GEARBOX

CHAPTER W

CONTENTS

Sect. W1. GEARBOX - DATA

(TYPE SE.4 SPEED).

Type:	Epicyclic Gearbox, 4 Forward Speeds.
Gear Ratios:	1st Speed 4·25:1 3rd Speed 1·596:1
	2nd Speed 2·408:1 4th Speed 1·00:1
Rotation:	Clockwise looking on Input End.
Mounting:	Independent mounting using bearer brackets.
Operation:	By Air Pressure 65 lb./sq. in.±2½ lbs.
Oil Pumps:	1. Plunger Pump on Output Shaft.
	1. Gear Pump driven from Input Shaft.
Oil Capacity:	2½ Gallons (approx.).
Brake Setting Gauge Dimensions:	1st Speed 1·875
	2nd Speed 2·125
	3rd Speed 2·125

Sect. W2. GEARBOX - DESCRIPTION

(*See figs.* 1 and 2).

The gearbox is a four speed independently mounted unit in which three gears; 1st, 2nd and 3rd speed, are provided by means of compounded epicyclic gear trains. The direct drive top gear is obtained by means of a multi-plate clutch.

All four gears are air-operated, each being provided with a separate cylinder. For the reduction gears, air pistons working in cylinders mounted on the bottom cover are used to apply band brakes.

In top gear the whole of the gearing rotates as a solid unit giving direct drive from input to output and takes the form of a multi-plate clutch which is engaged by axial pressure from three equally spaced air cylinders contained within the front cover.

When the change speed selector lever is moved into a gear engaged position, air flows through an electro-magnetic air valve and air restrictor into the cylinder required. When a different gear is selected the air pressure is transferred to the newly required cylinder, the air restrictors controlling the flow of air as the change over is effected.

Sect. W3. GEARBOX - BRAKE OPERATION

(*See figs.* 2 and 3).

The brake mechanisms in this gearbox are used to bring into operation the reduction gears, 1st, 2nd, and 3rd speed, one brake band being provided for each.

When a gear is engaged the appropriate brake grips the brake drum bringing it to rest, thus providing a reaction so that power is transmitted to the gearbox output shaft.

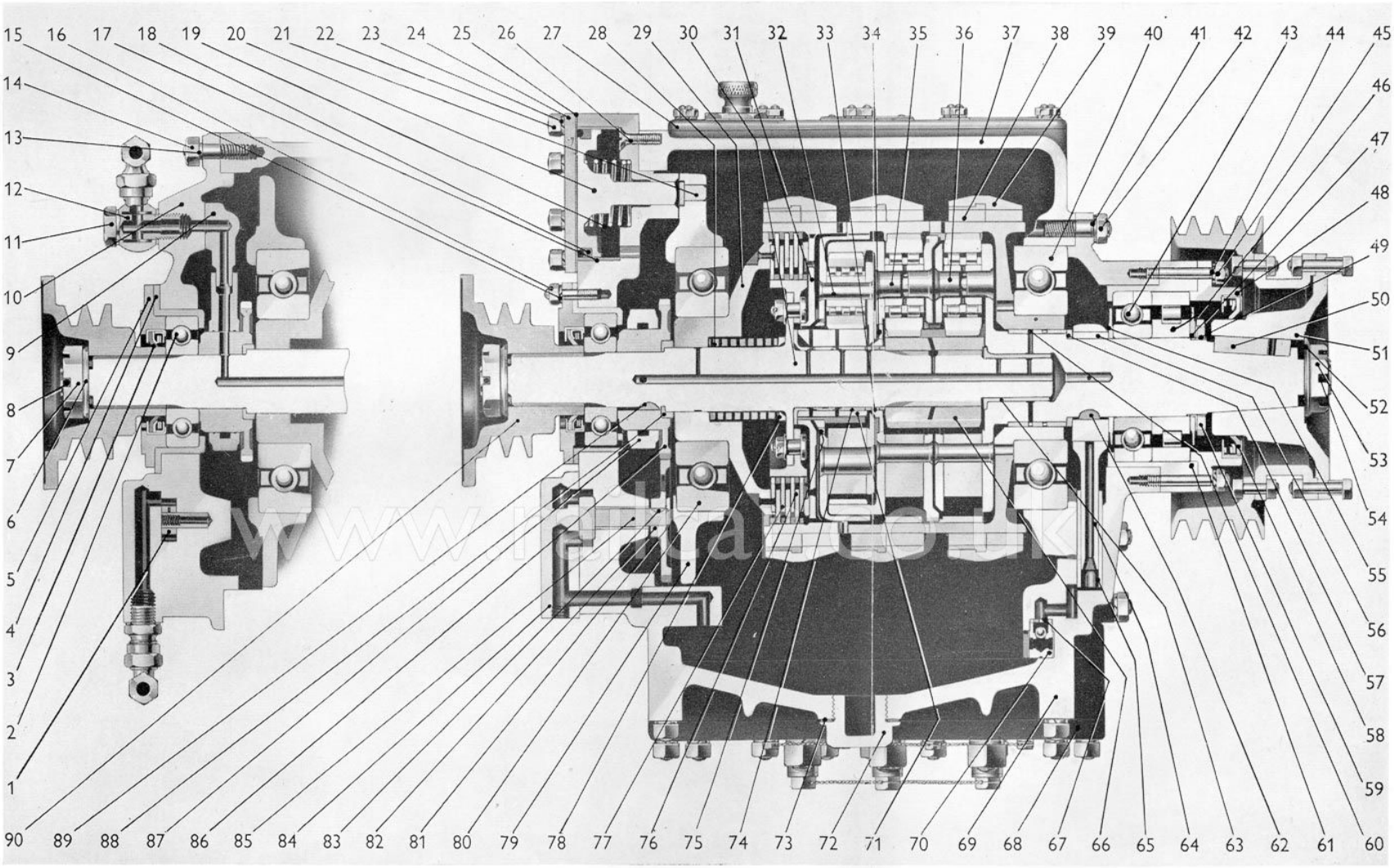


Fig. 1. Section through Gearbox.

1. PUMP GEAR DRIVEN
2. BEARING
3. OIL SEAL (INPUT)
4. BEARING SLEEVE (FRONT COVER)
5. OIL SEAL HOUSING (INPUT)
6. INPUT NUT WASHER
7. INPUT NUT
8. SPLIT PIN
9. BRACKET FOR OIL MUFF
10. FRONT COVER
11. BANJO BOLT
12. BANJO UNION
13. SPRING WASHER
14. NUT
15. SPRING WASHER
16. NUT
17. TOP SPEED CYLINDER LINER
18. SEAL FOR CLUTCH PISTON
19. TOP SPEED PISTON SPRING
20. TOP SPEED PISTON
21. CLUTCH THRUST RING BUTTON
22. NUT
23. SPRING WASHER
24. TOP SPEED AIR CYLINDER COVER PLATE
25. GASKET
26. CONE HEADED SCREW
27. INSPECTION COVER ASSEMBLY
28. CLUTCH RETURN SPRING
29. CLUTCH ACTUATION MEMBER ASSEMBLY
30. INPUT SHAFT ASSEMBLY
31. 3RD SPEED BRAKE DRUM ASSEMBLY
32. 3RD SPEED TRAIN ASSEMBLY
33. BUSH—3RD SPEED PLANET CARRIER
34. BUSH—3RD SPEED ANNULUS
35. 2ND SPEED TRAIN ASSEMBLY
36. 1ST SPEED TRAIN ASSEMBLY
37. GEARCASE
38. INTERNAL BRAKE BAND
39. EXTERNAL BRAKE BAND
40. BEARING
41. SPRING WASHER
42. NUT
43. BEARING
44. SPRING WASHER
45. NUT
46. BEARING
47. OIL THROWER
48. OIL SEAL HOUSING
49. OUTPUT SHAFT LOCKNUT WASHER
50. OUTPUT SHAFT KEY
51. OUTPUT COUPLING
52. OUTPUT SHAFT WASHER
53. OUTPUT SHAFT NUT
54. OUTPUT SHAFT SPLIT PIN
55. OIL PUMP WASHER (REAR)
56. OIL PUMP ECCENTRIC (REAR)
57. OIL PUMP WASHER
58. OIL SEAL (OUTPUT)
59. DRIVEN SHAFT LOCKNUT
60. BUSH—1ST SPEED ANNULUS
61. SLEEVE
62. OIL PUMP ECCENTRIC KEY
63. OUTPUT SHAFT BUSH
64. OIL PUMP PLUNGER
65. OIL PUMP OSCILLATING CYLINDER
66. 1ST AND 2ND SPEED SUNWHEEL
67. OIL PUMP VALVE BODY WASHER
68. PLATE FOR CYLINDER BLOCK
69. BASE PLATE
70. OIL PUMP VALVE BODY
71. 3RD SPEED SUNWHEEL
72. OIL DRAIN PLUG
73. OIL DRAIN PLUG WASHER
74. 3RD SPEED SUNWHEEL BUSH
75. 2ND SPEED BRAKE DRUM BUSH
76. CLUTCH PLATE (OUTER)
77. CLUTCH PLATE (INNER)
78. ABUTMENT WASHER
79. CLUTCH THRUST RING
80. BEARING
81. CIRCLIP
82. PUMP GEAR
83. KEY FOR OIL PUMP
84. OIL PUMP COVER
85. PUMP GEAR AND DRIVING SHAFT
86. OIL PUMP DRIVING GEAR
87. OIL MUFF
88. SPACING PIECE
89. DRIVING GEAR KEY
90. INPUT COUPLING

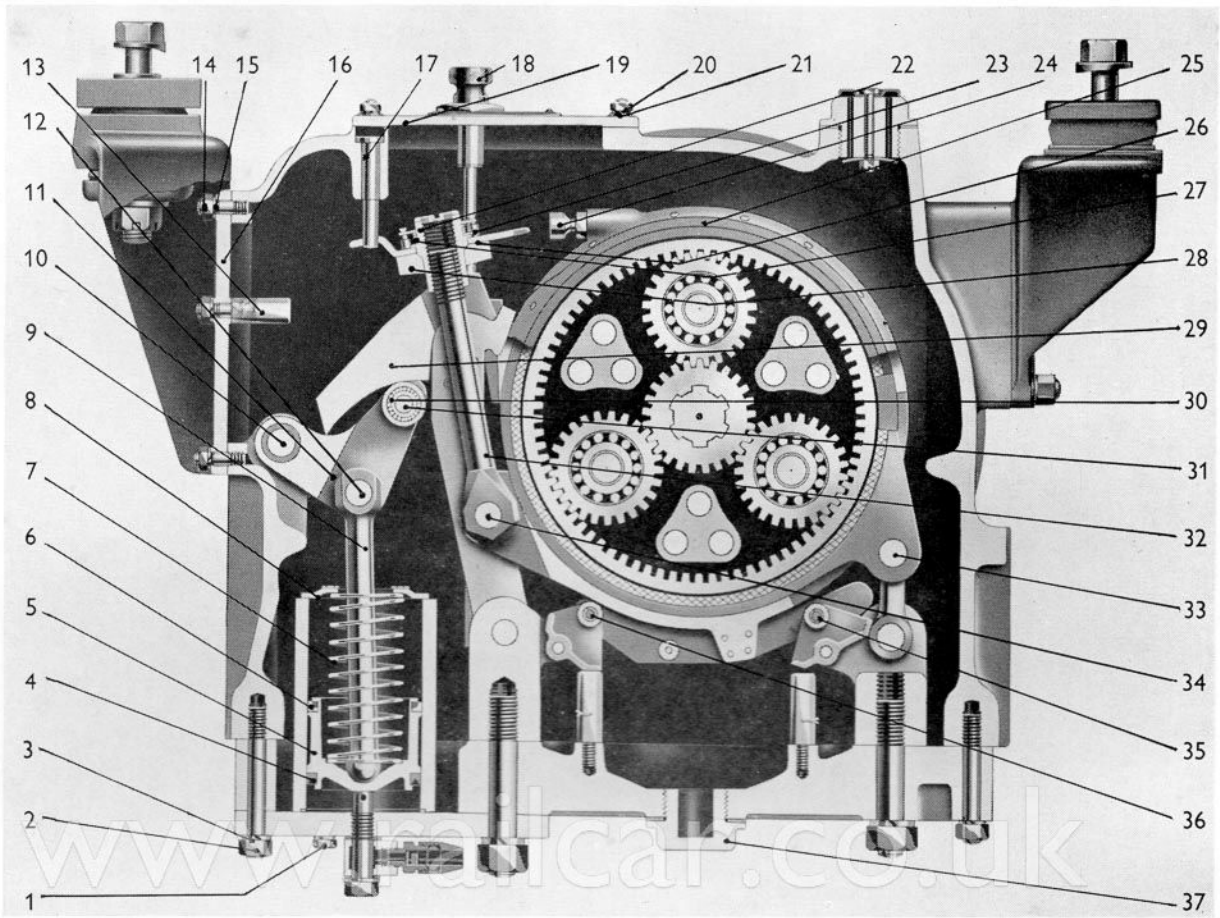


Fig. 2. Section through the 1st Speed Brake Band (Brake Off)

1. SETBOLTS
2. NUT
3. SPRING WASHER
4. SEAL
5. PISTON
6. SEAL
7. PISTON SPRING
8. SPRING RETAINER PLATE
9. OPERATING STRUT
10. ACTUATING LINK PIN
11. CAM PLATE
12. OPERATING STRUT BOLTS
13. CAM PLATE STOP
14. NUT
15. SPRING WASHER
16. MOUNTING BRACKET
17. ADJUSTER STOP
18. DIPSTICK
19. INSPECTION COVER
20. NUT
21. SPRING WASHER
22. ADJUSTER NUT
23. ADJUSTER RING PIN
24. ADJUSTER SCREW
25. BRAKE BAND
26. ADJUSTER RING
27. ADJUSTER SPRING
28. ADJUSTER TABLE
29. THRUST PAD
30. CAM ROLLER OUTER RACE
31. ACTUATING LINK BOLT
32. PULL ROD
33. INTERNAL BAND PIN
34. PULL ROD PIN
35. CENTRALIZER SPRING
36. CENTRALIZER SPRING
37. OIL DRAIN PLUG

Features of the Brakes (*See fig.* 2).

The brake consists of two concentric bands whose friction linings are situated side by side. The outer band when constricted by the brake mechanism closes the inner band, both linings being brought into contact with the brake drum.

By using suitable anchorage for the inner and outer bands, the brake is balanced, so preventing the shafts and bearings from being subjected to any load arising from the application of the brakes. The brakes are centralized about the drums in such a manner as to prevent them rubbing when in the **off** position.

The brake linings are made from an extremely hard-wearing material suitable for working in oil. It is inevitable, however, that some wear will take place in time, and this is corrected by the Automatic Adjuster Mechanism (*see fig.* 4), which keeps the brakes constantly at their correct setting.

Operating Sequence of the Brakes (*See fig.* 2).

The sequence of operations during brake application is as follows:

When the change speed selector lever is moved into a gear position, air is admitted to the cylinder, forcing the piston (5) upwards. This movement applies an

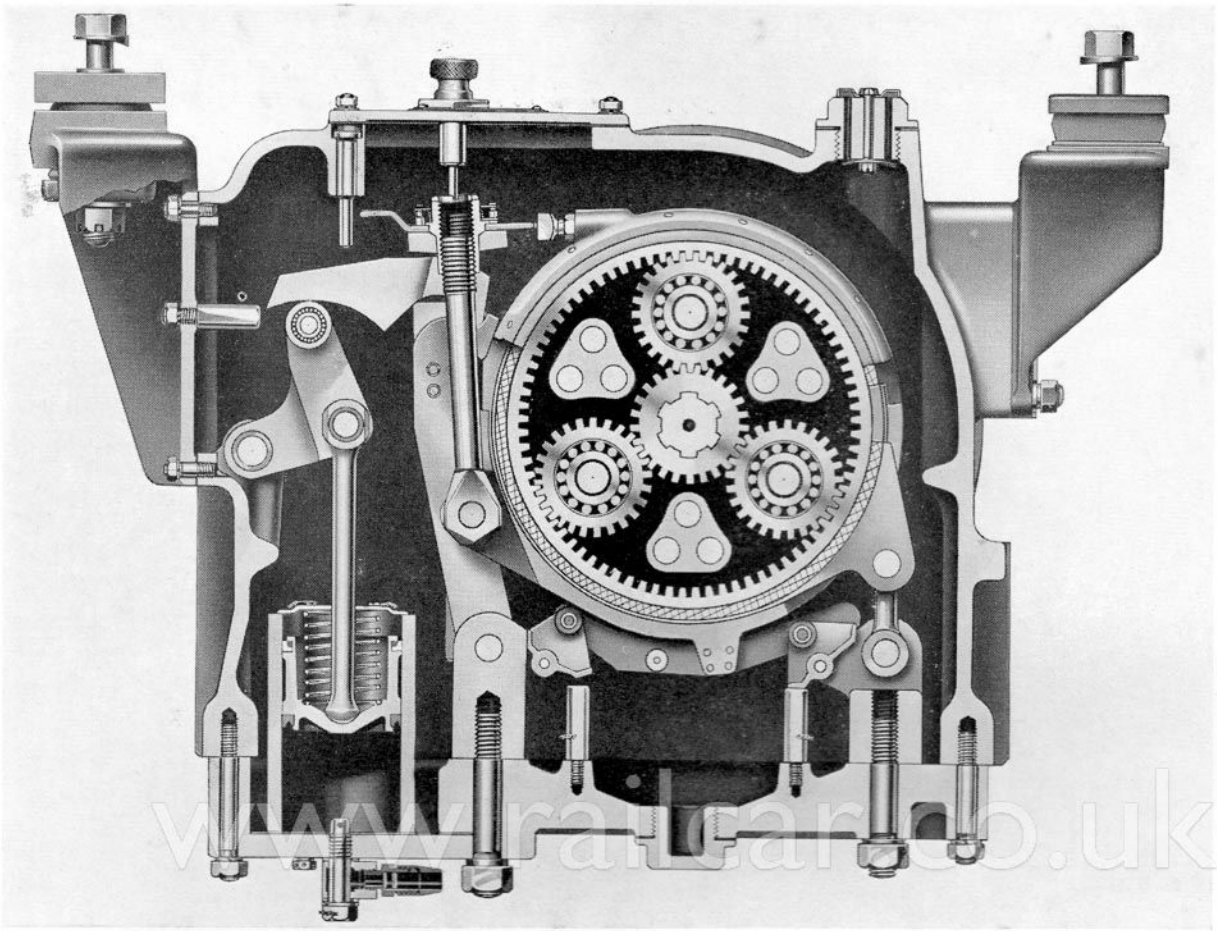


Fig. 3. Section through the 1st Speed Brake Band (Brake On)

upward force to the thrust pad (29) which pivots about its knife edge on the hooks, thereby raising the adjuster mechanism (22, 27, 28) and with it the pull rod (32). Since the pull rod is attached to the lower end of the outer band (the upper end of which is anchored by the hooks) this action constricts the brake band.

Sect. W4. GEARBOX - AIR PRESSURE

At all times when the gearbox is in use, correct air pressure (65 lb. per sq. inch ± 2½lbs.) **must** be maintained. This is essential because **air pressure alone** holds the friction surfaces of brakes and clutch together and prevents them from slipping.

Sect. W5. GEARBOX - AUTOMATIC ADJUSTER

(*See fig.* 4).

This is a device for keeping the brakes constantly at their correct setting, this being accomplished by reducing the effective length of the pull rod and thus taking up the wear of the brake linings. There is one set per reduction gear train. The height to which the thrust pad is allowed to swing determines the grip of the brake, and the travel of this thrust pad is governed by the automatic adjuster nut. Wear on the brake linings will allow the thrust pad to move higher. When this happens

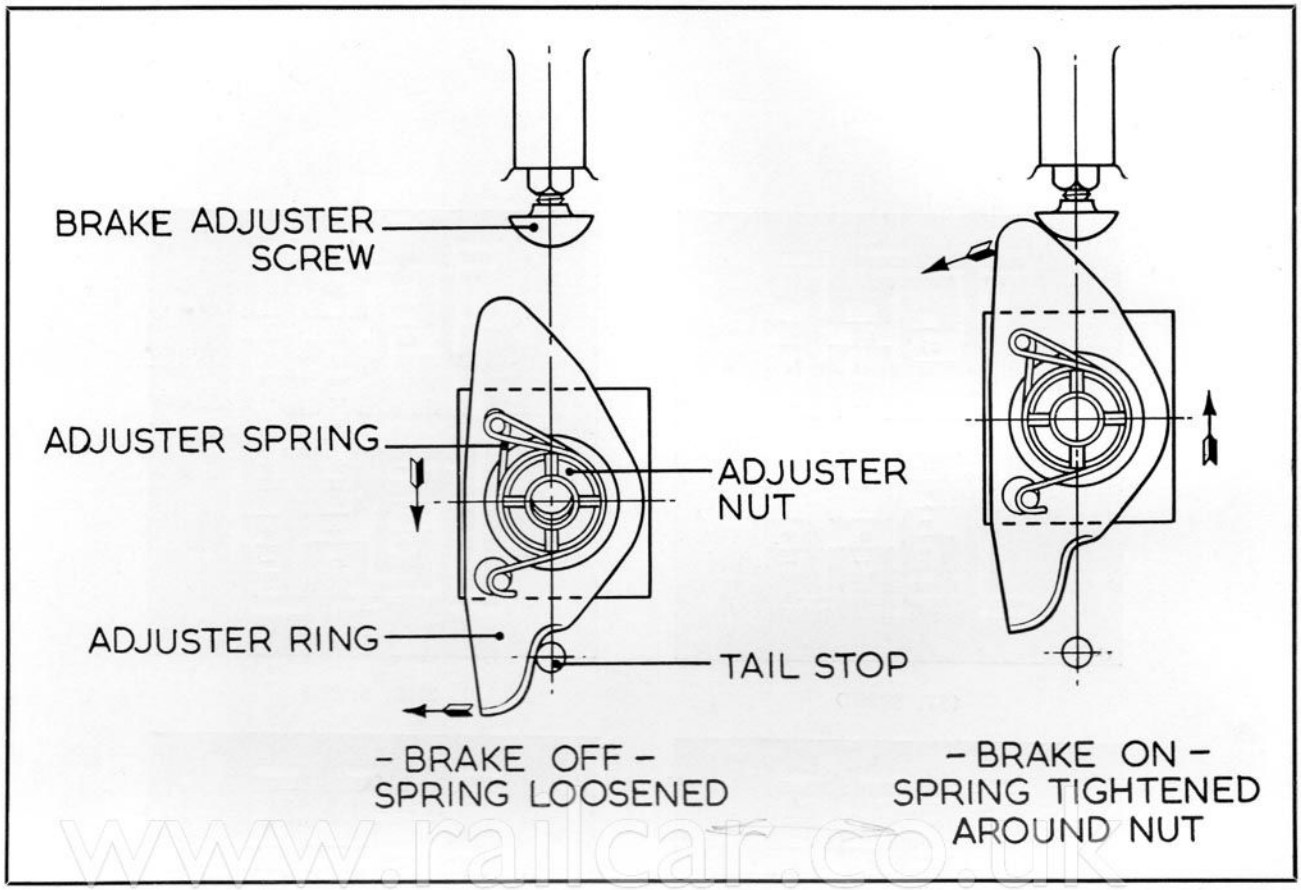


Fig. 4. The Automatic Adjuster

the automatic adjuster ring striking the adjuster screw will be rotated **anti-clockwise.**

The spring is pinned to the adjuster ring in such a way that this action loosens the spring from contact with the adjuster nut. When the brake approaches the **off** position the rear portion of the adjuster ring strikes the tail pin. The adjuster ring now rotates in a clockwise direction taking with it the adjuster nut which is thereby screwed down, taking up the movement caused by the wear of the linings.

Sect. W6. GEARBOX - PRINCIPLE OF OPERATION

(*See figs.* 5 and 6).

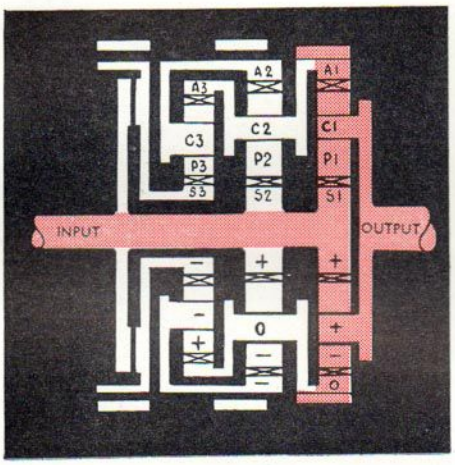
There are in this gearbox three trains each composed of the parts shown on fig. 6.

With 1st gear engaged the brake holds stationary the 1st speed annulus (A1), so that revolution of the sunwheel (S1), which is connected to the driving shaft causes the planets (P1) to roll round the internal teeth of the annulus, taking with them the planet carrier (C1) in the same direction as the driving shaft, but at a lower speed, the 1st speed planet carrier being integral with output shaft.

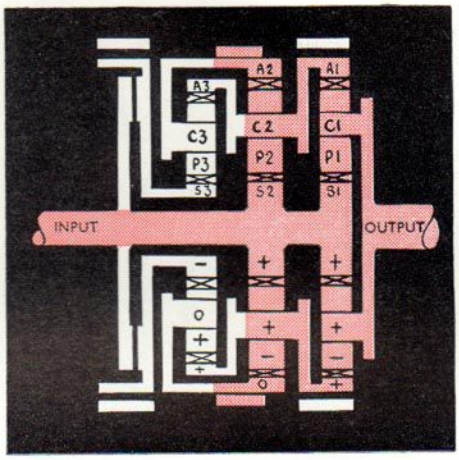
With the 2nd gear engaged, the annulus (A2) of the second gear train is held stationary, thus speeding up the 1st gear annulus through its inter-connection with the 2nd speed carrier.

With 3rd speed engaged a speeding up of the 1st and 2nd gear annuli is brought about by holding stationary the 3rd speed sunwheel.

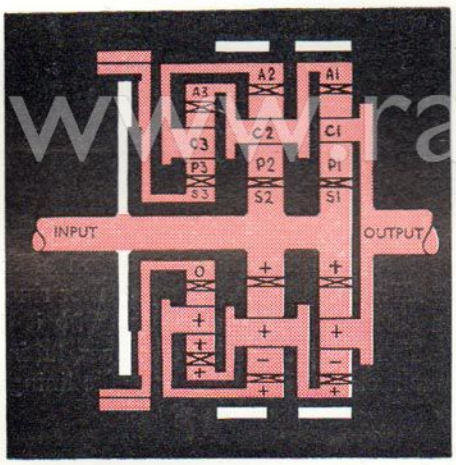
Top gear is obtained by means of a plate clutch which, when engaged, connects the 3rd speed sunwheel to the 1st and 2nd gear sunwheel, thereby locking the whole assembly, and giving a direct drive. The top speed clutch needs no adjustment since wear on the clutch plates is compensated by increased movement of the operating pistons.



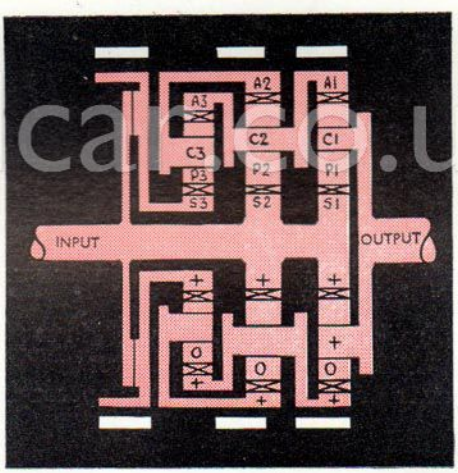
1ST. SPEED



2ND. SPEED



3RD. SPEED



4TH. SPEED

□ = ITEMS TRANSMITTING TORQUE

□ = ITEMS NOT TRANSMITTING TORQUE

ROTATION

\+ = CLOCKWISE LOOKING ON INPUT

− = ANTI-CLOCKWISE LOOKING ON INPUT

○ = NO ROTATION

GEAR	3rd	2nd	1st
ANNULUS	A3	A2	A1
CARRIER	C3	C2	C1
PLANET	P3	P2	P1
SUN	S3	S2	S1

Fig. 5. Torque Transmission Diagram

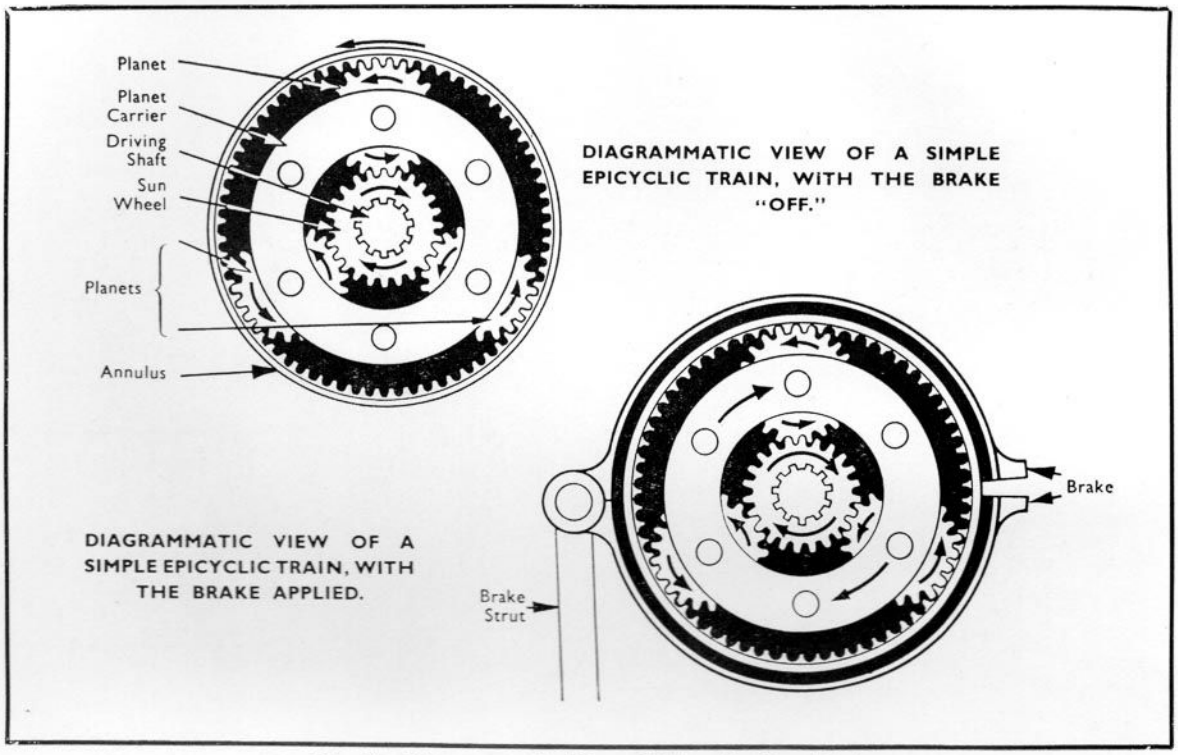


Fig. 6. Diagrammatic View of Epicyclic Gear Train

Sect. W7. GEARBOX - LUBRICATION

(*See figs.* 8 and 9).

Lubrication is provided by a plunger type pump on the output shaft, and a gear type pump on the input shaft. The input pump oil passes through an external pipe and filter to an oil muff and is then delivered to the various bushes, gear trains and bearings. The plunger pump is driven by an eccentric on the output shaft and drains oil from the sump, delivering it to the various bushes, etc., via a centre hole along the shaft.

The gearbox requires $2\frac{1}{2}$ gallons of oil.

The oil specification relating to the gearbox is quoted in Railway Standing Instructions.

Sect. W8. GEARBOX - OIL FILTER

(*See fig.* 10).

Note: In earlier gearboxes of this type a paper filter element was incorporated in the filter but this has now been superceded by the fitment of a metal edged element. Under normal running conditions this element will not require renewing; however, instructions regarding renewal are given (see renewing the filter element) should damage necessitate this. The paper element should in all cases be renewed with the metal edged element. This element should be cleaned with trichlorethylene or petrol which should be applied with a small soft brush. The seals at each end of the filter element should be removed before cleaning and replaced afterwards.

The filter assembly consists of a sump (3) positioned by a centre bolt (5) to a filter head (1). The bolt screws into a centre tube which is locked in the filter head and retains an element guide. The sump beds on a seal (2) carried in a groove formed in the filter head. The lower end of the centre bolt is fitted with a spring (8), washer (11), gasket (12), and a lower element guide (7), retained by a circlip (6). The base of the sump has a reinforcing plate (9) bored to accommodate a seal (10). A filter element (4) is assembled in the sump between the upper and lower element guides.

The filter head is formed with inlet and outlet passages and bored to receive a relief valve which consists of a spring (15) and ball valve (16) retained in the bore by a threaded body (17).

Note: Under normal conditions the filter element has an unlimited life, if however, due to damage, it needs renewing the following instructions apply.

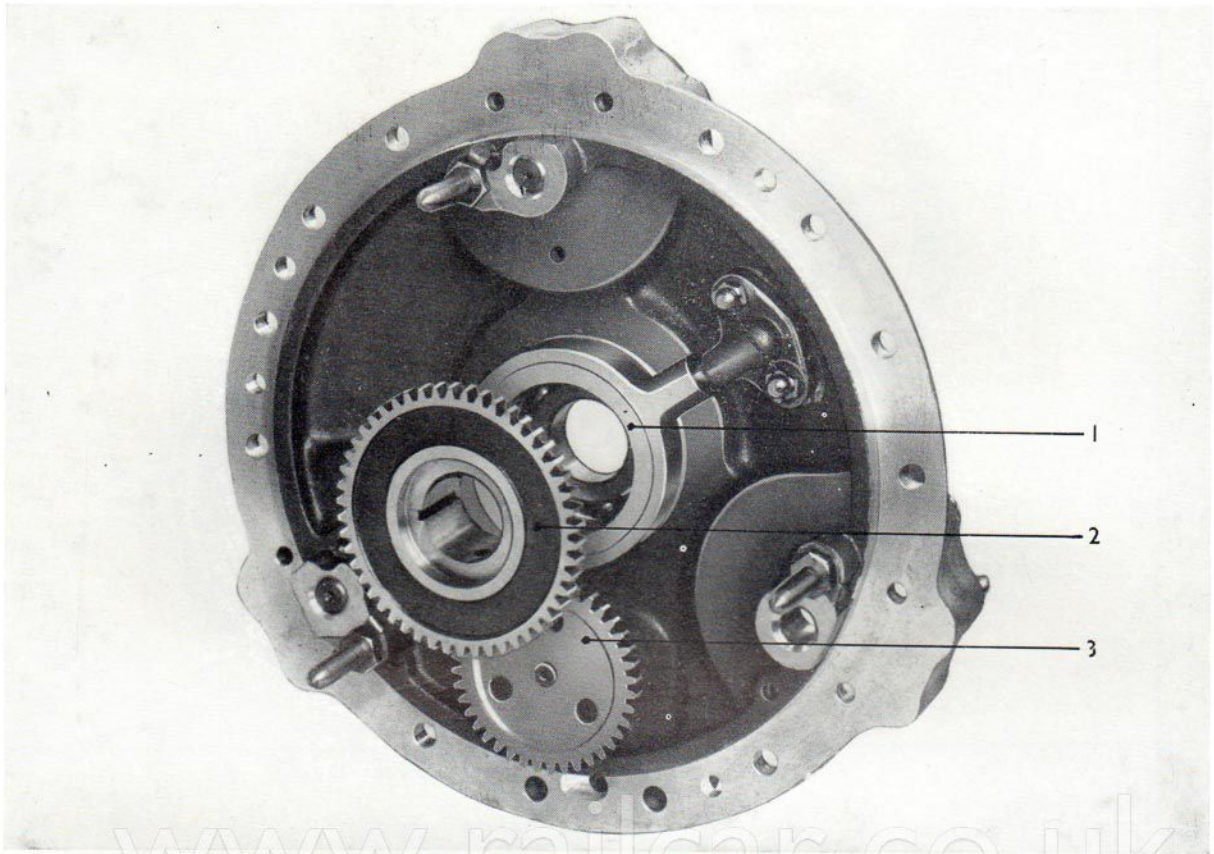


Fig. 7. Internal View of Front Cover

1. OIL MUFF
2. PUMP — DRIVING GEAR (POSITIONED IN OIL MUFF)
3. PUMP GEAR

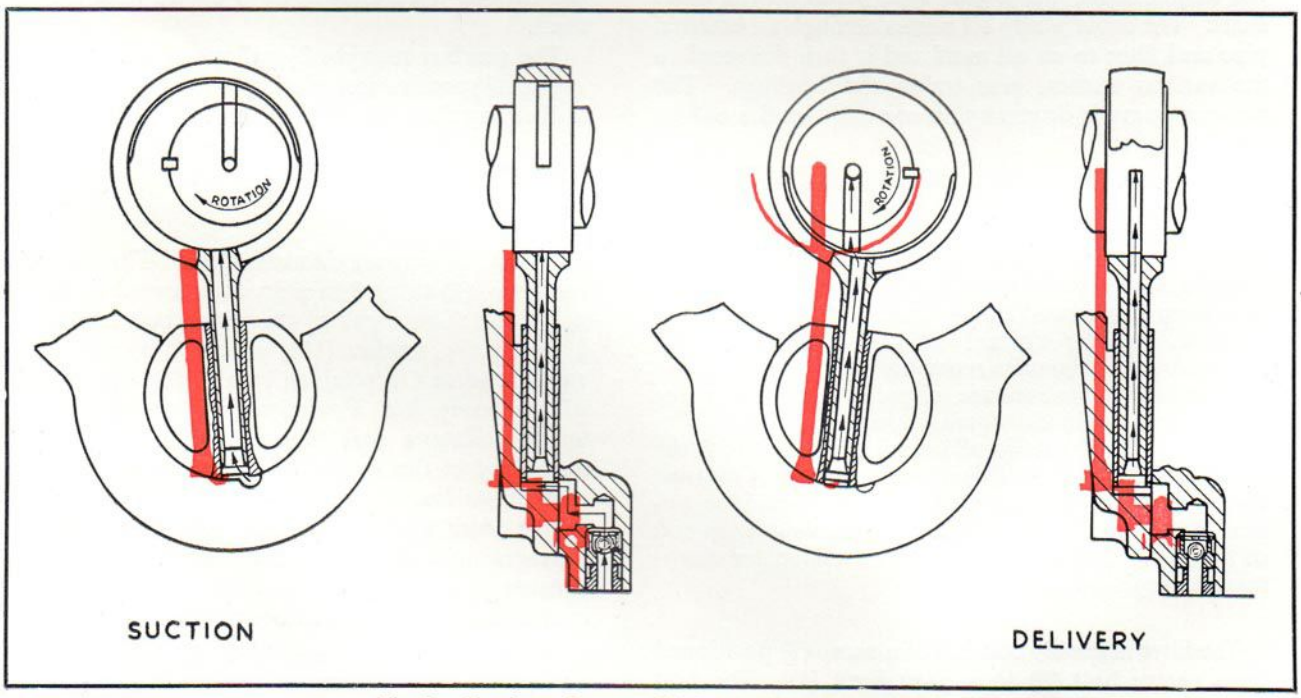


Fig. 8. Gearbox Output Oil Pump (Plunger Type)

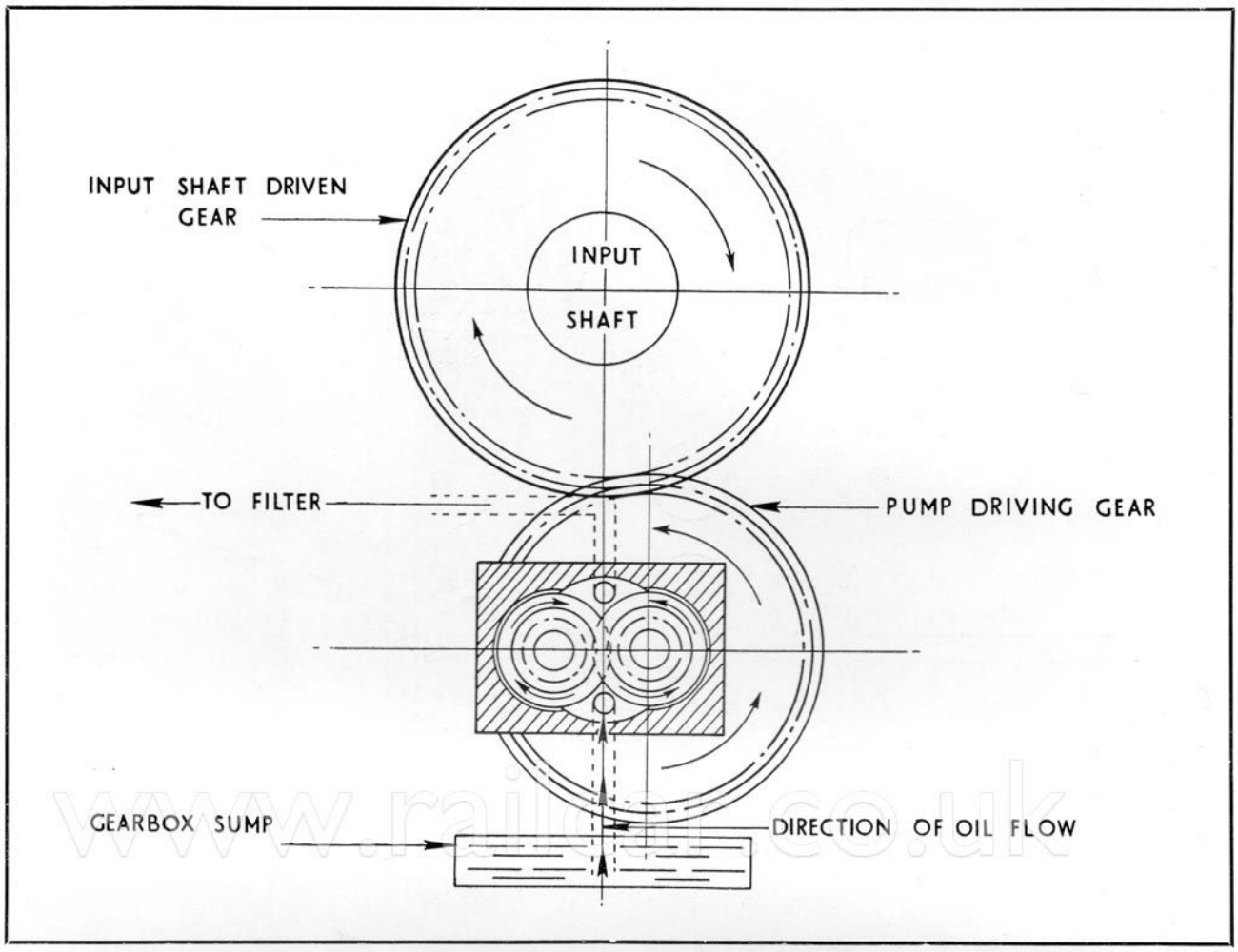


Fig. 9. Diagram of Input Oil Pump

Renewing the Filter Element (*See fig.* 10).

1. Clean the exterior of the filter assembly before removing sump.
2. Unscrew the centre bolt (5) and withdraw the sump (3) and filter element (4) from the head (1). Remove element from the sump.
3. Thoroughly clean the interior of the sump and examine seal (2). Replace seal if damaged, and ensure it is correctly assembled in its groove in the filter head.
4. Place the new element in the sump so that it rests on lower element guide, and then assemble the sump to the filter head, ensuring that the former seats squarely on the seal (2). Screw the centre bolt (5) into the centre tube firmly enough to ensure that there will be no oil leakage past the seals (2) and (10).

Dismantling and Assembling the Filter (*See fig.* 10).

Unscrew the centre bolt (5) from the centre tube, withdraw the sump (3), extract the seal (2) from the head (1) and remove the filter element (4). Extract the circlip (6) from the centre bolt (5), slide the lower element guide (7), gasket (12), washer (11), and spring (8), off the centre bolt and withdraw the sump. Remove the seal (10) and reinforcing plate (9) from the centre bolt (5).

To assemble the filter place the seal (10) and reinforcing plate (9) on the centre bolt (5), followed by the sump (3). Slide the spring (8), washer (11), gasket (12), and lower element guide (7), recess foremost, over the centre bolt and fit the circlip (6). Place the filter element (4) in the sump so that it rests on the lower element guide. Fit the seal (2) in its groove in the filter head, place the sump into position and screw the centre bolt into centre tube firmly enough to ensure that there will be no oil leakage past the seals (2) and (10).

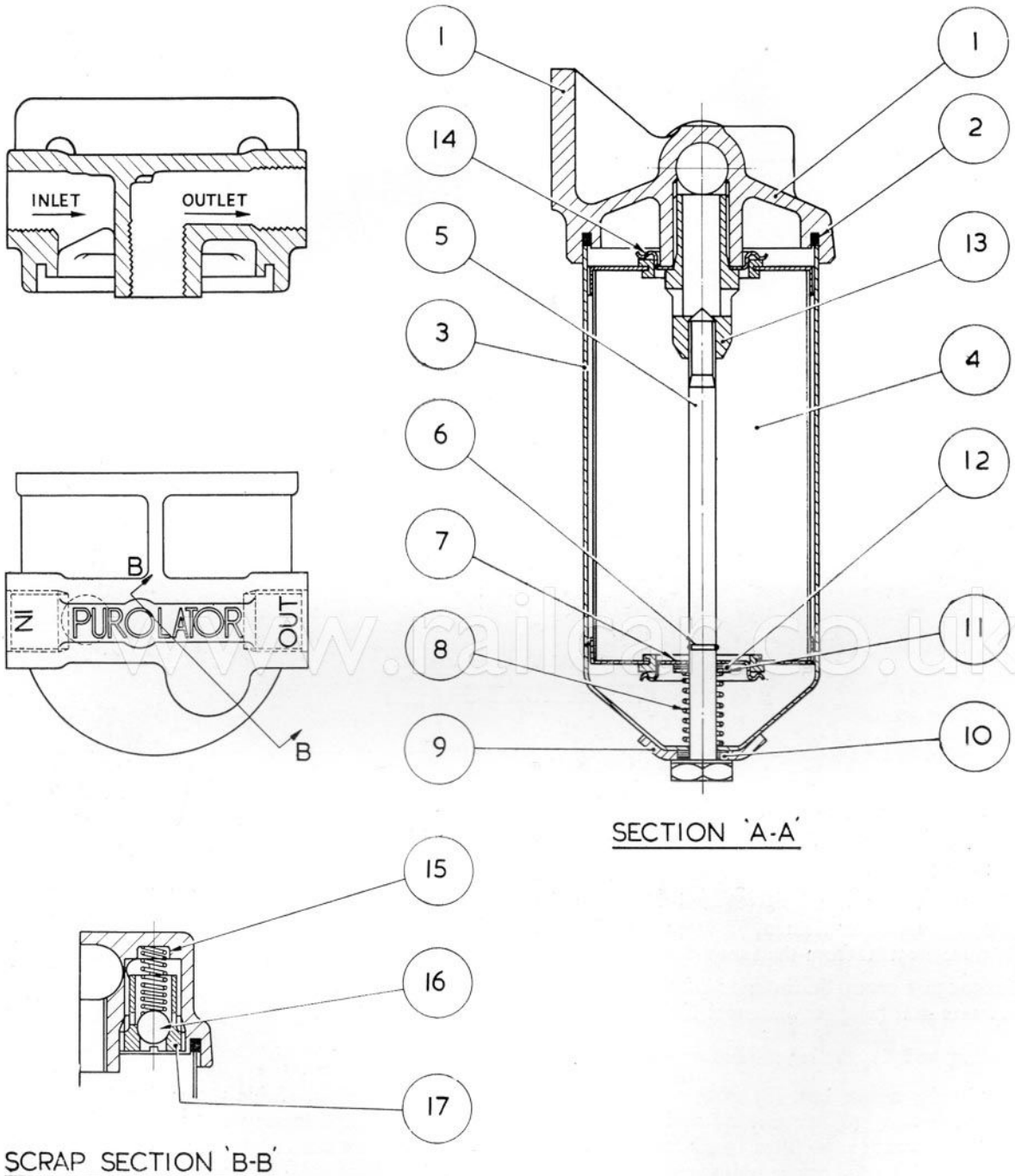


Fig. 10. Section through Oil Filter

Sect. W9. GEARBOX - MAINTENANCE

The following maintenance procedure should be carried out at the intervals quoted in Railway Standing Instructions.

Check oil level with the dipstick, top up if necessary. Any oil leakage should be traced and corrected.

Check upper piston seals on 1st, 2nd, and 3rd speed pistons for oil leakage by removing gearbox cylinder block air unions. If oil leakage is suspected check piston seals and replace if necessary. The free flow of air indicates clear supply pipes. If the flow is unduly restricted, clean the air restrictors in gearbox air inlet unions and also the supply pipe if necessary.

Check all the pistons for air blockage by engaging each gear in turn. Leaking air can be detected escaping from the gearbox breather. Replace any seal found to leak.

Thoroughly clean top of gearbox and remove inspection cover. Ensure that main air reservoir pressure does not fall below 65 lb. per sq. inch during the following tests. Engage each brake in turn and check that the appropriate setting gauge (see fig. 13) will enter.

Check that the brakes are still serviceable. Relining is necessary when top faces of the adjuster nut and pull rod coincide.

Check filter element (see section W8) and renew if choked or damaged. Clean filter and bypass valve.

Drain gearbox and refill with new oil.

Remove gearbox for complete overhaul.

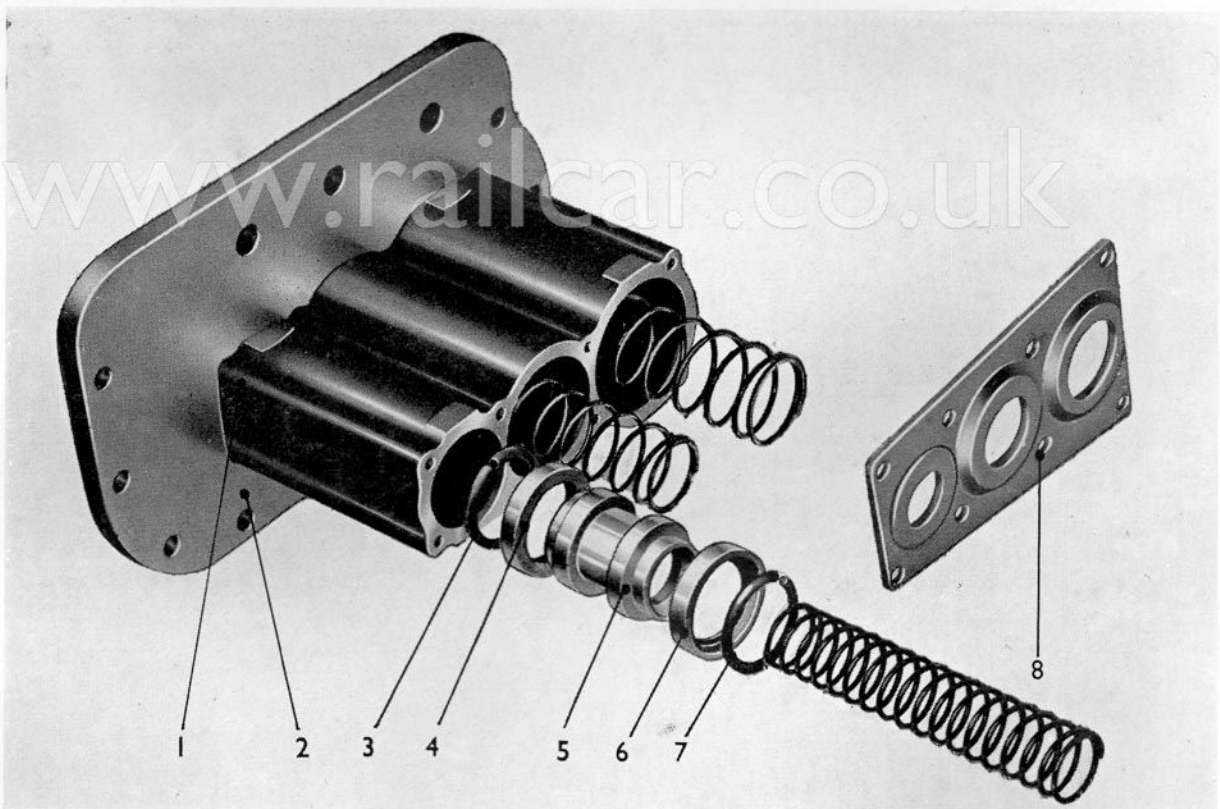


Fig. 11. View of Piston and Cylinder

1. CYLINDER BLOCK
2. CYLINDER BLOCK PLATE
3. PISTON SEAL RETAINING RING
4. PISTON SEAL
5. PISTON
6. PISTON SEAL
7. PISTON SEAL RETAINING RING
8. SPRING RETAINER PLATE

Sect. W10. GEARBOX - SERVICING THE AIR PISTONS

(*See fig.* 11).

To remove and fit 1st, 2nd, and 3rd speed pistons.

1. Remove drain plug (fig. 1, item 72) from beneath main case and drain away oil.
2. Take off nuts securing cylinder block plate (2) and remove together with cylinder block (1).
3. Remove spring retaining plate (8) from cylinder block.
4. Remove the piston return springs and pistons (5)
5. Carefully examine seals (4) and renew if hardened, or having worn or cracked lips. Remove the piston seal retaining rings and fit new seals by stretching them over the flanges on the pistons, the lip to be facing outward when in position. Replace the piston seal retaining rings.
6. Inspect cylinder block plate gasket and renew if necessary.
7. Insert pistons and piston return springs into their cylinders, and replace spring retaining plate and secure in position with setscrews and locking wire.
8. Fit the cylinder block plate (2) and secure with nuts and spring washers.

To Remove and Fit 4th Speed Pistons (*See fig.* 12).

1. Remove air pipes which are connected to cylinder covers.
2. Remove the cylinder covers (1), the pistons (4) will then emerge under pressure of the piston return springs (5).
3. Inspect seals (3) and renew if hardened or damaged.

Remove the piston seal retaining rings and fit new seals by stretching them over the flanges on the pistons, the lips to be facing outwards when in position. Replace the piston seal retaining rings.

Note: To avoid damaging the piston seal retaining rings they should be removed and replaced with great care.

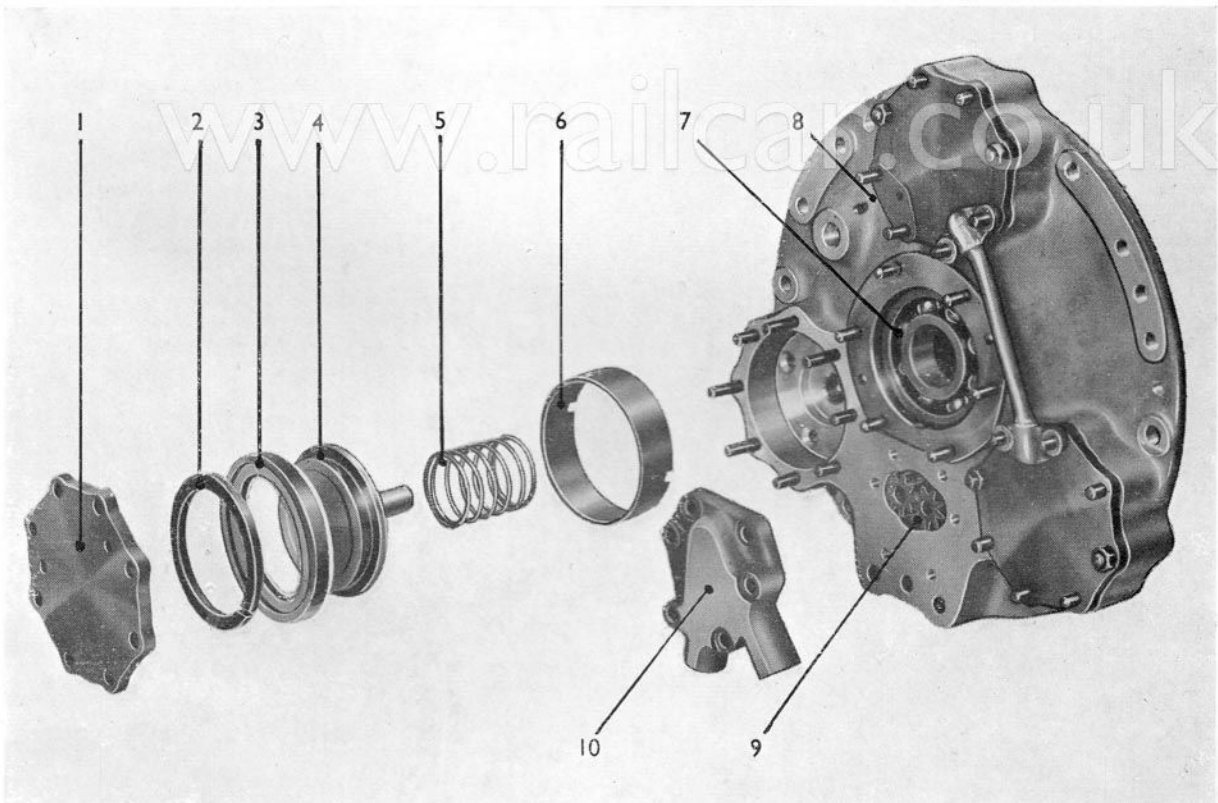


Fig. 12. View of Top Speed Piston Assembly and Oil Pump

1. CYLINDER COVER
2. PISTON SEAL RETAINING RING
3. PISTON SEAL
4. PISTON
5. SPRING
6. CYLINDER LINER
7. BEARING
8. FRONT COVER
9. OIL PUMP
10. OIL PUMP COVER

4. Wash the components in paraffin, drain and immerse in clean oil.
5. Examine gaskets and replace if necessary.
6. Fit pistons and springs, replace cylinder covers and secure with nuts and washers.

Note: When new seals are being fitted or the pistons are removed for examination, cylinder liners, seals and pistons should be oiled before being replaced, preferably with "Oildag" colloidal graphite. If the gearbox has been standing without use for some months, the pistons should be withdrawn and the parts oiled as described above.

Sect. W11. GEARBOX - RENEWING INPUT SHAFT OIL SEAL

(*See fig.* 1).

Remove the split pin (8), nut (7), and washer (6), on input shaft, and withdraw input coupling.

Remove nuts (16) and spring washer (15), and take off oil seal housing (5). Remove faulty oil seal (3) from housing.

Clean the oil seal housing joint face, and wash the oil seal housing and coupling in paraffin and drain.

Lay the oil seal housing on the bench, with joint face uppermost and with great care press the oil seal into position, lip facing inward.

Lightly smear the oil seal housing joint face with a suitable shellac jointing compound and replace housing, securing with nuts and spring washers.

Slide input coupling back into position, and fit washer, nut and split pin.

Sect. W12. GEARBOX - RENEWING OUTPUT SHAFT OIL SEAL

(*See fig.* 1).

Remove split pin (54), nut (53), and washer (52), on output shaft, and withdraw output coupling using suitable extractor.

Remove nuts (45) and spring washers (44) and withdraw oil seal housing (48). Remove faulty oil seal (58) from its housing. Clean the oil seal housing joint face and wash the oil seal housing and coupling in paraffin and drain.

Lay the oil seal housing on the bench with joint face downwards and with great care press the oil seal into position, lips facing inward. It should be noted that the oil seal should only be pressed down until it is flush with face of oil seal housing.

Lightly smear the oil seal housing joint with a suitable shellac jointing compound and replace housing, securing with nuts and spring washers.

Replace output coupling and secure with washer, nut and split pin.

Sect. W13. GEARBOX - SERVICING THE BRAKES

Air Supply for Brake Adjustment

It is essential that dry compressed air, maintained at the correct pressure, is available and connected through a suitable two-way valve to the brake receiving attention.

The air supply may be obtained from any compressor of suitable capacity, or from a **"live"** railcar or locomotive in which an engine can be kept running.

If the gearbox is already installed in a railcar in the absence of an independent supply, its own reservoir may be charged by running the engines with the gearbox in **"Neutral"** and the inspection cover in place.

The engine must be stopped before the cover is removed. Brake setting can proceed until the main reservoir pressure drops to 5 lb. per sq. inch higher than the gearbox operating pressure, when it is necessary to recharge by replacing the inspection cover and starting the engines again.

Fitting the Automatic Adjuster Spring

The spring is fitted over adjuster nut with the wide coil uppermost. The eyelet and loop are placed on adjuster ring pin, and the remaining half loop is fitted over the table pin.

Sect. W14. GEARBOX - THE BRAKE SETTING DIMENSION

(*See figs.* 13 & 14).

When a gear is engaged it will be seen that the adjuster mechanism travels inwards towards the brake band when moving from the off to the on position. By measuring the gap between brake band and the adjuster mechanism with the brake in the on position it is possible to obtain the setting required for each brake. The surfaces used for measuring are the face of the boss on the brake band on which the locknut rests, and the face of the adjuster table. The brake setting dimensions are as follows:

1st, 1·875 2nd, 2·125 3rd, 2·125

Sect. W15. GEARBOX - BRAKE ADJUSTMENT

(*See figs.* 4, 13 & 14).

1. Remove the adjuster spring.
2. Loosen the locknut on the adjuster screw in the brake band, and screw the adjuster screw right in.
3. Apply the brake and try gauge between the face of the adjuster table and the boss on the brake band. The correct setting is that which just allows the gauge to enter.
4. If gauge will not enter, release brake and screw the adjuster nut clockwise, apply the brake and check with the gauge until the correct setting is obtained.
5. If the gauge has too much clearance the adjuster nut must be screwed anti-clockwise to obtain the correct setting.

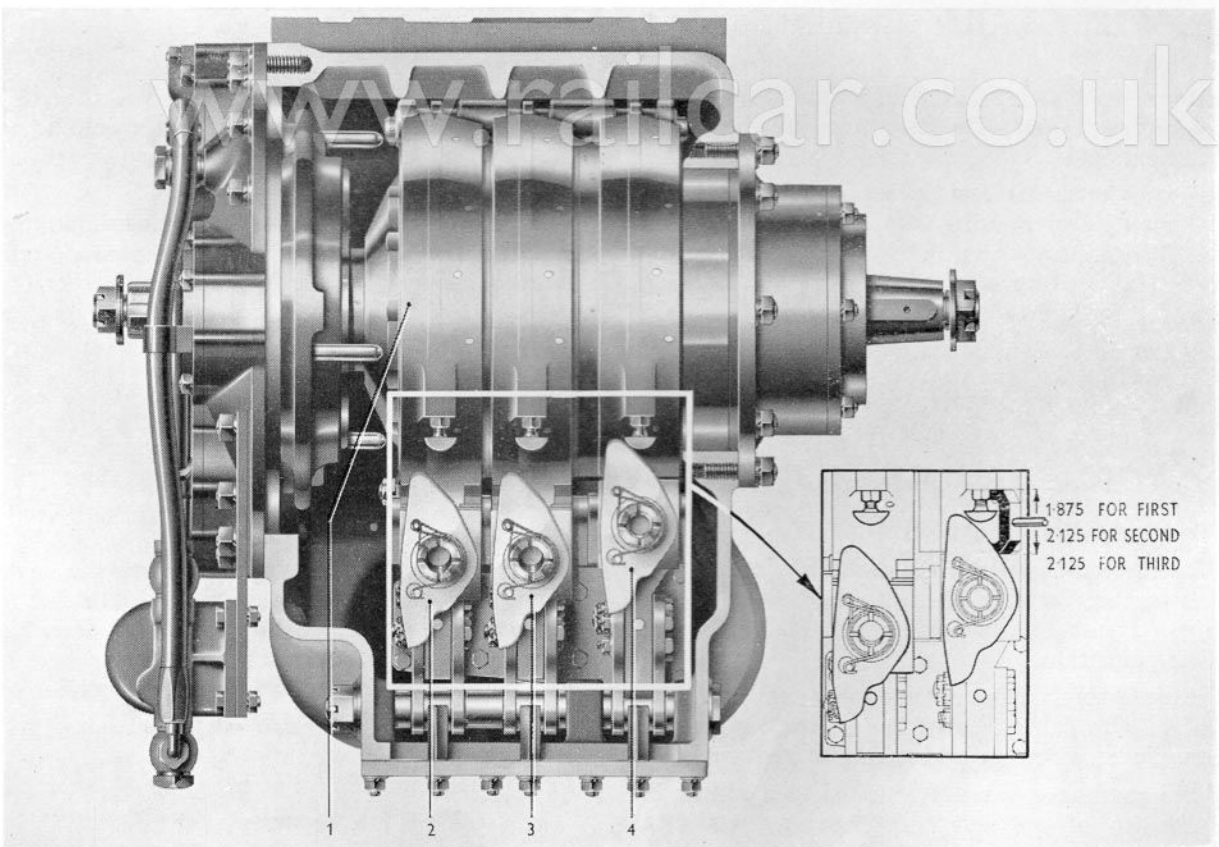


Fig. 13. Brake Setting Dimensions

6. When the correct setting has been obtained release the brake, hold the adjusting ring against the tail pin and replace the spring.
7. Apply and release the brake, moving the adjuster screw out at each release, until the adjuster ring just touches the screw in the **on** position.
8. Lock the adjuster screw, with face which contacts the adjuster ring vertical.
9. Release the spring, then screw the adjuster nut **anti-clockwise** half a turn and replace the spring.
10. Apply and release the brakes several times and note if the adjuster nut has turned. (This may be seen by laying a straight edge across the inspection aperture parallel to the slots in the nut when the brake is in the **off** position, and then sighting the slots at each release.)
11. If the adjuster nut has turned, apply and release the brake repeatedly until the nut stops turning. When the nut appears to have stopped turning, another six applications should be made to ensure that no further movement takes place.
12. If the adjuster nut has not turned, move the adjuster screw out half a turn at a time, until the nut commences to turn. Apply and release the brake until the nut has ceased to turn, and check the gap with the gauge.

Excessive Gauge Clearance:

1. If the gauge has too much clearance release the brake and adjuster springs and then move the adjuster screw half a turn inward and relock.
2. Release the adjuster spring and screw the adjuster nut half a turn in the **anti-clockwise** direction.
3. Replace the adjuster spring, apply and release the brake until the adjuster nut stops turning.
4. Check the gap.

Repeat the operations 1 to 4 if required.

Note: Should the mechanism fail to respond to this setting sequence (especially failure of the adjuster nut to turn when the adjuster spring is considerably deflected) see failure of Automatic Adjuster, Section W16.

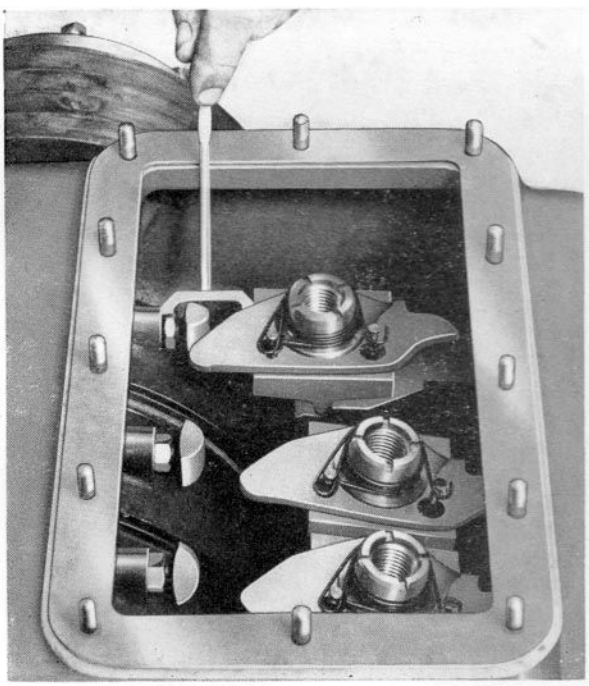


Fig. 14. Application of Toggle Setting Gauge

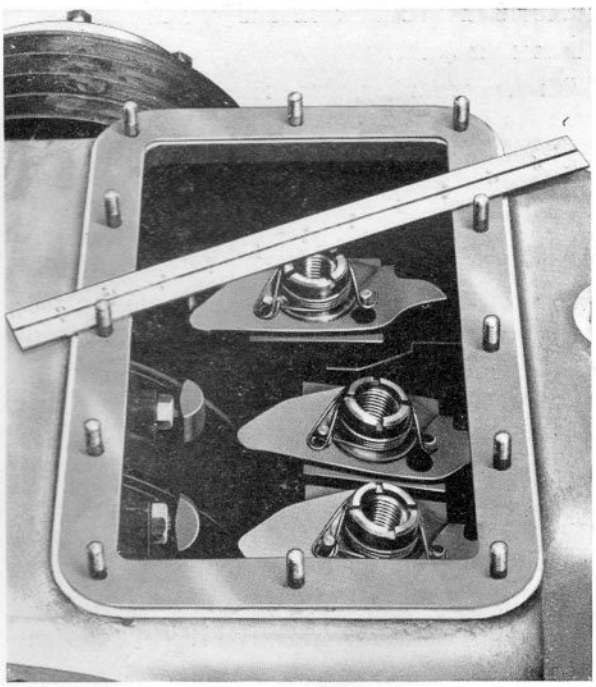


Fig. 15. Checking Movement of Adjuster Nut

Final Adjustment

Insufficient Gauge Clearance:

1. If the gauge will not enter, release the brake adjuster spring and move the adjuster screw half a turn outwards and relock.
2. Apply and release the brake until the adjuster nut stops turning.
3. Replace the adjuster spring, apply and release the brake until the adjuster nut stops turning.
4. Check the gap.

Repeat the operations 1 to 3 if required.

Sect. W16. GEARBOX - FAILURE OF AUTOMATIC ADJUSTER

This mechanism depends on the ratcheting effect of the automatic adjuster spring turning the adjuster nut. This lifts the pullrod and reduces the clearance between the brake band and the drum so reducing the amount of movement permitted to the linkage.

Adjustment compensates for normal lining wear, but the mechanism will not work if the brake is badly out of adjustment.

If failure is suspected, first adjust the brake according to Section W15.

A fault in the automatic adjuster will become apparent in the application of paragraph 11.

When failure is established:

1. Engage the brake.
2. Remove the spring.
3. Check that the ring swings freely around the nut. It should have both vertical and journal clearance.
4. Release the brake.
5. With the special key, turn the adjuster nut clockwise (to test for tightness), and back again. If tight refer to 6(B).
6. If checks 3 or 5 reveal trouble, remove the adjuster nut, ring and table.

A. Tightness of the ring may be occasioned by the intrusion of foreign matter or by wear.

Remove parts from the gearbox, clean and check that they are free from damage. Burrs, etc., should be removed. Fit the ring to the nut and check that in its working position it swings freely. With the ring in position press the nut into its seating on the table and test for clearance between the face of the ring and the abutment shoulder on the nut. If less than ·005″ clearance exists, the underside of the plate should be filed down to give ·005″ to ·010″ clearance.

B. Remove the thrust pad and check the fit of nut on the pullrod. It should screw down by hand (without the use of the key) until the rod protrudes $\frac{1}{8}$″ above the top of it. Tightness in the nut may be corrected by the use of a $\frac{7}{8}$″ B.S.F. free fit tap.

C. If (A) and (B) do not reveal the trouble, fit new automatic adjuster spring.

Sect. W17. GEARBOX - TO REMOVE AND REFIT

Drain the oil from the gearbox by removing the drain plug fitted in the bottom cover. Disconnect the propeller shaft couplings from the front and rear of gearbox, also the pulley belts if fitted. Release the air connections from the gearbox. Pack up the gearbox and remove the mounting bolts.

Remove the gearbox from the railcar to the bench for dismantling.

To replace the gearbox, reverse the above procedure.

Sect. W18. GEARBOX - TO DISMANTLE

(*See fig.* 2).

Clean outside of gearbox thoroughly, masking the breather and air unions to prevent entrance of foreign matter.

Check the necessity for relining the brakes by observing position of the adjuster nut (22) on the pullrod (32). Brake life is exhausted when the top faces of the adjuster nut and pullrod coincide. Preparatory to removing the running gear the brake adjuster mechanisms must be slackened off. Access

to the adjusters is obtained by removing the inspection cover on top of gearcase. Remove the eye and loop of each adjuster spring (27) from adjuster ring pin (23) and the half loop from table pin to release the adjuster nut (22), this should then be screwed three complete turns **anti-clockwise.**

To Remove Front Cover (*See fig.* 1).

Disconnect external oil pipes and remove filter and filter mounting bracket. Take off split pin (8), slotted nut (7), and washer (6). Withdraw input coupling, remove nuts and spring washers securing oil seal housing (5) and remove oil seal housing together with oil seal (3).

Disconnect air pipes which are connected to top speed cylinder covers. Remove the cylinder covers (24), and withdraw pistons (20), piston spring (19), and cylinder liners (17). Unscrew cone headed screws (26) which are located in the piston bores. Withdraw the input pump cover (84) and remove all nuts (14) and spring washers (13) securing the front cover to the gearcase (37). The front cover (10) can now be removed, which will be complete with bearing (2), oil muff (87) and input oil pump assembly.

To Remove Rear End Cover (*See fig.* 1).

Remove split pin (54), slotted nut (53), and washer (52), with suitable extractor, withdraw the output coupling and pulley. Remove oil seal housing (48), and utilising the $\frac{1}{4}$" B.S.F. tapped hole provided remove the shaft key (50). Unlock tab washer (49) and take off the nut (59), tab washer and oil thrower ring (47).

Remove the nuts (42) and spring washers (41), allowing the end cover to be withdrawn complete with bearings.

Next remove rear oil pump washer (55), oil pump plunger (64), eccentric (56), key (62), oscillating cylinder (65), and oil pump washer (57). To further dismantle end cover, tap out the bearings together with bearing sleeve (61).

Dismantling the Running Gear (*See fig.* 1).

Depress clutch thrust ring (79) to facilitate removal of the oil pump driving gear (86), key (89), and the spacing piece (88), and then allow the clutch thrust ring and the actuating member (29) to come out under the action of the return spring (28). Withdraw these two components together with the ball bearing, clutch return spring and abutment washer (78). The input shaft assembly (30) can now be withdrawn.

Remove 3rd speed sunwheel bush (74) and top speed clutch plates (76) and (77).

Remove 3rd speed brake drum (31) followed by bush (75).

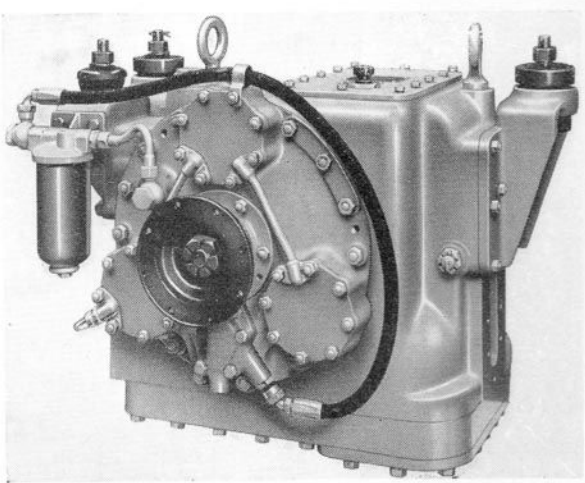


Fig. 16. View of Gearbox (a)

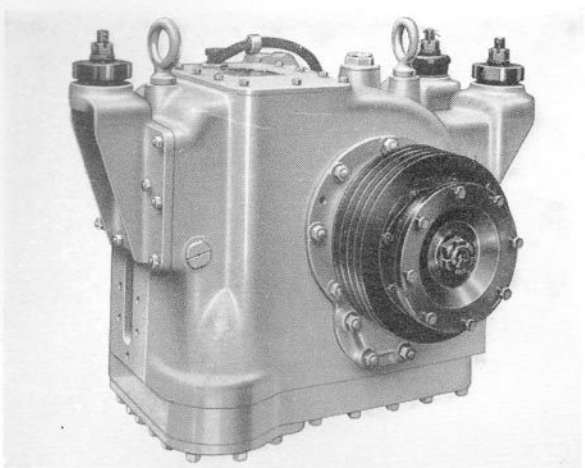


Fig. 17. View of Gearbox (b)

Remove 3rd speed train assembly (32), consisting of 3rd speed carrier and 2nd speed drum, followed by 3rd speed bushes (33) and (34).

Remove 2nd speed train assembly (35), consisting of 3rd speed annulus and 2nd speed planet carrier.

Remove 1st and 2nd speed sunwheel (66) and bush (63).

Remove the 1st speed train assembly (36) and bush (60).

Remove the 1st speed brake drum (fig. 19, item 18), together with ball bearing (40).

Removal of Brake Bands (*See fig.* 2).

Remove the automatic adjuster spring (27), nut (22), ring (26), table (28), and thrust pad (29), from each brake. It is advisable to keep these in sets for subsequent reassembly to the same band.
Remove the nuts securing the base plate to the gearcase and lift gearcase away. The brake bands and their associate parts are now readily accessible.

Press down on top of each brake band (25) to release the hooks. Withdraw split pins from the internal band link pins (33) and remove the pins, lift away the brake bands (25) complete with pullrods (32), first placing rag round the centralizers (36) and (35) to prevent the small but powerful springs from flying out.

To remove pullrods from brake band, tap clear pullrod pins (34).

Removal of Brake Operating Mechanism, etc. (*See fig.* 2).

To dismantle the brake operating mechanism from the gearbox remove split pin, and slotted nut from pin (10), allowing the pin to be withdrawn, thus allowing the actuating link assemblies together with the operating struts (9) and the distance pieces to be removed from the gearcase.

To release the cylinder block from cylinder block plate remove the eight setbolts (1).

The oil pump non-return valve (fig. 1, item 70), situated in the output end of the gearcase, can be removed when the case is lifted clear of the gearbox base.

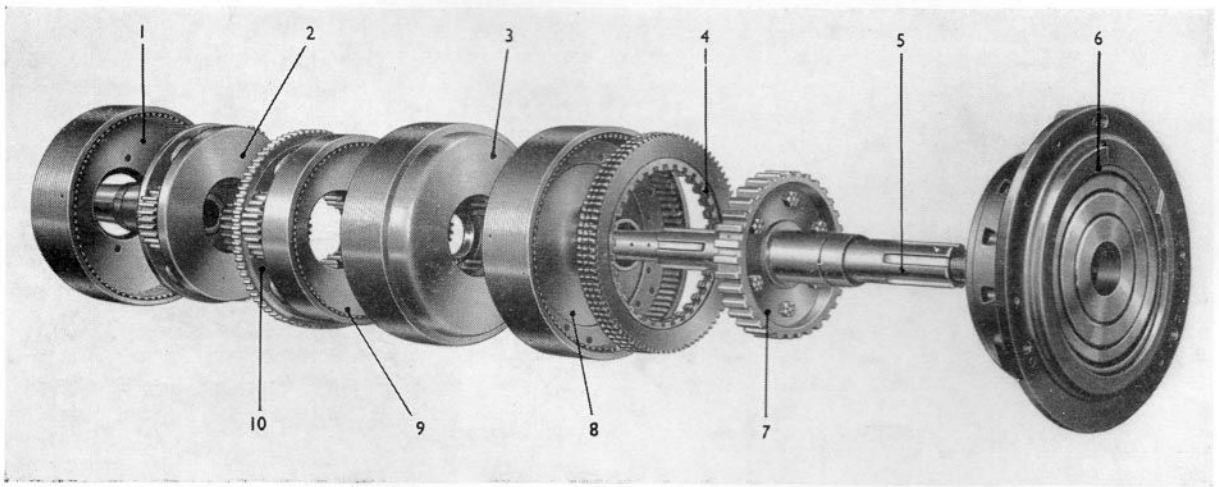


Fig. 18. Exploded View of Running Gear (Viewed from Input End)

1. 1ST SPEED BRAKE DRUM
2. 1ST SPEED GEAR TRAIN AND OUTPUT SHAFT
3. 2ND SPEED BRAKE DRUM
4. CLUTCH PLATE
5. INPUT SHAFT
6. CLUTCH THRUST RING
7. CLUTCH DRIVING MEMBER
8. 3RD SPEED BRAKE DRUM
9. 3RD SPEED ANNULUS
10. 2ND SPEED GEAR TRAIN

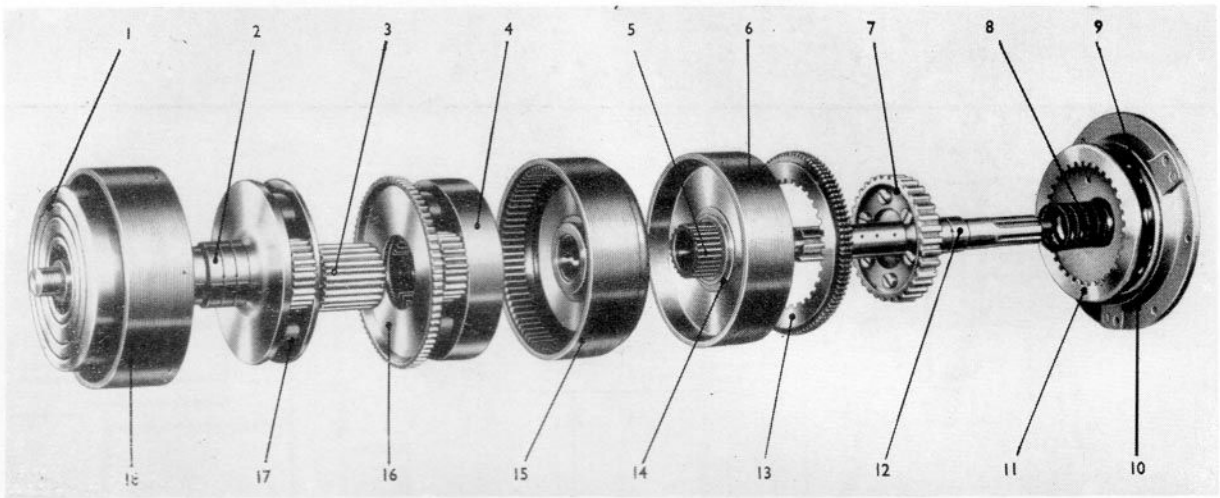


Fig. 19. Exploded View of Running Gear (Viewed from Output End)

1. 1ST SPEED BRAKE DRUM BEARING
2. 1ST SPEED BRAKE DRUM BUSH
3. 1ST AND 2ND SPEED SUNWHEEL
4. 3RD SPEED ANNULUS
5. 3RD SPEED SUNWHEEL
6. 3RD SPEED BRAKE DRUM
7. CLUTCH DRIVING MEMBER
8. CLUTCH RETURN SPRING
9. CLUTCH THRUST BEARING
10. CLUTCH THRUST RING
11. CLUTCH ACTUATION MEMBER
12. INPUT SHAFT
13. CLUTCH PLATE
14. 2ND SPEED BRAKE DRUM BUSH
15. 2ND SPEED BRAKE DRUM
16. 2ND SPEED PLANET CARRIER
17. 1ST SPEED GEAR TRAIN AND OUTPUT SHAFT
18. 1ST SPEED BRAKE DRUM

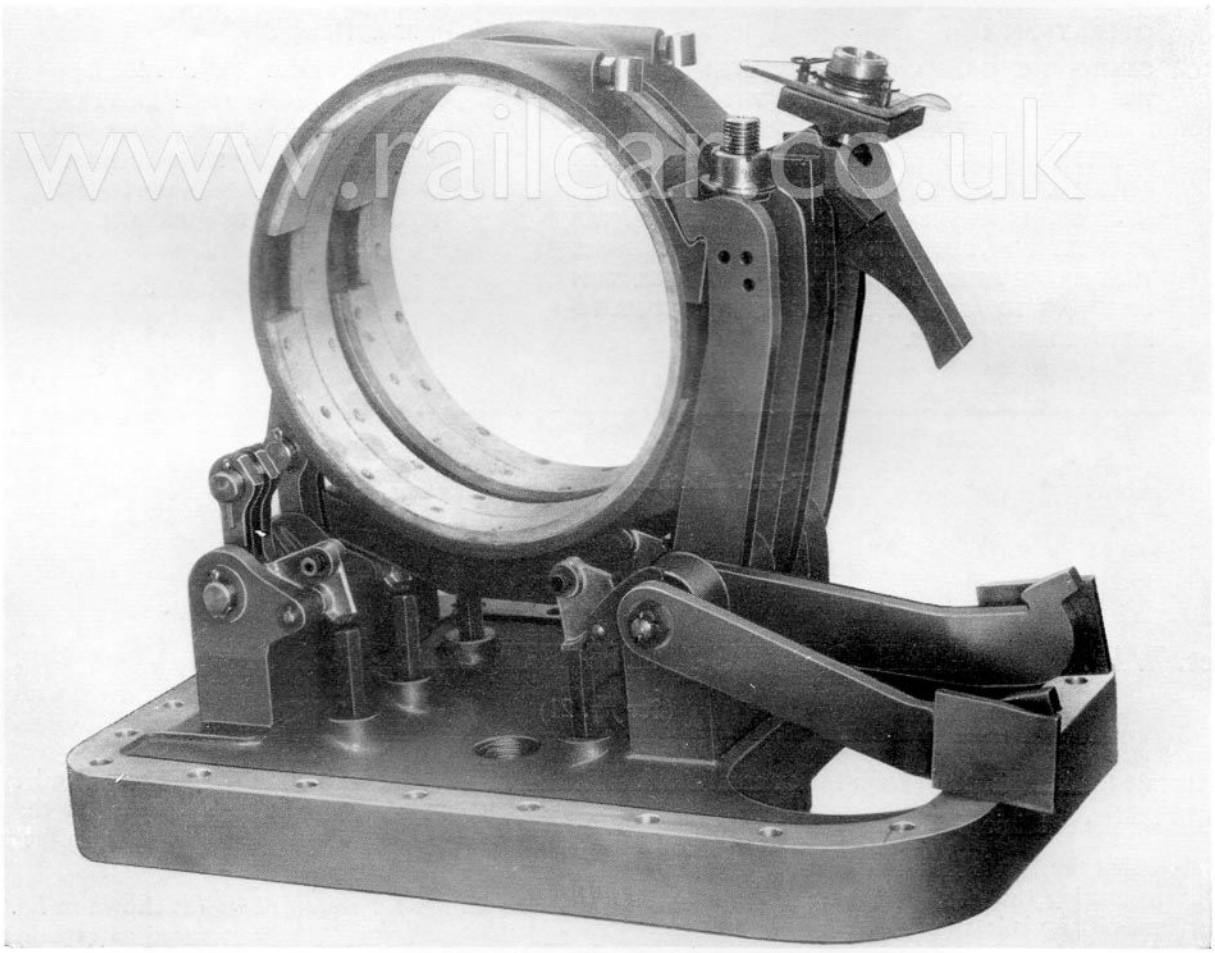
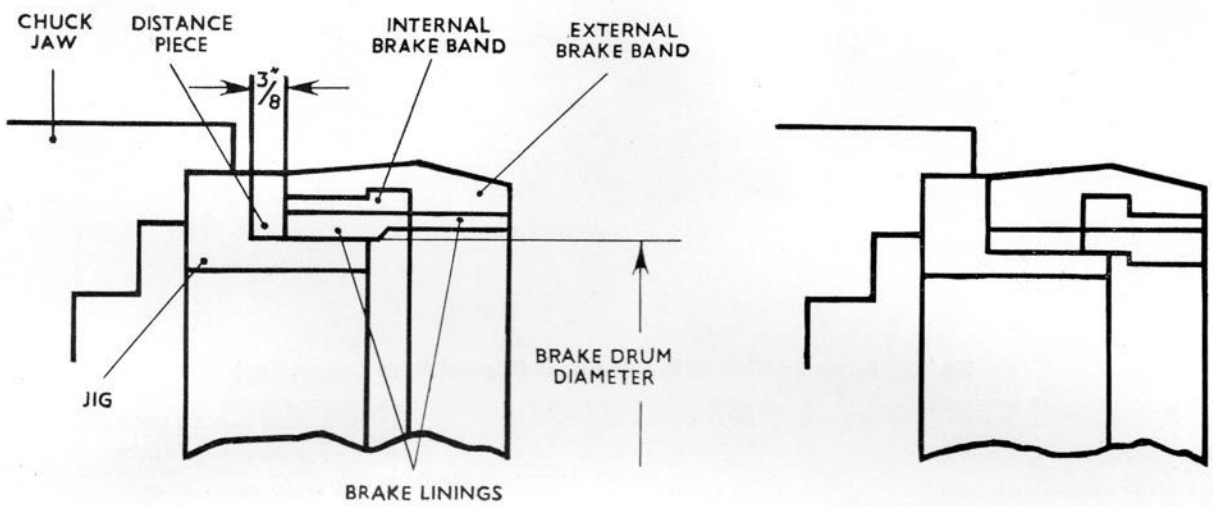


Fig. 20. View of Brake Band Assembly, Hooks, Centralizers and Base Plate



OPERATION 1

CENTRE THE JIG, HAVING A DIAMETER EQUAL TO THE BRAKE DRUM DIAMETER IN THE CHUCK, OR BOLT TO FACE PLATE. PLACE DISTANCE PIECE IN POSITION AND NIP BRAKE BAND ASSEMBLY, WITH INTERNAL BRAKE BAND ADJACENT TO DISTANCE PIECE ON JIG AS SHOWN. (THIS IS IMPORTANT). TAP ASSEMBLY TO HOLD DISTANCE PIECE. THIS ENSURES THAT BRAKE ASSEMBLY IS SQUARE WITH AXIS. SKIM UP LINING TO AS NEAR END OF JIG AS POSSIBLE TO REMOVE HIGH POINTS.

OPERATION 2

REMOVE BRAKE BAND ASSEMBLY AND DISTANCE PIECE REVERSE BRAKE BAND ASSEMBLY AND REPLACE ON JIG. NIP BAND AND TAP UP TO JIG FACE. SKIM UP LINING TO SUIT PREVIOUS OPERATION.

Fig. 21. Method of Skimming Brake Linings

Sect. W19. GEARBOX - RELINING THE BRAKE BAND

(*See fig.* 21)

Separate the internal band from the external band.

Remove the old linings from the bands.

Check that the bands have not taken a permanent set by measuring the gap. Renew the outer and inner bands if gap is less than 2·0″.

Renew the brake band linings and rivet into position.

After relining, the lug on the internal band is fed through its slot in the external band and the free end again pushed toward the centre, when the band will slip easily into position.

The linings are skimmed up (as shown in fig. 21), and the bands can then be replaced as explained in Section W20.

Sect. W20. GEARBOX - TO ASSEMBLE

Ensure that all parts are thoroughly clean and fit for further service.

Replace Pistons

Refer to Section W10 for replacement of the pistons.

Replace Brake Bands (*See fig.* 2).

Before commencing ensure that the adjuster nuts (22) are an easy fit on the pull rod (32) ($\frac{7}{8}$" B.S.F. free fit). Tight threads may be eased by use of a tap. Ill-fitting or damaged pull rods can be corrected by the use of a die nut.

It is essential that brakes which have not been relined are assembled in their original positions, together with their original drums.

Considerable time in the adjustment of the brakes can be saved by making a practice of re-assembling brakes, pullrods, thrust pads and adjuster components in their original positions.

Replace pull rods (32) on to brake bands (25) and replace in position pull rod pins (34).

Insert the springs into the right and left hand centralizers (35) and (36), and compress each spring in turn with a small suitable clamp and pass the ears of the brake band over them, at the same time pushing the clamps clear. Replace the internal band link pins (33) securing with split pins.

Compress the external bands and engage the brake hooks.

Fit to the pullrods (32), thrust pads (29), adjuster tables (28), and the adjuster rings (26), secure these with adjuster nuts (22) and screw down far enough to keep them in position.

Replace the adjuster springs (27).

Replace Running Gear (*Fig.* 1).

Press on to 1st speed brake drum (fig. 19, item 18), ball bearing (40) and replace in the casing. It should be noted that the ball bearing should be pressed further into the case than its normal working position, to ensure that when the end cover is replaced it is fully positioned against the ball bearing, which will be correctly repositioned as end cover is secured. Locate into position bush (60) together with the 1st speed train assembly (36) which includes output shaft. Replace oil pump washer (57) then fit oil pump eccentric key (62) and oil pump eccentric (56) to the output shaft, ensuring that the oil hole in the eccentric registers with the oil way in the shaft. Slide the oil pump oscillating cylinder (65) on to the pump plunger (64). Replace oil pump oscillating cylinder into its housing in end cover.

Smear the joint faces of the end cover with jointing compound and replace on to the casing. At the same time it is necessary to guide the oil pump plunger into position on to the oil pump eccentric.

Secure rear cover with nuts (42) and spring washers (41).

Replace oil pump washer rear (55), bearings (43) and (46) together with sleeve (61), and oil thrower ring (47).

Refit locknut washer (49) and tighten shaft locknut (59) into position and lock with washer (49). Replace oil seal housing (48) together with oil seal (58), coating joint face of oil seal housing with jointing compound and securing with nuts (45) and spring washers (44). Replace shaft key (50), output coupling and pulley; secure with output shaft washer (52), output shaft nut (53), and split pin (54).

Replace bush (63) and 1st and 2nd speed sunwheel (66).

Replace 2nd speed gear train assembly (35), followed by bush (34), 3rd speed gear train assembly (32), and bushes (75) and (33).

Replace 3rd speed brake drum assembly (31) and

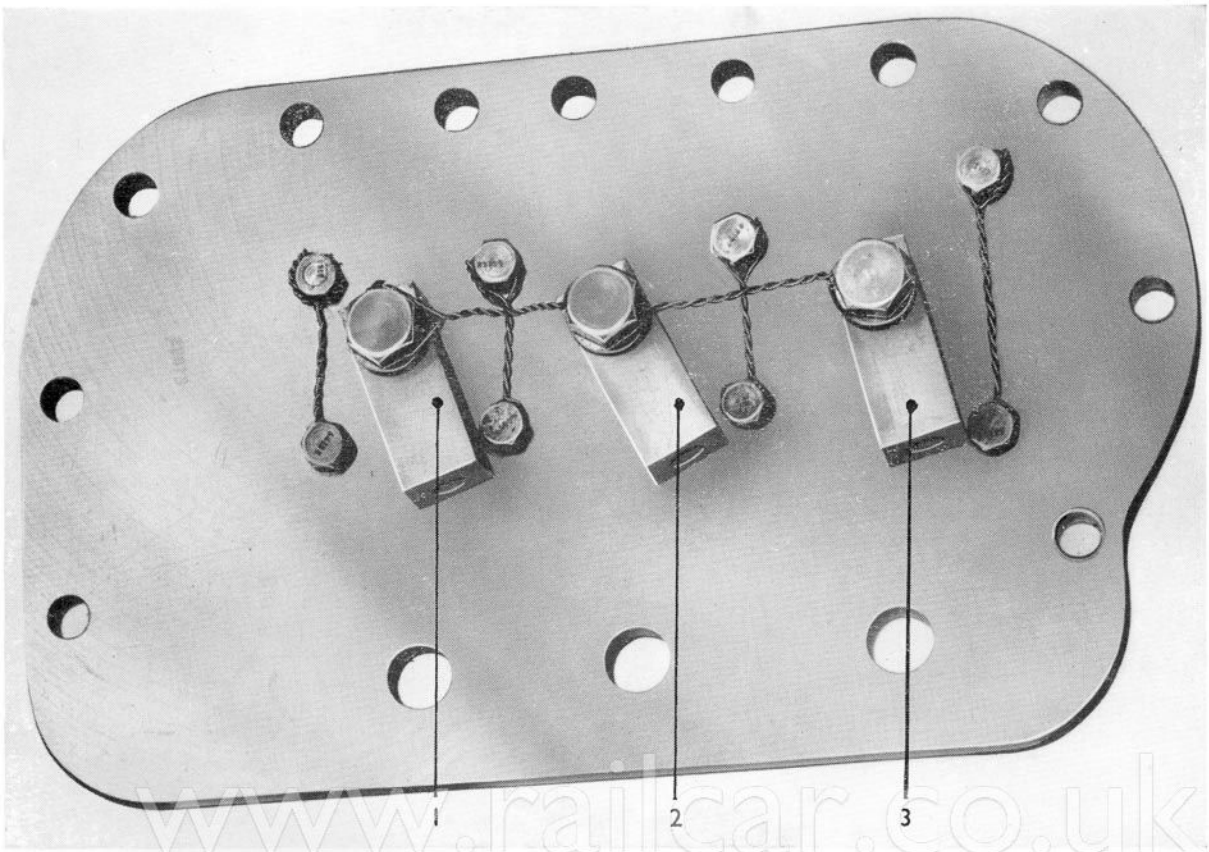


Fig. 22. View of Cylinder Block Plate Showing Location of Air Restrictors

1. 3RD SPEED 2. 2ND SPEED 3. 1ST SPEED

bush (74). Guide home input shaft assembly (30) into the running gear assembly. Replace the clutch plates (76) and (77) in that order.

Position abutment washer (78). Clutch return spring (28) and clutch actuation member assembly (29) can now be replaced together with ball bearing (80) and clutch thrust ring (79). The cut-away section on the clutch thrust ring must be positioned toward the bottom of the gearcase as this ensures a clearance for the pump gear (82).

Replace Front Cover Assembly (*See fig.* 1).

Depress clutch thrust ring (79) and replace spacing piece (88), oil pump driving gear key (89), and oil pump driving gear (86). Assemble oil muff (87) on to oil muff bracket (9) in front cover (10). Coat joint face of gearcase with jointing compound and replace front cover together with oil pump assembly, at the same time locating the oil muff (87) over oil pump driving gear and engaging pump gear (82). Secure front cover with nuts and spring washers, and cone-headed screws (26) inside cylinder bores.

Replace 4th speed piston liners (17) slots inwards, piston spring (19), and clutch piston (20), together with seals (18). Next replace cover plates (24) together with gasket (25). Replace ball bearings (2) together with bearing sleeve (4). Fit the oil seal housing (5) complete with oil seal (3). Coat joint face with jointing compound and secure with nuts (16) and spring washer (15). Replace coupling and secure with input nut washer (6), input nut (7), and split pin (8). Replace driven pump gear (1) into oil pump assembly and replace oil pump front cover (84). Replace mountings, filter brackets, external filter, pipes, covers, dipstick, etc.

Replace Brake Operating Mechanism, etc. (*See figs.* 2 and 11).

Assemble the actuating link and piston rod assemblies and distance pieces on to the gearcase by threading actuating link pin through case from output end, and replacing slotted nut and split pin. Do not tighten down adjuster nuts (fig. 2, item 22) or these will constrict brake bands (fig. 2, item 25) and so prevent the entry of running gear assemblies. The cylinder block (fig. 11, item 1) cylinder block plate (fig. 11, item 2), together with pistons (fig. 11, item 5), seals (fig. 11, item 6), return springs, spring retaining plate (fig. 11, item 8), and gasket can now be replaced into gearcase and secured into position with nuts and spring washers.

Replace Gearcase to Bottom Cover (*See fig.* 1).

Fit the oil pump non-return valve assembly into the gearcase ensuring that the valve body washer (67) is in position. Cover the joint faces with a suitable shellac and replace gearcase onto the bottom cover and secure into position.

Position of Air Restrictors Assembly (*See fig.* 24).

It should be noted that if restrictors are removed they must be replaced in their original position, to facilitate the connection of the air feed pipes and to ensure that the correct size of restrictor is used for each cylinder.

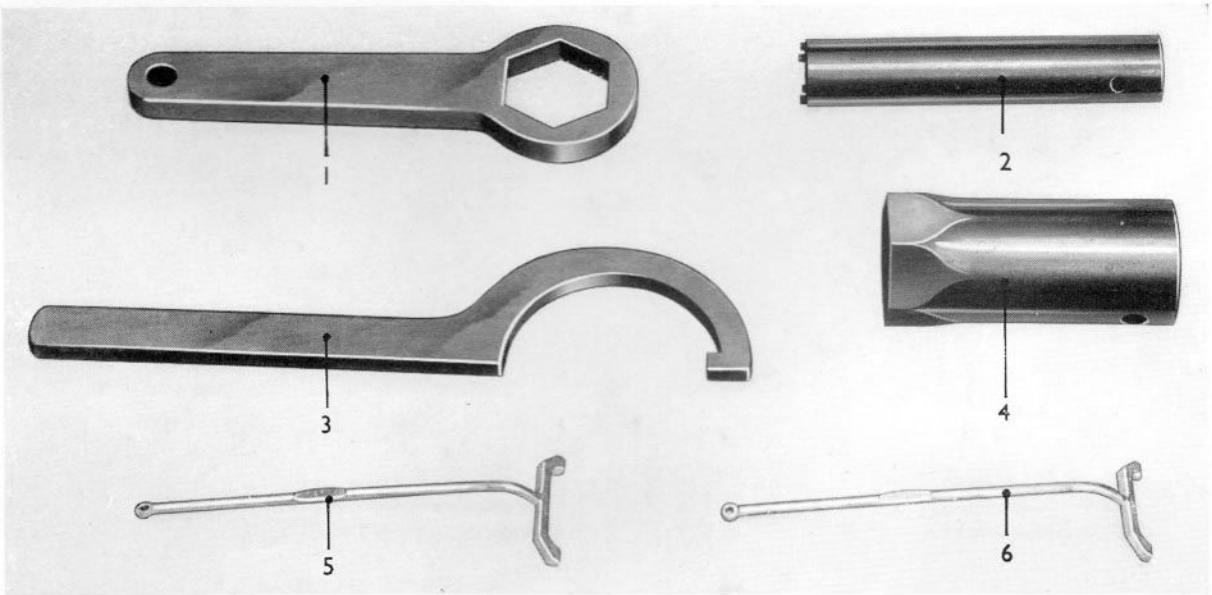


Fig. 23. Special Tools

1. RING SPANNER
2. SPANNER FOR AUTO ADJUSTER NUT
3. "C" SPANNER
4. SPANNER FOR OIL FILLER PLUG
5. TOGGLE SETTING GAUGE, 2ND AND 3RD SPEEDS
6. TOGGLE SETTING GAUGE, 1ST SPEED