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## **SECOND SECTION**

# RECONDITIONING

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PART

## LIST OF OPERATIONS IN THE SECOND SECTION OF THE MANUAL N° 814-2

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« D » Vehicles All Types

Operation Number	DESCRIPTION				
	ENGINE - CARBURETTOR - IGNITION				
D. 100-3 D. 112-3	Overhauling an engine Overhauling a cylinder head				
	CLUTCH				
Dh. 314-3	Work on hydraulic clutch mechanism ( <i>hydraulic gear change</i> ) - Replacing a centrifugal regulator drive pulley - Replacing a centrifugal regulator front bearing				
	GEARBOX				
D. 330-3 Dh. 334-3	Overhauling a four-speed gearbox ( <i>bydraulic gear change - All Types. DV and Estate</i> ) Work on hydraulic gear control unit				
Dm. 340-3	- Overhauling a gearbox cover Overhauling a five-speed gearbox (on vehicles with manual gear change All Types except DT				
Dbw. 350-3 Dbw. 354-3	(optional) and DV) Overhauling a BORG WARNER gearbox Work on gear mechanisms : - Overhauling an oil pump - Overhauling a hydraulic unit				
	FRONT AXLE				
D. 413-3	Work on wheel swivel : - Replacing a swivel upper ball joint - Replacing a swivel lower ball joint				
	STEERING				
D. 444-3	Work on a power steering : - Overhauling a steering unit - Overhauling a rack hydraulic control - Overhauling a steering pinion and rotating union assembly - Leak test on rack hydraulic control				
	TOOLS				
	List of special tools mentioned in the manual				
	Manufacturing drawings for special tools not sold.				

## D VEHICLES ALL TYPES

Op. D. 100-3







I. OIL CIRCULATION DIAGRAMS.

#### a) D Vehicles All Types except D.IE.







NOTE : The cooler is no longer fitted to DJ.IE vehicles (as from 9/1970).

## II. PARTICULAR FEATURES.

## 1. Engine casings :

a) Cylinder block :	
<ul> <li>The engine casing and the crankshaft bearing caps are matched.</li> <li>The crankshaft bearing caps are marked from the front of the engine (fly numbers 1-2-3-4.</li> </ul>	wheel end) with the
- Crankshaft main journal diameter :	. 68.7 ± 0.05 mm
- Overall flatness of the seating surface for the cylinder head :	within 0.005 mm
- Tightening torque on cap securing screws :	90 to 100 mAN (9 to 10 m.kg)
b) Engine sump : Tightening torques :	
- Securing screws :	14 to 19 m/N (1.4 to 1.9 m.kg) 35 to 45 m/N (3.5 to 4.5 m kg)
- Tightening torque on screws securing clutch housing closing plate :	9 to 12 mAN $(0.9 \text{ to } 1.2 \text{ m.kg})$
<ul> <li>c) Timing gear cover :</li> <li>Tightening torque on screws and nuts :</li> </ul>	14 to 19 mAN (1.4 to 1.9 m.kg)
2. Crankshaft and connecting rods :	
a) 5 - bearing crankshaft :	64 04 + 0.010 mm
I und dim eter	• 0.005 mm
- Journal alameter	63.54 + 0.010
	. 0.005
First possibility :	54 + 0.010 • 0.005 mm
Second possibility :	$\dots 53.5 \stackrel{+}{}_{-}^{0.010} 0.005 mm$
- Bearing shells :	
Inner diameter (two possibilities) :	. 64.04 and 63.54 mm
- Width :	28.6 + 0.100  mm
- Outer diameter ( shells not under strain )	. 68.705 <sup>+</sup> 1.200 mm - 0.200 mm
NOTE : The bearing shells are made of aluminium-tin alloy in all engine Borg-Warner gearbox, whose bearing shells are in copperlead.	s except those fitted with α
- Crankshaft end-float :	0.045 to 0.160 mm s of the central bearing, except for
engines fitted with a Borg-Warner gearbox which have two half thrust-rin each side of the central bearing.	gs (upper and lower) placed on
- Half-thrust rings for central bearing (two possibilities) :	· 3.10 to 3.14 mm
	( 3.14 to 3.18 mm
- Tightening torque on bearing fixing screws :	90 to 100 mAN (9 to 10 m.kg)
<ul> <li>b) Connecting rods :</li> <li>- Distance between centres of small end and big end :</li> </ul>	160 ± 0.05 mm
- Bore of smallend bush :	. 25.005 + 0.009 • 0.003 mm
- Clearance of gudgeon pin in small end :	0.012 to 0.018 mm
	57.60 + 0.005
- Diameter of big end :	. 57.03 0.015 mm

-	Big end bearing shells :	
	Bore (two possibilities) :	54 and 53.5 mm
	Width :	+ 0.100 25 - 0.150 mm
	Outside diameter (unstressed) :	57.695 + 0.100 mm
	- Diametrical clearance of connecting rods on crankpins :	0.013 to 0.050 mm
	-Maximum weight variation of connecting rods in any engine :	7 g maximum
	- Tightening connecting rod cap nuts :	68 to 75 mAN (6.8 to 7.5 m.kg)
	- Fitting : Numbers are marked on the connecting rod body and cap at « a » ( ca	imshaft side),

## NOTE :

On engines type DY produced since February 1968 and on All Types of engines, except engine type DV, the big end bearing shells, the connecting rod and the small end bush are drilled so as to spray the inner face of the piston crown. 1190



- It is not possible to replace small end bushes without special tools.

#### 3. Pistons and piston rings :

## a) Pistons :

- Depth of ring	g groove :		Piston dia. 93.5 mm	Piston dia. 90 mm	Piston dia. 86 mm
- Compres - Scraper	ring		2 + 0.060 mm + 0.040 mm 2 + 0.050 + 0.030 mm	2 + 0.050 2 + 0.030 mm	2 0.045 0.030 mm
- Collector ring ( expander ) :			4 + 0.040 + 0.020 mm	5,	0.040 0.02 0 mm
- Bore ( for gu	dgeon pin) :			25	+ 0.010 + 0.003 mm
	/ - Diameter	:		25	0 • 0.004 mm
Gudgeon pin	Į	/ Piston	dia. 93.5 mm :		.9 • 0 100 • 0.300 mm
	- Length	Piston	dia. 90 mm :		• 0.100 • 0.300 mm
		Piston	dia. 86 mm :		• 0.100 • • 0.400 mm

b) Piston rings :

Ring		o. Thickness	Width (mm)		Clearance at gap (mm)			
		(mm)	dia. 93.5	dia. 90	dia. 86	dia. 93,5	dia. 90	dia. 86
Compressor	1	2 • 0.010 - 0.022	4 ± 0.12	3.9 ± 0.12	3.82 0 - 0.25	0.35 to 0 55	0.35 to 0.55	0.20 to 0.40
Scraper	1	2 - 0.010 - 0.022	4 ± 0.12	3.9 ± 0.12	3.82 0 - 0.25	0.35 to 0.55	0.35 to 0.55	0.20 to 0.40
Collector	1	* <sub>5</sub> - 0.010 - 0.022	2.9 ± 0.12	3 ± 0.12	3.17 0 - 0.25	0.25 to 0.40	0.25 to 0.40	0.20 to 0.40

\*NOTE : For the 93.5 dia. pistons, the thickness of the oil collector ring is  $4_{-0.012}$  mm.

CAUTION : Certain engines have been fitted with ordinary oil collector rings or with spring loaded collector rings. When repairs are made, the blade expander type ring should be fitted to all types of engine.

#### 4. Liners and cylinder head gaskets :

- a) Paper gaskets for liners :
  - 9/1968 : Gasket with extra thickness for 90 mm diameter liners only
  - 9/1968 : Gasket without extra thickness for 86 and 90 mm diameter liners
  - 9/1971 : Gasket without extra thickness for 93.5 mm diameter liners
- b) Cylinder head gasket : Two types of gaskets corresponding to the two types of liner gaskets :
  - gasket with circular crimping : to be fitted with liner gaskets with extra thickness.
  - gasket with oval crimping : to be fitted with liner gaskets which have no extra thickness.

IMPORTANT : These instructions should be carefully observed when the cylinder head gasket is being replaced.

c) Pistons and liners are matched.

#### 5. Cylinder head :

- Original thickness :		90 mm
- Maximum out of flatness :		0.10 mm
- Maximum skimming (surfacin		0.10 mm
a) Valve seat :		
- Seat angle : Inlet :	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	120 degress
Exhaust :		90 degress
- Width of seats :		0.8 to 1.2 mm
- Nominal diameter of sec	its :	
Inlet	10/1968 :	45 mm
miet	10/1968 :	47 mm
Exhaust :		37.5 mm

b) Valve guides :		Outer dia. of guide	Cylinder head bore	Guide bore	
Inlet	First possibility	13 + 0.059 mm + 0.039 mm	13 <sup>+</sup> 0.007 mm - 0.013 mm	8 + 0.015 mm	
Inter	Second possibility	13.25 <sup>+</sup> 0.059 mm + 0.039 mm	13.25 + 0.007 • 0.013 mm	- 0.010	
Exhaust	First possibility	13 + 0.065 mm + 0.045 mm	13 + 0.023 mm • 0.013 mm	8 99 <sup>+</sup> 0.015 mm	
	Second possibility	13.25 <sup>+</sup> 0.065 mm	13.25 <sup>+</sup> 0.023 mm	• 0.010 mm	

c) Replacing and positioning guides : Use tool 3079-T

d) Tightening torques :			
· Cylinder head screws	1	first tightening final tightening	30 m/N 、3 m.kg) 60 - 65 m/N(6 to 6.5 m.kg)
NOTE : Observe the tight	eni	ng sequence :	
- Exhaust valve rocker sh	aft	nut :	21 - 28 mAN (2.1 to 2.8 m.kg)
- Rocker cover screw :			6 - 8 mAN (0.6 to 0.8 m.kg)
- Nut holding closing plat	e :	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	21 - 28 m \ (2.1 to 2.8 m.kg)

## 6. Valves

a) Valves

	INLET		EXHAUST
	All Types	All Types	All Types
- Seat angle : - Outside dia. of head :	12 47 mm	0° 49 mim	90° 39 ± 0.1 mm
· Dia. of stem	7.95+	0.015 mm	0 8.95 <sub>0.350</sub> mm
- Total length : ( mm )	115. 47 <sup>+</sup> 0.600 - 0.250	116.05 + 0.600 - 0.250	104 +0.550 -0.350
	•		

b / valve springs :	OUTER	INNER			
	All Types	All Types	All Types		
Direction of spiral :	to the right	to the left			
Length under load :	39 mm for 28.9 ±1.6 kg 30.5 mm for 60 ± 3.2 kg	30.7 mm for 7.4 ± 0.5 kg 22 mm for 12 ± 1 kg	31 mm for 12.6 ± 1 kg 22 mm for 25 ± 1 kg		

c) Upper caps :

→ 10 · 1968 : The upper spring caps are different on the inlet and exhaust values; they should not be mixed up.

45 + 0.25 mm

- 1

► 10 / 1968 : They are identical.

d ) Cotters

- Length

----- 10 1968; The cotters are different from the inlet and exhaust values: do not mix them up.

10 1968 : They are identical.

## 7. Timing :

a) Camshaft : - End-float	0.05 to 0.09 mm
Cam lift : Inlet }10 1968	. 6.199 ± 0.02 mm . 6.638 ± 0.02 mm
Exhaust	6.144 ± 0.02 mm
b) Push-rods :	
- Diameter	24 + 0.05 - mm + 0.01

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c) Adjustment :

		10/ 1968
<ul> <li>Theoretical valve clearance :</li> <li>Inlet open :</li> <li>Inlet closed :</li> <li>Exhaust open :</li> <li>Exhaust closed :</li> </ul>	1 mm 5° 37° 40° 30' 6° 30'	1.1 mm 0° 30' 42° 30' 38° 30' 4° 30'

## d) Timing setting :

With pistons 1 and 4 at or about TDC, bring the marks on the camshaft and crankshaft pinions oposite each other and aligned with the centres of the two pinions. e) Timing chain :

0.1 to 0.5 mm
. 14 to 19 mΛN (1.4 to 1.9 m.kg)
14  to  19  mAN (1.4  to  1.9  m.kg)
-14 to 19 mAN (1.4 to 1.9 m.kg)
9 to 11 mAN (0.9 to 1.1 m.kg)

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## 8. Rockers :

a) Rocker s	haf	ts:	
Tatal		Inlet :	189.10 + 0.3 • 0.75 mm
- Total length		Exhaust :	213.36 + 0.3 • 0.75 mm
- Maximu	m o	ut-of-round :	lmm
b) Clearance	e a	rockers :	
нот	ş	Inlet :	0.20 mm
nor	(	Exhaust :	0.25 mm
	\$	Inlet :	0.15 mm
COLD	l	Exhaust :	0.20 mm

## 9. Flywheel :

- Maximum skimming (same value on both faces) :	0.5 mm
- Tightening bolts (Spherical imprint on bolt head):	90  mAN (9  m.kg)

## 10. Lubrication circuits :

- Recommended oils :	
TOTAL GTS 20 W 50 (or GT 20 W 40)	
- Cold countries :	
TOTAL GTS 10 W 30 (or GT 10 W 30)	
- Capacity of sump : - After draining and refilling :	4.5 litres
- After changing cartridge or dismantling :	5 litres
- Difference between min. and max . levels :	1 litre
- Pressure : oil at 60° C and engine running at 2000 rpm :	3.8 bars (54 psi) minimum
- Tightening torques :	· · ·
- Screw securing pump bell housing :	10 mAN (1 m.kg)
- Grub screw securing pump on engine housing :	6 mAN (0.6 m.kg)
- Screw securing pump bracket on crankshaft bearing cap :	$35 \pm 5 \text{ mAN} (3.5 \pm 0.5 \text{ m.kg})$
- Union on external cylinder head lubrication pipe :	14 to 19 mAN (1.4 to 1.9 m.kg)
- Oil pressure switch :	22 mAN (2.2 m.kg)





## 1155



## OVERHAULING THE ENGINE

## DISMANTLING

 Place the engine on stand 2509-T, fitted with the adapters 4010-T.

Drain the oil from the engine.

Mark the position of the clutch mechanism on the engine flywheel.

- Remove :
- the clutch mechanism,
- the engine flywheel.
- 2. Remove :
  - the water pump cover,
  - the breather and its gasket.
- 3. Removing the cylinder head : Remove :
  - the rocker s! aft lubrication pipe (1),
  - the rocker cover and its gasket,
  - the seals from the sparking plug wells and the washers,
  - the exhaust valve rocker lines,
  - the assembly of inlet valve rocker line and supports ( leave the screws in position to avoid losing any parts ),
  - the cylinder head screws,
  - the push-rods ( mark their position ).
  - the cylinder head and its gasket,
  - the tappets (remove them from their housing using tool MR. 630-27/4, if necessary), Mark their position.

NOTE : Since the cylinder head is made of aluminium do not remove the studs unless they are damaged.

Clamp down the liners using securing screws 3074-T.

4. Remove the timing-gear casing.

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5. Removing the sump and the oil pump :

#### Remove :

- the sump,
- the grub screw (1) holding the oil pump,
- the securing screw for the oil pump body on  $N^{\circ}\ 3$  main bearing.

11300

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Remove the oil pump from its housing.

- 6. Remove the camshaft :
  - Remove :
  - the chain guide (3),
  - the chain tensioner (2).



CAUTION : Before removing the tensioner, it must be « set » to avoid losing any parts.

Bring the slider pad (5) into contact with the body (6).

Using a 3 mm « Allen » key (7) or a screwdriver at « a » (according to model), rotate clockwise in order to lock the tensioner.

Remove the camshaft gear (4) and the chain.

Remove the securing fork (8) from the camshaft.

Withdraw the camshaft from the rear of the engine ( timing-gear end ).

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7. Remove the assemblies of connecting rods pistons - liners :

#### NOTES :

- Both the body and the cap of the connecting rod are marked with the same number at « a ». When the connecting rods are fitted to the engine, these numbers should face the camshaft.
- Before dismantling, mark the order of fitting the connecting rods into the engine using an electric stylus (or with a paint spot). Begin marking (connecting rod N° 1) at the clutch end.
- The connecting rods must in no case be marked with a punch which might damage the parts and have serious consequences.
- If the bearing shells, pistons and liners are to be used again, it is essential to fit them in the same place they occupied before dismantling.
- The liners should be replaced the same way round with respect to the pistons.
- a) Remove :
  - the connecting rod caps,
  - the screws 3074-T retaining the liners. Remove the assemblies of connecting rods pistons - liners and gaskets. Remove the bearing shells.
- b) Remove the pistons from the connecting rods. Extract one of the circlips retaining the gudgeon pin and remove this pin by hand.
- c) Remove the piston rings (using ring pliers).

## 8. Remove the crankshaft :

#### NOTES :

- The bearing caps are marked with a number except for bearing (2) at the flywheel end which is not marked. Bearing N° 4 is at the timing-gear end.
- After fitting the bearing caps, the numbers must be facing towards the camshaft.
- If the bearing shells are to be used again, they should be marked so that they can be replaced in the same position they occupied before dismantling.

Remove :

- the bearing caps,
- the shells and half-thrust rings (1) on the central bearing Nº 2,
- the crankshaft,
- the upper shells and the two other half-thrust rings.







#### PREPARATION OF COMPONENTS.

- Prepare the cylinder head. (see relevant operation).
- 10. Prepare the cylinder block :

NOTE : Grinding the crankshaft journals can only be done in a specialized workshop (see Special Points).

a) Remove the closing plates and the drain plug.

b) Remove the 3 oil-way plugs.

NOTE : From December 1965 onwards, the aluminium plug (1) has been replaced by a hexagonal-head steel plug which is fitted with a copper gasket. The engine casing must be spot-faced at the position of the plug, otherwise an aluminium plug only can be fitted. Remove the aluminium plugs (2). For this purpose, drill a 6 mm dia. hole in each, then enlarge this to 12 mm.

Remove the first few threads from the plugs, using a scriber. Tap a 14 mm hole with a thread pitch of 1.5 mm, thus removing the remainder of the plug. Remove any shavings which may have fallen into the oil pipes.

- c) Clean the cylinder block and the oil pipes.
- d) Check the joint faces (liners, cylinder head, lower timing casing).
   The seating surface for the cylinder head must be flat to within 0.05 mm.

 e) Fit the two aluminium plugs (2). Screw them home until they are completely in their housing (1 mm below the joint face).
 Expand these plugs using the punch

MR. 630-31/43.

This should be done gradually to avoid damaging the cylinder block.

Tighten the steel plug (1) fitted with its seal.

- f) Fit the closing plates. Fit new gaskets each time the plates are removed.
  Tighten the cylinder block drain plug to 30 to 40 mAN (3 to 4 m.kg).
  Make sure that the centring pins are fitted to the block.
- g) Rest the cylinder block on the cylinder head joint face.

Fit the crankshaft bearing shells into the block and in the bearing caps, the latter should not yet be fitted. Where appropriate, pay attention to the marks made when dismantling.  Prepare the crankshaft : Clean the crankshaft, particularly the oil passages.

NOTE

- The timing gear on the crankshaft cannot be replaced.
- The crankshaft bearings can be machined to two different dimensions (see particular features).
- The bearing shells on the connecting rod and on the crankshaft can be replaced separately.
- Prepare the assemblies of connecting rods pistons - liners :

NOTE

- The liner-piston assemblies are sold in matched pairs. The same applies to the gudgeon pins and pistons.
- The liner may be placed in any position with respect to the piston.
- The small end bushes cannot be replaced in a repair shop. These are fitted after being nitrogen - cooled and a special reamer is required.

IMPORTANT : The connecting rod cap bolts must be renewed after each engine overhaul.

- a) Oil the gudgeon pins, the small end bushes and the gudgeon pin bores in the pistons. On each piston, fit a circlip in one of the grooves.
- b) Assemble pistons and connecting rods : Position each piston with respect to the corresponding connecting rod. as shown in the adjacent photograph.

With the assembly fitted in the engine, the following conditions must be satisfied :

- the top « a » of the piston must be towards the timing-gear end (rear of the engine).
- the number « b » marked on the big end must face the camshaft.
- c) Fit the gudgeon pins. Fit the remaining circlips.





#### 13. Fit the rings to the pistons :

Fit the rings using ring pliers so that the inscription on each ring faces upwards.

Fit in order :

a) The oil collector ring (1) or (5).
 Place the expander gap (4) diametrically opposite that of the ring (5).

NOTE : Certain engines (DV-DY-DL) have been fitted with simple oil collector rings (1). These should be replaced by expander rings (5).

Vehicles fitted with a 93.5 mm dia. piston 7/1972 : The oil ring (6) is fitted with a spring expander.

- b) The conical scraper ring (2).
- c) The chromium-plated compression ring (3) : Orientate the ring gaps :
  - compression ring (3), gap facing the figures « b » on the big end,
  - ring (2) and (1): gaps at 120° from the gap in the ring (3).







#### 14. Fit the pistons in the liners :

Oil pistons and liners.

Use :

- a bush 3072-T for the 90 mm dia. pistons,
- a bush 3070-T for the 86 mm dia. pistons,
- a piston ring fitting collar, available in the trade, for the 93.5 mm dia. pistons.

Fit the collar on the rings (start the positioning operation from the piston skirt end, with the inner chamfer of the collar towards the piston). Fit the pistons in the liners.

CAUTION : Where appropriate, orientate the liners with respect to the pistons according to the marks made during dismantling.

VERY IMPORTANT : Inserting the oil return ring in the collar requires considerable force which must be restricted as the ring starts to slide in the collar so as to avoid breaking the scraper ring by striking it with the edge of the collar.

#### 15. Prepare the camshaft :

 a) The end-float of the camshaft must lie between 0.05 and 0.07 mm.
 Fit the clamp fork (1) in the groove on the

shaft.

Measure the existing clearance using feeler gauges.

If this clearance is greater than 0.07 mm, select among the other clamp forks sold by the Replacement Parts Department the part which will give the required clearance.

 b) Make sure that the camshaft pinion dowel is in position.

#### 16. Prepare the timing gear :

- a) Check the condition of the chain tensioner and guide.
- b) It is recommended that the timing chain be replaced systematically.
- c) Check the flatness of the joint face of the timing casing ; if necessary, correct this using a hide mallet.

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#### 17. Prepare the distributor drive.

#### 18. Prepare the sump :

Remove the inspection plate and clean the sump and the plate.

#### 19. Prepare the engine flywheel :

a) Replace the starter ring :

Remove the ring using a hammer punch. Heat the new ring using a blow torch fitted with an 800 tp 1000 l nozzle, until a temperature of 200° to 250° C is reached (pale straw colour).

Place the ring on the flywheel, the toothchamfer side towards the rear of the flywheel and fit it quickly using a hammer and punch, if necessary.

It must not be possible to insert a 0.05 mm feeler gauge between the ring and the flywheel.

- b) Resurface the seating face of the disc on the flywheel :
  - 1° Remove the circlip and the gearbox drive shaft centring bearing.
  - 2° Where appropriate, skim the seating surface « a » of the disc and the seating surface « b » of the clutch mechanism by the same amount.

The distance between the two skimmed surfaces must be :

10/1972 = 29 + 0.2 mm

Skimming should not exceed 0.3 to 0.5 mm.

- 20. Prepare the clutch mechanism.
- 21. Prepare the water pump.
- Check the oil pump and overhaul it if necessary.



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#### ASSEMBLY.

## NOTE :

 The bearing caps are marked with a number except for bearing (1) at the flywheel end which is not marked. Bearing N° 4 is fitted at the timing end.

After fitting the bearings, the figures must be

- towards the camshaft.
- If the bearing shells are being used again, they must be fitted in accordance with the marks made when dismantling.
- Connecting rods are sold in sets of four, matched by weight. If replacement is necessary, it is essential to replace all the connecting rods.

#### 23. Adjust the end-float of the crankshaft :

#### IMPORTANT :

- The end-float is adjusted by means of the half-rings (2) and (3) located on each side of the central bearing, with the anti-friction surface in contact with the crankshaft.
- The lower half-rings fitted on the bearing cap have a positioning lug « a ».

 There are two classes of half-rings (marked I and II on the steel face).

Rings class 1 : thickness 3.10 to 3.14 mm. Rings class II : thickness 3.14 to 3.18 mm. The two half-rings placed on the same side of the bearing must have the same thickness. The half-rings on one side of the bearing may have a different thickness from those placed on the other side.

#### Adjust as follows :

- a) Oil the shells. Place an upper half-ring (3) of type I at each side of the bearing.
- b) Fit the crankshaft.
   Fit the two intermediate bearings (1) and (3).
   Tighten the bolts to 50 mAN (5 m.kg).
- c) Push the crankshaft as far as it will go towards the timing gear, rotating it at the same time (hold the half-rings).







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d) Using a set of feelers A, measure the existing clearance.

#### The correct clearance should be between 0.045 and 0.16 mm.

If the clearance is greater than 0.16 mm : replace the half-ring (1) at one side of the central bearing ( or on both, according to the value of the clearance), by a ring of type II, in order to obtain the correct clearance.

( To replace a half-ring (1), pivot it around the crankshaft journal, without removing the crankshaft ).

## 24. Fit the crankshaft :

#### Fit :

- the cap of the central bearing (  $N^{\circ}$  2 ), fitted with the half-rings whose thickness was found above
- the two end bearings (bearing N° 4 towards the timing gear).

NOTE : Place the anti-friction surface of the rings in contact with the crankshaft.

Tighten the bolts :

First tightening to 50 mAN (5 m.kg). Second tightening to 100 mAN (10 m.kg).

## Make sure :

- That the crankshaft turns smoothly,
- That the end-float remains unchanged.

Place the engine on its side, with the camshaft uppermost.

- 25. Fit the assemblies of connecting rods pistons liners :
  - a) Fit the gaskets on the liners :
    - Put the gasket on the liner so that the black marks which outline the positions are parallel to the end faces of the big end and the extra-thickness (brown paper) is towards the liner.
    - Push the seal by hand up to the first shoulder of the liner.

Complete the fitting using plate MR.630-64/25.

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- NOTE : If the assemblies of connecting rods pistons - liners and the connecting rod bearing shells are to be reused, they must be fitted in accordance with the marks made when dismantling.
  - b) Insert a connecting rod piston liner assembly from the top of the cylinder block with the piston at T.D.C. in the liner.
  - c) In turn, fit the three other assemblies, holding the liners using retaining screws 3074-T.

#### IMPORTANT :

- Fit the assemblies so that :
- the top « a » of the piston is towards the timing gear,
- the figure « a » (marked on the big end ) is facing towards the camshaft.
- d) Fit the bearing and oil them.

Link up each connecting rod to the crankshaft and fit the connecting rod caps. Lightly tighten the nuts.

#### IMPORTANT :

The figures marked at « b » on the connecting rod and on the cap should be identical and at the same side.

Finally tighten the connecting rod big head nuts to 68 to 72 mAN (6.8 to 7.2 m.kg).

#### NOTE :

Since March 1966. the finishing of crankshafts has been modified and the bearing shells sold by the Replacement Parts Department are made of an aluminium-tin alloy.

These shells can be fitted on all crankshafts. However, copper-lead shells (grey in colour) used previously can be fitted only on crankshafts produced *before March* 1966. (On these crankshafts the webs at each side of the crank pins have a slightly bluish appearance which is not present on later models).

NOTE : On engine to be fitted with a Borg-Warner gearbox, the bearing shells are in copper-lead.

#### 26. Fit the camshaft :

Insert the shaft into the cylinder block from the timing case end.

Fit the clamp fork (1) (see paragraph 15). Tighten the screw (2) to 14 to 19 mAN (1.4 to 2 m.kg) (serrated washer under the head).







#### 27. Fit the oil pump :

Place the oil pump in its housing so that the conical hole in the body of the pump corresponds with the tapped hole in the cylinder block.

a) Vehicles produced — 10/1966: Smear the threads of the pointed screw (1) with MASTI-JOINT HD 37. Tighten the screw to 6 m. (0.6 m.kg). Smear the inner surface of the locknut (2) with MASTI-JOINT HD 37. Tighten the locknut.

It is recommended that the existing screw and the locknut be replaced by new parts (with a NYLSTOP nut).

b) Vehicles produced >> 10/1966 : The screw (1) is modified (the diameter of the screw has been reduced at the slot) and the locknut (2) is of the NYLSTOP type. The parts must not be smeared with MASTI-JOINT during fitting. A NYLSTOP nut must never be fitted on the old type of screw. Tighten the bolt holding the pump bracket on bearing N° 3 to 35 mAN (3.5 m.kg).

#### 28. Fit the sump :

Place the cork gasket (3) in the groove of the bearing cap at the flywheel end (smear the ends of the seal with HERMETIC).

Smear HERMETIC on the two surfaces of the sump which bear on the cylinder block. Position the sump.

Place a long screw on the left-hand side of the bearing marked N° 4 (timing gear end), two long screws on the right-hand side of the engine (2nd and 3rd screws starting from bearing N° 4 at the timing end bearing).

Tighten all the screws to 14 to 17 mAN (1.4 to 17 m.kg).

Grease the surface of the cardboard joint of the inspection plate which is in contact with the sump and smear HERMETIC on the other surface. Fit the plate, and tighten the bolts to 9 to 12 mAN (0.9 to 1.2 m.kg).

29. Tighten the drain plug (new seal) to 25 to 35 mAN (2.5 to 3.5 m.kg).

## 30. Fit the timing gear :

Bring the pistons in cylinders  $N^\circ$  1 and  $N^\circ$  4 to about T.D.C.

a) Put the chain over the crankshaft gear wheel and then put the camshaft gear wheel in the chain. Position the gear wheels so that the taut section of the chain at « c » is at the opposite side to the tensioner and that a straight edge passing through the centre lines of the two wheels also passes through the mark « a » (punch mark or spot of red paint on a tooth) of the camshaft wheel, and through the mark «b» (electric stylus mark in a tooth gap) of the crankshaft wheel.

The two marks should face each other.



BRAMPTON







Turn the camshaft until the centring dowel and the tapped holes are opposite the holes drilled in the gear wheels.

Tighten the screws holding the camshaft timing wheel.

b) Prepare the « BRAMPTON » chain tensioner. NOTE : The SEDIS tensioner must not be dismantled in any circumstances.

Fit :

- the cylinder (3) in the body (4),
- the spring (2) in the cylinder (3),
- the assembly (1) of slider pad and plunger in
- the body (4) (the spring is partly compressed).

Insert a 3 mm Allen key A through the tapped hole for the plug (7).

Turn it clockwise in order to engage the plunger (1) in the slot of the cylinder (3).

Bring the slide carrier (1) into contact with the body (4).

Continue to turn the key in the same direction and lock the carrier (this facilitates the positioning of the tensioner).

c) Fit the chain tensioner : insert the filter (5) in its housing « a » of the body (4).

Fit the tensioner. Tighten the screws to 17 mAN (1.7 m.kg).

Release the carrier by turning the Allen key A or the screwdriver « b » (according to model) anticlockwise and make sure that the pad bears correctly on the chain.

In the case of «BRAMPTON» tensioner being fitted, tighten the plug (7) after fitting the tab washer (6). Bend back the tab.

d) Fit the chain guide (8) :

Put the guide (8) in position. Fit the screws without tightening them (plain washer under the heads).

Move the chain guide in position until there is a clearance of 0.1 to 0.5 mm, as measured with a set of feelers.

Tighten the screws.

#### 31. Fit the timing cover :

Using HERMETIC, stick the gasket to the cover. Smear the other face with grease. Fix the cover by means of the three nuts (1) (spacers under the nuts) and the screws (plain washer under the heads). Tighten to 14 to 18 mAN (1.4 to 1.8 m.kg).

#### 32. Oil the tappets.

Fit them according to the marks made when dismantling.





#### 33. Fit the cylinder head :

 a) Make sure that the dowel pins are present on the cylinder block.
 Fit the cylinder head gasket.
 Place the cylinder head on the block.

Fit the pushrods (position marked during dismantling). The exhaust valve pushrods are the longer.

- b) Prepare the inlet valve rocker line (3): The lubrication hole « a »nearest to one end of the shaft indicates the front end. Begin the assembly from this end. Place on the shaft (previously oiled, with the lubrication holes facing the valves):
  a long screw (7) fitted with its bracket (6),
  - a thick washer (5),
  - a rocker (see diagram for orientation),
  - a spring,
  - a thin washer (4),
  - a long screw.

Continue assembly in the same order. The thick washer should be replaced by a thin washer (4).

Fit the rocker unit brackets on the long screw.

Position the bracket as indicated in the photograph.

The front support has a chamfer which must be orientated towards the pushrod to allow this to pass.

Fit an O-ring (2) over the long screws between the shaft supports and the cylinder head (except on the front screw).

Place the rocker assembly on the cylinder head.



c) Fit the exhaust valve rockers : Place on the shaft (6) (lubrication holes facing downwards) starting from the front :

Provisionally tighten the cylinder head screws and those on the inlet rocker line to 40 mAN (4 m.kg).

- a rocker arm (2),
- $-\alpha$  spring (3),
- a washer (5).

Place each assembly on its support.

Fit the shaft retaining caps (1) and (4) and the nuts.



NOTA : The rear nuts holding the exhaust valve rocker shafts on cylinders Nº 1 and 3 have been replaced by screws with long heads recessed and tapped.

> This makes it possible to fit the rocker cover.

d) Following the order indicated above, finally tighten the cylinder head screws and the screws holding the inlet valve rocker line to 60 to 65 mAN (6 to 6.5 m.kg).

Tighten the nuts holding the exhaust valve rocker lines to 22 to 28 mAN (2.2 to 2.8 m.kg).

#### 35. Fit the distributor drive :

Bring Nº 1 piston to T.D.C. on the compression stroke.

Place a gasket smeared with grease on the distributor drive.

Grease the lips of the seal (7).



Offer up the distributor drive.

Before engaging the gears, the drive slot « a » must make an angle of 45° with the camshaft centre line.

After engaging the gears and securing the drive on the engine casing (two long screws in the upper part, one short in lower part, plain washer under screw head) the drive slot should be parallel to the centre line of the camshaft and the small side « b » should be orientated as shown in the figure.

#### 36. Fit the engine flywheel :

Place the flywheel on the crankshaft. Tighten the screws to 90 m/N (9 m.kg) (spherical imprint on screw head).

Fit the new bearing in the flywheel. Fit the circlip.

## 37. Fit the clutch :

Make sure that the bearing faces of the disc on the flywheel and on the plate are perfectly clean.

Fit the disc. Engage a mandrel 3106-T into the disc hub in order to center it with respect to the flywheel bearing.



Fit the mechanism in accordance with the marks made when dismantling.

Vehicles type D All Types produced up to December 1969 : Replace the type 1 by type 2. Tighten them to 40 mAN (4 m.kg) (grower washer).

Vehicles type D All Types produced between December 1969 and October 1972 : Tighten the screws to 40 mAN (4 m.kg) (shakeproof washer). Since October 1972 on rebicles type D All Types, the clutch mechanism is held in position by Allen screws. These should be tightened to 35 mAN (3.5 m.kg) (shakeproof washer).

While tightening, make sure that the mandrel slides freely.

NOTE : If there are twelve holes in the casing and the flywheel has six tapped holes, the mechanism must be fitted so that three of the screws are in line with the toggles.

#### 38. Fit the rocker-cover :

Place the rubber seal on the rocker-cover. Fit the rocker-cover and tighten the screws (brass washer under the heads) to 7 m.N (0.7 m.kg).

#### OVERHAULING A CYLINDER HEAD.









#### VEHICLES ALL TYPES

#### DISMANTLING.

#### 1. Strip down the cylinder head :

- a) Remove :
  - the exhaust manifolds and their gaskets,
  - the protective screen between exhaust manifolds and cylinder head
  - the heater pipe on the cylinder head,
  - the inlet manifold and its gaskets,
  - the sparking plugs,
  - the water pump and its cover,
  - the exhaust rocker assemblies,
  - the inlet rocker line and its supports.
- b) Strip down the inlet rocker line assemblies.

#### 2. Remove the valves :

Use spring compressor 3084-T and tool 3077-T. Hold the valves using support MR. 630-63/13. Extract :

- the cotters (1),
- the upper cup (2),
- the springs (4),
- the thrust washers (5) for the springs,
- the seal (3),
- the valve (6).

NOTES : The cylinder head is made of aluminium, and it is not possible to replace the valve seats without special tools.

Avoid removing the studs.

#### 3. Lap the cylinder head (if necessary).

(This operation can only be carried out in a specialised workshop).

Original thickness :	± 0.1	mm
Maximum out-of-flatness :	0.10	mm
Maximum skimming :	0.10	mm

#### 4. Replace the sparking plug tubes (if necessary) :

- a) Extract the plug tube : using a pair of pliers, turn the tube first to the left and then to the right while pulling upwards.
- b) Clean the bore and the upper face of the cylinder head.
- c) Fit the sparking plug tube : smear the end of the tube with a sealing compound ( such as HERMECTIC ). Put it in position perpendicular to the plane of the cylinder head gasket. Fit it using mandrel MR. 630-31/71.
- d) Check that the tube is correctly positioned :

the height should be : 56.5 \_ 0.5 mm.

	ITEM	OD of guide	Bore in cylinder head	Bore of guide
Inlet	First possibility	13 + 0.059 mm + 0,039 mm	13 <sup>+</sup> 0.007 mm - 0.013 mm	a + 0,015 mm
	Second possibility	13.25 + 0.059 + 0.039 mm	13.25 <sup>+</sup> 0.007 • 0.013 mm	• 0.010 mm
Exhquat	First possiblity	13 + 0.065 mm + 0.045 mm	13 <sup>+</sup> 0.023 mm - 0.013 mm	R 00 + 0.015 mm
	Second possibility	13.25 + 0.065 + 0.045 mm	13.25 <sup>+</sup> 0.023 mm • 0.003 mm	0.010 <sup>mm</sup>

5. Replace the valve guides (if necessary).



D. 11-1

2



#### Inlet valve seats

For the seating : 120° biconical wheel	3046-T
For the top clearance :	
150° biconical wheel	3047 <b>-</b> T
For the bottom clearance :	
90° biconical wheel	3047 <b>-</b> T

- NOTE : The Replacement Parts Department sells guides with two different outer diameters. A guide can be replaced only by one having the same diameter.
- a) Extract the defective guide or guides using tool 3079-T.
- b) Fit the guide using the shouldered bush D.
  Smear the screw C and the thrust faces of the washer B with tallow.
  Tighten the nut A until the shouldered part of the bush sits on the face of the valve seat.
- c) Ream the exhaust valve guides (Reamer 1642-T)

to a dia. of 8.99 + 0.015 mm. - 0.010 mm. Ream the inlet valve guides (Reamer 3080-T) to

a dia. of 8 + 0.015 mm. • 0.010

Check the bore using a go no-go gauge or, if not available, with the stem of a new valve.

#### 6. Grind the valves and valve seats :

a) Valve seats :

Seat angle : inlet :	120 degress
exhaust :	90 degress
Width « b » of seat :	0.8 to 1.2 mm
Use the following grinding wheels :	

#### Exhaust valve seats

For the seating : 90° biconical wheel	1627 <b>-</b> T
For the top clearance :	
150 biconical wheel	1627 <b>-</b> T
For the bottom clearance :	
60° monoconical wheel	1633 <b>-</b> T

The largest diameter of the seat must be equal to the largest diameter of the valve.

b) Valve :

On the valve heads, make a slight chamfer at " a » to round off the edge.

Grind in the valve using the valve-grinder 1615-T.

	INLET		EXHAUST	
	All Types 	All Types	All Types ————————————————————————————————————	All Types 10/1968 except DV
- Seat angle - Outer diameter of head - Diameter of stem :	120 degress 47 mm 49 mm		90 degress 39 ± 0.1 mm	
- under head	7.95 <sup>+</sup> 0.	.015 mm	8.95 <sup>+</sup> 0	.015 <sup>mm</sup>
- cotter area	7.94 <sup>+</sup> 0 • 0.	mm .07	8.94 <sup>+</sup> 0 mm - 0.030	7.94 <sup>+</sup> 0 mm • 0.050
- Total length (mm)	115.47 + 0.600 - 0.250	116.05 + 0.600 • 0.250	104 <sup>+</sup> C - C	.550 .350

Manuel 814-2

Carefully clean the cylinder head to remove any trace of grinding paste in the valve chambers and gas passages.

#### FITTING.

6. Set the springs-rates : Use fixture 2420-T.

	OUTER	INNER All Types All Types (DY.DL.DLF) except DX.DJ.DXF.DJF DYF.DV 10/1968		
	All Types			
- Direction of spiral	to the right	to the left		
- Length under load	39 mm for 28.9 ±1.6 kg 30.5 mm for 60 ± 3.2 kg	30.7 mm for 7.4 ± 0.5 kg 22 mm for 12 ± 1 kg	31 mm for 12.6 ± 1 kg 22.5 mm for 25 ± 1 kg	



#### CAUTION :

10/1968 : the upper cups (2) and the cotters (1) are different for the inlet and exhaust valves : they must not be mixed up.

10/1968 : these parts are identical.



7. Fit the valves :

Fit :

- the valve (7),
- the thrust washer (5) for the outer spring,
- the shouldered thrust washer (6) for the inner spring,
- the seal (3).

NOTE : To fit the valve seals, use the plastic cap sold with each seal and the tool VSIT 2. (Floquet).

To facilitate fitting, smear the seal and the fitting cap with grease.

When the seal is worn or badly fitted, it must be replaced.

A seal which has been removed must never be used again.

Fit :

- the springs (4),
- the upper cup (2),
- the cotters (1).

Use tool 3077-T and spring compressor 3084-T. Hold the valves by means of support MR. 630-63/13.

## 8. Assemble the inlet valve rocker shaft :

The lubrication hole « a » nearest one end of the shaft indicates the front end. Begin assembly at this end. Place on the shaft, previously oiled with the lubrication holes facing the values :

- a long screw (8) fitted with its cap (9),
- a thick washer (10),
- a rocker (11) (see photograph for position),
- α spring (12),
- a thin washer (13),
- a long screw (14).



4



Continue assembly in the same order (the thick<sup>\*</sup> washer (1) is replaced by a thin washer (2) for the other cylinders).

Fit the brackets on the long screws. Position the brackets as shown in the the illustration.

The front bracket has a chamfer which must face the push-rod to allow adequate clearance.

Place an O-ring (3) on the long screws between the shaft support and the cylinder head, except on the front screw.



## 9. Assemble the cylinder head :

#### Fit :

- the water pump cover and the water pump ( the gaskets are fitted dry ),
  - CAUTION : The seal is directionnal : the corner « a » must be placed at the top left of the water pump cover ( as seen from the front of the engine ).
- the inlet manifold (gaskets smeared with MASTI-JOINT HD 37),
- the cylinder head heater pipe (seal smeared with MASTI-JOINT HD 37).
- the protective screen between exhaust manifold and cylinder head,
- the exhaust manifolds (metal/plastic seals).

NOTE : The inlet and exhaust valve rocker assemblies will be fitted after fitting the cylinder head and after positioning the push rods.



I. REPLACING A CENTRIFUGAL REGULATOR DRIVE PULLEY.



#### DISMANTLING.

IMPORTANT : It is essential to use the clamp 2229-T to immobilise the centrifugal mechanism. Any other procedure would damage the shafts and links.

- 1. Remove the three screws (2) and disconnect the front part (1) from the body (3).
- 2. Fit the regulator mechanism into the clamp 2229-T, with the jaws of the clamp gripping the bearing (4) and slightly tighten the bolt A.
- 3. Tighten the drive pulley in the vice (fit special jaws) and unscrew the pulley by means of the hexagonal head B of the clamp.



## FITTING.

- 4. By hand, screw the pulley on the shaft (1) until it comes into contact with the bearing (2).
- 5. Fit the regulator mechanism into the clamp 2229-T and tighten the bolt A.
- 6. Hold the pulley in the vice and tighten it against the bearing (2) by means of the hexagonal head B of the clamp. Tighten it to 20 mAN (2 m.kg).
- Connect the front part to the regulator body. Tighten the screws (3) ( contact washer ).







#### DISMANTLING.

- 1. Remove the drive pulley and the rotating assembly (1) : (See chap. III, same operation).
- 2. Remove the four rivets (2) and remove the plate (3) holding the bearing.
- 3. Remove the front bearing.

#### FITTING.

- 4. Push the front bearing right home into its housing.
- 5. Fit the retaining plate (3) and fit four new rivets. NOTE : For this later operation, stainless steel « POP » rivets may be used : outside diameter equals 3.2 mm, length 7 mm.
- 6. Fit the rotating assembly (1). Screw up the drive pulley (see chap. III, same operation) and make sure that it can turn freely.

## OPERATION Nº D. 330-3 : Overhauling a four-speed gearbox.

DX . DJ . DL . DV . DT VEHICLES

FOUR-SPEED GEARBOX (Hydraulic gear change)

D. 33-2



FOUR-SPEED GEARBOX ( Manual gear change )





#### DIFFERENTIAL



Ratios :				
Vehicles All	Types (except	DV)	 97	1967

Gears	Ratio	Crown wheel and pinion	Speedo - meter
First Second Third Fourth Reverse	$\frac{12}{39} \times \frac{(3\ 25\ 1)}{33}$ $\frac{17\ (1.94\ 1)}{33}$ $\frac{22\ (1.27\ 1)}{28}$ $\frac{27\ (0.85\ 1)}{23}$ $\frac{13}{22} \times \frac{22\ (3.15\ 1)}{41}$	8/35 (4.375:1)	<u>10</u> (2,10:1) 21

Gears	Ratio	Crown wheel and pinion	Speedo- meter
First Second	$\frac{12}{39} (3.25 \pm 1) \\ \frac{18}{33} (1.83 \pm 1) \\ \frac{18}{33} $	8∕35 (4,375∶1) (/)\`)	
Third	<u>23</u> (1.17 1) 27	7/34 (4.857:1)	<u>7</u> 16
Fourth	<u>28</u> (0,79:1) 22	(DT)	(2,28:1)
Reverse	$\frac{13}{22} \times \frac{22(3,15+1)}{41}$		

Vehicles All Types (except DV and DT) - 9/1967

Gear	Ratio	Crown wheel Speedo- and pinion meter	
First Second Third Fourth Reverse	$\frac{12}{39} (3.25 \pm 1)$ $\frac{18}{39} (1.83 \pm 1)$ $\frac{29}{35} (1.21 \pm 1)$ $\frac{27}{23} (0.85 \pm 1)$ $\frac{13}{22} \times \frac{22}{41} (3.15 \pm 1)$	8/35 (4,375:1)	<u>10</u> (2,10 1) 21

Vehicle	ς DV	. 9.	1969	until	97	1971
r chille	3 1/1	, ,	1	****		

Gears	Ratio	Crown wheel and pinion	Speedo- meter	
First Second Third Fourth Reverse	$ \frac{12}{39} (3.25 \times 1) \\ \frac{18}{33} (1.83 \times 1) \\ \frac{29}{35} (1.21 \times 1) \\ \frac{27}{35} (0.85 \times 1) \\ \frac{27}{23} \\ \frac{13}{22} \times \frac{22}{41} (3.15 \times 1) \\ $	7/34 (4.857:1)	7 16 (2.28 1)	

Vehicles type DV and DT - 9/1971

Gears	Ratio	Crown wheel and pinion	Speedo- meter
First	12 (3.25 1) 39		
Second	$\frac{18}{33}$ (1.83 : 1)	7/34	
Third	$\frac{30}{34}$ (1.13 : 1)	(4,857:1)	16 (2,28:1)
Fourth	<u>28</u> (0.79 1) 22		
Reverse	$\frac{13}{22}  \frac{22}{41} (3.15 \pm 1)$		





3
Modifications ( Gearbox All Types ) - 9/ 1969

- The intermediate sliding reverse pinion and the first/second synchronizer have been modified (wider teeth on the gear ).

- The gearbox housing has been modified to permit movement of the new reverse gear intermediate pinion.

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NOTE : It is possible to fit the new pinions into a former casing on condition that the gauge 3188-T ( 3 mm thick ) is used for setting the reverse gear to « neutral ».

# 3169-T

#### OVERHAULING A FOUR-SPEED GEARBOX

#### DISMANTLING

- 1. Place the gearbox on a stand (stand 3169-T).
- 2. Remove the clutch lock :(Vehicles type bub ) (Hydraulic gear change)
  - a) Slacken the screw (2) securing the flange.
  - b) Remove the screws (1) securing the lock and the two plates (3). Remove the lock.
- 3. Remove the cover (spanner 1677-T).

#### 4. Remove the drive outlet shaft-bearing assembly :

Remove the screws (4) and take out the shaftbearing assembly., the adjusting washers and the spacers.

NOTE : If no repairs are to be done on the differential. mark the position of the adjusting washers.

#### 5. Uncouple the clutch housing :

Remove the nuts and the screws, hold the differential in position against the clutch housing and take out the housing and differential assembly.

Remove the clutch thrust support tube and the oil return flange.

#### 6. Remove the front caps :

- the cap (6) from the front shaft bearings (do not lose the adjusting shims ),
- the cap (7) for the reverse gear selector fork shaft,
- the cap (5) for the 3rd gear/4th gear selector fork shaft.







# 3179-T

#### 7. Remove the reverse gear selector fork shaft :

a) Vehicles type bub (Hydraulic gear change):

Slacken the screws securing the fork (1) and operating dog (2).

Remove the shaft, the fork, the operating dog, the return spring and its cups.

b) Vehicles type bym (Manual gear change):

Remove the shaft by rotating through one quarter of a turn. Remove the fork and the operating dog after slackening the retaining screw. Remove the shaft. Remove the ball and locking spring.

8. Remove the 3rd and 4th gear selector fork shaft :

Slacken the pointed screw (3) securing the fork. Slacken the screws securing the operating dog (4). Remove the shaft, the dog and the fork.

#### 9. Remove the 1st and 2nd gear selector shaft :

a) Vehicles type bub (Hydraulic gear change):

Slacken the screws securing the fork (6) and the operating dog (5). Remove the shaft and the operating dog.

- b) Vehicles type bym (Manual gear change): Slacken the screws securing the fork. Remove the shaft by rotating it through one quarter of a turn. Remove the ball and the locking spring.
- 10. Engage two gears. Remove the starter dog (spanner 1734-T ) and the lower nut locking the bearings ( spanner 3179-T ).
- 11. Remove the plugs and the interlock plungers.

#### 12. Remove the primary shaft :

Remove the rear bearing using a bronze drift.

Remove the front bearing ( do not lose the balls ).

Remove the shaft and pinion assembly from the top of the gearbox.

NOTE : The inner bearing cage is in two parts : do not confuse them.

13. Remove the 1st gear/2nd gear selector fork.



## 

### 14. Remove the reverse gear intermediate pinion :

Slacken the locknut and the shaft securing screw. Remove the shaft and the pinion.

#### 15. Remove the bevel pinion :

- a) Remove the front bearing by tapping the end of the shaft with a mallet.
   Complete removal by hand or by using small levers.
  - NOTE : The inner bearing cage is in two parts: do not mix them up.
- b) Remove the bevel pinion towards the rear.
- c) Remove the gears and the adjusting washer.
- 16. Strip down the primary shaft :

#### Remove :

- the 4th speed idler pinion (1),
- the needle bearing cage (2),
- the synchro ring (3),
- the clip (4) locking the synchro hub (circlip pliers ),
- the synchroniser (5),
- the synchro ring (6),
- the 3rd speed idler pinion (8),
- the needle bearing cage (7).

#### 17. Remove the control shaft :

Remove the locking ring, remove the control shaft (9) and the spring from the primary shaft (10).

#### 18. Strip down the front casing :

Remove the speedometer drive pinion assembly (13) and cup (12).

Remove the starting relay shaft (11).



19. Strip down the differential :

Remove the crown wheel.

Remove :

- the planet gear (4) and its thrust washer (5),
- the spindles (1) from the satellites,
- the satellite gears (2),
- the satellite thrust washers (3),
- the crosshead (6),
- the other planet gear and its thrust washer.

Remove the tapered roller bearings (extractor 2405-T with pad 1742-T ).

#### 20. Strip down the differential shafts :

Slacken the stop screw from the locknut for the bearing on the shaft.

Remove the nut (spanner 1770-T bis ).

Drive out the shaft.

Remove the screw (9) locking the nut (8) securing the bearing in the housing.

Remove the nut (8) ( spanner 1771-T bis ).

Drive out the outer bearing cage (7) using a tube of 65 mm external diameter.







• Extract the inner cage from the shaft (extractor 2405-T).

Remove the seal.

Remove the oil retaining washer and bearing/ stop ring assembly.

#### 21. Strip down the clutch housing :

Remove :

- the fork return spring (2),
- the clutch slave cylinder ( on vehicles type bih) (Hydraulic gear change ),
- the lever operating the clutch thrust rod (on vehicles type bum) (Manual gear change).
- the thrust bearing retaining springs (3) and the thrust bearing,
- the thrust bearing guide screw (1),
- the fork adjusting screw and the spring anchorage plate,
- the fork dust excluder,
- the securing screw from the fork ball joint (The ball is prevented from turning by a Mechanindus dowel ).

Disconnect the ball from the fork.



9



#### 22. Strip down the cover :

On vehicles type bub (Hydraulic gear change):

- Remove the pipe assemblies.
- Compress the return springs of the gear change operating pistons,
- Use a screw (3), 4 mm in diameter and 85 mm long, under head fitted with a nut (2) and a plain washer,
- Screw the screw (3) into the piston and compress the spring by tightening the nut (2).

NOTE : The reverse gear cylinder-piston assembly (4) has no return spring.

Remove the neutral stop (1).

Remove the screws locking the cylinders and remove the cylinders.

Remove the filler plug.

On vehicles type bum (Manual gear change):

- Slacken the cap securing screws.
- Remove the cap (7) and the gear change operating shaft (6).
- Remove the filler plug (5).











#### FITTING

- 23. Assembling the clutch casing :
  - a) Fit the clutch fork ball joint ( the position is given by a Mecanindus pin which fits into a hole in the housing ). Tighten the screw.
  - b) Fit the thrust bearing guide screw (1), with its locknut. Adjust it so that its end is betu een 94 and 95 mm from the joint face on the engine side. Tighten the locknut.
  - c) Grease the ball joint and the guide screw fit the clutch fork and insert the pin (2).
  - d) Position the thrust bearing (guide greased) and fix it in position using the two retaining springs (3).
  - e) Fit the spring anchorage plate and the adjusting screw (5).

Vehicles type bub (Hydraulic gear change) and DJ.IE:

Length of screw (5) : L = 66.5 mm

Vehicles type bim (Manual gear change):

Length of screw (5) : L = 48.5 mm

f) Vehicles type bub (Hydraulic gear change): Fit the clutch slave cylinder and the operating rod.

Vehicles type him (Manual gear change): Fit the thrust rod control lever and the thrust rod.

g) Fit the fork return spring (4).

NOTE : When changing a gearbox casing, fit the blanking plug (6) into the bore for the reverse gear operating shaft (clutch casing end) using CURTYLON.



#### 24. Prepare the differential :

- a) Fit in the casing :
  - one thrust washer,
  - one planet wheel (4),
  - one fixed thrust washer (2),
  - one satellite gear (3),
  - one spindle (5).

Rotate the planet gear and make sure that at the point of minimum clearance there is still a clearance of 0.1 mm. otherwise replace the thrust washers to satisfy this requirement. Remove the satellite gear and the thrust washer.

Mark the position of this assembly in the casing.

- b) Repeat the same operation for each satellite gear.
- c) Fit all the satellite gears.
- d) Place the second planet gear (1) and its thrust washer in the crown wheel.
- e) Place the crown wheel on the casing. Gradually tighten the securing screws checking continuously that the gears can turn freely. Tighten the screws to between 115 - 125 mAN 11 to 12 m.kg )

At the point of minimum clearance, there must still be a clearance of 0.1 mm on this planet gear, if not, replace the thrust washer.

- f) Inject gear oil into the casing (using a syringe) so that all the parts are satisfactorily lubricated. This avoids dismantling the casing.
- g) Fit the bearings ( mandrel 1768-T ).

#### 25. Prepare the primary shaft :

- a) Fit the spring, the drive shaft pin and the circlip.
- b) Place on the shaft :
  - the 3rd speed loose pinion (9) fitted with its needle bearing cage (8), previously greased (bearing grease).
  - the synchro ring (7),
  - the synchroniser fitted with its drive blocks the collar with a groove « a » being towards the 3rd speed pinion, (where appropriate ).

Select a suitable circlip (6) to obtain a maximum clearance, of 0.1 mm.





NOTE :

- It is essential to fit :
- either a gear with short dogs C, with a slider without groove on collar A.
- or a gear with long dogs D, with a slider with a groove « a » on collar B.

c) Fit :

- the synchro ring (3),
- the 4th speed loose pinion (1) fitted with its needle bearing cage (2) previously greased ( bearing grease ).

#### 26. Prepare the bevel pinion :

If necessary, fit the bearing (tube 44 mm. internal diameter × 240 mm. long).

27. Prepare the assembly of differential shaft and housing :

NOTE : If the first method of adjusting the differential is used, only the right-hand assembly must be prepared.

IMPORTANT : The right-hand differential shaft is the shorter.

- a) Fit the bearing (4) in the housing. Tighten the nut (5) to 100 mAN ( 10 m.kg ) (spanner 1770-T bis). Lock the nut with the grub screw (6).
- b) Fit the seal (7) using tool 1772-T.



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Manual 814-2

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- c) Place the oil stop washer (2) on the shaft. Bring up the thrust bearing (1), and fit the mandrel 1767-T bis. Cover the oil stop washer with the mandrel centring bush and fit the spacer using a press.
- d) Fit the differential shaft thus prepared into the housing, using a press (use a tube of 30 mm internal diameter).

Tighten the bearing locknut to 145 mAN (15m.kg) Tighten the screw locking the nut.

#### 28. Assemble the cover :

On vehicles type bub (Hydraulic gear change): Fit the cylinder-piston assemblies.

Compress the spring using clamp 3171-T and hold the piston in the cylinder by means of a screw, 4 mm in diameter and 40 mm long (see paragraph 22). If no clamp is available, use a screw (see paragraph 22).

Fit each cylinder by screwing it home into the cover.

Place the « neutral » stop (3) on its locating dowels. Tighten the screws (plain washer).

#### On vehicles type bum (Manual gear change):

Change the seals (8) and (11) on the gear change control shaft (10); wrap the flange (7) with adhesive paper and pass the seal over it.

Place the gear change control shaft (10) in the cover cap (5). Compress the spring (9) using the clamp 3171-T fitted with its spacers. The seals fit into the grooves (4) and (6) in the cap.

Fit the cap on the cover using CURTYLON.











#### 29. Prepare the front bearing cap :

- a) Fit :
  - the speedometer drive pinion (3).
  - the cup (2) smeared with HYPERIX under the collar (turn it so that the notch lines up with the hole for the cap fixing screw),
  - the shaft (1) for the starting handle fitted with its seal.
- b) Determine the thickness of shims to be placed behind the primary shaft bearing. To do this :
  - Place a straight edge 1651-T fitted with dial gauge 2437-T on the cap, with the point of the dial gauge in contact with the bearing thrust face.

Bring the zero of the dial opposite the large needle. Note the position of the totalising needle.

- Place the bearing in the bore of the casing with the collar agaisnt the joint face.
- Place the straight edge on the collar of the outer cage of the bearing.
- The movement of the large needle of the dial gauge from its calibration position indicates the thickness of shims to be placed in the cap. The maximum permissible clearance is 0.05 mm.
- Select appropriate shims from amongst those sold by the Replacement Parts Department.
   Position them in the recess in the cap.
- If several shims are necessary, the thickest should be placed towards the gearbox.
- c) Determine the thickness of shims to be placed behind the bevel pinion shaft bearing.

Proceed as above.

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#### 30. Fit the bevel pinion :

- a) Place in the gearbox :
  - the first gear loose pinion (1) fitted with its distance bush (2) and its needle cage (3) previously greased (bearing grease),
  - the synchro ring (4),
  - the synchroniser (5) fitted with its driving dogs (the groove of the slider should face the drive pinion ).
  - the synchro ring (6),
  - the second gear loose pinion (9) fitted with its distance bush (8) and the needle bearing cage (7), previously greased (bearing grease),
  - the washer (10),
  - the pinion (11),
- b) Engage the bevel pinion by hand.
- c) Fit the front bearing (13) and tighten the nut (12) to 250 - 280 mAN (25 to 28 m.kg) (spanner 3179-T and clamp 3181-T).
- d) Fit the front cap fitted with its adjusting shims. Tighten the screws.
   Make sure that the loose pinions turn freely.

#### 31. Adjust the conic distance :

A dimension expressed in millimeters and hundreths of a millimeter is engraved on the ground face of the bevel pinion. This figure indicates the clearance which must remain after adjustment between the centre line of the differential and the ground face of the bevel pinion.

This dimension varies with each bevel pinion.



The conic distance must be set using fixture 3170-T fitted with dial gauge 2437-T.

This fixture is so designed that the distance between the centre line of the ground contact surfaces and the pads is 60 mm. This number is engraved between the pads.

- a) Carefully clean the bearing housings and the ground contact faces of the fixture.
- b) Calibrate the fixture. To do this : Place the fixture on a surface plate.
   Bring the zero of the dial gauge opposite the large needle.

Note the position of the dial gauge needles.

Example : totalising needle between 4 and 5, large needle on zero.

c) Measure the distance to the bevel pinion :

Put the fixture in the place of the differential.

Pivot the fixture until the large needle of the dial gauge changes its direction of rotation.

Note the needle readings.

Example : totalising needle between 0 and 1, large needle on 86.

Return the needles to the position they had in paragraph b.

Allow the dial gauge stem to return slowly, counting the number of revolutions and fractions of a revolution described by the large needle until the moment when the point rests once again on the ground face of the bevel pinion.

In the example chosen, this would be : 3.86 mm.

The conic distance is therefore :

60 + 3.86 = 63.86 mm

If for example the distance engraved on the pinion is 63.95, the bevel pinion must by moved away from the centre line of the differential by :

63.95 - 63.86 = 0.09 mm



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d) Adjust the bevel pinion :

Remove the front cap.

Remove the bearing locknut.

Remove the bevel pinion and the adjusting washer (1).

Measure the thickness of the washer : for example 2.81 mm.

This washer must therefore be replaced by another of thickness :

2.81 - 0.09 = 2.72 mm

Washers are available with thicknesses from 1.65 mm to 3.13 mm in steps of 0.04 mm

Select a washer from amongst those sold by the Replacement Parts Department whose thickness is nearest to the one determined above : i.e. 2.73 mm.

#### Fit :

- the washer,

- the bevel pinion and tighten the nut,
- the front cap, and check the setting.

Remove the front cap.

#### 32. Fit the reverse gear layshaft :

Place the reverse gear in the gearbox with the groove for the fork towards the rear.

Insert the shaft and turn it until the grub screw locking the shaft enters its recess. Smear the screw thread with CURTYLON. Tighten the screw and its locknut.

33. Place the 1st gear / 2nd gear selector fork in the groove of the slide, the heads of the screws facing the inside of gearbox.

#### 34. Fit the primary shaft :

- a) Place the assembly of shaft and pinion, prepared in paragraph 25, in the gearbox.
- b) Fit the front bearing and then the rear bearing using a tube ( inside diameter 30 mm, length 300 mm ).
- c) Engage two gears and tighten the screw to 145 - 165 mAN (15 to 17 m.kg). (spanner 1734-T).

#### d) Fit :

- the oil return flange with the slot on the retaining boss,
- the thrust bearing support tube fitted with its sealing gaskets.









#### FITTING AND ADJUSTING THE DIFFERENTIAL

#### FIRST METHOD

- 35. Fit the differential :
  - a) Place the differential together with its bearings into the gearbox casing. Hold it in position by means of clamps MR. 630-64/15.
  - b) Connect up the clutch casing to the gearbox, smearing the joint faces with CURTYLON. Lightly tighten the nuts. Remove the clamps.
  - c) Place an adjusting washer and a distance washer with total thickness 7 mm against the right-hand differential bearing. The adjusting washer is that which has the smaller diameter ; position is next to the bearing.

Fit the right-hand shaft and housing assembly ( interpose a paper gasket ).

Lightly tighten the screws. Tighten nuts and screws linking the clutch casing to the gearbox, then the screws of the bearing housing.

#### 36. Set the bearing clearance :

- a) Place the wide spacer on the left-hand bearing housing.
- b) Place fixture 3177-T fitted with dial gauge 2437-T and an extension 3178-T on the spacer : completely cover the pressure plate of the fixture and adjust the dial gauge so that it reads 9 to 10 mm when the extension is in contact with the bearing face of the housing. Bring the zero of the dial opposite the large needle of the dial gauge. Note the position of the needles.
- c) Fit the fixture on the gearbox, interposing a paper gasket. Tighten the securing screws. Screw down the adjusting screw A so as to move the pressure plate forward. At the same time, engage the pins in the splines of the planet gear.

Tighten the adjusting screue A to 100 m N(10 m.kg) and then slacken it by 1/3 of a turn. Tighten the clamp B.

d) Bring the needles of the dial gauge to the positions they occupied in paragraph b by pulling on the dial gauge stem. Allow the dial gauge stem to return slowly into contact with the bearing cage, counting the revolutions and fractions of a revolution, for example : 8.40 mm.

#### 37. Measure the crown wheel to pinion backlash :

- a) Fit the fixture 3175-T :
  - Place the clamp C over the shoulder of the bevel pinion bearing. Fit the screws and tighten them to 10 m/N (1 m.kg).
  - Replace the nut by the index D.
  - Bring the pointer of the index D approximately to the horizontal.
  - Fix the dial gauge 2437-T fitted with the extension 3176-T on its support.

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b) Immobilize the crown wheel using a screwdriver. Read off the clearance between the teeth by operating the index D by hand. Check this measurement five times in succession by rotating the bevel pinion using the index D, through one turn each time. Note the minimum clearance measured, i e 0.64 mm. The backlash must be between 0.16 and 0.24 mm at the point of minimum clearance on the large diameter of the crown wheel, which corresponds to a reading of 0.26 to 0.34 mm on the fixture i.e. an average of 0.30 mm.

#### 38. Adjusting the backlash :

In the example chosen, the clearance must be reduced by : 0.64 - 0.30 = 0.34 mm.

To obtain a correct clearance between teeth without changing the clearance in the bearings determined in paragraph 36, the total overall thickness of the shims must not be altered. The thickness of the shims on the right-hand side must be increased by 0.34 mm and those on the left-hand side reduced by the same amount, i.e. :

7.00 + 0.34 = 7.34 mm on the right 8.40 - 0.34 = 8.06 mm on the left

Choose shims and distance pieces from amongst those sold by the Replacement Parts Department in order to obtain this setting.

- 39. Prepare the left-hand bearing housing (see paragraph 27).
- 40. Fit the bearings and the assemblies of distance pieces and shims in their respective positions and check the backlash adjustment.

Modify this if necessary.

NOTE : The adjusting washer is the one which has the smaller diameter : it should be positioned next to the bearing.

#### 41. Fit the front cap :

Fit the bevel pinion nut (1) and tighten it to 250 - 280 m.N (25 to 28 m.kg) (spanner 3179-T).

Lock the nut by knocking over the metal into the shaft groove.

Fit the front cap together with its shims, smearing the joint face with CURTYLON.

Also put some sealing compound CURTYLON under the head of the three lower securing screws Tighten the screws.









#### ADJUSTING THE DIFFERENTIAL

#### SECOND METHOD

42. Fit the front cap ( see paragraph 41 ).

#### 43. Prepare the differential :

Place an adjusting washer and a distance washer (1) with a total thickness of 7 mm against the differential bearing ( the adjusting washer is the one with the smaller diameter and should be placed next to the bearing ).

Hold the differential in position using clamps MR. 630-64/16 ( tighten the nuts by hand ).

Fit the assembly of right-hand shaft and bearing (interpose a paper gasket). Tighten the screws.

 Lay the gearbox on its right-hand side and chock it in position,

45. Place on the left-hand differential bearing :

 adjusting washers and a distance washer with a minimum total thickness of 9 mm (2),

- the distance piece (3).
- 46. Fit the left-hand bearing without seal on the spacer, Position the washers by tapping lightly on the differential shaft.

#### Remove :

- the left-hand bearing,
- the distance piece (3),
- the assembly (2) of adjusting washers and distance washer,

Place the distance piece (3) next to the bearing.

#### 47. Adjust the clearance of the bearings :

a) Fit straight edge 1754-T fitted with dial gauge 2437-T on the collar of the left-hand bearing, so that the tip of the dial gauge stem is in contact with the bearing thrust face. Bring the figure zero on the dial in line with the large needle.

Note the position of the needles.

Example : large needle on zero small needle on zero

b) Fit straight edge 1754-T on the geabox casing so that the tip of the dial gauge stem bears on the distance piece.

Make two measurements at « a » and « b ».

Example at « a » : 7.76 mm, at « b » : 7.80 mm Take the average of these two measurements. Example :

$$\frac{7.76 + 7.80}{2} = 7.78 \text{ mm}$$

To the mean value found above, add in all cases :

0.10 mm (thickness of seal) plus 0.30 mm (in order to produce a slight stress on the bearings) i.e. a total of: 0.40 mm.

In the example chosen :

7.78 + 0.40 = 8.18 mm

c) From amongst the washers sold by the Replacement Parts Department choose an adjusting washer and a distance washer, the total thickness of which will be equal to the value determined.

The adjusting washer is the one with the smaller diameter.

d) Place these washers on the left-hand bearing ( the adjusting washer next to the bearing ).

Fit the distance spacer.

Fit the left-hand bearing together with its paper gasket.

NOTE :

The thickness of washers determined in paragraph « c », added to that of the washers fitted under the right-hand bearing (see paragraph 43) represents the *total overall thick*ness of washers for adjusting the clearance of the bearings.

Thus, in the example chosen :

#### 8.18 + 7 = 15.18 mm

These washers must be distributed between the left-hand and right-hand side for adjusting the clearance between teeth, *uithout changing* the total thickness.

48. Measure the backlash : ( see paragraph 54 )

- Adjust the backlash ( see paragraph 55 ).
- 50. Release the bearings and connect the clutch housing to the gearbox, smearing the joint face with CURTYLON. Fit the bearings and tighten the screws securing the housing and the bearings.





#### ADJUSTING THE DIFFERENTIAL

#### THIRD METHOD

51. Fit the front cap ( see paragraph 41 ).

#### 52. Fit the differential :

Place the differential fitted with the bearings into the gearbox casing.

Hold it in position using clamps MR.630-64/16 (tighten the nuts by hand). Fit the left-hand and right-hand assemblies of shaft and bearings tagether with the shims removed during dismantling. Interpose the paper gaskets. Tighten the screws.



#### 53. Adjust the pre-load on the bearings :

The differential bearings must be fitted with a specific pre-load which can be checked by measuring the torque required for turning the differential.

To ckeck this torque, proceed as follows : Fix and wind a string around the differential casing and pull on it by means of a spring balance to rotate the casing.

Read the measure indicated by the spring balance when the casing just begins to turn.

- a) Bearings which have been used :
  - The spring balance should read between 4 and 6 kg.
  - If the reading is less than 4 kg : increase the thickness of adjusting washers.
  - If the reading is more than 6 kg : reduce the thickness of adjusting washers.

b) With new bearings :

The spring balance should read between 6 and 9 kg.

- If the reading is less than 6 kg : increase the thickness of adjusting washers.
- If the reading is more than 9 kg : reduce the thickness of adjusting washers.

NOTE : An adjusting washer with a thickness of 0.10 mm corresponds approximately to :

- 0.250 kg for new bearings

- 0.500 kg for bearings which have been used IMPORTANT : The total thickness of washers on both sides, as determined above, corresponds only to the setting of the pre-load on the bearings. These washers must be distributed behind the left-hand and right-hand bearings to adjust the backlash, but their total overall thickness must not be altered.







#### 54. Measure the backlash :

Fix the rod MR. 630-52/20, fitted with the support 2041 T and the dial gauge 2437-T, on the gearbox casing.

Adjust the position of the dial gauge so that the probe rests perpendicularly on the flank of one tooth and on the greatest diameter of the crown wheel.

Measure the clearance between teeth on 4 teeth at an angular distance of about  $90^{\circ}$ .

The difference between any two readings must not exceed 0.1mm.

Otherwise, the crown-wheel is running out or badly fitted.

Note the minimum clearance measured : Example : 0.73 mm

#### 55. Adjust the backlash :

a) At the point of minimum clearance the backlash must be between 0.16 and 0.24 mm. i.e. an average of 0.20 mm.

Subtract this theoretical clearance from the minimum clearance noted in paragraph 52. Thus in the example chosen.

$$0.73 - 0.20 = 0.53 \text{ mm}$$

Moving a 0.15 mm adjusting washer alters the clearance by 0.10 mm. It is therefore necessary to move a thickness of washers of :

$$\frac{0.53 \times 0.15}{2} = 0.79 \text{ mm}$$

0.10

- b) In the example chosen, it is therefore necessary to reduce the distance to the crownwheel by 0.79 mm. Consequently,
  - on the left-hand side : the thickness of washers must be reduced by : 8.20 - 0.79
     = 7.41 mm
  - on the right-hand side. the thickness of washers must be increased by the same amount, i.e.: 7 + 0.79 = 7.79 mm.
- c) Fit adjusting washers as determined and check the clearance between the teeth.
- 56. Remove the bearings and link up the clutch casing to the gearbox, smearing the joint face with MASTI-JOINT HD. 37. Replace the bearings and tighten the screws securing the casing and bearings.
- 57. To determine the « neutral » position of the reverse gear shaft ( vehicles type bvb Hydraulic gear change only ).
  - a) Place the shaft (1) in the gearbox casing.
  - b) Fix the fixture 3147-T and the screw B aligned in the centre line of the shaft (1).

c) Insert the rod MR. 630-64/3 into the interlock plunger holes until its end enters the notch of shaft (1). Hold the rod in this position to immobilise the shaft in « neutral ».

- d) Note the angular position of the shaft by making a mark on its end on the casing.
- e) Note the longitudinal position of the shaft : bring the screw B into contact with the end. Tighten the locknut A (take care not to overtighten.
- f )Slacken the screw holding the fixture. Remove the shaft and the rod MR. 630-64/3.



#### 58. Fit the 1st gear/2nd gear shaft :

- A) Vehicles type bub (Hydraulic gear change):
- a) Place the shaft in the bore in the gearbox and engage the operating dog (1) and the fork.
- b) Hold the slider (2) in the « neutral » position using one of the sets of gauges 3180-T (select the set of gauges which will give the least play on the slider ).
- c) Insert rod MR. 630-64/3 in the interlock plunger holes and immobilise the shaft in « neutral ». Hold it in this position. Tighten the fork securing screws to 40 mΛN (4 m.kg).
- d) Position fixture 3172-T with the centring dowels engaged in the locating holes of the gearbox.

Holding the shaft in « neutral » by means of rod MR. 630-64/3, bring the operating dog into contact with the probes of the fixture at «  $\alpha$  » and « b ».

Tighten the screws to 40 mAN (4 m.kg). Remove the fixtures and the rod.







 a) Position the lst/gear 2nd gear shaft in the bore in the gearbox.
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Fit the spring-loaded locking ball in its housing.

Compress the assembly of spring and ball using a 6 mm diameter rod and then fully engage the shaft in the fork and in the housing as far the « neutral » position.

b) Immobilise the slider (2) at « neutral » using a set of gauges 3180-T (select the set of gauges which will give the least play on the slider ).

Tighten the fork securing screws to 40 mAN ( 4 m.kg ).

Remove the gauges.



#### 59. Fit the 3rd gear/4th gear shaft :

- A) Vehicles type bub (Hydraulic gear change):a) Insert the interlock plunger (the shortest) in
- its bore.
  b) Fit the shaft (9) and pass it through the fork (7) and the operating dog (4). Tighten the grub screw (8) which retains the fork. Lock the screw with a piece of wire.
- c) Adjust the operating dog (see paragraph 58 A sections c and d ).
- B) Vehicles type bim (Manual gear change):
- a) Insert the interlock plunger (the shortest) in its bore.

Fit the 3rd gear/4th gear shaft into the gearbox ( proceed as described in paragraph 58 B  $\alpha$  ).

b) Tighten the grub screw (10) which retains the fork. Lock the screw with a piece of wire.

#### 60. Fit the reverse gear shaft :

A) Vehicles type bub (Hydraulic gear change):

- a) Insert the interlock plunger (the longest one) in its bore.
- b) Position the shaft and fit in the following order :
  - a thrust cup for return spring (6),
  - the return spring (5),
  - a thrust cup for return spring (3),
  - the operating dog (2),
  - the fork (1).







- c) Fix the gauge 3174-T, adjust it as in paragraph 57, with the screw A in line with the centre line of the shaft.
- d) Place the shaft in its « neutral » position. To do this :

Compress the spring using the clamp 3171-T. Bring the shaft up against the end of the screw A (longitudinal positioning).

Bring the reverse intermediate gear to the «neutral» position using gauge :

3183-T (Vebicles up to 9/1969) or

3188-T (Vehicles as from 9/1969) (see page 4) placed between the 1st gear idler and the reverse intermediate gear. Tighten the fork screw to 40 mAN (4 m.kg).

- e) Adjust the operating dog (see paragraph 58 A, sections c and d).
   Remove the gauges and the clamp.
- B) Vehicles type bim (Manual gear change):
- a) Insert the interlock plunger (the longest one) in its housing.
  Put the reverse gear shaft in the gearbox (proceed as described in paragraph 58 B a).
  Tighten the grub screw (1) which retains the operating dog. Lock the screw with a piece of wire.
  b) Put the reverse intermediate gear in the « neutral »
- b) Put the reverse intermediate ged in the "neutral" position using the gauge : 3183-T (Vehicles up to 9/1969) or 3188-T (Vehicles as from 9/1969) (see page 4) between the 1st gear loose pinion and the reverse intermediate gear.
- c) Position fixture 3173-T parallel to the shaft and move the operating dog to bring the fixture locators and the operating dog into contact. Tighten the fork securing screws to 40 m/N (4 m.kg).

Remove the fixtures.

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### ADJUSTING THE STROKE OF THE GEAR ENGAGEMENT

( Vehicles type bvh ( Hydraulic gear change ) only)

- 61. Mark the « neutral » position of the different gears : NOTE : When the gearbox cover is removed, the gearbox is not in « neutral ». the reverse gear shaft is brought by its return spring beyond the «neutral» position. To engage a gear, it is always necessary to bring reverse gear to « neutral » using a screw driver or the gauge 3183 T or 3188-T (see paragraph 59).
  - a) Note the position of 1st gear : Engage 1st gear, with the 1st/2nd synchro slider bearing against the 1st gear loose pinion. Measure and note the projection of the shaft in relation to the front face of the gearbox. i.e. : 34.3 mm
  - b) Note the position of 2nd gear : Engage 2nd gear with the synchro slider bearing against the 2nd gear loose pinion. Measure and note the projection of the shaft.
     i.e. : 55.3 mm
  - c) Note the position of 3rd gear : Engage 3rd gear with the synchro slider bearing against the 3rd gear loose pinion. Measure and note the projection of the shaft.
     i.e. : 1.3 mm
  - d) Note the position of 4th gear : Engage 4th gear with the slider bearing against the 4th gear loose pinion. Measure and note the projection of the shaft.
     i.e. : 23.9 mm
- Fit the upper cover ( bvh Hydraulic gear change only ):

Smear the joint face with CURTYLON. Tighten the screws.

- A Adjust the reverse gear cylinder (First method):
  - a) Fix the gauge 3174-T, adjusted as per paragraph 57, the screw A aligned with the shaft centre line.
  - b) Introduce HYPERIX into the hole of the cylinder locking screw.
     Screw up the cylinder until the shaft is in contact with screw A of gauge 3174-T.
  - c) Smear the cylinder locking screw with CUR-TYLON.
  - d) Remove the gauge.
- 63. B Adjust the reverse gear cylinder
  - (Second method):
  - a) Note the « neutral » position of reverse gear. To do this :

Determine the end float of the reverse gear shaft in « neutral ».

Engage 3rd or 4th gear.

Remove the gauge 3183-T or 3188-T, if necessary.





Push the reverse gear shaft towards the rear end of the gearbox and note, using a depth gauge, the distance « m » between the end of the shaft and the front of the gearbox, i.e. :

$$m = 1.6 mm$$

Pull the shaft forward and note the distance  $\ll ml \gg i.e. : ml = 2.6 mm$ .

Take the average of these two measurements :

$$\frac{m+m1}{2} = \frac{1.6+2.6}{2} = 2.10 \text{ mm}$$

In the example chosen, the shaft must therefore be placed at distance m = 2.10 mm.

. b) Adjust the reverse gear cylinder : Screw up the assembly of cylinder and piston until it is in contact with the operating dog, while inserting HYPERIX compound into the tapped hole which receives the cylinder locking screw. Then screw in the cylinder until the shaft projects by 2.10 mm from the front of the gearbox (distance previously determined ). Smear the cylinder locking screw with CURTY-LON.

Place a cylinder pad (rubber pellet ) in the tapped hole., then tighten the screw.

NOTE : The gear change cylinder pads must be replaced each time the cylinders are dismantled.

64. Adjust the stroke of the different gears :

NOTE : To engage the different gears during this operation, fit a screw (diameter 7 mm, pitch 1 mm, or preferably the rig MR. 630-66/19) in the tapped hole.

a) Adjust the stroke of 1st gear :

Fully engage 1st gear. Make sure that the gear is engaged by checking the projection of the shaft (i.e. 33.3 mm as measured in paragraph 61 section a).

Screw the assembly of the 2nd gear cylinder and piston to bring it into contact with the operating dog., while inserting HYPERIX compound in the tapped hole receiving the screw (1). A slight movement of the 1st gear/ 2nd gear shaft (which can be felt with the hand) shows that the piston is touching the operating dog. Then screw in the cylinder by half a turn to obtain a clearance of 0.7 to 0.9 mm between the sliding gear and the loose pinion.

Smear the cylinder locking screw (1) with CURTYLON.

Place a cylinder pad (rubber pellet ) in the tapped hole, then tighten the screw.



b) Adjust the stroke of 2nd gear :

Fully engage 2nd gear. Make sure that it is engaged by checking the projection of the shaft (for example : 55.3 mm measured in paragraph 61 section b). Bring the assembly of 1st gear cylinder and piston up against the operating dog and proceed as indicated previously.

c) Adjust the stroke of 3rd gear :

Fully engage 3rd gear. Make sure that the gear is engaged by checking the projection of the shaft (i.e. 1.3 mm as measured in paragraph 61 section c).

Bring the assembly of 4th gear cylinder and piston up against the operating dog and proceed as decribed in paragraph a) above.

#### d) Adjust the stroke of +th gear :

Fully engage 4th gear. Make sure that it is engaged by checking the projection of the shaft (i.e. 23.9 mm as measured in para graph 61 section d) above ).

Bring the assembly of cylinder and piston up against the operating dog and proceed as described in section a) above.

#### ADJUSTING THE STROKE OF THE GEAR ENGAGEMENT

(Vehicles type bym - Manual gear change - only)

- 65. Adjust the stroke of 4th gear : Engage 4th gear with the 3rd gear/4th gear synchro slider up against the 4th gear loose pinion. Bring the screw (3) into contact with the fork shaft and screw in by half a turn to obtain a clearance of 0.4 to 0.6 mm between the slider and the 4th gear loose pinion. Tighten the locknut (2).
- Fit the upper cover (bvm Manual gear change only):

Smear the joint face with CURTYLON. Tighten the screws.

67. Fit the shaft caps (1) and (4) using CURTYLON.









#### ADJUSTING THE CLUTCH LOCK (Vehicles type bvh - Hydraulic gear change -only)

68. Fit the blanking plugs, previously smeared with CURTYLON, in the bore receiving the interlock plungers at « a » ( on each side of the gearbox ).

#### 69. Fit the clutch lock :

With the 1st gear/2nd gear shaft in « neutral », bring up the lock with the plunger locked in « neutral » position ( ball assembly in the centre ).

Place the clamp (1) on the shaft (the shaft should project about 1 mm through the clamp ).

Tighten the screws securing the lock (interpose the thrust plate or plates ).

Tighten the clamp screws (2) to 20 mAN (2m.kg)

Engage 1st gear by pushing on the shaft and make sure that the clamp (1) is not stressed.

Check that there is a clearance J between the clamp and the head of the screw securing the cover (3).

70. Fit :

- the cover (4) on the 1st gear shaft using CURTYLON,
- the cover (3) (fitted with its O-ring) on the lst gear/2nd gear and 3rd gear/4th gear shafts using CURTYLON.
- Remove the screw A securing the pistons in the cylinders.
- 72. Fit the hydraulic pipes.

BVH VEHICLES Hydraulic gear change

#### OVERHAULING A GEARBOX COVER

#### DISMANTLING

- 1. Remove the hydraulic pipes.
- 2. Compress the gear change return springs. Use a screw A (diameter 4 mm, pitch 0.75 or 0.70 mm, length under head 85 mm) fitted with a nut and a flat washer. Screw the screw A into the piston and compress the spring by tightening the nut. NOTE : The reverse gear cylinder/piston assembly (2) has no return spring.
- 3. Remove the « neutral » stop (1).
- Remove the cylinder grub screws. Slacken the locknuts and remove the cylinder from inside the cover.
- 5. Remove the filler plug.

#### 6. Replace the seals on the operating pistons :

- a) Mark each piston and the corresponding cylinder; remove the cylinder by hand.
- b) Remove the O-rings from the cylinders using a brass hook ( do not scratch the cylinder ).
- c) Clean the cylinders and pistons by immersing them in *alcohol* (LHS 2) or *gasoline* (LHM). Blow dry with compressed air.
- d) Moisten the new seal with special fluid for hydraulic circuits and fit it in the cylinder groove.

#### 7. Calibrate the return springs :

Use fixture 2420-T Length : 48.8 mm 31.5 mm

Load in kg : 24.5 ± 1.5 turns in contact



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#### ASSEMBLY.

8. Place on the piston (4) :

- the spring thrust cup (5),
- the sleeve (1),
- the return spring (2).

NOTE : The sleeve (1) is no longer fitted on vehicles produced since 9/1970.

Place the cylinder (3) over the piston (4). Compress the spring using tool 3171-T, and hold the piston in the cylinder using a screw A (dia. 4 mm, pitch 0.75 or 0.70 mm, length 40 mm). If the tool 3171-T is not available, use a screw B (dia. 4 mm, pitch 0.75 or 0.70 mm, length 85 mm) fitted with a flat washer and a locknut.



#### 9. Assemble the cover :

Position the cylinder/piston assemblies. Fit each cylinder by screwing it right home into the cover.

Place the « neutral » stop (6) on its centring pin. Tighten the screws (flat washer ). Fit the filler plug.



FIVE-SPEED GEARBOX



DIFFERENTIAL



#### ASSEMBLY.

8. Place on the piston (4) :

- the spring thrust cup (5),
- the sleeve (1),
- the return spring (2).

NOTE : The sleeve (1) is no longer fitted on vehicles produced since 9/1970.

Place the cylinder (3) over the piston (4). Compress the spring using tool 3171-T, and hold the piston in the cylinder using a screw A (dia. 4 mm, pitch 0.75 or 0.70 mm, length 40 mm). If the tool 3171-T is not available, use a screw B (dia. 4 mm, pitch 0.75 or 0.70 mm, length 85 mm) fitted with a flat washer and a locknut.



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3

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4

#### 9. Assemble the cover :

Position the cylinder/piston assemblies. Fit each cylinder by screwing it right home into the cover.

Place the « neutral » stop (6) on its centring pin. Tighten the screws (flat washer ). Fit the filler plug.

10. Adjust the gear change control.





#### RATIOS :

Vehicles type DJ All Types and DP

Gears	Ratio	Crown- wheel pinion	Speedo- meter
First Second Third Fourth Fifth Reverse	$ \frac{12}{39} (3.25:1) \\     \frac{17}{33} (1.94:1) \\     \frac{28}{37} (1.32:1) \\     \frac{33}{32} (0.97:1) \\     \frac{37}{29} (0.78:1) \\     \frac{13}{22} \times \frac{22}{41} (3.15:1) $	8/35 (4.375:1)	10/21 · (2.10 : 1)

Gears	Ratio	Crown- wheel pinion	Speedo- meter
First Second Third Fourth Fifth Reverse	$\frac{12}{39} (3.25 \pm 1)$ $\frac{17}{33} (1.94 \pm 1)$ $\frac{28}{37} (1.32 \pm 1)$ $\frac{37}{32} (0.97 \pm 1)$ $\frac{37}{29} (0.76 \pm 1)$ $\frac{13}{22} \times \frac{22}{41} (3.15 \pm 1)$	7/34	7/16 (2.28:1),







OVERHAULING A FIVE-SPEED GEARBOX.

#### DISMANTLING.

- 1. Put the gearbox on a stand (stand 3169-T). Remove the calipers, brake discs and the front crossmember.
- 2. Remove the upper cover.
- 3. Remove the shaft-gearbox outlet bearing assemblies :

#### Remove the screws.

Remove the shaft-bearing assembly, the adjusting washers and spacers. These parts are matched and should not be mixed up.

4. Remove the clutch casing :

Remove the nuts and screws from the casing. Hold the differential in position against the clutch casing and remove the assembly from the gearbox.

- 5. Remove the tube (2) supporting the thrust bearing and the oil return flange (1).
- 6. Slacken the screws securing the reverse gear fork and engage two gears (1st and reverse, for example ).

Remove the cover (3).

Remove the screw (12) and the deflector (11) (vebicles produced since November 1971). Unlock and remove the screw (4) securing the fork (5).

Remove the 5th gear synchro assembly (6), the needle bearing cage and the fork.

Remove the gear (9) and speedometer drive socket (10).

Slacken the screws (8) and remove the housing (7).

7. Remove the speedometer drive wheel (13) (spanner 3179-T bis).









- Remove the reverse gear selector fork shaft : Slacken the screws securing the fork (1) and the operating dog (2). Remove the shaft, the fork, the operating dog and the shaft locking ball with its spring.
- 9. Remove the 5th gear selector fork shaft : Slacken the screws securing the fork (3). Remove the shaft, the fork, the shaft locking ball with its spring.
- 10. Remove the 3rd gear-4th gear fork shaft : Slacken the screws securing the fork (4) and the stop (6). Remove the shaft, the fork, the shaft locking ball with its spring and the 3rd gear stop (6).
- 11. Remove the 1st gear-2nd gear selector fork shaft : Slacken the screws securing the fork (5). Remove the shaft, the shaft locking ball and its spring.
- Remove the blanking plugs (8) and release the interlock plungers.
- Slacken the locknut and remove the screw securing the shaft for intermediate reverse pinion. Remove the shaft and the pinion.

#### 14. Remove the primary shaft :

- a) Release the rear bearing (bronze drift).
- b) Release the front bearing (do not lose the balls).

(If necessary, use extractor 2400-T).

- c) Remove the bearing (7) and push the bevel pinion towards the rear.
- Remove the assembly of shaft and gears from the top of the gearbox.

NOTE : The inner cages of the front bearings are in two parts : do not mix them up.

15. Remove the 1st gear-2nd gear selector fork (5).



16. Remove the bevel pinion :

- a) Withdraw the bevel pinion towards the rear.
- b) Remove the gears, the 1st gear-2nd gear synchro and the conic distance adjusting washer.

#### 17. Strip down the primary shaft :

#### Remove :

- the 4th gear loose pinion (7) with the synchro ring (6) and the needle bearing cage (5),
- the synchro hub locking ring (4) (use tool 3253-T),
- the synchroniser (8),
- the 3rd gear loose pinion (2) with the synchro ring (1) and the needle cage (3).

#### 18. Disconnect the control shaft (if necessary) :

Remove the locking ring (9). Disconnect the control shaft (10) from the primary shaft. Remove the spring (11).

#### 19. Remove the differential :

- a) Remove the bearings (13) (extractor 2405-T).
- b) Remove the screws (12) and then :
- the crown wheel (14).
  - the satellite spindle (20),
  - the planet wheel (17) and its thrust washer (18),
- the two satellite spindles (21),
- the satellite gears (16) and their stop washers (15),
- the crosshead (19),
- the other planet wheel and its thrust washer.



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- 20. Strip down the differential shafts :
  - a) Slacken the grub screw (4) in the nut (3) which locks the bearing on the shaft.
     Remove the nut (3) (spanner 1770-T bis) and drive out the shaft.
  - b) Remove the grub screw (1) in the nut (2) which locks the bearing on the shaft. Remove the nut (2) (spanner 1771-T bis) and tap out the inner races (5) and outer races (7) from the bearing (tube of 65 mm external diameter).
  - c) Extract the inner cage (8) from the shaft (extractor 2405-T).
     NOTE : Do not mix up the ball races (5).
  - d) Remove the seal (6) from the housing.
  - e) Remove the oil retaining washer and bearing distance bush assembly. To do this :
    - place the distance bush on a block,
    - with a chisel expand the bush,
    - remove the bush and the oil retaining washer.
- 21. Strip down the clutch housing :

Remove :

- the fork return spring (9),
- the adjusting screw (11) and the spring anchorage plate (12),
- the dust excluder (10),
- the retaining springs (13) and the thrust bearing,
- the pin (14) and remove the fork,
- the fork ball joint (the ball joint is prevented from rotating by a Mecanindus dowel).


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22. Strip down the upper cover :

- a) Remove the screws (1).
- b) Disconnect the cap (2) from the cover and remove the gear change operating shaft (3).



d) If necessary, remove the seals (5).







# ASSEMBLY.

- 23. Fit the bevel pinion :
  - a) Fit the roller bearing (1) on the pinion. Pay attention to the direction of fitting : washer (2) on the pinion side.

(Use tube : inside diameter = 44 mm, length = 240 mm).

- b) Place in the gearbox :
  - the first gear loose pinion (3) fitted with its needle bearing cage (7) (smeared with bearing grease) and its distance bush (6),
     the synchro ring (4),
  - the synchroniser (5) with the reverse gear teeth facing forward,
  - the synchro ring (9),
  - the second gear loose pinion (11) fitted with its needle bearing cage (10) (smeared with bearing grease) and its distance bush (8),
  - the adjusting washer (12),
  - the double pinion (13) for 3rd and 4th gears.
- c) Fit the bevel pinion (16) together with its bearing (1) and on the end of the pinion fit :
   - the front bearing (17),
  - the 5th gear pinion (14) (with the shoulder «a» towards the gearbox),
  - the speedometer drive wheel (15), and tighten it to 250 to 280 mAN (25 to 28 m.kg) (spanner 3179-T bis and retaining tool 3181-T bis).
- d) Fit the front housing with CURTYLON on the mating faces. Tighten the screws.
- e) Check that the pinions rotate freely.





## 24. ADJUST THE CONIC DISTANCE :

A dimension expressed in millimetres and hundreds of a millimetre is engraved on the ground face of the bevel pinion this figure represents the distance which must remain after adjustment between the differential centre line and the ground face of the bevel pinion.

This distance is different for each bevel pinion. Adjustment of the conic distance must be made by the use of fixture 3170-T fitted with dial gauge 2437-T.

This fixture is so designed that the distance between the centre line of the ground contact faces « a » and the faces of the probes « b » is 60 mm. This figure is engraved between the probes.

a) Carefully clean the bearing surfaces and the ground contact faces of the fixture.

b) Calibrate the fixture : Place the fixture on a surface plate. Bring the zero of the dial gauge in line with the large needle. Note the position of the totalising needle. e.g. : totalising needle between 4 and 5,

- large needle on 0.
- c) Measure the distance of the bevel pinion : Put the fixture in the place of the differential. Rotate the fixture until the large needle of the dial gauge changes its direction of rotation.

At this point note the readings of the needles : i:e. : totalising needle between 0 and 1, large needle on 86.

Return the needles to the positions they occupied in section b).

Allow the dial gauge stem to return slowly and count the number of revolutions and fractions of a revolution described by the large needle until the stem once again rests on the ground face of the bevel pinion.

Thus, in the example chosen :

The conic distance is therefore : 60 + 3.86 = 63.86 mm

The dimension engraved on the pinion is for example 63.86 mm.

The bevel pinion must threrefore be moved away from the differential centre line by :

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d) Adjust the bevel pinion :

Remove the front housing.

Remove the speedometer drive wheel and the 5th gear pinion.

Remove the bevel pinion and the adjusting washer (1).

Measure the thickness of the washer.

For example : 2.81 mm.

This washer must therefore be replaced by another of thickness : 2.81 - 0.09 = 2.72 mm.

Washers are available in thicknesses from 1.65 mm to 3.13 mm in steps of 0.04 mm.

From the washers sold by the Replacement Parts Department, select one the thickness of which is nearest to that determined above, i.e., 2.73 mm.

#### e) Fit :

- the adjusting washer (1),
- the bevel pinion, the front bearing, the 5th gear pinion, and the speedometer drive wheel. Tighten it to 250 to 280 mAN (25 to 28 m.kg).
- the front housing, and tighten the securing screws.

f) Check the setting.

g) Remove the front housing.

- h) Remove the speedometer wheel, the 5th gear pinion and the bearing (2).
- i) Pull back the bevel pinion so that the gears fall into the bottom of the box, but without releasing the adjusting washer which is between the 3rd gear pinion and the 2nd gear wheel.
- j) Install the 1st gear-2nd gear operating fork (3) with the heads of the securing screws facing the inside of the gearbox.





#### 25. Prepare the primary shaft :

- a) Fit the spring (4), the control shaft (3) and the circlip (2). (If these have been removed).
- b) Place on the primary shaft (1) :
  - the 3rd gear idler (5) together with its needle bearing cage (8) (smeared with bearing grease),
  - the synchro ring (6),
  - the synchroniser (7), so that the collar with a groove « b » is towards the 3rd gear pinion (5),
  - the circlip (9) (pliers 3253-T).
  - IMPORTANT : The maximum play at the hub of the synchro (7) must be 0.10 mm : rings (9) of different thicknesses are available so that this condition can be met.
- c) Fit :
  - the synchro ring (12),
  - the 4th gear idler (11) together with its needle cage (10) (smeared with bearing grease). Engage 4th gear.

#### 26. Fit the primary shaft :

- a) Place the assembly thus prepared in the gearbox.
- b) Fit the front bearing, then the rear bearing (tube 30 mm internal diameter and 300 mm long).

#### 27. Fit the bevel pinion :

- a) Put the bevel pinion in position, rotating it to help in fitting the conic distance adjusting washer.
- b) Fit the front bearing (13), the 5th gear pinion (shoulder towards the bearing) and the speedometer wheel.

#### 28. Fit the reverse intermediate gear :

Put the gear in its casing with the fork groovetowards the rear.

Insert the shaft and orientate it so that the grub screw holding the shaft engages in its recess. Smear the threads of the screw with CURTYLON. Tighten the screw and its locknut.

- 29. Engage two gears (one of them being reverse) and tighten the speedometer wheel to 250 to 280 mΛN (25 to 28 m.kg).
- Fit the casing (14) (smear the seal plane with CURTYLON). Tighten the securing screws (15).
- 31. Fit the 5th gear idler, synchroniser and operating fork assembly on the primary shaft. Fit screw (17) together with the deflector (16) (vebicles produced after November 1971). Tighten the screw (17) to 145 to 165 mAN (14.5 to 16.5 m.kg).









- 32. Fit the 1st gear-2nd gear fork shaft (1):
  - a) Put the locking ball and its spring in position.
    - b) Insert the shaft (1) in the casing, compress the spring and ball assembly (using a rod 6 mm in diameter) and complete fitting the shaft in the fork (5) and the housing up to the « neutral » position.
    - c) Immobilise the slider in « neutral » using one of the sets of gauges 3180-T. Choose the set of gauges which will give the the least play on the slider.
    - d) Tighten the screws (4) to 40 mAN (4 m.kg). Remove the gauges 3180-T.
    - e) Fit the interlock plunger.
- 33. Fit the 3rd gear-4th gear shaft (7) :
  - a) Put the fork (6) in position.
  - b) Put the 3rd gear stop in position.
  - c) Fit the shaft (7). Proceed as described in paragraph 32 (sections a and b).
  - d) Tighten the grub screw and lock it using a piece of wire.
  - e) Fit the locking dog.
  - f) Adjust the 3rd gear stop. To do this : With the shaft (7) in the neutral position : Measure the clearance between the fork and the hub of the sliding gear. Select 3rd gear.
    Place the fork in the centre of the slider groove (even up the play).
    Push the stop (8) up against the casing and tighten the two screws.
- 34. Fit the 5th gear shaft (3):
  - a) Fit the 5th gear fork on the shaft (3). Tighten and lock the grub screw (1). Insert the shaft (3) into the casing.
  - b) Fit the locking ball and the spring.
    Compress the assembly of spring and ball (rod, 6 mm diameter) and finish inserting the shaft.
  - c) Fit the 5th gear selector mechanism (9) and complete the fitting of the shaft.
  - d) Fit the interlock plunger.
- 35. Fit the reverse gear shaft (2) :
  - a) Position the fork.
  - b) Fit the shaft (2). Proceed as described in paragraph 32, sections a and b, and place the operating dog on the shaft. Tighten the grub screw and lock it in position using a piece of wire.
  - c) Bring the reverse intermediate gear to «neutral» using gauge 3188-T, placed between the 1st gear idler and the reverse intermediate gear.
  - d) With the notch in the operating dog vertical, tighten the fork screws to 40 mAN (4 m.kg).
- Fit and lock the grub screw (10) on the 5th gear operating shaft (3).



- 37. Check that the gearchange mechanism operates correctly and fit the blanking plugs (CURTYLON) in the bores for the interlock plungers (on each side of the casing).
- Fit the speedometer drive gear (1), after greasing the shaft with bearing grease.
- 39. Fit the front cover (4) (CURTYLON). Tighten the securing screws.

40. Adjust the 4th gear stop :

- Engage 4th gear.
- Gently push the slider against the fork. Using a set of feeler gauges, measure the clearance « j » between the slider and the 4th gear pinion.

Put a shim of thickness = j + 0.5 mm between pinion and slider. Tighten the screw of the stop (2) until it bears against the shaft of the 3rd and 4th gear fork.

Tighten the locknut (3) and check the clearance.

41. Prepare the assemblies of differential shaft and housing :

NOTE : The differential shaft on the right-hand side is the shorter.

- a) Fit the bearing (9) in the housing. Tighten the nut (6) to 100 mAN (10 m.kg) (spanner 1770-T bis). Lock the nut using the grub screw (5).
- b) Fit the oil seal (10) using tool 1772-T.
- c) Position the oil retaining washer on the shaft. Fit the spacer (12) and position the mandrel 1769-T bis. Centralise the oil retaining washer with the mandrel centring bush and fit the spacer using a press.
- d) Fit the differential shaft thus prepared into the housing and position it using a tube of 30 mm inside diameter under a press. Tighten the bearing locking nut (7) to 145 mAN (15 m.kg). Tighten the grub screw (8) in the nut.







#### 42. Prepare the differential :

 a) Place in the casing one thrust washer, one planet wheel (4), one fixed thrust washer (2), one satellite gear (3) and one spindle (5).

Rotate the planet wheel and make sure that at the point of minimum clearance, there is a clearance of 0.1 mm. otherwise replace the thrust washers until this condition is met. Remove the satellite and its thrust washer. Mark the position of this assembly in the casing.

- b) Repeat the same operation for each of the satellites.
- c) Fit the satellites.
- d) Place the second planet wheel (1) and its thrust washer in the crown wheel.
- e) Position the crown wheel in the casing. Gradually tighten the securing screws, ensuring meanwhile that the pinions rotate freely. Tighten the screws to 115 - 130 mAN (11.5 to 13 m.kg).

At the point of minimum clearance there must be a clearance of 0.1 mm on this planet wheel, otherwise replace the thrust washer.

- f) Using an oil gun, inject gearbox oil into the casing in order to lubricate all parts (this avoids dismantling the casing).
- g) Fit the bearings ( mandrel 1768-T ).

## 43 a. ADJUSTMENT OF THE DIFFERENTIAL BEARINGS (1st Method).

- A) Check that the differential and its bearings are properly positioned :
  - α) Place the differential together with its bearings in the gearbox casing.
  - b) Place an adjusting washer and a distance washer with a total thickness of 7 mm against the right-hand differential bearing ( the adjusting washer is the one which has the smaller diameter and should be placed next to the bearing ).

Hold the differential in place using the clamps MR. 630-64/16 (tighten the nuts by hand ).

Fit the assembly of shaft and right-hand housing ( interpose a paper gasket ). Tighten the screws.

- c) Lay the gearbox down on its right-hand side. Chock it in position.
- d) On the left-hand differential bearing, place : - the distance piece (6),

- the adjusting washers (8) and a distance washer (7) with a total thickness of at least 9 mm.

Place the left-hand housing, without a seal on the distance washer.

Fit the assembly in position, tapping lightly on the differential shaft.

- e) Remove :
  - the left-hand housing,
  - the assembly of adjusting washers (8) and distance washer (7).

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 b
 0

 MR. 630 - 64/16
 0

- B) Adjusting the pre-load on the differential bearings : NOTE : The bearings must be fitted with a specified pre-load.
  - a) Place straight edge 1754-T, fitted with dial gauge 2437-T, on the collar of the left-hand housing, so that the probe of the dial gauge is touching the bearing face of the housing. Bring the zero of the movable dial of the gauge in the line with the large needle. Note the position of the needle. Example : large needle 0
  - small needle 0 b) Place straight edge 1754-T on the gearbox
  - casing so that the probe bears on the distance piece.

Make two measurements at « a » and « b ». Example: a = 7.76 mm b = 7.80 mmTake the average of these two measurements : Example:  $\frac{7.76 + 7.80}{2} = 7.78 \text{ mm}$ 

c) To the average value found above, *add in all* cases :

0.10 mm (thickness of the seal) plus 0.30 mm ( stress on the bearing ) i.e. a total of 0.40 mm

In the example chosen :  $7.78 \pm 0.40 = 8.18 \text{ mm}$ 

From the washers sold by the Replacement Parts Department, choose an adjusting washer and a distance washer the *total thickness* of which is nearest to that determined above, i.e. 8.20 mm (the adjusting washer is the one with the smaller diameter).

d) Place these washers on the left-hand bearing.
 ( the adjusting washer next to the bearing ).

Fit the distance piece.

Fit the left-hand housing together with its paper gasket.

IMPORTANT : The thickness of washers fitted behind the right-hand bearing (see paragraph A/b) together with that of the washers fitted behind the left-hand bearing (see paragraph B/c) corresponds only to the setting of the bearing stress.

These washers must be distributed to the left and to the right to adjust the backlash but their total overall thickness must not be altered.

i.e. 7 + 8.2 = 15.20 mm



# 43 b. ADJUSTING THE DIFFERENTIAL BEARINGS (2nd Method):

A ) Fit the differential :

Place the differential fitted with its bearings in the gearbox housing. Hold it in position using the clamps MR. 630-64/16 ( tighten the nuts by hand ). Fit the lefthand and right-hand assemblies of shafts and housings together with the shims removed when dismantling. Interpose the paper gaskets. Tighten the screws.



B) Adjust the pre-load on the bearings :

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The differential bearings must be fitted with a specific pre-load. This pre-load is checked by measuring the torque required for turning the differential.

To check this torque, proceed as follows : - Fix and wind a string around the differential casing and pull on it by means of a spring

balance to rotate the casing.

Read the value indicated by the spring balance when the casing just begins to turn.

- a) Bearings which have already been used: The spring balance should read between 4 and 6 kg.
  - If it reads less than 4 kg : increase the thickness of the adjusting washers.
  - If it reads more than 6 kg : reduce the thickness of the adjusting washers.

- b) New bearings :
  - The spring balance should read between 6 and 9 kg.
  - If it reads less than 6 kg : increase the thickness of adjusting washers.
  - If it reads more than 9 kg : reduce the thickness of adjusting washers.

NOTE : A 0.10 mm adjusting washer corresponds approximately to :

- 0.250 kg for new bearings

- 0.500 kg for bearings which have been used. IMPORTANT : The total thickness of the washers on the left and on the right as determined above corresponds only to setting the bearing stress.

These washers must be distributed behind the left-hand and right-hand bearings to set the backlash but their total overall thickness must not be altered.





# 44. ADJUSTING THE BACKLASH

# A ) Measure the clearance between teeth :

Fix support 5602-T of dial gauge 2437-T on the gearbox casing.

Adjust the position of the dial gauge so that the stem bears perpendicularly on the flank of a tooth and the greatest diameter of the crown wheel.

Note the clearance between teeth on four teeth spaced at about  $90^{\circ}$ ,

The difference between any two measurements should not exceed 0.1 mm.

Otherwise the crown wheel is running out or badly fitted.

Note the minimum clearance read. Example : 0.73 mm.

#### B ) Adjust the backlash :

IMPORTANT : The clearance between teeth is odjusted by distributing the adjusting washers behind the left-hand and right-hand bearings. However the total overall thickness of the shims must not be altered. This thickness was determined either in paragraph 43 a) (1st method), or in paragraph 43 b) (2 nd method).

a) The clearance must be between 0.16 and 0.24 mm. i.e. 0.20 mm on the average. Subtract this theoretical clearance from the minimum clearance noted in paragraph 44, i.e. in the example chosen

$$0.73 - 0.20 = 0.53 \text{ mm}$$

The existing clearance must therefore be reduced by 0.53 mm.

Moving a 0.15 mm adjusting washer changes the clearance by 0.10 mm and it is therefore necessary to move a thickness of washers of :

$$\frac{0.53 \times 0.15}{0.1} = 0.79 \text{ mm}$$

b) In the example chosen, it is necessary to bring the crown wheel near by 0.79 mm and, consequently, to decrease the thickness of washers at the left-hand side. This thickness will become :

and to increase the thickness of the washers at the right-hand side by the same amount :

$$7 + 0.79 = 7.79 \text{ mm}$$

c) Check the backlash adjustment again.



- a) Fit the ball joint of the clutch fork (the position is given by a pin which engages in a hole of the clutch housing).
   Tighten the screw and grease the ball joint.
- b) Fit the clutch fork and position the pin (9). Fit the dust excluder (4) and the locking pin (3).
- c) Grease the ball joint guide (7) and the screw guide (8).

Position the thrust bearing. Fix it in position using the retaining springs (6).

d) Fit the bracket (1), the adjusting screw (5) and the fork return spring (2).

NOTE : If the gearbox casing is being replaced, fit the sealing washer (10) ( using CURTYLON) in the bore for the reverse gear selector fork shaft ( clutch casing end ).

#### 45. Fit the clutch casing :

- a) Slacken the screws securing the gearbox outlets.
- b) Fit the clutch casing (CURTYLON). Hand tighten the gearbox outlet securing screws and tighten the nuts securing the clutch casing.
- c) Finally tighten the screws securing the gearbox outlets :
  - 7 mm diameter screws : 28 mAN (2.8 m.kg)
  - 9 mm diameter screws : 40 mAN ( 4 m.kg ).





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- 47. Assemble the upper cover :
  - a) Fit the operating shaft (2) together with the seals (3) in the cap (5) by compressing the three springs (4).
  - b) Fit the assembly thus prepared in the cover ( CURTYLON ).
  - c) Tighten the mounting screws (1).

#### 48. Fit the upper cover :

- a) Place the fork operating shafts in « neutral », with the notches of the operating dogs arranged vertically.
- b) Fit the cover to the gearbox ( CURTYLON ).
- c) Tighten the screws.

#### 49. Fit the brake calipers :



- a) Fit the brake discs. Tighten the nuts to 85-110 mAN (8.5 to 11 m.kg) after interposing a spacer (tube diameter 12 × 17 mm length 15 mm). Make sure that the disc run out does not exceed 0.15 mn and that the difference in thickness (taken at a minimum of four equidistant points) on the average diameter of the disc rim does not exceed 0.02 mm. Otherwise replace the disc.
- b) Fit the calipers equipped with brake pads. Fit the securing screws but do not tighten them.
- 50. Fit the front supporting crossmember.

# DESCRIPTION OF THE GEARBOX.

# DBW VEHICLES - ALL TYPES



The gearbox comprises :

- An epicyclic gear train which provides three forward gears and one reverse gear.
- Two multidisc-clutches, each operated by a hydraulic piston.
- Two band brakes, each operated by its hydraulic servo piston.
- A free wheel which locks the planet gear carrier to obtain 1st gear.
- Two pinions A (ratio = 38/33) positionned at the outlet of the epicyclic gear train, relay the mouvement to the bevel pinion.
- A valve-chest situated in the lower part of the housing gear provides automatic control of the clutches and brakes for changing gear.
- A centrifugal governor which operates in conjunction with the valve chest.
- The crown wheel and pinion/differential assembly fitted in a separate casing.

# POWER-FLOW TABLE OF THE EPICYCLIC GEAR TRAIN COMPONENTS.

Position of Selector lever	Gear	Rear clutch	Front clutch	Rear brake	Front brake	Free wheel
«1»	lst	x			x	
«2» or «D»	1 st	x				X
«1», «2» or «D»	2nd	X		x		
« D »	3rd	x	x			
« <b>N</b> » : neutral						
« <b>R</b> »	Reverse		x		x	
« <b>P</b> » : Parking					X	



## CHARACTERISTICS

#### 1. Ratios :

Vehicles fitted with tyres 180 - 380 XAS, 180 HR 380 XAS, and 185 HR 380 XAS which under load have a circumference of 2.07 m.

Gear	Gearbox ratio	Crownwheel pinion	Total ratio	Speed at 1000 rpm engine speed	
				km	Miles
1 2 3 Reverse	0.481 (2.08 : 1) 0.794 (1.28 : 1) 1.151 (0.87 : 1) 0.550 (1.82 : 1)	8/35 (0.228) ('4.375:1)	0.110 (9.09 : 1) 0.181 (5.52 : 1) 0.263 (3.80 : 1) 0.126 (7.94 : 1)	13.667 22.544 32.689 15.650	8.54 22.544 20.43 9.78
	Speedomete	er drive ratio :	10/21 (2.10 : 1)		

# 2. Lubrication of the transmission system :

IMPORTANT : Since the lubricating oils are different, the assembly of bevel gear and differential is placed in a separate casing.

#### a) Lubrication of gearbox/converter assembly :

- The lubricating oil in the gearbox is pressurised by a pump driven by the converter impellor. This pump feed the converter and the hydraulic valve chest as well as lubricating the epicyclic gears.

- Grade of oil : ESSENTIAL	TOTAL ATF 33
• Capacity of gearbox, converter and circuits (when filled at the works):	about 6 litres
	(10.5 imp. pts)
- Amount of oil renewed when the system is drained and refilled :	about 2.5 litres
	(4.4 imp. pts)

## - Filling : this is done through the front dipstick tube.

- Determining the oil level : this must be done with the engine running and the selector lever in the position \* P \* :
  - cold : between the lower marks
  - hot : between the upper marks.

If necessary, restore the level under the same conditions.

#### a) Lubrication of the crown wheel and pinion / differential assembly :

	- Grade of oil :	TOTAL	EP 80
.*	- Capacity :	1.2 litre	

- Filling : this is done through the rear dipstick pipe.
- To read the level : rear dipstick.



- A Drain plug for gearbox and converter assembly.
- B Drain plug for crown wheel and pinion/différential assembly.

# OVERHAULING A BORG-WARNER GEARBOX.

NOTES :

- The epicyclic gear train and control assembly are in a compartment separate from the crown wheel and pinion/ differential assembly : these assemblies can be overhauled independently and are dealt with separately in this operation.
- Overhauling the valve chest and the oil pump is dealt with in another operation.
- The special tools for repairing Borg-Warner gearboxes are sold as a kit under the number 3190-T by the Fenwick Company.

# 1. OVERHAULING AN EPICYCLIC GEAR AND CONTROL ASSEMBLY.



REMOVAL.

- 1. Remove switch (1).
- 2. Remove the lower housing.
- Remove the magnetic plate (6). Mark and remove the tubes (2), (3), (4), (5), (7) and (8).
- Disconnect the « Kick-down » cable from the cam (9).
- Remove coupling clamp (14) connecting linkage rod to slide valve (13).
- Remove the three screws (10), (11) and (12). Remove the valve chest.





# OPERATION Nº Dbw. 350-3 : Overhauling a BORG-WARNER gearbox.

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- 7. Remove :
  - the tube (3) and the connecting rod (1),
  - the front cover (2) and its gasket.
- Remove the centrifugal governor (there are two types of governors and fittings) : 1st Fitting : Remove snap ring (4) (pliers 3253-T), governor (5) and ball (6).

**2nd Fitting :** Slacken nut (9) and remove the governor (8).

NOTE : These two types of governors are interchangeable.

9. Remove the two rings (7). Place selector shaft in « Parking » position (pushed fully towards the front). Bend back the locking tab (10) and remove the nut (11) (2 inch or 51 mm spanner).

















- Remove the metal peened into the secondary shaft and withdraw the speedometer drive wheel (3) (spanner 3179-T bis). Remove the two pinions (1) and (2) and the thrust washer (5) from the primary shaft pinion.
- Remove front bearing carrier (6), its gasket, the two centring pins (4) and (7) the locking pawl.
- Remove ring gear (8) and needle thrust bearing (13).
- Release locknut (12) and slacken the screw (11) in order to loosen the front brake band.
- 14. Remove planet carrier (14) and needle thrust bearing (15). CAUTION : In the event of this thrust bearing being renewed, it is essential to replace it by one of the same thickness.
- Remove the plate (17) and the front brake band (16).
- 16. Unhook the spring (10) from hole « a » in the housing. Remove shaft (9), spring (10) toggle lever (18) and its tappet (between toggle lever and piston (19)).





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- Remove the shaft and forward sun gear assembly (5) and the needle thrust bearing placed between the forward and rear sun gears.
- Release the locknut (4) and slacken the rear brake band adjusting screw (3).

#### 19. Remove :

- the three screws (1) securing the central bearing carrier,
- the central bearing (6) and front clutch unit assembly,
- the steel washer and the anti-friction washer placed between the front and rear clutch units;
- the plate linking toggle lever (12) and rear brake band (14),
- the rear clutch unit and primary shaft assembly.
- the needle thrust bearing of the rear unit,
- the rear brake band (14).
- 20. Remove :
  - the screw (11) and release lock plate (10).
  - the front piston (7) (if necessary drive it out using compressed air through hole « a »), Rock the toggle lever (12) and remove ring (9), guide plug (8), the spring between plug and rear piston and then the piston (if necessary, drive out these parts using compressed air through hole « b »).

Take precautions against oil spray.

- 21. Remove :
  - pivot-screw (18), pulley (17) and lever (16),
  - screw (2), spring and detent ball for the
  - manual selector shaft (13).
  - manual selector shaft (13).

IMPORTANT : Do not remove the pin (15) and toggle lever (12) unless absolutely necessary.





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# 22. Stripping the front housing :

Remove the needle bearing (1) (extractor 1671-T and end-piece 3190-T.A).

#### 23. Stripping the front bearing carrier :

Remove :

- the needle bearing (3) (use a tube diameter  $35 \times 44$  mm),
- the assembly of bearing and needle thrust
- bearing (2) (use a tube diameter  $45 \times 52$  mm).

#### 24. Stripping the front clutch unit :

- a) Remove snap ring (5) and release thrust disc (4) together with the steel and fibre disc.
- b) Compress spring (8) and withdraw ring (6) (cap 3190-T.D).

Remove snap ring (6), cup (7) and spring (8).

c) Remove piston (9) by tapping the body of the clutch unit against a piece of wood.



- d) Remove the three rings (1), the bush (2) and the needle bearing (if necessary). Use extractor 1671-T with extension 3190-T.A.
- 25. Stripping the rear clutch unit and primary shaft
  - shaft and friction plate assembly (4),
  - anti-friction washer (8),
  - clutch plates (6), and thrust plates (5)
  - snap-ring (11) and diaphragm (10),
  - piston (9) (by tapping clutch unit body on a
- 26. Stripping the forward sun gear shaft : Remove the two rings (14), seal (12) and needle thrust bearing (13).
- 27. No operation can be carried out on a planet carrier housing with the exception of renewing the free wheel (15).





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# 28. Dismantling the centrifugal governor : 1st Fitting :

- a) Remove the two screws (1) and the plate (3).
- b) Remove the two screws (2) and the cap (4).
- c) Remove spring retainer (5) and release spring (6), dash-pot (7) and piston (8).
   2nd Fitting :
- a) Remove snap ring (9) and weight (10).
- b) Release piston (13), spring (12), dash-pot (11), nut (14) and its washer.
- 29. Dismantling the valve chest : (See corresponding operation).
- Carefully clean all the parts in gasoline and blow them dry with compressed air.
  - (The blue HYLOMAR sealing compound is cleaned with trichloretylene).

## FITTING.

- Fitting the valve chest : (See corresponding operation).
- 32. Fitting the centrifugal governor :
  - 1st Fitting :
  - a) Fit piston (8), dash-pot (7), spring (6) and position spring retainer (5).
  - b) Fit the cap (4), so that the two oil holes correspond with the holes in the governor. Tighten the two screws (2) (Spring washer).
  - c) Fit the plate (3) and tighten the two screws (1).
  - 2nd Fitting :
  - a) Fit the spring (12) and dash-pot (11) on piston (13).
  - b) Insert the assembly in the body of the governor.Fit the weight (10) and the snap ring (9).
  - c) Fit the nut (4) (Spring washer) without tightening it.
- 33. Assembling forward sun gear shaft : Fit the two rings (15), seal (17) and needle thrust bearing (16).
- 34. Assembling the front clutch unit :
  - a) Fit the needle bearing (18) (shouldered mandrel : small diameter = 27; length = 5 mm (0.2"); large diameter = 33 mm; length = 50 mm (2").
  - b) Position piston (19) fitted with a new seal (Bush 3190-T.E) in body (20).



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Assembling the front clutch unit (continued) :

c) Fit bearing bush (10).

d) Position spring (2) and cup (3).

- e) Place cone 3190-T.C on the clutch unit hub and place snap ring (4) on the cone. Position the ring with a press using tool 3190-T.B.
- f) Stack discs in the clutch unit (five laminated paper discs and five dished steel plates (four notches) : place a steel plate (5) and a paper disc (6) alternately, always starting with a steel plate. The steel plate must always be placed the same way round.

Finish with the thrust plate (7), the flat surface towards the clutch plate and fit snap ring (8).

g) Fit the three rings (9).











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35. Assembling the rear clutch unit :

- a) Fit piston (1) with a new seal and thrust ring (2) for the diaphragm (3) (Use bush 3190-T.F).
- b) Fit diaphragm (3) and its snap ring (4).
- c) Position :
  - the hub (8) with its thrust face upwards,
    the clutch plates.

Proceed as for the clutch plates beginning with the thrust plates (5), then placing a paper disc (6), a steel plate (7) and so on. NOTE : The clutch unit has five smooth paper discs and four flat steel discs (two or three notches).

d) Fit anti-friction washer (9), shaft assembly(12) and plate (11) and fit snap ring (10).
 NOTE : The locking rings (4) and (10) are identical.

## 36. Assemble the satellite carrier shaft :

Offer up the free-wheel on the planet carrier so that the free-wheel flange is outside the planet-carrier, and check that the free-wheel turns clockwise freely.









#### 37. Assembling the front bearing carrier :

- Fit :
- the bearing and needle thrust bearing assembly (1),
- (Use a tube of diameter  $45 \times 52$  mm for fitting the bearing).
- the bearing (3) (use a tube  $\phi = 35 \times 44$  mm),
- the two dowels (2).

## 38. Fit the manual selection control :

- a) Offer up the selection shaft (4) in the gearbox so that the detent ball will enter one of the six grooves in the shaft. Fit the detent ball, spring and screw (5). Tighten the screw moderately.
- b) Put in position :
  - lever (15), with its upper end in the selector shaft notch (4).
  - the pulley (6),
  - the pivot-screw (16) (interpose a copper washer).

NOTE : The sick-down scable (17) must pass in front of the pulley (6).

- 39. Fit retainer (11), toggle lever (13), spacer (8), washer (14) and pin (7) (if these parts were removed).
- 40. Fit the rear piston assembly (19), spring (18) and guide plug (10). (Position the guide plug as shown on the diagram). Push on plug (10), fit the retainer (11) and tighten the screw (12) (plain washer). Then drive in the plug (10) using a universal valve lifter (type FACOM U 13) using boss « a » as a fulcrum and position snap ring (9).





- 41. Fit the rear brake band (5) as shown in the adjacent diagram and fit the plate linking toggle lever (4) and heel «d » of the rear brake band.
- Place the needle thrust bearing of the rear clutch unit in its housing in the casing.
- Grease and position steel washer (7) and friction washer (6) on front clutch unit (8).
- 44. Position rear clutch unit (10) and primary shaft assembly (9) on the front clutch unit. Fit the assembly thus prepared in the casing.



- 45. Adjust the rear piston stop screw :
  - a) Make sure that the piston is right home in its housing. To do this, blow compresed air through the hole « a ».
  - b) Fit the screw (2) and the spring (1) on the lever (4).

NOTE : Place the long tail « c » of the spring (1) in the notch « b » of the locking tab (3), and the short tail of the spring (1) pointing towards the outside of the gearbox.

c) Screw in the screw (2) so that twd or three threads project above the lever (4).











46. Fit the epicyclic gear train assembly :

#### $\alpha$ ) Fit :

- the central bearer (1), so that the two oil boles correspond with the holes + d > in the housing. Tighten the screws (10), (11) and (12) to 20 mAN (2 m.kg) (serrated washer).
  the front brake band (6).
- b) Fit the forward sun gear and shaft (2) assembly (insert the needle thrust bearing between sun gears (2) and (3).
- c) Fit :
  - the planet gear housing (13) together with the free-wheel (see paragraph 36) (insert the needle thrust bearing and the thrust plate between sun gear (2) and planet gear,
    the needle thrust bearing (14).
- d) Fit control piston (9) of front brake band (6), the push-rod between piston (9) and toggle lever (8), link plate (7), toggle lever (8), pin (5) and the spring (4). First of all place end « a » on the toggle lever (8) then place end « b » in the hole « c » of the housing.
- e) Fit the shaft and ring gear assembly (15).
- f) Fit the parking lock pin (18), spring (19) and pawl (17).
- g) Fit front bearer (20). Insert t<sup>1</sup> 2 paper gasket between bearer and casing.















- 47. Position washer (1) with its lugs in firm contact with the housing ribs, thus preventing it from rotating.
  - Fit :
  - transfer drive pinion (2),
  - driven pinion (5).
  - speedometer drive wheel (6), - lock washer (4) and nut (3).
- 48. Place the manual selection control shaft in « parking » position by pushing it right home towards the front of the gearbox. Tighten the nut (3) to between 150 and 180 mAN (15 to 18 m.kg) and bend over lock washer (4). Tighten the speedometer drive wheel (6) to between 200 and 220 mAN (20 to 22 m.kg) (spanner 3179-T bis).

#### 49. Fit the centrifugal governor :

Fit the two snap rings (7) and hook in their ends.

#### 1st Fitting :

Fit driving ball (8), centrifugal governor (11) (with plate (9) facing forward) and the snap ring (10).

#### 2nd Fitting :

Fit centrifugal governor (12) (opening « a » facing forward) and tighten the screw (13) to 26 mAN (2.6 m.kg).

## 50. Fit the front casing :

Insert a paper gasket. Tighten the securing screws to between 17 and 20 mAN (1.7 to 2 m.kg)

NOTE : If the needle thrust race fitted to the front of the housing has been removed, fit the new race using a shouldered mandrel (small diameter = 19 × length = 15 mm, large diameter =  $23 \times \text{length} = 135 \text{ mm}$  ).





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 Link up connecting rod (1) to the lever (2) and clamp (6) to the rod (1).

Place the manual selection control shaft *in position* «  $N \gg (neutral)$ , by operating the linkage rod/ lever assembly : with the selector shaft *in* « *parking* » *position* (see paragraph 47), push the link/ lever assembly right home towards the front, then bring it back three notches towards the rear, to obtain position «  $N \gg$ .

If necessary, slacken the screw securing the manual selection shaft detent ball.

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- 52. Fit the valve chest :
  - a) Position an O ring under the shoulder of the tube (3) and then fit the latter so that the O-ring is in contact with gearbox housing.
  - b) Fit the valve chest : link up the kickdown cable (19) to the cam (18), after checking that it is correctly positioned on the return pulley. Fit the valve chest on tubes (3), (4) and (5) and make sure that it bears correctly against the casing. Tighten the screws (7), (8) and (13) to 10 mAN (1 m.kg) (Shake proof washer).
  - c) Fit the linkage clamp (6) to the manual selection control shaft (17), after positioning the shaft so as to obtain the same distance «a» on each side of the boss « b ». Tighten the clamp securing screw (6).

d) Fit :

- connecting tubes (9), (10), (11), (14), (15) and (16),
- the magnetic plate (12).

53. Fit the lower housing. Insert the gasket. Tighten the securing screws to 10 mAN (1 m.kg) (plain washer).

# II. OVERHAULING A CROWN WHEEL AND PINION / DIFFERENTIAL ASSEMBLY







#### DISMANTLING

- 1. Remove the converter :
- 2. Remove the drive outlet shaft/housing assemblies :

Remove the securing screws. Remove the shaft-housing assembly, the adjusting washers and the spacers. These parts are matched and should not be mixed up.

#### 3. Remove the converter casing :

Remove the nuts and securing screws. Hold the differential against the converter casing and remove the assembly from the gearbox.

- Remove the front housing (1) : Remove the seal.
- 5. Remove the transfer pinion (3): Place selection shaft in « Parking » position ( pushed as far as it will go forward ). Release the metal peened at « a ». Remove the speedometer drive wheel (2) which acts as a nut ( spanner 3179-T bis ). Remove the gear (3).
- 6. Remove the bevel pinion : Remove the flange (4) securing the rear bearings. Drive the pinion towards the rear by tapping its end « b ».
- Remove the shim or shims (5) which are used for obtaining the conic distance.
- 8. Remove the two seals (6).
- 9. Remove the three O rings (7 ), (8) and (9).



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#### PREPARATION

- 11. Prepare the bevel pinion :
  - a) Place in turn on the pinion : - the roller bearing (4) ( with shoulder « a » of inner bush towards the pinion ), - the ball bearing (3). Fit them in the press using a tube ( inside diameter 41 mm, length 350 mm).
  - b) Fit and tighten the nut (2) to between 180 -200 mAN (18 to 20 m.kg). Bend the tab back into the groove of the shaft.
- 12. Prepare the differential : (See Operation Dm. 340-3).
- 13. Prepare the differential shaft and bearer assemblies (See Operation Dm. 340-3).

# FITTING

NOTE : If the conic distance has to be set, postpone the following operation so as not to damage the sealing rings.

#### 14. Fit the two sealing rings (1) :

Place these in their housing in the gearbox casing, fitting them back to back ( the sides carrying the maker's name must be facing each other) (see figure). Fit them using mandrel 3190-T.G, taking care not to block the vent hole.

- 15. Fit the adjusting shim or shims (5).
- 16. Fit the bevel pinion :

CAUTION : Wrap adhesive tape round the end of the shaft (thread, splines and grooves) in order to protect the seal lips.

Fit securing flange (6). Tighten the screws (7) to 15 mAN ( 1.5 m.kg ).









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# 17. ADJUSTING THE CONIC DISTANCE

A dimension in millimeters and hundreds of a millimeter is engraved on the ground face of the bevel pinion. This dimension is the distance which must exist after setting, between the centre line of the differential centre line and the ground face of the bevel pinion.

This distance varies with each bevel pinion. The conic distance must be set using adjustment fixture 3170-T fitted with the spacer 3190-T.H and dial 2437-T. This fixture has been designed so that the distance between the centre line of the ground faces « a » and the faces of the contacts « b » is 60 mm. This number is engraved between the contact faces.

- a) Carefully clean the bearing housing faces and the ground faces of the fixture.
- b) Calibrate the fixture :

Place fixture on a surface plate. Bring the zero of the dial gauge in line with the large needle. Note the position of the totaliser needle.

Example : Totaliser needle between 4 and 5 Large needle on 0

c) Measure the distance of the bevel pinion :

Position the fixture in the place of the differential. Pivot the fixture until the large needle on the dial gauge changes its direction of rotation.

Note the readings of the needles :

Example : Totaliser needle between 9 and 1 Large needle on 86

Return the needles to the position they occupied in paragraph b).

Allow the dial gauge stem to return slowly and count the number of revolutions and fractions of a revolution described by the large needle until the stem contacts the ground face of the bevel pinion again.

In the example chosen : 3.86 mm. The conic distance is therefore :

60 + 3.86 = 63.86 mm

The dimension engraved on the pinion is for example 63.95 mm

The bevel pinion must therefore be moved away from the differential centre line by :

63.95 - 63.86 = 0.09 mm.

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d) Adjust the bevel pinion :

Remove the bevel pinion securing flange. Withdraw the bevel pinion and remove the adjusting washer (1).

Measure the thickness of the washer. i.e. 2.81 mm

It is therefore necessary to replace this washer by another of thickness : 2.81 - 0.09 = 2.72 mm Washers are available in thickness from 1.65 mm to 3.13 mm in steps of 0.04 mm.

From the washers sold by the Replacement Parts Department, select the one whose thickness is nearest to the value determined above, i.e. 2.73 mm.

- e) Fit:
  - adjusting washer (1),
  - bevel pinion,
  - flange (2) which holds the bearings.
  - Tighten the screws (3) to 15 mAN (1.5 m.kg)
- f ) Check the setting.
- g) Fit the transfer pinion (6) and the speedometer drive wheel (7).
  - Place the selector shaft in « *Parking* » position ( push it right home towards the front). Tighten the drive wheel (7) to  $200 - 220 \text{ m}\Lambda N$  ( 20 to22 m.kg) ( spanner 3179-T bis ).
  - Lock the wheel (7) by peening the metal at «a».
- h) Fit the front casing after inserting a paper gasket.
- i) Fit the three O-ring seals (4), (5) and (8) on the casing.
- Fit the differential and the gearbox outlet housings.
   Adjust the pre-load on differential bearings

   (See Operation Dm. 340-3).
- Set the tooth-clearance ( See Operation Dm. 340-3 ).
- 20. Remove bearers and link up the converter casing to the gearbox. Coat the sealing faces with HYLOMAR compound. Position the bearers and tighten the securing screws of the casing and the bearers.
- 21. Fit the converter.

# I - OVERHAULING AN OIL PUMP









# DISMANTLING.

- 1. Remove the converter. Position it flat on the starter ring side and protect its opening by means of a pluq.
- 2. Remove the screws (1) securing the oil pump body (2) and remove the oil pump.

#### 3. Remove :

- securing screw(3) of the plate (4), - plate (4),
- gears (5) and (6),
- O-ring seal (7),
- lip type seal (8).

#### FITTING

- 4. Fit :
  - gears (5) and (6),
  - plate (4) and tighten screw (3),
  - a new O-ring seal (7), previously moistened with TOTAL ATF 33 oil.
- 5. Present the oil pump (2) previously filled with TOTAL ATF 33 oil in its housing in the converter casing. Centre it using mandrel 3190-T.J.
- 6. Tighten the screws (1) (flat washer) to between 15 and 20 mAN ( 1.5 to 2 m.kg ), making sure that the centring mandrel 3190-T.J remains free.
- 7. Fit a new lip type seal (8) ( the face carrying the maker's name towards the outside ) and check with mandrel 3190-T.L that the oil pump turns smoothly.



II - OVERHAULING A VALVE CHEST.









# DISMANTLING

- Withdraw the manual operating slide valve (5) from the lower casing of the valve chest (9).
- 2. Remove the four screws (7) and the strainer (8).
- Remove the two screws (3) and disengage support and cam assembly (2) and (1).
   NOTE : The two screws (3) have a different pitch from the other screws holding the upper casing (10).
- Remove the screws (4), (6) and (18) and disengage the upper casing (10).
- Remove the four screws (16) and (17) and lift off the plate (15) which covers the control slides.
- Remove the eight screws (11), (12) and (14) and withdraw the oil collector (13).
- 7. Remove the partition plate (20).
- 8. Strip down the lower casing :
  - a) Remove the ball (24) and its spring (23).
  - b) Remove stop plates (21) and (22). Remove change-down slide valve (19), spring (26) then the acceleration slide valve (25) and spring (27).




#### 8. Strip down the lower casing ( continued ) :

c) Remove the three screws (1) (retaining the thrust plate (2) which is held by the springs (5) and (4).

Remove thrust plate (2), spring (4) and secondary regulator slide valve (3), spring (5) and the primary regulator slide valve (7) together with its sleeve (6).

- d) Remove thrust plate (8), spring (15) and the rear servo control slide valve (14).
- e) Remove the pin (10) by rocking the plug (9). Remove plug (9), the modulator slide valve (11), rod (12) and spring (13).

#### 9. Strip down the upper casing :

- a) Remove the three screws (19). Disengage thrust plate (18), spring (23), slide valve (22), and piston (24).
- b) Remove the three screws (16). Disengage plate (17), 1st/2nd gear control slide valve (21), 2nd/3rd gear control slide valve (20) and its spring (25).





Manual 814-2



10. Carefully clean all the parts with petrol and dry them with compressed air. Examine all parts. If any light scratches or traces of seizing are revealed on a slide-valve, a piece of N° 600 abrasive paper ( dampened in TOTAL ATF 33 oil ) may be used. Any other servicing is not provided for the

Any other servicing is not provided for the value chest.

Before reassembly, all parts are to be moistened with TOTAL ATF 33 oil.

## FITTING.

## 11. Assemble the upper casing :

- a) Position the lst/2nd gear control slide
   valve (2), the 2nd/3rd gear control slide
   valve (1) and its springs (7).
- b) Fit the plate (8). Tighten the screws (9) to between 2.5 and 3.5 mAN (0.25 to 0.35 m.kg).
- c) Position slide valve (3), spring (4) and piston (6).
  Fit plate (5) and tighten the screws (10) to between 2.5 and 3.5 mAN (0.25 to 0.35 m.kg).

#### 12. Assemble the lower casing :

- a) Position rod (14) fitted with spring (15), modulator slide valve (13), plug (11) and pin (12).
- b) Position rear servo control slide valve (16), spring (17) and plate (18).
- c) Position primary regulator slide valve (23) fitted with its sleeve (22), spring (21), secondary regulator slide valve (19) and spring (20).

Fit thrust plate (24) and tighten the three screws (25) to between 2.5 and 3.5 mAN (0.25 to 0.35 m.kg).









- 12. Assemble the lower casing ( continued ) :
  - d) Position plate (1), accelerator slide valve (3) fitted with spring (2), spring (5) change-down slide-valve (6) and stop plate (4) by pushing the slide-valve (6).
  - e) Fit spring (7) and ball (8) ( after laying the lower casing down flat ) and position the body partition plate (9).
- 13. Position the upper casing (13) and hand tighten the ten securing screws (19), (20) and (24). Insert support and cam assembly (10) and (11) under the two screws (15).

NOTE : The two screws (15) have a different pitch from the other screws securing the upper casing (13)

- Fit the oil collector (12) and position the eight securing screws (16), (17) and (18).
- 15. Fit plate (14) which bears the feed channels for the regulator slide-valves and hand tighten the four securing screws (22) and (23).
- Position the strainer (26) after checking that its thrust face is flat and hand tighten the four securing screws (25).
- Tighten all screws to between 2.5 and 3.5 mAN (0.25 to 0.35 m.kg)
- Position the manual control slide-valve (21) in its bore.



I - REPLACING AN UPPER SWIVEL BALL JOINT



Manual 814-2

## DISMANTLING

- 1. Remove the bellows from the ball joint.
- Hold the swivel in a vice using bush 3318-T and soft jaws.

Clear the peened metal from the slots of the nut (4), using tool MR. 630-66/16.

Push back the peened metal at each side of the nut slots using a punch, in order to avoid damaging the swivel when slackening the nut.

- Remove the nut (4) using key 3310-T held in place by a nut.
- 4. Remove :
  - the upper cup (3),
  - the ball (2),
  - the shim (1).
- Extract the lower seating of the ball joint using extractor 3311-T.
- 6. Remove the ball joint nipple (7).

Clean the ball joint passage and housing.

7. If necessary, retap the swivel threads using a special tap A (  $50\,\times\,125$  ).







## FITTING.

NOTE : The ball joint is supplied by the Replacement Parts Department complete with its cups and shim. These should not be separated.

 Place the lower seating (1) of the ball joint in its housing on the swivel. Use tool 1553-T with extractor unit 1750-T and thrust pad MR. 630-21/23. The seating must not be positioned by hammering

which would damage the swivel bearings. It is possible to use the extractor 2400-T fitted with hooks 1331.

 Position the shim (2). Smear universal joint grease on the lower seating, the ball (3) and the upper cup (4).

Position :

- the ball (3),
- the upper cup (4).
- 10. Tighten the nut (5) to 140 mAN (14 m.kg), using spanner 3310-T.

Check that the ball joint swivels normally and lock the nut by peening metal from the swivel into the two diametrically opposed slots in the nut.

NOTE : The peening should be done at 45° or 90° distant from that done previously. If necessary, reduce the height of the nut (5) by rubbing down its inner face ( for example by rubbing it on emery paper placed on a surface plate ).

 Fit the nipple (6) and grease the whole ball joint moderately. Remove any excess grease.

12. Fit the ball joint bellows and its retaining collar.



3314-T 1369 3318-T 2531 5 2 3 4 6 Manual 814-2 7 2437-T 3306-T 527 2437-T 1528

#### II - REPLACING A LOWER SWIVEL BALL JOINT

#### DISMANTLING

- 1. Remove the ball joint bellows.
- Hold the swivel in the vice using the bush 3318-T and jaws.

Free the peened metal from the slots in the nut (6), using tool MR. 630-66/16.

- Push the peened metal back to each side of the nut slots using a punch, to avoid damaging the swivel when slackening the nut.
- Remove the nut (6) using key 3314-T held in place by a nut.
- 4. Remove :
  - the ball (5),
  - the spacer (4),
  - the lower seating (3),
    the Mecanindus pin (7),
  - the flexible washer (2),
  - the friction pad (1).
- Remove the ball joint nipple. Clean the ball joint passage and housing. Retap the threads if necessary (see chapter I, paragraph 7).

## FITTING

- Determine the thickness of the spacer (4) : Use the dial gauge support 3306-T fitted with a dial gauge 2437-T.
  - a) Place this assembly on a surface plate, Make sure that the integrating needle is between 8 and 9, otherwise change the position of the dial gauge. Then bring the zero of the scale opposite the

I hen bring the zero of the scale opposite the large needle.

b) Place the assembly thus calibrated on the swivel. By counting the number of revolutions and fractions of a revolution of the needles, determine the difference between the calibration reading (noted in paragraph 6 a) and the new reading, and let « d » be this difference.





7. The Replacement Parts Department supply the lower ball joint complete with cups. *These should not be separated.* A self-adhesive label is placed in the cup.

Calculate the difference between the number in « d » found in paragraph 6 b and the dimension marked on the label. This difference gives the thickness of the spacer (4) which should be fitted.

From the spacers sold by the Replacement Parts Department choose the one, the thickness of which is immediately above the size found.

These spacers are available in thicknesses between 5.5 and 6.20 mm in steps of 0.05 mm.

- 8. Fit the friction pad (1), the Mecanindus pin (7), the flexible washer (2) (convex side facing the cup), the cup (3) (position the notch « a » on the pin), the spacer (4) previously determined (cutout side downwards), the ball (5) lightly smeared with « universal joint » grease, and the cupped nut (6).
- Tighten the cupped-nut to 390 mAN (40 m.kg) using key 3314-T held by a nut. Check the articulation of the ball joint which should be stiff.
- 10. Lock the nut by peening metal into the notches.
- Fit a nipple and lightly grease the whole ball joint.

Remove any excess grease.

12. Fit the bellows and its retaining collar.

D VEHICLES ALL TYPES

## I - OVERHAULING A STEERING UNIT







## DISMANTLING

- With the steering unit on the bench : Slacken the lock-nuts (5) and remove the end caps, right and left-hand (6) using a pipe wrench. Remove the collars (1, 2, 3, 4) holding the bellows (9) and (10). Remove the piping (7) for the rack control. Remove the seal-holder plates.
- Hold the steering unit in a vice by means of the support 1999-T and its screwdriver portion A. Disconnect the track-rods (8) and (11) from the central yoke. Drain any liquid from the steering unit by operating the rotating union to full lock position (righthand side then left-hand side).
- Remove the nut securing the yoke on the ball joint.

Remove the retaining spring.

Disconnect the yoke from its ball joint using extractor 1967-T.

Remove the rubber sealing washer (12).





4. Disconnect the cylinder-piston assembly :

Turn the steering to full right-hand lock position.

Remove the locking ring from the link pin.

Remove the link pin from the operating piston using extractor 1969-T.

#### NOTE :

On vehicles produced since July 1967, the operating piston rod has a smaller diameter ( old rod diameter 21 mm, new rod diameter 19 mm ).

Interpose a piece of foil MR. 630-22/9 a between the extractor 1969-T and the operating piston (1).

5. Slacken the lock-nut on the end of the housing using spanner 2186-T and an open-end spanner A ( or an adjustable spanner ), keeping the jaws behind the sealing area of the feed pipe flange to avoid making a burr on the joint face which would result in a leak.

Disconnect the assembly of end-fitting, cylinder and piston.

Remove the lock-nut (4).

Remove the right-hand bellows (3), the sliding closing plates (2) and the steering guide block.



2

3

# Open the locking tab on the central ball pin.

6. Disconnect the steering rack operating rod :

Slacken the collar B on the support 1999-T so that the steering housing can rotate freely in the support.

Insert screwdriver A of fixture 1999-T into the steering rack slot, by adjusting the position of the rack and the steering.

Unlock and remove nut (1) using key MR.630-16/7. Remove the spring (2) and the thrust pad guide (.3). Disconnect the operating rod by unscrewing it with spanner 1982-T.

Remove the anti-rattle bush from the operating rod.

#### 7. Remove the central ball pin :

Screw the pad ( of assembly 1966 T ) as far as it will go on the steering rack, then unscrew by one turn and fit extractor 1966 T.

Place a spacer on the ball pin shaft and lightly tighten the nut on the ball pin.

Extract the ball pin by turning the screw on the extractor 1966 T using spanner 1982-T. Remove the extractor and the pad. Tighten the collar B.

Remove the bellows (4).



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- 8. Remove the steering rack.
- Disconnect the assembly of steering pinion and rotating union :

Remove the metal cap (4).

Remove the locating rod from the rotating union. Clear the peened metal of the nut (3) from the groove and remove the nut (3). Remove the assembly of pinion and rotating union by tapping on the end of the pinion with a bronze drift, if necessary.

CAUTION : Do not lose the balls from the upper bearing.

Drive out the lower bearing (2) and the outer bush (1) from the upper bearing.

## 10. Strip down the track rods :

Disconnect the steering levers from the track rods using extractor 1964-T and pad 1968-T. Remove the rubber cup (5) and the nylon sealing cup for the ball joint. Disconnect the adjustable sleeve (6) from the right-hand track rod. Remove the flexible bushes from the rod in the press ( use mandrel MR. 630-31/57 ).

NOTE : The steering ball joints cannot be dismantled. Either the whole left-hand track rod or the right-hand end fitting must be replaced. If the steering ball joints are in good condition it is essential not to clean the rods by immersion, thereby avoiding degreasing the ball joints. Clean the mechanical parts.

- Strip down the steering pinion and rotating union assembly (see page 16).
- Remove the steering rack control ( see page 11 and 12 ).

MR. 630-31/57

4



## FITTING

- Prepare the steering rack control ( see page 13 on )
- Prepare the steering pinion and rotating union assembly (see pages 16 or 17).
- 15. Build up the track rods :

Position the flexible bushes in the track rod sockets using the mandrel MR. 630-31/57. Fit the adjusting sleeve together with its clamps on the right-hand track rod, screwing it by the same amount on the track rod and on the end carrying the ball pin so that the distance in « a » is equal to 402 mm between the centre line of the ball pin and the centre line of the flexible bush.

#### 16. Connect the levers on the track rods :

Place a small amount of grease in the annular space between the ball pin and the casing. Fit the lever inserting the nylon cup (2) and the rubber cup (1). The cone of the ball pin must be carefully degreased.

Tighten the nut (3) to 40 mAN (4 m.kg).

- 17. Fit the outer bush of the upper bearing and the lower bearing ( make sure that the bore of the housing is clean ).
- Fit and adjust the assembly of operating pinion and rotating union :

Without removing the steering housing from the support 1999-T, position the vice ( see figure ).







a) Fit the steering pinion without the balls of the rear bearing and without the rotating union. Tighten the nut (2) to 50 mAN (5 m.kg) after interposing a washer (3) of 3 mm thickness. Position the support 1997-T fitted with the dial gauge 2437-T (fitted with a flat plunger) on the steering system. Interpose a ball (1) of 6 mm diameter. The dial gauge should be set so that it reads about 6 mm. With the dial gauge plunger resting on ball (1),

bring the scale zero opposite the large needle and note the position of the integrating needle ( for example between 7 and 8 ).

- b) Remove :
  - the dial gauge support ( without removing the dial gauge ),
  - the nut (2) and the steering pinion.
- c) Place the upper bearing ( be careful of the position of the nylon race ) on the steering pinion.
  Engage the pinion in the steering unit.
  Tighten the nut (2) to obtain free movement of
  - the steering pinion without any play.
- d) Position the support 1997. T together with the dial gauge on the steering unit. Place the needles of the dial gauge in the position they occupied previously, then bring the dial gauge plunger into contact with the ball (1) counting the number of revolutions and fractions of a revolution, i.e. 4.28 mm.
- e) From amongst the adjusting washers sold by the Replacement Parts Department, choose the one corresponding to the above thickness. In the example chosen, washer n° DS. 442-346 should be fitted.
- f ) Remove :
  - the dial gauge support 1997-T,
  - the nut (2),
  - the steering pinion and the lower bearing.





g) Fit the rotating union on the steering pinion ( see pages 16 or 17 ).

Position the rubber seal (4) on the collar of the rotating union.

Fit the upper bearing, smeared with grease. NOTE : ( For vehicles which use LHS 2 synthetic fluid, use grease of the

type TOTAL SPECIAL HC. For vehicles which use LHM mineral fluid, use mineral grease of the « bearing or universal

joint » type such as TOTAL MULTIS ). Be careful of the position of the nylon race (5) ( make sure that the balls do in fact bear

against the race ).

Place the adjusting washer (6) on the pinion with the recessed part towards the pinion. Grease the pinion ( TOTAL SPECIAL HC or TOTAL MULTIS according to the fluid used).

- h) Fit and tighten the nut (7) to 50 mAN (5m.kg) using torque wrench 2471-T. Check that the pinion rotates freely and without play in the steering housing. Peen the metal of the nut (7) into the groove of the pinion, supporting the pinion meanwhile from the opposite side. Fit the metal cap (8) filled with grease (TOTAL SPECIAL HC or TOTAL MULTIS GREASE according to the fluid used in the vehicle).
- 19. Fit the rotating union (11). Screw the rod to the bottom of the thread and tighten the lock nut (10). Take up any play of the rod (11) in the bracket (12) by twisting the bracket lightly with a pair of pliers.
- Completely degrease the steering rack and place it on the cone which takes the steering box ball joint; engage it with the pinion.
- 21. Fit the thrust pad guide (3). Fit the spring (2). Tighten the nut (1) and then slacken it by 1/6th of a turn using key MR. 630-16/7. Drill and pin the nut (1).
- Fit the left-hand bellows (9): (the smaller diameter end first ).



- 23. Fit the steering rack ball joint :
  - a) Without removing the steering housing from the support 1999-T, position the assembly in the vice ( see figure ).

Slacken the collar B of the support 1999-T so that the steering housing can rotate freely in the support.

Engage the screwdriver C of the assembly 1999-T in the steering rack slot by rotating the rack and the steering unit.

b) Introduce the ball joint through the opening in the housing, having previously degreased the cone.

Center the ball joint in the opening of the housing using the guide block (1). Bring the cones together by striking on the eye of the ball joint with Tee-spanner 1982-T. Remove the guide block.

c) Fit the lockwasher. Screw in the operating rod and tighten it to 70 mAN (7 m.kg) using spanner 1982-T.





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24. Fit the right-hand bellows (2)., beginning with the larger diameter. Place the guide block previously greased on the ball joint stem. Fit the sliding covers (1).

Place the bellows over the ends of the sliding *covers*.

Fit and tighten the collars (5).

NOTE : On rehicles produced up to September 1969, the operating rod is fitted with a damping bush (4) : during repairs, it is recommended that this bush be eliminated.

Fit the cylinder-piston assembly, previously smeared with special hydraulic fluid (LHS2 or LHM according to the model of vehicle ), in the steering casing.

Screw the end of the casing right home and then slacken it slightly ( no more than 1 turn ). Fit the locknut (3).

- 25. Fit the link pin (8) between the piston and the operating rod :
  - a) Bring the holes in the piston opposite that in the operating rod by rotating the piston with a tommy bar.
  - b) For a 21 mm diameter piston : use tool 1969-T.
  - c) For a 19 mm diameter piston : also use tool MR. 630-22/9 a which is an adapter for tool 1969-T for this type of piston.

Interpose the shim B between the piston and the body of the tool.

- Interpose the plate A between the thrust screw and the pin (6)

NOTE : The pin (6) must be renewed after each dismantling.

d) Fit the locking ring (7).

26. Fit the locknut (3) and the right-hand lock cap.



30. Fit the locknut (8) and the left-hand steering lock cap Fit the cover (7) protecting the steering pinion ( do not fit the collar ).

7

- 31. Remove the steering unit from the support Fit the left-hand bellows at a distance « b » = 58 ± 2.5 mm and the right-hand bellows at a distance « a » = 574 ± 2.5 mm Tighten the collars (6).
- Check that there are no leakages from the cylinder piston assembly ( see page 18 ).

33. Adjust the pressure cross-over point.

6

- **34.** Place adhesive paper or a blanking plate on the flange face of the hydraulic pipe on the rotating union.
- Paint the assembly except for threads pinion splines and seal area.

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g





## DISMANTLING

- Dismantle the assembly of end-fitting, cylinder and piston :
  - a) Grip the rack control cylinder in the vice ( use jaws MR. 630-43/23 ).
  - b) Slacken and disconnect the cylinder (2) from the end-fitting (1) of the steering housing. Use a plain or adjustable spanner, keeping the jaws away from the feed pipe joint face to avoid burring this face which would lead to leakages.

c) Remove the piston (3) from the cylinder (2).

- 2. Disconnect the end-fitting (4) from the cylinder :
  - a) Grip the rack control cylinder in the vice (use jaws MR. 630-43/23).
  - b) Unscrew the end-fitting (4) from the cylinder using tool 3513-T.



3. Strip down the end-fitting (4) of the casing :

5. Strip down the piston (2) :

Remove :

- the O-rings (3) and (15),
- the spacer (16),
- the Teflon seal (18),
- the rubber seal (17),
- the rilsan bush (19).

Remove :

- the Teflon seal (13),
- the rubber seal (12),
- the locking rings (10),
- the washers (14) retaining the piston seal,
- the piston washers (11) ( rilsan ).

4. Strip down the end-fitting (1) of the cylinder :

Remove :

- the spacer (9),
- the Teflon seal (7),
- the rubber seal (8),
- the rilsan bush (6),
- the O-ring (5).

6. Clean all parts in gasoline (LHM) or alcohol (LHS2).

Blow off with compressed air, particularly the fluid ducts.







## FITTING

- 7. Prepare the piston :
  - a) Place on the piston :
    - a locking ring (1),
    - a retaining washer for the piston seal,
    - two rilsan washers (3).
    - a retaining washer for the piston seal,
    - a locking ring (5).
  - b) Measure the width of the seal groove using gauge 1983-T.

The smaller side should enter the groove. The larger side should not enter the groove. From amongst the piston seal retaining washers sold by the Replacement Parts Department, choose those which give a width of :

$$a = 2.4 + 0.15$$
 mm

## 8. Fit the seals :

α) Fit the rubber seal (6) on a piece of 0.1 mm foil A wound around the end of the smallest diameter of the cone 3510-T.

All parts should be previously moistened with special hydraulic fluid. Push the foil, to bring it round the larger diameter of the cone 3510-T. Place the rubber seal (6) in the groove. NOTE : The foil must be changed for each operation.

- b) Fit the Teflon seal (7), previously moistened with hydraulic circuit fluid.
   Fit the seal (7) on the cone and slide it along so that it fits over the rubber seal (6).
- c ) Flatten out the Teflon seal using the mandrel 1985-T.

To do this, place the mandrel on the seal and move the bush B several times forward and backward

NOTE : Do not slide the mandrel over the joint without having first withdrawn the bush B from the split end.



9. Prepare the cylinder end-fitting.

Fit the seals using the assembly 3508-T.

Place the end-fitting (1) on the support A.

Place the bush C in the end-fitting of the cylinder. Using the plunger B, fit :

- the rilsan ring (2),
- the rubber seal (3) and the Teflon seal (4) with the plunger B in contact with the green side of the rubber seal (3).
- Remove the assembly 3508-T.

Fit the spacer (5).

NOTE : The cylinder end spacer is 1 mm thicker than the one on the steering casing end-fitting.

Fit the O-ring (6) in the groove on the cylinder end-fitting.

The seal bears a white mark which should be placed in the direction « f ».

NOTE : All parts should be moistened with hydraulic circuit fluid before fitting.



#### 10. Prepare the steering casing end-fitting :

Moisten all the parts with hydraulic circuit fluid. Fit the seals using the assembly 3509 T bis. Fit the end-fitting (7) on the guide support D. Place the bush F in the end-fitting. By means of the plunger E, fit :

- the rilsan seal (8),
- the rubber seal (9) and the Teflon seal (10), the green mark being in contact with the plunger E.

Remove the assembly 3509-T bis.

- Fit :
- the spacer (11),
- the O-rings (12) and (13).

NOTE : The spacer (11) is thinner than the one in the steering end-fitting. The O-rings (12) and (13) bear a white mark which should be placed in the direction « f ».







15. Fit the piston in the cylinder :

Smear the piston and the inside of the cylinder with hydraulic circuit fluid.

Fit the piston (1) and the cylinder (2) using tool 3512-T.

- 12. Fit the cylinder end and the end-fitting of the housing on the cylinder :
  - a) Place the end-fitting of the housing on the piston, near the hole for the linkage pin, using cone 3511-T.
  - b) Hold the cylinder in the jaws MR. 630-43/23 and, using torque wrench 3513-T and a special socket, tighten the cylinder end on the cylinder to 30 mAN (3 m.kg).
  - c) Turn the cylinder round in the jaws MR.630-43/23.

Tighten the housing end-fitting on the cylinder to 30 mAN ( 3 m.kg ). Use a plain or adjustable spanner, keeping the jaws away from the feed pipe joint face flange to avoid burring this face which would result in a leak.

13. Fit the assembly on the steering housing.



III - OVERHAULING A STEERING PINION AND ROTATING UNION ASSEMBLY (with O-ring seals)



#### DISMANTLING

NOTE : To avoid scratching the bore of the rotating union (16) when removing the pinion (2), wrap the teeth of the pinion with adhesive paper.

 Remove the collar (15) and the protective cover (11).

Remove the pinion from the rotating union. Remove the seals (3) from the rotating union. using a small brass hook (do not scratch the around bore of the union).

- 2. Strip down the steering pinion :
  - a) Slacken the locknuts (6) and remove the adjusting screws (7).
     Remove the needles (8).

b) Remove the locking pins (4) from the fork.

- Remove the fork and take the flexible bushes (5) off the fork.
  - Remove the slide values (9)

NOTE : The slide valves are matched, do not mix them up.

Use the rack MR. 630-43/13.

- c) Remove the dashpot plugs (12). NOTE : Each cup (14) is matched with its plug (12). Do not mix them up.
- 3. Clean all parts in gasoline (LHM) or in alcobol (LHS 2).

Dry with compressed air.

 Carefully examine all parts; they must not be oxidised, scratched or abnormally worn.

#### FITTING

- 5. Prepare the steering pinion :
  - α) Fit the assemblies of plugs (12). cups (14) and springs (13) previously moistened with special hydraulic fluid. Fit a new seal (10). Tighten the dashpot plug (12) to 18 - 22 mAN (2±0.2 m.kg)
  - b) Insert the slide valves (9), moistened with hydraulic fluid, into the liners (in the same order as found when dismantling).
  - c) Fit the flexible bushes (5) on the fork pins. Insert the fork in the pinion ( the machined parts of the fork are those on which the locknuts seat (6).

Insert and open out the split pins (4). Fit the needles (8). At each end of a needle place a 0.5 g. of grease (type ANTAR R.C.) when the vehicle employs LHS2 fluid, or bearing grease (TOTAL MULTIS) when the vehicle uses LHM fluid. Fit the adjusting screws (7) and the locknuts (6).

- 6. Fit the rotating union :
  - a) Place the seals (3) previously moistened with special hydraulic circuit fluid into the grooves of the rotating union.
  - b) Wrap adhesive paper round the pinion teeth (2) ( to avoid scratching the bore of the union ). Insert the pinion in the rotating union (16) after moistening it with hydraulic fluid (the boss (1) for the locking pin towards the pinion).
    - Remove the adhesive paper.
  - c) Fit the cover (11) without fitting the collar (15) which will be mounted only after adjusting the cross over pressures.





#### DISMANTLING

1. Proceed in the same way as for the pinion/union assembly fitted with O-rings.

#### FITTING

- Prepare the steerin pinion :

   a) Fit the assemblies of plugs (12), cups (14) and springs (13) previously moistened with special hydraulic fluid. Fit a new seal (10). Tighten the dashpot plug (12) to between 18 and 22 mAN (2±0.2 m.kg).
  - b) Insert the slide valves (9) moistened with fluid into the liners ( in the same order as found when dismantling ).
  - c) Place the flexible bushes (5) on the fork pins. Insert the fork into the pinion (the machined parts of the fork receive the locknuts (6). Insert and open out the split pins (4). Fit the valve needles (8). At each end of the needle, place 0.5 g. of grease (type ANTAR R.C.) when the vehicle uses LHS2 fluid, or bearing grease (TOTAL MULTIS) when the vehicle uses LHM fluid. Fit the adjusting screws (7) and the locknuts (6).

- 3. Fit the rotating union :
  - a) Place the rubber seals (3) and (17), previously moistened with special hydraulic circuit fluid, into the grooves on the rotating union (16).
  - b) Also fit the Teflon seals (18).
     NOTE : The seals (3), (17) and (18) are fitted by hand.
  - c) Wrap adhesive tape round the teeth of the pinion (2) to avoid scratching the machined areas of the rotating union and insert the drive pinion (moistened with fluid) into the union, with the boss « a » towards the pinion.
  - d) Fit the cover (11) without fitting the collar (15) which will be fitted only after adjusting the cross-over pressures (on the vehicle).



V-CHECKING THE HYDRAULIC STEERING RACK FOR LEAKS.

- Use the test bench 2290-T (painted grey) for systems using LHS 2, or the test set 3654-T (painted green) and its accessories 3655-T for systems using LHM fluid. Employ the pressure gauge graduated from 0 to 200 bars.
- 2. Disconnect the pipe assembly (1) from the steering end-housing.
- 3. Fit the pipe A ( interpose a seal holder plate ) in place of the other pipe. Connect one of the ends « c » of the pipe A to the opening « a » of the test bench pump, using the tube B.

Do not obstruct the other end « d » of the pipe A.

 Retighten the bleed screw « b » of the test bench. Operate the pump to raise the pressure.

The pinion rotates until the steering rack is at  $\mbox{\ \ full}$  lock ».

Stop pumping when the pressure reaches 175 bars.

- 5. There should be no pressure drop nor flow from the open end « d » of the pipe A.
- 6. Release the pressure.
- 7. Disconnect the pipe B from the pipe A and connect it to the other end « d », leaving the end « c » open.
- 8 Repeat the operations given above in sections 4 to 6.

## LIST OF SPECIAL TOOLS MENTIONED IN THE FIRST SECTION OF MANUAL 814-2

	NUMBERS		REFERENCE
ITEM	Methods-	Repairs	of tool on calo
	Old	New	
2 ENGINE			
Bonnet retaining catch Support for raising vehicle using trolley jack Support for engine/gearbox assembly Spanner Swivel socket spanner 12 mm across flats	MR. 4158	MR. 630 64/27	2505-T 3083-T bis 1677-T 2431-T bis
Dial gauge Spanner for cold start delayed thermal switch Torque wrench Dolly and mandrel for fitting damper sealing bush		MR. 630-12/28 MR. 630-34/31	2437 T 2471 T
Mandrel for centring the timing casing Hook for removing the connector from the electronic control unit Gegrhox support	MR 3301-260	MR. 630-31/82 MR. 630-64/38 MR 630-42/13	
Set of two liner retaining bolts Extractor for core plug Mandrel for fitting core plug in cylinder head Extractor for push rods	MR. 1540-170 MR. 3436 220 MR. 3670	MR. 630-23/3 MR. 630-31/45 MR. 630-27/4	3074-T
Spanner for carburettor (12 mm across flats) Spanner for carburettor (11 mm across flats) Gauge for checking petrol pump plunger Ligarex pliers		MR. 630 51/53	3081-T bis 3096-T 3087-T 2483-T
Spanner for H.P. pump nut Rod for aligning pulleys Rod for aligning pulleys Set of gauges for converting an old 3082-T into 3085-T			2280-T 3085-T 3082-T 3092-T
3 CLUTCH Mandrel for centring clutch disc			3106-T
GEARBOX ( and its controls )			
Spanner			1677-1 2421 This
Gearbox support Sling for removing and fitting gearbox and cylinder head Sling for gearbox Gauge for adjusting reverse gear pinion in neutral	MR. 3301-260 MR. 3320-150 MR. 3320-160	MR. 630-42/13 MR. 630-44/10 MR. 630 44/11	7491-1 DI2
position Tool for moving fork shafts Spanner for bearing nut on differential shaft Rod for setting selector		MR. 630 66, 19	3183 T 1770 T bis 2429 T bis
Support for holding engine and removing gearbox Extractor with separator Socket for locking bearing nut in gearbox outlet			1797-T bis 2405-T 1771-T bis
thrust stop on differential shaft Straight edge for dial gauge Bush and mandrel for fitting seal in gearbox outlet		MR. 630-34/26	1767 T bis 1754 T bis 1772 T 2437 T
Dial gauge support for checking run out in the disc Key for removing selector ball joint plugs	MR. 3365-250 MR. 3691-60	MR. 630-52/21 MR. 630-16/6	. 24371
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# LIST OF SPECIAL TOOLS MENTIONED IN THE FIRST SECTION OF MANUAL 814-2

	NUMBERS		REFERENCE
ITEM	Methods	- Kepairs	of tool on sale
	Old	New	
5 TRANSMISSION			
Extractor for track rod ball joints			3505-T
Extractor for tri-axe			1931 - T
<b>b</b> SOURCE AND RESERVE OF PRESSURE			
Spanner for H.P. pump nut ( seven pistons )			2280 T
7 FRONT AXLE			
Extractor for front suspension arm and oil pump			3312-T
pinion Bush for supporting swivel in α vice			3318-T
Castellated socket for nut of upper swivel ball pin			3310-Т
Extractor for upper swivel ball pin seating	· · · · · · · · · · · · · · · · · · ·		3311-T
Cross-cut chisel for nut of lower ball pin seating	MR. 4544	MR. 630-66/16	1750-T
Shell, collar and pad			1753 T
Pad	MR. 3408-270 a	MR. 630-21/23	
pins	· · · · · · · · · · · · · · · · · · ·		3306-T
Dial gauge			2437-1 3314-T
sputnet end piece for seating of lower swiver ball pin			
8 REAR AXLE			201 <b>8 T</b>
Extractor for rear drum hub Extractor for outer cage of outer bearing of rear drum			2018-1
hub	•••••		2019-T bis
Extractor with separator Spanner for nut on rear bearing casing			1757 T or 3459 T
Ligarex pliers			2483 T
Snap tool for crimping wheel dogs Bolt for fitting rear hub begrings	MR. 4114	MR. 630-64/23	
Mandrel for fitting bearing seal for rear wheel spindle	MR. 3676-170	MR. 630-31/72	2101 0
Rear brake lining centring tool		· · · · · · · · · · · · · · · · · · ·	2021-T
Tratate for deposing creatonce in rear hab bearings			
9 SUSPENSION			
Double end-piece for shock absorbers			3656-T 2471-T
Retaining spanner for holding rear suspension cylinders	MR.3434-30	MR. 630-14/4	
Tee-spanner: $6 \times 9$ mm across flats ( for screws with flats on head )			1677-т
Torque wrench			2473 - T

## LIST OF SPECIAL TOOLS MENTIONED IN THE FIRST SECTION OF MANUAL 814-2

ITEM	NUME Methods Ol:	BERS Repairs New	REFERENCE of tool on sale
DescriptionSTEERING SYSTEMTee-spanner for bolt on steering column securing clamp Compressor for steering column spring Extractor for conical nuts on anti-thief device Tool for conical nuts on instrument panel Tool to remove anti-thief device on steering system Extractor for track-rod ball joint Fixture for adjusting relay position Steering column and pinion alignment gauge Extractor for pin connecting piston to steering rack control rod Bracket for holding steering in vice Open-end spanner for adjusting rack end-housing Spanner for rack pressure pad securing nut Plate and foil for removing and fitting pin connecting piston to control rod . Used with 1969 T bis	MR. 3691-70 MR. 3304-50 α	MR. 630-16/7 MR. 630-22/9 a	1994-T 1991-T bis 3904-T 2661-T 2408-T 3505-T 1995-T 1955-T bis 1969-T bis 1999-T 2186 T
Image: Distance of the series of the seri	MR. 4148-50	MR. 630 64/ 32	3571-T 1797 T bis 2505-T 2110-T 3556-T 1677-T







Gearbox

Gearbox (4





(4) Gearbox









Manual 814-2

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9

Suspension

Steering

1

10

MR. 630-22, 9a ex MR. 3404-50 a Detail a 1969-T Bis 3 at 45° 80 a 22 А XXX b Detail b r\_9,5 Developed length : 40 mm Ø₌8 12 28 A : file the weld inside the yoke if necessary í


Steering (10)

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11) Brakes

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