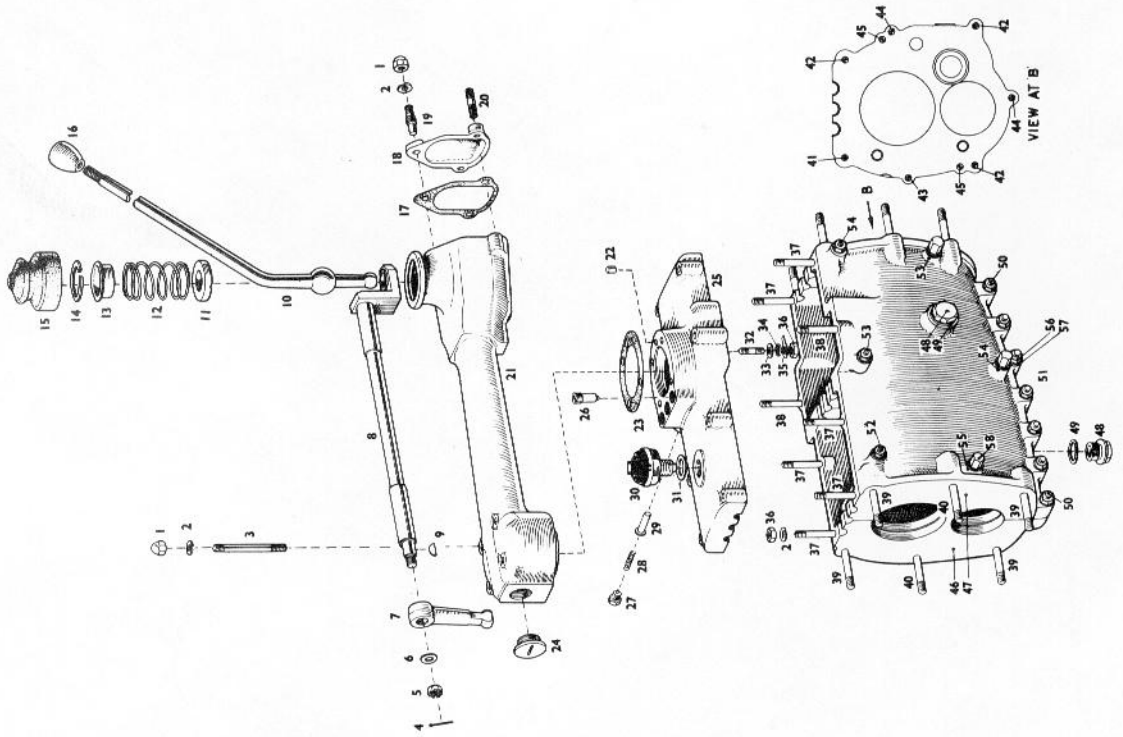
List of Contents

Gearbox and Overdrive

TYPE 404. REMOTE CONTROL GEARBOX COVER AND CASING.

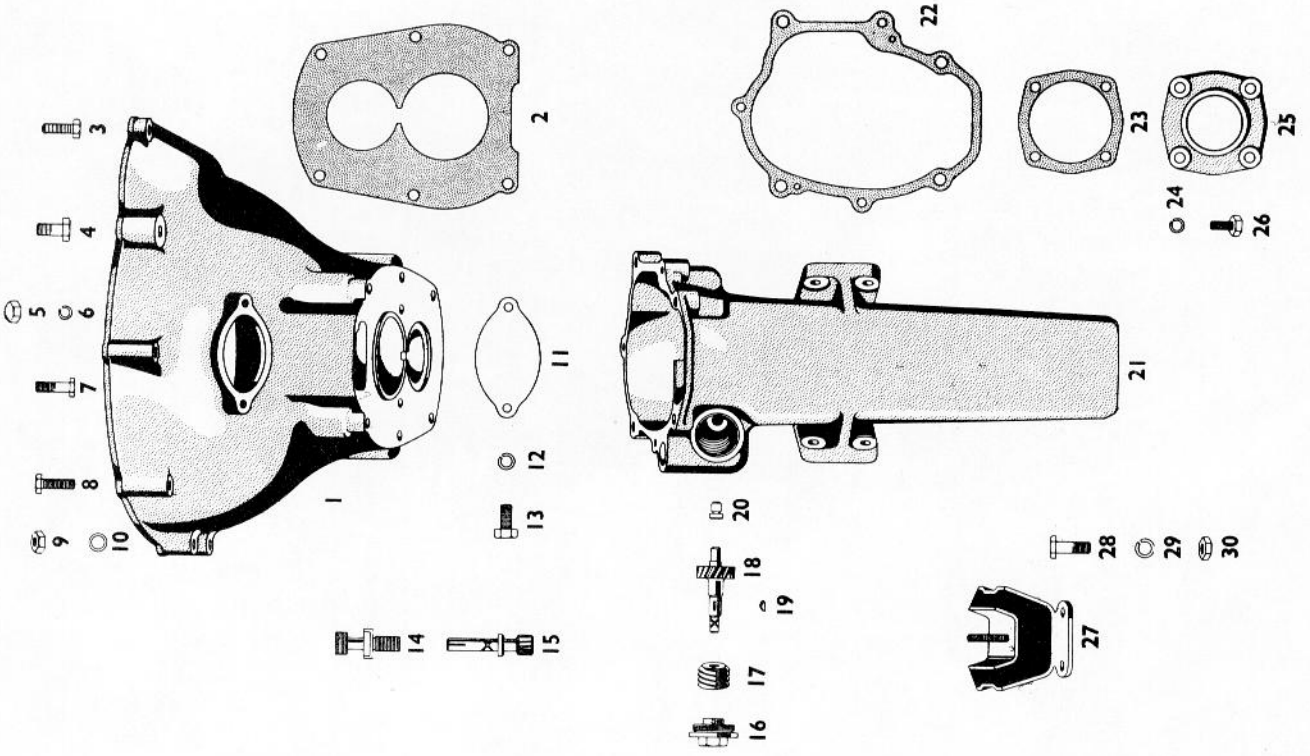
Part No.	Item	Description	No. off per car
N.454250	1	Dome Nut	7
AGS.585/D	2	¼" dia. Spring Washer	18
N.454540	3	Stud	4
-	4	Split Pin 1/16" dia. ¾" long	1
FN.405/L	5	5/16" BSF. Slotted Nut	1
-	6	5/16" Plain Washer	1
N.454510	7	Selector Finger	1
N.455120	8	Rocking Shaft Unit	1
N.454770	9	Key	1
N.454560	10	Gear Change Lever	1
N.454460	11	Bearing Cup	1
N.454570	12	Spring	1
N.454450	13	Retaining Plate	1
N.453880	14	Circlip	1
N.455110	15	Dust Excluder	1
N.704118	16	Gear Lever Knob	1
N.454070	17	Paper Washer	1
N.453920	18	Cover Plate	1
N.454620	19	Stud - Gear Lever Location	1
N.454030	20	Stud - Turret Cover	2
N.454530	21	Remote Gear Change Turret	1
N.453990	22	Dowel	1
N.454550	23	Joint Washer	1
N.454520	24	Plug	1
N.455390	25	Gearbox Cover)All 404 Cars	1
N.450470	26	Selector Ball Unit)Type 405 Cars	2
N.452750	-	Selector Ball Unit - Reverse)up to Chassis (Marked 'R')) 4136	1
N.455550	-	Gearbox Cover)Type 405 Cars	1
N.455560	-	Selector Ball Unit) Used on and	2
N.455570	-	Selector Ball Unit - Reverse)from Chassis (Marked 'R')) 4137	1
N.450660	27	Setscrew - Reverse Plunger	1
N.452270	28	Spring - Reverse Plunger	1

Part No.	Item	Description	No. off per car
N.450650	29	Reverse Plunger	1
N.451880	30	Oil Filler Plug) Type 404	1
FBS.520	31	Washer) Cars	1
N.452550	-	Overdrive Contact Switch -) Type 405 Lucas 515500-45) Cars	1
N.454440	-	Shim Washer)	as reqd.
N.453120	32	Stud	2
N.450600	33	Distance Washer - Selector Plate	2
N.450570	34	Distance Tube - Selector Plate	2
N.450590	35	Tabwasher	2
FN.104/L	36	Nut ¼" BSF	2
N.453090	37	Stud - Short - Gearbox Cover	6
N.453080	38	Stud - Long - Gearbox Cover	2
N.455340	39	Stud - Long - Clutch Casing	4
N.455360	40	Stud - Short - Clutch Casing	2
N.455370	41	Stud - Short - Extension Bracket	1
N.455350	42	Stud - Long - Extension Bracket	3
N.455380	43	Stud - Short - Extension Bracket	1
N.455260	44	Stud - Long - Extension Bracket	2
FBS.379/D5	45	Dowel	2
N.452730	46	Gearbox Casing - Offside) Paired	1
N.452740	47	Gearbox Casing - Nearside) Paired	1
N.452540	48	Plug	2
FBS.517	49	Washer	2
N.453110	50	Locating Bolt	2
FB.105/16D	51	Bolt	5
FB.105/43D	52	Bolt	1
FB.105/49D	53	Bolt	2
FB.105/41D	54	Bolt	2
FB.105/45D	55	Bolt	1
FN.105/L	56	Nut 5/16" BSF	20
AGS.585/E	57	Spring Washer	20
N.451080	58	Domed Nut	3
N.455710	-	Washer - to be used with the Domed Nut	3



TYPE 404. CLUTCH CASING. GEARBOX EXTENSION AND SPEEDOMETER DRIVE.

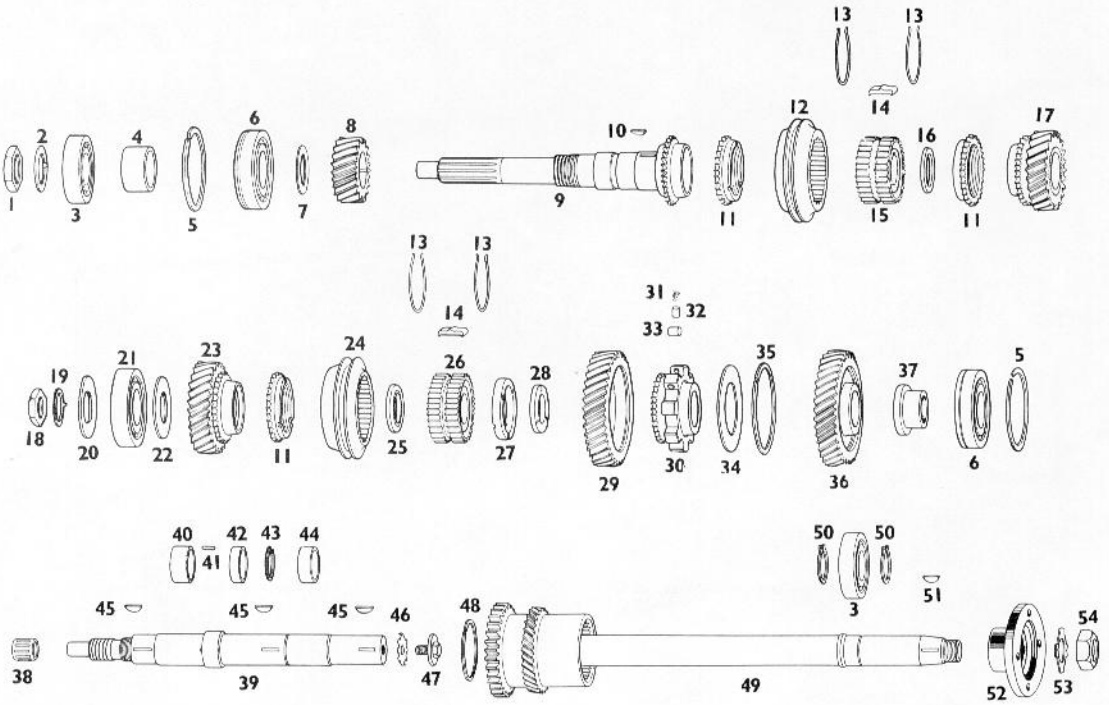
Part No.	Item	Description	No. off per car	Part No.	Item	Description	No. off per car
N.452760	1	Clutch Casing	1	N.451890	16	Cover (Speedo 1st Redn. Shaft)	1
N.450010	2	Joint Washer (Gear Box Front)	1	N.454230	17	Worm	1
WS.105/10D	3	Setscrew 5/16" BSW	1	N.451350	18	Gear (Speedo 1st Redn. Driven)	1
WB.106/22D	4	Bolt 3/8" BSW	2	N.452600	19	Key	1
WN.105/L	5	Nut 5/16" BSW	4	N.450400	20	Thrust Pad (Speedo Drive)	2
AGS.585/E	6	Spring Washer 5/16"	8	N.451170	21	Gear Box Extension Unit	1
WB.105/21D	7	Bolt 5/16" BSW	4	N.451190	22	Joint Washer (Gear Box Rear)	1
WS.105/17D	8	Setscrew 5/16" BSW	3	N.450960	23	Joint Washer (End Plate)	1
WN.106/L	9	Nut 3/8" BSW (Starter)	2	AGS.585/D	24	Spring Washer	4
AGS.585/F	10	Spring Washer 3/8" (Starter)	2	N.450890	25	End Plate	1
N.451750	11	Inspection Port Cover	1	FS.104/7D	26	Setscrew ¼" BSF	4
AGS.585/D	12	Spring Washer	2	N.311290	27	Rear Mounting Block	2
WS.105/3D	13	Setscrew ¼" BSW	2	FB.105/8D	28	Bolt 5/16" BSF	4
N.451010	14	Union (Speedo Drive)	1	AGS.585/E	29	Spring Washer 5/16"	8
N.454240	15	Gear (Speedo 2nd Redn. Driven)	1	FN.105/L	30	Nut 5/16"	8



TYPE 404. MAINSHAFT - GEARBOX.

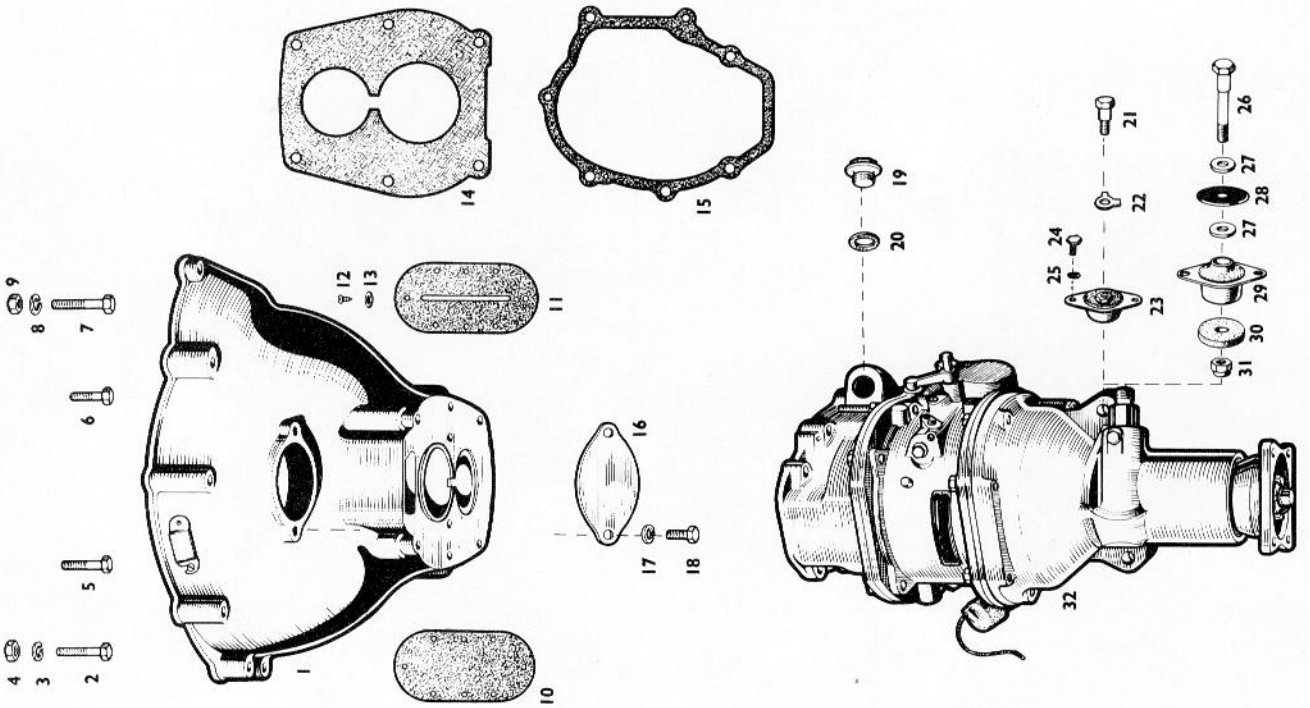
Part No.	Item	Description	No. off per car
N.453660	1	Bearing Retaining Nut	1
N.450810	2	Tabwasher - Drive Shaft	1
N.452390	3	Bearing - Front Drive Shaft	2
N.453670	4	Distance Piece - Drive Shaft	1
N.452720	5	Circlip	1
N.451550	6	Bearing - Drive Shaft	2
N.453650	7	Distance Washer - Drive Shaft	1
N.453440	8	Gear	1
N.453680	9	Drive Shaft	1
N.453210	10	Woodruff Key	1
N.455500	11	Synchroniser Blocker Ring	3
N.453610	12	Sliding Hub 3rd and 4th	1
N.453020	13	Retaining Ring	4
N.453030	14	Shifting Plate	6
N.453600	15	Hub Fixed 3rd and 4th	1
N.453810-7	16	Thrust Washer .100 thick	1
N.453810-8	-	Thrust Washer .080 thick	-
N.453570	17	Hub Free 3rd Gear	1
N.450930	18	Locknut - Mainshaft Front	1
N.450920	19	Tabwasher	1
-	20	Thrust Washer - Front - Centre Mainshaft Bearing	2
N.453800-7	-	Thrust Washer .195 thick	-
N.453800-8	-	Thrust Washer .190 thick	-
N.453800-9	-	Thrust Washer .185 thick	-
N.453800-10	-	Thrust Washer .180 thick	-
N.453800-11	-	Thrust Washer .175 thick	-
N.453800-12	-	Thrust Washer .170 thick	-
N.453800-13	-	Thrust Washer .165 thick	-
N.453800-14	-	Thrust Washer .160 thick	-
N.453800-15	-	Thrust Washer .155 thick	-
N.453800-16	-	Thrust Washer .150 thick	-
N.453800-17	-	Thrust Washer .145 thick	-
N.453800-18	-	Thrust Washer .140 thick	-
N.452420	21	Bearing - Centre Main Shaft	1
-	22	Thrust Washer - Rear - Centre Mainshaft Bearing	2
N.453800-1	-	Thrust Washer .225 thick	-
N.453800-2	-	Thrust Washer .220 thick	-
N.453800-3	-	Thrust Washer .215 thick	-

Part No.	Item	Description	No. off per car
N.453800-4	-	Thrust Washer .210 thick	-
N.453800-5	-	Thrust Washer .205 thick	-
N.453800-6	-	Thrust Washer .200 thick	-
N.453800-7	-	Thrust Washer .195 thick	-
N.453800-8	-	Thrust Washer .190 thick	-
N.453800-9	-	Thrust Washer .185 thick	-
N.453800-10	-	Thrust Washer .180 thick	-
N.453800-11	-	Thrust Washer .175 thick	-
N.453540	23	Hub Free 2nd Gear	1
N.453550	24	Sliding Hub - 1st and 2nd	1
N.452840	25	Thrust Washer	1
N.453590	26	Hub Fixed 1st and 2nd	1
N.452900	27	Distance Washer	1
N.452890	28	Thrust Washer	1
N.452820	29	Gear - Freewheel Mainshaft 1st	1
N.452870	30	Free Wheel Hub - Mainshaft 1st	1
N.450630	31	Spring - Freewheel	8
N.451260	32	Plunger - Freewheel	8
N.451300	33	Roller - Freewheel	8
N.451230	34	Roller Retaining Plate	1
N.451250	35	Retaining Ring	1
N.453710	36	Freewheel Assembly	1
N.451830	37	Bush - Bearing Location	1
N.450520	38	Needle Roller Bearing	1
N.453000	39	Main Driving Shaft Unit	1
N.453360	40	Distance Piece	1
N.452410	41	Needle Roller	240
N.453380	42	Distance Piece	1
N.451910	43	Circlip - Mainshaft	1
N.453370	44	Distance Piece	1
N.453220	45	Woodruff Key	3
N.451730	46	Tabwasher	1
N.450790	47	Nut Retaining Mainshaft	1
N.451180	48	Retaining Ring	1
N.450330/ SEL/A1	49	Hub, Reverse, & Speedo Unit Selective Assembly	1
N.452620	50	Bearing Retaining Ring	2
N.480021	51	Key	1
N.704112	52	Companion Flange	1
N.451600	53	Tabwasher	1
N.451610	54	Nut - Coupling Retaining	1



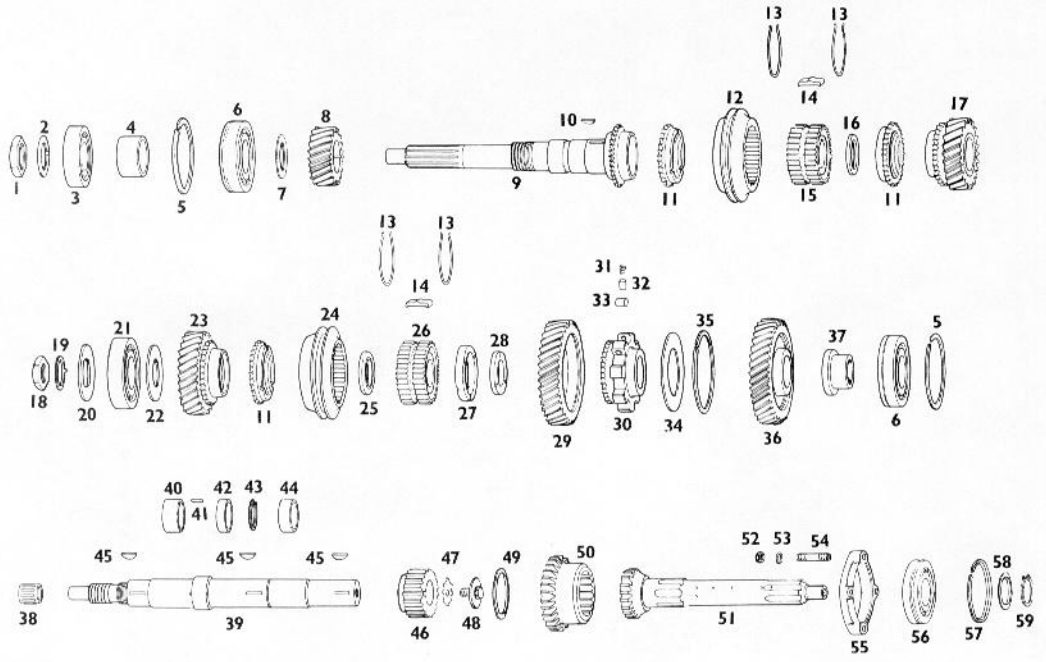
TYPE 405. CLUTCH CASING AND OVERDRIVE UNIT

Part No.	Item	Description	No. off per car	Part No.	Item	Description	No. off per car
N.455630	1	Clutch Casing Unit	1	AGS.585/D	17	Spring Washer ¼" dia.	2
WB.105/21D	2	Bolt 5/16" Whit. 2.5/8" long	4	WS.104/3D	18	Setscrew ¼" Whit. 3/8" long	2
AGS.585/E	3	Spring Washer 5/16" dia.	8	N.451880	19	Filler Plug	1
WN.105/L	4	Nut 5/16" Whit.	4	FBS.520	20	Washer - Filler Plug	1
WB.105/17D	5	Bolt 5/16" Whit. 2.1/8" long	3	N.455170	21	Bolt - Rear Engine Mounting) Used on	2
WB.105/10D	6	Bolt 5/16" Whit. 1¼" long	1	N.455240	22	Tabwasher) Chassis	2
WB.106/22D	7	Bolt 3/8" Whit. 2¾" long	2	N.455160	23	Metalastik Metacone Mounting) 4001 to 4184	2
AGS.585/F	8	Spring Washer 3/8" dia.	2	405-1-20158	24	Setscrew	4
WN.106/L	9	Nut 3/8" Whit	2	-	25	5/16" Shakeproof Washer	4
N.441000	10	Gaiter	1	N.455660	26	Bolt) Used on	2
N.440990	11	Gaiter - Operating Lever	1	-	27	½" dia. Plain Washer)	2
-	12	No.6 P.K. Screw Type Z Rd. Hd. 5/16" long	16	N.455670	28	Oil Shield)	2
-	13	4 B.A. Plain Copper Washer	16	N.455690	29	Rear Engine Mounting) Chassis 4185	2
N.450010	14	Joint - Gearbox - Front	1	N.455700	30	Rebound Washer)	2
N.451190	15	Joint - Gearbox - Rear	1	-	31	7/16" B.S.F. Philidas Nut) Onwards	2
N.461750	16	Inspection Port Cover	1	N.454400	32	Overdrive Unit complete	1



TYPE 405. MAINSHAFT - GEARBOX.

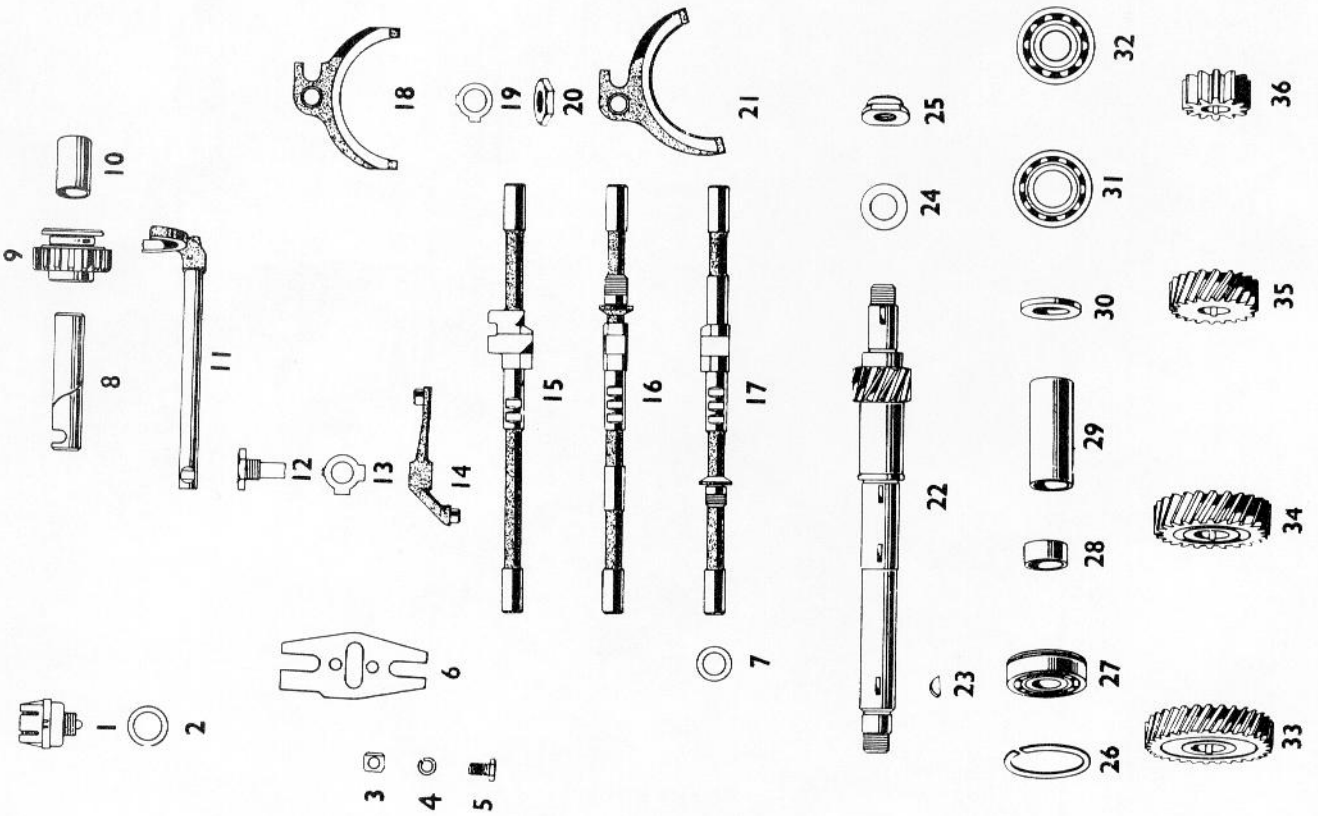
Part No.	Item	Description	No. off per car	Part No.	Item	Description	No. off per car
N.453660	1	Bearing Retaining Nut	1	N.453800-8	-	Thrust Washer .190 thickness	-
N.450810	2	Tabwasher - Drive Shaft	1	N.453800-9	-	Thrust Washer .185 thickness	-
N.452390	3	Bearing - Front Drive Shaft	1	N.453800-10	-	Thrust Washer .180 thickness	-
N.453670	4	Distance Piece - Drive Shaft	1	N.453800-11	-	Thrust Washer .175 thickness	-
N.452720	5	Circlip	2	N.453540	23	Hub - Free - 2nd. Gear	1
N.451550	6	Bearing - Driveshaft & Mainshaft	2	N.453550	24	Sliding Hub - 1st and 2nd	1
N.453650	7	Distance Washer - Drive Shaft	as reqd	N.452840	25	Thrust Washer	1
N.453440	8	Gear - Drive Shaft	1	N.453590	26	Hub - Fixed 1st and 2nd.	1
N.453680	9	Drive Shaft	1	N.452900	27	Distance Washer	1
N.453210	10	Woodruff Key	1	N.452890	28	Thrust Washer	1
N.455500	11	Synchroniser Blocker Ring	3	N.452820	29	Gear - Freewheel - Mainshaft 1st.	1
N.453610	12	Sliding Hub 3rd and 4th	1	N.452870	30	Freewheel Hub - Mainshaft 1st.	1
N.453020	13	Retaining Ring	4	N.450630	31	Spring - Freewheel	8
N.453030	14	Shifting Plate	6	N.451260	32	Plunger - Freewheel	8
N.453600	15	Hub - Fixed 3rd and 4th	1	N.451300	33	Roller - Freewheel	8
N.453810-7	16	Thrust Washer .100 thickness	1	N.451230	34	Roller Retaining Plate	1
N.453810-8	-	Thrust Washer .080 thickness	-	N.451250	35	Retaining Ring	1
N.453570	17	Hub - Free 3rd.Gear	1	N.453710	36	Freewheel Assembly	1
N.450930	18	Locknut - Mainshaft - Front	1	N.451830	37	Bush - Bearing Location	1
N.450920	19	Tabwasher	1	N.450520	38	Needle Roller Bearing	1
-	20	Thrust Washer - Front - Centre Mainshaft		N.453000	39	Main Driving Shaft Unit	1
		Bearing	1	N.453360	40	Distance Piece	1
N.453800-7	-	Thrust Washer .195 thickness	-	N.452410	41	Needle Roller	240
N.453800-8	-	Thrust Washer .190 thickness	-	N.453380	42	Distance Piece	1
N.453800-9	-	Thrust Washer .185 thickness	-	N.451910	43	Circlip - Mainshaft	1
N.453800-10	-	Thrust Washer .180 thickness	-	N.453370	44	Distance Piece	1
N.453800-11	-	Thrust Washer .175 thickness	-	N.453220	45	Woodruff Key	3
N 453800-12	-	Thrust Washer .170 thickness	-	N.450330	46	Hub	1
N.453800-13	-	Thrust Washer .165 thickness	-	N.451730	47	Tabwasher	1
N.453800-14	-	Thrust Washer .160 thickness	-	N.450790	48	Nut - Retaining - Mainshaft	1
N.453800-15	-	Thrust Washer .155 thickness	-	N.451180	49	Retaining Ring	1
N.453800-16	-	Thrust Washer .150 thickness	-	N.455040	50	Gear	1
N.453800-17	-	Thrust Washer .145 thickness	-	N.454120	51	Input Shaft	1
N.453800-18	-	Thrust Washer .140 thickness	-	FN.104/L	52	Nut ¼" BSF	4
N.452420	21	Bearing - Centre - Mainshaft	1	-	53	Washer ¼" Flat Spring	4
-	22	Thrust Washer - Rear - Centre Mainshaft		N.454410	54	Stud	4
		Bearing	1	N.454080	55	Bearing Retainer	1
N.453800-1	-	Thrust Washer .225 thickness	-	N.454370	56	Ball Race	1
N.453800-2	-	Thrust Washer .220 thickness	-	N.454150	57	Circlip	1
N.453800-3	-	Thrust Washer .215 thickness	-	N.454130-1	58	Distance Piece .097 thickness	1
N.453800-4	-	Thrust Washer .210 thickness	-	N.454130-2	-	Distance Piece .101 thickness	-
N.453800-5	-	Thrust Washer .205 thickness	-	N.454130-3	-	Distance Piece .105 thickness	-
N.453800-6	-	Thrust Washer .200 thickness	-	N.454130-4	-	Distance Piece .109 thickness	-
N.453800-7	-	Thrust Washer .195 thickness	-	N.454090	59	Circlip	1



TYPE 405. SELECTOR SHAFT AND LAYSHAFT.

Part No.	Item	Description	No. off per car
Lucas			
515500-45	1	Reverse Ligh Switch	1
N.452560	2	Washer - Reverse Light Switch	1
N.450580	3	Guide Block	2
AGS.585/D	4	Spring Washer	2
N.452780	5	Setscrew ¼" BSF	2
N.450560	6	Selector Plate. Used up to Chassis 4136	1
		Used up to Chassis 4136	
N.455520	-	Selector Plate	1
		Used on and from Chassis 4137	
N.452660	7	Distance Washer. Thickness .020"	
		(Selector Fork)	as reqd
N.452670	-	Distance Washer. Thickness .030"	
		(Selector Fork)	as reqd
N.452680	-	Distance Washer. Thickness .040"	
		(Selector Fork)	as reqd
N.451000	8	Spindle (Reverse Gear Idler)	1
N.451160	9	Reverse Gear (Idler) with Bush	1
N.450750	10	Bush (Reverse Gear Idler)	1
N.450360	11	Fork Selector (Reverse)	1
N.450860	12	Pivot Pin	1
N.452060	13	Tabwasher	1
N.450430	14	Fulcrum Lever (Reverse)	1
N.450180	15	Selector Shaft (Reverse)	1
N.453630	16	Selector Shaft - Q 1st & 2nd.) All Type 404 Cars) Type 405 Cars up	1
N.453640	17	Selector Shaft - 3rd & 4th.) to Chassis 4136.	1

Part No.	Item	Description	No. off per car
N.455610	-	Selector Shaft - 1st & 2nd.) Type 405 Cars) Used on and from	1
N.455510	-	Selector Shaft - 3rd & 4th.) Chassis 4137)	1
N.452380	18	Fork (Selector 1st and 2nd)	1
N.451720	19	Tabwasher	2
N.450670	20	Nut (Fork Retaining)	2
N.450530	21	Fork (Selector 3rd and 4th)	1
N.450301	22	Layshaft	1
N.453230	23	Key	1
N.450480	24	Tabwasher	4
N.450320	25	Nut	2
N.452710	26	Circlip	2
N.451530	27	Bearing (Front)	1
N.450690	28	Distance Piece (short)	1
N.450700	29	Distance Piece (long)	1
N.453740	30	Spacing Washer	1
N.453730	31	Roller Bearing - Centre	2
N.452440	32	Bearing - Rear	1
N.453430	33	Gear (Layshaft Driving)	1
N.453460	34	Gear (Layshaft 3rd)	1
N.450270	35	Gear (Layshaft 2nd)	1
N.450440	36	Gear (Reverse)	1



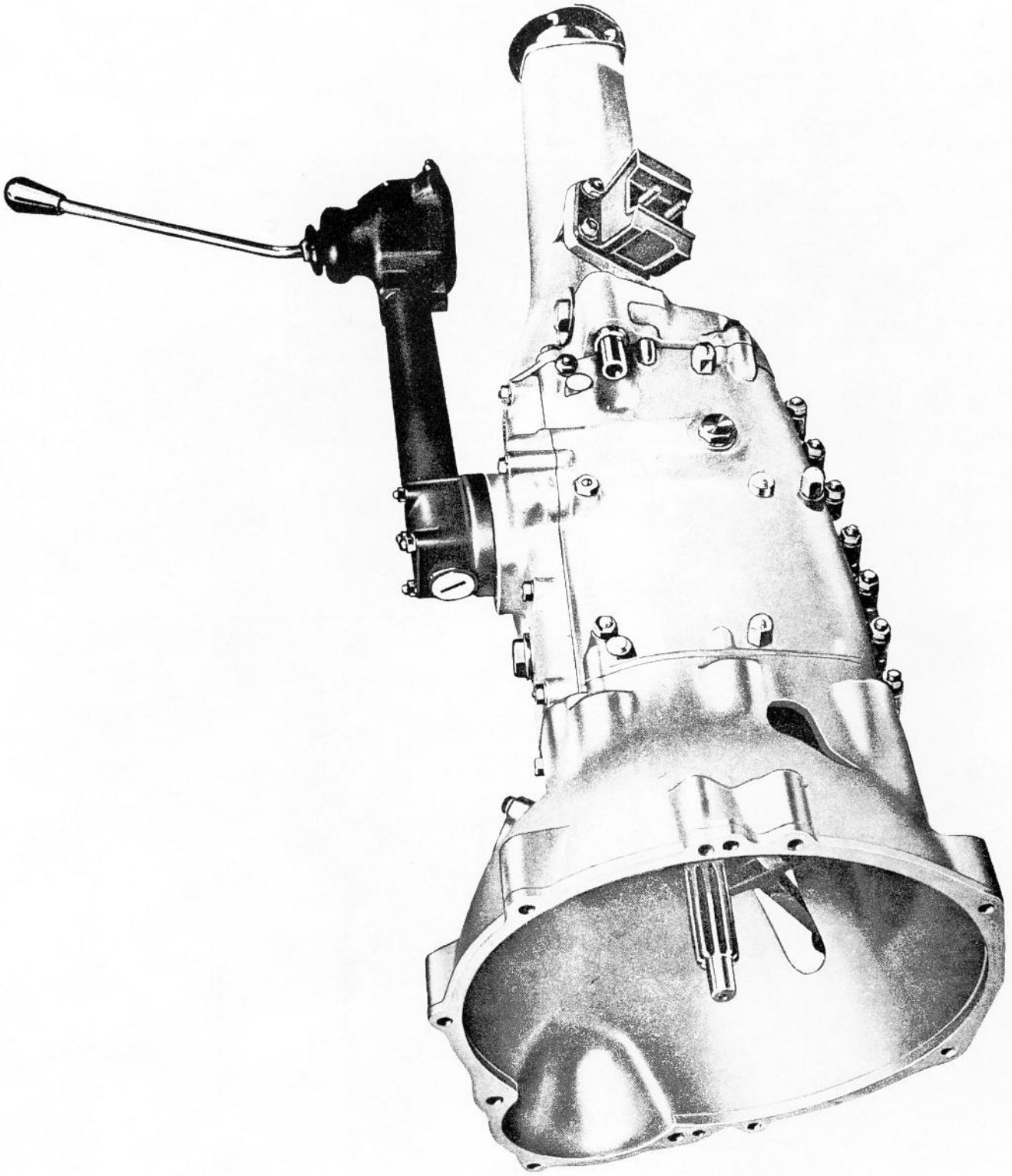


Fig. 51. Gearbox BWCR7

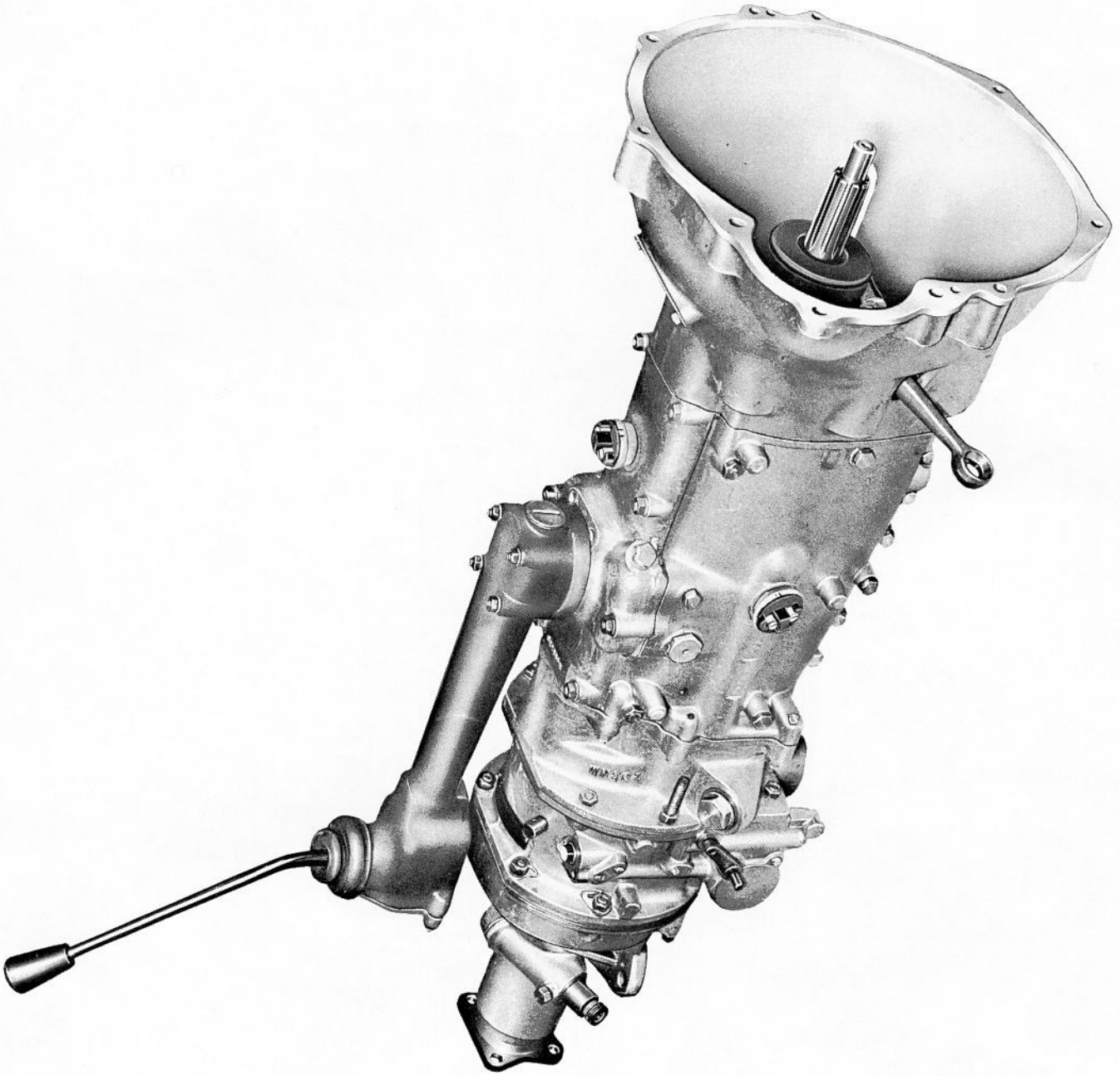
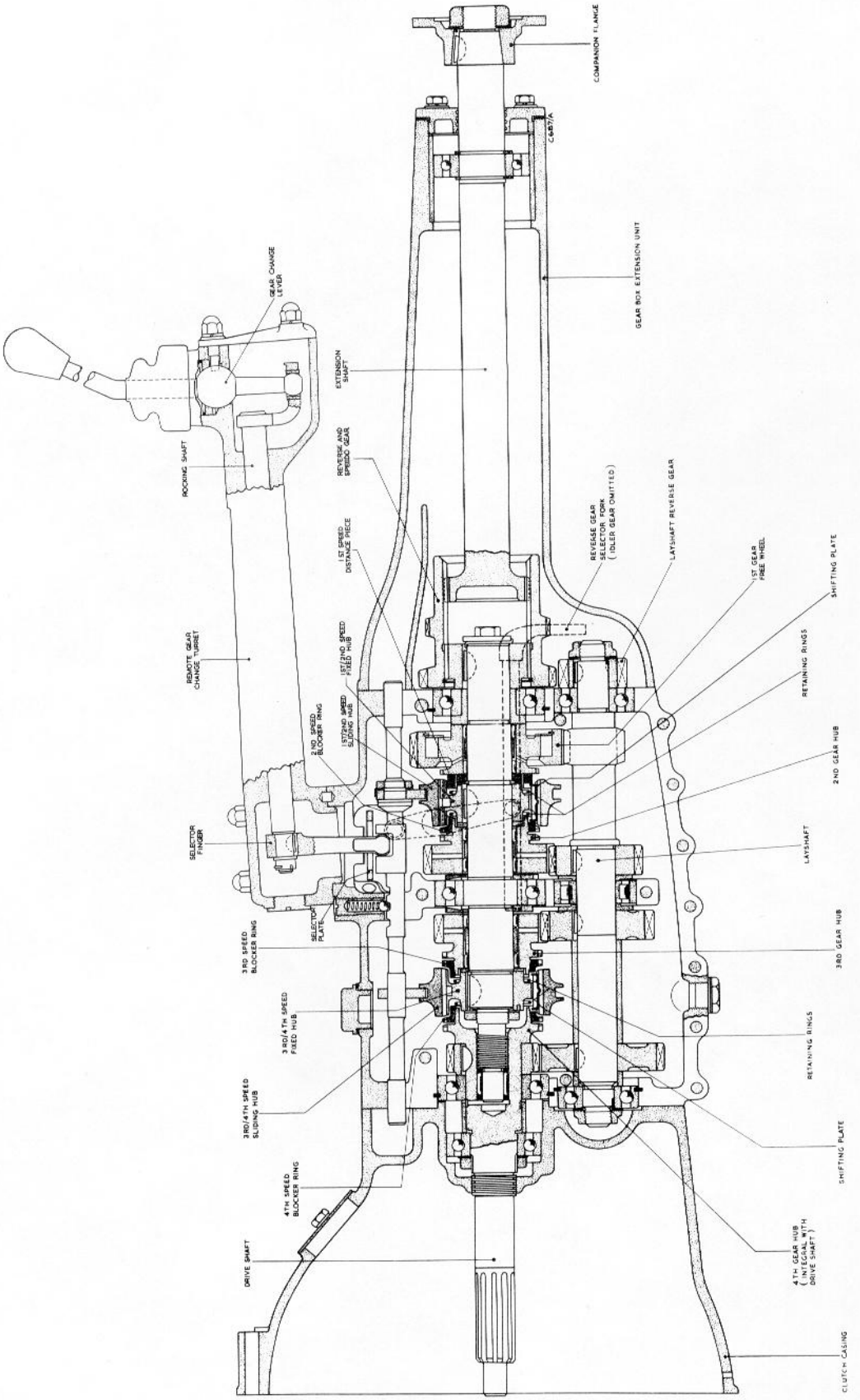
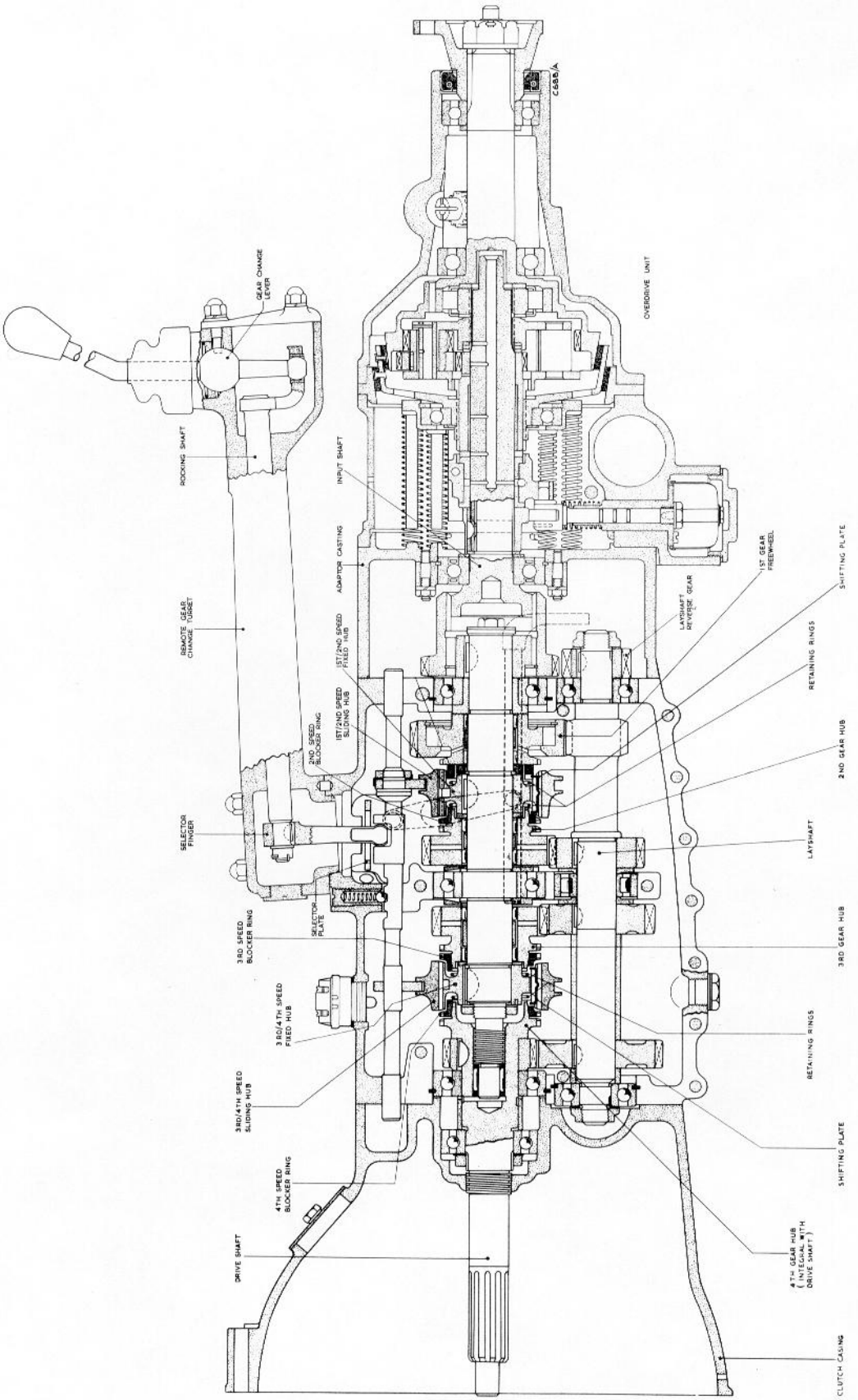


Fig. 52. Gearbox and overdrive BWCR11



Arrangement of gearbox without overdrive



Arrangement of gearbox with overdrive

Gearbox

Description

The gearbox fitted to the Type 404 Car is shown in Fig.51 and is stamped BW.CR7 followed by its serial number.

The gearbox and overdrive unit fitted to the Type 405 Car is shown in Fig.52 and is stamped BW.CR11 followed by its serial number.

Basically the gearbox portion forward of its rear face is identical in both cars but on Type 405 Cars the gearbox extension is replaced by an overdrive unit.

Type..... 'Bristol' with Borg-Warner Synchromesh, constant mesh helical gears.

Number of Speeds.....Four forward-one reverse. (Type 405 has Overdrive used in conjunction with Top Gear only).

Synchromesh in.....2nd., 3rd., and 4th. Gears.

1st. Gear..... Freewheel.

Replacements

Type 404.

A complete BW.CR7 gearbox is available as a re-conditioned exchange unit from the works.

Type 405 Car.

The gearbox portion only is available as a reconditioned exchange unit from the works.

The overdrive unit is a separate component, and is also available as an exchange reconditioned unit from the works.

In all instances exchange units are supplied subject to the return and inspection of the removed unit.

Removing the Gearbox from the Car

Drain the oil from the gearbox and refit the plug.

Remove the bonnet to enable the lifting sling to be used.

Remove the seats and floor covering.

Remove the clutch and brake pedal pads, slacken the accelerator pedal clamp screw and swing it clear of the toe-board.

Remove the four domed nuts attaching the remote control to the gearbox cover and lift this portion clear of the studs.

Remove the gearbox tunnelling, the floorboards and the toe-board.

Disconnect the speedometer flexible drive from the gearbox and the electrical connections to the reverse light switch (and overdrive switch).

Disconnect the companion flange at the rear of the gearbox or overdrive.

Fit the engine sling and take the weight of the engine. (see Removing the engine).

Remove the mountings securing the gearbox or overdrive to the chassis.

Remove the starter motor.

Supporting the gearbox, remove the remaining bolts securing the clutch casing to the engine.

Remove the bracket from the exhaust pipe clips and the clutch pull-off spring anchor bracket.

Withdraw the gearbox rearwards keeping it in line with the transmission to avoid damage to the clutch driven plate. When clear lift the gearbox from the car.

To Refit the Gearbox to the Car

Before refitting the gearbox, ensure that the joining faces are clean and undamaged and that the locating dowels are positioned correctly.

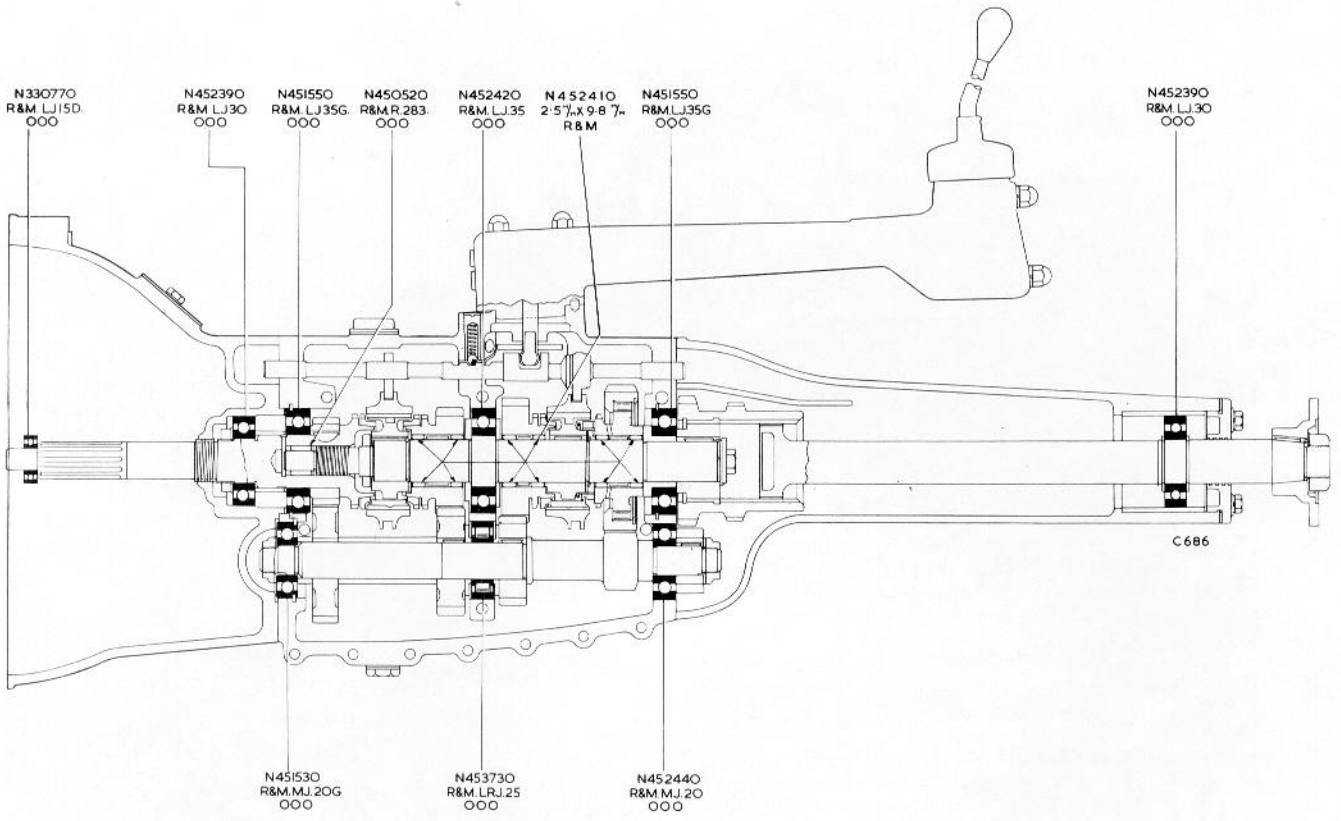
Reverse the operations of the removing procedure and finally refill with oil.

Servicing the Gearbox

The most common reasons for stripping the 'Bristol' Gearbox are, noisy races, dropping out of gear and the fracture of the 1st. (Freewheel) Gear.

To enable the ball races to be replaced without undue delay Fig.53 will indicate the bearings used in the gearbox fitted to the Type 404 Car and Fig.54 the bearings fitted in the gearbox and overdrive of the Type 405 Car.

Dropping out of gear, invariably 3rd. Gear, can be caused through insufficient or worn meshing of the dogs. It is not advisable to try to correct this by packing the



NOTE. N451550 DENOTES BRISTOL PART NUMBER

Fig. 53. Gearbox bearing diagram

selector forks or screwing in the selector ball units. New parts and the correct spacing by selective thrust washers is necessary. This is dealt with in detail.

The fracture of the 1st. Gear (Freewheel) can be caused by violent acceleration when in 1st. Gear causing the rollers in the freewheel to shoot out against the inner wall of the gear. Continuation of this will result in cracking the gear. When this is suspected the integral meshing gear of the layshaft should also be inspected.

Dismantling the Gearbox

Remove the clutch operating lever and its fulcrum bracket Fig.55 and release the six nuts securing the clutch housing to the front face of the gearbox.

Type 404 Cars.

Remove the nuts securing the gearbox extension to the rear face of the gearbox and withdraw the extension unit complete with its shaft.

Type 405 Cars.

Referring to Fig.56 detach the overdrive unit from the gearbox at Joint 'A'.

Proceed on both types as follows:

Remove the nuts securing the gearbox cover and lift off the cover.

Lift out the reverse selector shaft.

Remove the nuts and bolts securing the two halves of the casing and note where they are positioned as some act as close fitting locating bolts.

Separate the casing and lift out the selector shafts.

Remove the Layshaft assembly Fig.57.

Lift out the drive shaft and main driving shaft groups and withdraw the main driving shaft from the rear end of the drive shaft. Remove the needle roller race from either the front spigot of the main driving shaft or the recess in the drive shaft.

Dismantling the Layshaft Fig.58.

Release the tabwashers and remove the retaining nuts at each end of the shaft.

Referring to Fig.59 press the front bearing, short distance piece and gear from the shaft. Remove the key and remove the long distance piece.

Press off the 3rd. layshaft gear in a similar manner then remove the key and detach the front spacing washer.

Using the split bush TFN 8699 press the 2nd. layshaft gear, rear spacing washer and the centre bearing from the shaft as described for the layshaft driving gear, then

remove the key from the shaft.

Reverse the layshaft in the press and using the drift T178322 and the split bush T178321, press the shaft carefully until the rear bearing comes into contact with the key of the reverse gear. Now press the bearing back to its original position leaving a gap between the bearing and the reverse gear. Fit the split bush T188283 into the gap and press off the gear. Remove the key from the shaft and press off the rear bearing.

the remaining shifting plate retaining ring from the fixed hub.

Release the tabwasher and remove the special bolt from the rear end of the shaft, Fig. 62, then using the drift T178316, base T178317 and split bush T178318 withdraw the reverse gear and hub. Remove the key and locate the assembly in a press with the split bush T178315 beneath the front face of the 1st. gear then press off the 1st. gear and its hub and the bearing locating bush complete with the bearing.

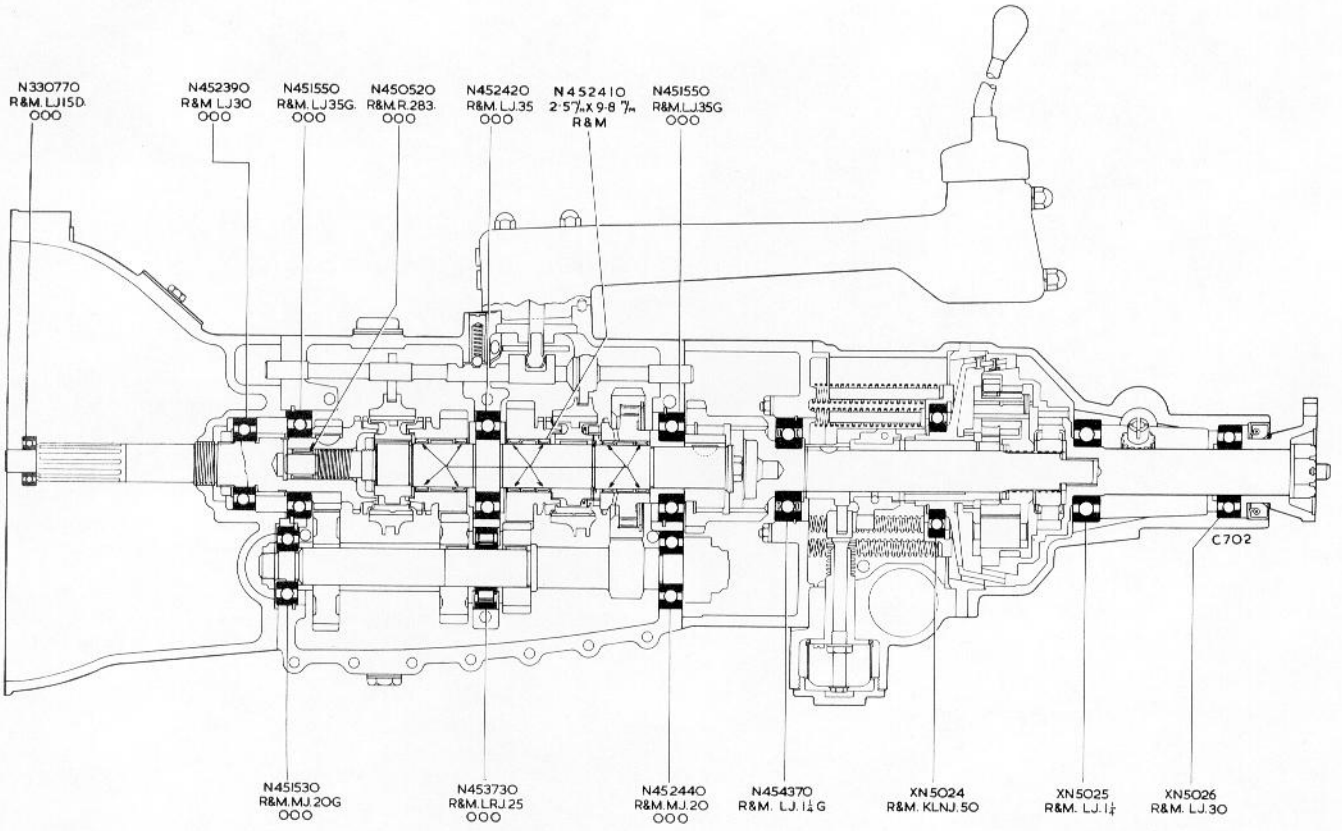


Fig. 54. Gearbox and overdrive bearing diagram

Dismantling the Main Driving Shaft Fig.60.

During the dismantling procedure, label the synchro mechanism and any thrust washers for position. This will considerably simplify re-assembly.

Lift out the 4th. speed blocker ring and withdraw the sliding hub. The three shifting plates will spring out as they are released. Remove the exposed retaining ring from the recess in the fixed hub.

Release the tabwasher at the forward end of the shaft and remove the locknut. Fig.61

Locate the split bush TFN 8699 in the recess in the 3rd/4th fixed hub and press the hub from the shaft. Lift out the 3rd. speed blocker ring then remove the key. Make provision to catch the needle rollers and slide the 3rd. gear hub from the shaft followed by the distance piece and the centre bearing front thrust washer. Remove

Referring to Fig. 63 withdraw the 1st/2nd speed sliding hub; the three shifting plates will spring out as they are released.

Remove the retaining ring from the recess in the fixed hub.

Locating the split bush TFN 8699 in the recess of the hub, press the hub from the shaft. Lift out the 2nd. speed blocker ring then remove the fixed hub key. Taking precautions to prevent the loss of the needle rollers, slide the thrust washer and 2nd. gear hub from the shaft. Remove the needle roller distance piece and the centre bearing rear thrust washer.

Finally press the centre ball bearing off of the shaft.

Dismantling the Drive Shaft

Referring to Fig.64 release the tabwasher and remove

the bearing retaining nut. Position the split bush TFN 8699 as shown in Fig. 65 and press off the front bearing, distance piece and rear bearing and the gear.

Should it be considered that removing the gear is unnecessary, remove the front bearing using split bush TFN 8699. Take off the distance piece and press off the rear bearing using the split bush T178320.

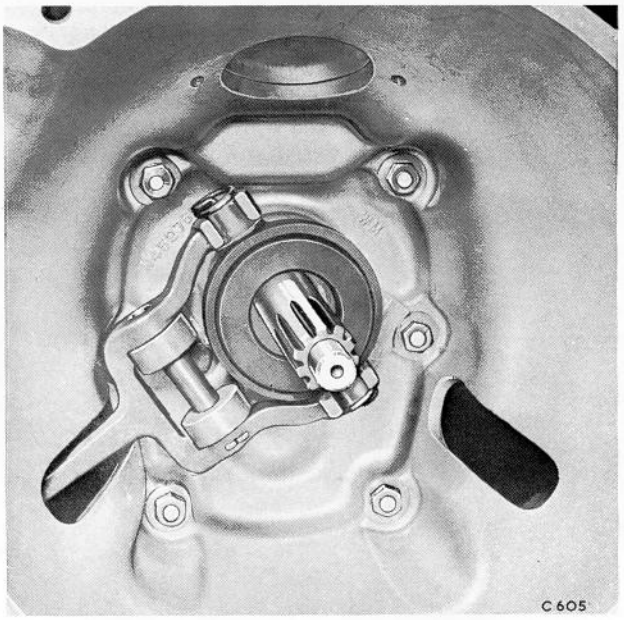


Fig. 55. Clutch casing and release mechanism

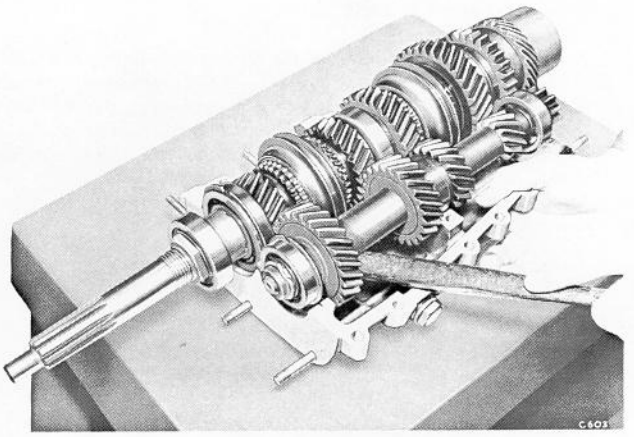


Fig. 57. Layshaft assembly

Dismantling the Freewheel

Referring to Fig. 66 remove the circlip and the retaining plate.

Ease out the freewheel mechanism until the rollers can be pushed down clear of the spring loaded plungers, then push the gear clear of the hub.

Reverse Selector Mechanism

Referring to Fig. 67 lift out the reverse fulcrum lever and, if necessary, release the tabwasher and unscrew the pivot pin bolt.

Unscrew and remove the reverse light switch. Slide out the reverse idler gear together with the fork selector.

Type 404 Cars.

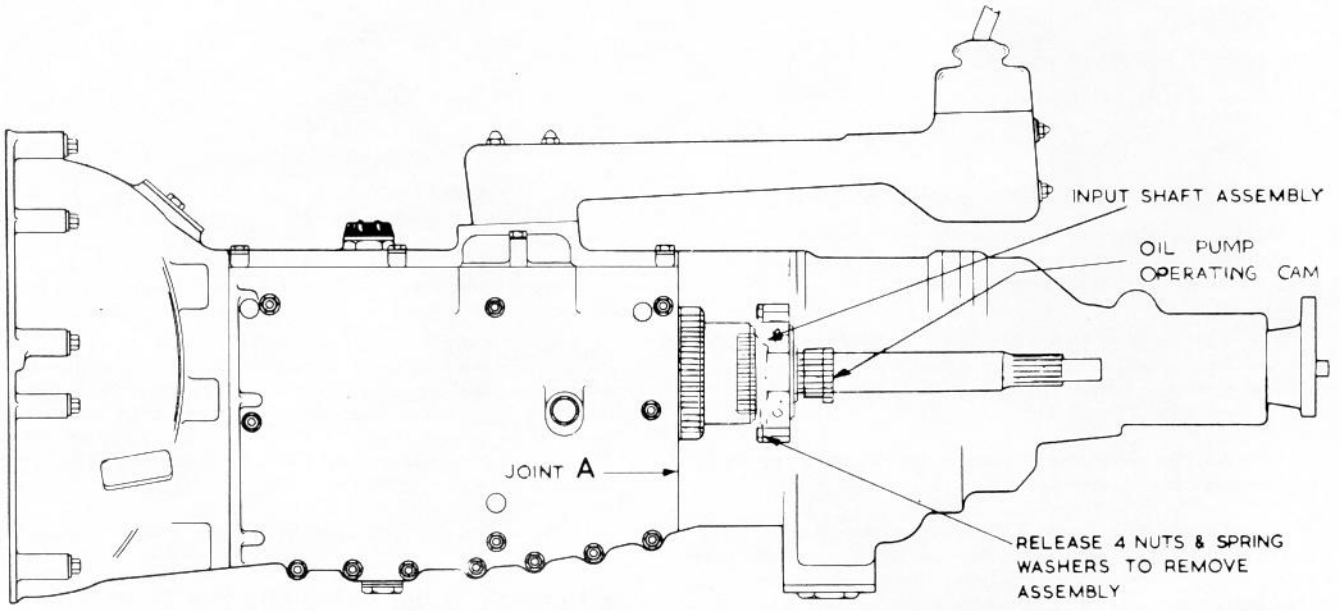


Fig. 56. Dismantling the overdrive unit from the gearbox

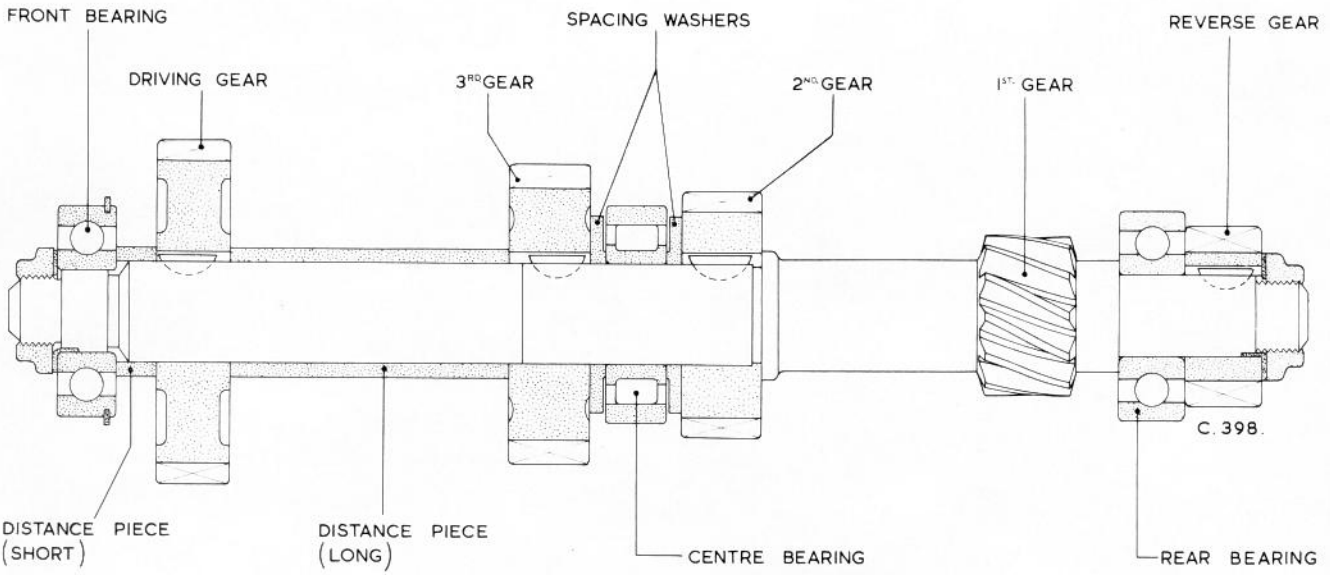


Fig. 58. General arrangement of layshaft

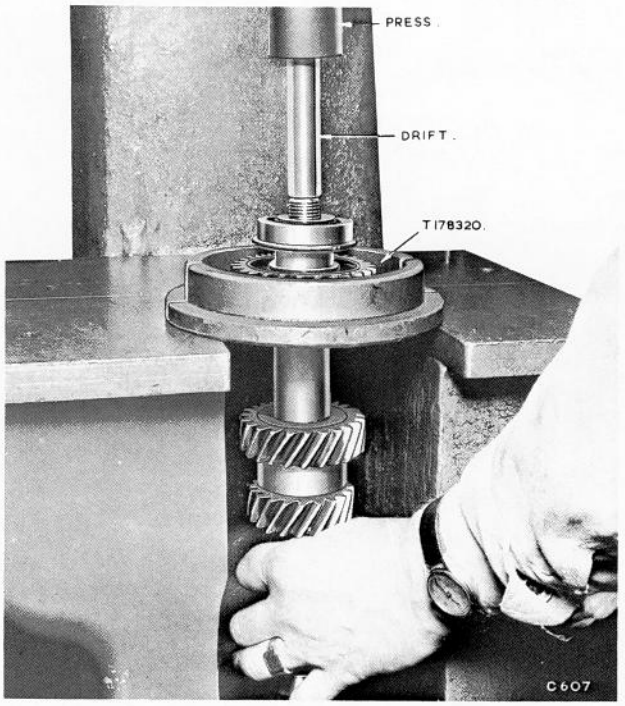


Fig. 59. Dismantling the layshaft

Dismantling the Gearbox Extension

Referring to Fig. 68 remove the screws securing the end-plate and withdraw the extension shaft from the casing.

Release the tabwasher, remove the nut and withdraw the companion flange from its taper on the shaft. Remove the bearing locating circlips and press the bearing from the shaft.

Unscrew the speedometer drive union from the front face of the casing and withdraw the 2nd. reduction speedometer driven gear.

Unscrew the cover and withdraw the 1st. reduction speedometer driven gear complete with the worm gear.

If necessary the worm gear can be pressed off.

Dismantling the Remote Control

Unscrew the gear lever knob. Remove the rubber dust excluder protecting the gear lever ball joint, followed by the circlip, spring retainer, spring and bearing cup, then lift out the gear lever.

Remove the dome nuts securing the cover plate and if necessary remove the special stud which provides location for the gear lever. This is screwed into the casting. See Fig.69.

Remove the plug from the other end of the casting and remove the split pin, nut and washer from the end of the rocking shaft and detach the selector finger located by its key. The rocking shaft can then be withdrawn.

Inspection of Parts Prior to Re-assembly

Carefully examine all components and check for wear on their essential locations. Pay particular attention to the mating splines of the fixed and sliding hubs and the dog teeth of the gear wheel hubs.

Excessive wear at these locations will result in accumulated and undesirable backlash.

Clean all bearings thoroughly in paraffin, spin by hand to test for running and if they are acceptable lubricate them lightly pending re-assembly. Renew bearings where harshness is noted or excessive wear.

The 2nd. and 3rd. gear wheels are a splined fit,

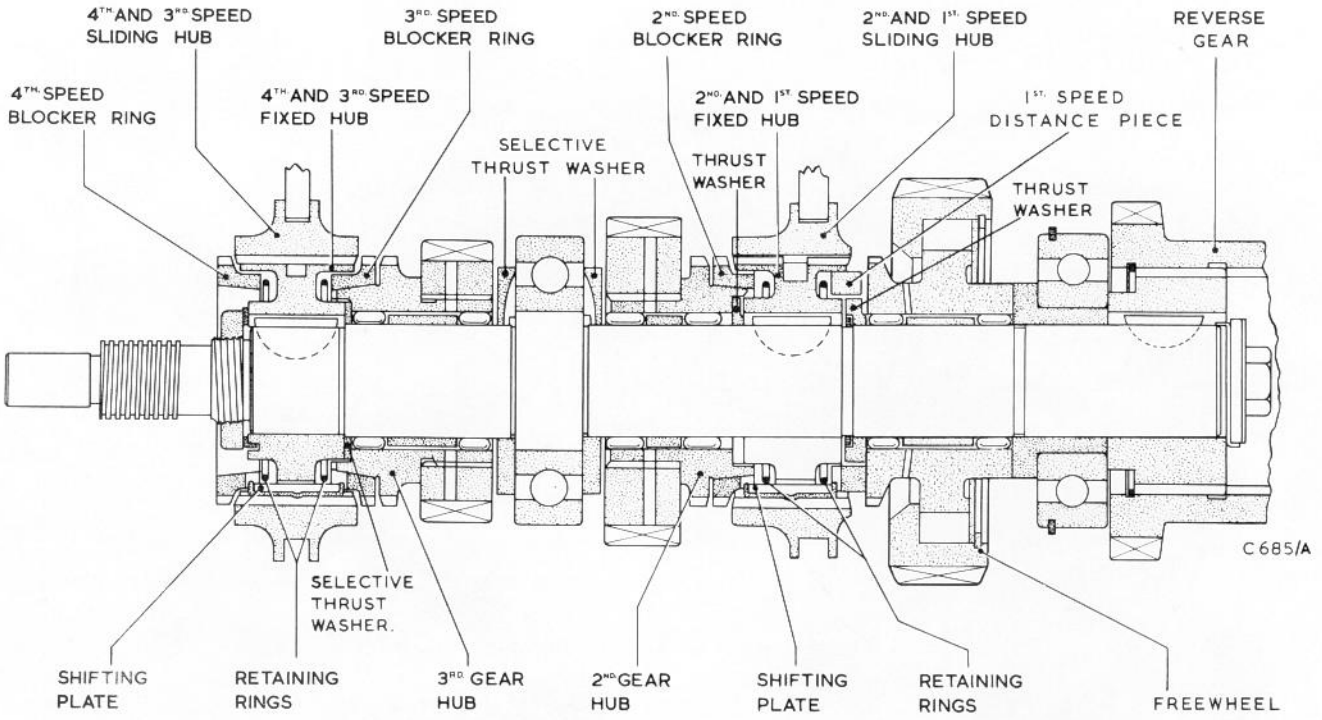


Fig. 60. General arrangement of main driving shaft

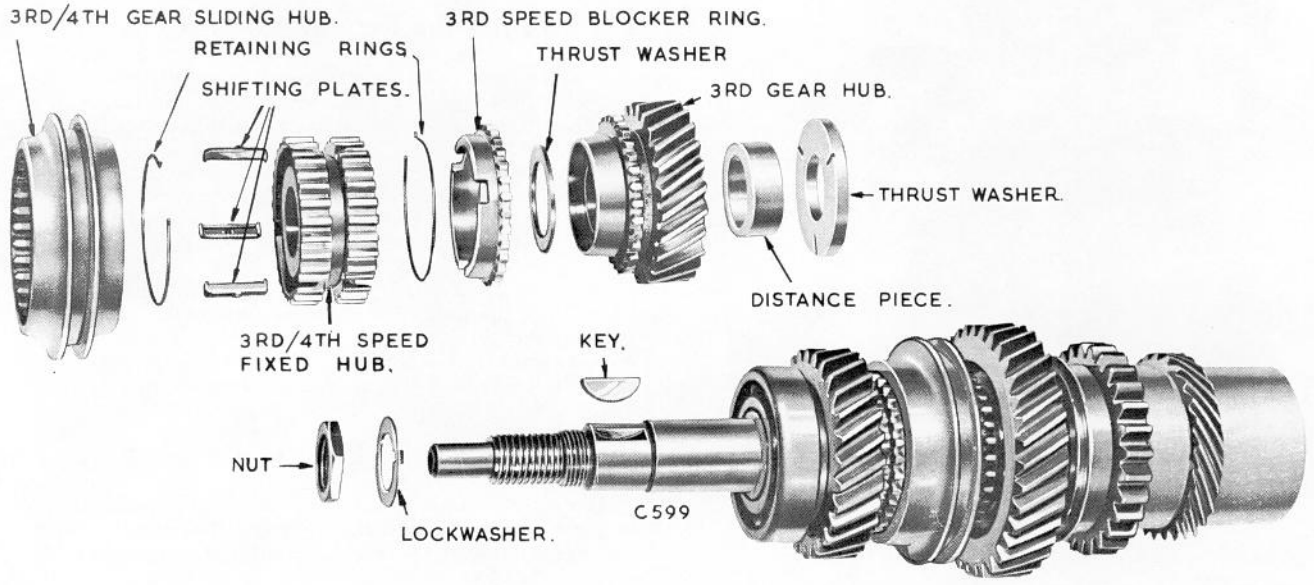


Fig. 61. Dismantling the main driving shaft Stage 1

finally peened to their respective hubs, no attempt should be made to separate them.

Check the freewheel gear for any signs of cracking using a magnaflux test where possible.

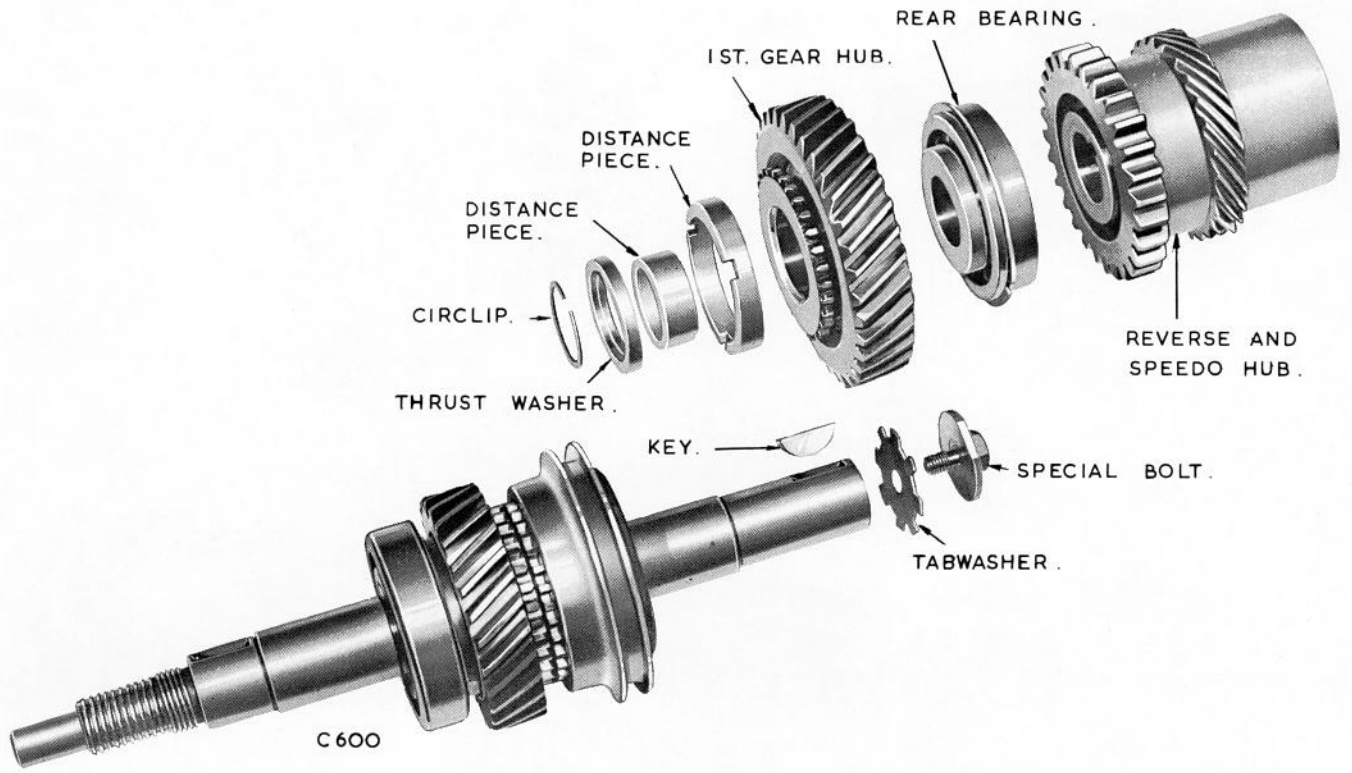


Fig. 62. Dismantling the main driving shaft Stage 2

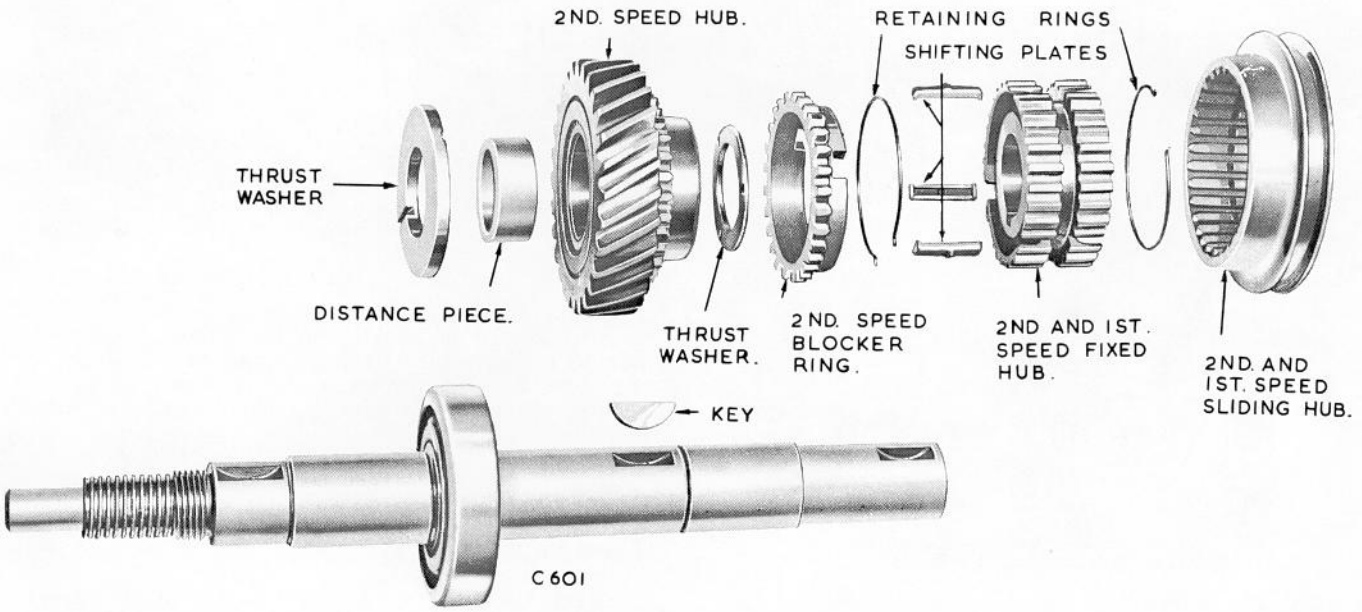


Fig. 63. Dismantling the main driving shaft Stage 3

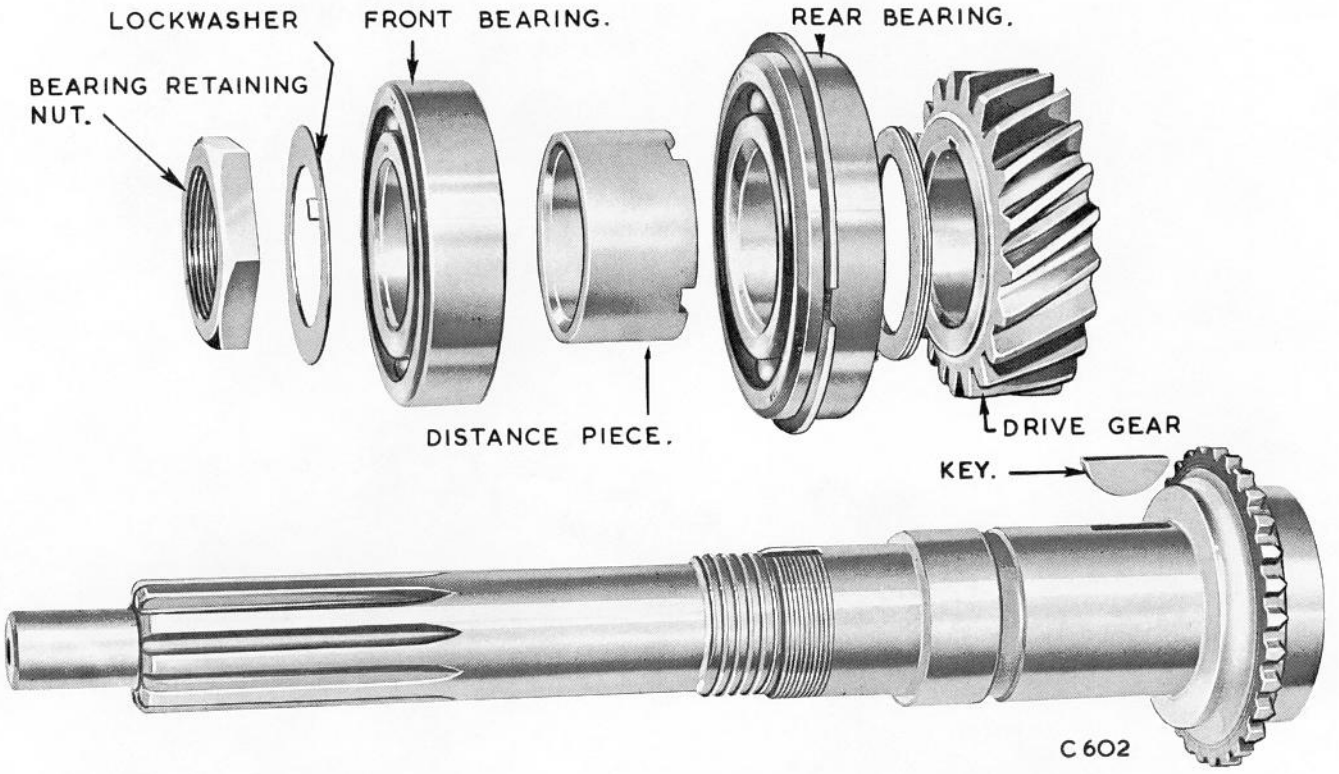


Fig. 64. Dismantling the drive shaft

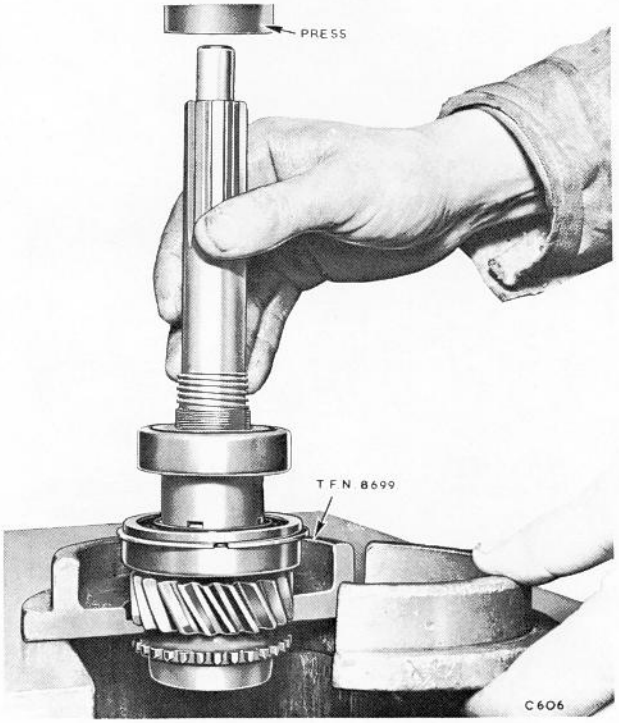


Fig. 65. Pressing components from drive shaft

Re-assembling the Gearbox

If the gear change lever mechanism in the gearbox cover has been dismantled, rebuild it as follows.

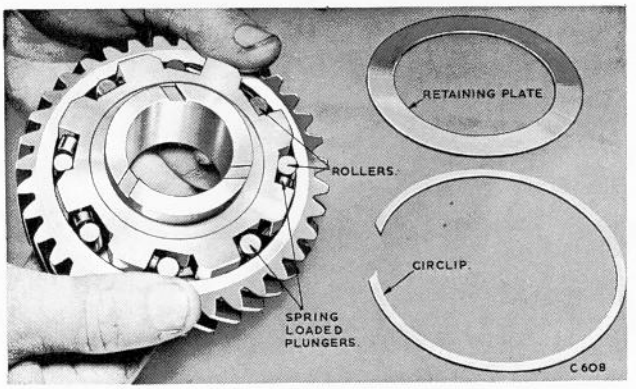


Fig. 66. Dismantling the freewheel

Fit a key to the rocking shaft, and position the shaft into the remote control casing. Fit the selector finger to the shaft and key, fit the washer and nut, tighten and secure with a split pin. The plug can now be fitted to the front end.

If the special stud, providing location for the gear change lever has been removed, refit the stud. Fit the joint and the cover plate, fit the spring washers and dome nuts and tighten.

Check that the gear lever is a good fit in the bearing cup and if not lap the parts together until a good bearing surface is obtained. This operation will eliminate gear lever vibration.

Fit the lever followed by the bearing cup, spring,

retaining plate and circlip. Finally fit the rubber dust excluder.

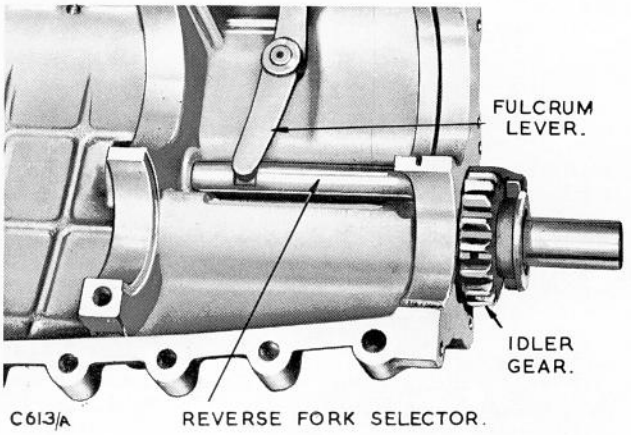


Fig. 67. Reverse selector mechanism

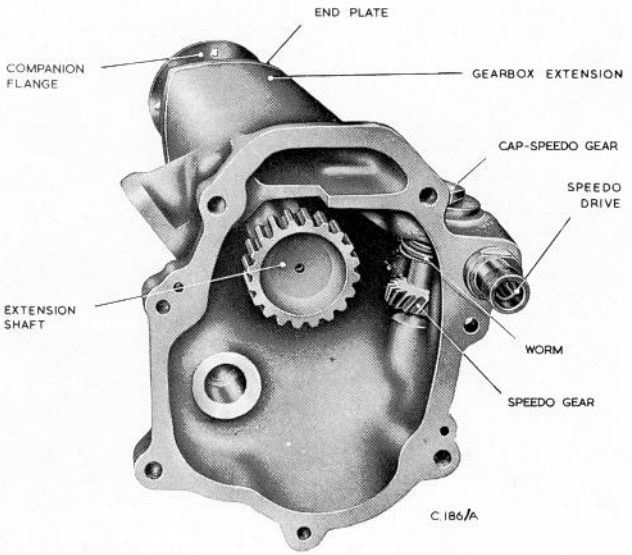


Fig. 68. Gearbox extension

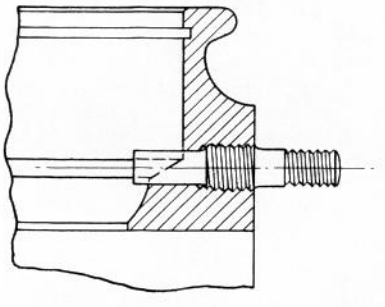


Fig. 69. Gear lever location—special stud

With the joint washer in position, fit the remote control over the studs of the gearbox cover and secure with the spring washers and dome nuts.

Fit a distance piece over each of the selector plate studs in the gearbox cover and position the selector plate, complete with its guide blocks, cut-away edge to the front of the cover Fig.70. Fit a distance piece to each stud and secure with tabwashers and nuts.

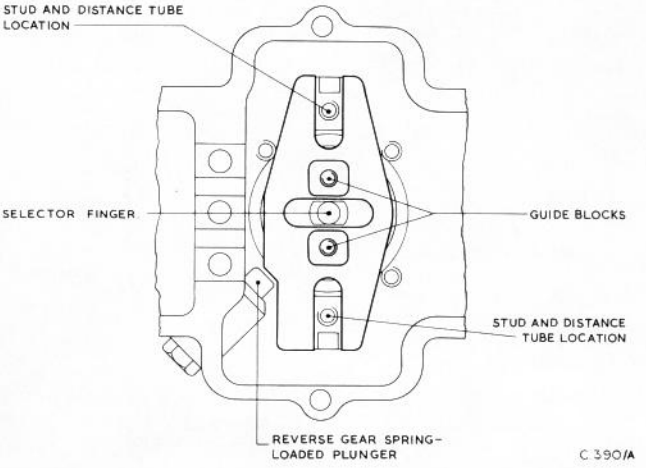


Fig. 70. Selector plate assembly

Layshaft Fig.58.

Where the original gears are being refitted it is important to re-fit the gears the correct way round to mate the established tooth bearing surfaces with those of the opposite gears.

Fit the 2nd. Gear key and using the drift and base T178296 press the shaft into the gear. Fit a spacing washer with its full face to the gear then press on the inner race of the centre roller bearing and fit the outer race. Fit the second space washer with the relieved face to the bearing, then fit the key and press on the 3rd. gear.

Slide on the long distance piece, fit a key and press on the layshaft driving gear using the drift T178297. Fit the short distance piece followed by the front bearing with its circlip towards the gear. Fit the tabwasher, tighten the nut and lock.

Using the base T178298 and the drift T.178297 press the rear bearing into position, fit the key and press on the reverse gear. Fit the tabwasher, tighten the nut and lock.

Main Driving Shaft

See that the 3/32 inch diameter dowels are in position on each side of the centre bearing location.

Locate the centre ball bearing in the base T178300 and using the drift press the mainshaft into position. It is important that the bearing is central with the raised portion of the shaft.

Fit the correct thrust washer to the long end of the shaft, locating its slot over the dowel. Well grease the shaft sufficient to retain the needle rollers and position 40 rollers next to the thrust washer, fit the short distance piece followed by a further 40 needle rollers.

Slide the 2nd. gear hub, gear wheel first, over the rollers, fit the thrust washer to the recess in the 2nd. gear hub and then insert the fixed hub key.

Fit the 2nd. speed blocker ring on the cone face of the 2nd. gear hub.

Fit a retaining ring to the front recess of the fixed hub so that one tongue of the ring engages one of the slots for the shifting plates, the other tongue resting against the recess in the hub.

Fit the fixed hub over the shaft, align the key and keyway and using the split bush TFN8699 and the drift press the hub on until it abuts the thrust washer. Fit the circlip into the groove and again using split bush TFN8699 press the hub back against the circlip to give the necessary clearance.

Fit the second retaining ring to the rear recess of the fixed hub but ensure that the tongue of the ring does not engage the same shifting plate slot as the front ring. Fit and temporarily retain by hand the three shifting plates, turning the 2nd. speed blocker ring as necessary so that the shifting plate notches in the blocker ring engage the ends of the shifting plates. Press the shifting plates down into their slots in the fixed hub and fit the sliding hub, long end first, over the assembly and centralise it. The central position can be felt by the shifting plates locating in the internal groove of the sliding hub.

Assembling the Freewheel

Referring to Fig. 66 fit the springs and plungers and fit the hub partially into position in the gear. Insert the rollers push the assembly right in and fit the retaining plate and circlip.

To continue with the main driving shaft assembly, fit the 1st. speed distance piece into the recess of the fixed hub, mating the notches to the ends of the shifting plates. Fit the 1st. gear thrust washer over the circlip. Grease the shaft and fit two rows of 40 needle rollers, as previously described, with the long distance piece between them, then slide the 1st. Freewheel gear assembly, dog teeth first, over the rollers.

Press the bearing location bush into the rear bearing with the retaining ring in the outer race located adjacent to the flange of the bush. Press the assembled bearing and locating bush, flange first, on to the shaft using the base and drift of Tool 178300. This completes the rear end of the shaft for the time being.

Commencing with the front end of the shaft fit the correct thrust washer locating its groove over the dowel. Grease the shaft and fit 40 rollers, followed by the distance piece and a further 40 rollers. Slide on the 3rd gear hub over the rollers and distance piece. Fit the thrust washer into the recess of the gear hub.

The 3rd/4th. speed fixed hub has a slight counterbore on one face only of the shaft bore. This must face the centre bearing. Fit a retaining ring to this side of the hub so that one tongue of the ring engages one of the slots for the shifting plates, the other tongue resting against the recess in the hub. Fit the key to the shaft and using the split bush TFN.8699 and a suitable drift press on the hub and secure it with its tabwasher locknut.

Fit the shifting plates and the front retaining ring then fit the sliding hub as described for the 1st and 2nd speed sliding hub.

Reverse the shaft and fit the key into the end. With the Reverse gear assembled with its hub and retaining ring, press this assembly on to the shaft and secure it with the tabwasher and special bolt.

Drive Shaft Fig.64.

If the gear has been removed, fit the key to the shaft and using the split bush TFN.8699 beneath the gear, press the shaft into position.

Fit the washer or washers to the gear face and using the drift T178299 press on the drive shaft rear bearing circlip to the front. Fit a needle roller bearing either to the spigot of the main driving shaft or into the recess of the drive shaft.

Fit the 4th. speed blocker ring to the drive shaft then assemble the shaft assemblies together. Trial fit them into the left-hand half of the gearbox casing to ensure that the bearing circlips locate correctly into the grooves. If the assembly has been assembled with its correct positioned original parts this should locate satisfactorily. If not some adjustment may be necessary to the washers located between the drive shaft gear and the rear bearing.

When this location has been determined, part the assemblies, slide the distance piece on to the drive shaft and press on the front bearing.

Fit the tabwasher, tighten the nut and lock.

Checking Drive Shaft and Main Driving Shaft

Again assemble the shaft assemblies together and locate them into the left hand side of the gearbox casing, ensuring that the notches of the blocker engage the ends of the shifting plates and that the bearing circlips are seating in the grooves of the casing.

Fit the selector fork and its original washers to the 3rd/4th. speed selector shaft, fit a lockwasher and secure temporarily with the fork retaining nut, then position the shaft and fork in the gearbox casing. Fit the gearbox cover assembly complete with the remote control mechanism and secure it with the casing studs.

Operate the gear change lever to engage the 3rd. and 4th. speeds in turn and check the engagement, then add or remove distance washers between the selector fork and the selector fork and the collar of the selector shaft, as necessary, to equalise the engagement. Fig.71. When satisfactory lock the nut with the tabwasher.

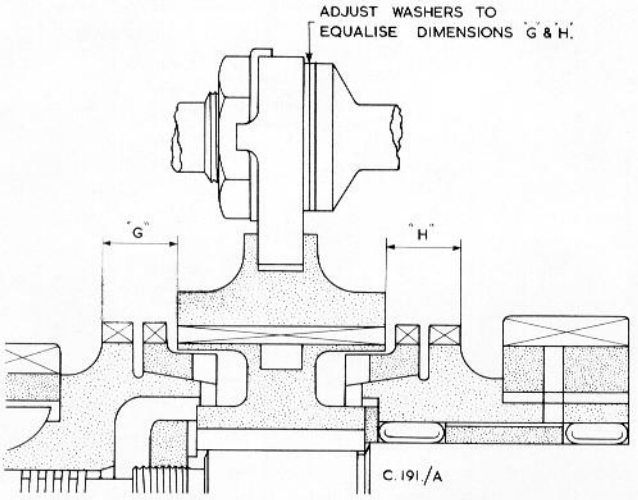


Fig. 71. Equalizing the selector fork location

Fit the 1st/2nd speed selector shaft in a similar manner and ensure adequate engagement of the sliding hub with the 2nd. gear hub. Full engagement with the first gear hub is then assured. The selector shaft in this instance will not have its full location which is partially in the right hand side of the casing.

Remove the gearbox cover assembly, followed by the drive shaft/main driving shaft assembly when these engagement checks have been completed.

Reverse Selector Mechanism

The spindle for the reverse idler gear is a slide fit in the casings being retained by one of the gearbox casing bolts. This spindle and the bush of the gear should be examined for wear before reassembly and renewed if worn badly.

The phosphor bronze bush is available as a spare and the old one should be pressed out and a new bush pressed in. The three 1/8" inch diameter holes should then be drilled through the bush from the gear and then the bore should be sized to .782 + .0005 inch.

To assemble the reverse gear mechanism Fig.67 slide the cut away end of the idler gear spindle into the right hand side of the casing. Fit the fork of the selector into the groove of the gear and slide the selector and gear into their respective locations.

Fit the tabwasher and pivot from the outside and lock. On the inside fit the fulcrum lever to the pivot pin, engaging its lower end in the slot in the reverse fork selector.

Final Assembly of Gearbox

Fit the drive shaft/main driving shaft assemblies in position in the right hand half of the gearbox casing locating the bearing circlips in the grooves.

Fit the layshaft assembly to the casing, meshing its mating gears and locating the circlip of the front bearing in the groove of the casing.

Fit the 1st/2nd. and 3rd/4th. selector shaft and fork assemblies into the sliding hubs ignoring the groove locations until the casings are fitted together.

Apply a thin coating of jointing compound to the mating gearbox joint faces and assemble the two halves together, ensuring that the bearing circlips are correct in the grooves. Fit the securing bolts washers and nuts and tighten to a torque loading figure of 7 to 9 lb.ft.

Overtightening can cause distortion and misalignment of the bearings resulting in noisy races.

Position the 1st/2nd. and 3rd/4th. selector shafts and put them in the neutral position. Fit the reverse selector shaft and engage it with the upper end of the reverse fulcrum lever.

Before fitting the gearbox cover attention should be given to the selector ball units. There are two types fitted as shown in Fig. 72 the earlier types have no positive depth location while the later type are identical except that the spring and ball housing is shouldered. The reverse ball selector of each type has a different spring tension and is stamped 'R' for identification. Its location is on the right hand side of the gearbox.

First check each unit to see that the ball will respond and seat itself with its spring pressure.

Screw them into the gearbox cover until the ball only protrudes into the half round selector shaft locations and the ball housing is just clear. From this position they can be finally adjusted back but they must not be screwed down otherwise they will foul the shaft and damage the housing thus preventing the ball from seating.

If an overdrive contact switch is fitted to the cover remove it at this stage.

To continue with the assembly, apply a thin coat of jointing compound to the faces and assemble the gearbox cover to the casings and secure with spring washers and nuts.

Check the gear lever in its engaged positions and if harsh or heavy the selector ball unit should be carefully unscrewed until correct. Peen as shown in Fig. 72 to finally lock them into position.

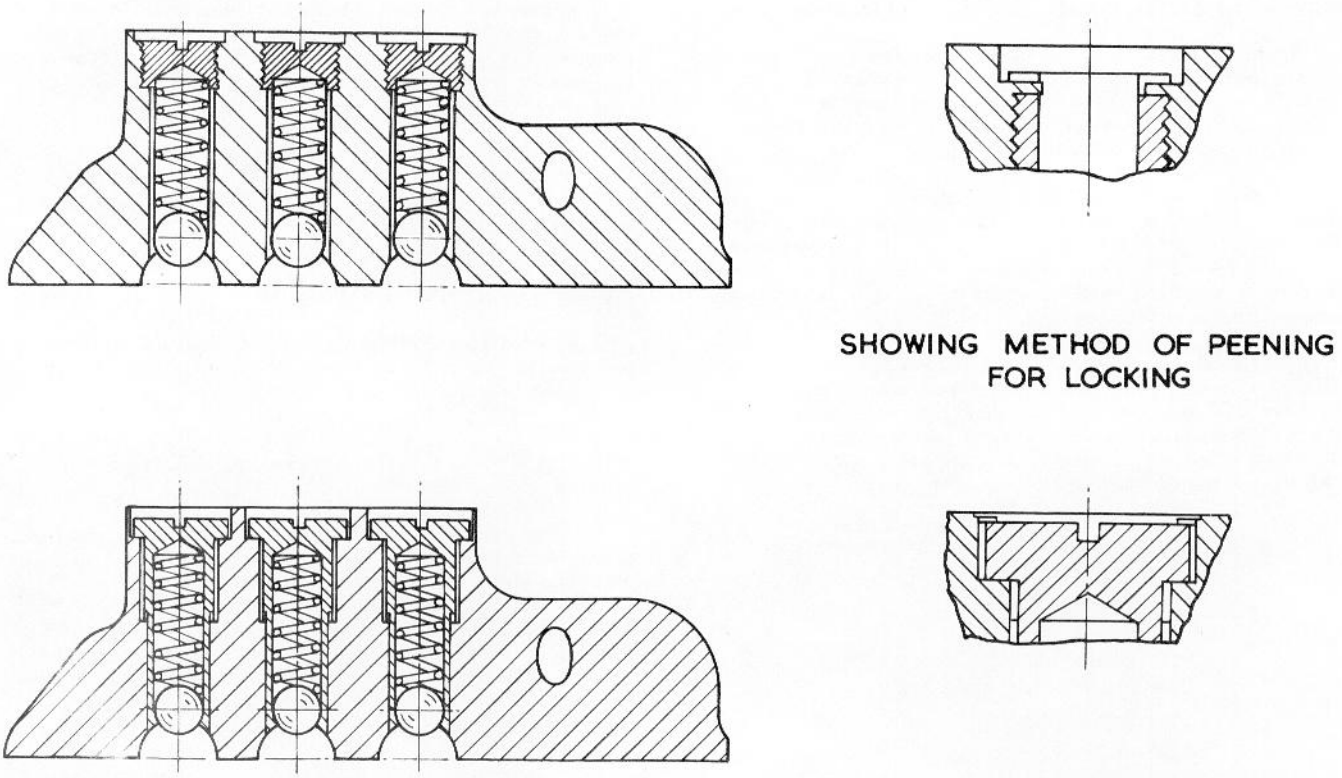


Fig. 72. Selector ball units

Clutch Casing

The leather gaiters at the clutch operating lever slots and also the timing aperture are only to be found on later cars.

To fit the clutch casing to the gearbox casing, fit a new joint washer to the front face, using jointing compound and assemble the clutch casing over the end of the drive shaft, locating the drive shaft front bearing into its housing. Secure the casing to the gearbox with the nuts and spring washers.

Fit the clutch fulcrum bracket to its correct position, right hand side for RH drive and left hand side for LH drive, and fit the tabwasher, tighten and setscrew and lock. Insert the clutch lever, fit the fulcrum pin and secure with a split pin.

Fit the clutch release bearing and cup assembly into the fork of the lever and secure it with its spring retainers.

Type 404 Cars.

Gearbox Extension Re-assembly

Fit the key to the 1st. reduction speedometer driven gear and fit the worm gear, then insert the gears into the extension casing with the lower end of the gear against its thrust pad. Screw the cover into position.

Fit the 2nd. reduction speedo driven gear to the drive union, then screw the union into position ensuring that the teeth of the gear and worm mesh correctly.

Fit the ball race to the extension shaft and secure it with the circlips. Fit the end plate to the shaft then fit the key and companion flange. Fit the tabwasher and nut, tighten the nut securely and lock.

Fit a new joint washer to the rear end of the extension, then insert the extension shaft and secure the end plate with the four set bolts and spring washers.

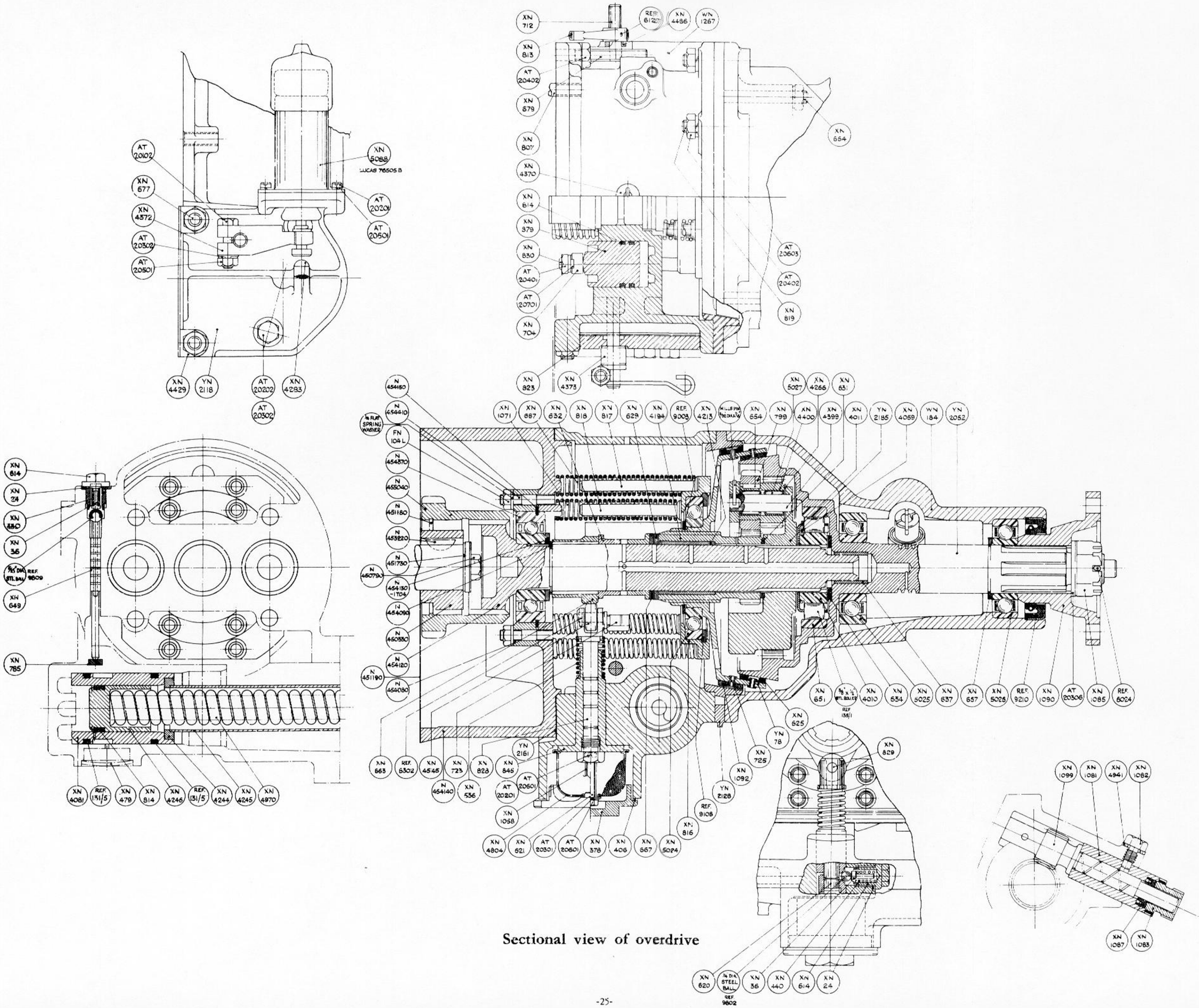
Finally assemble the extension unit to the rear of the gearbox by fitting a new joint washer, using jointing compound, then taking care that the teeth of the extension shaft engage in the hub and that the speedo gears mesh correctly, attach the extension unit to the gearbox and secure it with the nuts and spring washers.

Overdrive Contact Switch and Reverse Switch

These switches, Lucas 515500-45 are identical.

The reverse switch has a positive washer when it is fitted to the side of the gearbox, while the overdrive switch in the gearbox cover is controlled for height by shims. In this way the switch is smoothly operated by the selector shaft when Top Gear is engaged.

Both switches can be fitted and checked when the gearbox is in the car, but before the floorboards, tunnelling etc., are refitted.



Sectional view of overdrive

Laycock Part Number	Description	No. per Unit.
XN.24	Valve Plug Washer	2
XN.440	Valve Spring	2
XN.36	Ball Valve Plunger	2
XN.378	Drain Plug	1
XN.406	Drain Plug Washer	1
XN.479	Welch Washer	1
XN.536	Pump Plunger Spring	1
XN.614	Plug for Valve	2
XN.620	Plug for Pump Body	1
XN.621	Filter Bolt	1
XN.629	Thrust Washer	1
XN.631	Thrust Washer	1
XN.634	Thrust Washer	1
XN.649	Operating Valve	1
XN.657	Spacing Washer in the following sizes :–	1
XN.657E	.146'' ± .0005 thick	
XN.657F	.151'' ± .0005 thick	
XN.657G	.156'' ± .0005 thick	
XN.657H	.161'' ± .0005 thick	
XN.657J	.166'' ± .0005 thick	
XN.663	Cam	1
XN.664	Stud	2
XN.667	Thrust Washer in the following sizes :–	1
XN.667A	.113/.114'' thick	
XN.667B	.107/108'' thick	
XN.667C	.101/.102'' thick	
XN.667D	.095/.096'' thick	
XN.667E	.089/.090'' thick	
XN.667F	.083/.084'' thick	
XN.667G	.077/.078'' thick	
XN.677	Stud	2
XN.679	Stud	2
XN.704	Bridge Piece	2
XN.712	Valve Operating Shaft	1
XN.723	Pump Plunger Guide Peg	1
XN.807	Stud	3
XN.813	Operating Valve Setting Lever	1
XN.814	Operating Piston Ring	2
XN.814	Accumulator Piston Ring	2
XN.819	Stud	4
XN.823	Side Cover Plate Joint	1
XN.845	Pump Body	1
XN.879	Operating Piston	2
XN.888	Stud	1
XN.1058	Filter Distance Tube	1
XN.1082	Speedo Bearing Locking Screw	1
XN.1085	Slotted Nut	1
XN.1090	Coupling Flange	1
XN.1099	Speedo Driven Gear	1
XN.4010	Uni-Directional Clutch Inner Member	1
XN.4011	Uni-Directional Clutch Cage	1
XN.4059	Spring for Uni-Directional Clutch	1

Laycock Part Number	Description	No. per Unit.
XN.4081	Accumulator Housing	1
XN.4246	Accumulator Piston	2
XN.4266	Thrust Washer	3
XN.4283	Solenoid Stop	1
XN.4370	Breather	1
XN.4372	Solenoid Lever	1
XN.4373	Collar for Valve Operating Shaft	1
XN.4429	Stone Guard	1
XN.4486	'O' Ring	2
XN.4804	Filter	1
XN.4941	Washer for Locking Screw	1
XN.4970	Accumulator Spring	1
XN.5024	Ball Bearing 50 x 90 x 11m/m	1
XN.5025	Ball Bearing 1¼ x 2¾ x 11/16"	1
XN.5026	Ball Bearing 30 x 60 x 16 m/m	1
XN.5027	Torrington Bearing B.78	6
XN.5088	Solenoid	1
YN.2128	Brake Ring	1
YN.2161	Front Cover Plate Joint	1
REF.131/5	'O' Ring 1¾" dia.	2
REF.6024	Split Pin 1/8" x 1½"	1
REF.6127	Taper Pin No.000 1/16" x 5/8"	2
REF.9003	Seegar Circlip 1.7/8" dia.	1
REF.9108	Seegar Circlip 90 m/m	1
REF.9210	Oil Seal	1
REF.9802	Steel Ball ¼" dia.	1
REF.9809	Steel Ball 5/16" dia.	1
AT.20102	Bolt ¼" BSF	1
AT.20201	Setscrew No.10 Cheesehead	4
AT.20202	Setscrew 5/16" N.F. 2" x 1¾"	2
AT.20301	Plain Washer 3/16" dia.	1
AT.20302	Plain Washer ¼" dia.	1
AT.20306	Plain Washer ¾" dia.	1
AT.20401	Hexagon Nut ¼" UNF.2.	4
AT.20402	Hexagon Nut 5/16" NF2.	9
AT.20501	Hexagon Nut ¼" BSF	1
AT.20601	Spring Washer	5
AT.20603	Spring Washer	5
AT.20701	Tabwasher	4

Bristol Part Number	Description		No. per Unit.
N.450330	Hub-Reverse Gear		1
N.450790	Nut-Retaining Mainshaft		1
N.451180	Retaining Ring		1
N.451190	Joint-Gearbox-Rear		1
N.451730	Tabwasher		1
N.453220	Key		1
N.454080	Bearing Retainer		1
N.454090	Circlip		1
N.454120	Input Shaft		1
N.454130–1	Distance Piece .0975)		
N.454130–2	Distance Piece .1015)	Selective	1
N.454130–3	Distance Piece .1055)		
N.454130–4	Distance Piece .1095)		
N.454140	Adaptor Casting		1
N.454150	Circlip		1
N.454370	Ball Race		1
FN.104/L	¼" BSF Nut		4
N.454410	Stud		4
N.455040	Gear		1

Selective Assemblies

Pump Plunger Assembly S P.30003

Laycock Part No.		
XN.828	Pump Plunger	1
XN.4545	Roller	1
XN.829	Pin	1
REF.6302	Mills Pin 1/16" x ½"	1

Clutch Thrust Ring Assembly SP.30004

XN.816	Thrust Ring	1
XN.817	Pin for Clutch Spring (long)	4
XN.818	Pin for Clutch Spring (short)	4
XN.830	Pin for Thrust Ring	4

Clutch Sliding Member SP.30005

YN.78	Sliding Member	1
XN.625	Cone Clutch Inner Lining	1
XN.1092	Cone Clutch Outer Lining	1
XN.725	Rivet	24

Sunwheel Assembly SP.30007

XN.4194	Sunwheel	1
XN.4213	Bush for Sunwheel	1

	Laycock Part Number	Description	No. per Unit.
		Planet Carrier Assembly SP.30008	
	YN.2185	Planet Carrier	1
	XN.4400	Planet Wheel 15 teeth	3
	XN.799	Planet Wheel 21 teeth	3
+	XN.5027	Planet Bearings-Torrington B.78	6 sets
	XN.4399	Planet Bearing Shaft	3
	REF.6388	Mills Pin 3/32" x 7/16"	3
	XN.654	Key for Planet	3
+	XN.4266	Thrust Washer	3
+	XN.631	Thrust Washer	1
		Annulus Assembly SP.30009	
	YN.2052	Annulus	1
	XN.637	Bush	1
	XN.651	Uni-Directional Clutch-Outer Member	1
		Accumulator Piston Assembly SP.30011	
+	XN.4246	Accumulator Piston	1
+	XN.814	Accumulator Piston Ring	2 sets
+	XN.4081	Piston Housing	1
+	REF 131/5	'O' Ring 1¾" dia.	2
		Spacing Tube & Washer Assembly SP.30012	
	XN.4245	Tube for Piston Housing	1
	XN.4244	Washer	1
		Clutch Spring Set SP.30014	
	XN.687	Clutch Spring-long	4
	XN.1071	Clutch Spring-short	4
		Steel Roller Set. SP.30015	
	REF.135/1	Steel Rollers 3/8" x ½"	12
		Speedo Bearing Assembly SP.30020	
	XN.1081	Speedo Bearing	1
	XN.1083	Speedo Drive Screwed End	1
	XN.1087	Speedo Bearing Oil Seal	1
		Solenoid Bracket Assembly SP.30028	
	YN.2118	Solenoid Bracket	1
	XN.4097	Pin	1
+	XN.4283	Solenoid Stop	1

	Laycock Part Number	Description	No. per Unit.
		Rear Casing Assembly SP.30033	
	WN.184	Rear Casing	1
+	XN.819	Stud	4
		Speedo Drive Assembly SP.30048	
	XN.1081	Speedo Bearing	1
	XN.1083	Speedo Drive Screwed End.	1
	XN.1087	Speedo Bearing Oil Seal	1
+	XN.1099	Speedo Drive Gear	1
		Front Casing Assembly SP.30063	
	WN.1267	Front Casing	1
	XN.616	Screwed Plug	8
	XN.617	Screwed Plug	2
	XN.821	Screwed Plug	2
	XN.632	Bush	2
+	XN.479	Welch Washer	1
+	XN.712	Valve Operating Shaft	1
+	XN.813	Valve Setting Lever	1
+	XN.677	Stud	2
+	XN.807	Stud	3
+	XN.664	Stud	2
+	XN.679	Stud	2
+	XN.888	Stud	1
+	XN.723	Guide Peg-Pump Plunger	1
	XN.785	Cam Lever	1
+	XN.6127	Taper Pin No.000	2
+	XN.4486	'O' Ring	2
	REF 9901	No.2 Parker Kalon Drive Screws	2
	XN.768	Name Plate	1

Items marked thus + are also supplied separately.

The Laycock de Normanville Overdrive Unit

The Overdrive Unit is a standard fitment to the Type 405 Car being fitted to the rear of the Gearbox. It is self contained and in conjunction with the gearbox top gear provides an extra high gear when circumstances permit. This extra gear permits a fast cruising speed to be maintained, while the engine revolutions are reduced, thereby reducing engine wear and petrol consumption.

The overdrive is operated by a solenoid fitted to the left-hand side of the unit and is controlled by a plunger type switch fitted to the gearbox cover immediately forward of the gear change turret assembly. A magnetic relay switch is situated on the offside of the instrument panel.

When top gear is engaged, the plunger type switch comes into operation allowing the current from the ignition switch to continue to the magnetic relay switch on the panel. This latter switch is under the control of the driver and may be operated when it is desired to engage or disengage the overdrive. The magnetic relay switch will automatically switch 'off' when top gear is disengaged.

It is recommended that the overdrive is not brought into use at speeds below 40-45 mph.

Care and Lubrication

The oil in the Overdrive is common with that in the Gearbox.

Recommended grades of oil to use are:

MOBILOIL A.
ESSOLUBE 30
ENERGOL SAE 30
SHELL X-100 30
CASTROL XL.

The oil capacity of the Gearbox and Overdrive is 3.1/2 pints.

Checking Gearbox and Overdrive Oil Level

Set the car on level ground. Lift the carpet in front of the right hand front seat to expose the panel in the side of the front tunnel. Release the screws and remove the Panel (Fig.73). Clean off any dirt in the vicinity then remove the filler plug from the overdrive unit. If the oil is low fill until it is visible in the filler neck allowing sufficient time for the oil to find its level throughout the gearbox and overdrive unit.

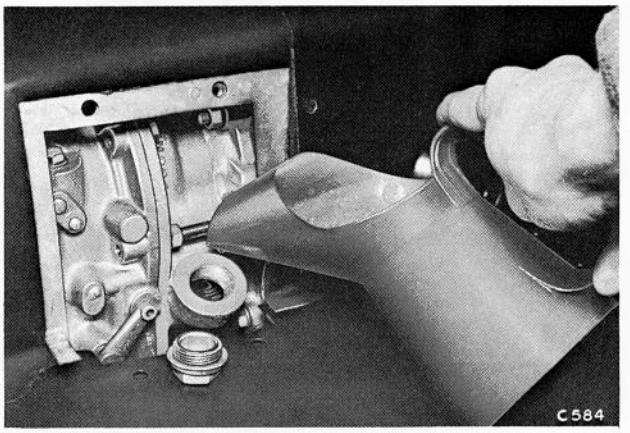


Fig. 73. Checking gearbox and overdrive oil level

Draining and Refilling Gearbox and Overdrive

To drain the unit it is necessary to remove the drain plugs from both the gearbox and overdrive unit Fig. 74 but refilling takes place through the overdrive only.

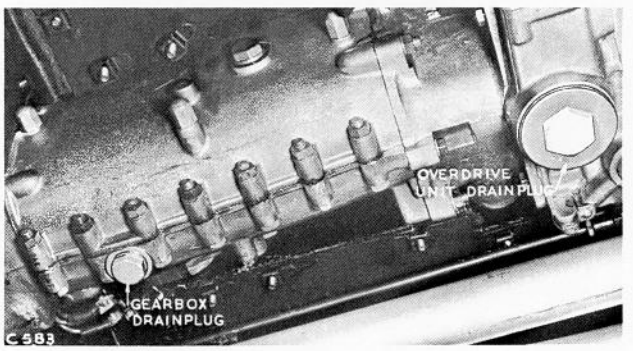


Fig. 74. Gearbox and overdrive unit drain plugs

After refilling drive the car a short distance then again top up with oil. This is necessary because some of the oil will be taken into the hydraulic system of the overdrive.

Never run a car without oil in the unit since air may enter this hydraulic system.

Cleanliness is essential and the smallest particle of dirt or 'fluff' from a wiping cloth which finds its way into

a valve of the overdrive mechanism will cause a great deal of unnecessary trouble. Make sure that the oil used for filling is perfectly clean.

Fitting a replacement Overdrive Unit to a Gearbox.

The Laycock de Normanville overdrive is adapted to the gearbox of the Bristol Car by an adaptor casting and a selective Input Shaft assembly. These parts are peculiar to the 'Bristol' Car. The adaptor casting is interchangeable with the gearbox but the splines of the Input shaft which locate in the Reverse Gear of the gearboxes are not interchangeable consequently the whole Input shaft assembly must at all times be kept with the gearbox.

To replace a complete Overdrive Unit the following procedure should be used.

Using Figs.75 & 76 dismantle the overdrive unit from the gearbox at Joint 'A' which will leave the reverse gear firmly in position on the rear face of the gearbox from where it can only be removed by the complete dismantling of the gearbox.

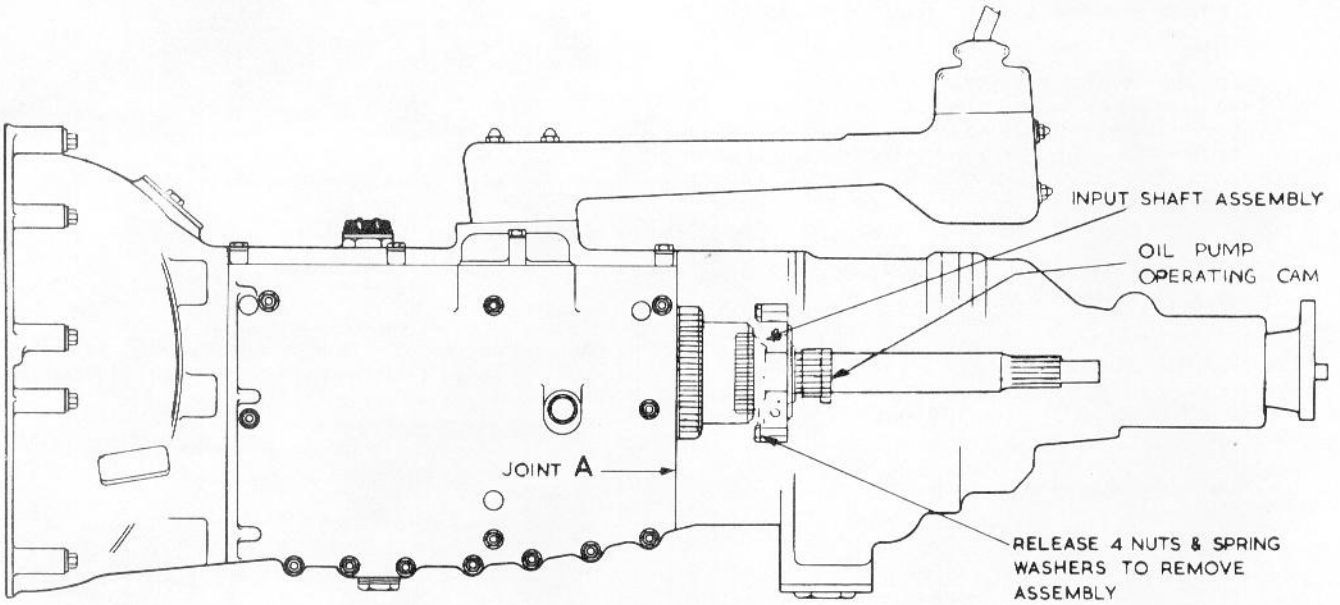


Fig. 75 Dismantling the overdrive unit from the gearbox

Next, from the front of the overdrive unit remove the four 1/4" Nuts and Spring Washers and take out the Input shaft assembly. This is a selective 'Bristol' assembly comprising the input shaft, bearing housing, ball race, selective distance piece and circlips and it should not be dismantled except for obvious repair or renewal of the ball race. The overdrive oil pump operating cam will either be on the front splines of the input shaft when it is withdrawn or left as a loose piece in the front of the overdrive.

This removed assembly should now be fitted into the replacement overdrive unit by the following method.

Visually check the splines at the rear of the bore in the overdrive which mate with the input shaft. There are two sets of identical splines here and the rear splines can be freely moved in an anti-clockwise direction with a long screwdriver or similar bar until they are both in line. It will be noted that rotating the coupling flange at the rear does not alter the relationship of the two sets of rear splines so that when they are initially lined up they will remain so.

Locate the overdrive oil pump operating cam (cam inwards) on the input shaft and insert the shaft into the overdrive. Press down the spring loaded oil pump plunger to allow the roller to locate on the cam and locate the four holes in the aluminium bearing retainer on to the studs.

Holding the input shaft, turn the coupling flange on the rear of the overdrive until the rear splines locate and push the shaft in to the bearing retainer face. The four spring washers and nuts can then be positioned and tightened.

Couple up the splines of the input shaft with the reverse gear of the gearbox and finally tighten the overdrive to the gearbox at Joint 'A'.

Diagnosis and Rectification of Faults

Five symptoms are numercially given and each has items for finding and rectifying the fault in the quickest manner.

The tests are arranged in progressive order so as to avoid any unnecessary dismantling.

(1) OVERDRIVE DOES NOT ENGAGE.

(a) Insufficient oil in the unit.

The overdrive unit must be filled to the level of the filler plug.

(b) Electrical Control System (Fig.77

When the electrical circuit is working correctly the solenoid can be heard to 'click' in and out when top

gear is engaged, the ignition switched on and the overdrive (dashboard) switched moved to the 'on' and 'off' positions. When the gear lever is moved into any other gear the circuit should become 'dead', that is, no 'clicking' of the solenoid should be heard.

To check this setting switch on the ignition, engage top gear and switch the overdrive switch into the 'on' position. This should operate the solenoid and move the valve operating shaft to the overdrive position. The hole in the setting lever should now be

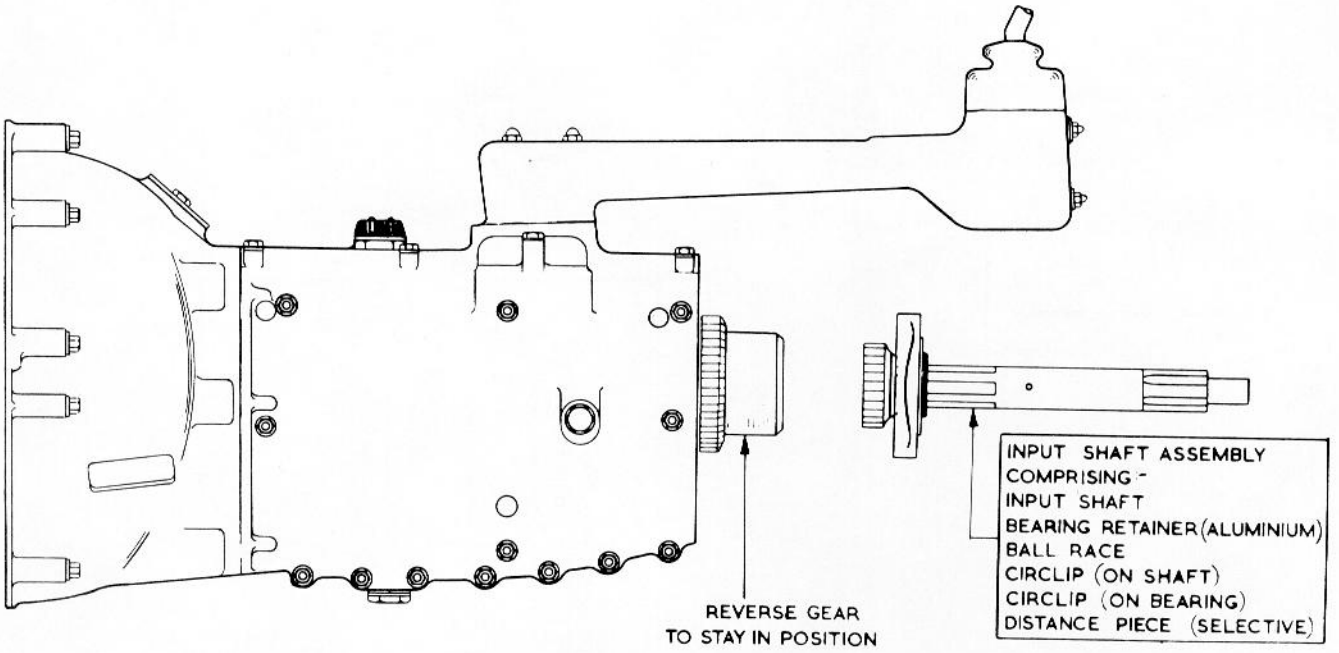


Fig. 76. Dismantling the overdrive unit from the gearbox

It has been found that most operational failures are due to corroded terminals and faulty wiring, so make a point of checking over the wiring and connections first.

Check the battery.

Check that voltage appears at the overdrive switch on the gearbox cover when the ignition is switched on. If so, apply a short circuit temporarily to the gearbox switch and switch on the ignition. If the circuit now operates, either the switch is faulty or its height in the gearbox needs adjusting by means of the shims fitted beneath it.

If the circuit still fails to operate when the overdrive (dashboard) switch is used locate the snap connector adjacent to the overdrive solenoid and pull out the wire. Check for continuity between the wire from the switch to chassis when the overdrive (dashboard) switch is operated. If there is no continuity the overdrive (dashboard) switch is faulty. If continuity exists the solenoid switch is faulty.

(c) Solenoid Lever not set correctly. Figs. 78 & 79

On the opposite side of the overdrive to the solenoid will be seen a valve setting lever (A) attached to the valve operating shaft (B). In the outer end of the lever is a 3/16 inch dia. hole (C) which must line up with the same diameter hole (D) in the overdrive casing when the lever is in the correct position.

in line with the hole in the overdrive casing and it should be possible to insert a 3/16 inch dia. pin or drill shank (E) into the two holes.

If the holes do not line up, the solenoid lever must be reset using the following procedure.

Slack off the clamping bolt (F) in the solenoid lever.

Energise the solenoid as already described and insert the 3/16 inch dia. pin through the hole in the valve setting lever into the hole in the casing.

Hold the solenoid lever (G) downwards so that it bears lightly against the solenoid stop (H) and tighten the clamping bolt (F).

Make sure that there is no end float in the valve operating shaft by pressing the valve setting lever and the solenoid lever inwards simultaneously when tightening the solenoid lever bolt. This expands the oil seals at either end of the shaft and prevents oil leakage.

Remove the pin from the setting lever and operate the solenoid several times by switching the ignition on and off (top gear engaged and the overdrive switch 'on').

Check that the hole in the valve setting lever corresponds with the hole in the casing by inserting the pin again.

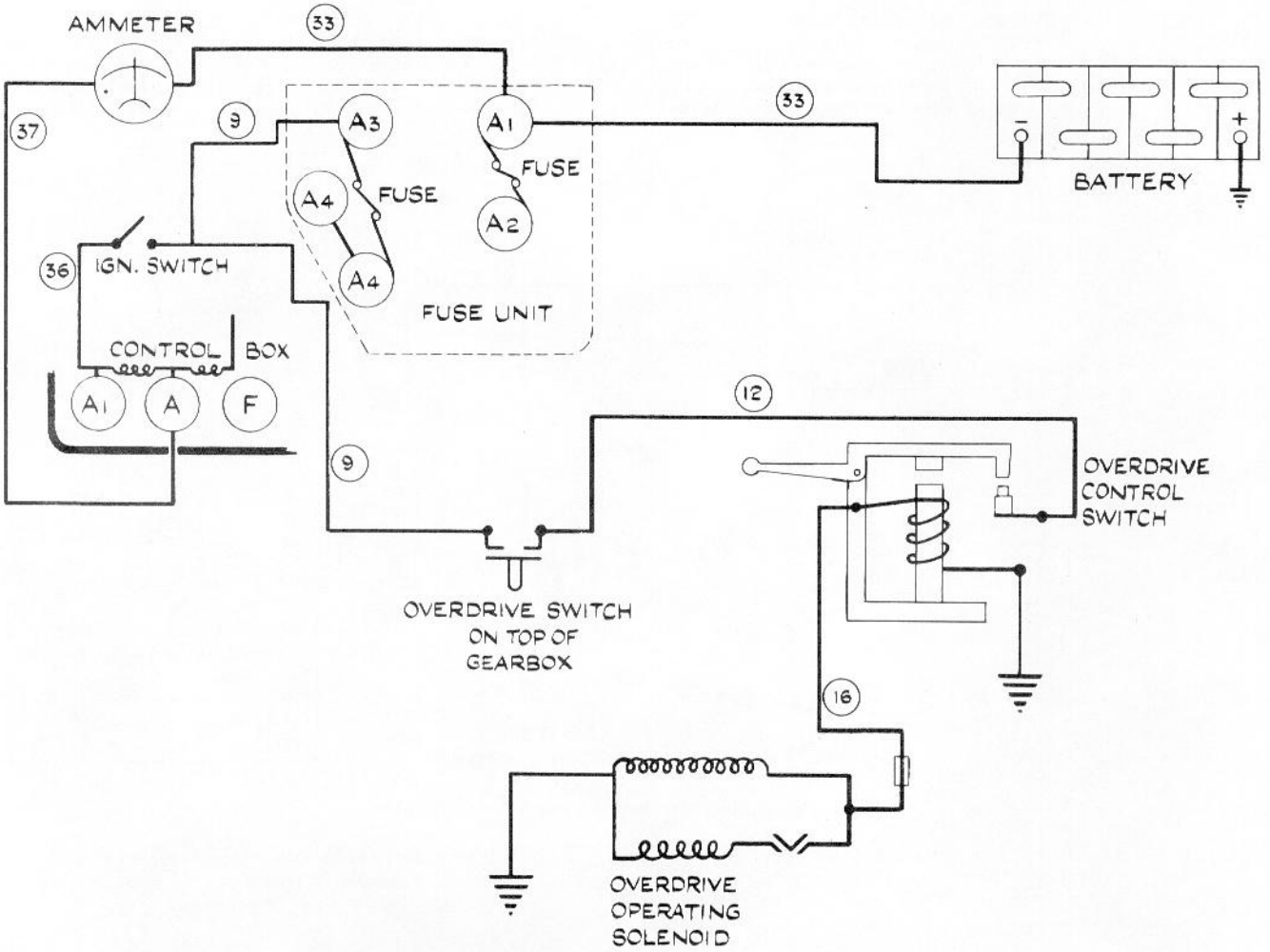


Fig. 77. Electrical control system

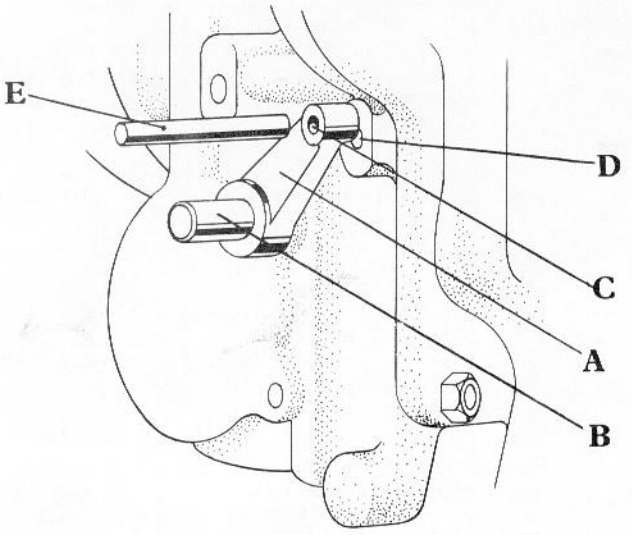


Fig. 78. Setting the operating valve

(d) Operating Valve leaking due to foreign matter in the Valve Seat Fig.80

The operating valve plug is situated at the top right hand side of the overdrive casing almost over the valve setting lever.

Before attempting to remove this plug it is very important to release all oil pressure from the system by operating the valve setting lever by hand about ten (10) times.

On removing the plug (I) and the spring (J) and plunger (K) the steel ball 'L' will be seen in the bottom of the valve chamber and a small magnet could be used to extract the ball. To remove the valve (M) a short length of wire 3/32 dia. should be inserted into the hole in the centre of the valve, which can then be lifted out.

Clean thoroughly and examine the seatings and if necessary 'grind-in' the ball seating of the operating valve using a spare 5/16 inch dia. steel ball and a fine grade grinding paste. Clean off all traces of the grinding paste and re-assemble.

The steel ball can be assisted in its reseating in the overdrive casing by lightly tapping on to its seat

using a soft copper drift.

(e) No Oil Pressure.

If the unit still fails to operate and the operating valve is seating and working correctly, check that the oil pump is working.

Jack up the rear wheels of the car, operate the valve setting lever about ten (10) times to release any oil pressure from the system and then remove the operating valve plug.

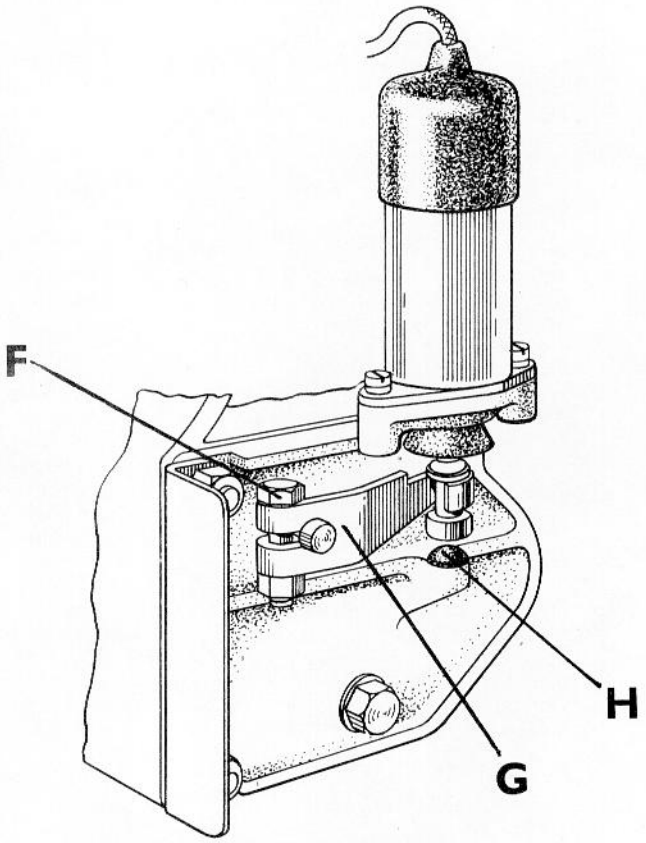


Fig. 79. Setting the solenoid lever

Start the engine and engage top gear with the engine ticking over slowly and note if any oil is being pumped into the valve chamber. If none appears, then the oil pump is not working probably due to foreign matter on the seat of the non-return valve. A flow of oil into the valve chamber does not indicate that the pressure is correct and this should be checked.

An adaptor Part No. 7H 5899 should be screwed into the casing, in place of the operating valve plug, and an 800 lb. per square inch pressure gauge screwed into the 1/8" BSP. thread of the adaptor.

Start up the engine, engage top gear and switch on the overdrive. The pressure gauge should read 500 p.s.i. ± 10 p.s.i. Low pressure indicates leakage and to remedy this fault proceed as follows:

Remove the drain plug (E) Fig. 81 and allow the oil to drain.
Remove the solenoid.
Slacken off the clamping bolt of the solenoid lever and remove the solenoid lever and the distance collar.
The solenoid bracket is secured by two (2) 5/16" dia. studs and two (2) 5/16" dia. bolts the heads of which are painted RED.

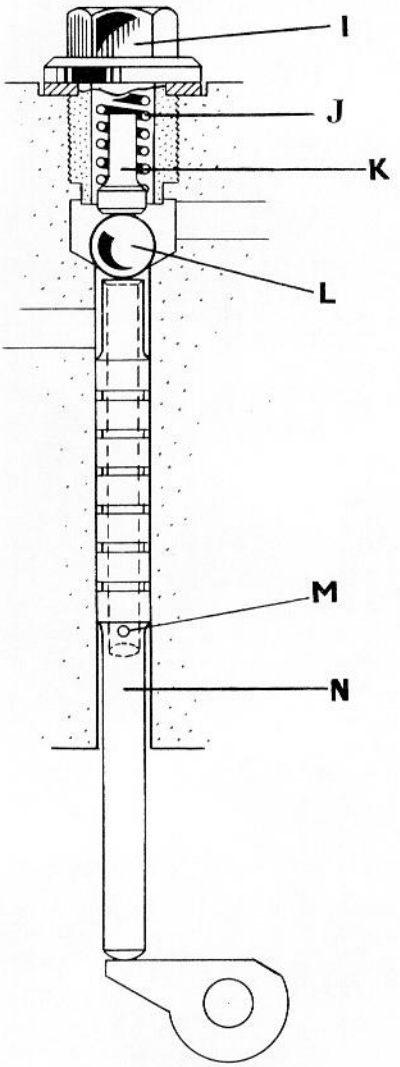


Fig. 80. The operating valve

Remove the nuts, washers and stoneguard from the studs before touching the bolts.

The two (2) bolts should now be slackened off together releasing the pressure on the internal accumulator spring.

The pump valve plug 'A' Fig. 81 can now be removed with a box spanner followed by the spring, plunger and ball.

Clean the valve seat and if necessary re-seat the ball by tapping it gently on to its seat using a copper drift.

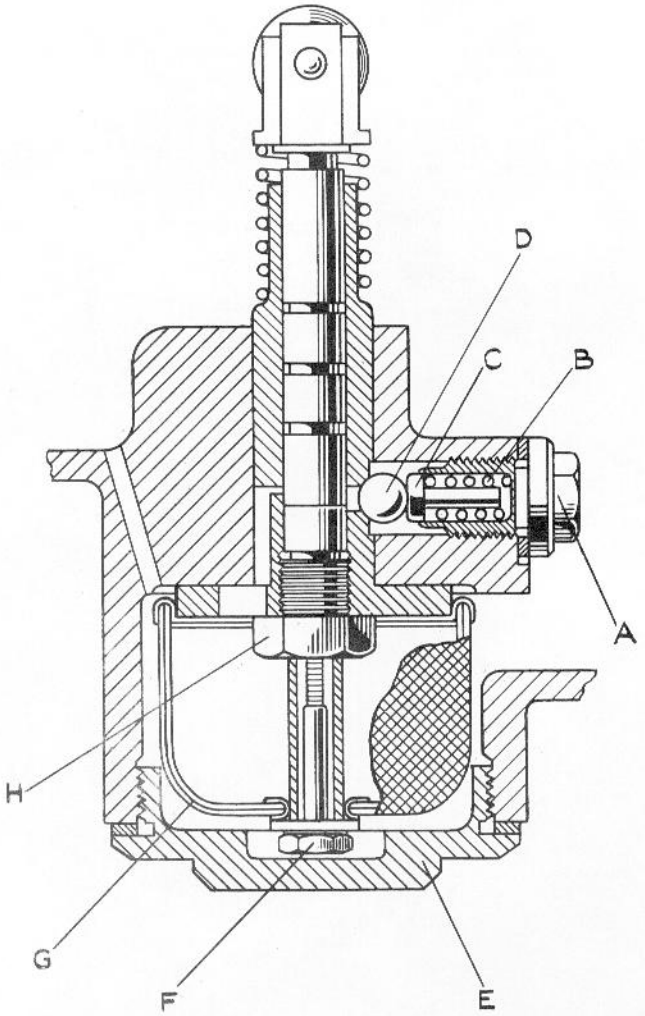


Fig. 81. Section view of oil pump showing the non-return valve

Re-assemble the valve and ensure that the valve plug is well tightened on to the soft copper washer which should be replaced by a new washer if damaged in any way.

Re-assemble the solenoid bracket and parts the reverse of the above procedure and ensure that the accumulator spring is located on its spigot at the back of the solenoid bracket. After re-assembly it will be necessary to reset the solenoid lever to the procedure already given.

(2) OVERDRIVE ON ALL GEARS.

(a) Electrical Control System.

If overdrive is obtainable on all gears the overdrive switch on the gearbox cover could be stuck.

(b) Solenoid lever not set correctly (described previously).

(3) OVERDRIVE DOES NOT RELEASE.

If this happens do not try to reverse the car as this may result in unnecessary damage.

(a) Blocked Restrictor Jet in the Operating Valve (Fig.80)

The operating valve should be removed as already described and the restrictor jet (M) should be cleared.

(b) Electrical system not operating correctly.

If the unit remains in overdrive after the ignition has been switched off then the electrical circuit is not at fault. If however the unit cuts in and out with the ignition switch a short circuit in the wiring or a faulty relay should be looked for.

(c) Solenoid lever not set correctly or Solenoid Plunger sticking.

It is very unlikely that any mal-adjustment of the lever will develop to prevent the overdrive from releasing. The setting and working of the valve setting lever, however, should be checked and corrected if necessary.

(d) Sticking Cone Clutch.

This fault has been known to occur as a result of heating up on a long run on a new unit before the linings are fully bedded in. The clutch invariably releases itself when it has cooled down a little, or it can be released by giving the casing a sharp blow with a hide hammer over the brake ring between the body of the overdrive and the rear cover.

(e) Damaged parts within the unit necessitating removal and dismantling of the unit for inspection.

Internal damage however is very unusual and it is recommended that all tests should be re-checked before deciding to remove the unit.

(4) CLUTCH SLIP IN OVERDRIVE.

(a) Insufficient oil in overdrive and gearbox.

The correct oil level must be maintained.

(b) Solenoid lever not set correctly.

Check the setting as already described.

(c) Insufficient Hydraulic Pressure.

Probably due to foreign matter on the ball seat of the pump valve or operating valve. Check the pressure with the adaptor and gauge as already described and clean and reseat valve if required.

(d) Worn or burned out cone clutch outer lining.

This is not experienced even after very large mileages unless the car has been driven for a long time in overdrive with the clutch slipping due to causes, a, b, and c given above. Removal of the unit and replacement of a cone clutch member would be necessary in this case.

(5) CLUTCH SLIP IN REVERSE OR FREE WHEEL CONDITION ON OVERDRIVE.

(a) Blocked restrictor jet in the operating valve causing sluggish return movement of the cone clutch.

Clean the restrictor jet as already described.

To Obtain Access to the Overdrive Unit for Testing and Rectification of Faults

Remove the two front seats and the carpets.

Detach the turret gear change by removing the four (4) domed nuts and lifting clear of the studs. This will allow the front tunnelling to be removed.

Remove the floorboards.

Re-attach the turret gear change.

Removing and Refitting the Overdrive Unit Only

Remove the two front seats and the carpets.

Detach the turret gear change by removing the four (4) domed nuts and lifting clear of the studs. This will allow the front tunnelling to be removed.

Remove the floorboards.

Unscrew the drain plugs (Fig.74) and drain the gearbox and overdrive unit. Refit the drain plugs.

Disconnect the propellor shaft at the overdrive end only and slide the end back to clear.

Remove the two (2) rear mounting bolts and disconnect the speedometer drive.

Turn the fan blades of the engine to the horizontal position (to avoid breakage when lifting) then lift and support the engine and gearbox sufficiently only to allow the overdrive unit to be withdrawn. Remove the nuts at Joint 'A' (Fig.75) securing the overdrive to the gearbox and manoeuvre the unit clear of the car.

To refit an overdrive unit, reverse the above procedure, ensuring that the input shaft splines mesh correctly in the reverse gear.

Stripping and Rebuilding the Overdrive

Removing and Refitting the Oil Pump

(Figs. 81, 82 & 83.)

Remove the solenoid bracket as previously described and lift out the accumulator spring and tube to give access to the oil pump non-return valve. Remove the oil pump non-return valve plug (A) spring, (B) plunger (C) and ball (D). Remove the drain plug (E). Remove the filter bolt (F) and the oil filter (G). Take out the plug (H) from the oil pump body and remove the two small screws. Using the oil pump extractor tool (Churchill L.183) screw the extractor bolt into the oil pump body in place of the removed screwed plug. Turn on the wing nut which will withdraw the pump body.

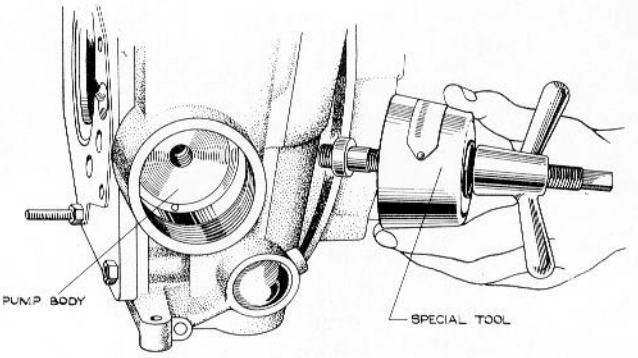


Fig. 82. Extracting the pump body from the casing using special tool Churchill L183

To replace the oil pump body which is an interference fit in the casing use two (2) number 10 UNF Studs about 3" long as guides (to locate the screw holes) and drive the pump body home with a suitable brass drift or use special tool (Churchill L.184) which incorporates the two guides.

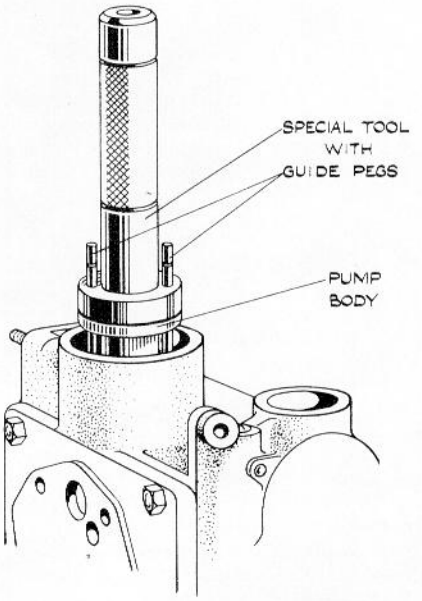


Fig. 83. Fitting the oil pump body using Churchill tool L184

The pump plunger is prevented from rotation, when in position, by a guide peg in the front casing. It is possible to guide it past the guide peg by means of a screwdriver inserted through the side of the casing.

Removing and Refitting the Accumulator Piston and its Housing

Remove the solenoid bracket as previously described and lift out the accumulator spring and spring tube. The accumulator piston housing is a push fit into the unit casing and the oil tightness of the housing is ensured by the two rubber rings.

The housing can be extracted easily together with the piston by the use of a special tool which fits into the bore of the housing and has a rubber ring which can be expanded by turning the tommy bar.

To use the extractor first remove the operating valve plug (Fig.80) to admit air to the rear of the housing, insert the nose of the extractor as far as it will go into the bore of the housing, tighten the tommy bar and pull (Fig.84)

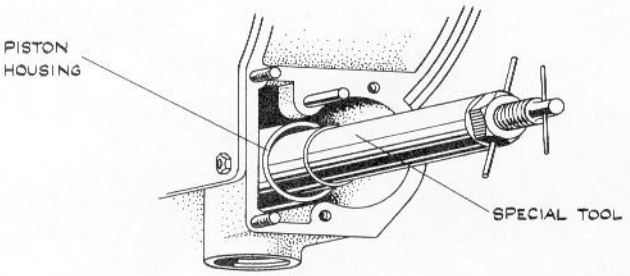


Fig. 84. Withdrawing the piston housing showing extractor tool Churchill L182 in position

Examine the bore of the housing for signs of wear such as a ridge or scoring. This examination should be carried out without removing the piston from the housing.

The accumulator piston is fitted into the housing with a special venturi tube (Churchill L.179) to ensure that the piston rings do not scrape as they enter the aluminium housing. Therefore do not remove the piston from the housing unless it is considered necessary. Should the piston be removed with no venturi tool available to insert it then it should be inserted at the front of the housing using a small piston ring clamp to compress the rings as the piston enters.

To reassemble the housing and piston assembly into the casing use either the withdrawal tool or push on the inner piston otherwise this piston may blow out backwards as the housing goes into the casing.

Dismantling the Body and Gears

First remove the adaptor casting which connects the overdrive unit to the 'Bristol' Gearbox. It will be noted that this is bolted together by four (4) short studs and two (2) long studs. Remove the nuts and washers from the short studs before touching the long studs. The nuts on the long studs should then be unscrewed simultaneously a few turns on each to release the compression on the inner clutch return springs.

Lift the clutch thrust springs from the supporting studs. Next remove the nuts from the six studs which hold the casings together and the front casing and rear casing can then be separated. Note the two (2) thrust washers between the bush in the front casing and the sun wheel splined extension.

Remove the bridge pieces from the front of the operating pistons and withdraw the cone clutch.

Withdraw the two (2) operating pistons.

Remove the small circlip securing the ball bearing to the cone clutch extension and remove the cone clutch from the ball bearing and Thrust Ring assembly.

Remove the larger circlip retaining the ball bearing in the Thrust Ring assembly and press out the bearing.

Using a hide faced hammer tap evenly around the cast iron brake ring and remove.

The removal of the solenoid cover and valves has been dealt with previously in the fault finding.

Sun Wheel, Planet Carrier and Uni-directional Clutch

Lift out the sun wheel and remove the thrust washers between the sun wheel and the planet carrier. Then remove the planet carrier.

Withdraw the un-directional clutch using the assembly ring (Churchill L.178) to retain the rollers and then lift out the thrust washers.

Dismantling Rear Casing and Annulus

Unscrew the set screw securing the speedometer drive bush and withdraw the bush and gear assembly.

Grip the coupling flange, withdraw the split pin and remove the slotted nut and washer. Withdraw the flange.

The annulus, which can now be drifted out easily from the rear will take the front ball bearing with it and leave the rear ball bearing in the casing.

Extract the rear ball bearing and the oil seal.

Inspection

Front Casing.

Examine for cracks or damage, oil leaks from the plugged ends of the oil passages or from the welch plug beneath the accumulator bore. Examine the bronze support bushes in the centre bore in which the input shaft should be a close running fit. See that the operating piston bores are free from scratches or scoring and at the same time check that the operating pistons and rings are not damaged.

The Gears

Inspect the teeth of the gears for damage. Examine the bronze bush in the sun wheel which should be a close running fit on the mainshaft, and examine the planet wheels which should be a close running fit on the planet pinions.

Cone Clutch Sliding Member Assembly

Examine the clutch linings for burning, wear or embedded foreign matter. See also that the cone clutch slides freely on the splines of the sun wheel extension. Make sure that the pins for the clutch springs and bridge pieces are rivetted tightly into the clutch thrust ring and that the thrust ring ball bearing is in good condition.

Clutch Springs

Examine for distortion or collapse. Free length of the outer springs should be 4.1/2 inches and the free length of the inner springs 4.1/4 inches. Replacement springs are supplied in sets.

Uni-directional Clutch

See that the rollers are not chipped or damaged and that the inner and outer members of the roller clutch are not damaged. See that the spring is not distorted or broken.

Replacement rollers are supplied in sets.

Ball Bearings

See that the ball bearings for the annulus are in good condition and free from any roughness when rotating slowly.

All Thrust Washers

Inspect for scoring.

Oil Pump

Examine the pump for signs of wear. The pump plunger should be a close sliding hydraulic fit in the pump body and the plunger roller should rotate freely on the roller pin with no slackness. Examine that the pump valve seat and ball are free from nicks and scratches.

Operating Valve

See that the ball seating and ball are free from nicks and scratches and the restrictor jet clear. Make sure that the valve slides freely in its bore in the front casing.

Re-assembly of Overdrive Unit

First build up the Rear Case assembly.

Drive the front ball bearing on the annulus and then press the annulus right home in the rear casing.

A selective spacing washer must now be fitted which should give an end float of .005 inch to .010 inch (see Fig.85). When a suitable washer has been decided upon fit this to the shaft, drive on the coupling, fit and tighten the slotted nut. The end float of the annulus must now be measured preferably with a dial indicator or measured from the face of the front casing to the face of the annulus. It is very important that no pre-load should develop on the annulus bearings when the unit warms up in use. If the end float does not conform to the correct limits, the slotted nut and coupling flange must be removed and another spacing washer selected. When the end float is correct remove the nut and flange and press home the oil seal with the lip of the seal inwards. Finally press on the coupling flange, tighten the slotted nut and lock with split pin.

ASSEMBLE THE FRONT CASING in the following order:

Assemble the oil pump with valve etc., the accumulator housing with piston, accumulator spring, tube and solenoid bracket as previously described.

Next fit the two operating pistons using a small piston ring clasp to assist assembly or special tool (Churchill L.179). The operating ball valve, plunger, spring and plug should now be fitted.

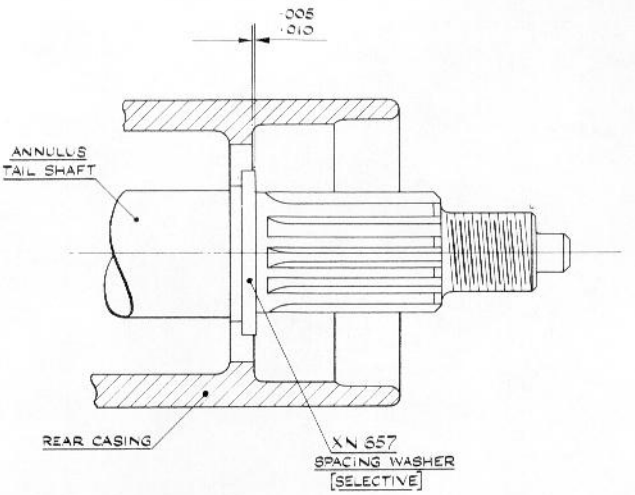


Fig. 85. Selection of washer for annulus end float

Finally drive home the cast iron brake ring using a hide hammer (Fig.86). The brake ring is spigotted to the main casing and is a light interference fit.

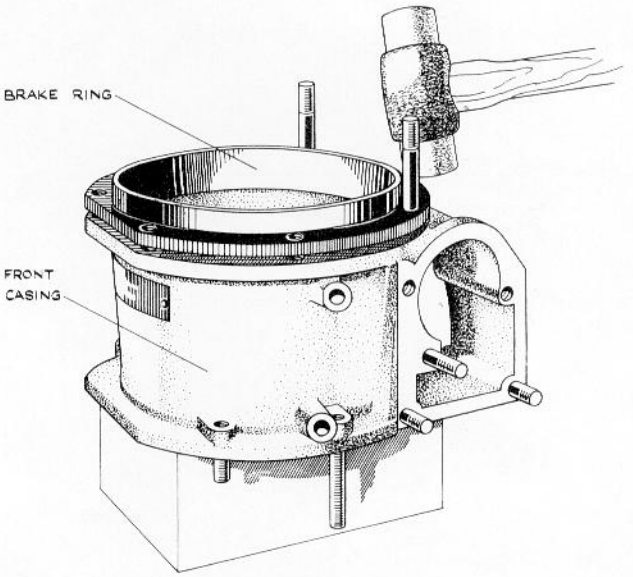


Fig. 86. Fitting the brake ring

THE SLIDING CLUTCH MEMBER should now be assembled.

Press the ball bearing into the housing in the thrust ring and secure with the external circlip. The thrust ring and bearing is then pressed on to the cone clutch member and secured with the internal circlip.

Assemble the Uni-directional Clutch

Fit the spring and centre member of the clutch to the cage, locating the spring to cause the rollers (when fitted) to rise up the inclined face of the centre member.

Position the roller assembly ring (Churchill L.178)

to cage and inner members then feed the rollers into position (Fig.87). Mount the rear casing flange down-

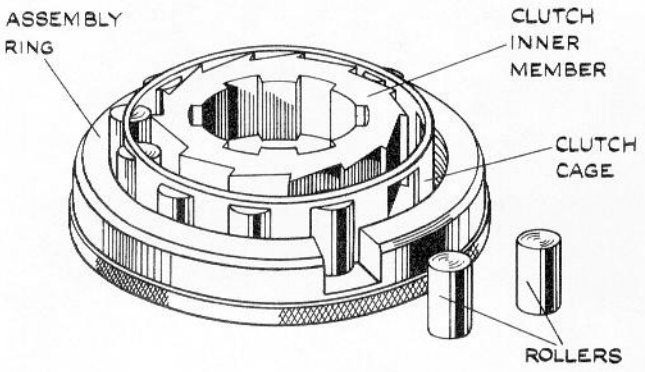


Fig. 87. Assembly of uni-directional roller clutch in assembly ring Churchill L178

wards in a suitable support. Fit the correct washer to the recess in the annulus. With assembly ring still in position to retain the rollers, fit the uni-directional clutch (open side of the cage inwards) to the annulus (Fig.88) and withdraw the assembly ring.

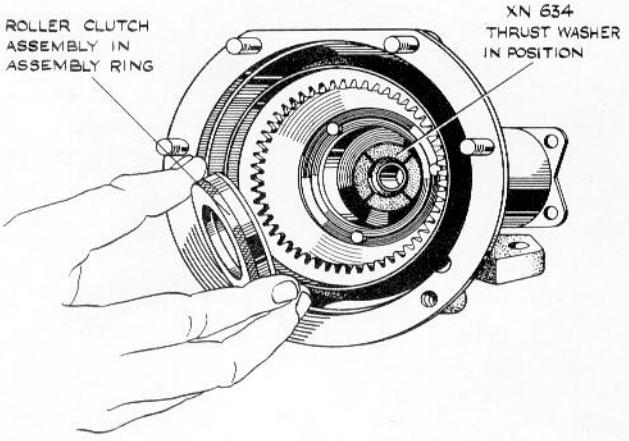


Fig. 88. Fitting uni-directional roller clutch to annulus

Assembly of Gears

With the rear casing held vertically by its coupling flange.

Place the three thrust washers for the rear of the sun wheel into position inside the planet carrier with the steel thrust washer between the two bronze ones.

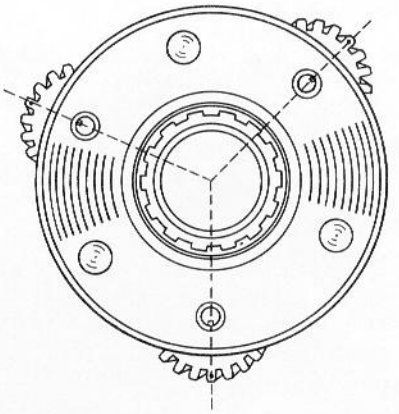


Fig. 89. Positioning the punch marks on the planet wheels

One tooth on each planet wheel is centre punch marked and the planet wheels should rotate in the carrier so that the punch marks are radially outwards as shown in Fig. 89. The sun wheel should now be inserted into the planet carrier and, with the punch marks still outward, the planet carrier should be placed into the annulus.

A dummy input shaft (Churchill Tool No.185) should now be inserted and left in place until the assembly is completed.

The next operation is to determine the correct amount of end float for the sun wheel which must be between .014 inch and .020 inch.

Place the bronze thrust washer (fixed size) over the dummy input shaft. A steel washer (selective) which is fitted between the bronze thrust washers and the central bush in the main casing serves also to make this adjustment and is supplied in seven thicknesses to suit the assembly.

Gauging the end float of the sun wheel can be carried out with feeler gauges using the following procedure.

With the bronze thrust washer and a steel thrust washer in position on the dummy input shaft and locating on the face of the sun wheel extension, place another steel washer of known thickness on the shaft (Fig.90).

The cone clutch assembly should be left out while the thrust washer is being selected.

Locate the front casing on the shaft and press down on the face of the thrust washers. The faces will not join because of the gap made by the additional (known size) thrust washer and the distance between the two casings should be measured with feeler gauges.

The width of the gap subtracted from the thickness of the known washer will give the amount of end float when that particular washer is removed. If the end float is found to be too much or too little a suitable washer from

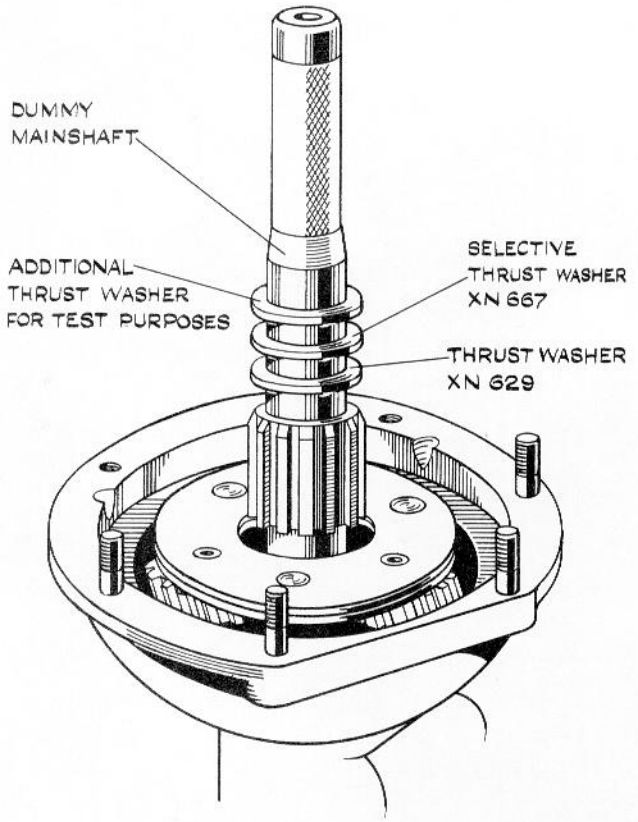


Fig. 90. Selecting a suitable thrust washer for sun wheel end float

the seven (7) selective sizes can be determined by calculation.

When the end float of the sun wheel has been determined the assembly can be completed.

Fit the cone clutch assembly into the front casing, join the two casings together, fit the spring washers and nuts on to the studs and tighten evenly.

The bridge pieces for the operating pistons can now be positioned with tabwashers and nuts and tightened and locked with the tabwashers.

The clutch springs should now be positioned with the four (4) longer springs on the outside pegs and the four (4) shorter ones on the inside pegs.

Fit a paper joint to the front face of the front casing and fit the adaptor casting over the studs. Locate the clutch springs on to their respective spigots on the inside face of the casting.

Tighten the adaptor casting by screwing down the nuts evenly on the two longest studs and finally tighten by means of the four (4) remaining studs.

The overdrive unit is then ready for use or if for storage the front face should be covered.

The assembly of the input shaft is selective to each gearbox and is covered by its own procedure previously given.

Gearbox and Overdrive

List of Contents