TYPE R14 GEARBOX

SERVICE MANUAL

SELF-CHANGING GEARS LTD

INSTRUCTIONS

FOR

GEARBOX

(TYPE R14)

MAINTENANCE AND OVERHAUL

GEARBOX

CHAPTER S

CONTENTS

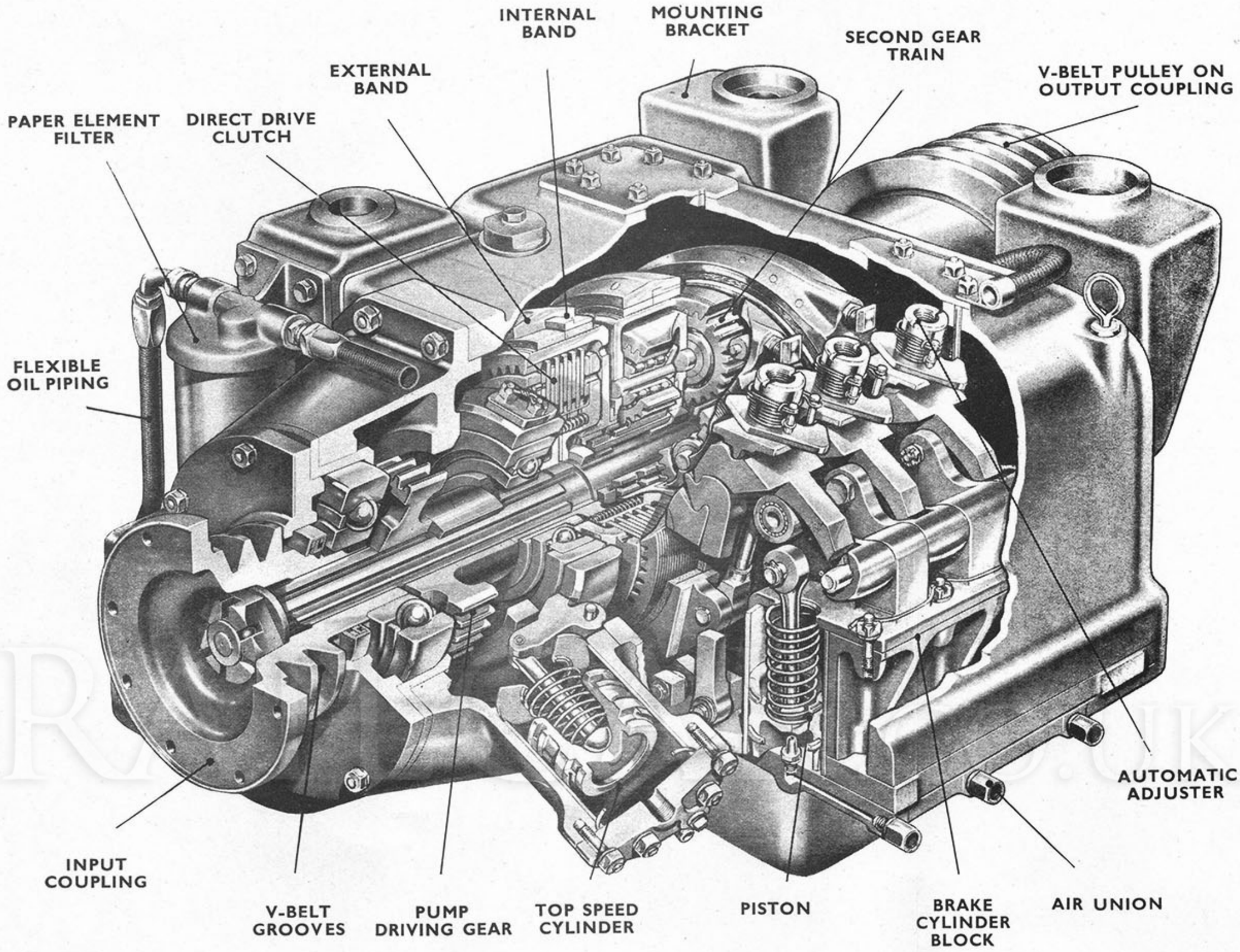


Fig. 1. The Gearbox

Sect. S1. GEARBOX—DATA

(TYPE R.14)

Type .. .. .. Epicyclic gearbox, 4 forward speeds

Gear Ratios

1st speed	4.28:1	3rd speed	1.59:1
2nd speed	2.43:1	4th speed	1.1

Rotation: Clockwise looking on input end
Mounting: Independent mounting using bearer brackets
Operation: By air pressure at 65 lbs./sq. in. $\pm$ 2½lbs.
Oil Pump: Gear pump driven from input shaft

Brake Setting Gauge Dimensions

First Speed : 1.30
Second Speed : 1.30
Third Speed : 1.45

Sect. S2. GEARBOX—DESCRIPTION

(*See Figs.* 2 & 4)

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, whilst an air piston working in a cylinder integral with the front cover is used to apply the direct drive top gear clutch.

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

Sect. S3. GEARBOX—BRAKE OPERATION

(*See Figs.* 3 & 4)

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

1. BALL BEARING.
2. BEARING HOUSING.
3. FRONT COVER NUT.
4. TRUNNION RING.
5. SLIDING PANEL.
6. BUSH.
7. INNER PLATE.
8. CLUTCH SPRING.
9. CLUTCH PLATE, INNER.
10. CLUTCH PLATE, OUTER.
11. THIRD SPEED BRAKE DRUM
12. CLUTCH INNER MEMBER.
13. THIRD SPEED GEAR TRAIN.
14. THIRD SPEED SUNWHEEL.
15. SECOND SPEED GEAR TRAIN.
16. ADJUSTING WASHER.
17. GEARCASE.
18. FIRST SPEED GEAR TRAIN.
19. BUSH.
20. BEARING COLLAR.
21. BUSH.
22. COVER PLATE.
23. OIL MUFF.
24. BEARING SLEEVE.
25. BALL BEARING.
26. ROLLER BEARING.
27. OIL SEAL HOUSING NUT.
28. OIL SEAL HOUSING.
29. OIL SEAL.
30. OUTPUT COUPLING.
31. O RING.
32. SPLIT PIN.
33. WASHER.
34. COUPLING NUT.
35. BEARING COLLAR.
36. PULLEY.
37. ROLLER BEARING.
38. OIL UNION.
39. BEARING HOUSING.
40. FIRST SPEED BRAKE DRUM.
41. SECOND SPEED BRAKE DRUM.
42. BUSH.
43. BUSH.
44. BUSH.
45. ADAPTOR FIRST SPEED.
46. ADAPTOR SECOND SPEED.
47. ADAPTOR THIRD SPEED.
48. SEAL.
49. O RING.
50. PISTON FOURTH SPEED.
51. PISTON ROD FOURTH SPEED
52. CYLINDER COVER.
53. SPRING.
54. SEAL.
55. CYLINDER LINER.
56. PLATE.
57. PIN.
58. SLEEVE.
59. PUMP DRIVING GEAR
60. BALL BEARING.
61. OIL SEAL HOUSING.
62. OIL SEAL.
63. INPUT COUPLING.
64. INPUT SHAFT.
65. SEALING WASHER.
66. WASHER.
67. SPLIT PIN.
68. INPUT COUPLING NUT.
69. BEARING HOUSING.
70. SET BOLT.
71. FRONT COVER.
72. PIVOT PIN.
73. OIL PUMP.
74. NUT.
75. SPLIT RING.

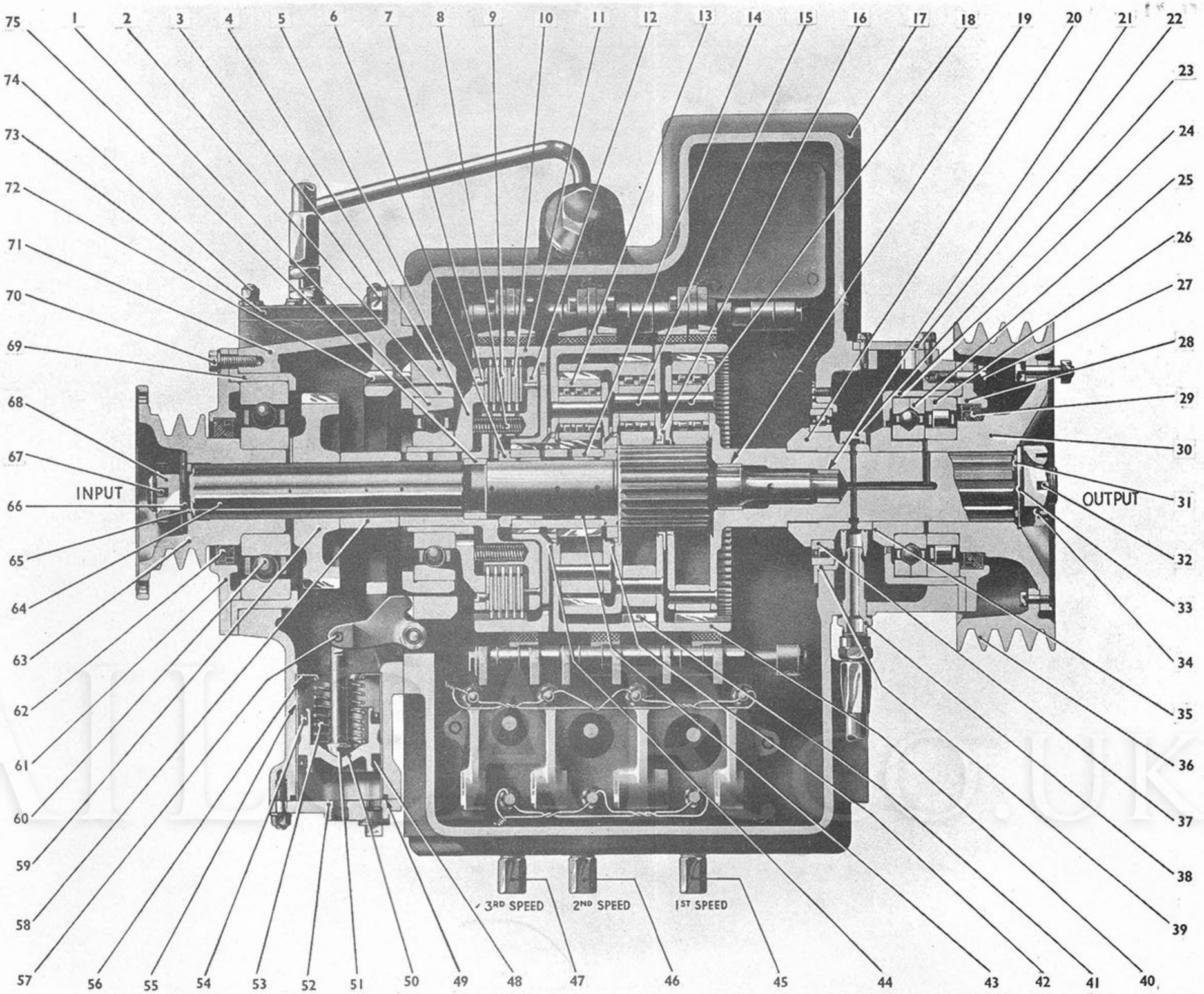


Fig. 2. Section through Gearbox.

FEATURES OF THE BRAKES

(*See Fig.* 4)

A band 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 anchorages 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 centralised about the drums in such a manner as to prevent them rubbing when in the "OFF" position.

The brake linings are made of a material suitable for working in oil which is extremely hard wearing. It is inevitable, however, that some wear will take place in time, and this is corrected by the Automatic Adjuster Mechanism (See Fig. 5) which keeps the brakes constantly at their correct setting.

OPERATING SEQUENCE OF THE BRAKES

(*See Figs.* 3 & 4)

The sequence of operation 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 (22) upwards. This movement applies an upward force to the thrust pad (12) which pivots about its knife edge on the hooks, thereby raising the adjuster mechanism (7, 8, and 9) and with it the pull rod (11). Since the pull rod is attached to the lower end of the outer band (3) (the upper of which is anchored by the hooks) this action constricts the brake band.

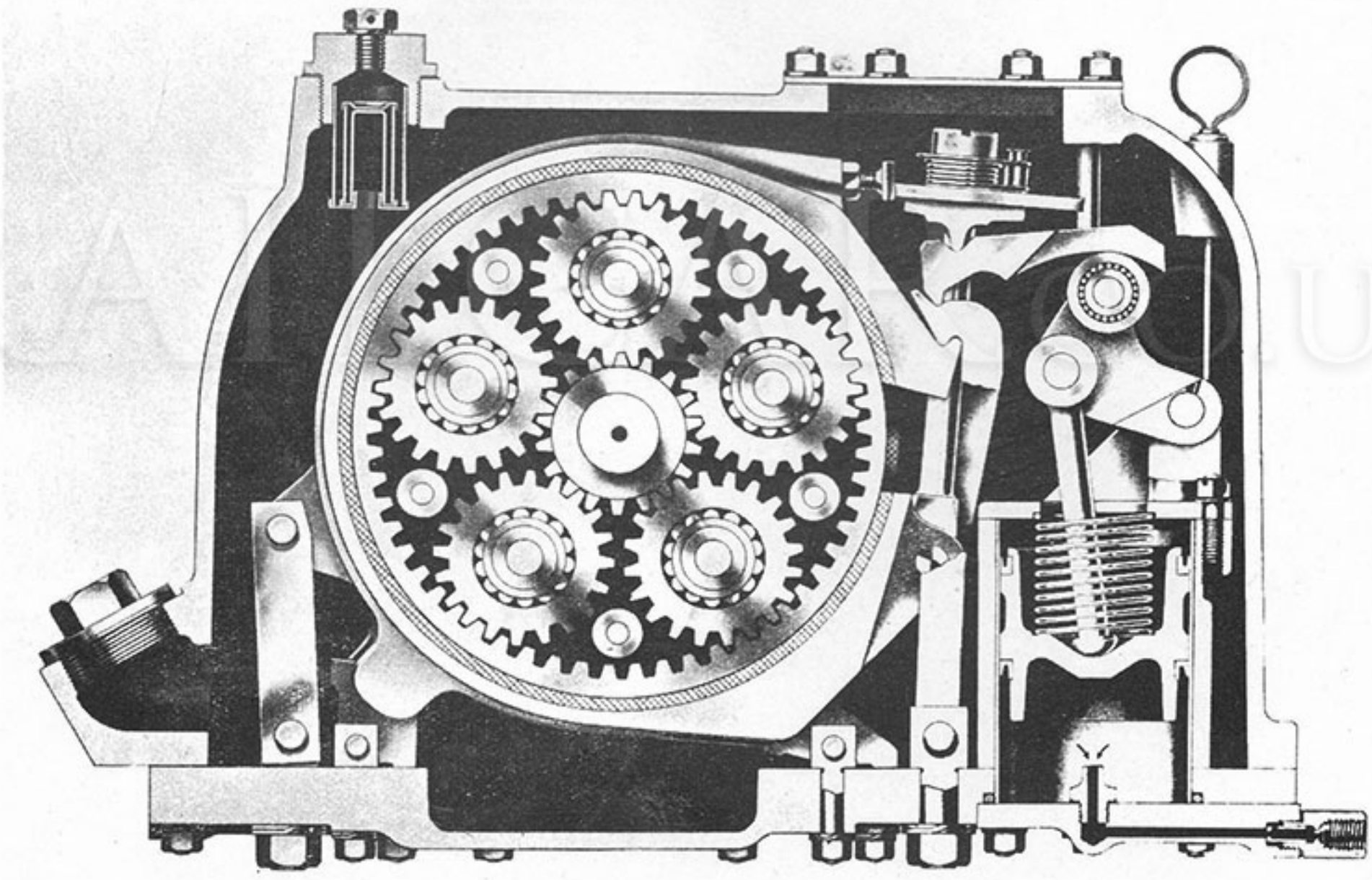


Fig. 3. Section through 1st Speed Band Brake. (Brake On)

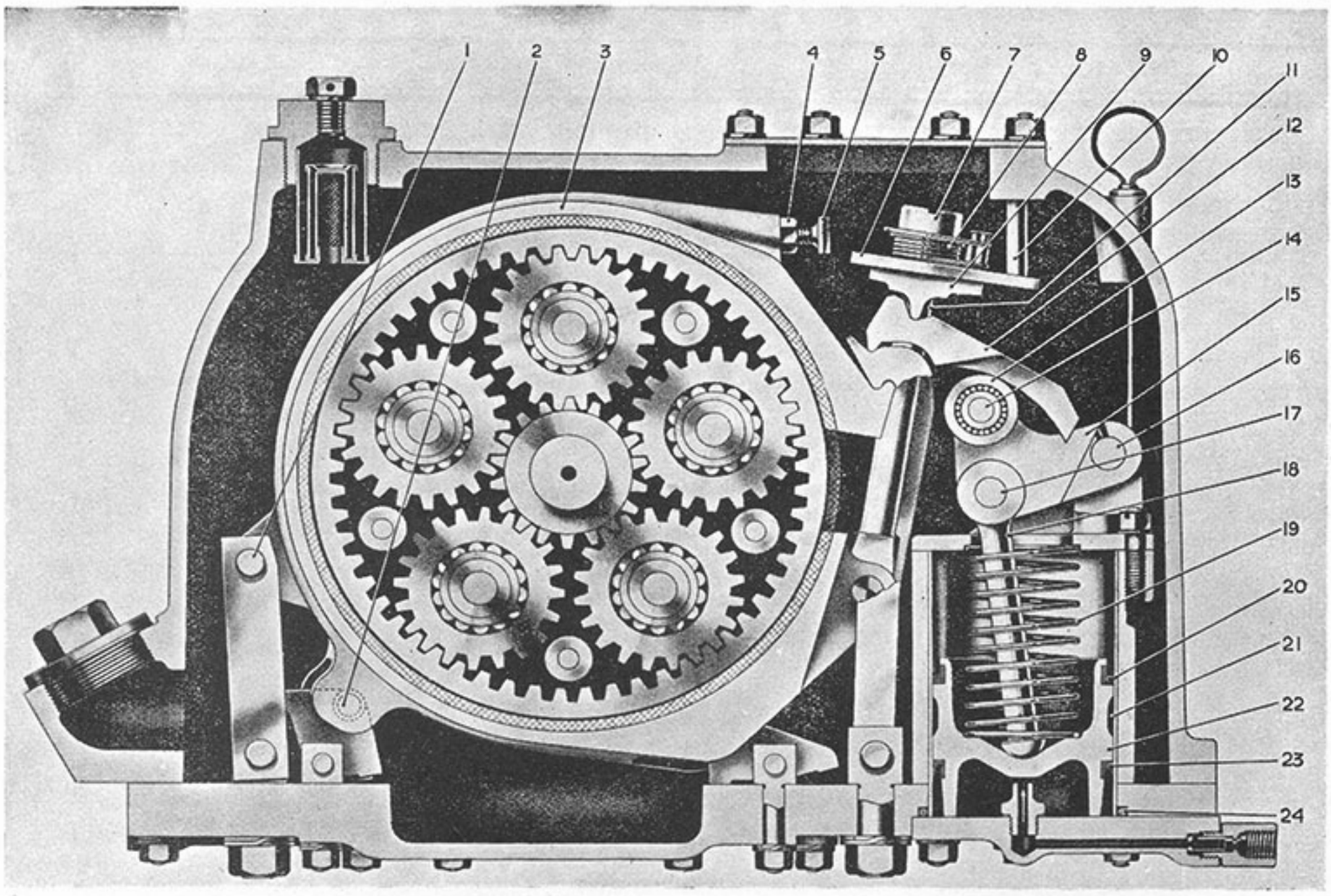


Fig. 4. Section through the 1st Speed Band Brake. (Brake Off)

1. LINK PIN
2. CENTRALISER SPRING
3. BRAKE BAND ASSEMBLY
4. LOCKNUT
5. ADJUSTER SCREW
6. ADJUSTER RING
7. AUTOMATIC ADJUSTER NUT
8. AUTOMATIC ADJUSTER SPRING
9. ADJUSTER TABLE
10. TAIL PIN
11. PULL ROD
12. THRUST PAD
13. CAM ROLLER RACE
14. CAM ROLLER PIN
15. OPERATING LEVER
16. SHAFT (long)
17. BEARING PIN, DOWEL, CIRCLIP
18. PISTON ROD
19. PISTON SPRING
20. SEAL
21. CYLINDER LINER
22. PISTON
23. SEAL
24. "O" RING

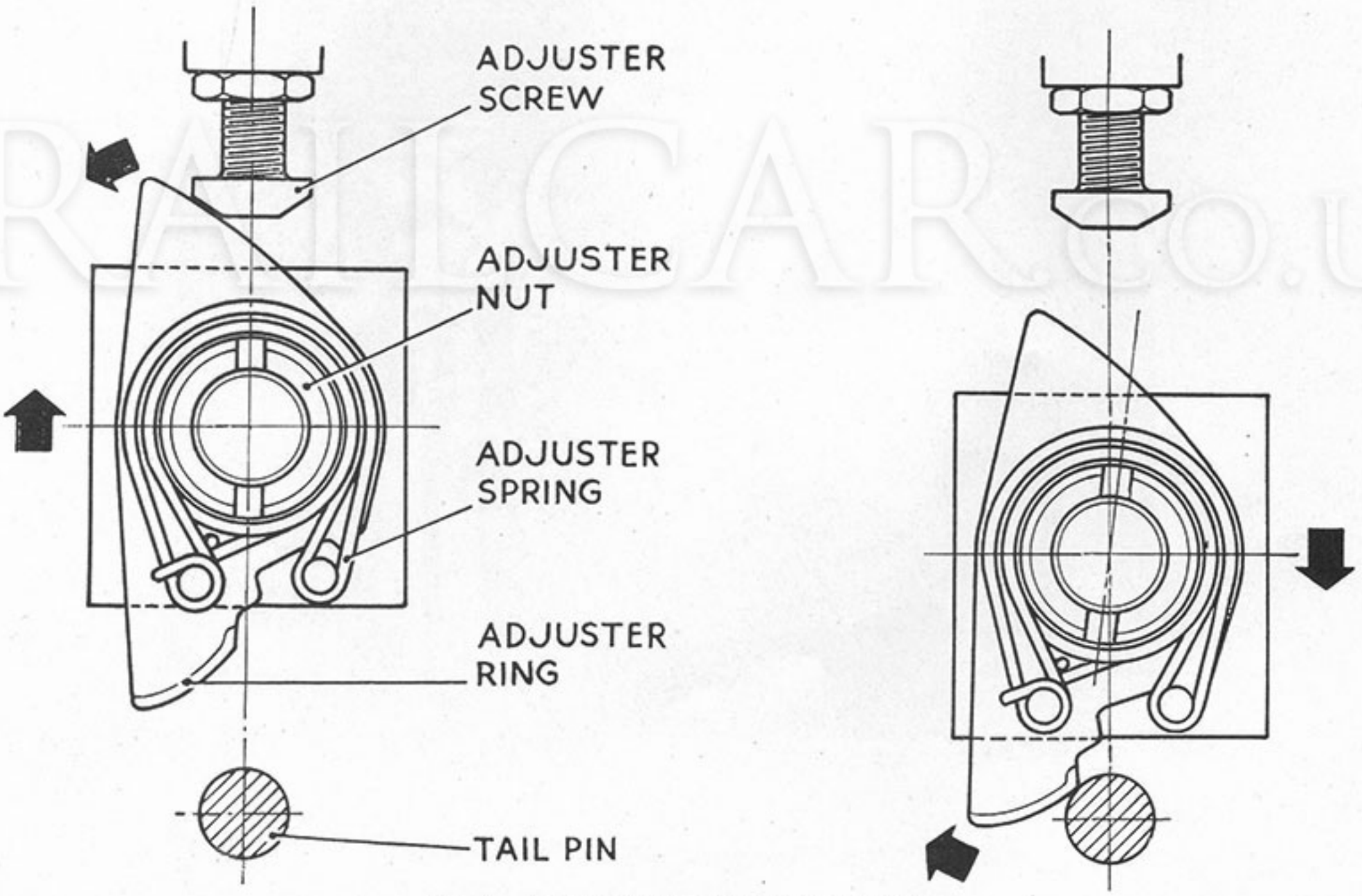


Fig. 5. Operation of the Automatic Adjuster.

Sect. S4. GEARBOX—AUTOMATIC ADJUSTER

(*See Fig.* 5)

This is a device for reducing the effective length of the pull rod and thus taking up the extra movement caused by 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 the automatic adjuster ring striking the adjuster screw will be rotated **anti-clockwise.** The adjuster ring is pinned to the spring 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. S5. GEARBOX—TOP SPEED CLUTCH OPERATION

(*See Fig.* 6)

Air is admitted to the cylinder (1) forcing the piston (3) to act through the lever (5) to move the trunnion ring (7) with bearing housing (6) and bearing against the clutch sliding panel (8). This then moves forward under pressure to lock the clutch plates (9) and (10) together, the running gear then revolving as a whole.

The top speed clutch needs no adjustment since wear on the clutch plates is compensated by increased travel of the operating piston.

KEY TO NUMBERS:—

1. CYLINDER
2. CYLINDER COVER
3. PISTON
4. SEALS
5. OPERATING LEVER
6. BEARING HOUSING
7. TRUNNION RING
8. SLIDING PANEL
9. CLUTCH PLATE (OUTER)
10. CLUTCH PLATE (INNER)

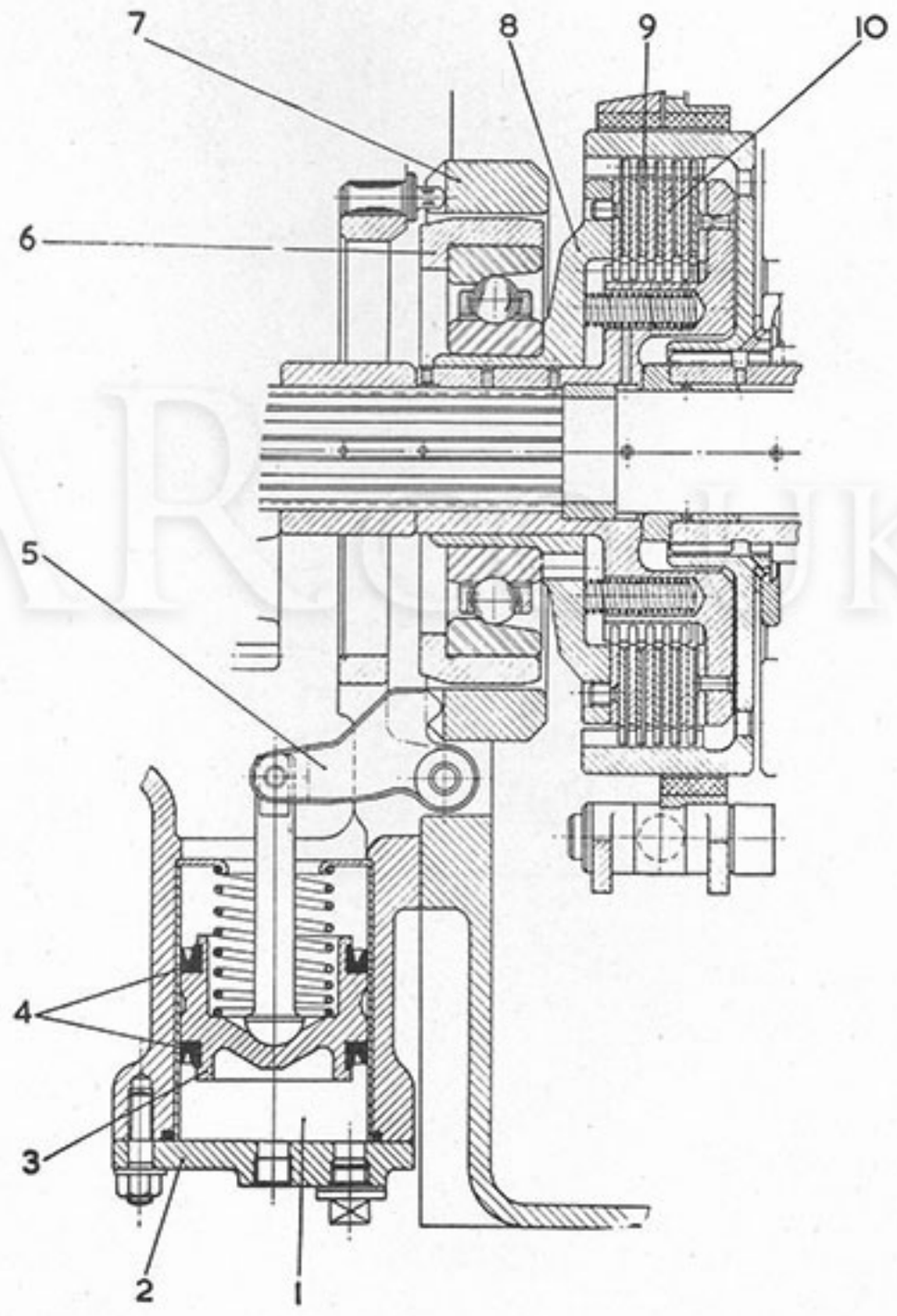
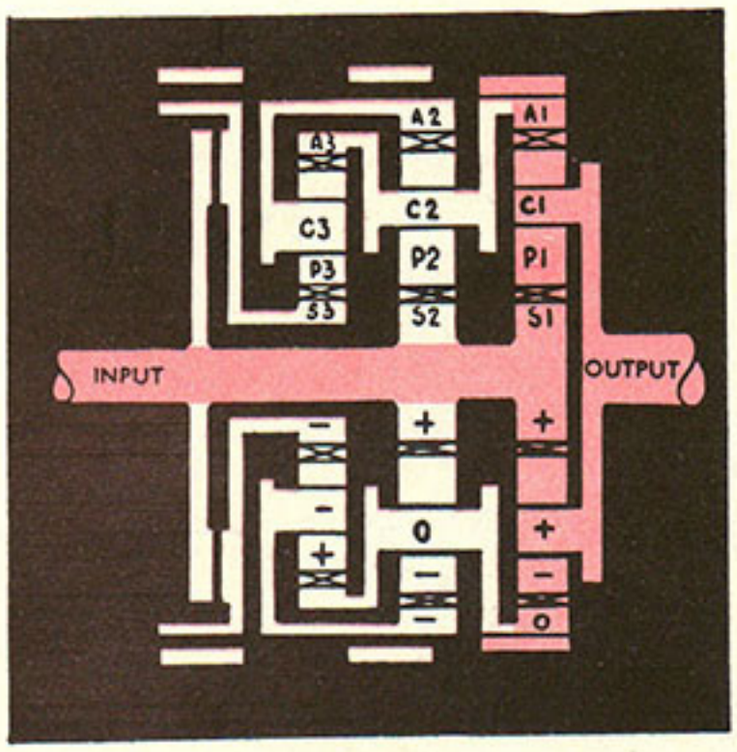
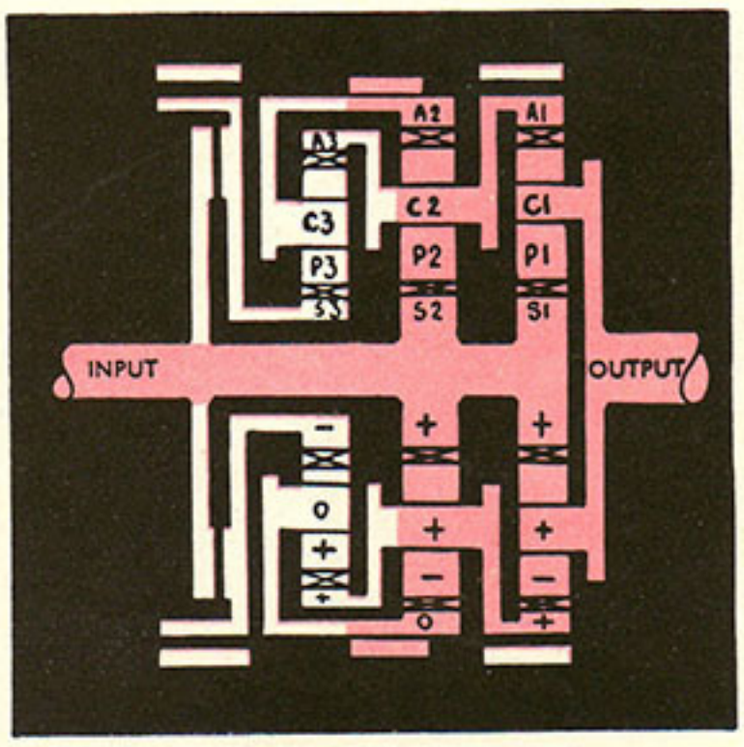


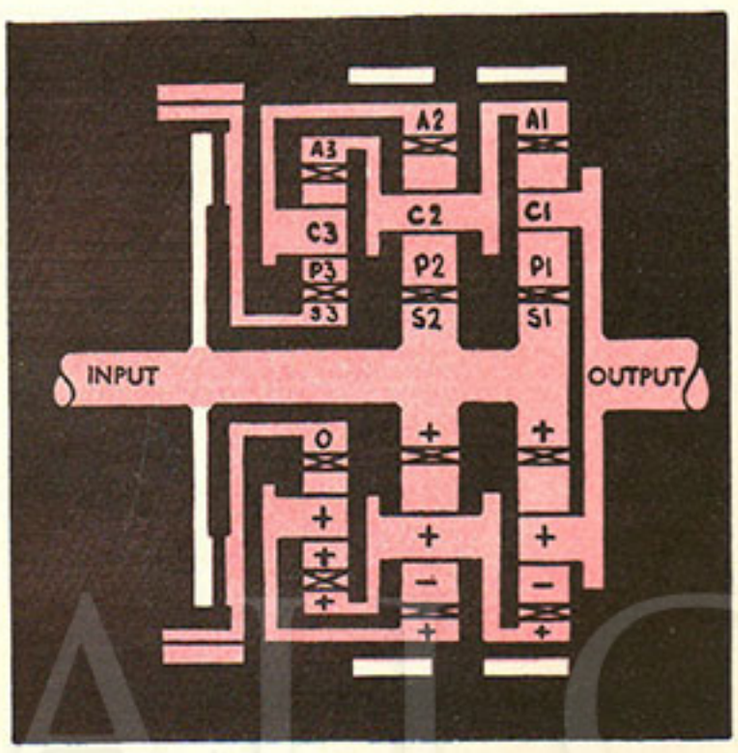
Fig. 6. Top Speed Clutch Actuation.



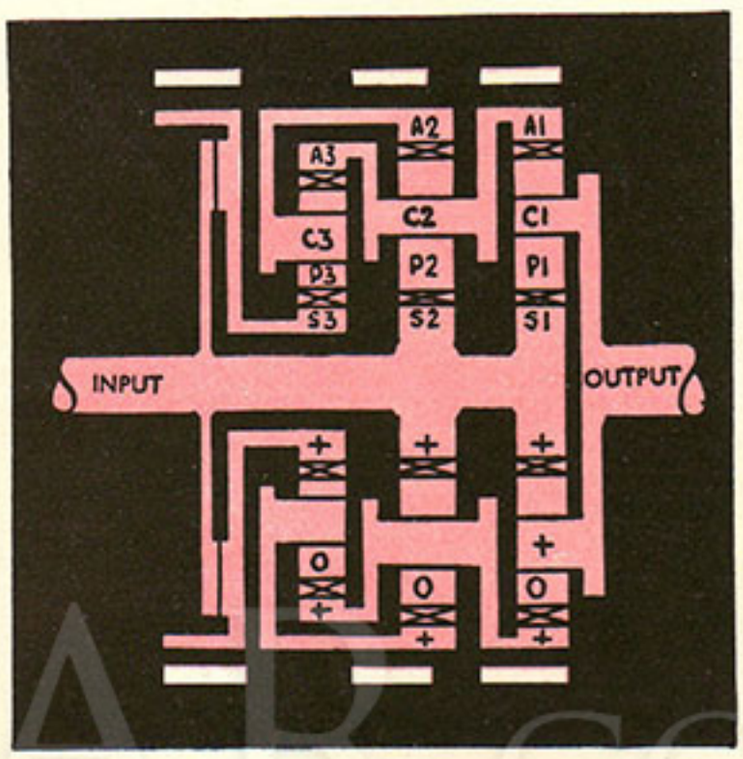
1ST. SPEED



2ND. SPEED



3RD. SPEED



4TH. SPEED

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

■ = ITEMS TRANSMITTING TORQUE.
□ = ITEMS NOT TRANSMITTING TORQUE.
ROTATION.
\+ = CLOCKWISE LOOKING ON INPUT.
− = ANTI-CLOCKWISE LOOKING ON INPUT.
○ = NO ROTATION.

Fig. 7. Torque Transmission Diagram.

Sect. S6. GEARBOX—AIR PRESSURE

At all times when the gearbox is in use, correct air pressure (65 lbs. $\pm 2\frac{1}{2}$ lbs. per sq. inch) 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. S7 GEARBOX—PRINCIPLE OF OPERATION

(*See Fig.* 7)

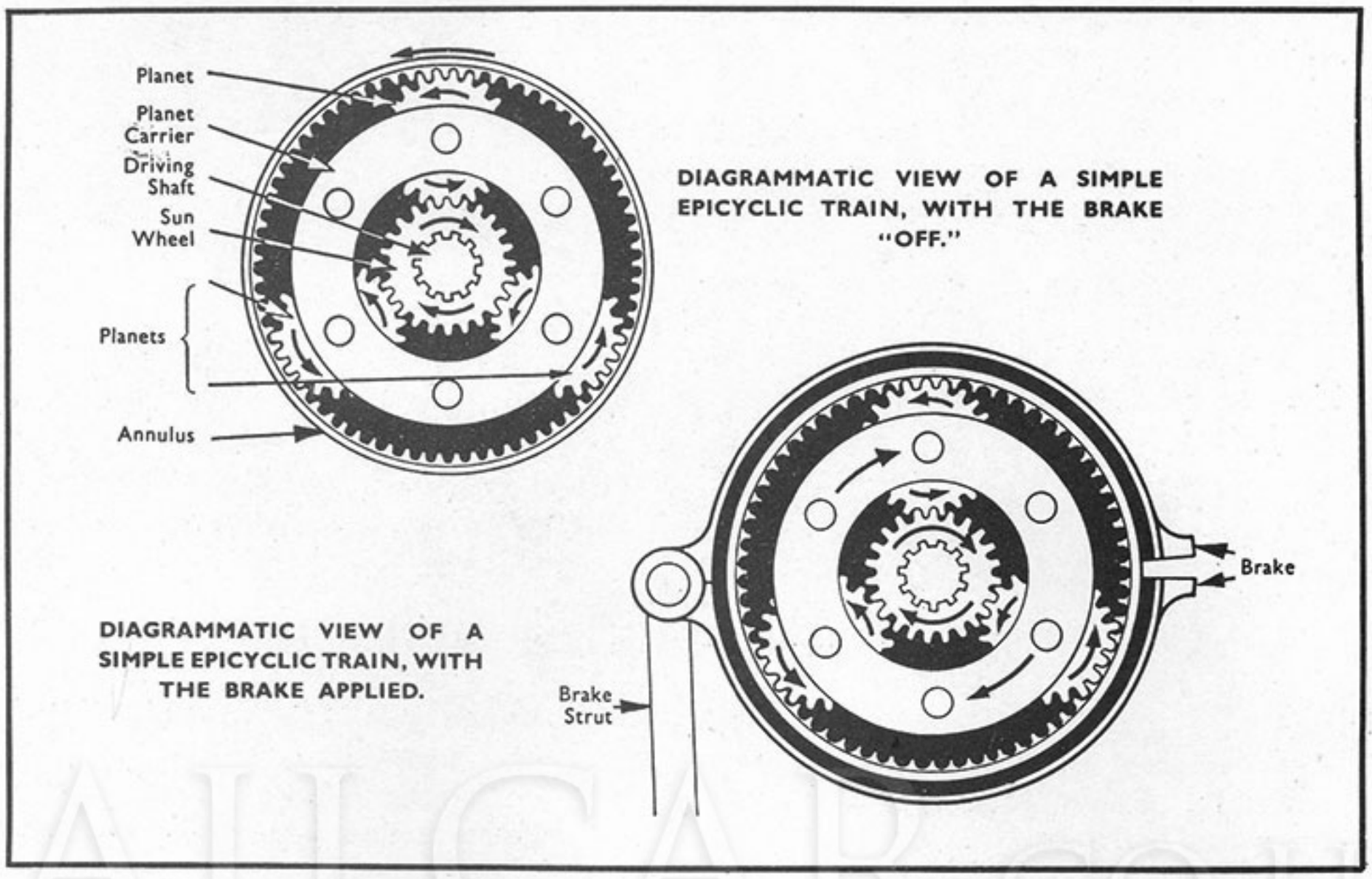


Fig. 8. Diagrammatic View of Epicyclic Gear Train.

There are in this gearbox three gear trains each composed of the parts shown on Fig. 8.

With 1st gear engaged the brake holds stationary the 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.

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 interconnection with the 2nd speed carrier.

A similar speeding up of the 1st and 2nd gear annuli is brought about by holding stationary the 3rd gear sunwheel, causing the 3rd speed planets to rotate round the 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.

Sect. S8. GEARBOX—LUBRICATION

Lubrication is provided by a gear type pump mounted on the front casing, the flow of oil passes through an external pipe and filter, to an oil muff where it is delivered to the gear trains and bearings.

The gearbox requires approximately 2½ gallons of oil.

The base lubricant should be 100% mineral oil of high quality possessing a high resistance to oxidation and a natural viscosity index of not less than 90.

When tested by I.P.114/55T the increase in acidity of the oil must not be greater than 0.1 milligramme KOH/gramme, the total acidity after oxidation must not exceed 0.2 milligramme KOH/gramme. In order to meet this clause and ensure satisfactory operation in service it is advised that oxidation inhibitors are included in the formulation.

The oil must also contain additives against corrosion and preferably in addition it should contain additives against frothing and must be consistent with the requirements of a high quality turbine lubricant.

The viscosity of the lubricant shall also conform to the following requirements:—

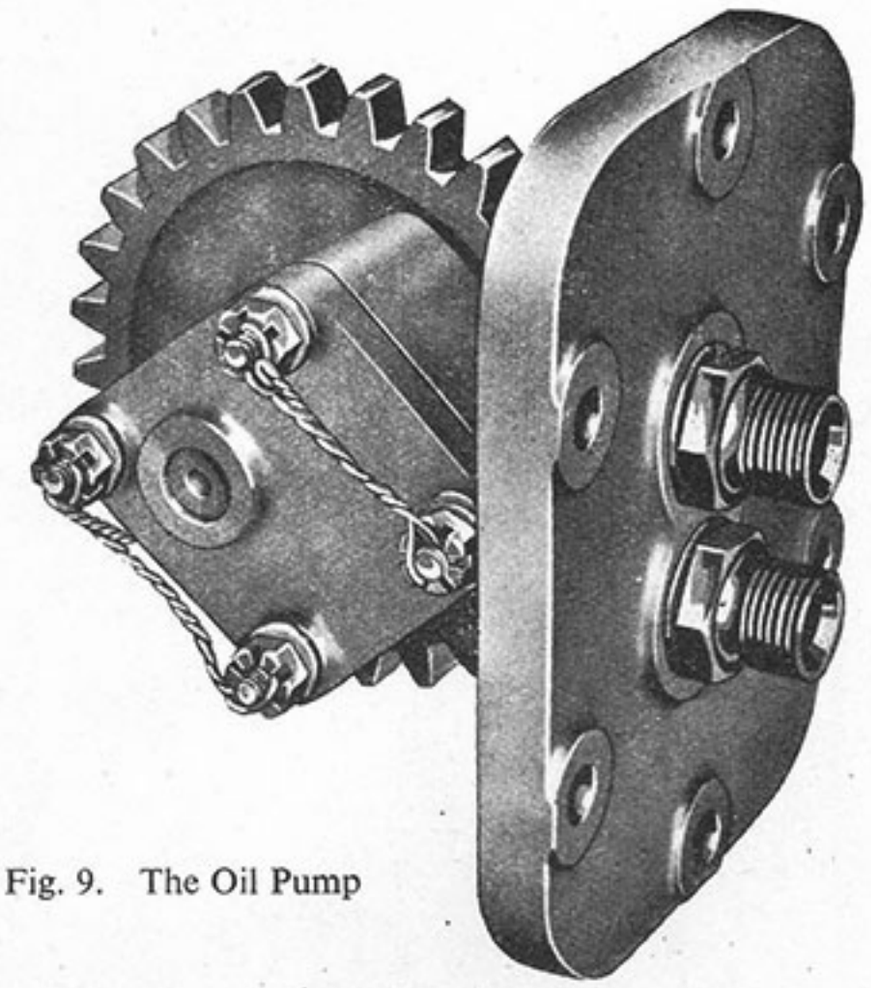


Fig. 9. The Oil Pump

	Climate	*Temperate*
Redwood No. 1 Viscosity at 140°F.	100-130	

Oil Changes

First change 1,000 then every 30,000 miles.
This applies also to reconditioned gearboxes.

Sect. S9. GEARBOX—ROUTINE ATTENTION

Daily.

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

Every 3000 miles.

1. Check upper piston seals for oil leakage by removing gearbox cylinder drain plugs (one gearbox at a time) and selecting each gear in turn. If oil is blown out replace leaking piston seal.
   The free flow of air indicates clear supply pipes. If the flow is unduly restricted clean air restrictors (if fitted) in gearbox air inlet unions and supply pipe if necessary.
2. Check lower piston seals for air leakage by engaging each gear in turn. Leaking air can be detected escaping from gearbox breather. Replace seals which leak.
3. Thoroughly clean top of gearbox and remove inspection cover.
   Ensure that main air reservoir pressure does not fall below 75 lbs. per sq. inch during the following tests. Engage each brake in turn and check that appropriate setting gauge (Figs. 13, 14) will enter. (Note, clearance up to $\frac{1}{16}$" is not abnormal, as the mechanism will not move so far when the brakes are engaged in this manner, as they will when under load.) If the gauge will not enter (see Section S14).
4. Check that brakes are still serviceable. (Relining is necessary when the top faces of the adjuster nut and pullrod coincide).

Every 6000 miles (in addition to the foregoing).

1. Check filter element and renew if choked or damaged. Clean filter, bypass valve.

Every 30,000 miles (in addition to the foregoing).

1. Drain gearbox and refill with new oil.

Every 150,000 miles.

1. Remove gearbox for complete overhaul.

Sect. S10. GEARBOX—SERVICING THE AIR PISTONS

TO REMOVE AND REPLACE 1st, 2nd & 3rd SPEED PISTONS

(*See Fig.* 10)

1. Remove the nuts which secure the cover plate to the bottom cover, and allow the cover plate to come away under the pressure of the piston return springs. Remove the gasket. As considerable oil will be released (from cylinders only) provision of an adequate tray is advisable.
2. Remove the pistons and springs.
3. Wash all components in paraffin, drain and immerse in clean oil.
4. Carefully examine both seals and renew if hardened, or having worn or cracked lips. Fit new seals by stretching them over the flanges on the pistons the grooves to be facing outwards when in position.
5. Inspect "O" ring seals (item 24 Fig. 4) at base of liners, and renew if hardened.
6. Insert each spring and piston, etc. into its cylinder (taking care not to damage the seal lips) until the top flange has entered, and tilt the piston to retain it until the other pistons are fitted.
7. Replace the cover plate and gasket, secure with nuts and washers.

TO REMOVE AND REPLACE 4th SPEED PISTON

1. Remove the cover and gasket, the piston will emerge under pressure of the piston return spring.
2. Inspect "O" ring seal at base of liner and renew if hardened.
3. Wash the components in paraffin, drain and immerse in clean oil.
4. Replace parts and secure with nuts and washers.

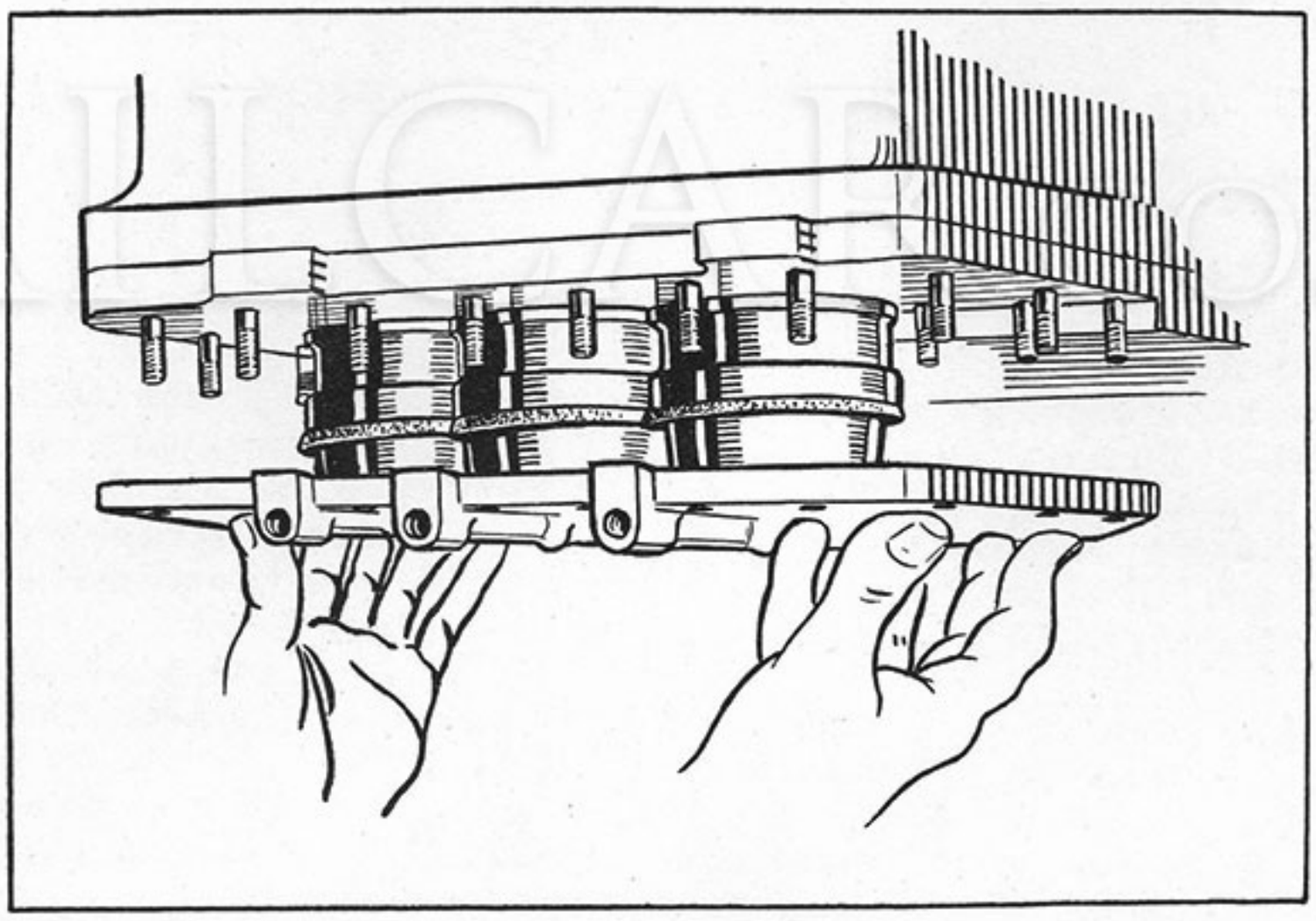


Fig. 10. Removing the Cover Plate (1st, 2nd & 3rd Speeds).

Sect. S11. GEARBOX—RENEWING INPUT SHAFT OIL SEAL

(See Fig. 2)

(Note—A new sealing washer (65), washer (66) and split pin (67), should be available.)

Remove the cardan shaft and freewheel complete, and all other drives taken from the gearbox input coupling.

Locally clean front face of gearbox including oil seal housing and coupling.

Engage third gear to lock input shaft.

Remove split pin (67) (taking great care not to damage screw threads of input shaft), nut (68), washer (66), and sealing washer (65).

Remove set screws (70) with spring washers, using special extractor tools—part number 37428. Remove coupling (63) complete with oil seal housings (61). As the withdrawal proceeds tap the end of the input shaft (64) back through the coupling.

With coupling flange downwards, adequately support oil seal housing (61) and press coupling (63) out of bearing.

Remove faulty seal from housing (61). Clean the seal housing joint face. Wash the seal housing and coupling in paraffin and drain. Clean the exposed parts of bearing housing (69), taking care to exclude any foreign matter from the bearing race.

Lay the seal housing on the bench with the joint face uppermost and with great care drive the oil seal (with the garter spring uppermost) into position.

Pack the space between the two sealing lips with medium grease.

Ease the oil seal in its housing on to the coupling. Press the bearing (and bearing housing) home on to the coupling.

Clean the gearcase face taking care to prevent foreign matter entering the gearbox.

Lightly smear with a suitable shellac jointing compound the joint faces of the gearcase and mating face on bearing housing.

Slide coupling onto shaft, lining holes (note these are unequally spaced) in gearcase and flanges. (The extractor tools may be screwed into gearcase to facilitate this assembly.)

With a thin blade apply a suitable shellac jointing compound to the faces of oil seal and bearing housings.

Secure with bolts and washers. Fit sealing washer (65) (new), washer (66) (new if rubber seal has hardened), nut (68) and split pin (67) (new).

Release 3rd gear.

Replace belt drives and cardan shaft.

Sect. S12. GEARBOX—RENEWING OUTPUT SHAFT OIL SEAL

(See Fig. 2)

(Note a new "O" ring (31), washer (33) and split pin (32) should be available.)

Remove the cardan shaft and belt drives (if fitted). Engage 1st gear.

If no pulley is fitted clean the rear face of gearbox including seal housing and coupling.

Remove split pin (32) (taking great care not to damage screw threads), nut (34), washer (33) and "O" ring (31).

Coupling (and pulley if fitted) can now be withdrawn (note the inner race of roller bearing (35) will come away with coupling flange.)

Remove nuts (27) and spring washers, and withdraw the oil seal housing (28).

Remove faulty seal, clean joint face and wash the seal housing in paraffin and drain.

Clean joint face of bearing sleeve (24) (in gearcase), taking care to exclude any foreign matter from the shaft splines and bearings.

Lay the seal housing on the bench with the joint face uppermost and with great care drive the oil seal (garter spring uppermost) into position.

Pack the space between the two sealinglips with medium grease.

Lightly smear with a suitable shellac jointing compound, the joint faces of the bearing and oil seal housing.

Secure oil seal housing with nuts and washers.

Replace coupling (and pulley if fitted).

Replace "O", ring washer, nut and split pin.

Release 1st Gear.

Replace belt drives (if fitted) and cardan shaft.

Sect. S13. GEARBOX—OIL FILTER

(*See Fig.* 12)

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 (13) and ball valve (15) retained in the bore by a threaded body (14).

RENEWING THE FILTER ELEMENT

(*See Fig.* 12)

1. Clean the exterior of the filter assembly before removing the sump.
2. Unscrew the centre bolt (5) and withdraw the sump (3) and filter element (4) from the head (1); remove the element from the sump.
3. Thoroughly clean the interior of the sump and ensure that the seal (2) is in good condition and correctly assembled in its groove in the filter head.
4. Place the new element in the sump so that it rests on the lower element 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, 10).

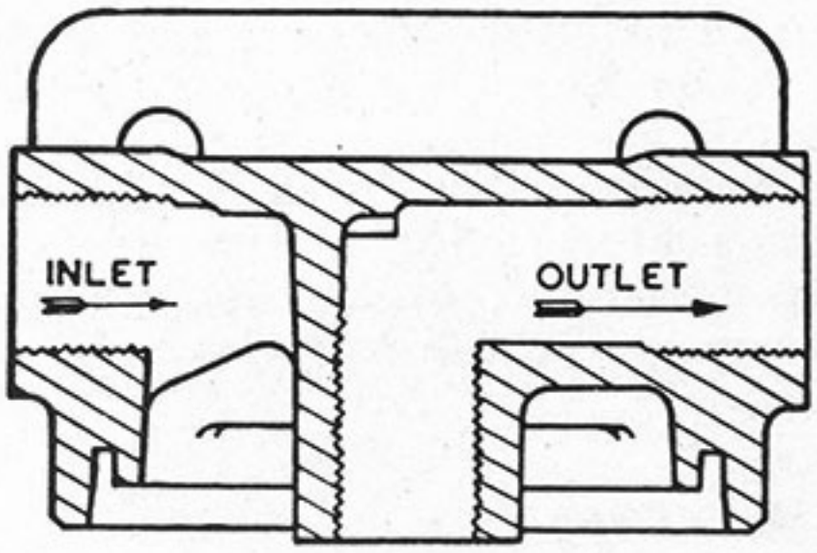
DISMANTLING AND ASSEMBLING THE FILTER

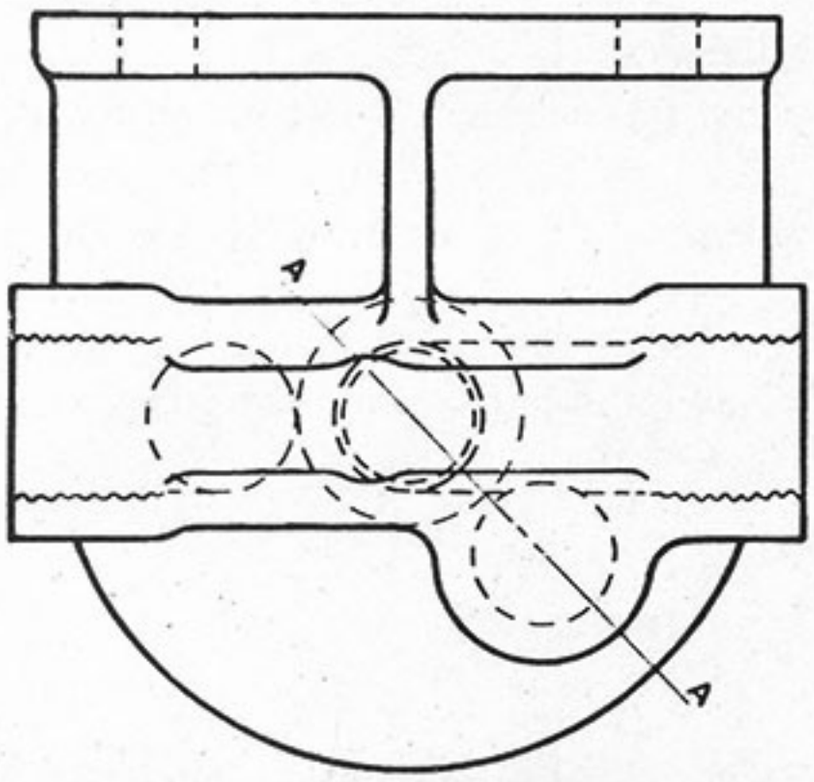
(*See Fig.* 12)

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), 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.

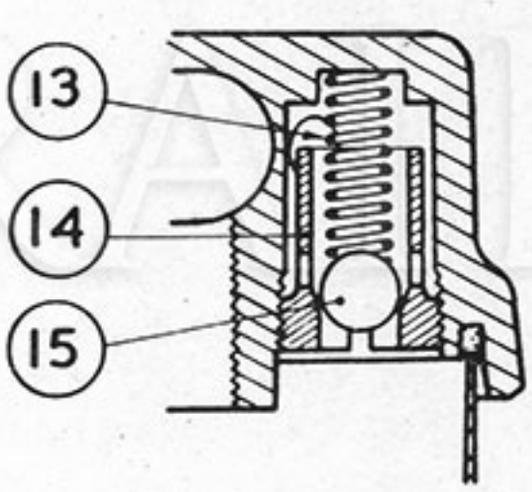
To assemble the filter place the seal (10) and reinforcing plate (9) on the centre bolt (5) followed by the sump (3). Slide the spring (8), washer (11), gasket (12) and lower element guide (7), recess foremost, over the centre bolt and fit the circlip (6). Place the filter element (4) in the sump so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

Fig. 11. View of Filter





PLAN



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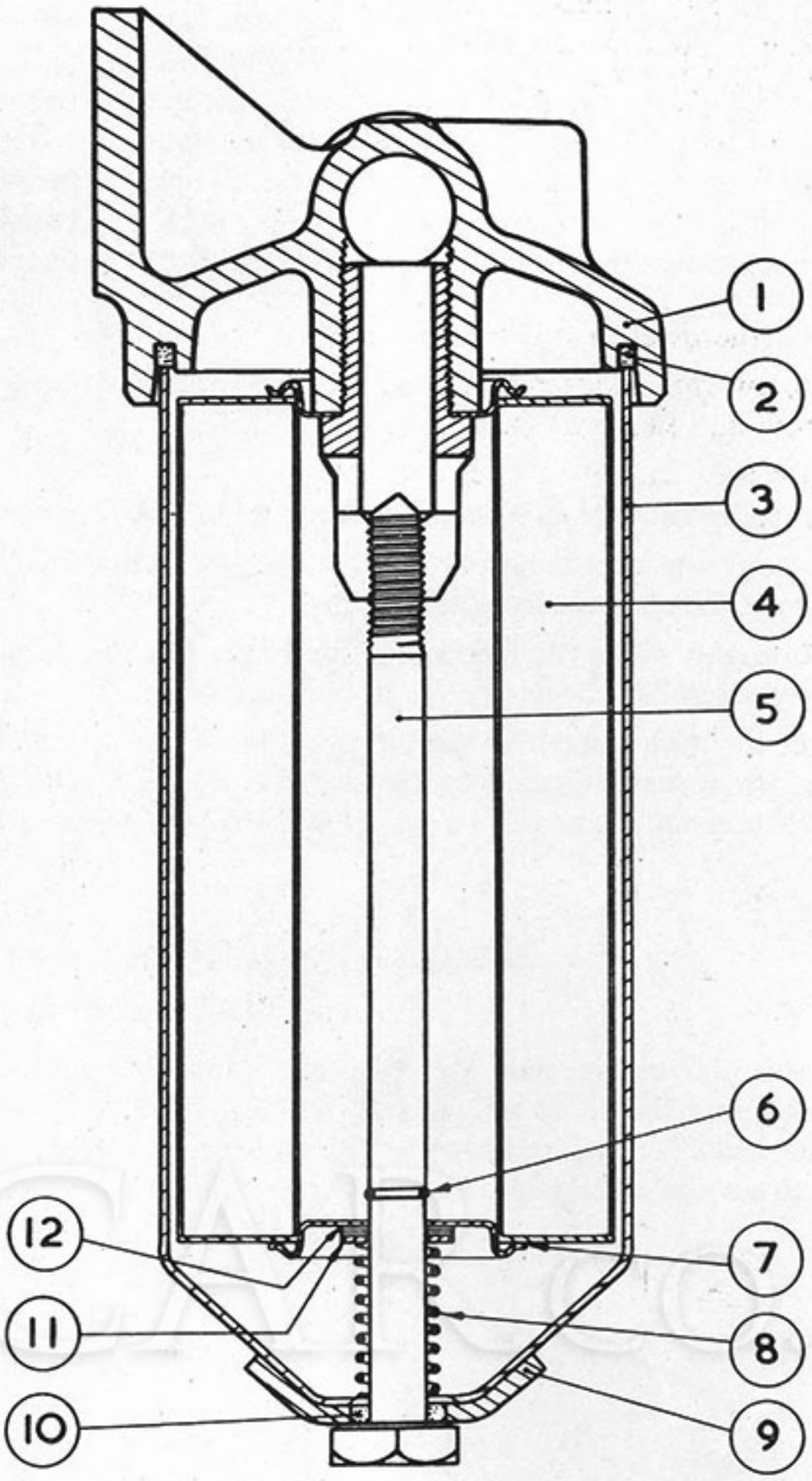


Fig. 12. Drawing of Filter.

Sect. S14. GEARBOX—SERVICING THE BRAKES

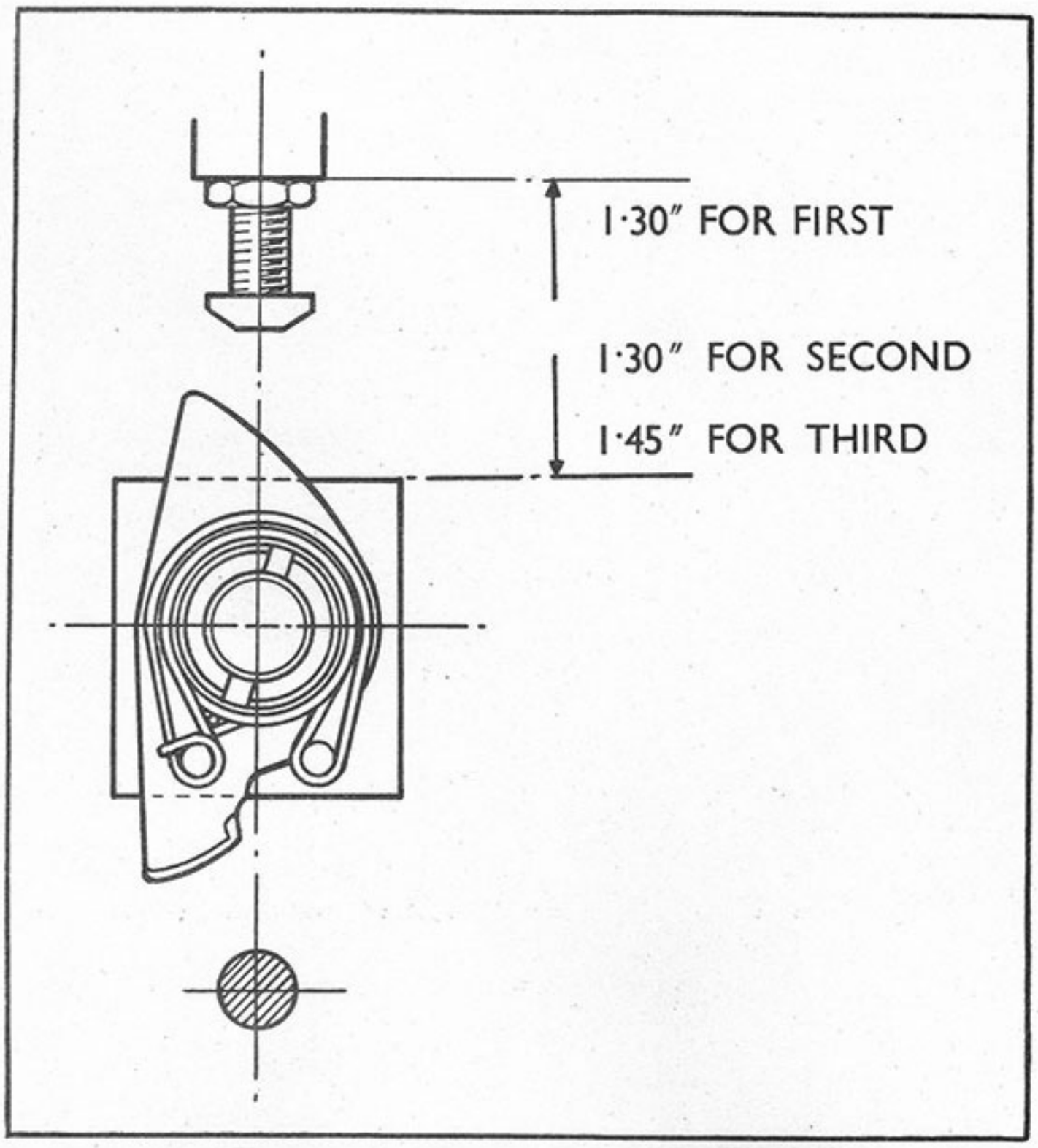


Fig. 13. Brake setting Dimensions

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 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 engines must be stopped before the cover is removed. Brake setting can proceed until the main reservoir pressure drops to 5 p.s.i. 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 the adjuster nut with the wide coils lying uppermost. The two eyelets and the loop which lies between them are placed on the adjuster ring pin and the remaining loop over the table pin.

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 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 convenient for measuring are the face of the boss on the brake band on which the locknut rests, and the face of the adjuster table.

SERVICING THE BRAKES

(*See Figs.* 5 & 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 the 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.
6. When the correct setting has been obtained, release the brake, hold the adjuster 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 the 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.) 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.

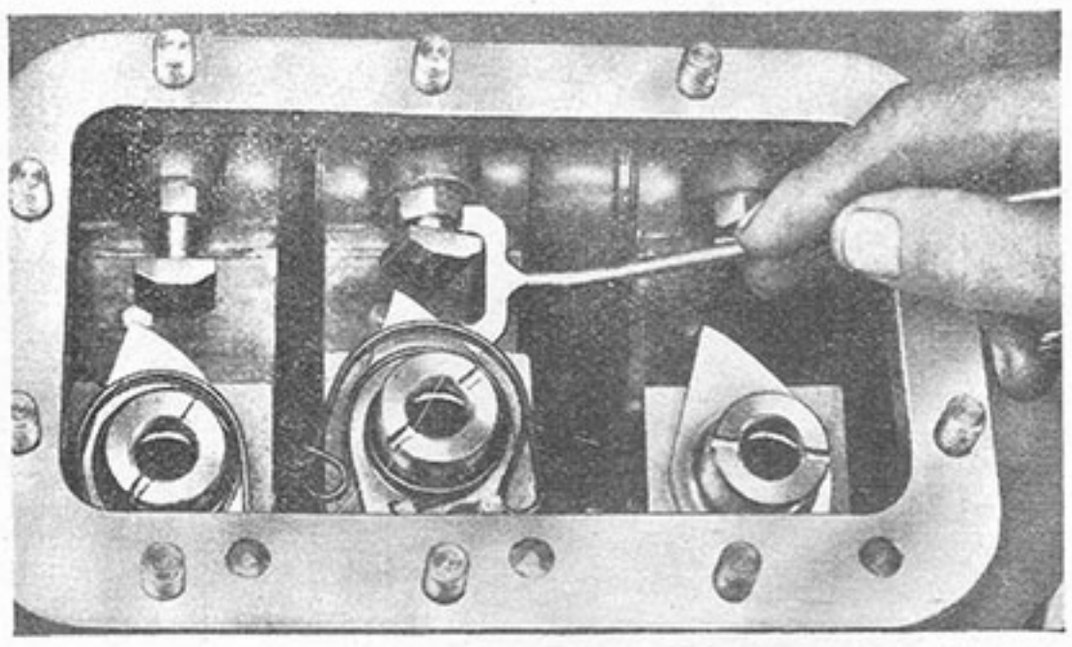


Fig. 14 GAUGE APPLICATION. This shows where the gauge should be applied.

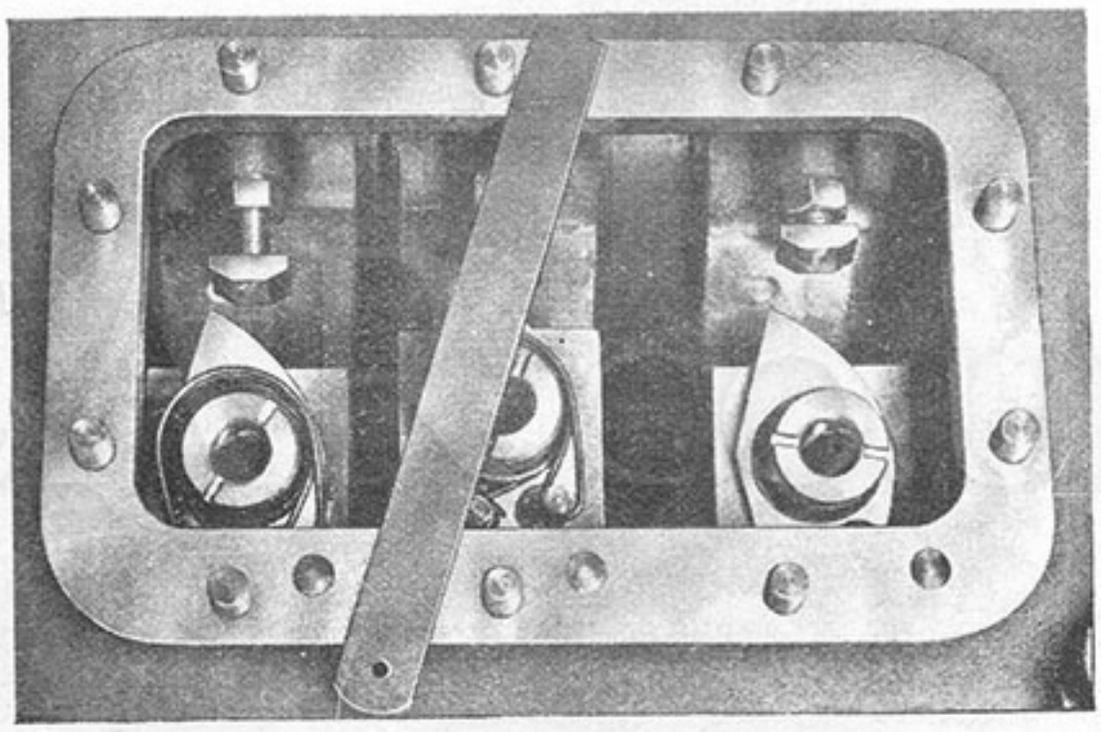


Fig. 15. Checking Movement of Adjuster Nut

11. 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.

FINAL ADJUSTMENT

Insufficient Gauge Clearance:—

1. If the gauge will not enter, release the brake and move the adjuster screw half a turn outwards and relock.
2. Apply and release the brake until the adjuster nut stops turning.
3. Check the gap.
   Repeat these operations 1 to 3 if required.

Excessive Gauge Clearance:—

1. If the gauge has too much clearance, move the adjuster screw half a turn inwards 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 these operations 1 to 4 if required.

NOTE—Should the mechanism fail to respond to this setting sequence (especially failure of adjuster nut to turn when the adjuster spring is considerably deflected) see Failure of Automatic Adjuster.

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 'Servicing the Brakes'.

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.

Clean the parts 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 tap ($\frac{11}{16}$″—16 UNS—2 B Thread).

If the pullrod threads are damaged the gearbox must be sent for overhaul.

(c) If (a) and (b) do not reveal the trouble. fit new automatic adjuster spring.

Sect. S15. GEARBOX—TO REMOVE AND FIT

Drain the oil from the gearbox by removing the two plugs fitted in the bottom cover and the front cover.

NOTE—The drain plug in the bottom cover is of the magnetic type and should be cleaned prior to replacement.

Disconnect the propeller shaft couplings from the front and rear of gearbox, also the pulley belts if fitted.

Release the four air connections at the gearbox.

Pack up the gearbox and remove the mounting bolts.

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

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

To replace the gearbox, reverse the above procedure.

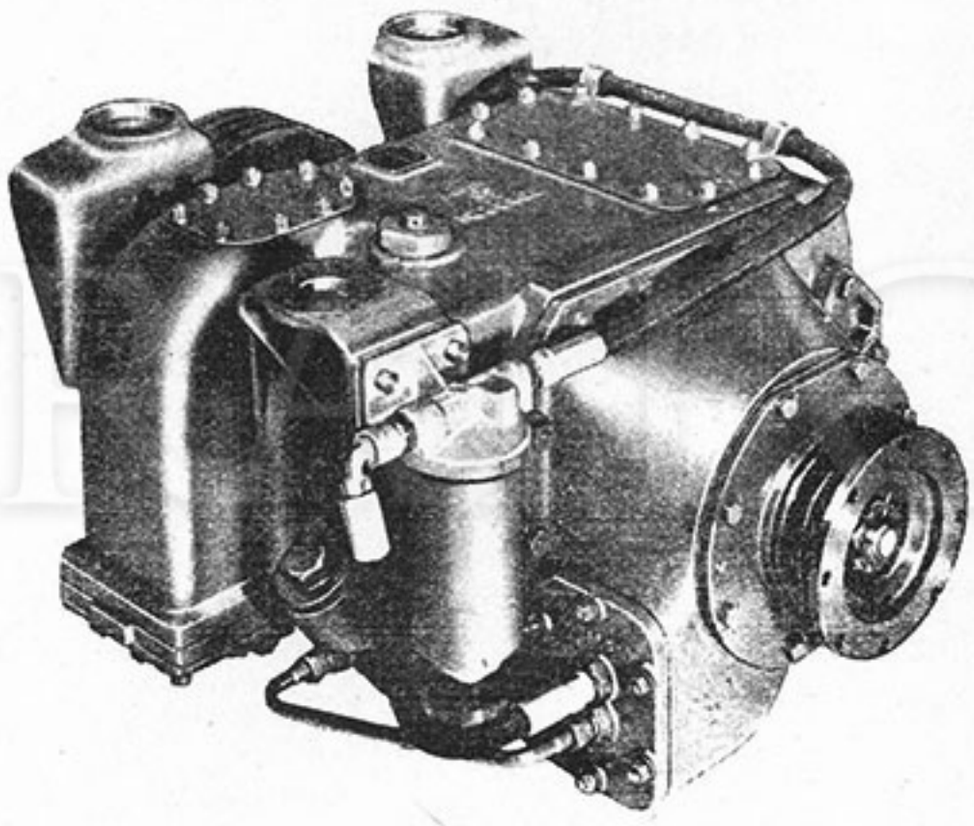


Fig. 16. View of Gearbox (a).

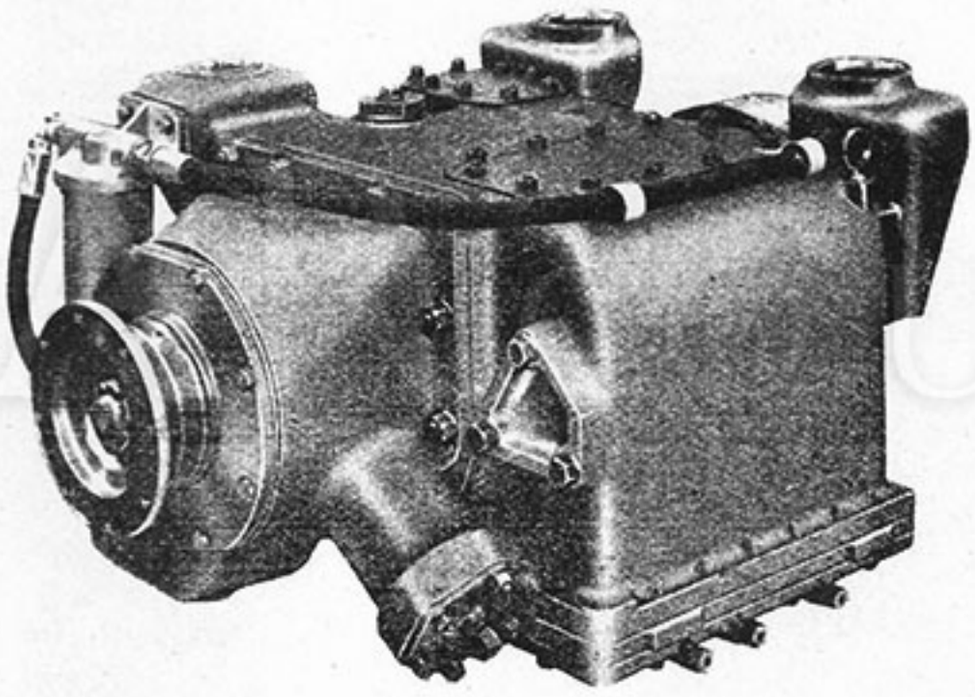


Fig. 17. View of Gearbox (b).

Sect. S16. GEARBOX—TO DISMANTLE

(*See Fig.* 4)

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

Support the gearbox on a suitable bench.

Check the necessity for relining the brakes by observing the position of the adjuster nut (7) on the pull rod (11). Brake life is exhausted when the top faces of the adjuster nut and pull rod coincide.

Preparatory to removing the running gear the three brake adjuster mechanisms must be slackened off. Access to the adjusters is obtained by removing the large inspection cover on top of the gearcase.

Remove the two eyes of each adjuster spring (8) from the ring pin (6) and the table pin (9) to release the adjuster nut (7) this should then be screwed three complete turns anti-clockwise.

REMOVE REAR END ASSEMBLY

(*See Fig.* 2)

Take off split pin (32) nut (34) and washer (33) followed by the "O" ring (31).

Next remove the output coupling (30) complete with pulley (36) (if fitted) and inner race of bearing (26).

Remove nuts (27) and spring washers from the studs, and take away the oil seal housing (28) with oil seal (29).

Using special extractor tools (Part No. 37428) withdraw the bearing sleeve (24) complete with outer race of bearing (26) bearing (25) and bearing collar (35).

There should be no necessity to disturb the cover plate (22). Next unscrew the oil union (38) out of the gearcase together with its copper washer; the oil muff (23) can then be removed from the bearing collar (20).

TO REMOVE FRONT COVER, etc.

(*See Fig.* 2)

Remove nuts (74) and the washers from studs, then remove oil pump assembly and gasket from the front cover (71).

Remove split pin (67) (taking great care not to damage screw threads of input shaft), nut (68), washer (66) and sealing washer (65).

Remove set screws (70) with spring washers, using special extractor tools—part number 37428. Remove coupling (63) complete with oil seal housings (61). As the withdrawal proceeds tap the end of the input shaft (64) back through the coupling.

With coupling flange downwards, adequately support oil seal housing (61) and press coupling (63) out of bearing.

Take from the input shaft (64) the pump driving gear (59) and sleeve (58).

Remove nuts (3) and spring washers securing the front cover (71) to the gearcase (17) this includes those situate in the pump mounting aperture. The front cover can then be taken away complete with the top speed piston (50), etc.

Note. Do not disturb pivot pin (72).

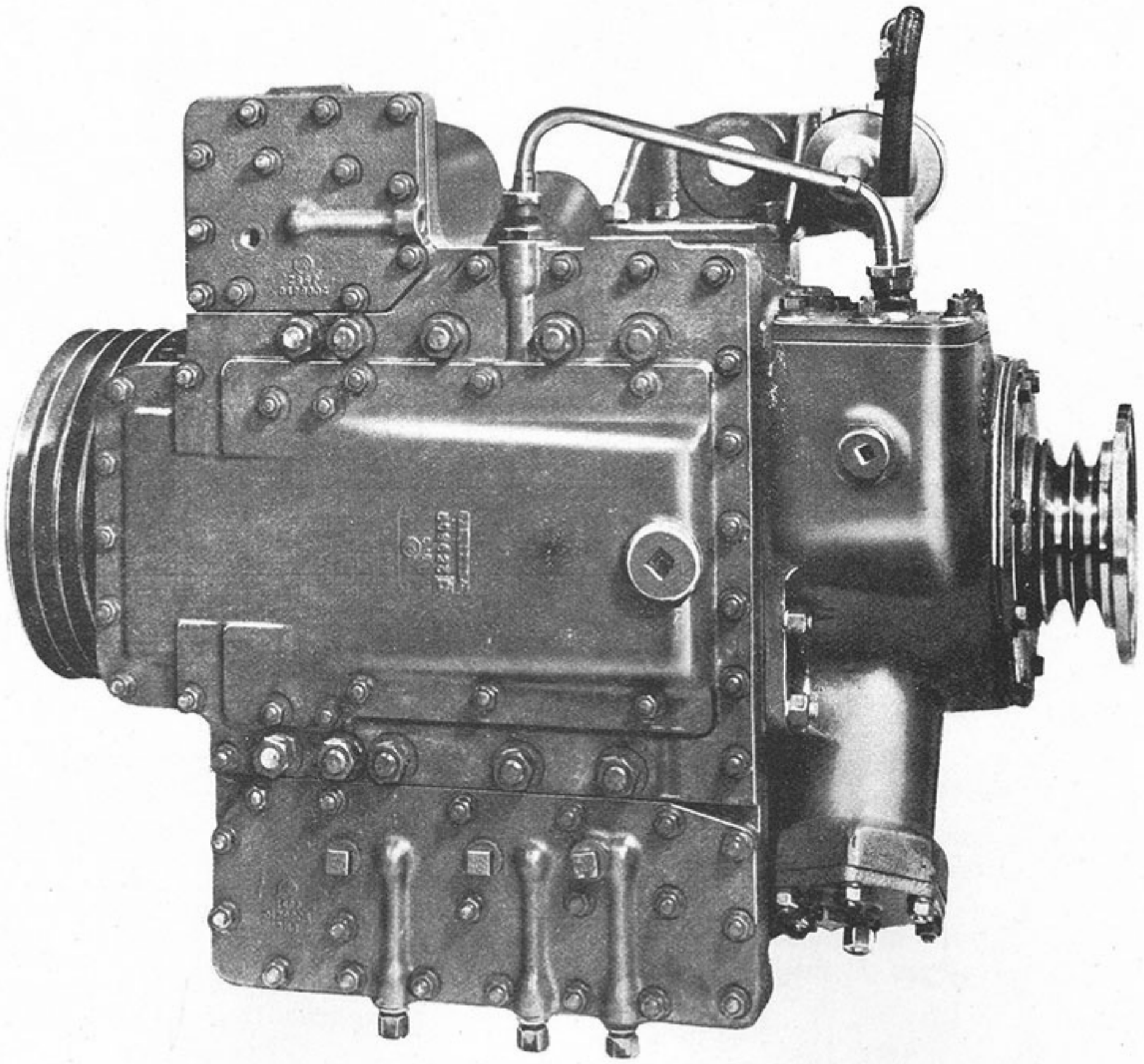


Fig. 18. View of the Bottom Cover, etc.

DISMANTLING THE RUNNING GEAR

(*See Fig.* 2)

Remove the bearing (1) bearing housing (2) trunnion ring (4) and the clutch sliding panel (5). The bearing housing and trunnion ring should be left assembled on the bearing unless a replacement is necessary.

Take out the clutch return springs (8), and spigot pins and remove the clutch inner member (12) complete with clutch plates (9-10). The split ring (75) can then be removed from the shaft (ensure removal of both halves).

The following components should next be removed, in the order given:—

Bush (6)
3rd speed brake drum (11), with Sunwheel (14) (Assembly)
Bush (44)
3rd Speed Planet assembly (13)
Bush (42)
Bush (43)
Input shaft (64)
2nd Speed Planet assembly (15)
Adjusting washer (16)
Bushes (19 and 21)
1st Speed Planet assembly (18) with output shaft assembly. Withdraw this centrally to avoid damage to surrounding parts.

The bearing collar (20) together with the inner race of bearing (37) can then be removed; the bearing outer race, together with the bearing housing (39) can be left in position unless replacement is necessary.

REMOVAL OF GEARCASE FROM BOTTOM COVER

(*See Fig.* 18)

From their studs unscrew all the nuts securing the bottom cover to the gearcase and lift the gearcase away, leaving the bottom cover, complete with brake bands, brake actuating mechanism and the air cylinders.

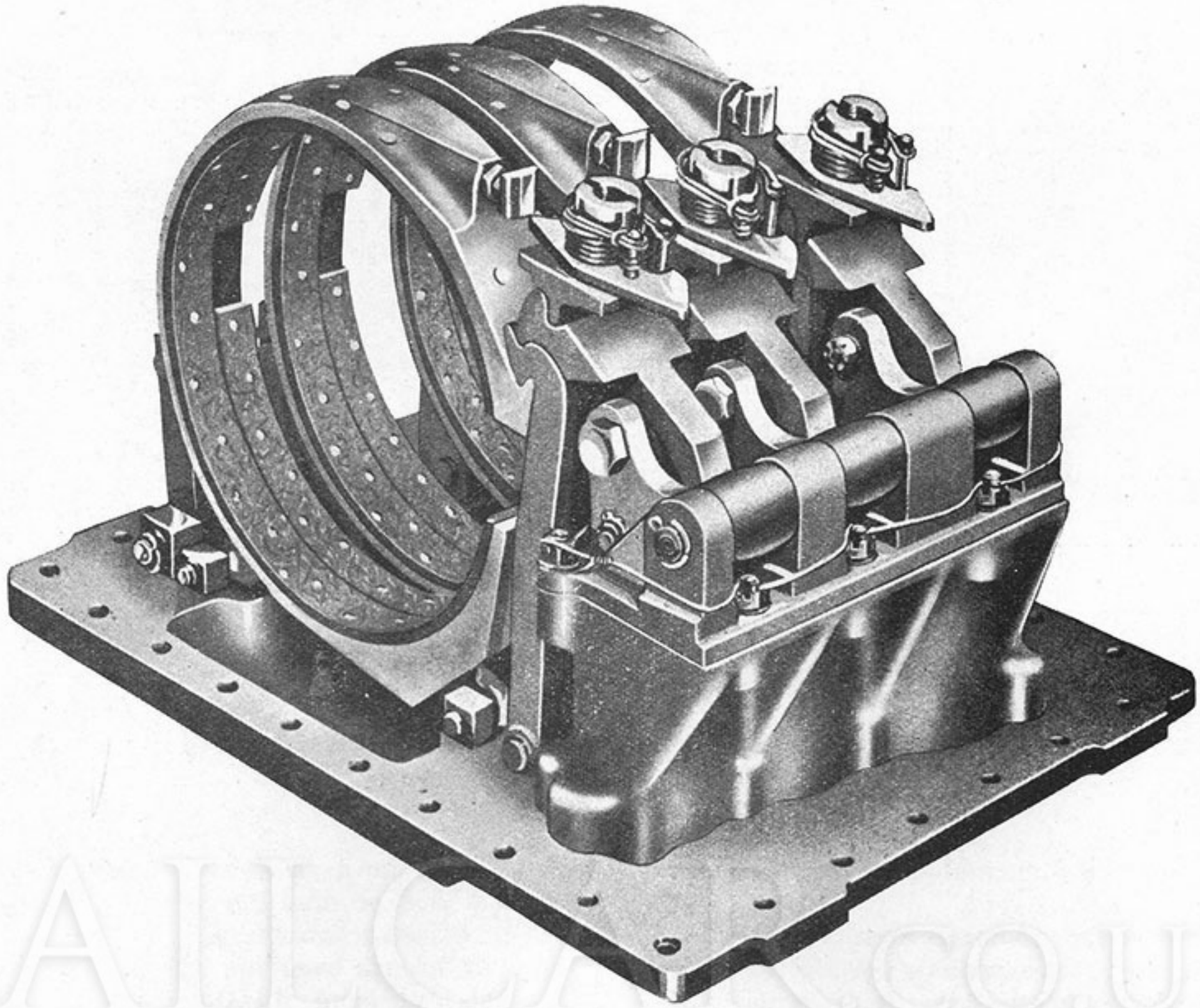


Fig. 19. The Bottom Cover and Brake Band Assembly

REMOVAL OF BRAKE BANDS

(*See Fig.* 4)

Remove the adjuster spring (8), nut (7), ring (6), table (9) and thrust pad (12) from each brake. It is advisable to keep these in sets for subsequent re-assembly to the same band.

Press down on top of each brake band (3) to release the hooks. Take out the split pins from the internal band link pins (1) and extract the pins.

Lift the bands away, first placing rag round the centralizers to prevent the springs (2) from flying out.

EXTRACTING THE PISTONS

Refer to Section S10 for removal of pistons.

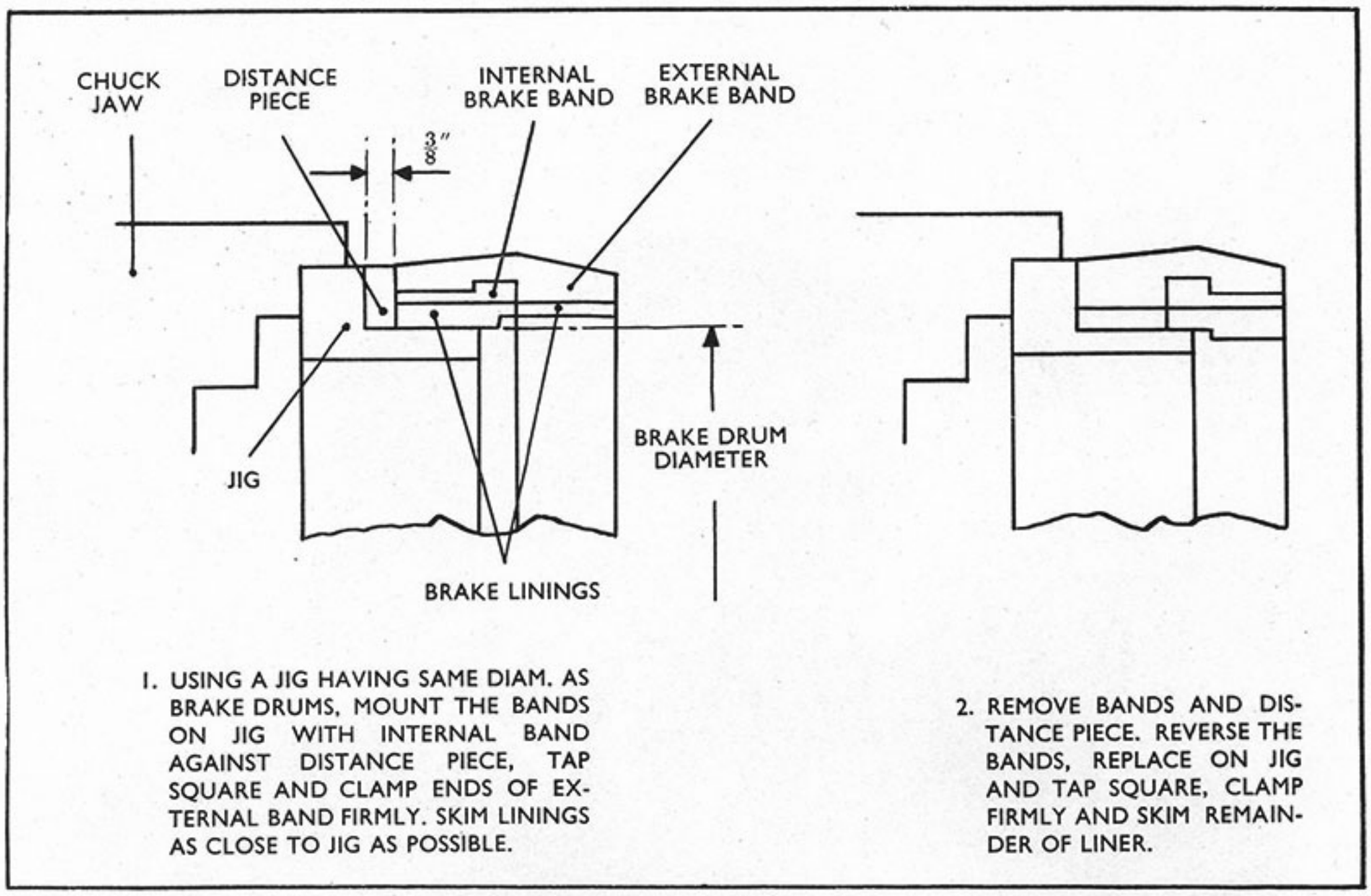


Fig. 20. Relining the Brake Bands.

Sect. S17. GEARBOX—RELINING THE BRAKE BANDS

(*See Fig.*20)

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 outer and inner band if gap is less than 2.0″.

To replace the internal lining, first cut through it and place it in the band securing with clamps. Next drill through the band and lining using an $\frac{11}{64}$″ drill.

Countersink to $\frac{5}{32}$″ depth the holes in lining using a $\frac{11}{32}$″ tungsten carbide tipped drill (90° included angle). Rivet the lining to the internal band and file flush. (Important).

Trim lining at extreme ends level with brake band, ensure also that the lining is flush at the lug side.

Position the new lining in the external band, ensuring the lining is level at the edge that will mate with the internal band lining. The band should then be drawn together by means of a clamp affixed across its ends.

Drill through band and lining and countersink as with inner band. Rivet the lining to the band leaving out the two end rivets.

Cut the lining and release the clamp, rivet the ends of the lining. The lining should then be trimmed at the ends, level at the lug end and leaving a $\frac{1}{8}$″ projection at the other end.

File the rivets level to the band on the machined surface.

After relining, the lug on the internal band is led 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 then skimmed up as show in Fig. 20, the bands can then be replaced as explained in Section S18.

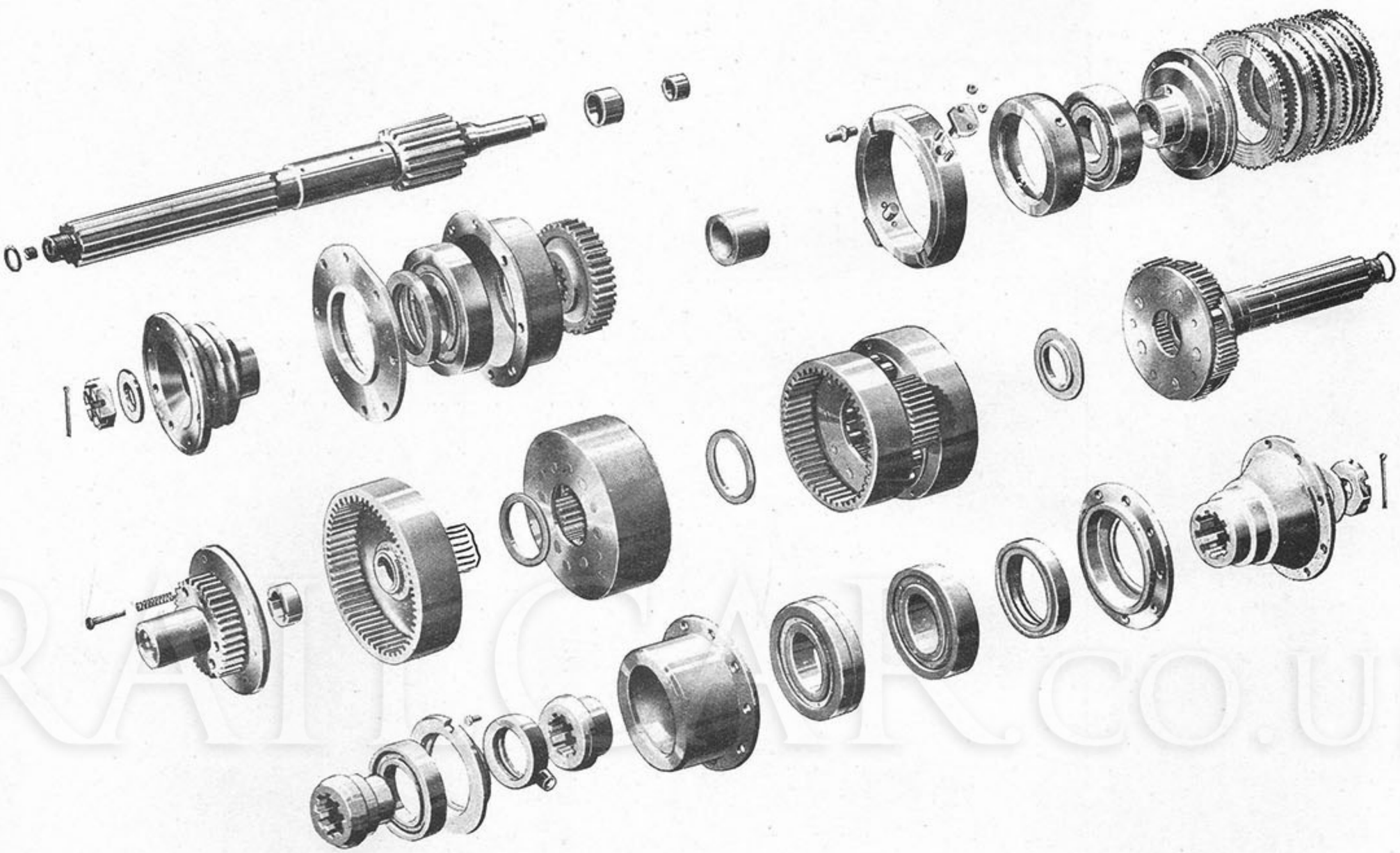
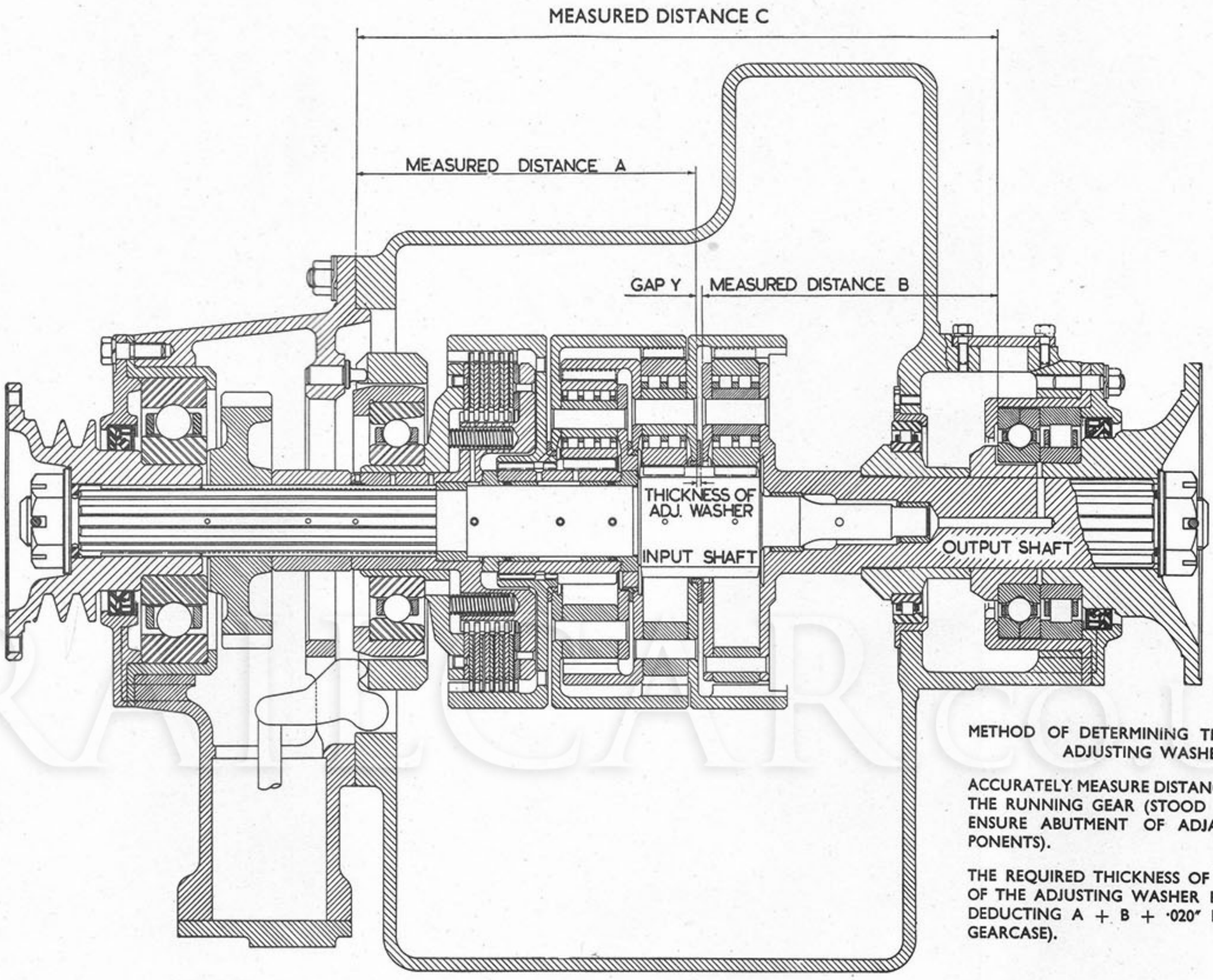


Fig. 21. Running Gear, Etc. (Shown in Sequence)



METHOD OF DETERMINING THICKNESS OF ADJUSTING WASHER

ACCURATELY MEASURE DISTANCES A & B ON THE RUNNING GEAR (STOOD ON END TO ENSURE ABUTMENT OF ADJACENT COMPONENTS).

THE REQUIRED THICKNESS OF THE FLANGE OF THE ADJUSTING WASHER IS FOUND BY DEDUCTING A + B + ·020″ FROM C (ON GEARCASE).

Fig. 22. Method of determining thickness of adjusting washer

Sect. S18. GEARBOX—TO ASSEMBLE

Note. ENSURE THAT ALL PARTS ARE THOROUGHLY CLEAN AND FIT FOR FURTHER SERVICE. (SEE SECTION S19).

CHECKING THE END FLOAT

(*See Fig.* 22)

From the Measured Distance C deduct the sum of A+B+thickness of flange of adjusting washer. If the remainder exceeds .050″ a new adjusting washer must be used, its flange thickness being determined as outlined in figure 22. When new flanged bushes are fitted ALL brakes should be re-lined.

REPLACE PISTONS

Refer to Section S10 for replacement of the pistons.

REPLACE BRAKE BANDS

(*See Fig.* 4)

Note. Before commencing ensure that the adjuster nuts are an easy fit on the pull rod (11) $\frac{11}{16}$″-16 UNS—2A thread. Tight nuts $\frac{11}{16}$″-16 UNS —2B thread 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 re-lined are assembled in their original positions.

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

Insert the springs (8) into the centralizers and compress each spring in turn and pass the ears of the band (3) over them.

Fit the internal band link pins (1) and secure with split pins.

Compress the external bands (3) and engage the brake hooks.

Fit to the pull rods (11), thrust pads (12) adjuster tables (9) and the adjuster rings (6), secure these with the adjuster nuts (7), screw down far enough to keep them in position.

Replace the adjuster springs (8).

REPLACE THE GEARCASE TO BOTTOM COVER

(*See Fig.* 18)

After applying jointing compound lower the bottom cover with brake assemblies inverted onto the gearcase, secure with nuts and spring washers onto bottom cover.

REPLACE RUNNING GEAR

(*See Fig.* 2)

Note. Ensure that all the running gear is pushed fully into position when in mesh. Dip all bushes in oil when fitting.

The first component to be replaced in the gearcase, (since the bearing housing (39) and outer race of bearing (37) are normally left undisturbed) is the bearing collar (20) together with the inner race of the bearing (37).

Replace next the 1st speed planet and output shaft assembly bushes (19 and 21).

The adjusting washer (16) should be fitted to the face of the 2nd speed planet assembly with a smear of grease.

Fit the 2nd speed planet assembly (15) with the adjuster washer into position followed by the bush (42). The input shaft (64) can now be replaced into mesh with the 1st and 2nd speed planet trains (15 and 18).

Fit bush (43), and replace the 3rd speed planet assembly, fit bush (44).

Replace the 3rd speed sunwheel (14) and brake drum (11) assembly and bush (6).

The split ring (75) should then be greased and positioned onto the shaft, and the clutch inner member (12) passed over it.

Replace the clutch plates (9-10) in the order shown on Fig. 1 and insert the springs (8) and spigot pins.

Position onto the clutch inner member (12) the sliding panel complete with bearing (1) bearing housing (2) and trunnion ring (4) in position.

The sleeve (58) should then be replaced followed by the pump driving gear (59).

REPLACE THE FRONT COVER ASSEMBLY

(*See Fig.* 2)

Fit to the front cover (71) the 4th speed actuating assembly (50 and 51, etc.) if these parts have been removed. The bearing housing (69) complete with bearing (60) oil seal housing (61) with oil seal (62) should then be fitted to the gearcase (first applying jointing compound).

Note. The oil seal (62) should be packed with grease before replacement.

Position front cover assembly to gearcase, first applying jointing compound, replace spring washers and nuts (3) to the studs (including the nuts situate in the pump mounting aperture).

Replace the oil pump assembly (73) with gasket, fastening with nuts and washers.

Tap the input coupling (63) into position and replace sealing washer (65) washer (66) nut (68) and split pin (67).

REPLACE THE REAR END ASSEMBLY

(*See Fig.* 2)

Fit the oil muff (23) over the bearing collar (20) and screw the oil union (38) into position in the casing, together with its copper washer.

Replace the bearing collar (35) to the output shaft, followed by the bearing sleeve (24) and bearings (25 and 26).

Pack the oil seal (29) with grease.

The oil seal housing (28) can then be replaced complete with oil seal (29) (first applying jointing compound), secure by replacing nuts (27) with spring washers to the studs.

The output coupling (30) complete with pulley (36) (if fitted) should next be fitted, tapping into position.

Replace "O" ring (31) washer (33) nut (34) and split pin (32).

The gearbox is now completely assembled.

THE BRAKES MUST NOW BE ADJUSTED SEE SECTION S14.

Sect. S19. PERMISSIBLE CLEARANCE FOR RUNNING GEAR BUSHES

Part No.	Item No. Ref. Fig. 2	Description	Dimension Ref.	Min^{m} Permissible Diametral Clearance (New)	Max^{m} Permissible Diametral Clearance (Worn)	Min^{m} Permissible Flange Thickness (Worn)
500067	6	3rd Speed Sunwheel-Bush	Bore	.0005″	.015″	.387″
			°/Dia.	.002″	.015″	
500067	43	3rd Speed Sunwheel-Bush	Bore	.0005″	.015″	.387″
			°/Dia.	.002″	.015″	
			Flange °/Dia.	.004″	.020″	
500046	42	3rd Speed Annulus-Bush	Bore	.002″	.015″	.088″
			°/Dia.	.003″	.015″	
500046	44	2nd Speed Annulus-Bush	Bore	.002″	.015″	·088″
			°/Dia.	.003″	.015″	
500078	19	Input Shaft Bush—(Large)	Bore	.001″	.010″	—
			°/Dia.	.0015″	.010″	
500063	21	Input Shaft Bush—(Small)	Bore	.001″	.010″	—
			°/Dia.	.0015″	.010″	
518525	16	Adjusting Washer	°/Dia.	.003″	.020″	Renew when Total End Float Exceeds .050″