraulic control box, filter, tank, pressure gauge, tool box, and two hoses for

connecting the trolley to the aircraft service or equipment to be tested.

31. The type of hydraulic pump to be coupled to the gasoline engine must have similar characteristics to, or preferably, be a duplicate of, the engine-driven pump of the system being tested. The type of pump to be used and the details of the tests to be applied will be found in the relevant aircraft Vol. 1. Provision is made for the aircraft pump to be driven by a flexible drive coupled to the trolley engine.

Engine

32. An air cooled single cylinder, four stroke gasoline Petter A.H.M. engine (Fig. 7), the speed of which is controlled by a centrifugal governor, provides the drive for the hydraulic pump. An oil-well type air cleaner is fitted to the carburettor air intake, and a butterfly type of choke is operated by a wire. The magneto is fitted with an impulse starter; it also has a cut-out button for stopping the engine. Lubrication is by splash which is provided by a dipper that is fitted to the bearing cap of the connecting-rod big-end.

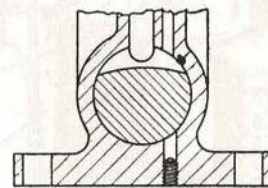
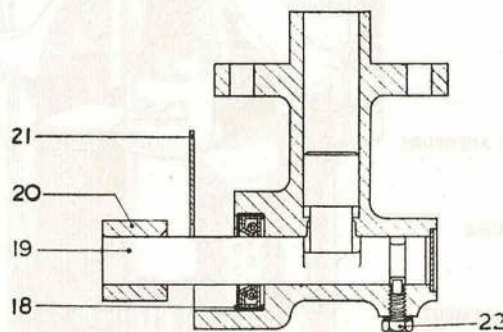
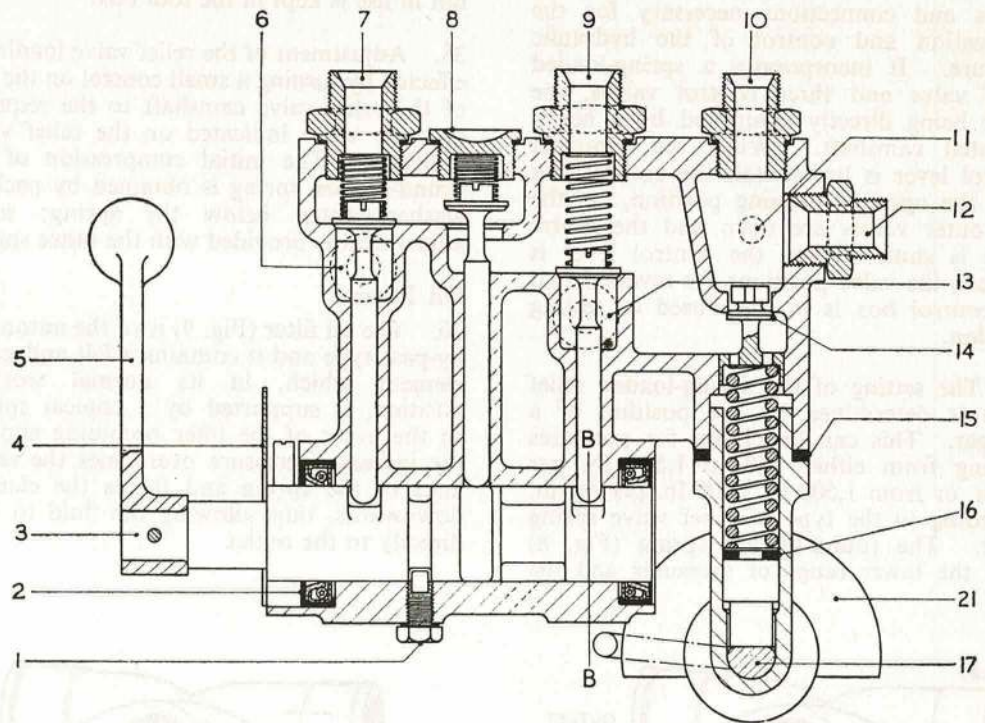


1. Gasoline Tank
2. Sparking Plug Adapter
3. Carburettor
4. H.T. Lead
5. Magneto
6. Gearcase
7. Drain Plug
8. Bedplate
9. Gasoline Tap

10. Slow-Running Trip Lever
11. Governor Link
12. Cap Nut
13. Governor Control Lever
14. Gear End Cover
15. Reversible Cover
16. Dipstick

17. Drain Plug
18. Flywheel
19. Flywheel Key
20. Crankshaft
21. Banjo Union Bolt
22. Silencer Adapter
23. Magneto Cut-Out Button
24. Contact Breaker Cover

Fig. 7. ENGINE



SECTION ON B-B

SIDE VIEW OF RELIEF VALVE CAMSHAFT

- | | | |
|------------------------------------|-------------------------------------|--------------------------------|
| 1. Camshaft Positioning Screw | 9. Pump Suction Connection | 15. Relief Valve Joint Washer |
| 2. Oil Seal | 10. Pressure Connection to Aircraft | 16. Packing Washers |
| 3. Camshaft | 11. Pressure Gauge Connection | 17. Relief-Valve Cam |
| 4. Control Valve Indicator | 12. Pressure Connection from Pump | 18. Oil Seal |
| 5. Control Lever | 13. Inlet Connection from Tank | 19. Relief-Valve Camshaft |
| 6. Return Connection to Filter | 14. Spring-Loaded | 20. Relief-Valve Control Lever |
| 7. Return Connection from Aircraft | | 21. Relief-Valve Indicator |
| 8. Valve Cap | | 22. Camshaft Positioning Screw |

Fig. 8. CONTROL BOX

Control Box

33. The control box (Fig. 8) contains the valves and connections necessary for the application and control of the hydraulic pressure. It incorporates a spring-loaded relief valve and three control valves, the latter being directly controlled by a hand-operated camshaft. When the camshaft control lever is horizontal, the control box is in the open or priming position, i.e. the two outer valves are open and the centre valve is shut. When the control lever is vertical, the valve positions are reversed and the control box is in the closed or testing position.

34. The setting of the spring-loaded relief valve is determined by the position of a plunger. This can be pre-set for pressures ranging from either 350 to 1,500 lb. per sq. in. or from 1,500 to 3,000 lb. per sq. in. according to the type of relief valve spring fitted. The round-section spring (Fig. 8) gives the lower range of pressures and the

higher range is obtained with the square-section spring (Fig. 12). The spring which is not in use is kept in the tool box.

35. Adjustment of the relief valve loading is effected by turning a small control on the end of the relief valve camshaft to the required pressure value indicated on the relief valve indicator. The initial compression of the round-section spring is obtained by packing washers fitted below the spring; screw adjustment is provided with the other spring.

Oil Filter

36. The oil filter (Fig. 9) is of the automatic by-pass type and it contains a felt and gauze element which, in its normal working position, is supported by a conical spring. In the event of the filter becoming choked, the increased pressure overcomes the resistance of the spring and forces the element downwards, thus allowing the fluid to flow directly to the outlet.

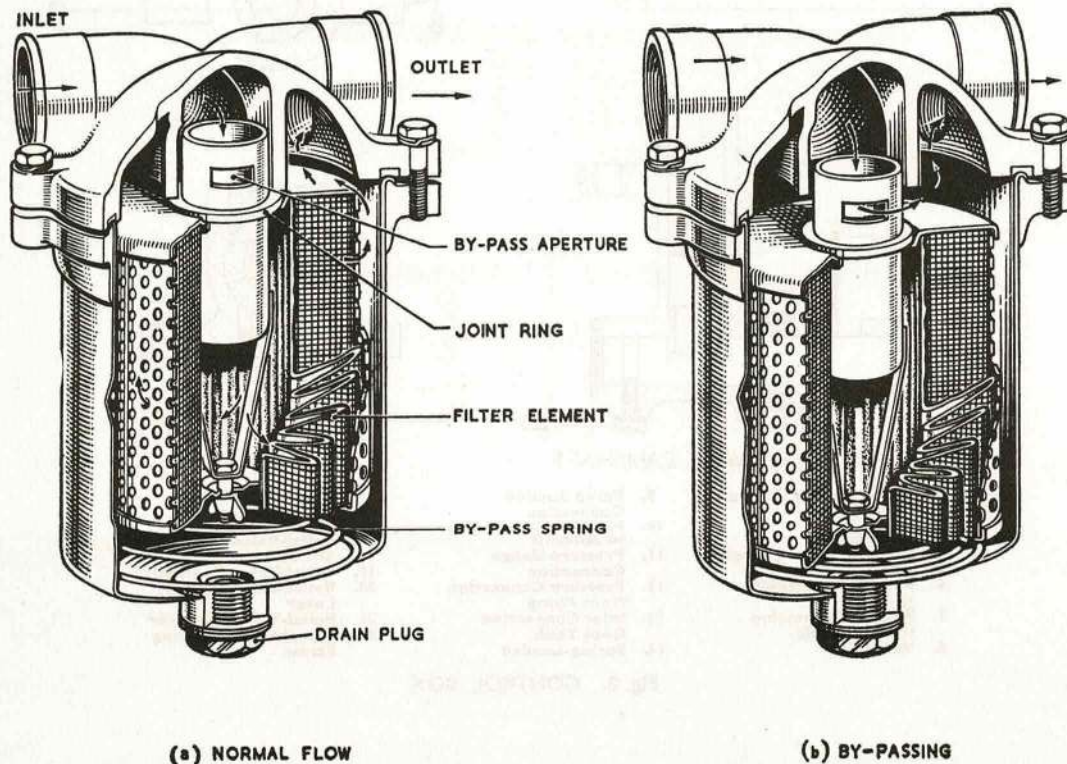


Fig. 9. OIL FILTER

Oil Tank

37. The capacity of the oil tank is normally one gallon, therefore refilling is necessary whilst a system requiring more than this amount is being replenished. The one-gallon tank may be replaced by a five/seven-gallon tank as a local modification.

Hydraulic Circuits

38. There are two hydraulic circuits, the **open** or **primary circuit** (Fig. 10) and the **closed** or **testing circuit** (Fig. 11). In the open circuit, circulation is from the pump, through

the control box, filter and tank, and then back again through the control box to the pump. In the closed circuit, circulation is from the pump, through the control box to the aircraft system, and back through the control box to the pump. The open circuit enables the aircraft system to be vented and replenished; the closed circuit enables the components of the hydraulic system to be tested. The trolley system may be separately primed and vented, before being connected to the aircraft, by coupling the hose ends to the dummy connections and starting the engine.

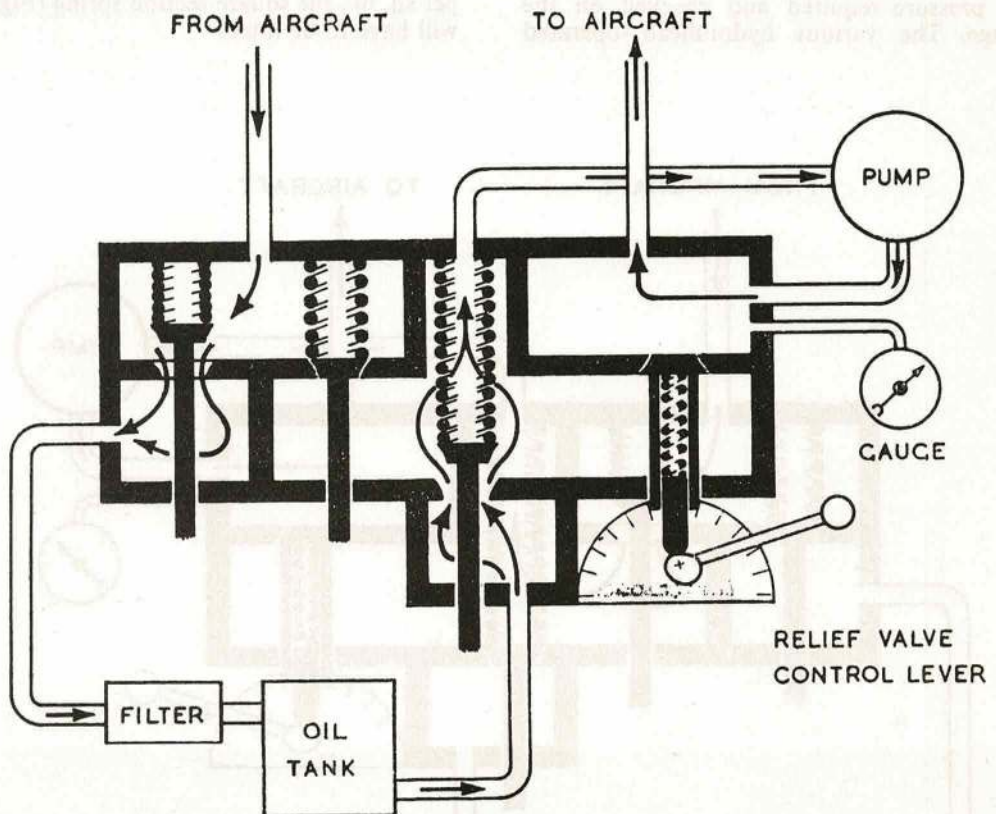


Fig. 10. OPEN OR PRIMING CIRCUIT

39. Priming and Replenishing. When the trolley control is set to "open circuit", i.e. when the camshaft control lever is horizontal, and the engine is started, hydraulic fluid is circulated by the pump through both the aircraft and trolley systems. If running on this circuit is continued, the aircraft pipe lines will become fully primed and fluid will be delivered to the aircraft header tank. The aircraft system is thus replenished and the tank filled to the correct working level.

40. Testing. When the control is set to "closed circuit", i.e. with the camshaft control lever vertical, the aircraft system should operate under the same conditions as with the engine-driven pump. The pressure is governed by the setting of the relief valve control lever, which should be set at the pressure required and checked on the gauge. The various hydraulically-operated

components may then be tested, provided that the necessary precautions have been taken and that conditions are such that it is permissible to operate these parts.

41. Relief Valve. If the pressure in either circuit exceeds the predetermined setting, the relief valve opens automatically and fluid circulates only through the trolley components without increasing the pressure on the hoses.

Operating Instructions

42. Before commencing a test, the hydraulic fluid to be used and the pressure to be applied must be ascertained from the relevant aircraft Vol. 1. If the pressure exceeds 1,500 lb. per sq. in., the square-section spring (Fig. 12) will have to be fitted.

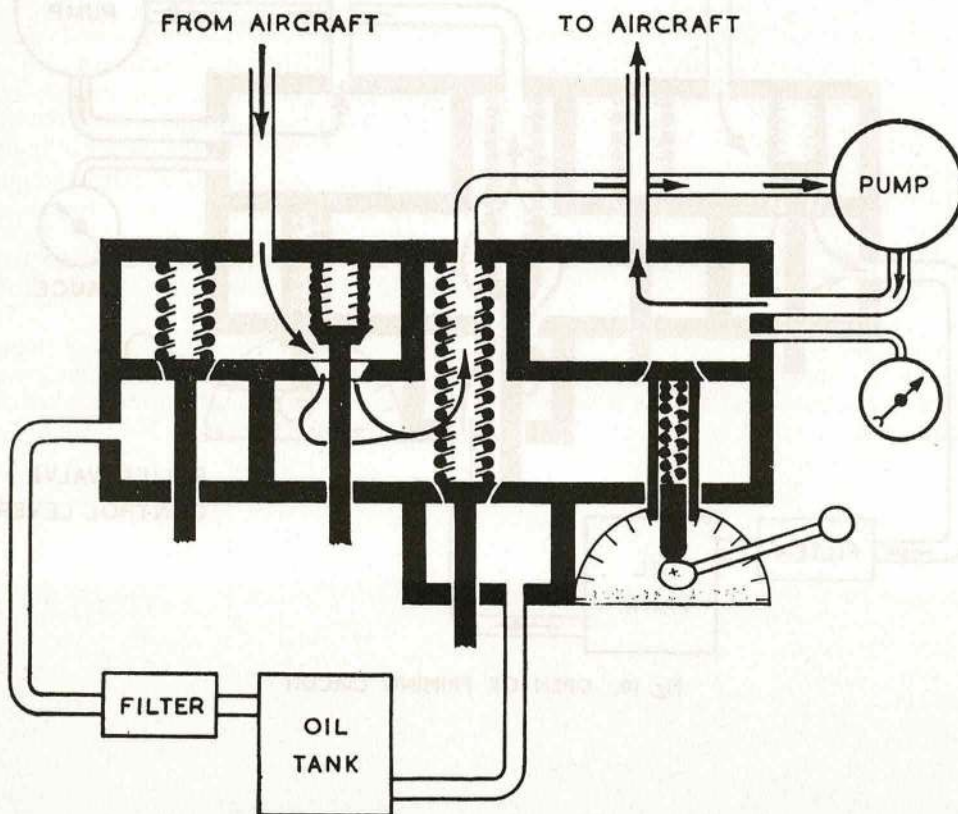


Fig. 11. CLOSED OR TESTING CIRCUIT

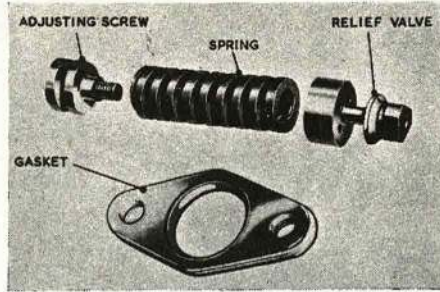


Fig. 12. SQUARE SECTION SPRING

43. To fit the spring, first remove the bolts from the flange of the relief valve spring casing and remove the casing complete with the spring, the relief valve and the gasket. Remove the spring and any packing washers from the casing and fit the square section spring and its adjusting screw. Fit the relief valve and secure the assembly, the thick gasket to be between the abutting faces. When the trolley engine is subsequently run it may be necessary to alter the screw adjustment of the spring so that the pressure on the indicator agrees with that shown on the gauge.

44. Should the trolley have been used previously with a different fluid, flush out the tank, pipelines and hoses completely, otherwise serious damage may result to the aircraft components from chemical reaction.

45. In order to free the trolley system of air, the hoses should be connected to the dummy connections on the trolley and the engine run for a few minutes before the hoses are connected to the aircraft.

Starting the Engine

46. To start the engine:—

- (a) Turn on the gasoline tap and check the oil level in the sump.
- (b) Close the choke by pulling the control wire towards the rear of the trolley.
- (c) Set the throttle in the nearly closed position by placing the slow-running trip lever behind the governor lever.
- (d) Engage the starting handle and turn it slowly through two revolutions; the handle should then be pulled up smartly and the engine should start.

Note: The magneto, on this engine is fitted with an impulse starter; therefore, the starting movement of the handle should always be a smart pull upwards; do not attempt a full revolution. The impulse starter coupling clicks over when the engine is being started and when it is slowing down to stop. Do not allow the engine to run continuously under about 165 r.p.m. as this causes unnecessary strain and wear on the impulse mechanism.

(e) After the engine has started, release the choke wire gradually until the engine runs smoothly with the choke fully open.

(f) If the engine fails to start, the mixture may have become too rich. In this event, open the throttle fully and turn the engine over a few times with the handle; close the throttle and try to start the engine again.

(g) When the engine is running smoothly, disengage the trip lever from the governor lever; the engine will increase speed to the maximum permitted by the governor.



This file was downloaded
from the RTFM Library.

Link: www.scottbouch.com/rtfm

Please see site for usage terms,
and more aircraft documents.