SECTION M

THE BRAKING SYSTEM

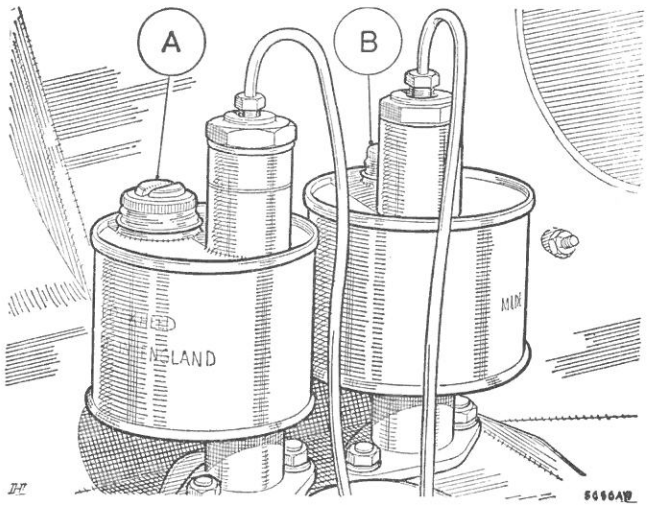

Fig. M.1

(A) *The brake and* (B) *the clutch master cylinder and hydraulic fluid reservoir*

GENERAL DESCRIPTION

The Lockheed hydraulic brake operating equipment comprises a combined fluid supply tank and master cylinder in which the hydraulic pressure is generated and wheel cylinders which operate the brake-shoes. Steel pipe lines, unions, and rubber hoses convey the hydraulic pressure from the master cylinder to wheel cylinder(s) in each brake-drum. A valve is fitted in the fluid line to limit the pressure to the rear wheel cylinders.

Section M.1

MAINTENANCE

Periodically examine the quantity of brake fluid in the master cylinder. The level should be kept $\frac{1}{4}$ in. (6 mm.) below the bottom of the filler neck, but not higher. The necessity for frequent topping up is an indication of a leak in the system which should at once be traced and rectified.

Adjust the brake-shoes to compensate for wear of the linings. The need for this is shown by the pedal going down almost to the floorboards before solid resistance is felt. For foot brake adjustments see Section M.2 or M.12.

Section M.2

BRAKE-SHOE ADJUSTMENTS (Mk. I)

As the brake linings wear the foot pedal will travel nearer to the floorboards before the brakes come into operation. When the travel becomes excessive the brake-shoes must be adjusted to bring the linings into closer relation with the brake-drum.

One common adjuster controlling the adjustment on both the leading and trailing brake-shoes is located on the back of each brake backplate.

Jack up the car and turn the adjuster screw in a clockwise direction until the brake-drum is locked, then slacken the screw until the shoe is just free of the drum. The drum should be free to rotate without rubbing.

Repeat this adjustment on the other three road wheels.

Section M.3

HAND BRAKE ADJUSTMENT

The hand brake operates on the shoes in the rear brake drums and is automatically adjusted when the hydraulic brake shoe adjustment is carried out.

If hand brake travel is excessive, the rear brake shoes must be adjusted to the drums. Chock the front wheels and raise the rear of the car until both wheels are free to rotate. Set the hand brake to the 'off' position and adjust the shoes as detailed in Section M.2.

With the shoes correctly adjusted, apply the hand brake until the pawl within the lever engages with the third notch on the ratchet. Turn the cable adjusting nuts at the hand brake lever until it is just possible to rotate each wheel by heavy hand pressure. It is most important that the road wheels offer equal resistance in order to obtain full braking power. Return the lever to the 'off' position and check that both wheels rotate freely. If either wheel binds after correct adjustment has been made, check that the brake shoe pull-off springs are correctly fitted (Fig. M.6) and that the wheel cylinders are not partially seized. Check that the hand brake cable sector pivots for stiffness in operation, and lubricate with engine oil.

Rectify fault and carry out complete readjustment.

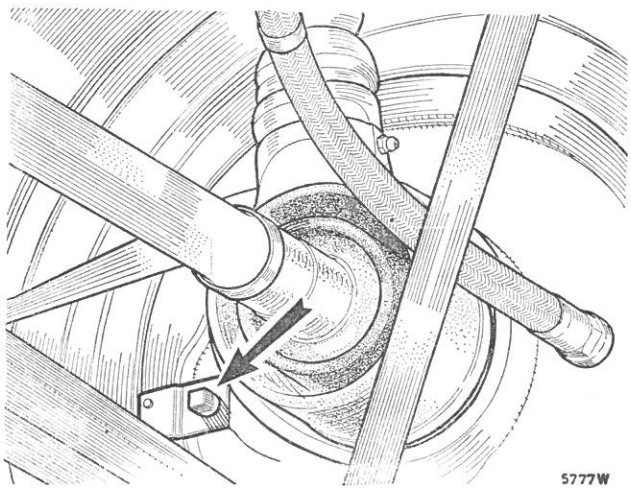

Fig. M.2

The front brake-shoe adjuster (Mk. I). One square-headed adjuster is provided on each of the four brake back-plates

Section M.4

BLEEDING THE HYDRAULIC SYSTEM
(Expelling Air)

Bleeding the braking system is not a routine maintenance job and should only be necessary when some portion of the hydraulic equipment has been disconnected or the fluid level allowed to fall so low that air has entered the system through the master cylinder.

Fill the fluid reservoir to the correct level with Lockheed Super Heavy Duty Brake Fluid (or, if not available, with fluid to Specification S.A.E. 70.R3) and keep it at least half-full throughout the bleeding operation, otherwise air will be drawn into the system necessitating a fresh start.

Attach the bleeder tube to the wheel cylinder bleeder screw and immerse the free end of the tube in a clean jar containing a little brake fluid.

Open the bleed nipple one full turn. Depress the brake pedal slowly and allow it to return without assistance. Repeat this pumping action with a slight pause before each depression of the pedal. When the fluid entering the jar is completely free of air bubbles hold the pedal firmly against the floorboards and tighten the bleeder screw.

This process must be repeated on each bleed screw at the three remaining backplates.

After bleeding top up the fluid reservoir to its correct level.

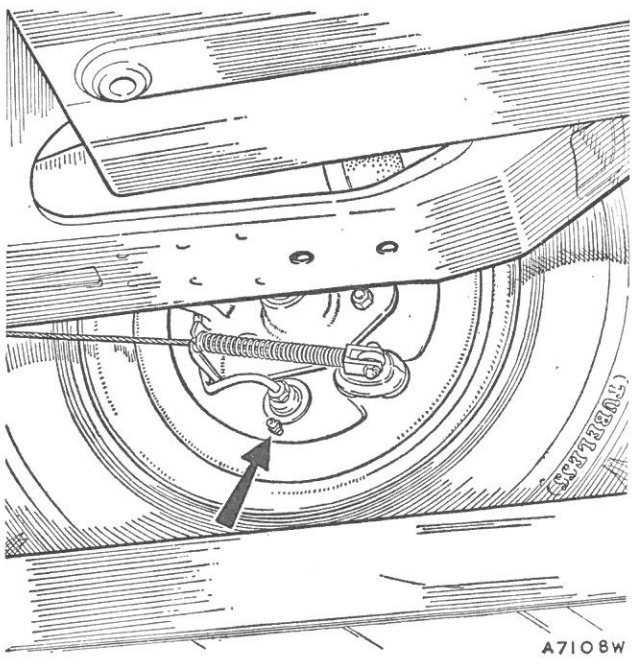

Fig. M.3

A rear wheel cylinder bleeder screw. One bleeder screw is provided on each of the four brake backplates

NOTE.—Clean fluid bled from the system must be allowed to stand until it is clear of air bubbles (approximately 24 hours) before it is used again. Dirty fluid must be discarded.

Section M.5

MASTER CYLINDER

Construction and operation

The master cylinder piston is backed by a rubber cup and is normally held in the 'off' position by a return spring. Immediately in front of the cup, when it is in the 'off' position, is a compensating orifice connecting the cylinder with the fluid supply. This port allows free compensation for any expansion or contraction of fluid, thus ensuring that the system is constantly filled; it also serves as a release for additional fluid drawn into the cylinder during brake applications.

Pressure is applied to the piston by means of the push-rod attached to the brake pedal.

The reduced skirt of the piston forms an annular space which is filled with fluid from the supply tank via the feed hole. Leakage of fluid from the open end of the cylinder is prevented by the secondary cup fitted to the flange end of the piston.

By releasing the brake pedal after application the piston is returned quickly to its stop by the return spring, thus creating a vacuum in the cylinder; this vacuum causes the main cup to collapse and pass fluid through the small holes in the piston head from the annular space formed by the piston skirt. This additional fluid finds its way back to the reserve supply tank under the action of the brake return springs through the outlet valve and compensating orifice until the system finally comes to rest. If the compensating orifice is covered by the piston cup when the system is at rest pressure will build up as a result of brake application. The combination inlet and outlet check valve in the head of the cylinder bore prevents fluid pumped out from the cylinder when 'bleeding' the system from returning to the cylinder, thus ensuring a fresh charge being delivered at each stroke of the pedal.

Removing

Remove the split pin and withdraw the clevis pin securing the master cylinder push-rod to the pedal lever.

Disconnect the pressure pipe union from the master cylinder, remove the two bolts securing the cylinder to the bulkhead, and then withdraw the assembly complete from the car.

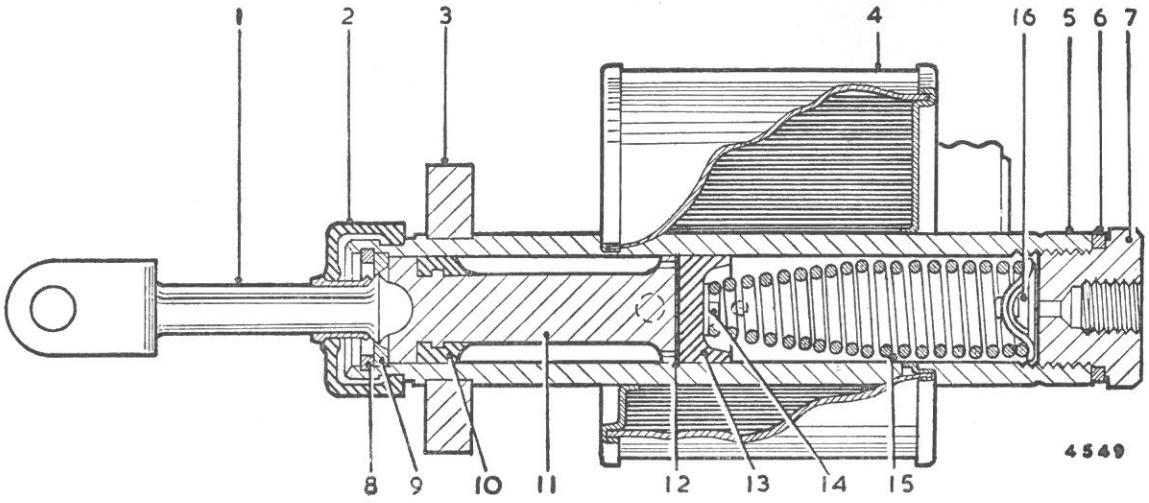

Fig. M.4

A section through the brake master cylinder

1. Push-rod.
2. Rubber boot.
3. Mounting flange.
4. Supply tank.
5. Body.
6. Washer.
7. End plug.
8. Circlip.
9. Stop washer.
10. Secondary cup.
11. Piston.
12. Piston washer.
13. Main cup.
14. Spring retainer.
15. Return spring.
16. Non-return valve.

Dismantling

Remove the filler cap and drain out the fluid.

Pull back the rubber dust cover, remove the circlip with a pair of long-nosed pliers, and the push-rod and dished washer can then be removed.

Withdraw the remaining parts from the cylinder barrel.

To remove the secondary cup from the piston carefully stretch the cup over the end flange of the piston, using only the fingers.

Reassembling

Clean all parts thoroughly, using Lockheed Super Heavy Duty Brake Fluid for all rubber components. All traces of fuel or trichlor-ethylene used for cleaning the metal parts must be removed before assembly.

Examine all rubber parts for damage or distortion. It is usually advisable to renew the rubbers when rebuilding the cylinder. Dip all the internal parts in brake fluid and assemble them wet.

Stretch the secondary cup over the end flange of the piston with the lip of the cup facing towards the opposite end of the piston. When the cup is in its groove work it round gently with the fingers to make sure it is correctly seated. Fit the valve cup and body to the return spring.

Insert the return spring into the barrel, making sure that the spring seat is positioned on the end of the spring to receive the piston main cup.

Insert the main cup, lip first, taking care not to damage or turn back the lip, and press it down onto the spring seat.

Replace the dished washer with its concave side in contact with the main cup.

Insert the piston, taking care not to damage or turn back the lip of the secondary cup

Push the piston down the bore and replace the push-rod, retaining circlip, and rubber dust cover.

Refitting

Secure the master cylinder by means of the two bolts to the bulkhead and refit the pressure pipe union to the cylinder barrel.

Line up the push-rod yoke with the pedal lever and secure the yoke to the lever with the clevis pin and split pin.

Check the brake-shoe adjustment.

Refill and bleed the system as in Section M.4.

Check the system for leaks with the brakes fully on.

Section M.6

FRONT WHEEL CYLINDER ASSEMBLY (Mk. I)

Removing

Jack up the car, remove the road wheel, and thoroughly clean the brake backplate.

Disconnect the flexible fluid supply hose as detailed in Section M.10.

Unscrew and remove the bleed screw. Remove the circlip and dished washer from the wheel cylinder boss protruding through the brake backplate.

Take out the two brake-drum retaining screws and withdraw the drum. Pull the brake-shoes apart and extract the cylinder.

Examining

Remove the dust seals from the ends of the cylinder and extract both pistons. The rubber piston seals can be

removed from their recesses and new seals fitted by using the fingers only.

Do not clean the rubber parts with anything other than Lockheed Super Heavy Duty Brake Fluid. All traces of fuel, etc., used for cleaning metal parts must be removed before reassembly.

Refitting

The procedure for refitting a front wheel cylinder is a reversal of the removal sequence. In addition, attention must be given to bleeding the hydraulic system and adjusting the brake-shoes as detailed in Sections M.4 and M.2.

Section M.7

REAR WHEEL CYLINDERS

Removal

Jack up the car under the rear sub-frame, remove the road wheel, and thoroughly clean the brake backplate.

Disconnect the flexible fluid supply hose as detailed in Section M.10.

Unscrew and remove the bleed screw. Remove the circlip and dished washer from the cylinder boss protruding through the brake backplate.

Take out the two brake-drum retaining screws and withdraw the drum. Remove the brake-shoes (see Section M.8) and extract the cylinder.

Examining

Remove the dust seals from the ends of the cylinder and extract both pistons. The rubber piston seals should be removed and new seals fitted by using the fingers only.

Do not clean the rubber parts with anything other than Lockheed Super Heavy Duty Brake Fluid. All traces of fuel, etc., used for cleaning metal parts must be removed before reassembly.

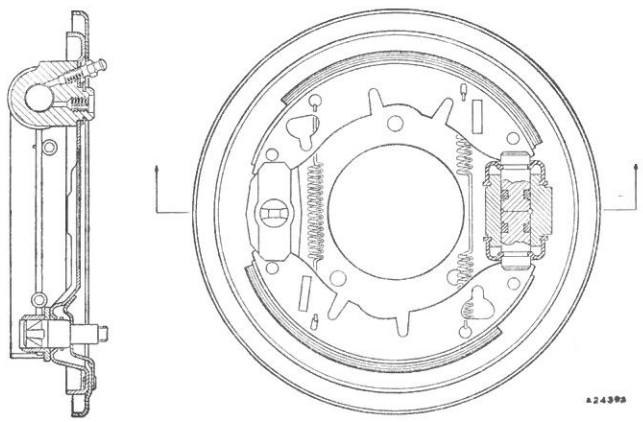

Fig. M.5

The right-hand front brake assembly, showing the fitted positions of the leading and trailing brake-shoes, with the pull-off springs anchored in the correct holes in the shoe web

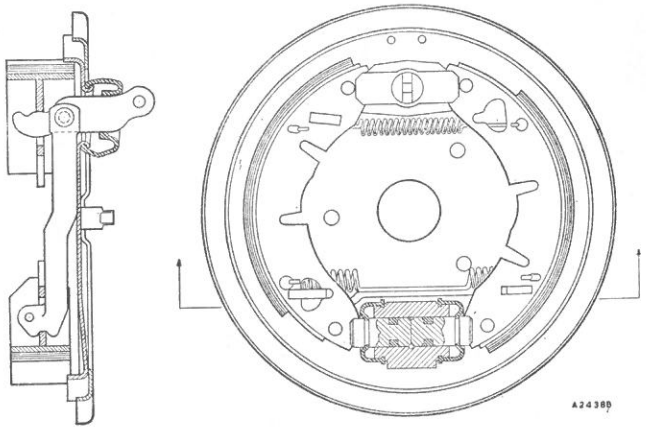

Fig. M.6

The right-hand rear brake assembly, showing the pull-off springs anchored in the correct holes in the shoe web

Refitting

The procedure for refitting a rear wheel cylinder is a reversal of the removal sequence. In addition, the hydraulic system must be bled and the brake-shoes adjusted as detailed in Sections M.4 and M.2 respectively.

Section M.8

BRAKE-SHOE ASSEMBLIES

Removing front shoes (Mk. I)

Jack up the car and remove the road wheel.

Unscrew the two retaining screws and remove the brake-drum.

Note and mark the position in which the pull-off springs are fitted. Release the springs from the shoe web and remove the shoes from the backplate.

NOTE.—Do not operate the brake pedal with the shoes removed from the backplate.

Refitting is a reversal of the above procedure; make sure that the pull-off springs are anchored in their correct holes in the shoe web (see Fig. M.5).

Removing rear shoes (all models)

Chock the front road wheels and set the hand brake in the 'off' position.

Jack up the car under the rear sub-frame and remove the road wheel.

Unscrew the two brake-drum retaining screws and remove the drum.

Note and mark the position in which the pull-off springs are fitted. Release the springs and remove the shoes.

NOTE.—Do not operate the brake pedal with the shoes removed from the backplate.

Refitting is a reversal of the removal procedure; make sure that the pull-off springs are anchored in their correct holes in the shoe web and that the shoes on the front

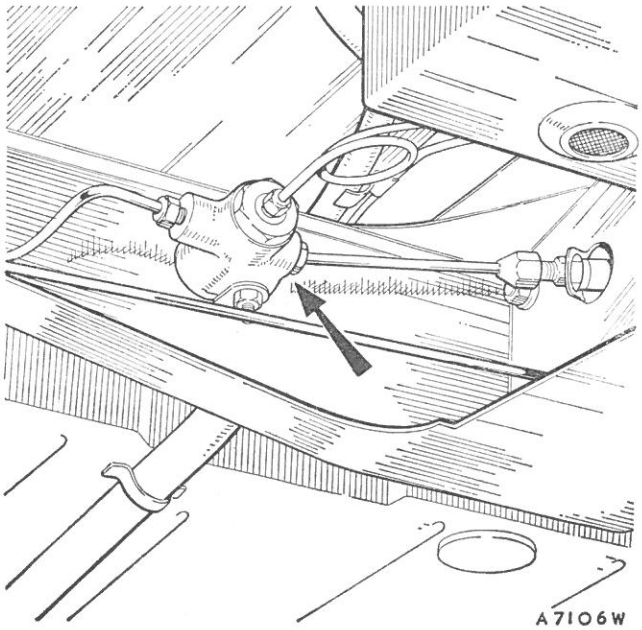

Fig. M.7
The hydraulic pressure regulating valve

brake assembly are fitted with their leading and trailing edges as shown in Figs. M.5 and M.6.

Relining

If it becomes necessary to renew the full set of brake linings due to excessive wear it is essential that the material used for relining is the same as originally specified or of an approved alternative, otherwise the present front to rear brake balance will be adversely affected.

Under no circumstances can linings of varying manufacture, type, or characteristic be tolerated at the different brake stations.

Any divergence from these stipulations may give rise to serious consequences due to out-of-balance braking.

For information as to approved lining materials refer to **'GENERAL DATA'.**

Do not reline the brake-shoes with different types of lining.

Owing to the need for the brake linings to be perfectly concentric with the brake-drums, special precautions must be taken when relining the shoes. It is not recommended that relining be undertaken unless all the specialist facilities are available. We advise the use of replacement shoes obtainable from BMC Service Ltd. Renewal should be carried out in axle sets to ensure even braking conditions.

After riveting the new linings to the brake-shoes it is essential that any high-spots should be removed before replacement on the backplate.

When new linings are fitted turn the adjusters to their fully 'off' position before attempting to refit the brake-drums over the new linings. The hand brake must also be in the fully released position.

Do not allow grease or paint to come into contact with the brake linings.

Do not clean the rubber parts with anything other than Lockheed Super Heavy Duty Brake Fluid. All traces of fuel, etc., used for cleaning metal parts must be removed before reassembly.

Section M.9

PRESSURE REGULATING VALVE

A regulating valve is fitted in the brake fluid line (see Fig. M.7) and is designed to control the hydraulic pressure to the rear brake-shoe operating cylinders. When the pressure in the fluid line reaches a predetermined figure the valve will close and prevent any pressure in excess of this being applied to the rear brakes; all additional pressure is transferred to the wheel cylinders operating the front brakes.

Removing

Disconnect the three pressure lines from their connections on the valve body and remove the nut and washer to release the valve from its location on the rear sub-frame front cross-member.

Dismantling

Clean the exterior of the assembly.

Unscrew and remove the end plug and sealing washer.

Extract the valve assembly and the return spring.

Examine the rubber seals; if they are worn or damaged a new piston and seal assembly must be fitted.

Reassembling

Thoroughly clean and lubricate the body bore and all the component parts with Lockheed Super Heavy Duty Brake Fluid. Fit a new taper seal and piston seal in the positions shown in Fig. M.8; make certain that the taper seal is fitted with the small diameter positioned to enter the valve bore first.

Refit the return spring and the valve assembly, and secure in position with the end plug and sealing washer.

Refitting

Refit the assembly to the sub-frame cross-member, reconnect the three pressure lines, and bleed the system as detailed in Section M.4.

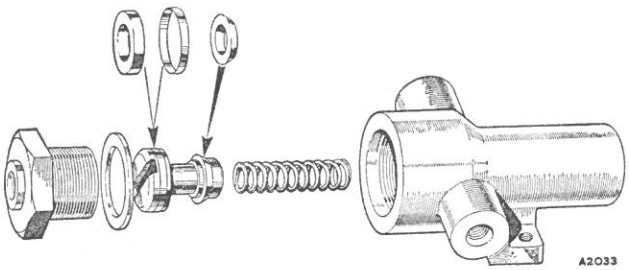

Fig. M.8
The hydraulic pressure regulating valve components

Section M.10

REMOVING THE FLEXIBLE HOSE

Do not attempt to release a flexible hose by turning either end with a spanner; it should be removed as follows.

Unscrew the metal pipe line union nut from its connection to the hose.

Hold the hexagon on the flexible hose and remove the locknut securing the flexible hose union to the bracket.

Unscrew the flexible hose from the cylinder.

Section M.11

HAND BRAKE CABLES

Removing

Chock the front road wheels and set the hand brake lever in the 'off' position.

Remove the cable adjusting nuts and remove the cable fairlead located in the centre of the floor and to the rear of the front seat. Draw the cable through the floor from underneath the car and release the cable from the guide channel on the rear sub-frame front cross-member.

Jack up the car under the rear sub-frame and remove the road wheel.

Remove the nut securing the cable swivel sector to the radius arm and allow the sector to be removed with the cable. Draw the cable through the frame and release it from the actuating lever on the brake backplate.

When fitting a new cable make certain that the corners of the sector are 'nipped' as shown in Fig. M.9.

Refitting

Refitting is a reversal of the removal procedure. Make certain that the guide channel is well lubricated. Use grease to Ref. C.

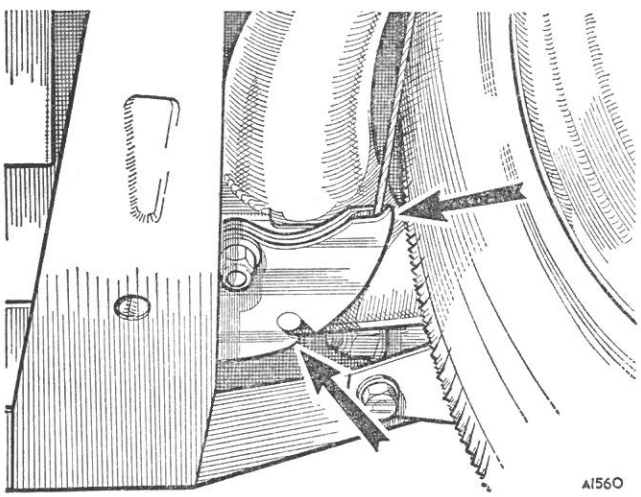

Fig. M.9

The hand brake cable sector mounted on the rear radius arms. Only the corners indicated must be 'nipped' to position the cable

The cable sectors are fitted with self-lubricating bushes. Should brake drag be suspected, lubricate the sector bushes lightly with oil.

Readjust the hand brake as detailed in Section M.3.

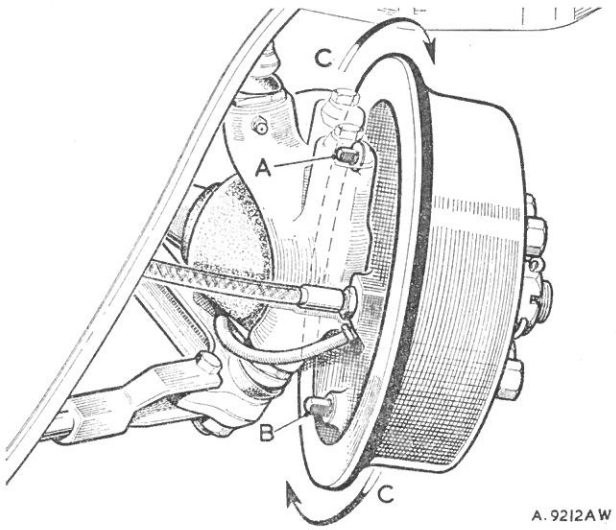

Fig. M.10

The two adjusters for the two-leading-shoe front brake

A. Rear shoe adjuster.
B. Front shoe adjuster.
C. Turn the adjusters in the direction of rotation as indicated.

Section M.12

TWO-LEADING-SHOE FRONT BRAKES (Mk. II)

Adjustment

Each front brake has two squared adjusters projecting from the rear face of the backplate, one adjuster for each brake-shoe. Jack up the car and deal with one adjuster at a time. Turn the adjuster in the same direction as the forward rotation of the front wheel until the drum is locked, then back off the adjuster the minimum amount necessary to allow the drum to rotate freely. Spin the wheel and apply the foot brake firmly to centralize the shoe. Re-check the adjustment, and repeat the complete operation with the other adjuster.

Carry out the same sequence on the other front wheel.

Dismantling

Jack up the car and remove the front road wheel. Back off both adjusters completely, extract the two retaining screws, and remove the brake-drum. The tips of the brake-shoes are retained to the wheel cylinder pistons by spring-loaded hooks, one to each shoe. Withdraw the hooks from their registers in the pistons and turn them to one side.

Mark the position of the shoe return springs in the shoes and note which end of the shoe is fitted to the wheel cylinder. Lift out one shoe from the recesses in the wheel cylinder and pivot, against the pressure of the return spring. Manœuvre the assembly of the shoes and springs over the front hub.

Wire the pistons to the wheel cylinder castings to prevent them from being accidentally pushed out.

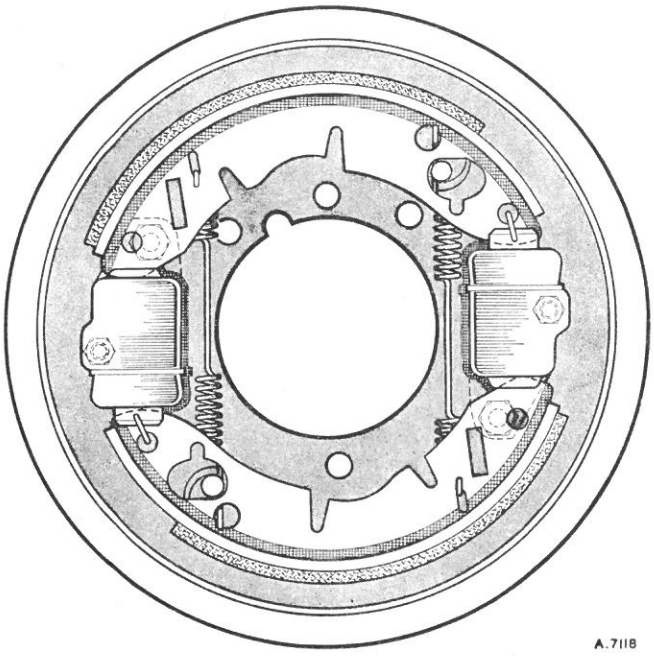

Fig. M.11

The left-hand front brake assembly, showing the fitted position of the shoes and pull-off springs

Reassembly is a reversal of the dismantling procedure. Ensure that the shoes are replaced the correct way round and the return springs are fitted in their correct positions. The shoes must register correctly in the grooves in the pistons and pivot points.

Wheel cylinder removal

Remove the brake-shoes as described under **'Dismantling'.** Disconnect the flexible brake hose from the front wheel cylinder (see Section M.10). Unscrew the two union nuts and detach the pipe bridging the two wheel cylinders.

Remove the two hexagon screws retaining each wheel cylinder to the backplate and detach the wheel cylinders.

Note that, on replacement, the piston of the wheel cylinder faces in the same direction as the forward rotation of the brake-drum and that the bleed screw is fitted to the rearmost wheel cylinder.

Section M.13

PREVENTIVE MAINTENANCE

To safeguard against the possible effects of wear, or deterioration, it is recommended that:

(1) Disc brake pads, drum brake linings, hoses, and pipes should be examined at intervals no greater than those laid down in the Passport to Service.

(2) Brake fluid should be changed completely every 18 months or 24,000 miles (40000 km.) whichever is the sooner.

(3) All fluid seals in the hydraulic system and all flexible hoses should be examined and renewed if necessary every 3 years or 40,000 miles (65000 km.) whichever is the sooner. At the same time the working surface of the pistons and of the bores of the master cylinder, wheel cylinders, and other slave cylinders should be examined and new parts fitted where necessary.

Care must be taken always to observe the following points:

(*a*) At all times use the recommended brake fluid.

(*b*) Never leave fluid in unsealed containers. It absorbs moisture quickly and this can be dangerous.

(*c*) Fluid drained from the system or used for bleeding is best discarded.

(*d*) The necessity for absolute cleanliness throughout cannot be over-emphasized.