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SECTION 13 — REVERSE ASSEMBLY

The reverse assembly consists of the reverse epicyclic gears, rear extension casing and output shaft, also, for assembling and dismantling purposes, the mainshaft. Two different types of reverse assembly are fitted, the 'R' series cars and the 'S' series cars.

Differences between the two reverse assemblies are shown pictorially and are explained in the following paragraphs.

The '1952' and '1953' models are similar in appearance and in the sequence of assembling and dismantling.

The 'S' series assembly differs from the 'R' series in the shape of the extension casing, gearbox-to-chassis mounting bracket and propeller shaft coupling flange; also it is not fitted with a ride control oil pump.

The gearbox-to-chassis mounting bracket is deleted on 'S2' and 'S3' series cars.

The different models of rear extension are not interchangeable.

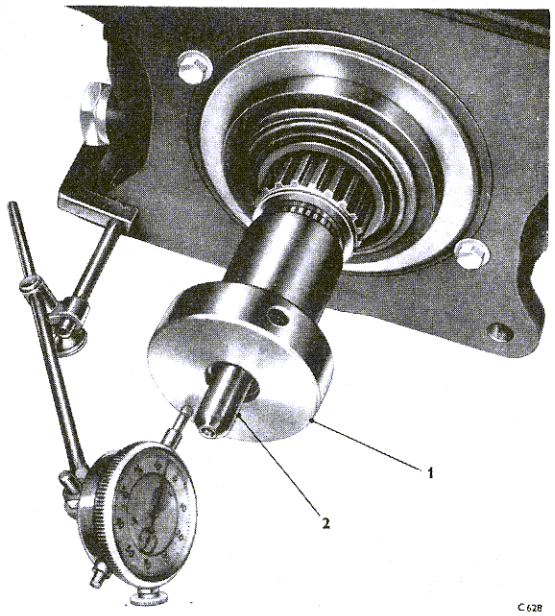

Fig. 96 Checking mainshaft end float

1 CENTRALISING SLEEVE
2 MAINSHAFT

To remove the reverse assembly, remove the gearbox from the chassis, as described in Section 1, then remove the following units.

Fluid coupling (see Section 2).
Side cover, sump and filter (see Section 3).
Control valve unit (see Section 4).
Parking brake bracket (see Section 5).
Front and rear servo units (see Section 6).
Rear pump and governor (see Section 7).
Ride control unit, if fitted (see Section 10).
Speedometer drive (see Section 11).
Road wheel brake servo drive (see Section 12).

'S' series rear extension — To remove

During removal of the reverse assembly from the gearbox, also during subsequent dismantling, all thrust and adjusting washers should be labelled for easy identification when re-assembling.

After removal of the units previously mentioned, check the end float of the mainshaft as follows.

Remove the spring ring from the mainshaft, screw on the end float checking sleeve to its fullest extent, then mount a dial test indicator as shown in Figure 96.

Fit the wedge tool in position between the forward end of the oil delivery sleeve cap and the front drum and tap it lightly to take up the drum assembly end float.

Push the mainshaft rearward and set the indicator dial at zero.

Pull the shaft forward and note the reading.

Repeat this operation to ensure that a correct reading is obtained. If this is within the limits stated in the 'Summary of Repair Data', the existing adjusting washer can be retained provided that it is otherwise serviceable.

If the end float is incorrect, measure the thickness of the adjusting washer and select a new one to give the correct end float.

Fit a holding tool to the output flange as shown in Figure 97. Unlock and remove the output shaft nut, tab washer, abutment washer and end nip adjusting washer; withdraw the output flange.

Hold the rear drum by applying the rear band with a suitable lever, then remove the six setscrews and washers which secure the driving flange to the rear drum.

Remove the blanking plug from the rear face of the extension casing to gain access to one of the securing setscrews. Remove the five setscrews and washers securing the extension (the parking pawl screw having already been removed).

Withdraw the reverse assembly from the gearbox casing, taking care to retain the stationary cone key, then remove the mainshaft and washers (see Fig. 98). If the reverse assembly sticks in the gearbox casing, tap the mainshaft with a soft-headed mallet to initiate movement.

Remove and discard the gasket.

Fit the rear clutch hub retainer.

'R' series rear extension — To remove

Check the mainshaft end float, remove the output flange, then remove the driving flange setscrews as already described for 'S' series cars.

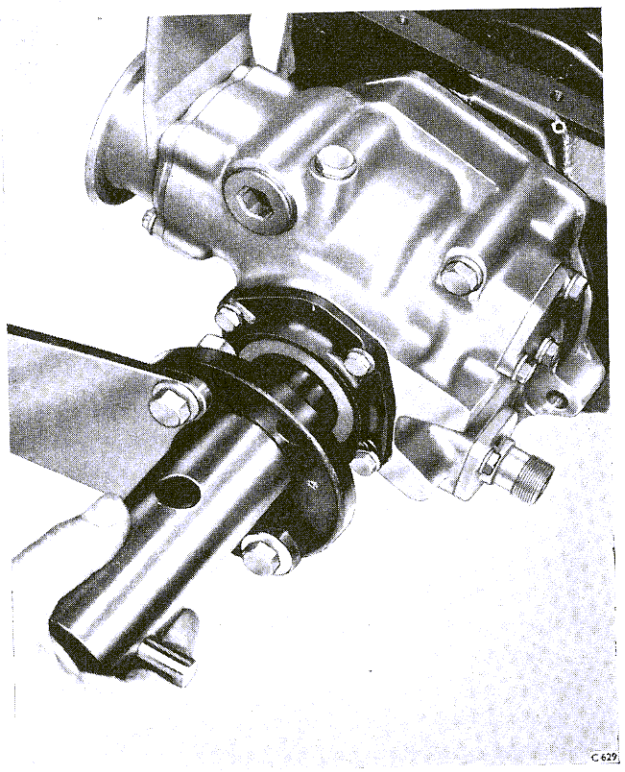

Fig. 97 Removing output flange securing nut

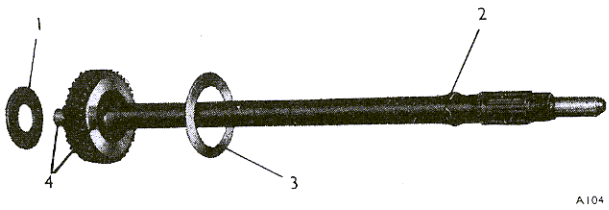

Fig. 98 Mainshaft and washers

1 END FLOAT ADJUSTING WASHER
2 SNAP RING
3 THRUST WASHER
4 OIL PASSAGES

Remove the two long studs and the setscrews which secure the end cover to the rear extension casing.

If the torque reaction bracket has not been removed, this also should be removed. Using a soft-headed mallet, tap the end cover rearward from its spigot location in the extension casing; discard the joint.

If the rear oil seal is to be renewed, press it from its bore in the end cover.

Remove the five setscrews securing the extension casing to the gearbox; two of these will be found inside the extension casing. The parking pawl locating screw will have been removed earlier.

Withdraw the reverse assembly from the gearbox casing; retain the stationary cone locating key.

If the assembly sticks in the gearbox casing, a few sharp blows with a soft-headed mallet on the front end of the mainshaft will be sufficient to start the assembly moving.

Discard the joint between the extension casing and the gearbox casing.

Withdraw the mainshaft, also the thrust washers, located one each side of the mainshaft sun gear.

Fit the rear clutch hub retainer.

Rear extension — To dismantle

The sequence of dismantling the rear extension is basically the same for all models. Any differences will be pointed out in the following paragraphs. For 'S' series cars reference should be made to Figure 99 and for the earlier models to Figure 101.

Remove the setscrews securing the end cover and remove the cover ('S' series cars). To remove the output shaft, set up the extension casing flange on blocks, rear end uppermost, to give at least 4·500 in. clearance between the output shaft planet carrier and the bench.

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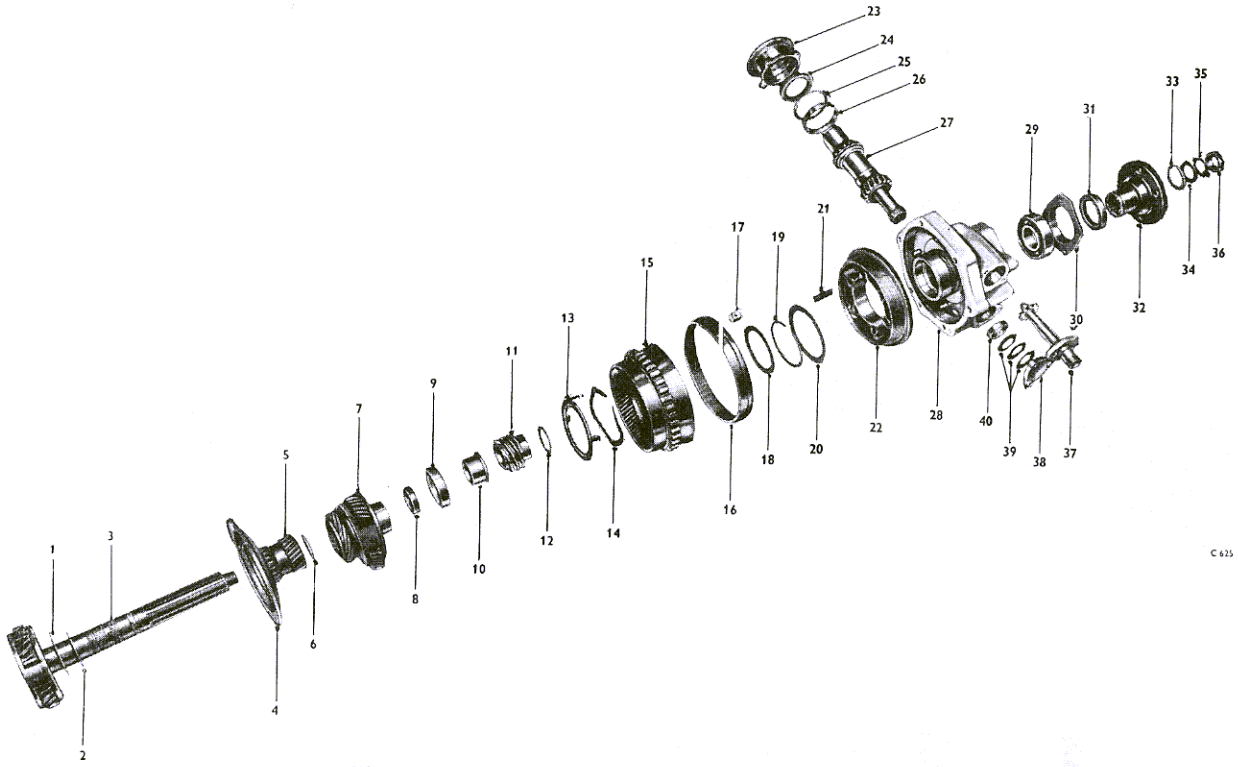

Fig. 99 Output shaft and reverse assembly — exploded

1	THRUST WASHER	11	SERVO DRIVE GEAR	21	CLUTCH RETURN SPRING	31	OIL SEAL
2	BACKING WASHER	12	LOCATING WASHER	22	REVERSE CLUTCH PISTON	32	COUPLING FLANGE
3	OUTPUT SHAFT	13	RETAINER	23	SERVO DRIVE END COVER	33	NIP WASHER
4	DRIVING FLANGE	14	CUSHIONING RING	24	OIL SEAL	34	ABUTMENT WASHER
5	REVERSE SUN GEAR	15	REVERSE ANNULUS GEAR	25	WASHER	35	LOCK-WASHER
6	SNAP RING	16	STATIONARY CONE	26	BEARING OUTER RACE	36	NUT
7	REVERSE PLANET CARRIER	17	LOCATING KEY	27	SERVO DRIVE	37	SPEEDOMETER DRIVE
8	SPACER	18	THRUST WASHER	28	EXTENSION CASING	38	BLANKING PLATE
9	FRONT BEARING	19	SNAP RING	29	REAR BEARING	39	DISHED WASHERS
10	DISTANCE SLEEVE	20	RETAINER	30	END COVER	40	SMALL BEARING OUTER RACE

Protect the output shaft threads then, using a press or a hammer and drift, drive the output shaft downward until the rear bearing becomes free on the shaft. Withdraw the rear extension casing and bearing, locating washer ('S' series cars only) and servo drive gear. On 'R' series cars drive the output shaft through the remainder of the assembly, and withdraw the distance sleeve from the casing.

On 'S' series cars fit a claw extractor and withdraw the front bearing and distance sleeve from the shaft.

Remove the thrust washer from the reverse annulus gear. Remove the annulus gear, distance piece and the reverse planet carrier from the output shaft, taking care not to damage the soft metal bush in the annulus gear. Remove the snap ring from the output shaft and lift off the reverse sun gear and driving flange, thrust washer and backing washer.

With the annulus gear on the bench, outer stationary cone uppermost, expand and remove the stationary cone using snap ring pliers as shown in Figure 100. Avoid over expanding the cone as this may result in distortion. Turn over the annulus gear and remove the retainer and cushioning ring by slightly turning the retainer and withdrawing the lugs from their holes; early retainers have two lugs instead of four as on the later models.

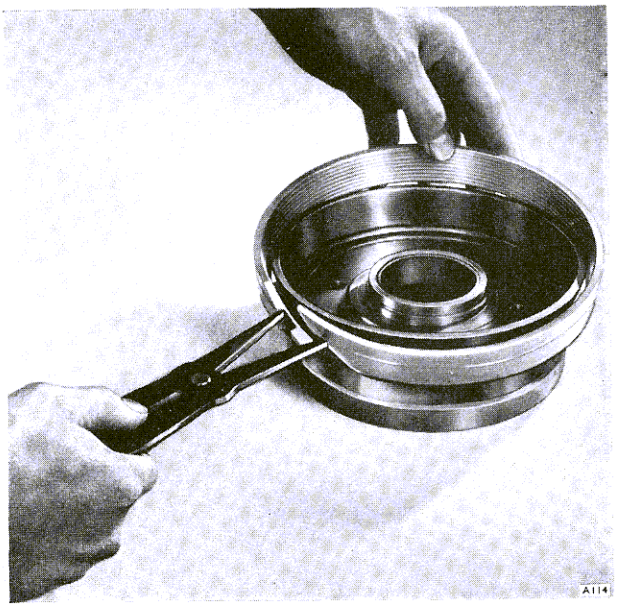

Fig. 100 Removing the outer clutch cone

Fit the clutch spring compressing tool to the extension as shown in Figure 102, ensuring that the gap in the spring ring is situated between two of the tool legs to facilitate removal.

Centralise the tool in the extension housing; on earlier rear extensions the tool is self-aligning. Screw down the tool nut until the clutch spring retaining washer is clear of the spring ring; remove the ring from the groove. Remove the tool and withdraw the retaining plate and six clutch springs.

Withdraw the inner cone clutch from the extension casing.

If difficulty is experienced in removing the clutch cone, place a hand over the extension casing to retain the piston, then apply air pressure of approximately 70 lb/sq.in. intermittently to the clutch apply duct as shown in Figure 103. This will lift the cone sufficiently to allow withdrawal from the casing; do not attempt to rotate the cone as it is located by dowels. Remove the clutch piston sealing rings.

On 'R' series cars remove the snap ring from the groove in the front bearing housing and tap out the bearing.

Rear extension — To inspect

Before inspection, all parts must be cleaned thoroughly using a suitable cleaning fluid, a brush and compressed air.

Examine the following for residual sludge. Gear teeth, external and internal splines, bores and sealing ring grooves and the mainshaft bearing housing at the front end of the output shaft.

The clutch apply duct in the extension casing and the oil passages at the rear end of the mainshaft must be blown through to ensure that they are free from obstruction.

Screw threads

Examine all screw threads, particularly any which were tight on removal; if necessary clean the threads.

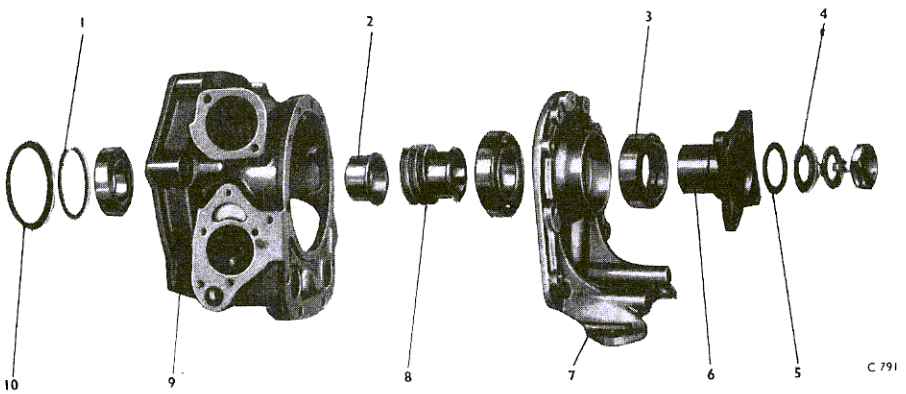

Fig. 101 Reverse assembly casing 1952/53 models

1 SNAP RING
2 DISTANCE SLEEVE
3 OIL SEAL
4 ABUTMENT WASHER
5 NIP WASHER
6 COUPLING FLANGE
7 END COVER
8 SERVO DRIVE GEAR
9 EXTENSION CASING
10 REVERSE PISTON INNER SEAL

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Gears

Examine all gear teeth for damage and wear. Examine the end thrust washers of the planet pinions for general condition.

Examine the planet pinion carriers around the pin bores for radial cracking, particularly across the narrowest sections, also check the pins for tightness in the bores; the pins are a press fit initially and should remain tight.

If any part of a planet pinion assembly is found to be unserviceable the complete assembly concerned must be renewed.

If any part of the reverse planet carrier is unserviceable, the complete assembly, including the rear pump driving gear, must be renewed; the pump driving gear is retained by a ball and snap ring and any attempt to remove it will render it unserviceable. The rear pump must be renewed complete with the reverse planet carrier; a worn gear must not be mated with a new gear in this instance.

The output shaft planet gear assembly, reverse sun gear and the reverse planet gear assembly may be changed independently of their mating gears.

Output shaft

Examine the bearing faces of the planet carrier, the shaft and the thrust and backing washers for scoring and for signs of uneven wear.

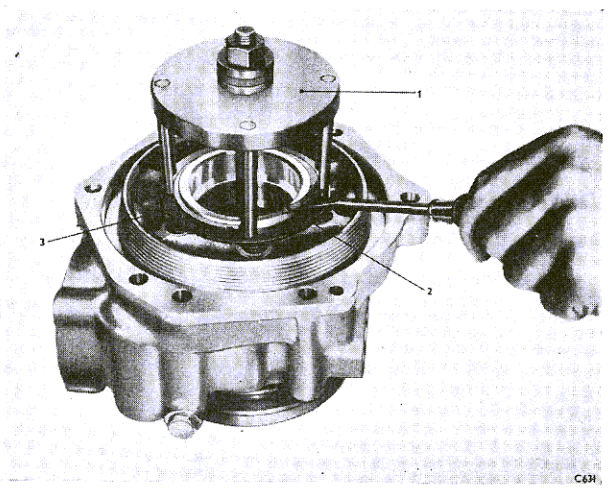

Fig. 102 Clutch spring compressing tool in position

1 COMPRESSING TOOL 2 SNAP RING 3 RETAINER

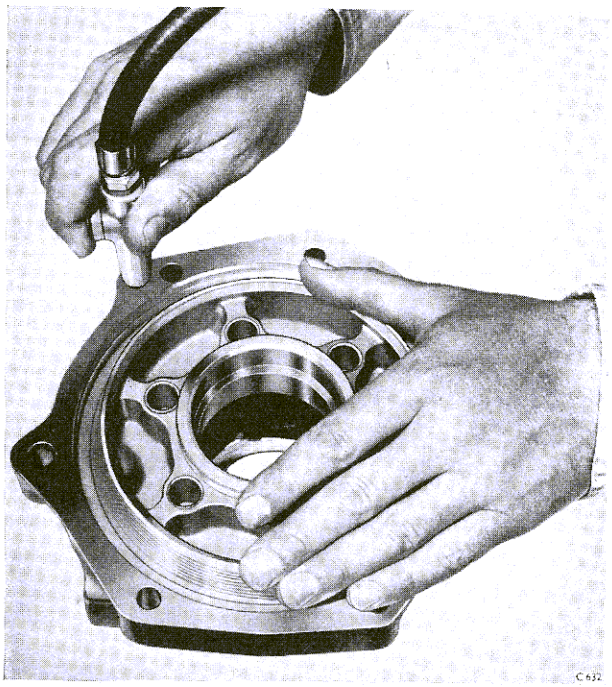

Fig. 103 Removing the inner clutch cone

Examine the mainshaft bronze bearing in the hollow end of the output shaft.

Check the splines for fretting and twisting which may indicate incipient failure.

If any part of the output shaft is found to be unserviceable, it must be changed as an assembly. The thrust and backing washers can, of course, be renewed independently if any doubt exists as to their serviceability.

Reverse sun gear and driving flange assembly

Check the driving flange and the thrust washer retainer for distortion; the retainer should be tight on the splines.

Examine the bronze bearing in the bore of the sun gear for scoring and uneven wear.

Any unserviceability will necessitate renewing the complete assembly.

The thrust washer retainer under the driving flange should not be disturbed as this is a press fit and jig-assembled.

Reverse planet carrier

Check that the rear pump driving gear is tight on the mounting and examine the gear for excessive wear.

Examine the bearing surfaces of the extension and the cushioning ring for scoring and uneven wear.

If any part of the reverse planet carrier is unserviceable the complete assembly and the rear pump must be renewed, as explained under 'Gears'.

Reverse clutch assembly

Examine the following parts for scoring, rough surfaces, signs of overheating and uneven contact. The mating faces of the outer stationary clutch cone, the reverse annulus gear and the inner stationary clutch cone.

Examine the thrust washer and the bearing surface in the reverse annulus gear for scoring and uneven wear; also examine the soft metal lining in the annulus gear bore for scoring, cracking and for bad adhesion to the shell.

Check the clutch spring retainer for damage or distortion and the springs for collapsed coils. Check that all the springs are of the same length.

Examine the outer stationary clutch cone for cracking in the vicinity of the keyway.

Examine the cushioning ring retainer for excessive wear on its bearing surface and for cracking at the bends of the lugs. Check that the cushioning ring has not lost its spring tension and become flattened during service.

Check the reverse clutch piston seals for loss of resilience and cracking. Any unserviceability of the reverse annulus gear, stationary clutch cone and the inner clutch cone will necessitate renewal of these parts as a complete assembly.

Two different reverse clutch assemblies are in service, one having an $11\frac{1}{2}°$ cone angle and the other a $12\frac{1}{2}°$ cone angle; these must be kept separate from each other. Other parts of the assembly can be renewed independently, but clutch springs should be renewed as a set.

Bearings and housing

Examine the front and rear ball bearings for wear and the outer races and their housings for signs of spinning; the outer race should be a light tap fit in the housing.

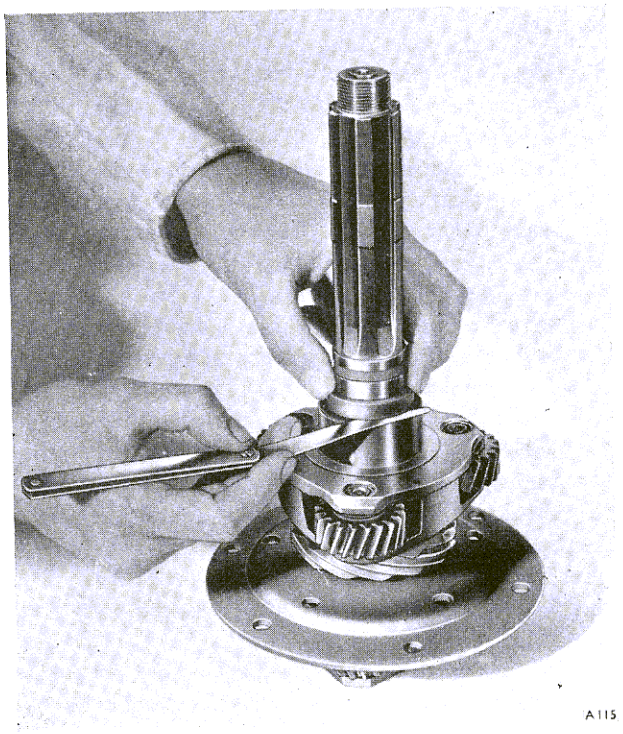

Fig. 104 Checking reverse planet carrier end float

The bearings can be renewed independently of the shaft or extension casing providing that due regard is given to the condition of the housing and mountings.

Rear extension, worm gear and coupling

Examine the extension for cracks and other damage.

Examine the internal splines of the worm gear and coupling for signs of fretting or other damage; also examine the bore of the distance sleeve for burrs which might become detached during assembly.

Check the coupling bolt holes for elongation.

Check the oil seal rubbing diameter for signs of grooving or burrs.

Check the oil seal for loss of resilience and any damage to the sealing lip which would account for a leaking seal.

All items in this assembly may be renewed independently.

Rear extension — To assemble

Before assembling, all parts must be clean and should be lightly oiled with clean gearbox oil.

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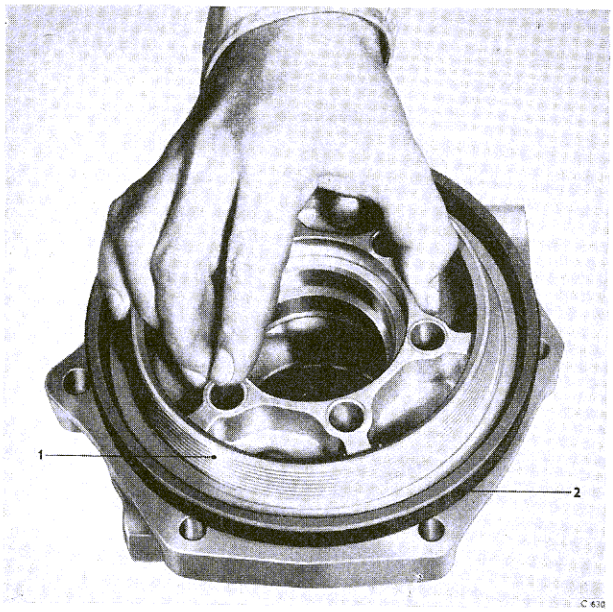

Fig. 105 Fitting inner clutch cone
1 CLUTCH CONE 2 GUIDE TOOL

New gaskets, oil seals and spring rings should be fitted where applicable; jointing compound must not be used except where stated.

Ensure that any new parts fitted are correct for the model concerned, particularly the reverse annulus gear thrust washer which is bronze for 'R' series cars and steel for 'S' series cars.

Stand the output shaft on end and assemble the thrust washer, backing washer and the driving flange and reverse sun gear, taking care not to damage the bronze bearing in the sun gear bore as it passes over the shaft splines.

Check that the washers are in the retainer on the underside of the driving flange, then fit the snap ring to the groove in the shaft. Rotate the sun gear assembly to ensure that it is free on the shaft. Fit the reverse planet carrier ensuring that the gears mesh correctly with the sun gear and check that it rotates freely.

Slide the distance piece in position on the shaft; on 'S' series cars, check the end float of the reverse planet carrier by holding the distance piece against the shoulder on the shaft and inserting a feeler blade between the distance piece and the planet carrier as shown in Figure 104. If the end float is not within the limits quoted in the 'Summary of Repair Data' the output shaft, or the reverse planet carrier, or both, must be renewed by selected parts.

Lightly smear the inner clutch cone outer seal with Mobilgrease M3 and expand the seal gently into its groove with the seal lip facing away from the conical end of the clutch cone. Grease the inner seal and fit it to the groove in the neck of the extension casing with the lip facing the bottom of the apply chamber. Ensure that both seals are fitted snugly into their grooves.

With the extension casing on the bench, apply chamber uppermost, fit the outer seal guide tool in position (see Fig. 105), ensuring that it is seated on the shoulder in the apply chamber. If a guide tool is not available, a narrow flexible strip of metal approximately 1·00 in. wide, of the correct length and free from burrs and jagged edges, should be inserted in the same manner as the tool.

Lower the inner cone squarely into the guide tool, seal first, then turn it to engage the four dowels. Push the cone into the chamber until it reaches the bottom, then remove the guide tool.

Do not try to force the piston into its chamber without the aid of a suitable guide, otherwise damage to the piston outer seal will almost certainly occur.

Fit the extension casing in position over the base of the clutch spring compressing tool and fit the six clutch springs into the sockets. Lay the clutch spring retainer plate and the spring ring in position on top of the springs and assemble the top portion of the tool ensuring that it is in a central position. Depress the retainer until the spring ring can be fitted into the groove. When the spring ring is in position, tap it into the groove to make sure it will not fly out when under pressure. Release the pressure and remove the tool.

Check the freedom of the piston in the apply chamber by applying an air pressure of approximately 70 lb/sq.in. to the clutch apply duct.

Hold the cone out by air pressure and check the seal for leakage indicated by the presence of grease bubbles. If leakage occurs fit a new seal.

Lubricate the outer stationary clutch cone and expand it into position on the reverse annulus gear, using snap ring pliers.

Care must be taken not to damage the inner face on the edge of the annulus gear during this operation. Do not over expand the cone owing to the risk of distortion and the subsequent loss of contact area.

Turn over the reverse annulus gear and fit the cushioning ring and retainer; if it has four lugs, rotate the retainer, to lock the lugs in their holes.

Rear assembly — 'S' series — Final assembly

Final assembly of the 'S' series reverse assembly differs only slightly from the 'R' series assembly procedure.

The thickness of the servo drive gear locating washer must be assessed before fitting the output shaft as described later in this Section.

The reverse assembly can be assembled completely before being refitted to the gearbox if a bench fixture for holding the assembly is available. If a fixture is not available, assessment of the output shaft end nip washer and the final tightening and locking of the securing nut should be left until the assembly is bolted to the gearbox casing.

With the output shaft standing on its end, lower the reverse annulus gear over the shaft (cushioning ring retainer downward), until it meshes with the reverse planet carrier. Spin the reverse annulus several times to check for freedom of rotation.

Position the thrust washer in the reverse annulus gear and retain it with a smear of petroleum jelly.

Fit the front bearing into its housing in the extension casing, then lower the bearing and casing over the output shaft and press down the bearing until it abuts against the distance piece. During this operation the outer clutch cone must be guided into its spigot in the extension casing, at the same time line up the keyway so that it is between the bottom two setscrew holes in the casing.

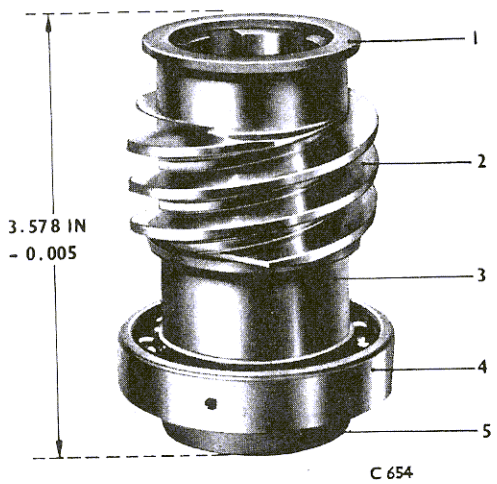

Fig. 106 Correct fitting of servo drive gear

1 LOCATING WASHER 3 DISTANCE SLEEVE
2 SERVO DRIVE GEAR 4 FRONT BEARING
5 DISTANCE PIECE

Fit the distance sleeve (flanged end uppermost) servo drive gear (worm gear end first), locating washer and rear bearing (see Fig. 106). The distance sleeve and inner race of the rear bearings are a tight fit on the shaft and should be pressed or driven into position.

Note If the distance piece, front bearing, distance sleeve or servo drive gear have been renewed, the length of the new part must be checked against the length of the discarded part and any difference allowed for in the locating washer, e.g. if a replacement gear was 0·005 in. shorter than the discarded one, the thickness of the locating washer must be increased by that amount.

The total length of spacer, bearing, sleeve, gear and adjusting washer should be 3·578 in.–0·005 in.

A few early 'S1' series gearboxes are fitted with a rear extension having a spacer, bearing, sleeve, gear and adjusting washer stack height of 3·607 in.–0·005 in. To conform to current assembly figures, this height should be reduced to 3·578 in.–0·005 in. by reducing the thickness of the spacing washer.

Fit the speedometer drive (see Section 11) and the servo drive (see Section 12) and check them for freedom of rotation.

If necessary, fit a new coupling oil seal in the end cover with the seal lip toward the bearing. Press in the seal squarely so that there will be no oil leak between the seal case and end cover.

Apply a thin coating of jointing compound to the face of the end cover and screw it to the extension casing.

Fit the output flange, applying a thin smear of oil where it passes through the seal. Check that the threads project approximately 0·500 in. above the base of the recess in the flange, indicating that the rear extension has been correctly assembled.

Rear assembly — 'R' series — Final assembly

Stand the output shaft on the bench with the planet gears lowermost.

Fit the reverse annulus gear over the shaft (cushioning ring downward) until it meshes with the reverse

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planet carrier. Spin the reverse annulus several times to check for free rotation.

Position the thrust washer in the reverse annulus gear and retain it with petroleum jelly.

Fit the front bearing into its bore in the extension casing and retain it in position with the snap ring.

Lower the bearing and casing over the output shaft and press down the bearing until it abuts against the distance piece. During this operation, guide the outer clutch cone into its spigot in the extension casing, at the same time line up the keyway so that it lies between the bottom two setscrew holes in the casing.

Fit the distance sleeve (flanged end uppermost), servo drive gear (worm end first), finally the rear bearing (see Fig. 101).

The distance sleeve and bearing are a tight fit on the shaft and should be pressed or driven into position.

Fit the speedometer drive (see Section 11), and the servo drive (see Section 12) checking it for freedom of rotation.

The end cover and coupling flange cannot be fitted to this model until the reverse assembly is fitted to the gearbox.

Rear extension — To fit

Remove the clutch hub retaining plate, check that the clutch hub is engaged correctly in all the driving clutch plates as described in Section 14.

Fit a new gasket to the gearbox-to-rear extension face and retain it with petroleum jelly.

Fit the bronze adjusting washer to the recess in the front face of the output shaft and retain it with petroleum jelly.

Fit the mainshaft into the bearing in the output shaft. Ensure that the bronze thrust washer is in position in the rear clutch hub, then fit the mainshaft and rear extension to the gearbox casing. Check that the stationary outer cone key is aligned with the keyway in the gearbox casing. Fit the key then the parking pawl screw, to align the rear extension. Fit the remaining setscrews and tighten them to finger tightness.

Apply air pressure of approximately 70 lb/sq.in. to the reverse clutch apply hole in the gearbox casing (see Fig. 107). This will apply and centralise the reverse clutch assembly. With the air pressure still applied, tighten the setscrews evenly. Release the air pressure and torque tighten the setscrews to the correct loading; remove the parking pawl screw.

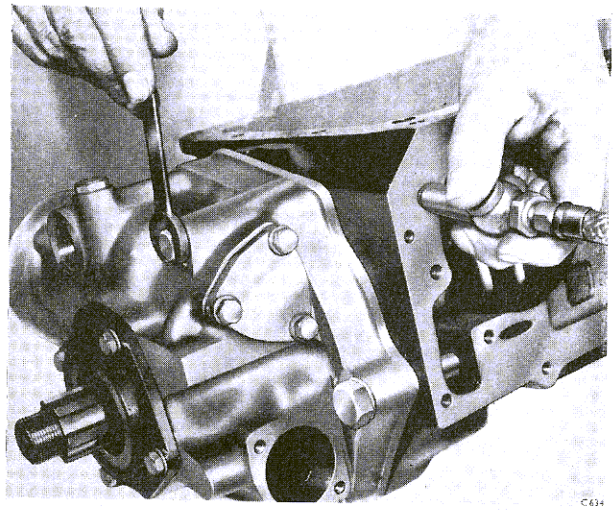

Fig. 107 Centralising reverse cone clutch

Align the driving flange holes and rear drum holes and fit the setscrews and washers; check the output shaft for freedom of rotation and the mainshaft for freedom of movement while the screws are being tightened progressively.

If the output shaft becomes stiff to turn, or locks, or the mainshaft cannot be moved, remove the rear extension and check that the rear clutch hub is home in the rear drum; also ensure that the mainshaft adjusting and thrust washers have not slipped from their respective recesses. If either of these washers have slipped and become trapped, it must be checked for damage or distortion and renewed if necessary.

If new clutch plates have been fitted to the front or rear drum a certain amount of stiffness may be encountered but it should still be possible to turn the output shaft by hand.

Check the end float of the mainshaft as described under 'Rear extension — To remove'. This is a routine assembly operation but may have to be carried out during investigations of stiffness as described in the previous paragraphs. Fit the mainshaft snap ring.

On 'S' series cars only, fit a new washer to the rear extension blanking plug; fit and tighten the plug.

On 'R' series cars, the extension casing end cover can then be fitted.

If necessary, fit a new coupling oil seal in the end cover with the seal lip toward the bearing; use a suitable dolly to ensure that the seal is fitted squarely.

Fit a new joint between the extension casing and the end cover, then fit the end cover to the casing and secure it with the setscrews and studs.

Lubricate the seal with clean gearbox fluid.

Fit the coupling, assess the thickness of the end nip adjusting washer and fit the adjusting washer, clamping washer, tab washer and nut. Tighten the nut and lock by turning up the tabs.

Output shaft end nip — To adjust

The end nip of the output shaft is set to ensure that all components are locked in their relative positions on the shaft.

In addition to the standard parts, the following extra parts will be required for this operation.

A slave adjusting washer of known thickness between 0·040 in. and 0·060 in.

A packing washer approximately 0·100 in. thick and of the same bore as the adjusting washer.

After the coupling has been fitted, the slave washer and packing washer should be fitted into the recess in the coupling. Fit the clamping washer and nut, then tighten, until all end clearance has been taken up.

Remove the nut and packing washer and fit the clamping washer. Refit and tighten the nut.

Mount a dial test indicator to read off the coupling flange as shown in Figure 108. Push the coupling into the casing and set the indicator dial to zero. Pull the coupling out and note the reading. The thickness of the end nip adjusting washer is — Thickness of slave washer + d.t.i. reading + 0·004 in. to 0·010 in. (0·008 in. is used on initial build).

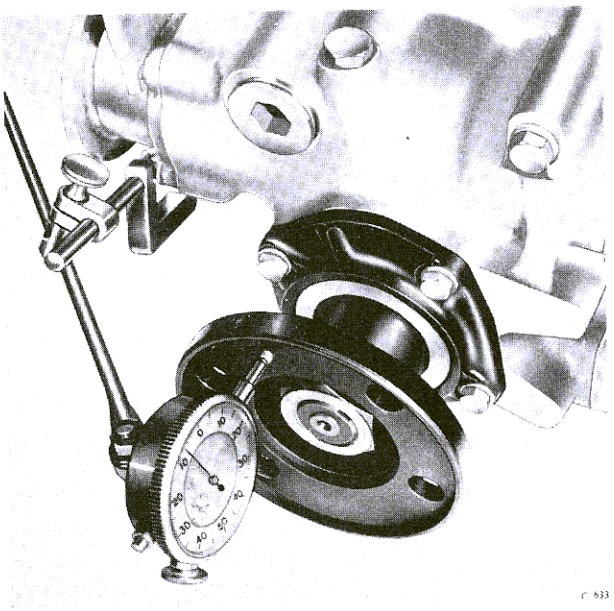

Fig. 108 Assessing thickness of end nip washer

Measure the thickness of the existing washer and if suitable and otherwise serviceable, refit it. If not suitable, select another to give the correct end nip.

Remove the nut, clamping washer and slave washer; fit the selected adjusting washer, clamping washer, tab washer and nut. Fit a holding tool to the coupling flange, tighten the nut and turn up the tabs. Remove the holding tool and refit the remaining units listed at the beginning of this Section.

The reverse unit can be tested for correct functioning, only by re-fitting the gearbox to the car and carrying out reverse and forward selection of gears as described in Chapter 2.