Chapter I

MASTER CYLINDER PART No. ACM.15354

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LIST OF ILLUSTRATIONS

Introduction

1. This master cylinder is in effect a manually operated pump which delivers fluid to hydraulic brake units. Normally, two of these cylinders are mounted side by side horizontally in the aircraft, with the port cylinder supplying the starboard brake and the starboard cylinder supplying the port brake (*fig.* 1). Each piston rod is connected to a cable which passes around pulleys mounted on the rudder bar and connects with a common cable for attachment to the hand lever. This method of connection permits both brakes to be applied equally and simultaneously when the rudder bar is central and provides for differential action when the rudder bar is off centre. When the brakes are applied and the rudder bar is moved to steer the aircraft to starboard, due to the arrangement of the pulleys, the pressure in the starboard brake unit remains constant while the pressure in the port brake unit is relieved proportional to the degree of rudder bar movement.

Description

2. The body of the unit (*fig.* 2) consists of a mild steel cylinder with an end cap, an inlet adapter, a delivery adapter; fixing lugs are also attached to it. The inlet adapter is recessed at its base to enclose four drillings in the cylinder wall so that fluid can be directed to either side of the piston. The delivery adapter embodies a spigot on its inner face which projects into the cylinder to form a stop to limit the travel of the piston. An angular drilling from the base of the spigot connects with the central drilling in the adapter to form the fluid passage. The end cap has an internal shoulder against which a circlip bears to retain the piston in the cylinder.

3. The piston has a spigot at one end and a conoid bore at the other. A U-section rubber washer is sleeved over the spigot and is retained by a spring retainer which sleeves over and bears on the end of the spigot. an inner and outer spring positioned in the cylinder bear on the flange of the spring retainer and return the piston to its normal position when the pressure on the piston rod is released. The piston rod is not connected to the piston but bears on the base of the conoid bore and is free to take up its own alignment within 5 degrees of the centre line of the piston. A rubber bellows, with a projecting ring in each end, engages a groove in the shoulder of the piston rod and in the end cap and retains the piston rod. A filter incorporated in the bellows provides for pressure balance within the bellows and the assembly prevents the ingress of dirt. A forked end is screwed on to the exposed end of the piston rod and is locked by a lock-nut. When the unit is installed the piston and piston rod are held in firm contact by the opposing action of the return springs and the operating cable.

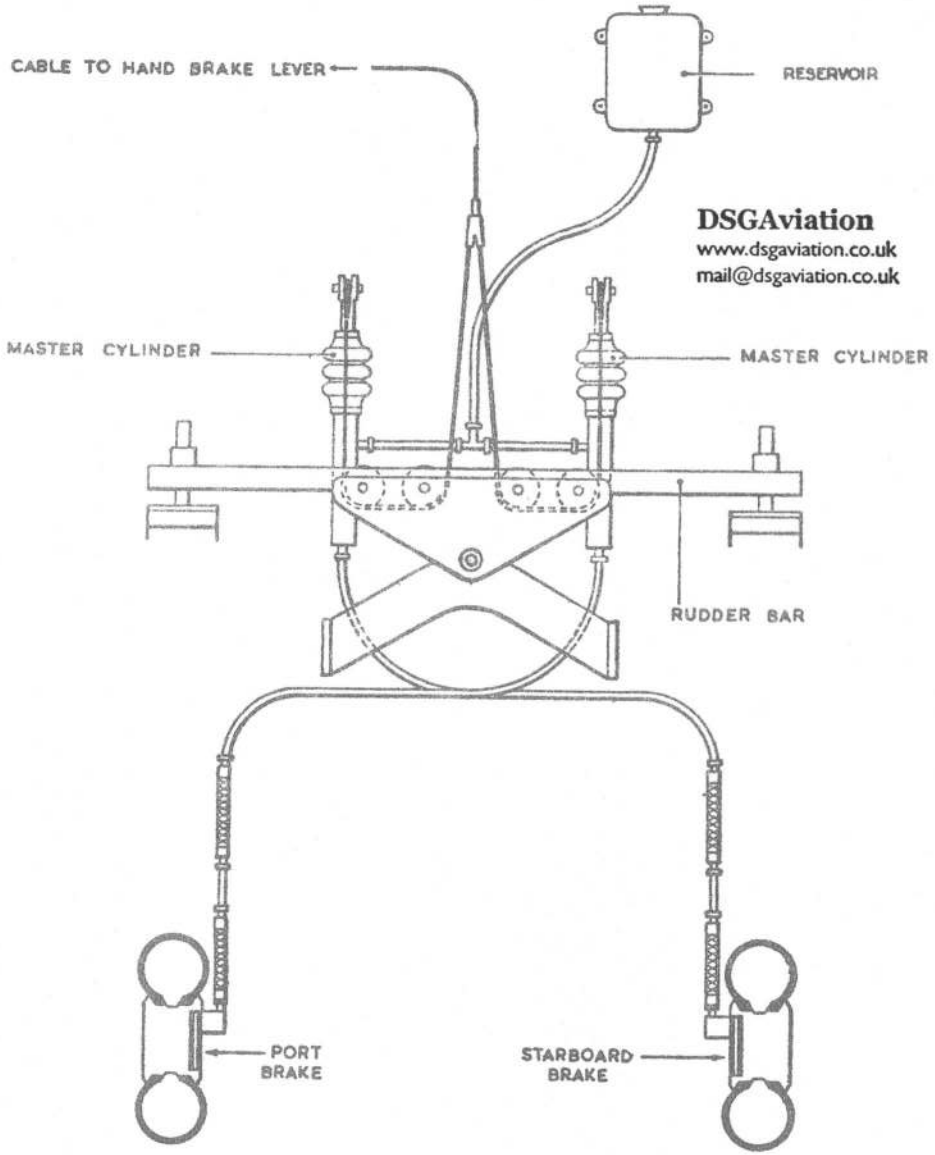

Fig. 1. Typical brake system employing master cylinder

Principle of operation (*fig.* 3)

4. In its normal position the piston is held in contact with the circlip in the end cap by the pressure of the return springs and the supply ducts in the cylinder wall are positioned two at each side of the piston head. Fluid from the reservoir is thus fed under gravity into each end of the cylinder to make up any deficiencies. When pressure is applied to the piston rod, the initial movement of the piston causes the U-washer to blank off the holes entering the spring chamber. Further movement of the piston expels fluid from the spring chamber to operate the brake unit. The fluid in the opposite end of the cylinder is carried forward by the movement of the piston. When the brakes are released the brake return springs apply pressure to the fluid in the brake unit and return it to the master cylinder. The piston is returned to its normal position by the return springs and if, for any reason, there is a tendency for cavitation in the spring chamber, the lips of the U-washer collapse and fluid flows past the piston head to make up the deficiency as the piston is returning. When the piston reaches its normal position two of the supply ducts are open to the spring chamber so that any cavity remaining is filled with fluid from the reservoir. The cylinder is now charged ready for the next operation.

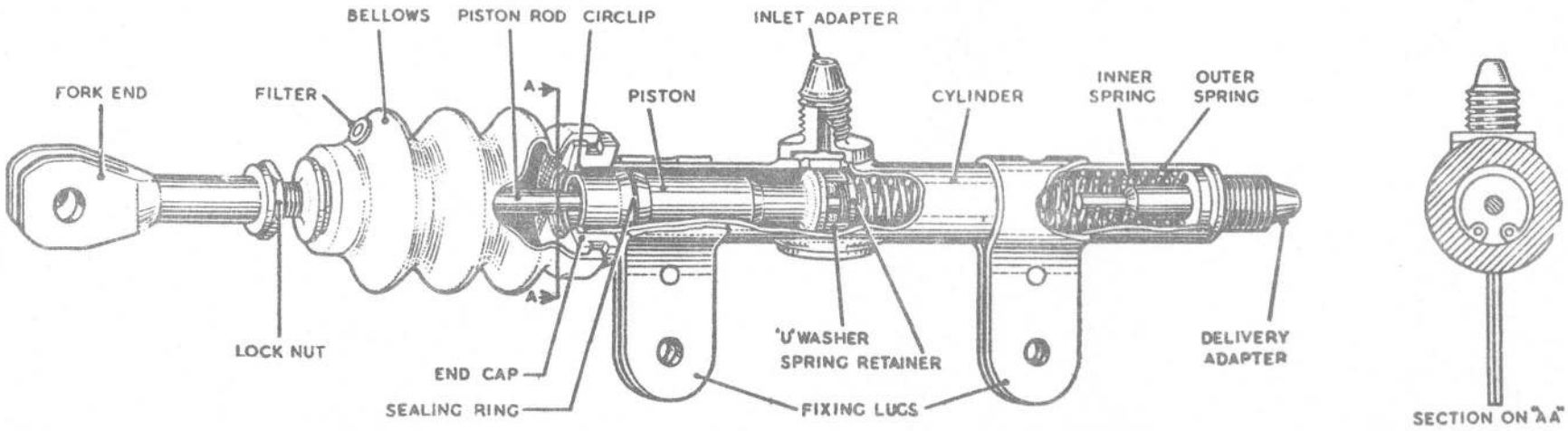

Fig. 2. Sectional arrangement of master cylinder, part No. ACM.15354

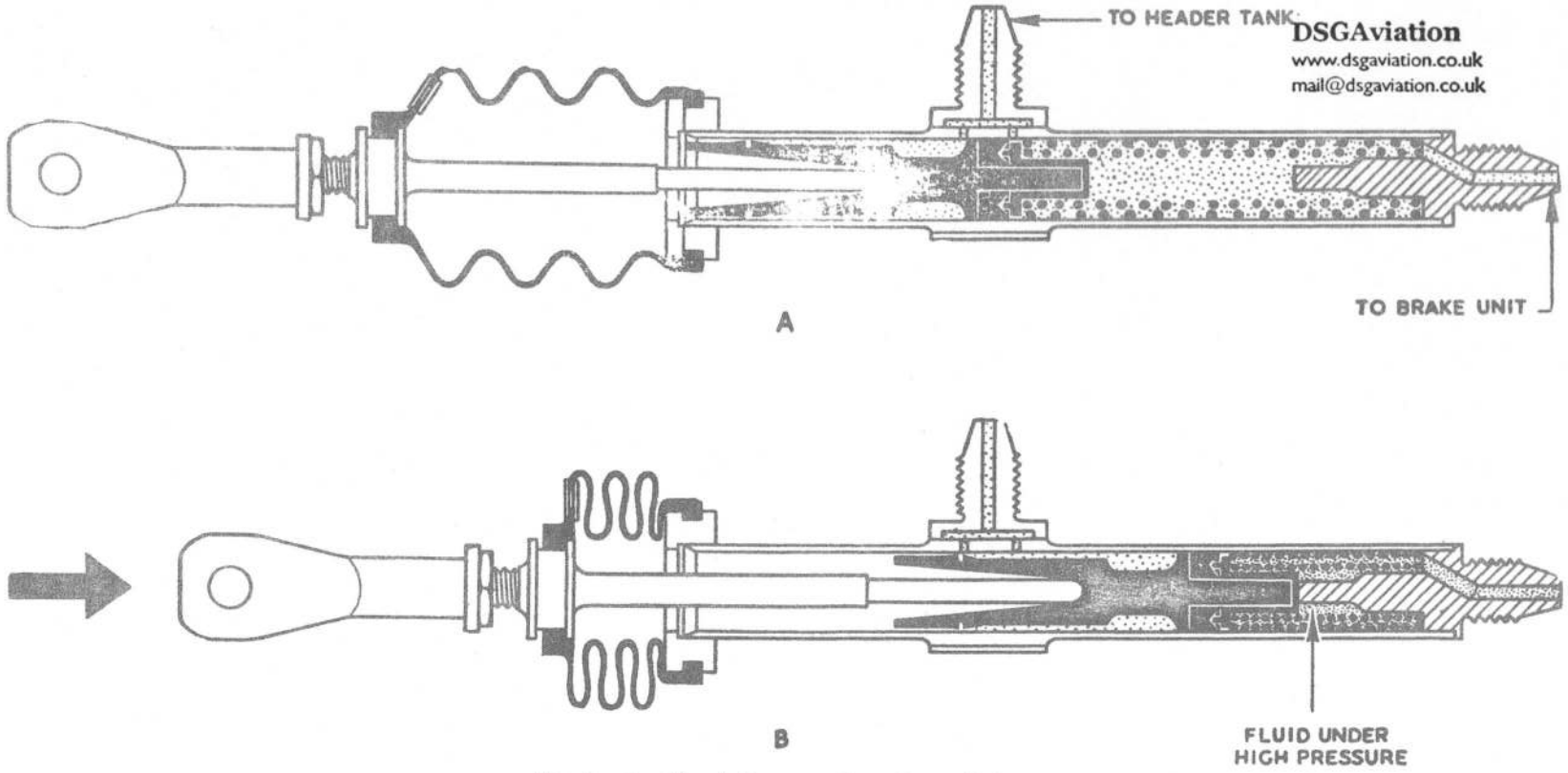

Fig. 3. Functional diagram of master cylinder

Leakage

5. Failure to maintain hydraulic pressure when the brakes are applied may be due to leakage from the pipe-line or the brake unit, but, if no leakage is visible in these parts, it will be due to a faulty U-washer in the master cylinder. To remedy this, renew the U-washer.

6. Leakage from the open end of the cylinder, visible when the bellows are disengaged, will be due to faulty sealing by the sealing ring adjacent to the end of the piston ; renew the sealing ring.

7. Leakage caused by damaged adapters will necessitate the renewal of the cylinder as, being brazed, they are regarded as integral parts.

Dismantling

8. (1) Disengage the bellows from the groove in the end cap and withdraw the piston rod and bellows.

(2) Disengage the bellows from the groove in the collar of the piston rod and separate the parts. Remove the fork end and lock-nut.

(3) Extract the circlip from the end cap and withdraw the piston spring retainer and return springs.

(4) Remove the U-washer and Sealing ring from the piston.

Assembling

9. (1) Position a U-washer over the spigot of the piston so that the flat face of the washer is contacting the face of the piston.

(2) Position a rubber sealing ring in the groove in the piston adjacent to the bored end.

(3) Position a spring retainer on the spigot of the piston so that the collar of the retainer engages the groove in the U-washer.

(4) Place an inner and outer spring on the spring retainer and insert the springs together with the piston in the cylinder. Ensure that the springs pass over the spigot and bed on the base of the cylinder and that the springs can operate easily without fouling.

(5) Push the piston into the cylinder until the groove in the end cap is visible and fit the circlip ; position it so that the gap between the ends is in line with the fixing lugs.

(6) Engage the neck of the bellows in the groove in the shoulder of the piston rod. Screw a lock-nut and a fork end on to the piston rod and ensure that sufficient threads are engaged.

(7) Test the unit as described in para. 10 and, after the tests are completed satisfactorily, engage the neck of the bellows in the groove in the shoulder of the piston rod, insert the piston rod in the conoid bore of the piston and engage the bellows in the groove in the end cap. The filter in the bellows should be in line with the inlet adapter.

Testing

10. (1) Mount the master cylinder (less bellows) in a test rig as illustrated in fig. 4.

(2) Bleed all air from the spring chamber and pipe-line as follows :—

(*a*) Slacken the union nut connecting the gauge to the pipe and press the lever to drive the piston into the cylinder to the extent of its travel.

(*b*) Holding the piston against the stop, tighten the union nut previously slackened, then release the lever and allow the piston to return to its normal position under the influence of the return springs. The depression created in the spring chamber will be filled by fluid transferred past the U-washer.

(*c*) Repeat (*a*) and (*b*) until oil, free from air, is discharged from the slackened union and then tighten the union.

(3) With the lever of the test rig horizontal and the piston at half stroke, suspend a 32 lb. weight from the end of the lever ; the pressure indicated on the gauge should read 600 lb. per sq. in.

(4) Allow the unit to remain under the conditions produced in (3) for 15 minutes. During this period no leakage should be evident and there should be no change in the position of the lever. As the load on the piston is constant, although there may be leakage from the circuit, the gauge reading will not change until the piston reaches the end of its travel ; then, as the system is leaking, the indicated pressure will gradually fall off.

(5) Check the level of the fluid in the reservoir and leave the master cylinder in the test rig for 10 hours (with or without the weight) and, at the end of this period check the level of the fluid. Change in the fluid level indicates leakage past the sealing ring adjacent to the bored end of the piston. Examine the end cap for visible leakage and, if necessary, renew the sealing ring.

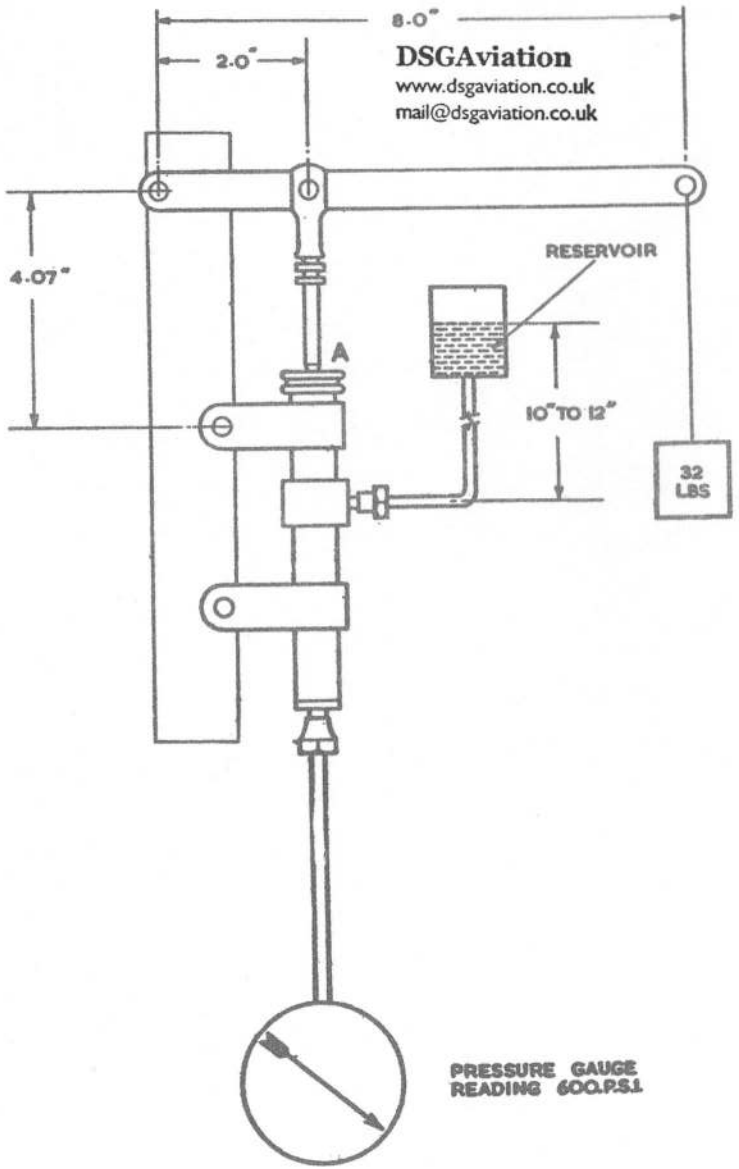

Fig. 4. Test rig