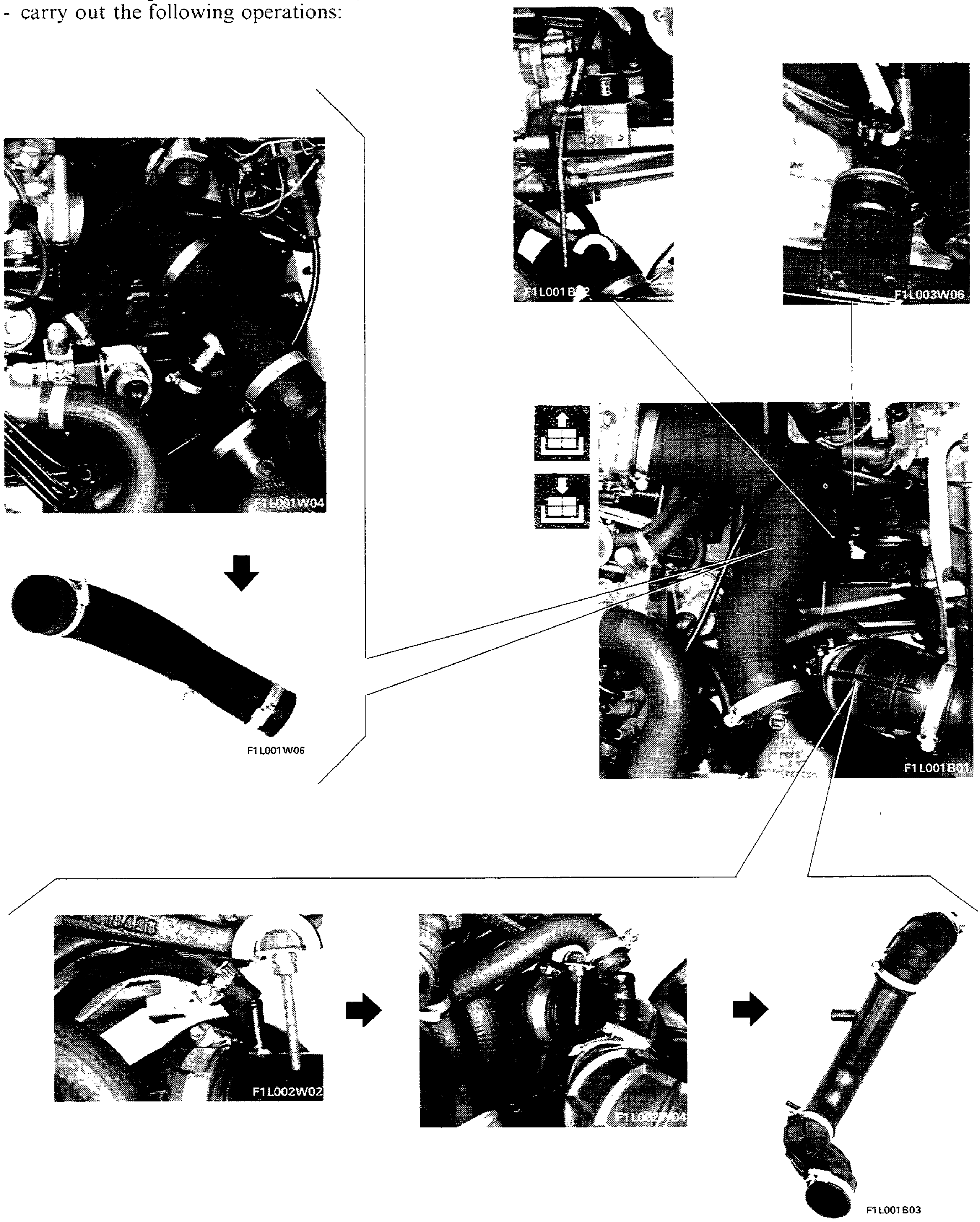
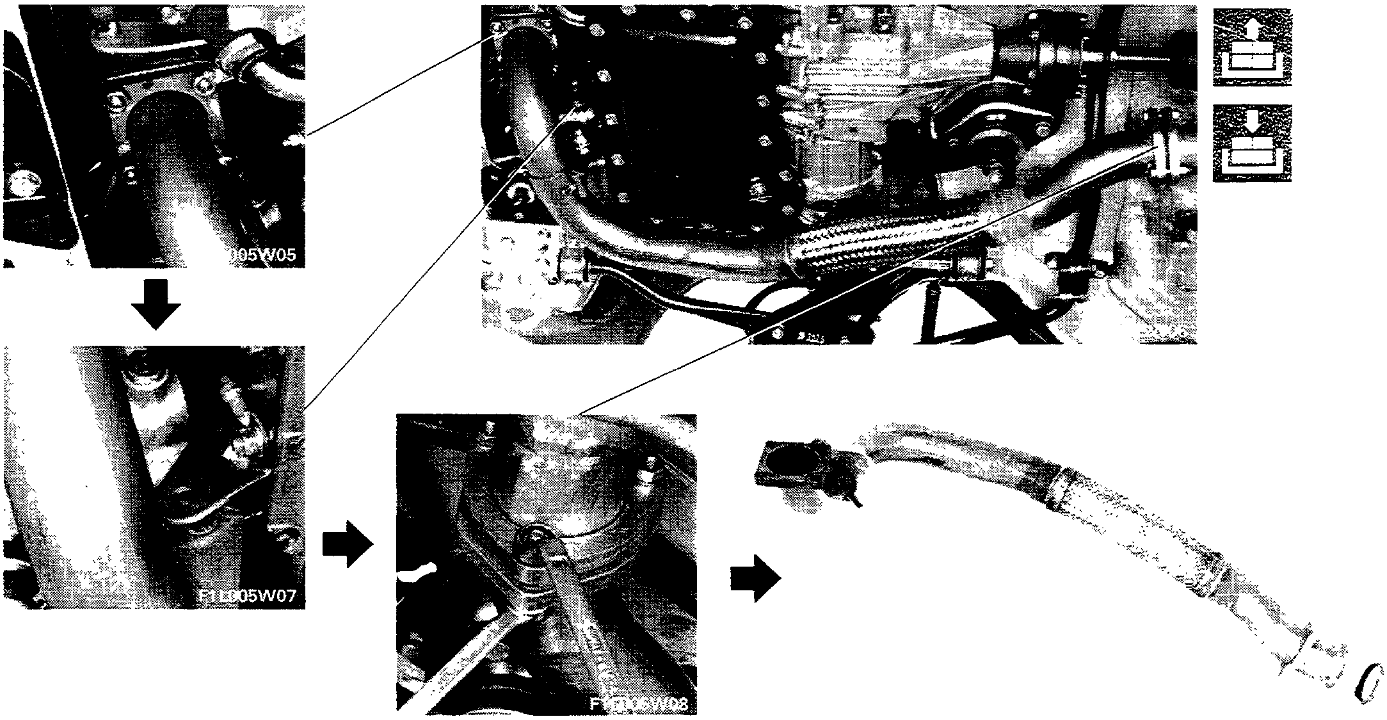
Position car on lift.

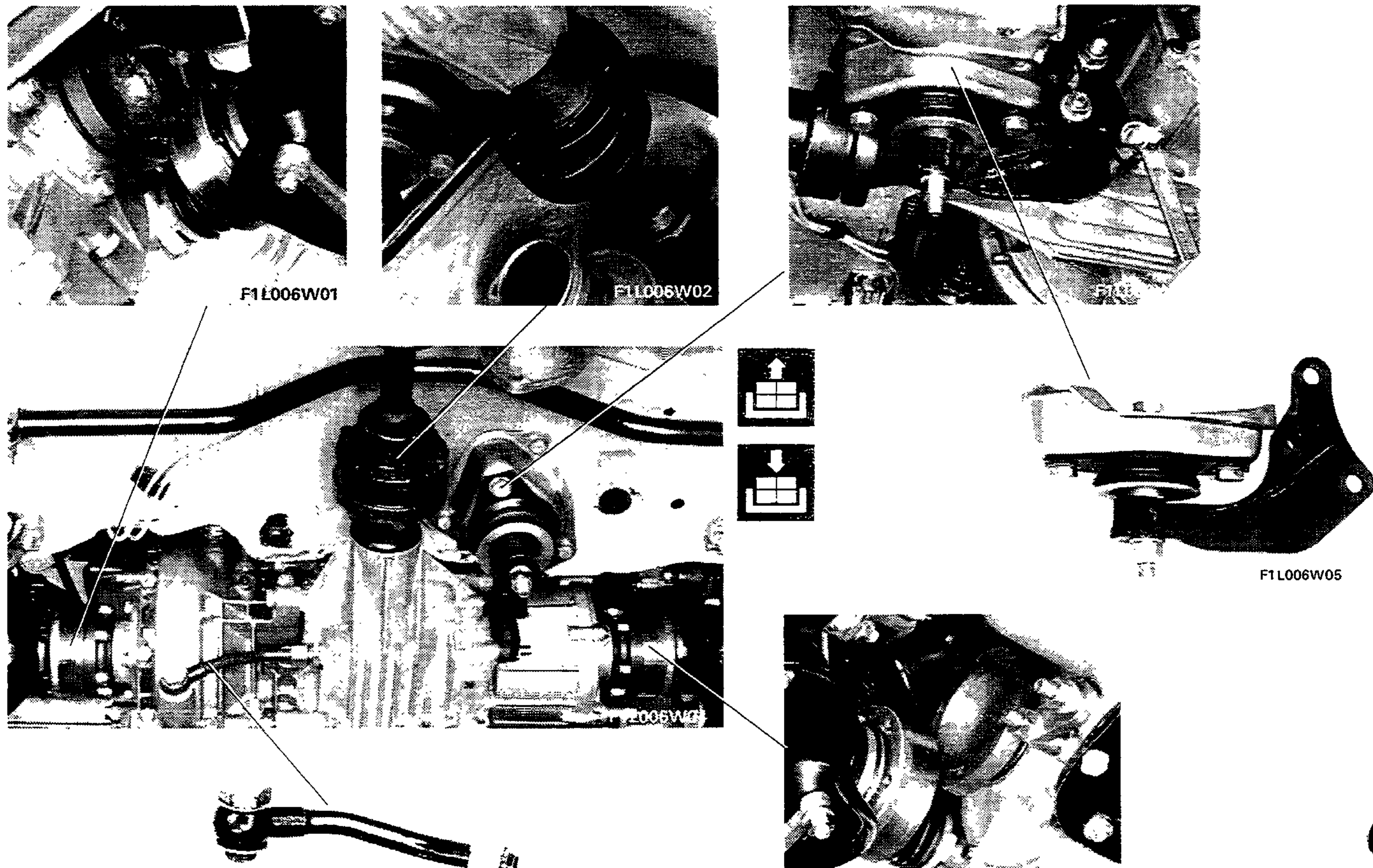
Proceed as follows:
- disconnect negative lead from battery:
- carry out the following operations:

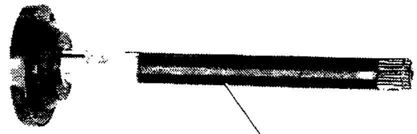


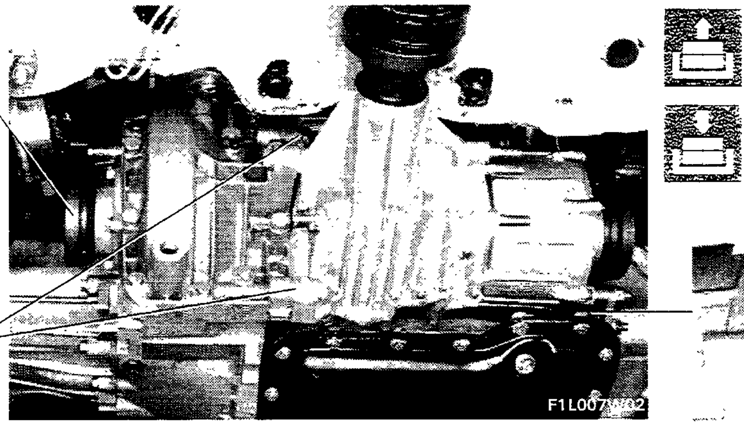
21-27.

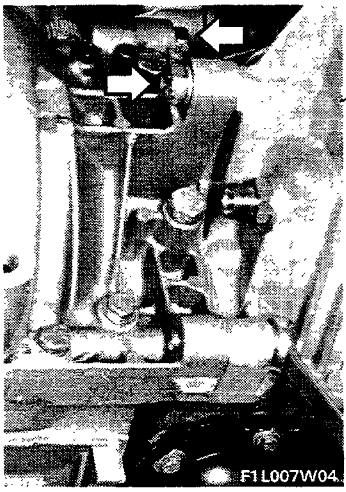
- remove the front wheels;
- raise the lift and, working from beneath the car, drain the gearbox oil;
- carry out the following operations:

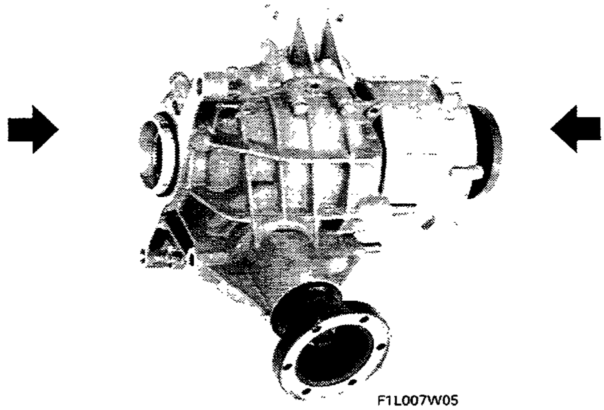





F1L007W01


F1L007W02


F1L007W04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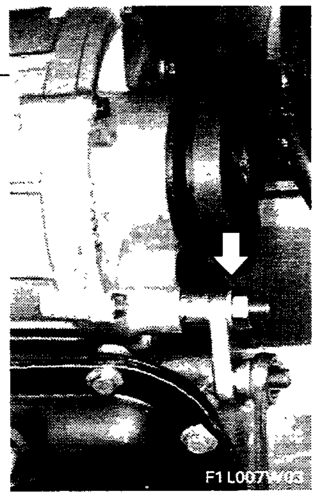
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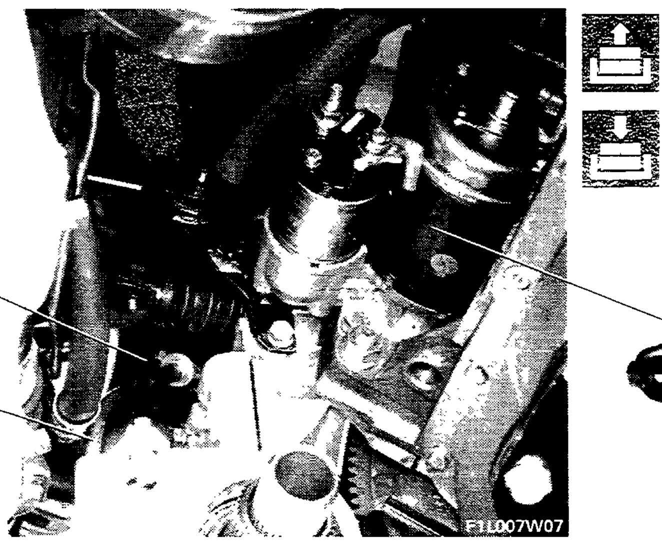
F1L007W06


F1L007W09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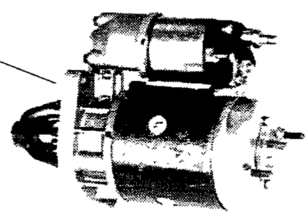
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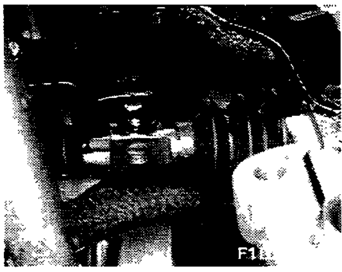

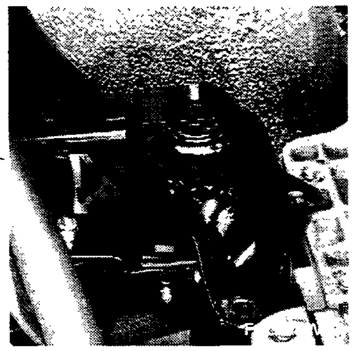

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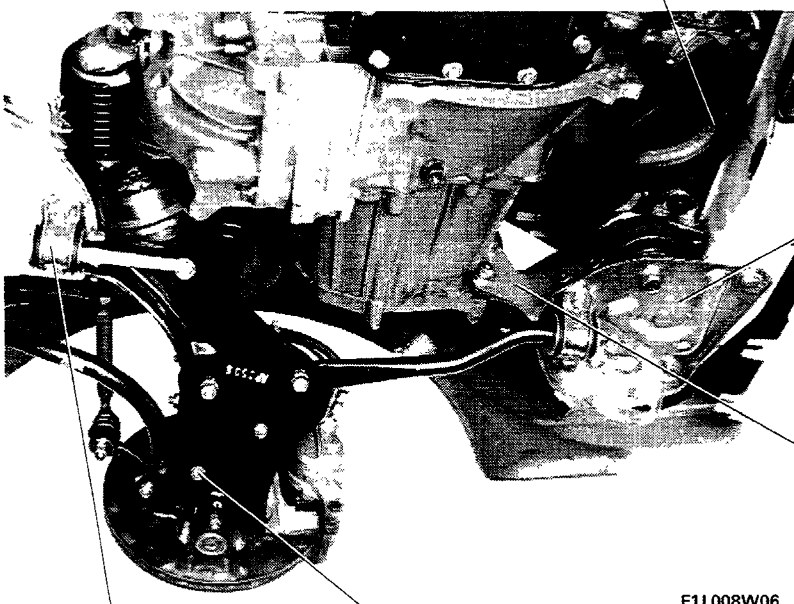

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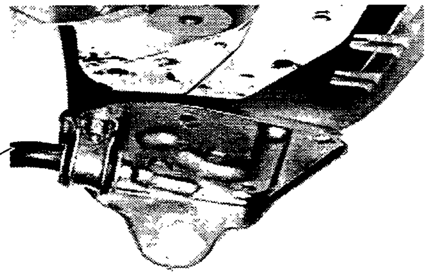

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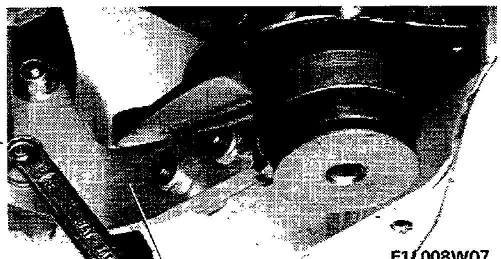
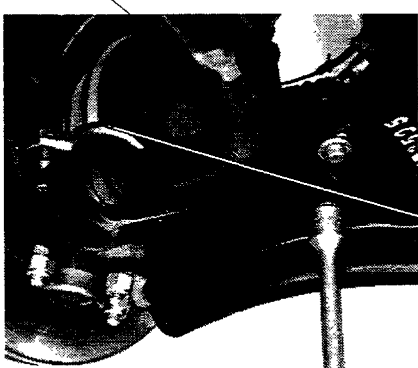


F1L008W07

F1L008W08

F1L008W11



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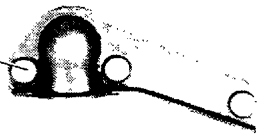
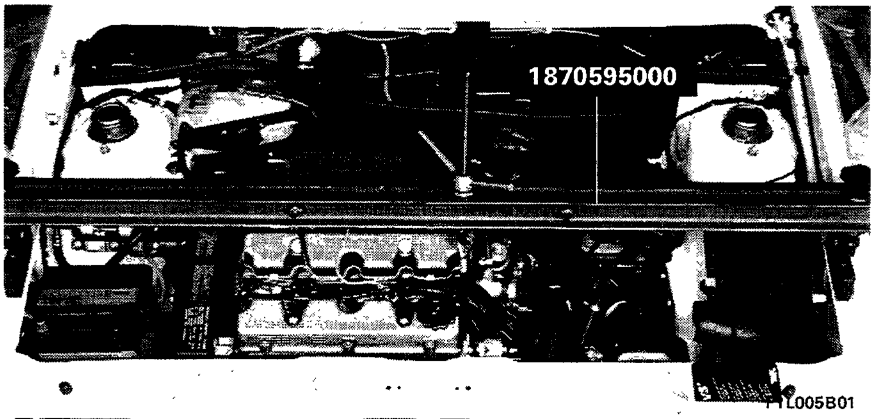
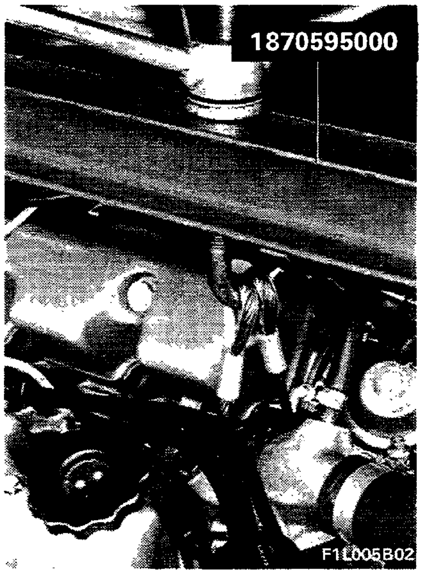


F1L008W09

- lower the lift, position crossbeam 1870595000 in engine compartment and support engine using special hook;
- then carry out the following operations:

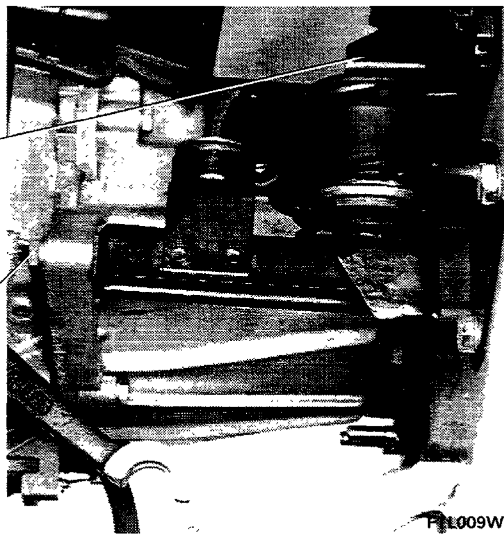


F1L005B01



F1L005B02


F1L00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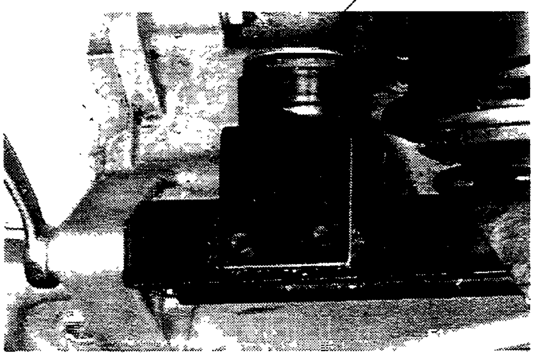
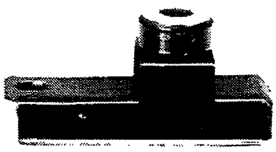
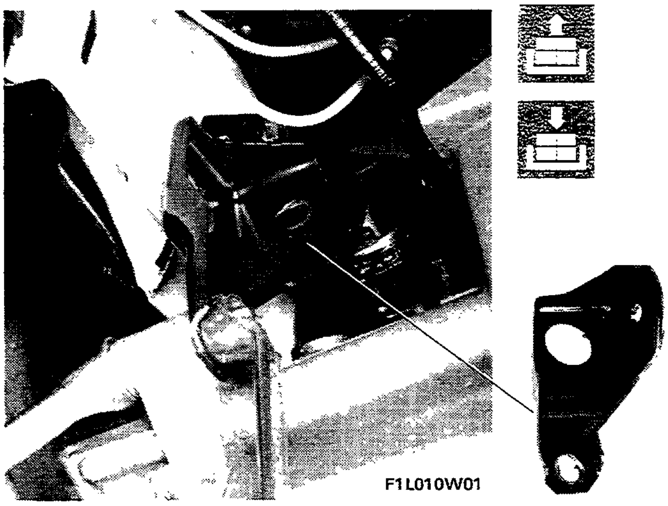


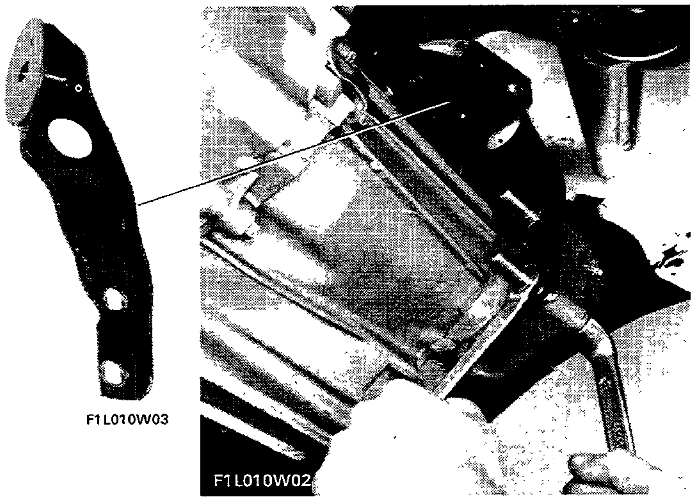

F1L009W06

21-27.

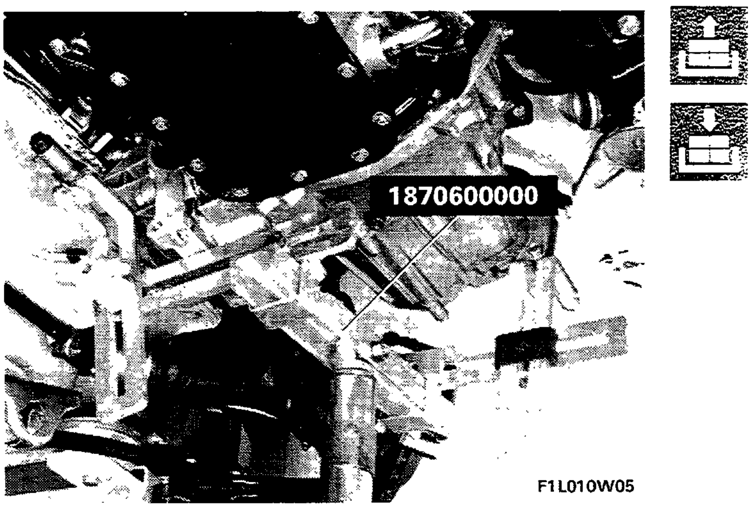
- raise the lift and, working from beneath, proceed as follows:



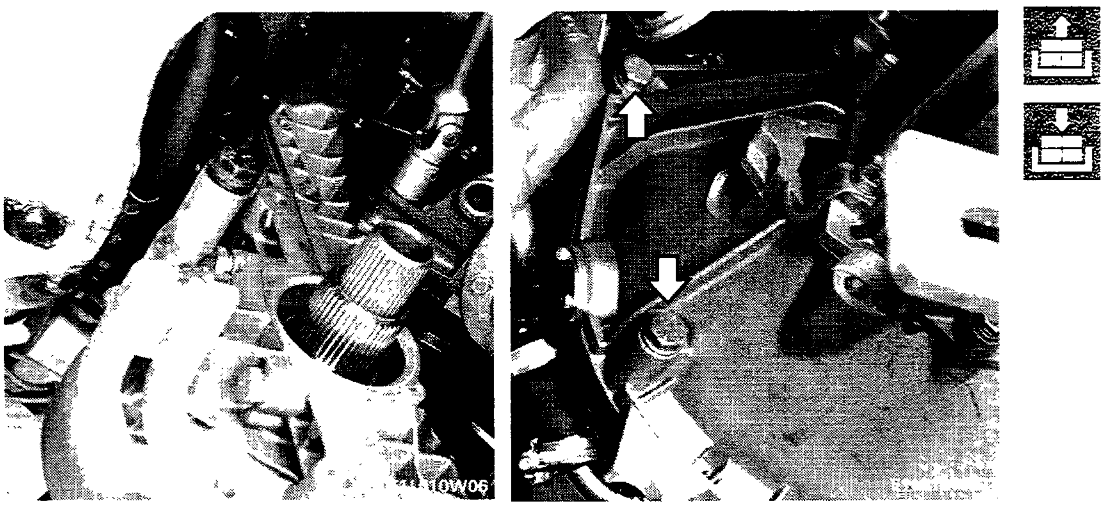
Removing-refitting rear gearbox support bracket

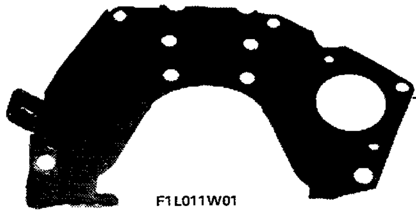


Removing-refitting front gearbox support bracket

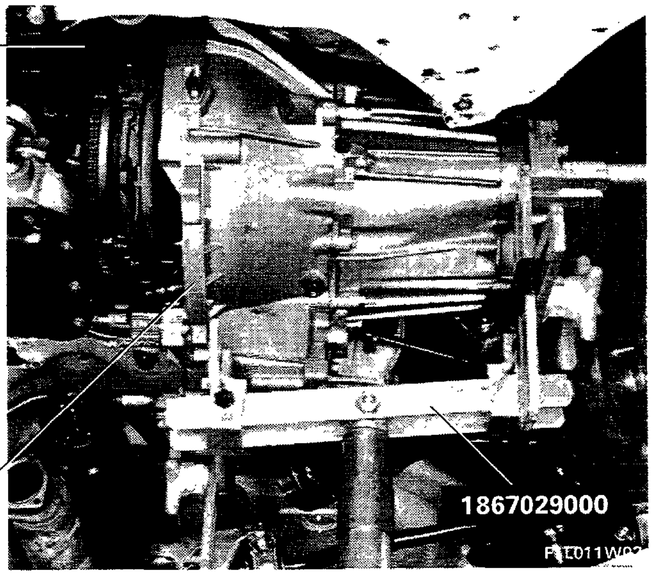


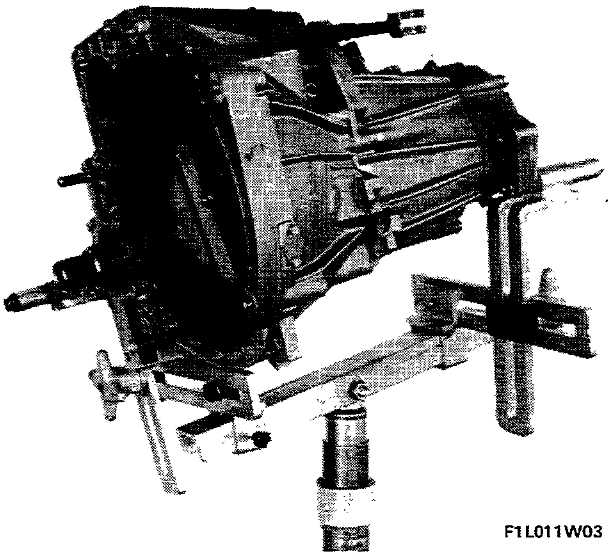
- remove bolts retaining the flywheel cover, arrange gearbox-differential support 1870600000 as shown in the diagram and position the hydraulic jack;
- remove the bolts retaining the gearbox-differential unit to the engine;





F1L011W01



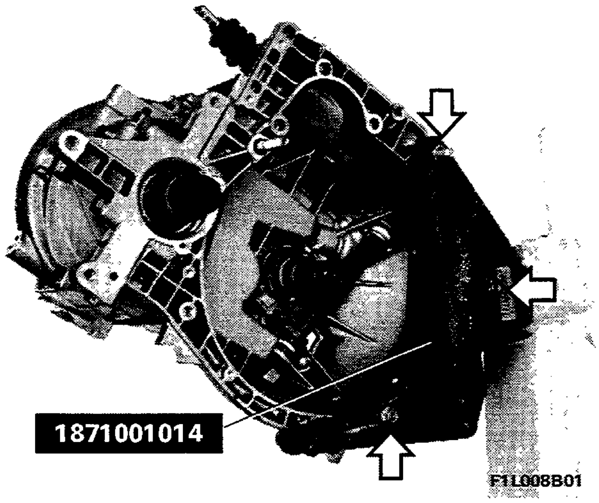


F1L011W03

- move the gearbox-differential unit until this is free of the engine centring pins and the clutch shaft slides out of the driven plate;

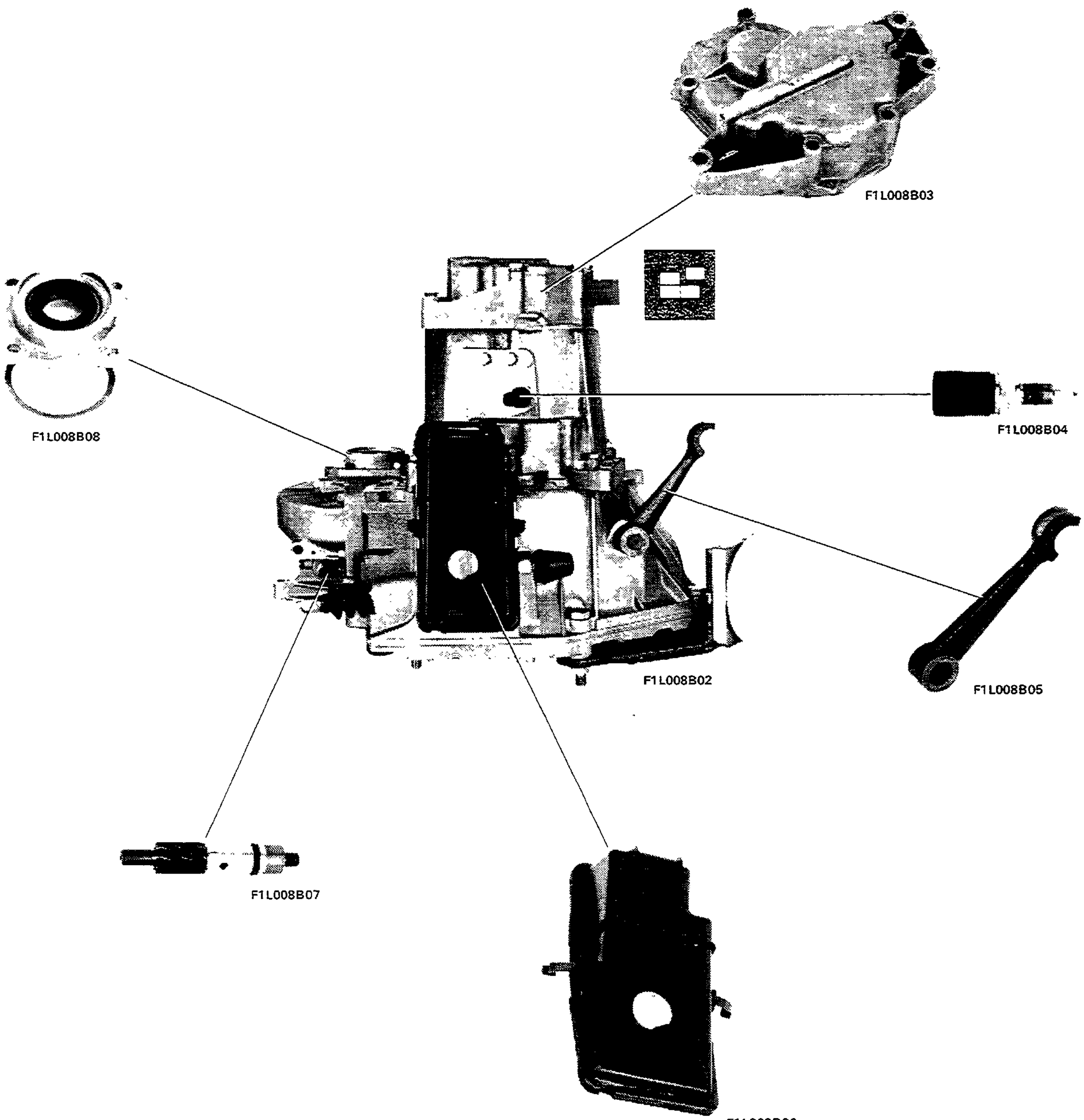
NOTE *Carry out removal operations in reverse order to refit the gearbox-differential unit.*

Clutch pedal height.

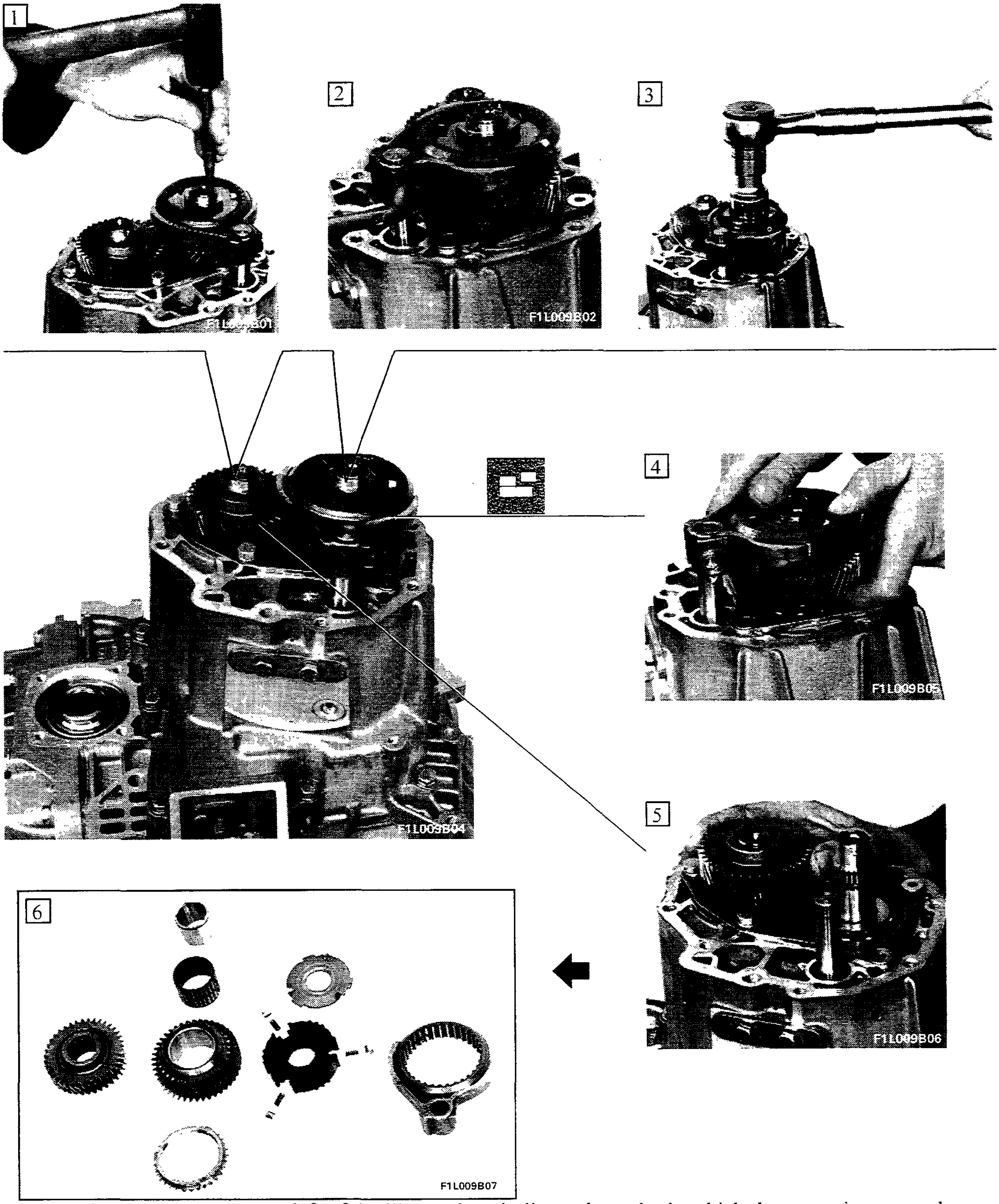


OPERATION SEQUENCE

- Position gearbox on rotary stand using support 1871001014;
- carry out the following operations:

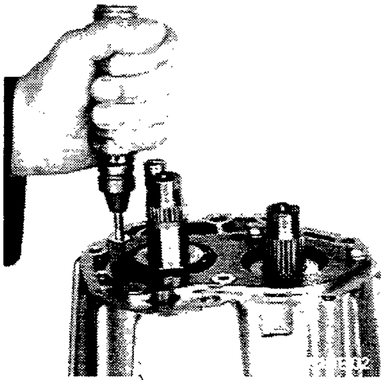


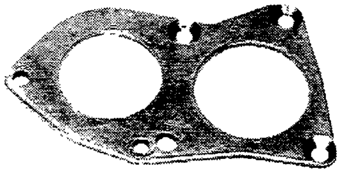
- engage 5th gear by hand and then use the gear lever to engage any speed. This operation is necessary to release the lock collars that secure the gears.



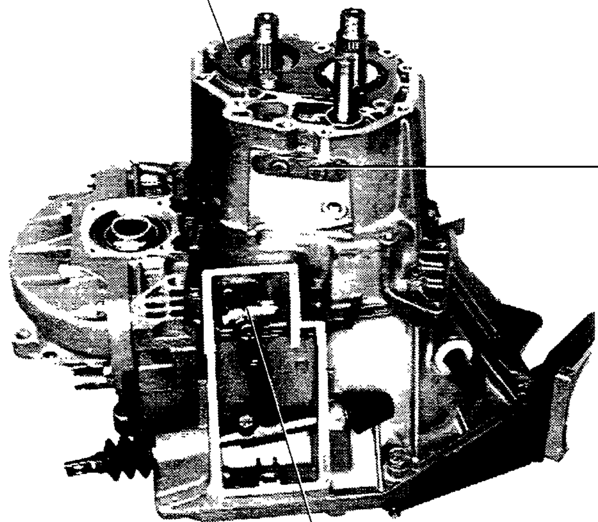
The numbers shown at the top left of the illustrations indicate the order in which the operations must be carried out.

21-27.





F1L010B03



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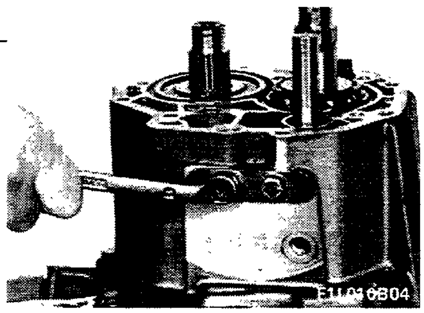

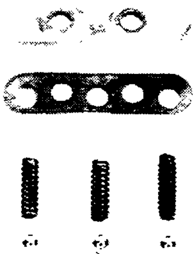

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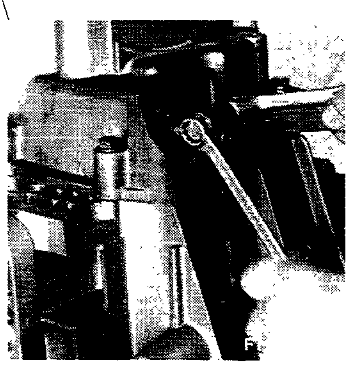
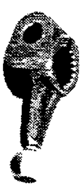
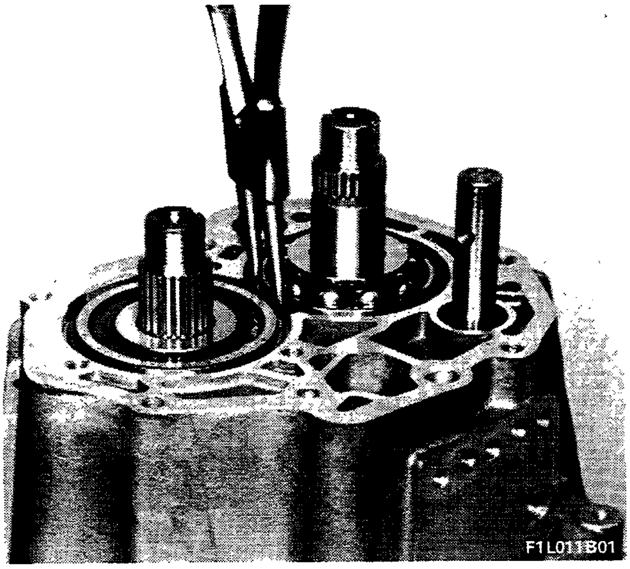


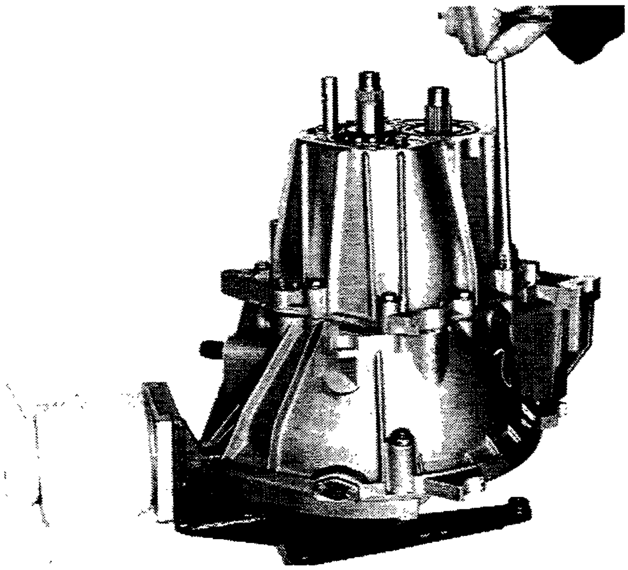


F1L010B07

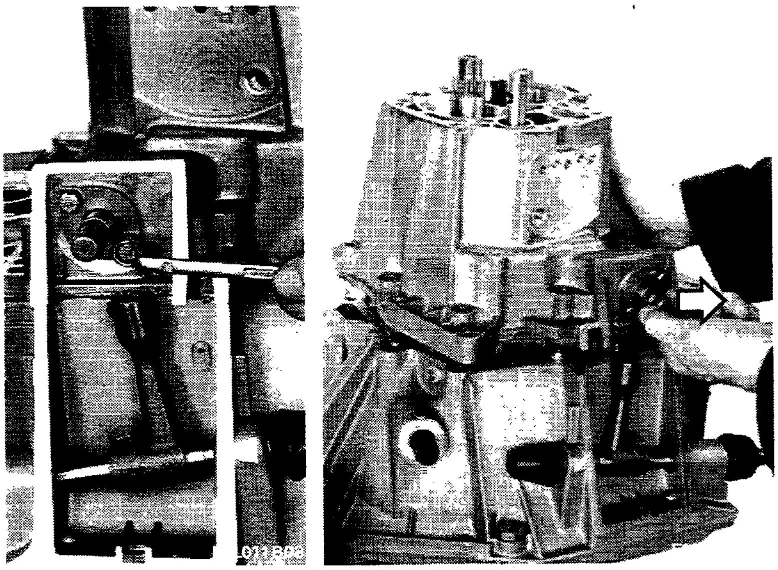


Removing rear bearing retaining rings

NOTE *To extract bearing retaining rings, turn until the opening is at the front as shown in the diagram.*



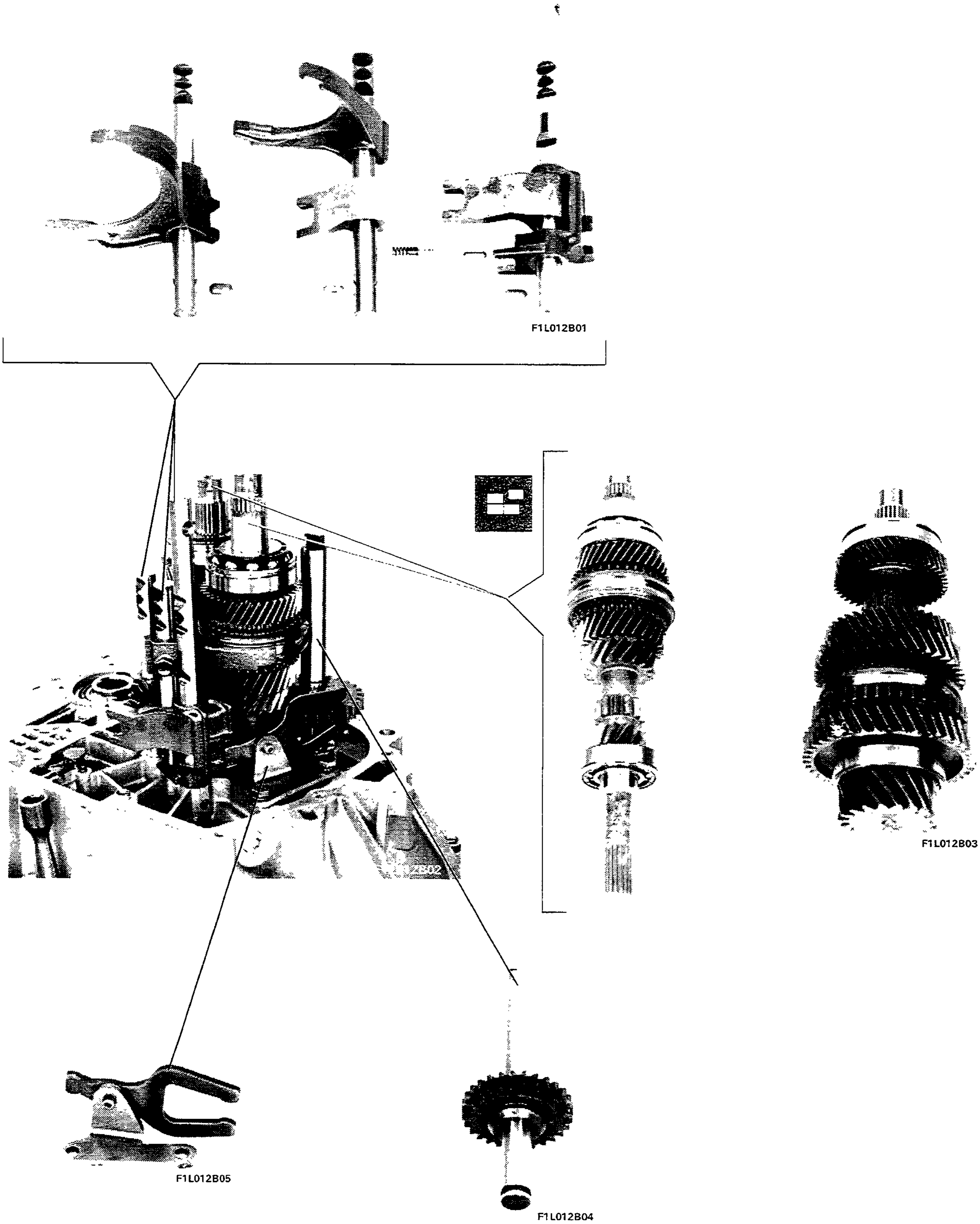
Removing gearbox casing

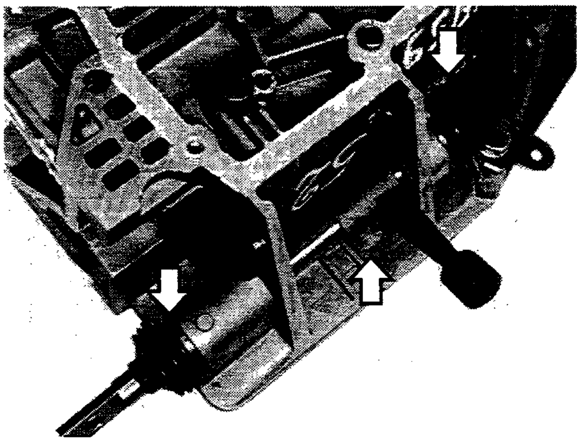


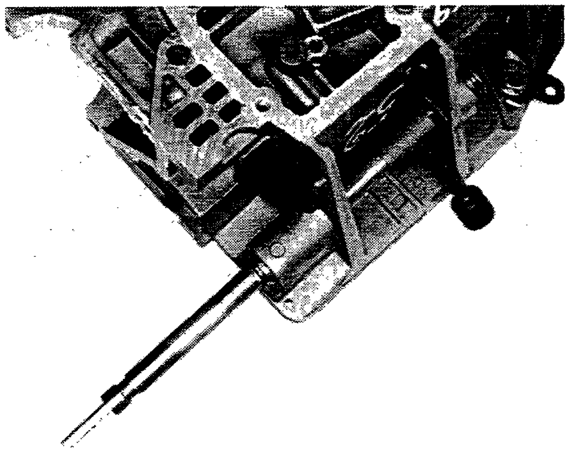
Removing gearbox casing

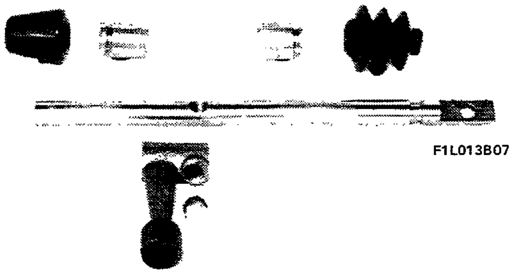
Slacken bolts retaining bushing to gearbox to release the end of the gear shift lever from the dogs.
Move gear shaft backward in the direction arrowed and then remove gearbox casing.

21-27.









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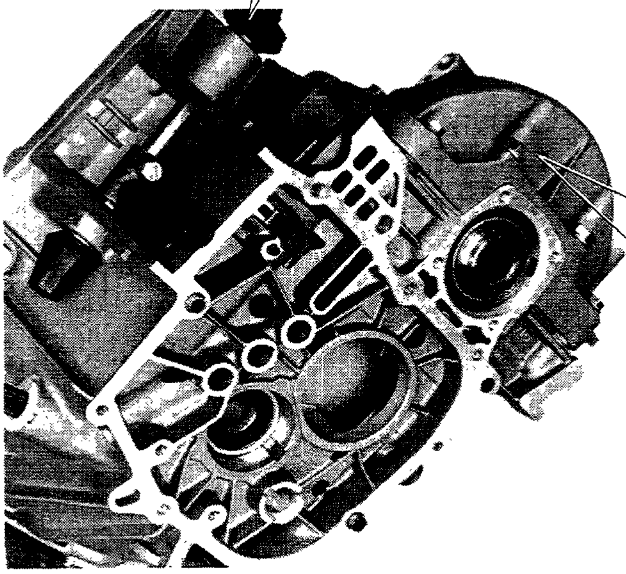
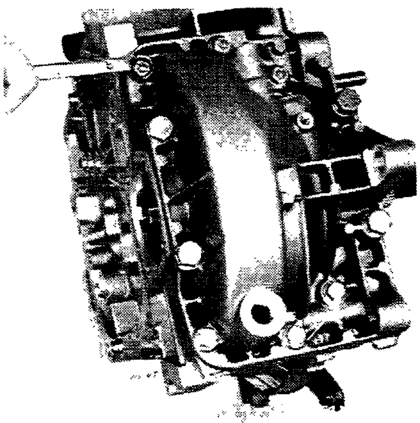
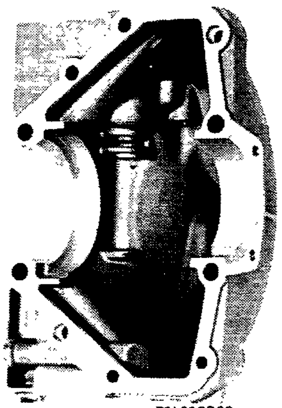
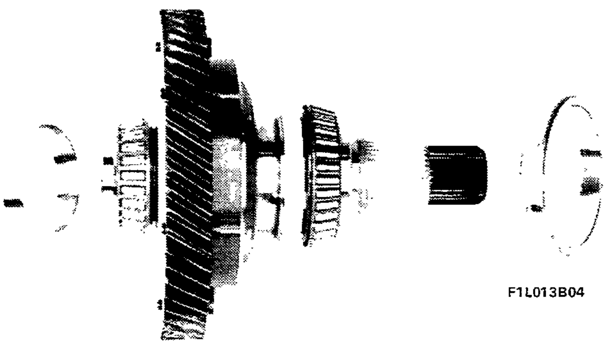




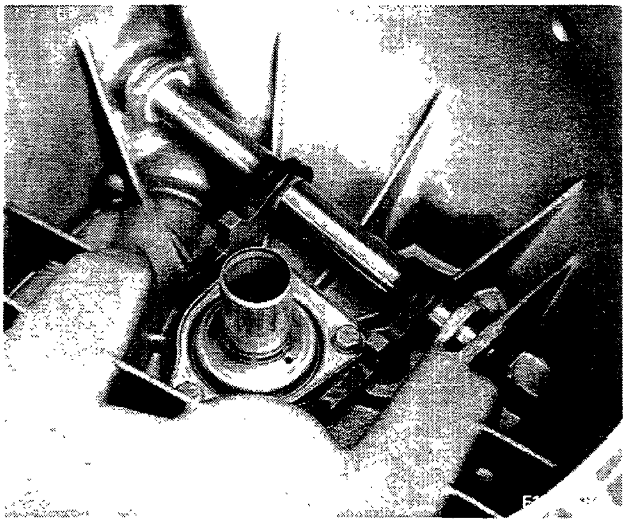


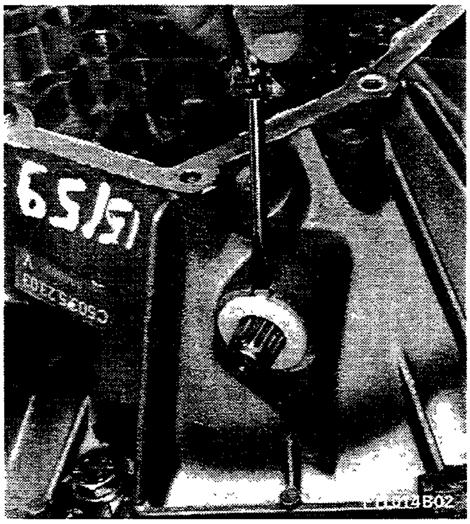


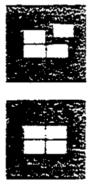
F1L013B04

F1L013B03

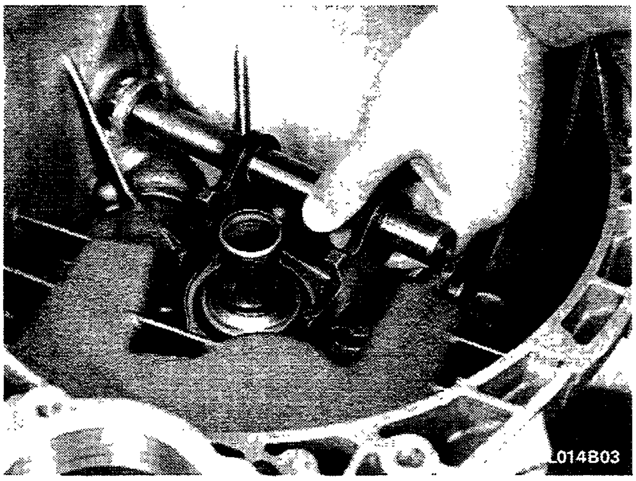
21-27.

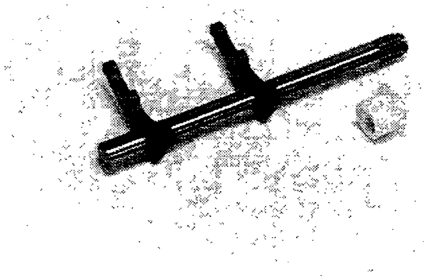


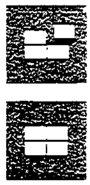




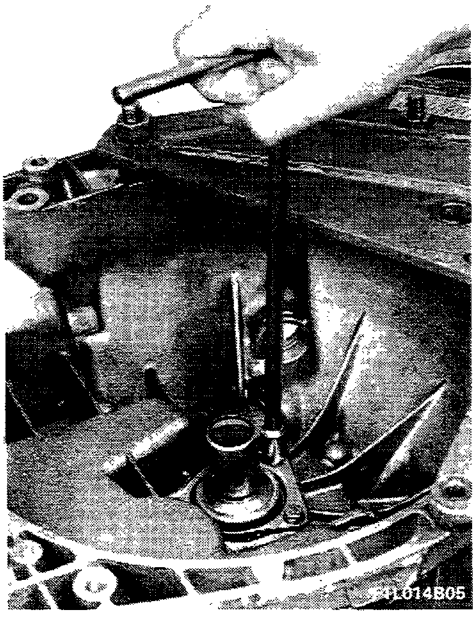
Removing-refitting fork and thrust bearing control shaft

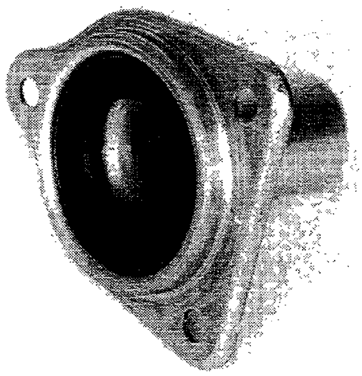


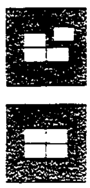




Replace the bushing whenever excessive play is noted in the fork control shaft.





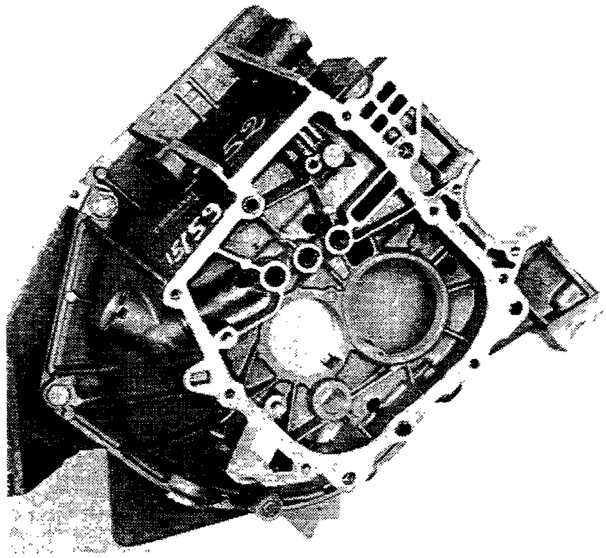


Removing-refitting thrust bearing sleeve

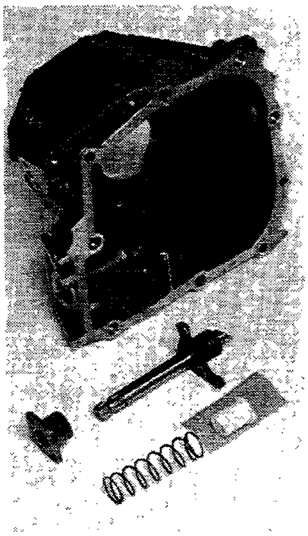
Replace the sleeve and gasket whenever gear oil leaks are noted.

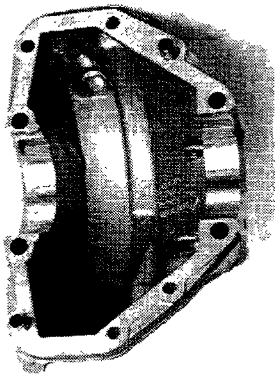
Checking bell housing, central housing, rear cover and differential cover

The housing, cover, support and differential cover should not show signs of cracks. The bearing and rod seats should not be worn or damaged.
The contact surfaces should be flat (use a fine file for slight unevenness).



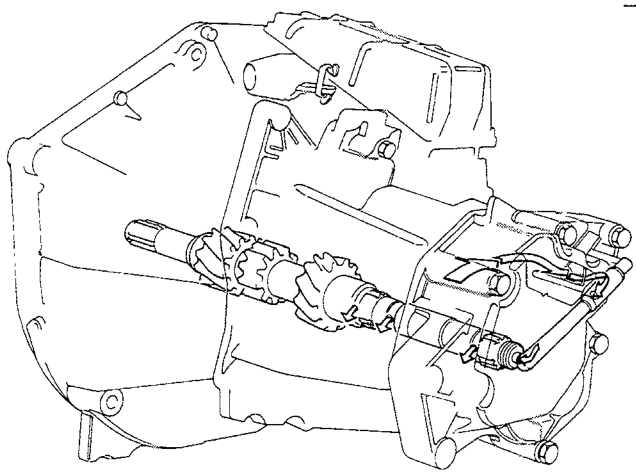
Bell housing



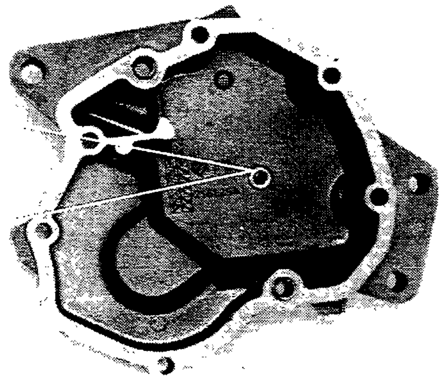


Central gearbox housing

Differential cover



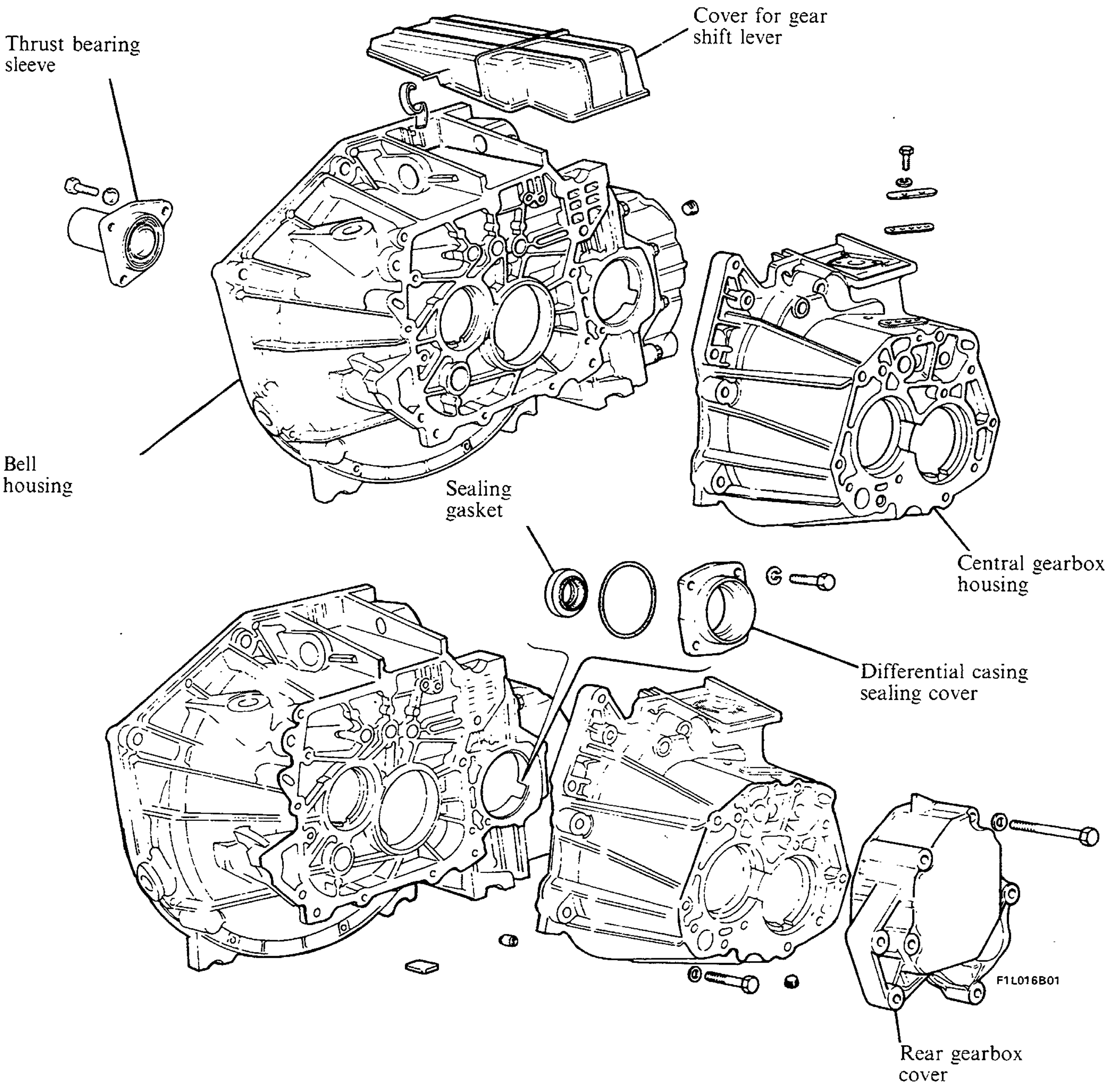
F1L015B05



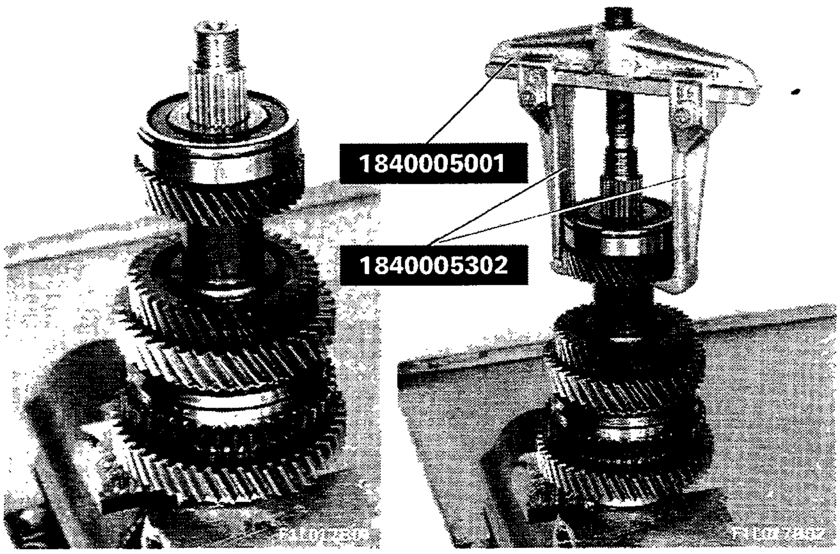
Rear gearbox cover

NOTE *The inner main shaft lubrication duct located inside the rear gearbox cover must not be obstructed. (Only for Delta HF 4WD).*

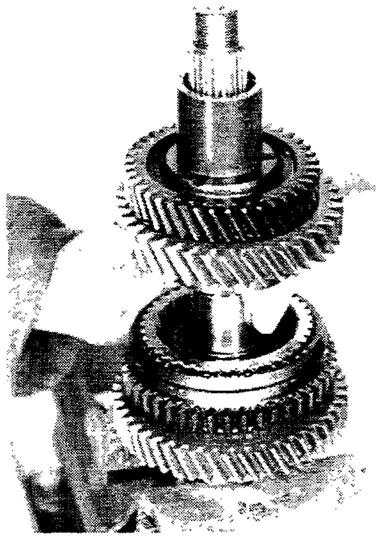
External gearbox parts, supplied as spares



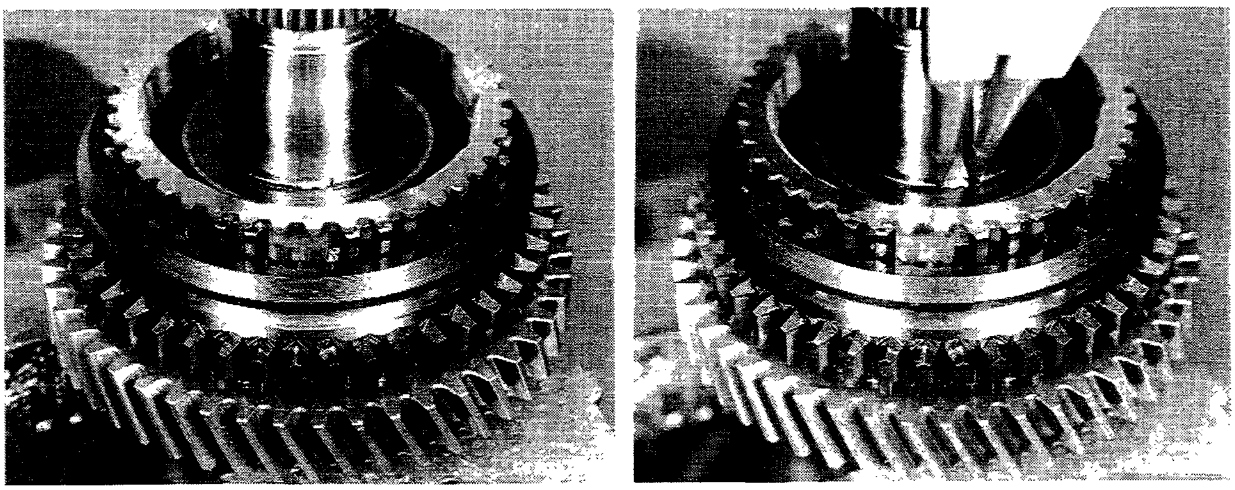
LAYSHAFT (disassembly)



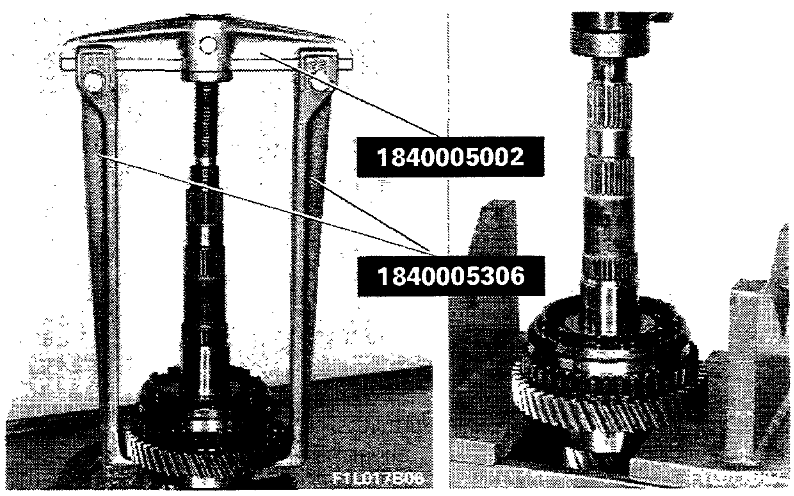
Extracting rear bearing and 4th speed driven gear from layshaft



Removing 3rd and 2nd speed driven gears and spacer



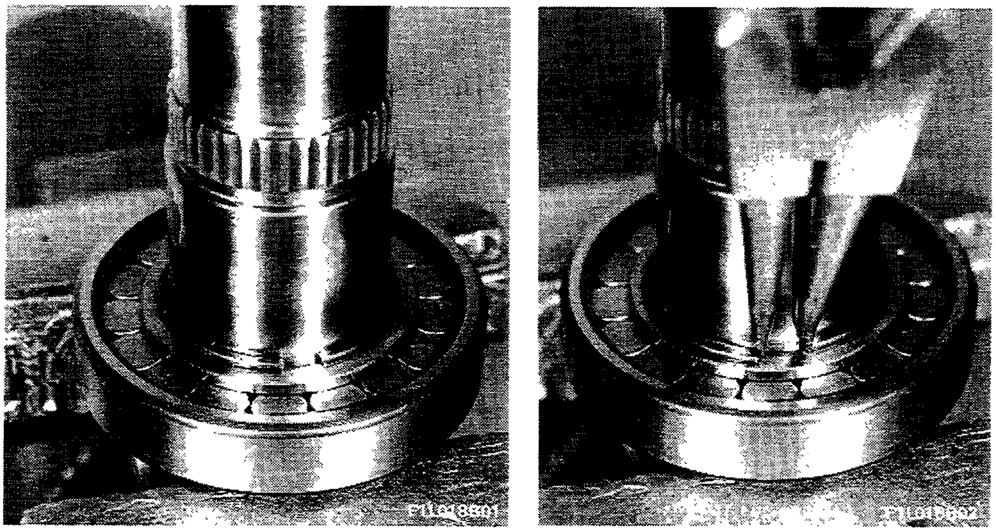
Removing 1st and 2nd speed sliding engagement hub retaining ring, reverse gear (outer part) and 1st speed gear from layshaft using tool 1881101000.



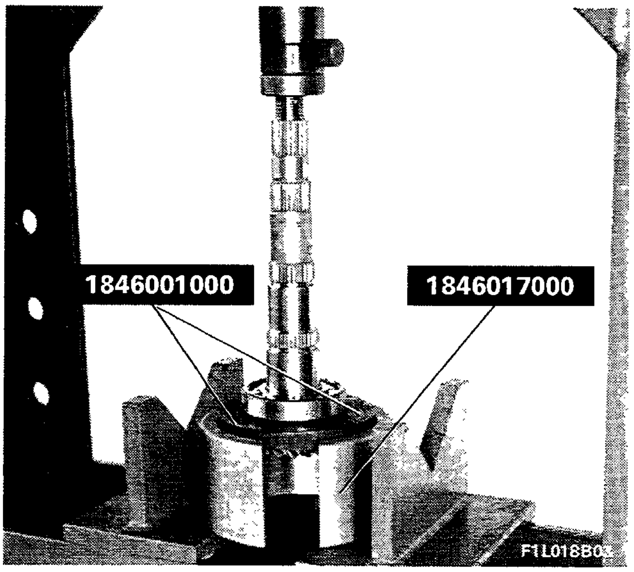
Extracting 1st and 2nd speed sliding engagement hub, reverse gear (external part) and 1st speed gear from layshaft

Disassembly operations may also be carried out using a press.

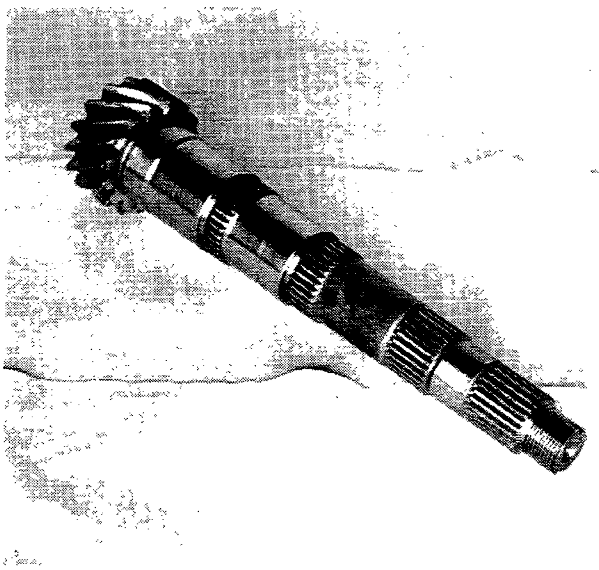
21-27.



Removing front bearing retaining ring from layshaft



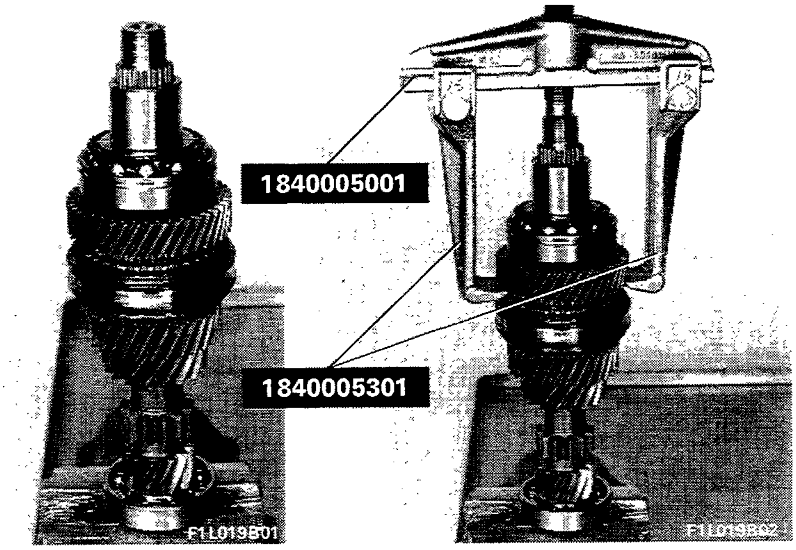
Extracting front bearing from layshaft



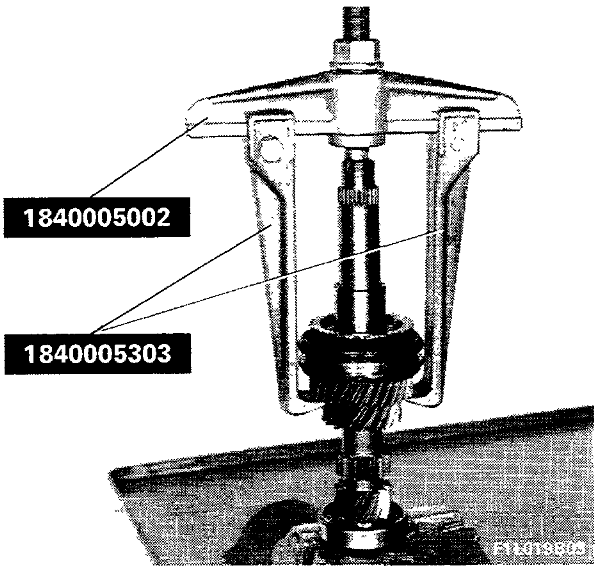
Layshaft - pinion for spur gear-pinion set

Whenever the layshaft-pinion assembly is replaced, the crown wheel must also be replaced.

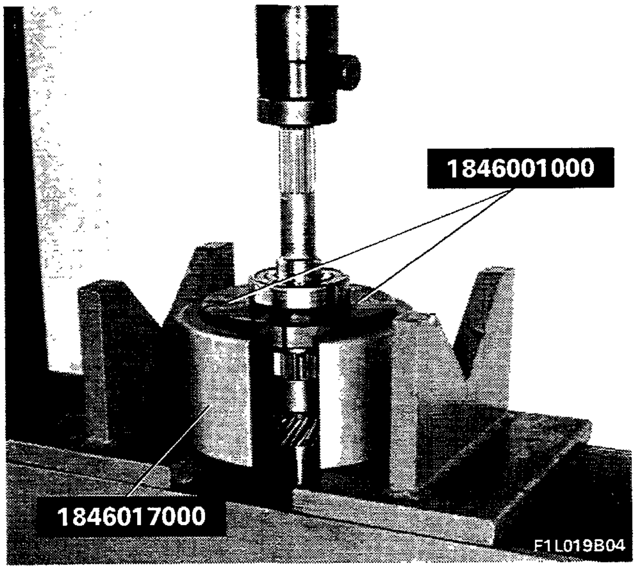
MAIN SHAFT (disassembly)



Removing rear bearing and 4th speed driving gear from main shaft



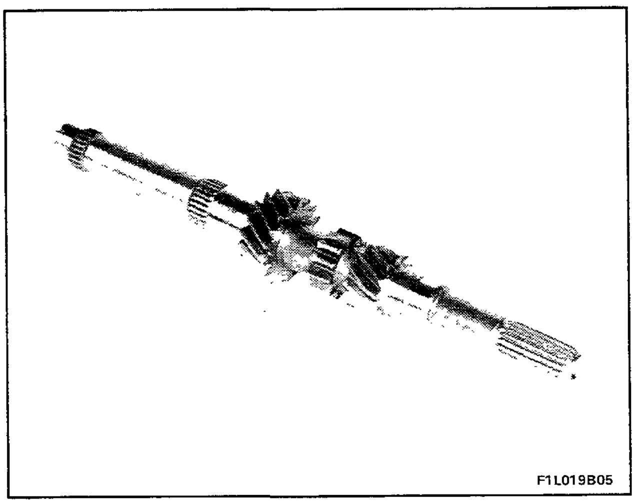
Extracting 3rd speed driving gear and sliding sleeve complete with 3rd-4th speed engagement hub from main shaft



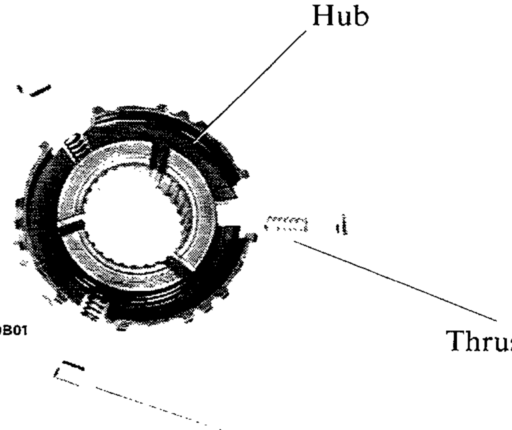
Extracting front bearing from main shaft using hydraulic press

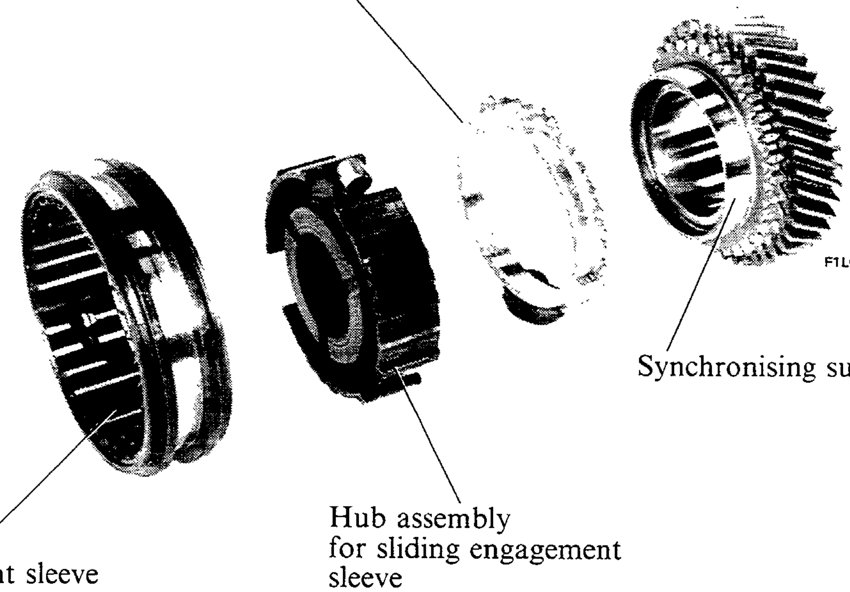
Checking main shaft

Checking gears for signs of binding or excessive wear.
If a high mileage has been driven, it is advisable to replace all main shaft gears whenever the main shaft is replaced.
On the Delta HF 4WD the main shaft has a port for lubricating 3rd and 4th speed gears.



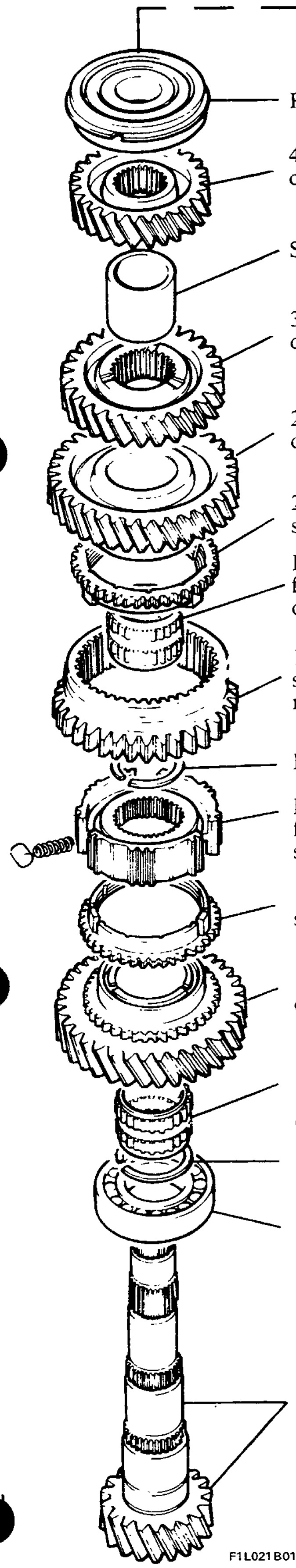
SYNCHRONISING RINGS

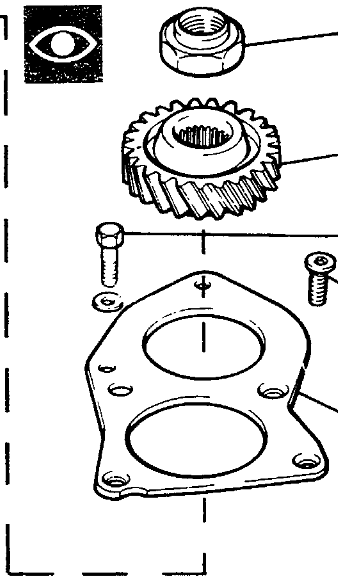




Checking synchroniser components

The synchronising ring should not show signs of wear or ovalisation on its inner surface.
It is advisable to replace the synchroniser in all cases.
Check that the hubs and sliding engagement sleeves are unnotched and that the two slide over one another without excessive play or binding. Replace sleeve inner teeth if they show signs of wear.
Check condition of thrust springs and rollers. Replace if necessary.





LAYSHAFT (assembly)

GEARS - BUSHINGS

The gear teeth and side engagement teeth (synchroniser crown) should not be notched or excessively worn.
Also check that the inner gear surfaces do not show signs of binding or excessive wear.

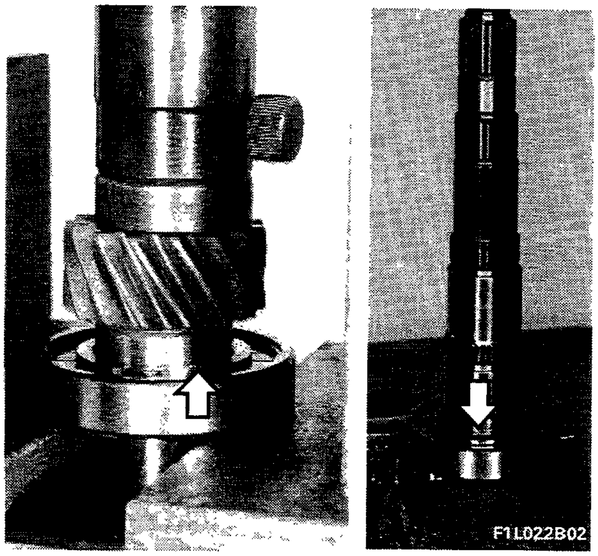
HUBS - SLEEVES

Check that the 1st-2nd gear hubs and sliding sleeves do not show signs of notching and that they slide over one another without excessive play or binding. Replace internal sleeve teeth of they are worn.

BEARINGS

Replace bearings whenever scoring, excessive play or wear are noted.

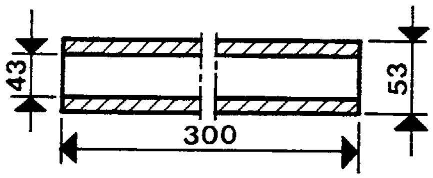
21-27.



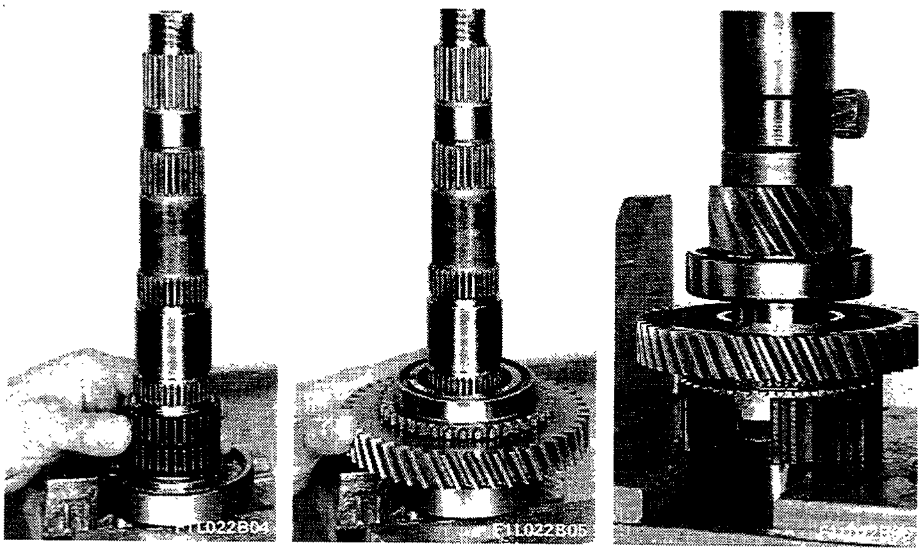
parts involved with transmission oil prior to final assembly.

Installing front bearing and retaining ring on layshaft

Use a tool of the size and shape shown below in order to fit front bearing properly.

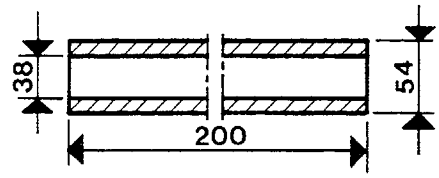


F1L022B03



Installing roller bearing, 1st speed driven gear and hub for 1st-2nd speed sliding sleeve

Use a tool of the size and shape shown below to fit hub properly.



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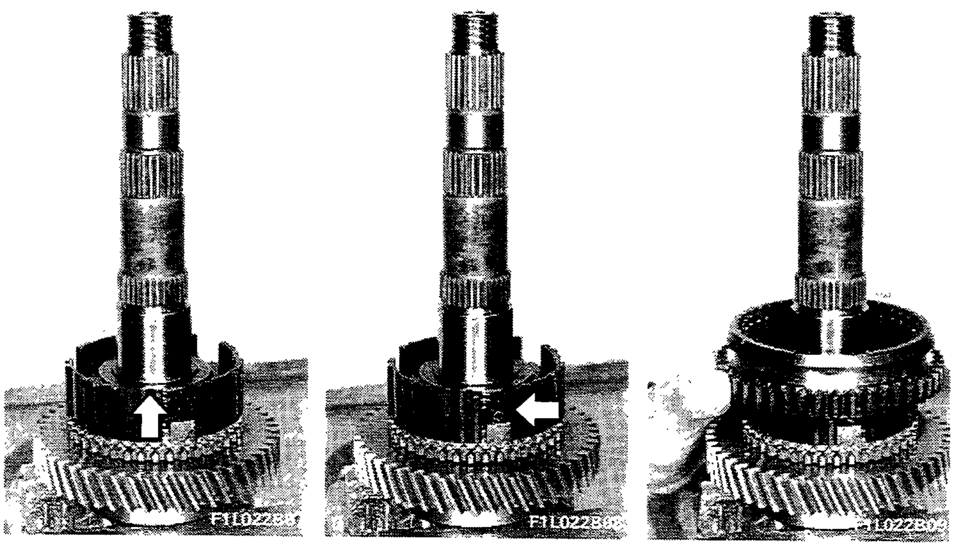
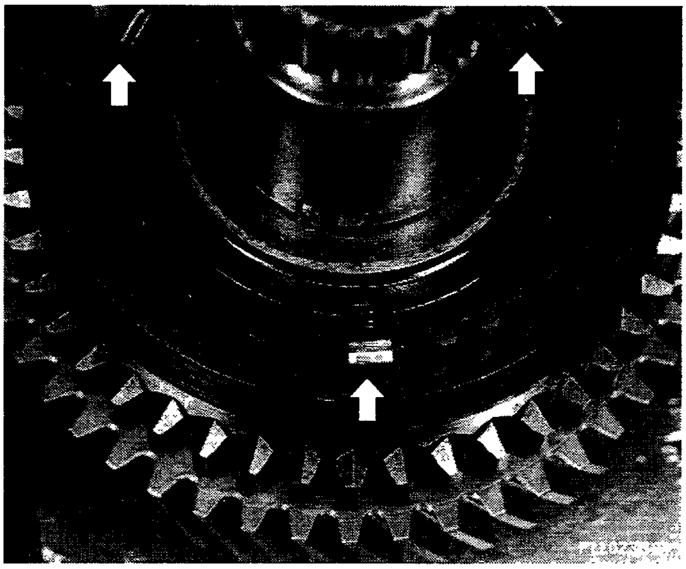
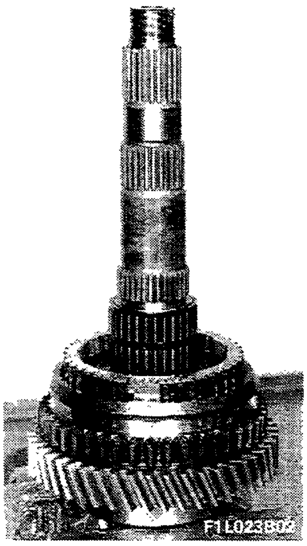


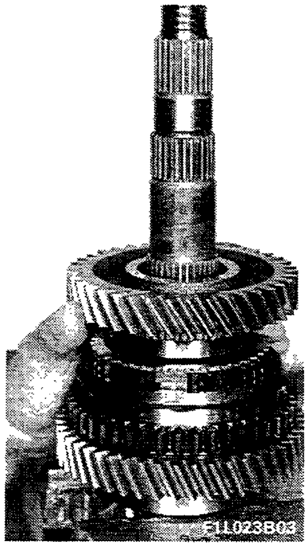
Installing hub retaining ring, springs for rollers and 1st-2nd speed sliding gears and reverse gear (external part)



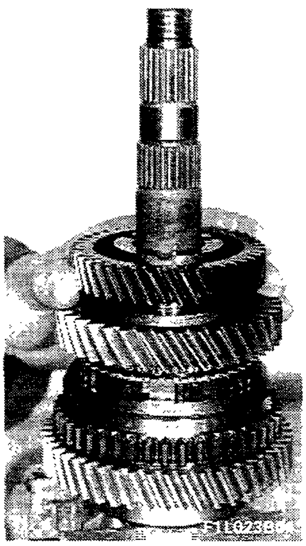
Move the sliding sleeve to neutral position in order to avoid losing synchroniser rings and rollers

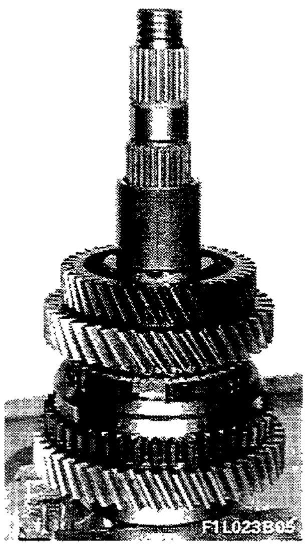
Using a screwdriver, fit the three synchroniser rollers between the springs positioned on the hub and the grooves on the 1st-2nd speed engagement sleeve





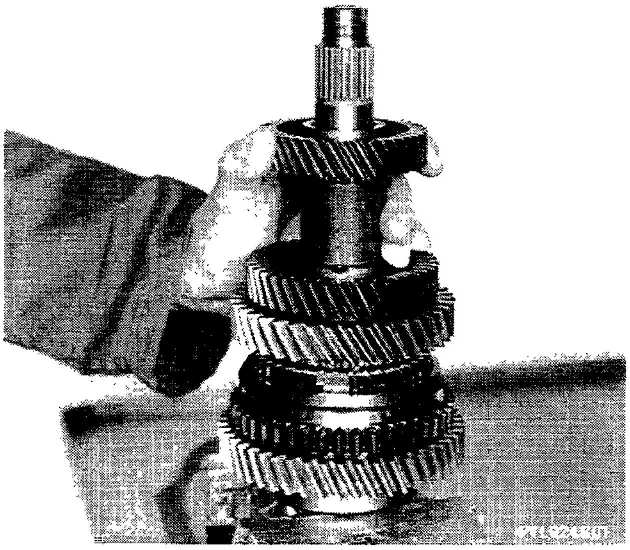
Installing 2nd speed synchroniser ring and 2nd speed driven gear



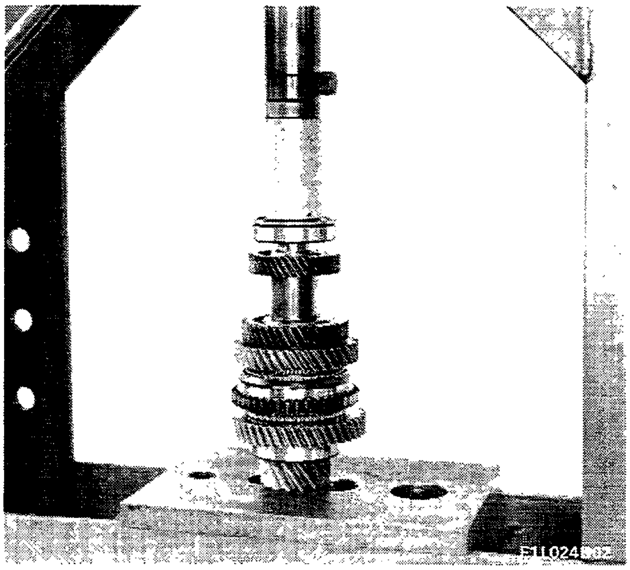


Installing 3rd speed driven gear and spacer

21-27.

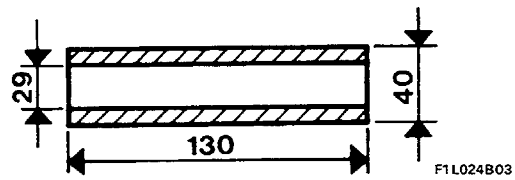


Installing 4th speed driven gear

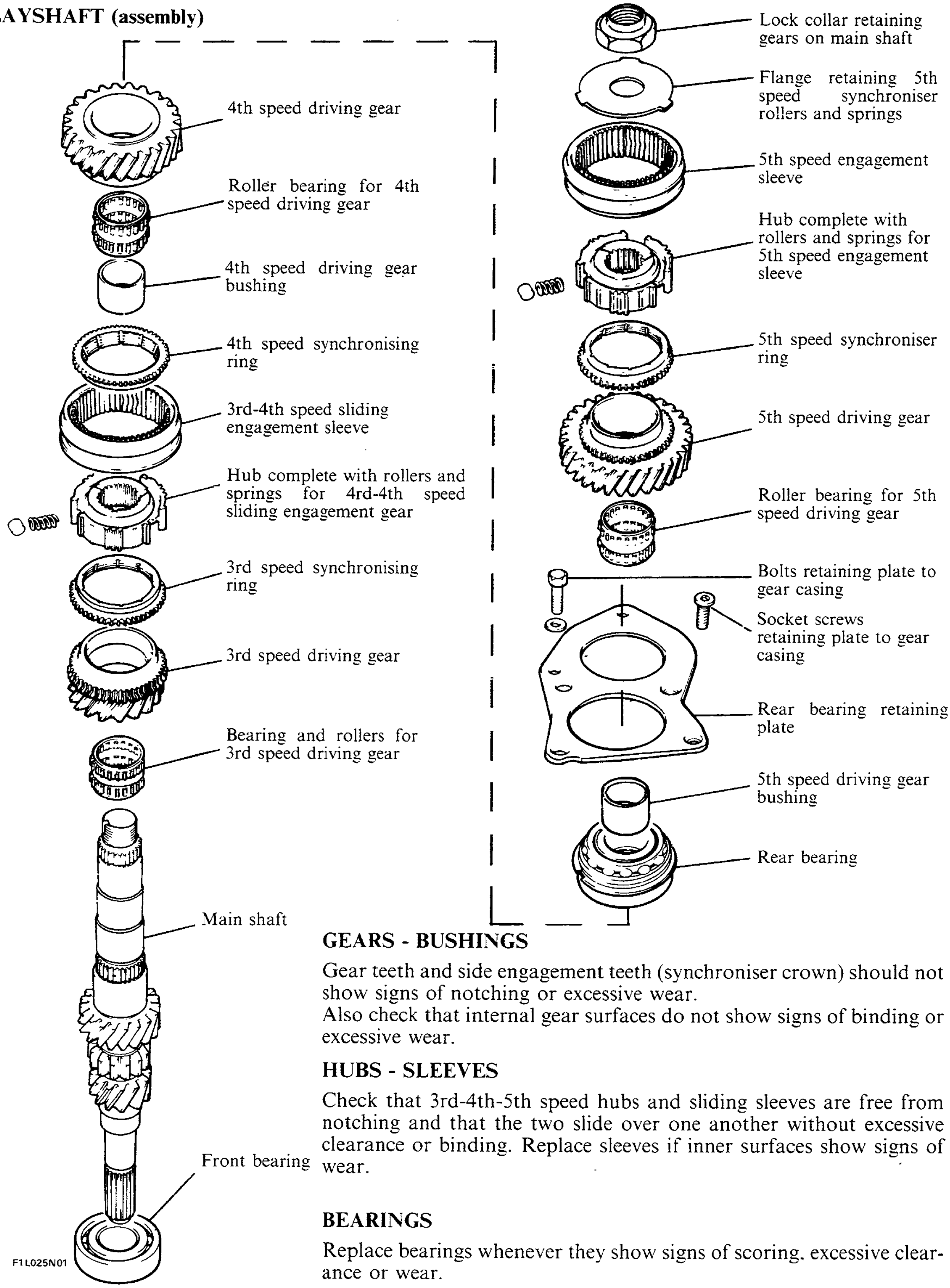


Fitting rear bearing to layshaft

Use a tool of the size and shape shown below in order to fit rear bearing properly.



LAYSHAFT (assembly)



GEARS - BUSHINGS

Gear teeth and side engagement teeth (synchroniser crown) should not show signs of notching or excessive wear.
Also check that internal gear surfaces do not show signs of binding or excessive wear.

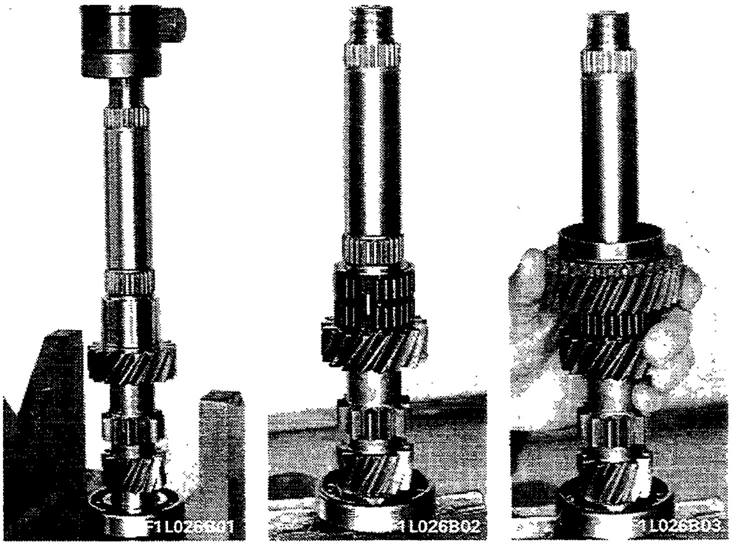
HUBS - SLEEVES

Check that 3rd-4th-5th speed hubs and sliding sleeves are free from notching and that the two slide over one another without excessive clearance or binding. Replace sleeves if inner surfaces show signs of wear.

BEARINGS

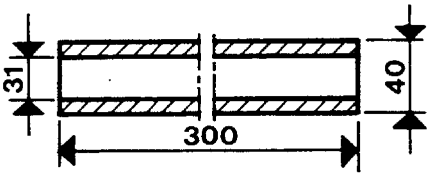
Replace bearings whenever they show signs of scoring, excessive clearance or wear.

21-27.



Fitting front bearing, roller bearing and 3rd speed driving gear to main shaft

Use a tool of the size and shape shown below in order to fit front bearing properly.



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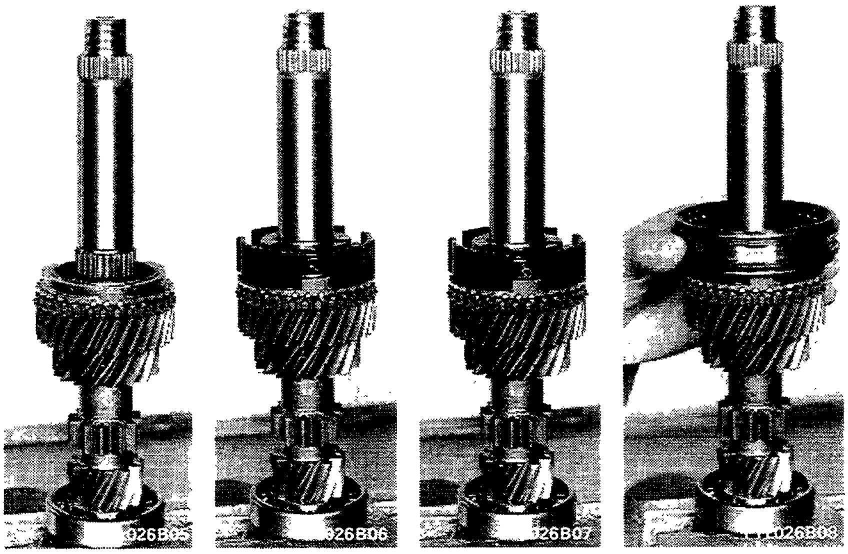
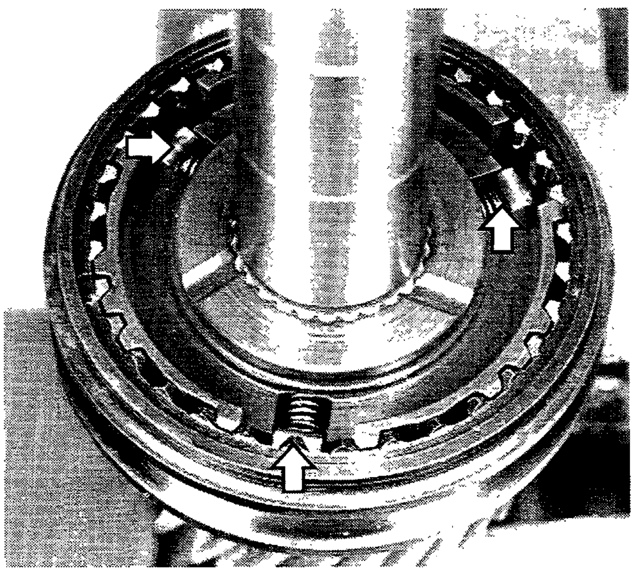


Installing 3rd speed synchroniser ring, 3rd-4th speed engagement sleeve hub, springs for rollers and 3rd-4th speed engagement sleeves

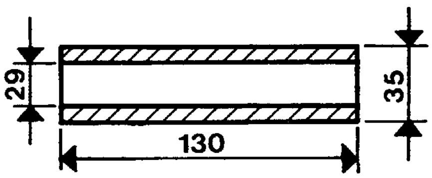


Move sliding sleeve to neutral position to avoid losing synchroniser springs and rollers.

Using a screwdriver, fit the 3 synchroniser rollers between the springs positioned on the hub and the grooves on the 3rd-4th speed engagement sleeve

Fitting bushing for 4th speed driving gear and 4th speed synchroniser ring

Use a tool of the size and shape below in order to fit 4th speed driving gear bushing properly.



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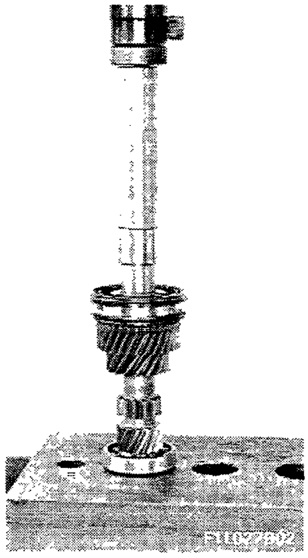
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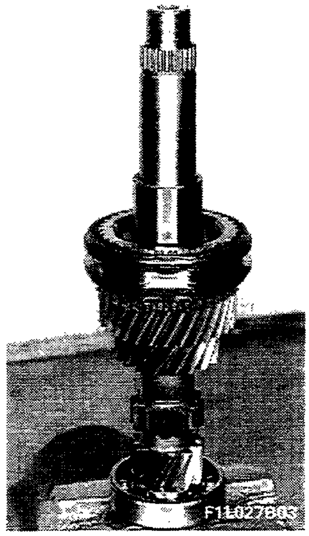
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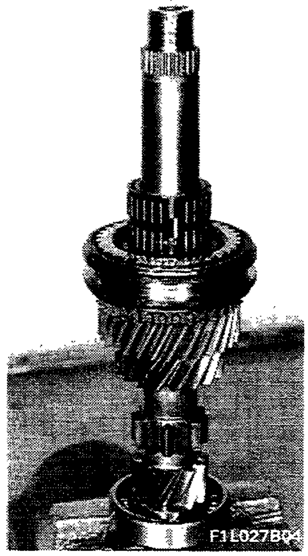
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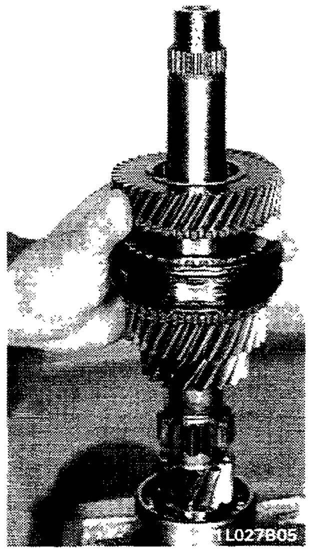
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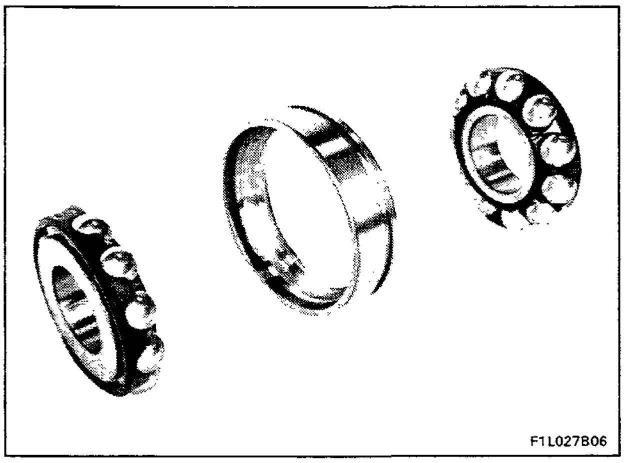
Fitting roller bearings and 4th speed driving gear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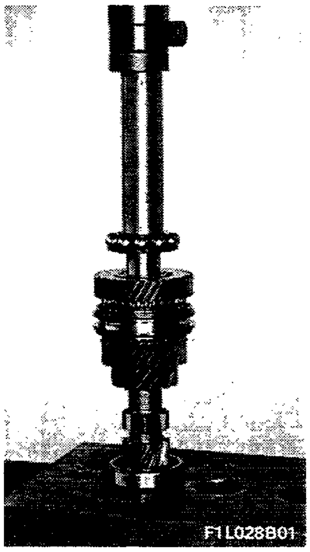
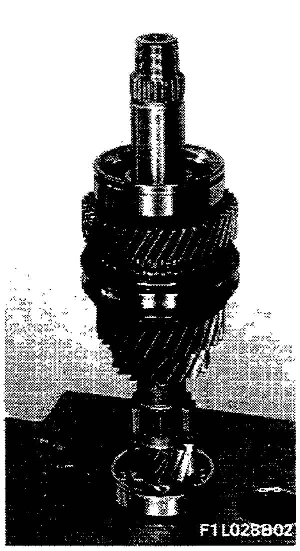
Rear bearing

Check that the outer race, inner race and balls do not show signs of scoring, overheating or excessive wear - otherwise replace entire rear bearing unit.

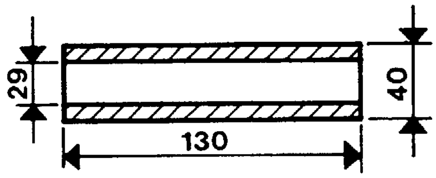
21-27.





Fit the inner race, cage and ball ring (front)

Use a tool of the size and shape shown below in order to fit components correctly.



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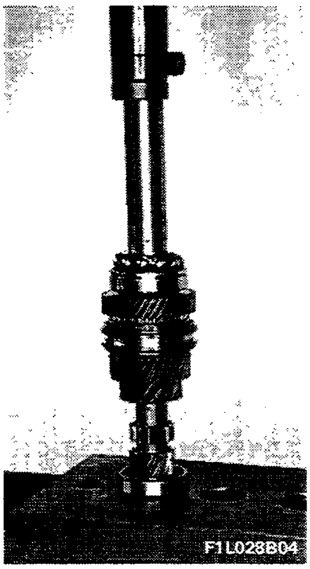
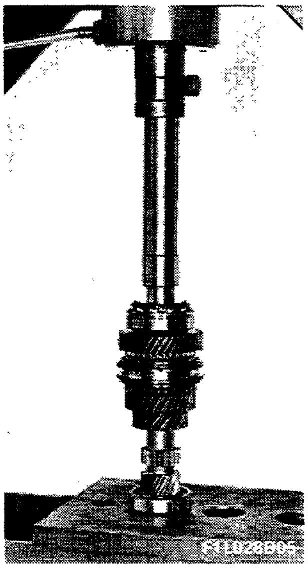
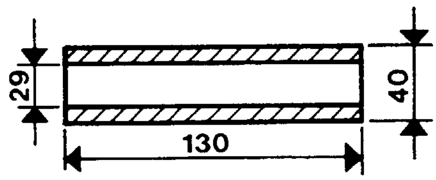
Fit rear bearing outer race





Fit the inner race, cage, ball ring (rear) and bushing for 5th speed driving gear

Use a tool of the size and shape shown below in order to fit above components properly.



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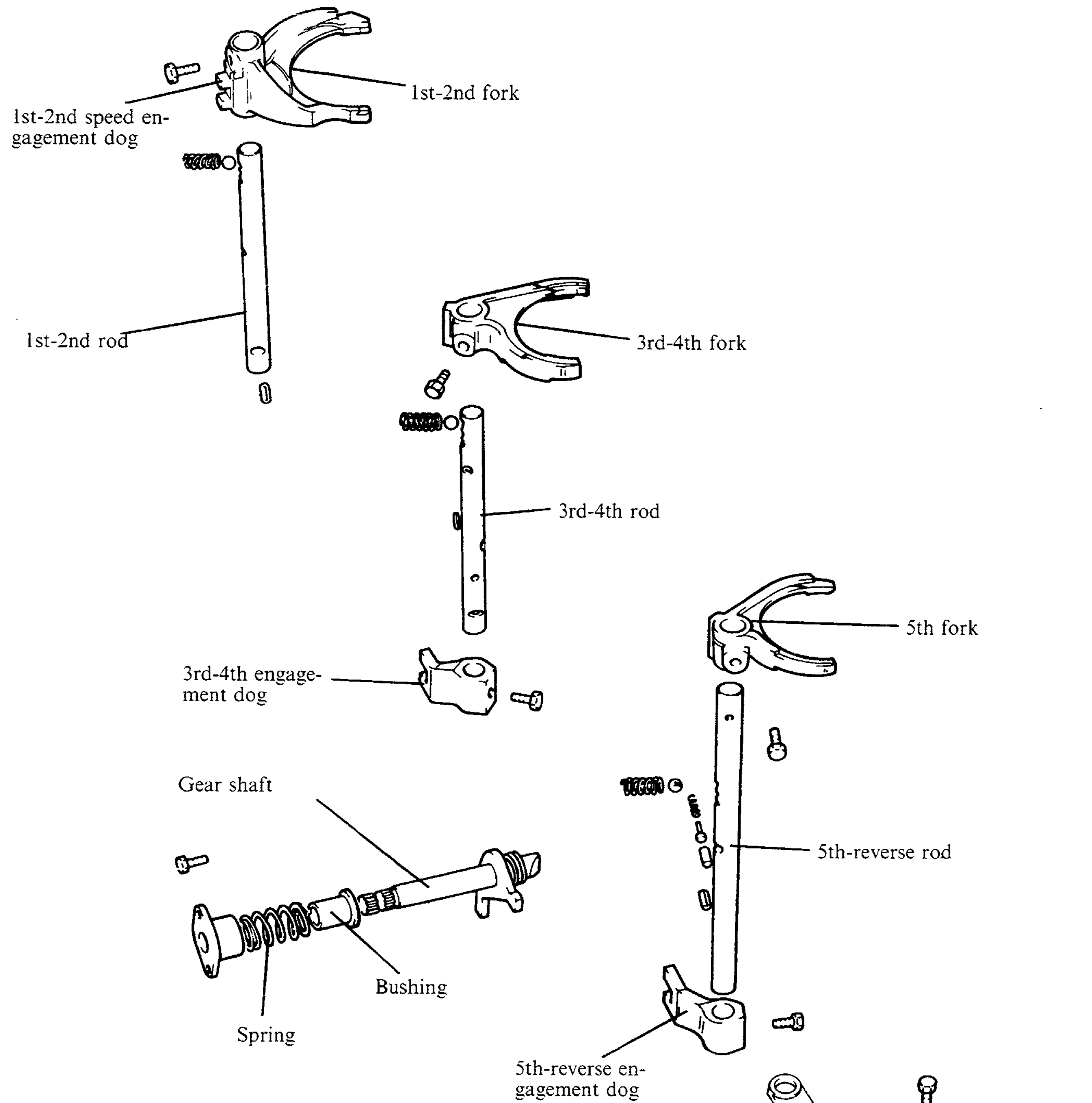
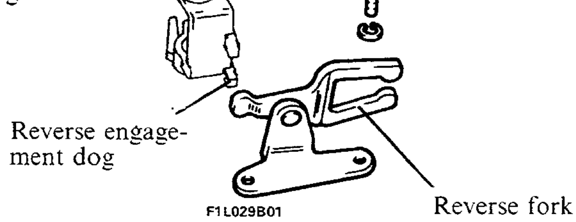
RODS AND FORKS





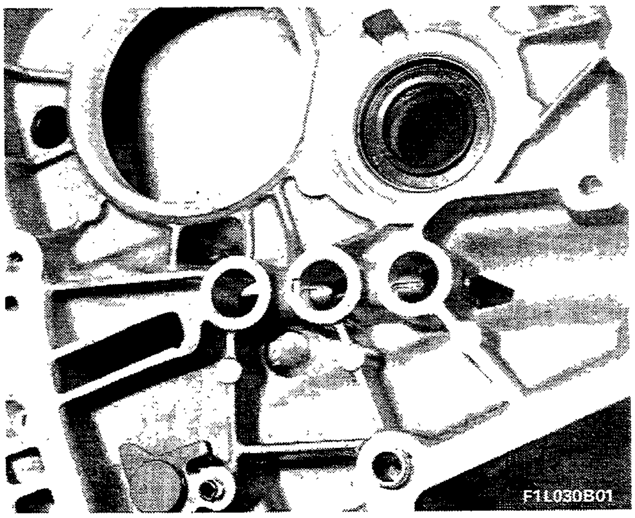
Checking rods

Rods should not show signs of distortion or wear on ball seats. They should also slide freely in their seats without excessive play.

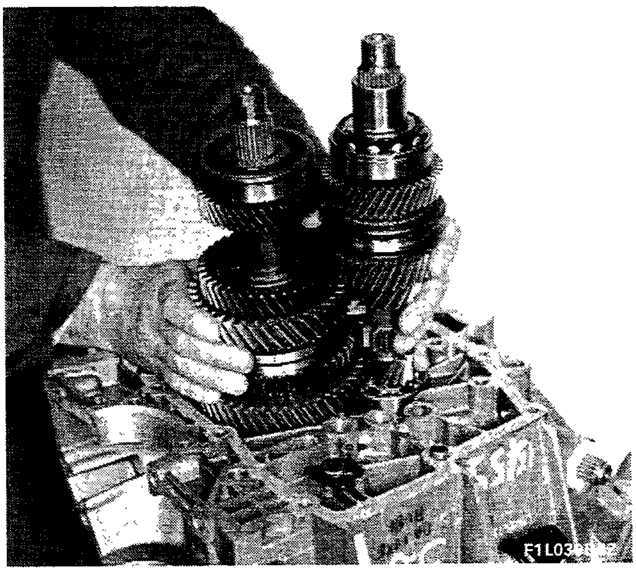
Checking forks

Forks should not show signs of distortion or wear on sliding sleeve contact surfaces.

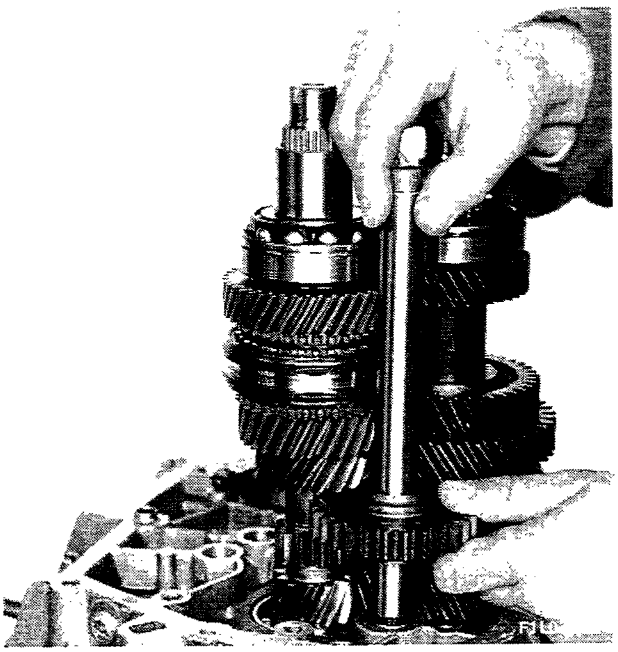
21-27.

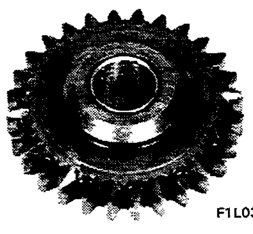


Fitting safety pawls



Fitting main and layshaft assembly

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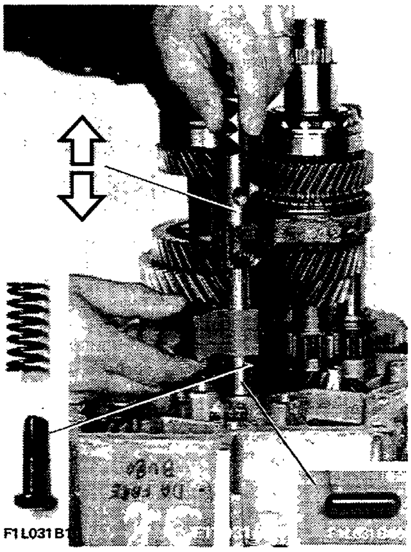
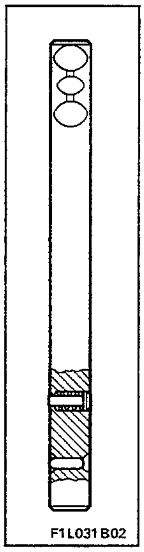
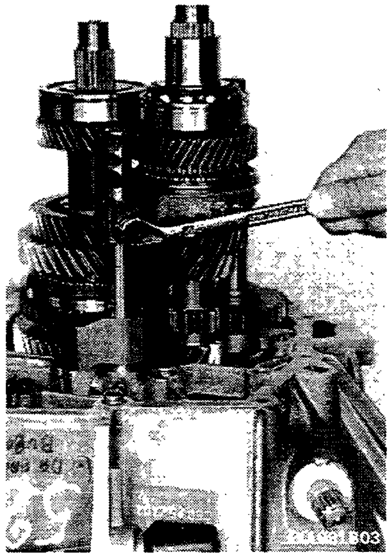
Fitting reverse idler shaft and gear

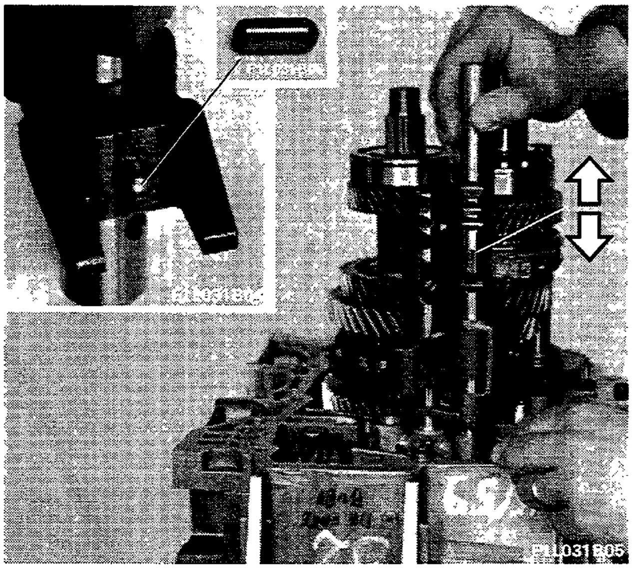
The reverse idler gear must be fitted so that the engagement teeth face downward.

Fitting 3rd-4th speed rod, fork and dog

Before fitting the rod, position the spring, safety catch for locking reverse dog (when 5th speed is engaged) and safety pawl that prevents simultaneous engagement of more than one gear.

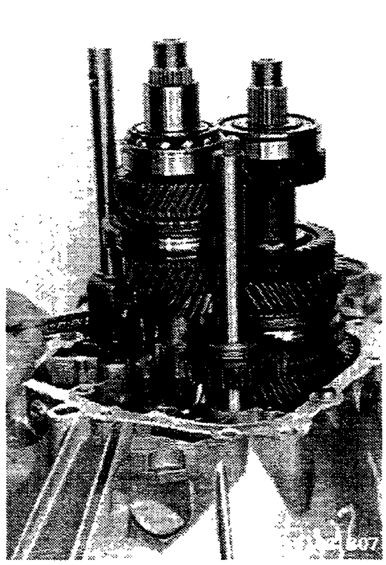







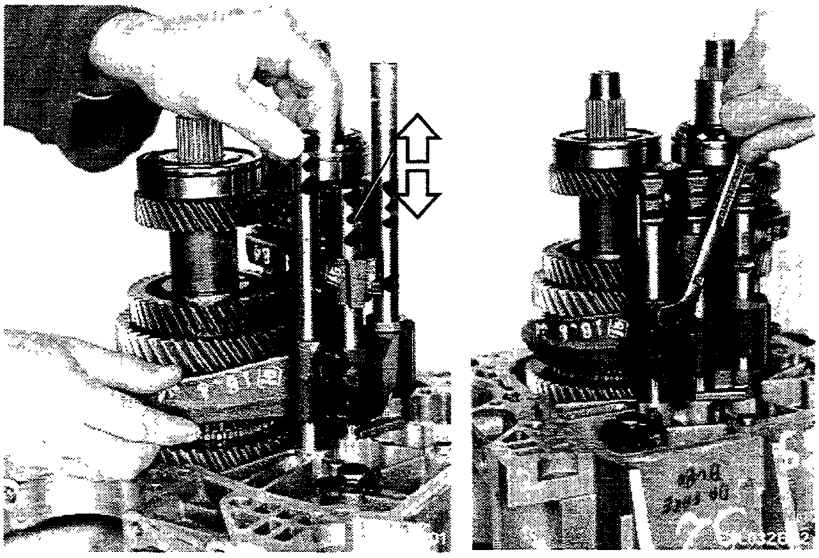
Fitting 5th speed and reverse rod and dog

Before fitting dog, position the safety pawl for locking reverse dog during engagement of 5th gear.



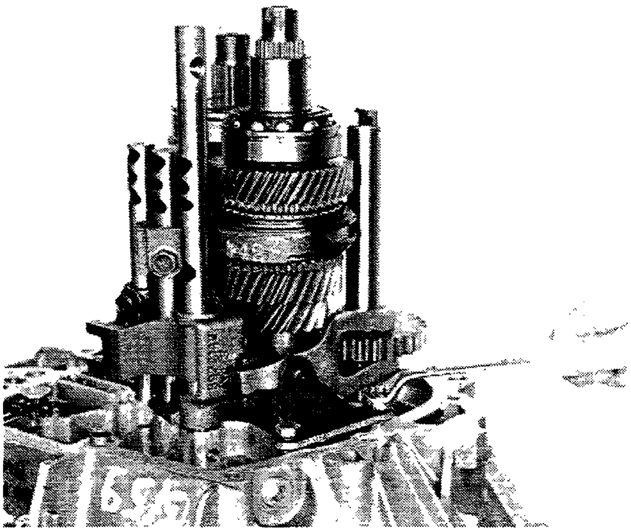
Fitting 5th speed and reverse dog retaining bolt to rod

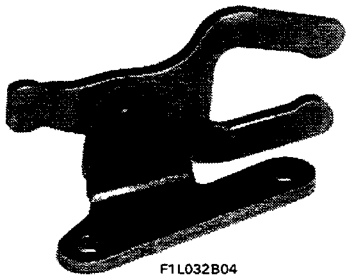
21-27.



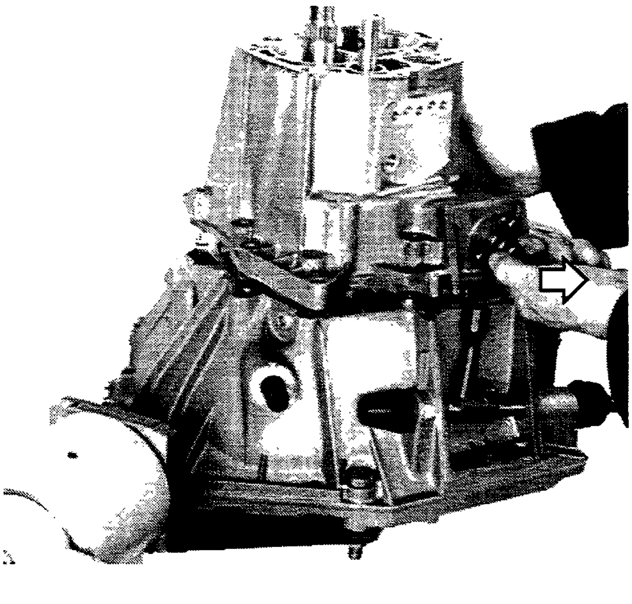
Fitting 1st-2nd speed rod and fork

Move 3rd-4th speed rod to and fro as arrowed to facilitate assembly.





Fitting reverse idler gear fork

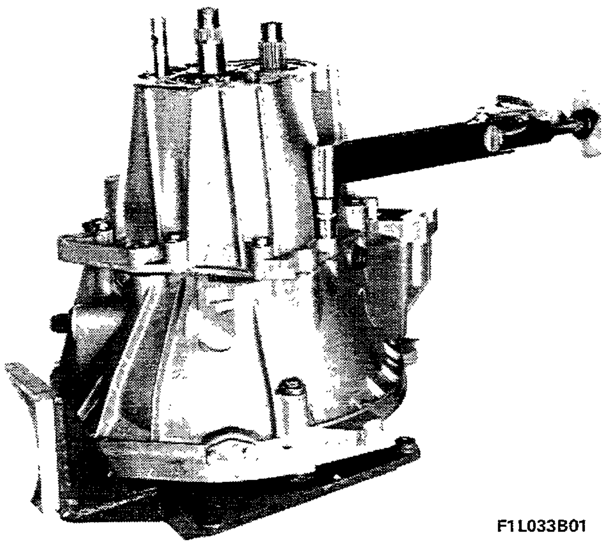


Fitting gear casing

Move gear shift lever back as indicated by the arrow so that the end of the lever engages with the dogs.

Spread LOCTITE (573) sealant over the contact surfaces between the bell housing and gear casing.

Fitting gear casing and final tightening of bolts retaining bushing to gear casing



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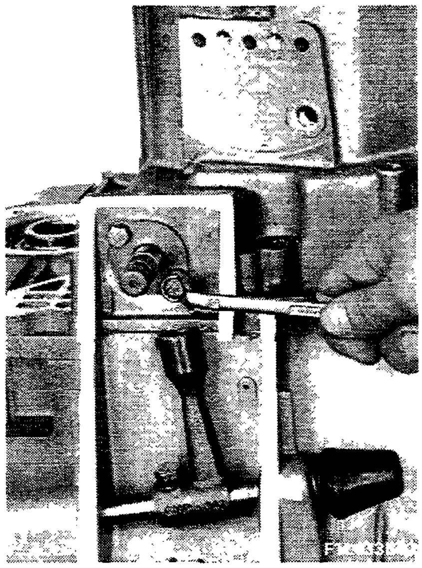
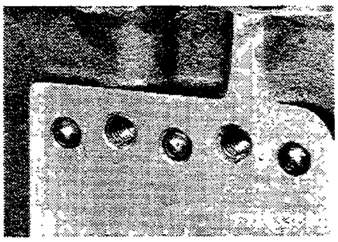
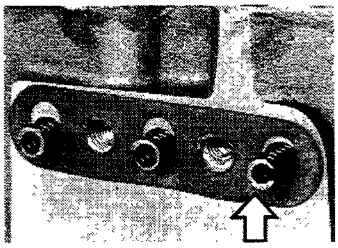
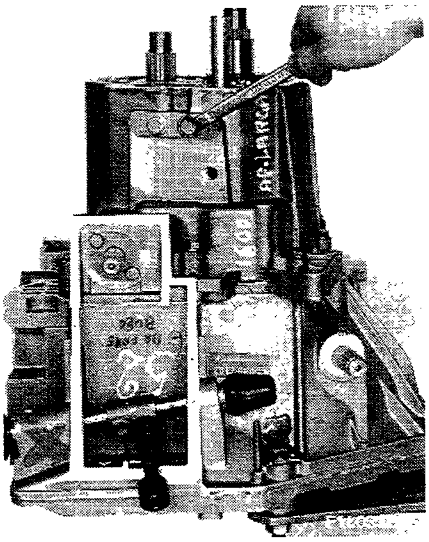


Fitting gear lever positioning balls and springs

The arrow indicates the spring with the largest wire diameter to be fitted to the 5th speed and reverse rod.

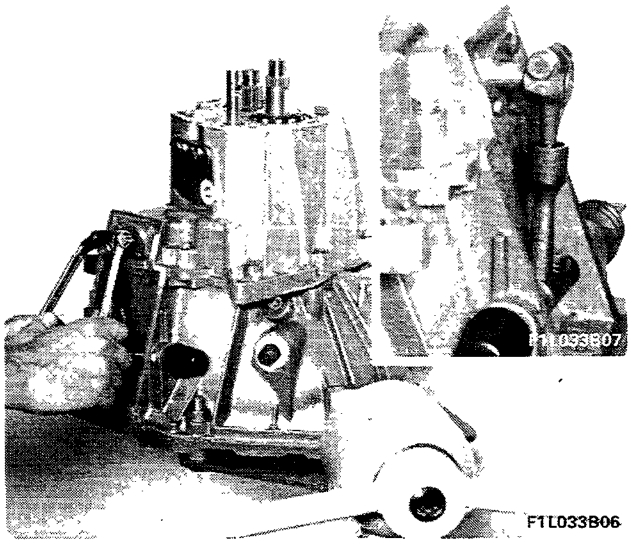






Fitting idler lever for gear engagement

Fit the idler lever as shown in the illustration to ensure efficient gear engagement.



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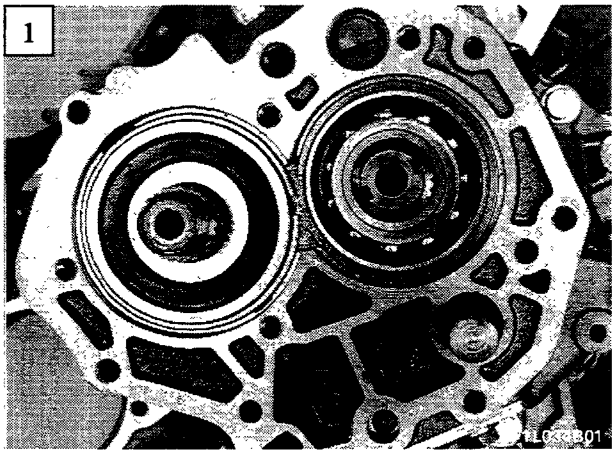
21-27.

1

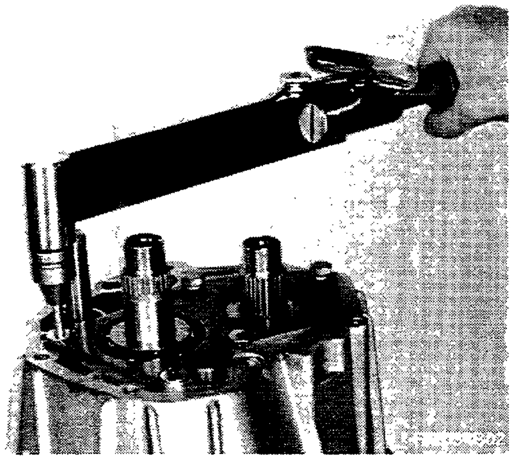


Fit bearing retaining rings

To facilitate installation of retaining rings, arrange them so that their openings face to the front as shown.

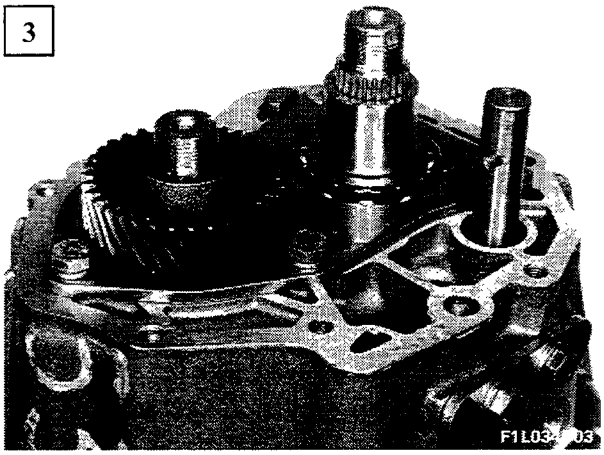
2,5 daNm

2



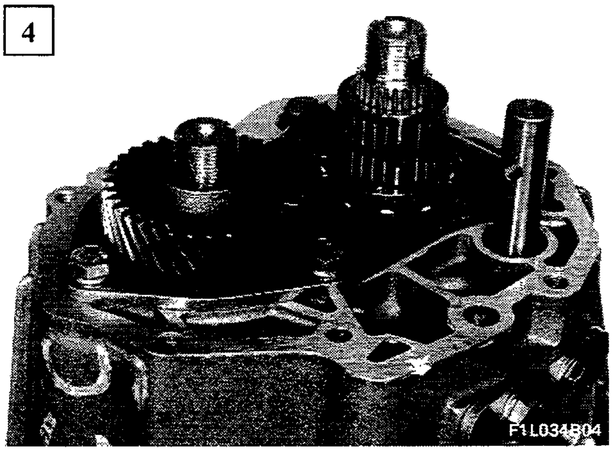
Fit rear bearing retaining plate

3



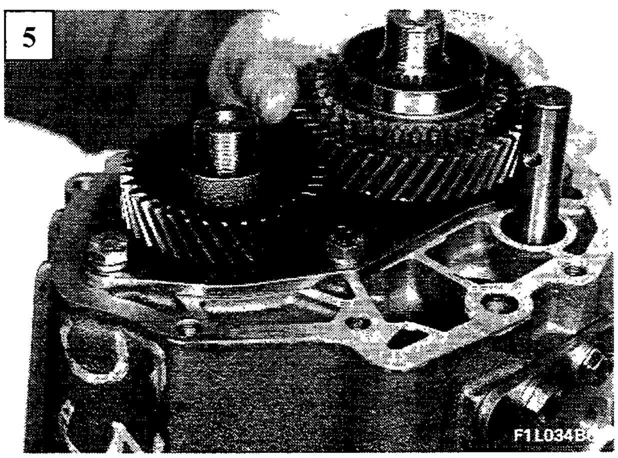
Fit 5th speed driven gear to layshaft

4



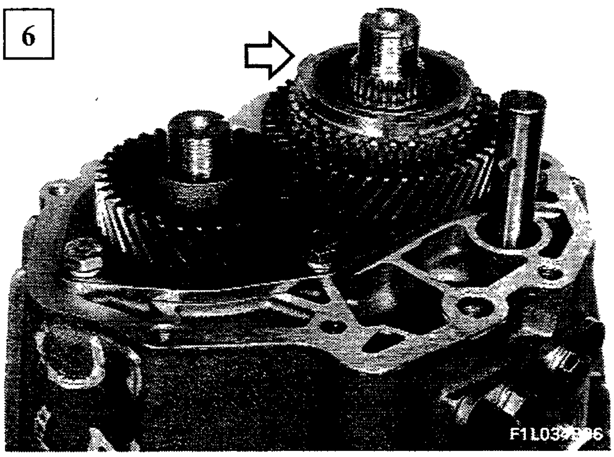
Fit needle roller bearing for 5th speed driving gear to bushing (located on mainshaft)

5



Fit 5th speed driving gear on roller bearing

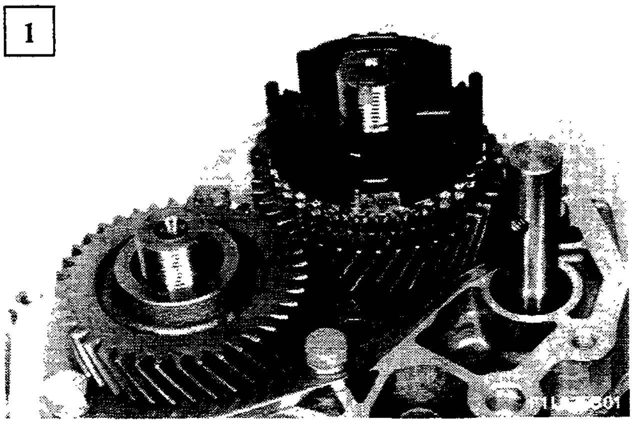
6



Fit synchroniser ring on 5th speed driving gear

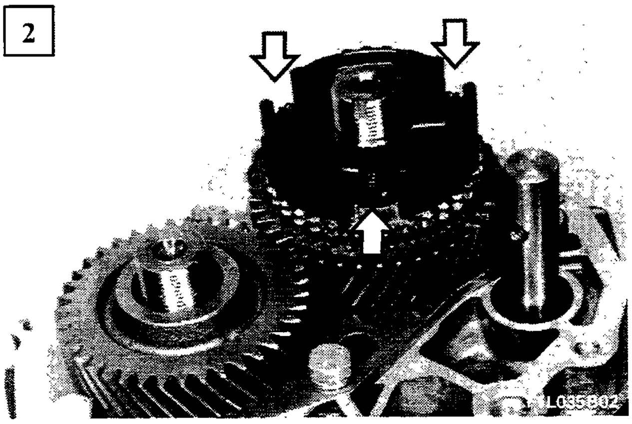
The numbers on the top left of the illustrations indicate the order in which the operations should be carried out.

1



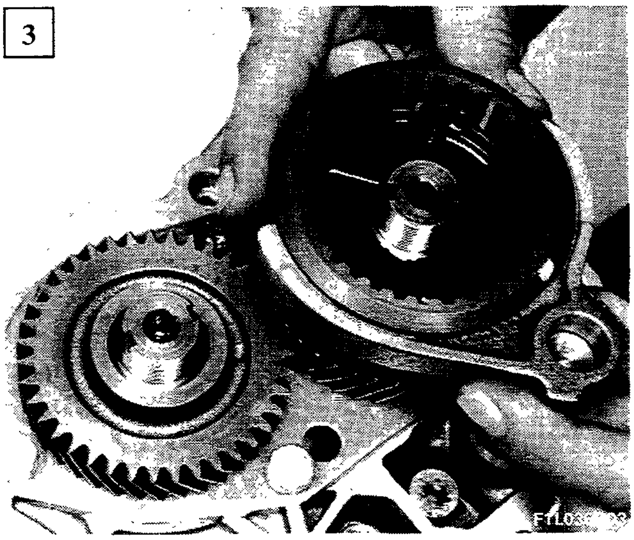
Fitting 5th speed engagement sleeve hub

2



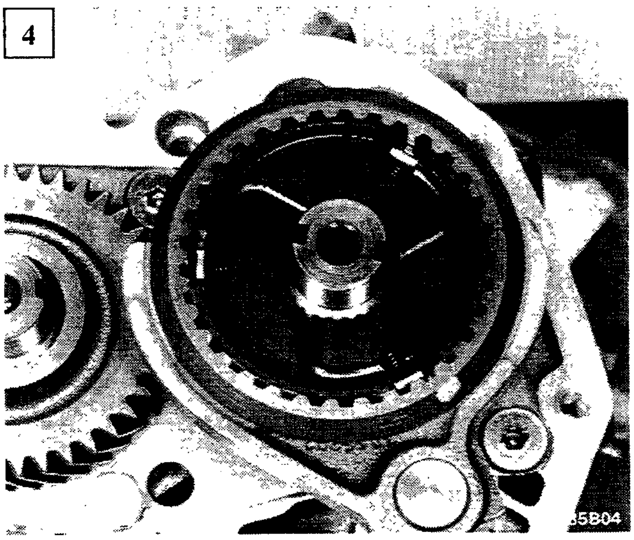
Fitting synchroniser spring on 5th speed engagement sleeve hub

3



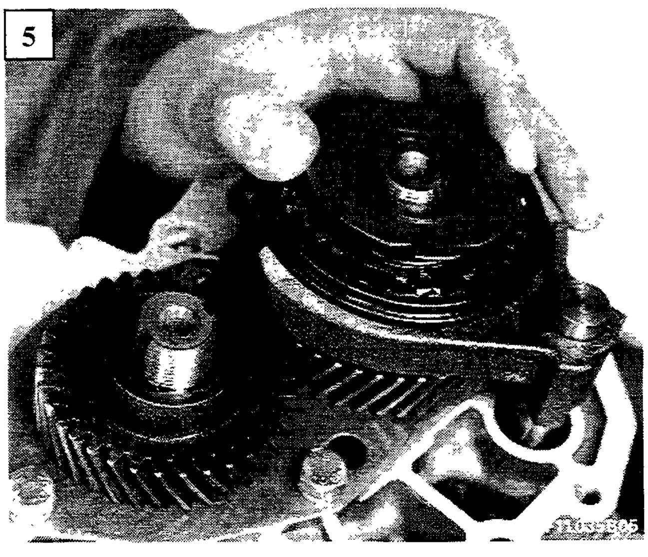
Fitting 5th speed sliding sleeve and fork

4



Using a screwdriver, fit the 3 synchronisation rollers between the springs on the hub and the grooves on the 5th speed engagement sleeve

5

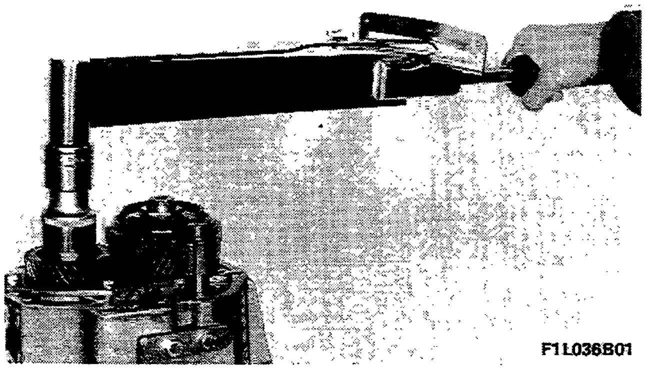


Move the sliding sleeve to neutral position to avoid losing the springs and synchroniser rollers

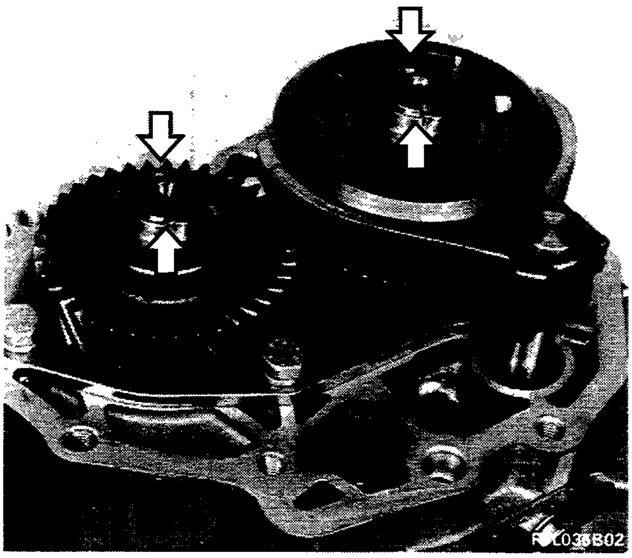
Fit roller retaining flange and 5th speed synchroniser springs

The numbers on the top left of the illustrations indicate the order in which the operations are to be carried out.

21-27.

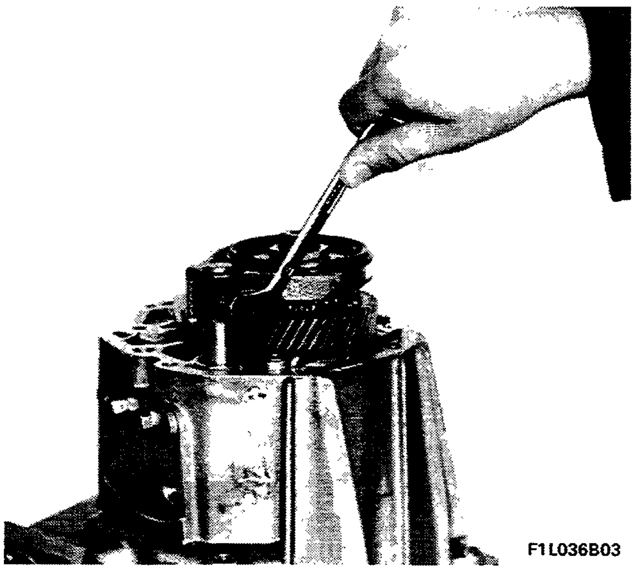


Tightening main and layshaft gear lock collars

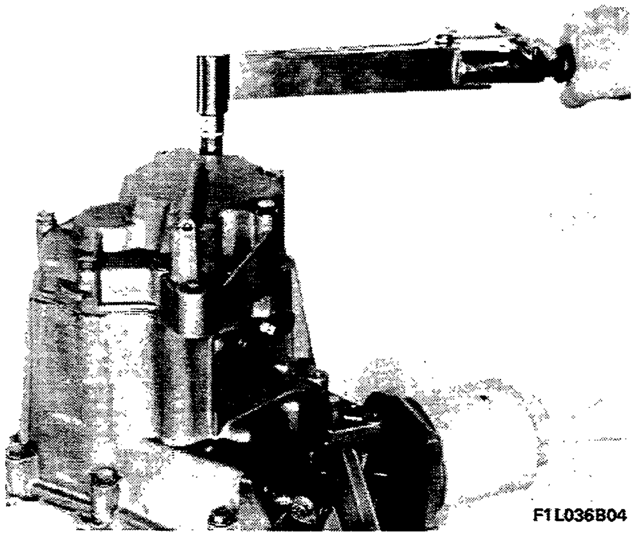


Staking main and layshaft gear lock collars

Renew gear lock collars whenever they are removed.

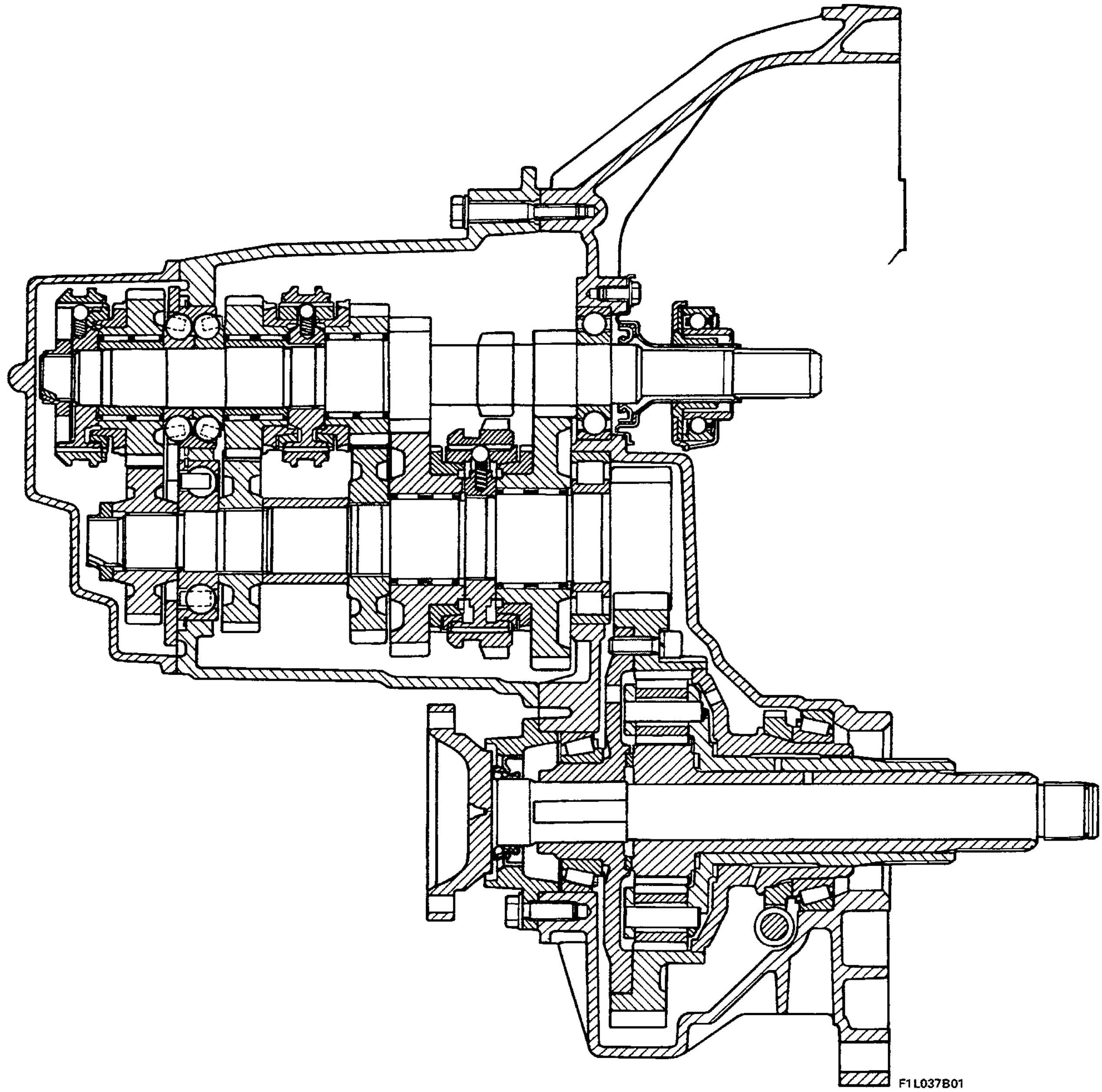


Fitting 5th speed fork retaining bolt



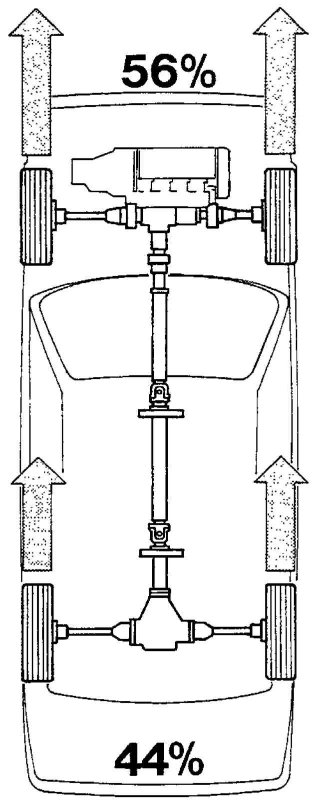
Fitting rear cover

Spread LOCTITE (573) on the contact surfaces between bell housing and rear cover.



Longitudinal section through gearbox-differential

21-27.



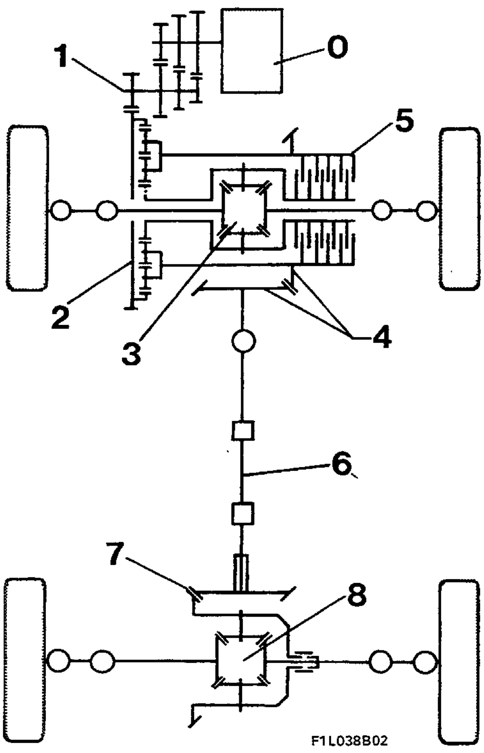
F1L038B01

FOUR WHEEL DRIVE

The main feature of the LANCIA four wheel drive system is an asymmetrical torque distribution of 56% to the front axle and 44% to the rear axle. This system provides slightly more driving torque at the front axle to permit maximum possible speed under slippery conditions for a front-engined vehicle.

Compared to two-wheel drive, a four-wheel drive system permits the torque to be distributed over two wheel contact surfaces. This permits:

a. Better traction on poor road surfaces, especially when the friction coefficient is extremely low as on gravel, snow, ice, mud etc.
b. improved hill-climbing ability
c. better grip during cornering.



F1L038B02

DRIVE TRANSMISSION

The four wheel drive system hinges around an epicyclic differential or torque distributor (2). This receives drive produced by the engine via the gear layshaft (1) and transmits it via an epicyclic gear system to the differentials at the front (3) and rear (8) axles.

The epicyclic distributor consists of a crown wheel (A) with internal and external teeth that receives drive via its external teeth and transmits it via the internal teeth to the first satellite (C) which meshes with the second satellite (D) that in turn meshes with pinion (E). Three pairs of satellites (120° apart) evenly distribute the transmitted force. The satellites turn freely on their shafts that are fixed to carrier (F). Hollow shaft (G) is integral with ring wheel (H) that transmits drive across bevel pinion (I) and propellor shaft (6) to rear differential (8).

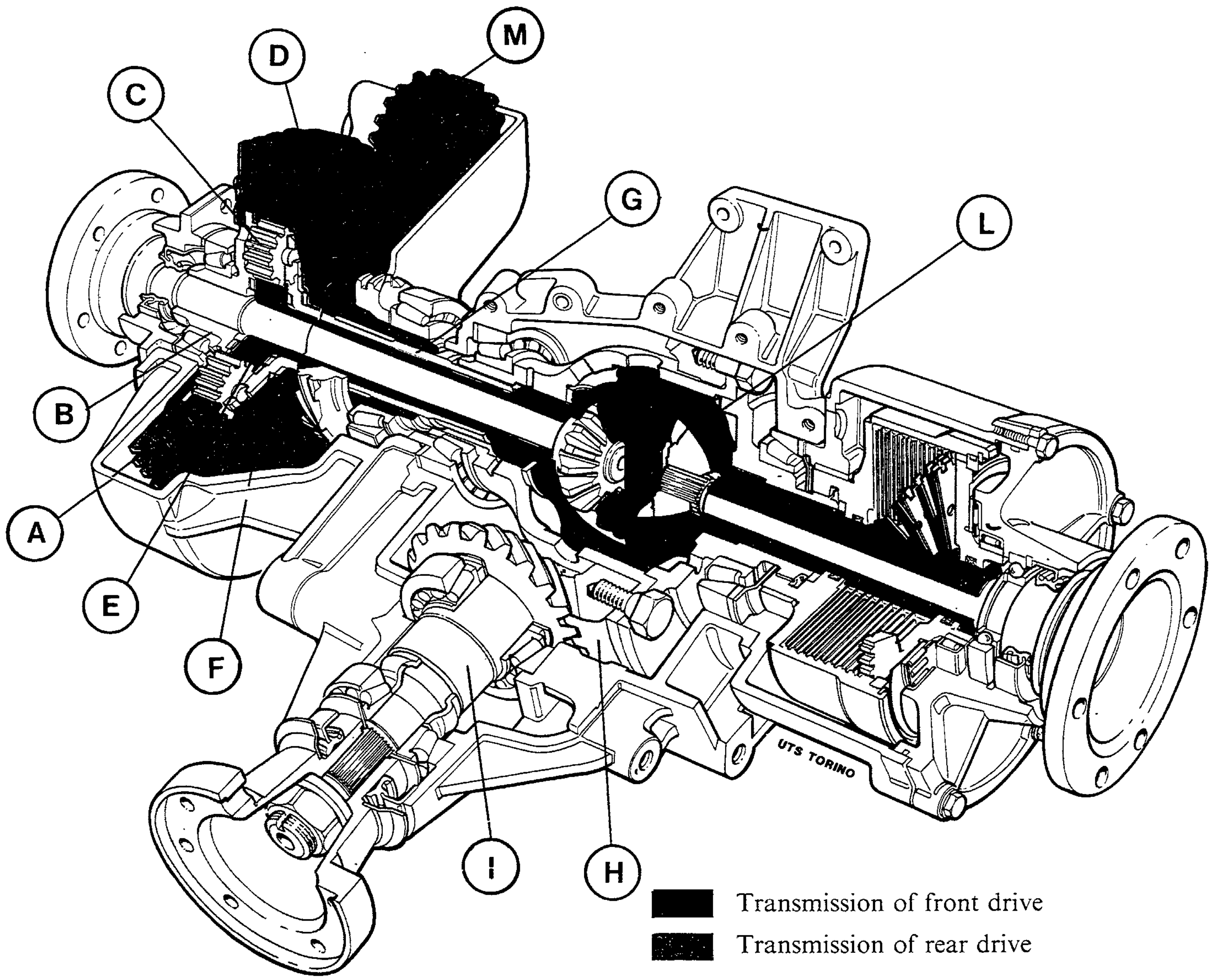
The pinion hollow shaft is integral with front differential casing (L) and drive is therefore transmitted directly to the front wheels.

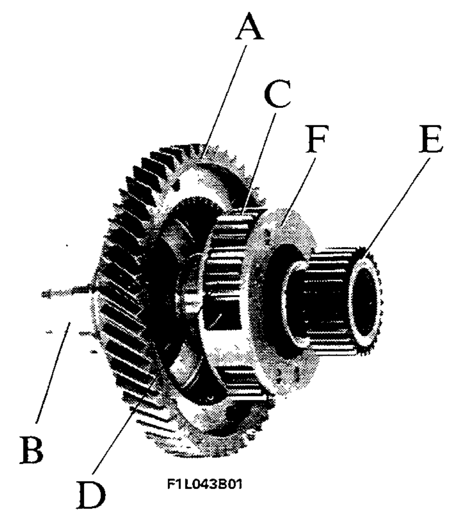
Key

0. Engine
1. Gearbox
2. Epicyclic differential or torque distributor
3. Car front differential
4. Bevel drive
5. Ferguson viscous coupling
6. Propeller shaft
7. Bevel reduction drive
8. Car rear differential

* A conventional differential can only transmit an equal torque to each satellite and thus to each drive shaft. The torque distributor or central differential can: 1) transmit the same torque, or different torques, to the 2 axles of the car 2) produce a different number of revs at front and rear axles. This function is essential since it prevents transmission components and tyres being subjected to harmful forces (when one set of wheels faces a bump or pot-hole while the other travels over flat ground) and therefore permits safe driving up to top speed.

DIFFERENTIAL ASSEMBLY WITH EPICYCLIC DISTRIBUTOR (photograph) **AND FRONT DIFFERENTIAL**





Key

A. Crown wheel of epicyclic system
B. Crown wheel shaft
C. 1st satellite
D. 2nd satellite
E. Pinion
F. Epicyclic gear train
G. Epicyclic train hollow shaft
H. Ring gear
I. Propeller shaft bevel pinion
L. Front axle differential
M. Gearbox spur pinion.

Operation of epicyclic differential with good grip on road

If the wheels do not slide over the ground, the 3 components of the epicyclic system turn together with the same angular velocity. The satellites are locked and transmit drive through the system components without turning about their shafts. In this case Ferguson coupling (5) that can connect the pinion shaft to the satellite carrier does not come into operation. Each pair of satelllites is subject to a force system in equilibrium.

The difference between the torques transmitted by the planetary train (rear axle) and pinion (front axle) arises because, although the same force is transmitted to both systems by the crown wheel, their torque arms (i.e. arms through which the force acts) are very different and therefore give rise to two quite different torques. A first glance suggests that the torques transmitted by the planetary train and pinion should be very different from the stated ratio of 56 (front) to 44 (rear). Indeed one would imagine that the torque transmitted by the planetary train (with its much larger arm) would be greater than that transmitted by the pinion (with its much smaller arm).

In order to resolve this apparent discrepancy (see explanation on following page) we need only consider that although all teeth engaged transmit the same force, i.e. that produced by the crown wheel, the reaction of the pinion, an equal and opposite force, acts on the second satellite. As a result of this the resultant force acting on the first satellite shaft will be directed in the direction of rotation whereas the force acting on the shaft of the 2nd satellite is lesser and directed in the opposite direction. The resultant force generated by the two satellites on the epicyclic train is thus much smaller than the force transmitted by the crown wheel (and therefore than the force acting on the pinion) and acts with an arm equal to the mean radius of the rays passing through the 2 satellite shaft centre lines. For this reason the torque transmitted to the epicyclic train connected to the rear axle (44%) is smaller than the force (56%) transmitted to the pinion shaft (front axle).

Operation of epicyclic differential on roads with low friction coefficient

If the friction coefficient of one of the 2 axles is very low and does not permit the transmission of all the torque, the other axle will transmit a reduced torque that still respects the 56%-44% ratio. The 2 satellites will now start to turn on their shafts and the revs of the crown wheel will be discharged to the epicyclic train and pinion according to the reactions offered by these components. In this event, the Ferguson coupling comes into operation almost immediately to establish a measured degree of locking with continual variations between pinion and epicyclic train dependent on the reciprocal difference in revs. Ferguson coupling operation is described on page 64. When drive reaches the 2 front or rear differentials it is relayed to the 2 drive shafts with equal or differential speed depending on the grip of the 2 wheels on the ground. The torque transmitted by each of the 2 wheels is always the same whatever the circumstances. Rear differential operation is explained on page 74.

Demonstration of asymmetrical torque distribution

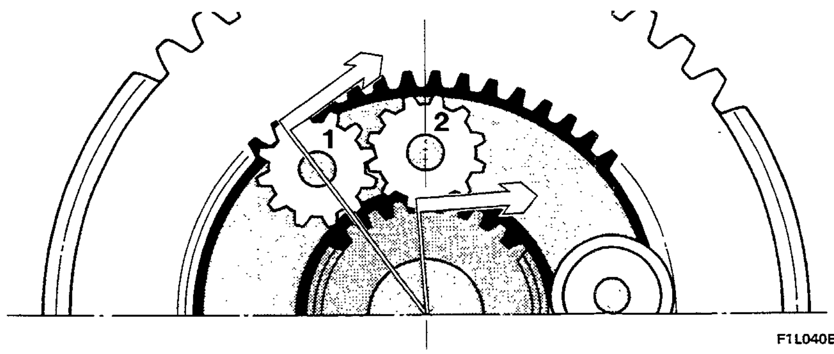
T = Drive - R = Resistance applied at pinion (R equal and opposite to T) - Resultant of T and R: on satellite 1 S_1, on satellite 2 S_2 -Tangential resultants of S_1 and S_2: $S_1 = T_1$; $S_2 = T_2$ -Momentum generated by forces acting on satellite shafts : $T_1 \times r_1 = M_1$ (clockwise); $T_2 \times r_2 = M_2$ (anticlockwise) - $M_1 - M_2 = M_{TR}$ (resultant momentum applied to epicyclic train)

Simplified indirect demonstration of asymmetrical distribution of drive

Let us suppose that the crown wheel transmits a force of 10 daN to the 1st satellite, since the two satellites have the same no. of teeth, the 2nd satellite is bound to transmit the same force to the pinion. In a system of meshed gears, the primary radii are proportional to the number of teeth and therefore the drive transmitted by the crown wheel is proportional to 10 x 54 (54 = No. of crown wheel teeth) = 540;
while the drive transmitted by the pinion (front axle) is proportional to 10 x 30 (30 = no. of pinion teeth) = 300.
The drive component that must be transmitted to the other part of the system, i.e. the epicyclic train, will be
540 - 530 = 240
If we now compare the torques transmitted, we will obtain:

$$\frac{300}{240} = \frac{\text{pinion torque}}{\text{epicyclic train torque}} = \frac{56 \text{ (front axle)}}{44 \text{ (rear axle)}}$$

NOTE *If we decrease the no. of pinion teeth and the no. of crown wheel teeth remain the same, the ratio will approach 50:50.*



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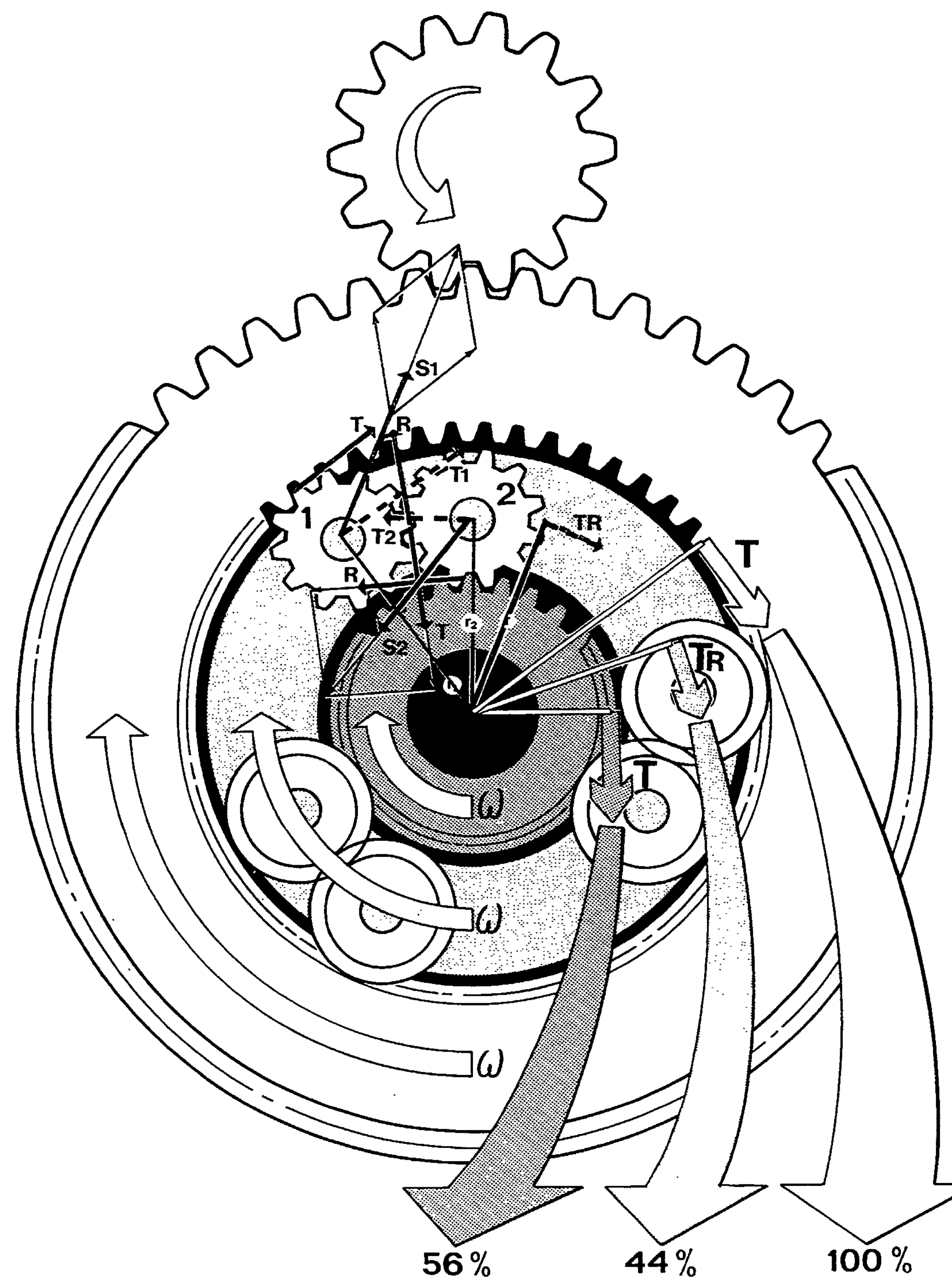
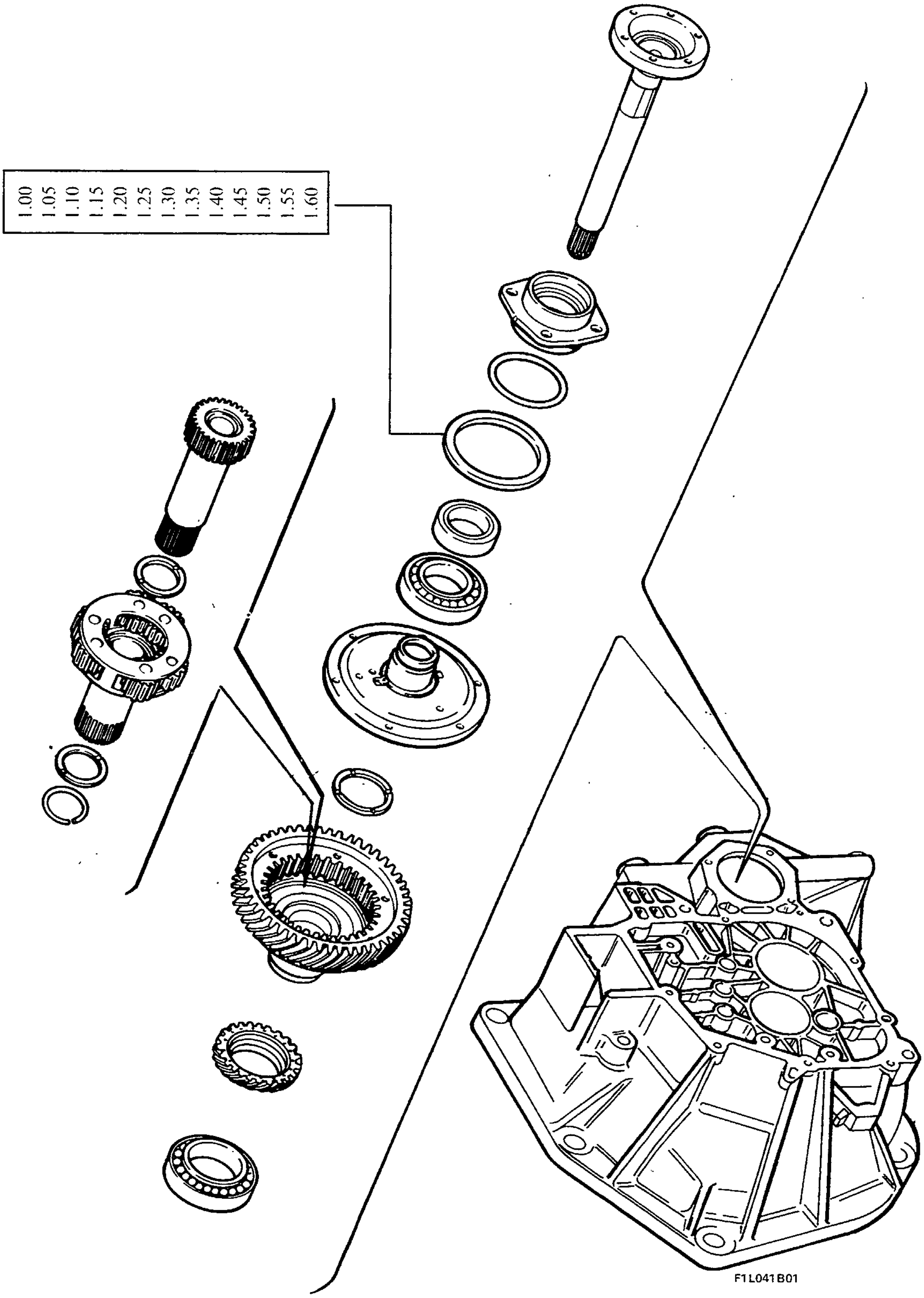


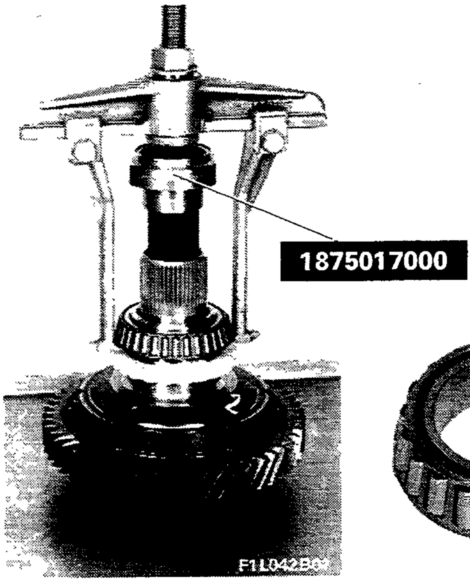
F1L040B01
F1L040B02

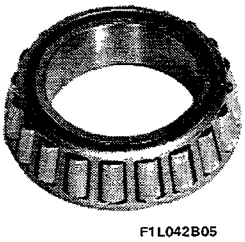


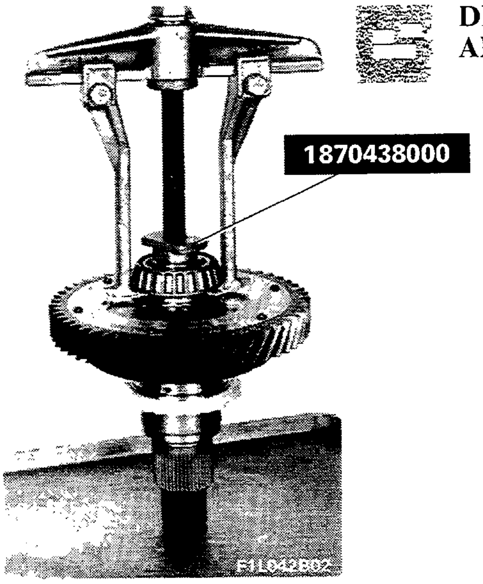
Components of central differential unit

21-27.

DISASSEMBLY AND CHECKS

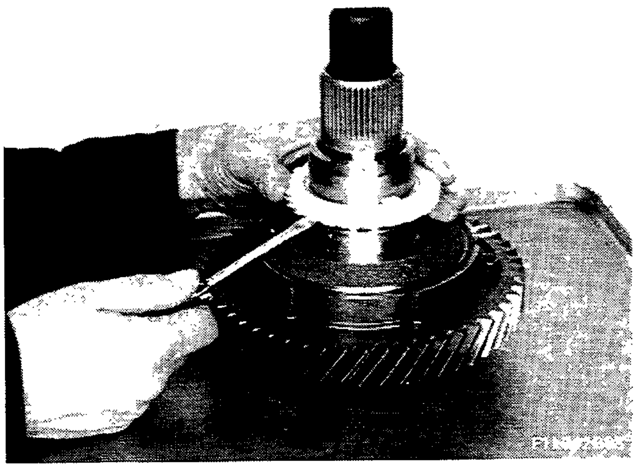




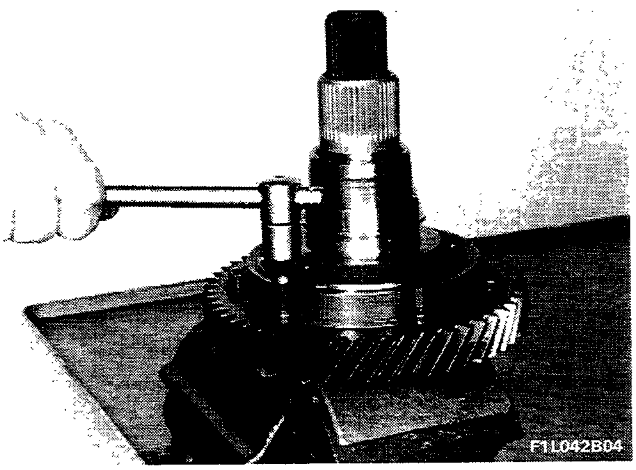


Remove roller bearings from differential housing

Replace bearings whenever they show signs of scoring, hot spots or excessive wear.

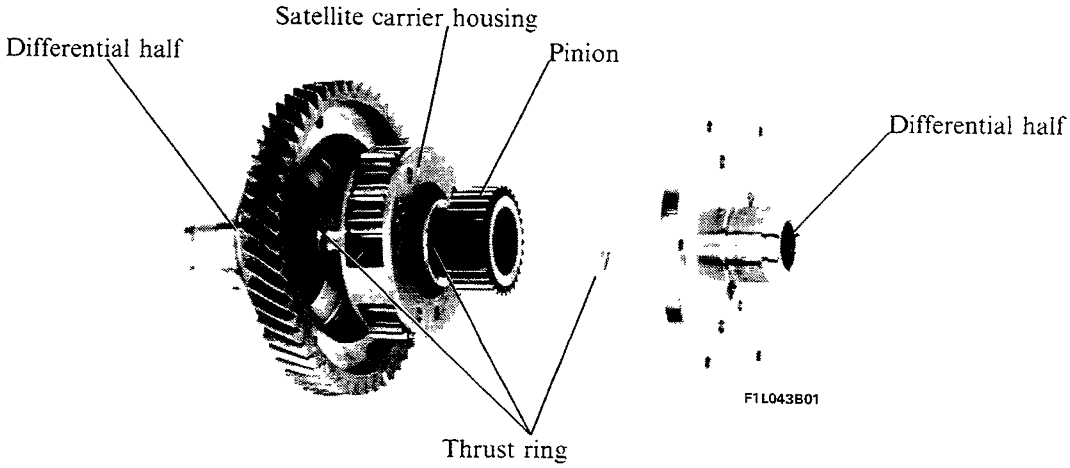


Removing mileometer gear



Removing central differential-distributor halves

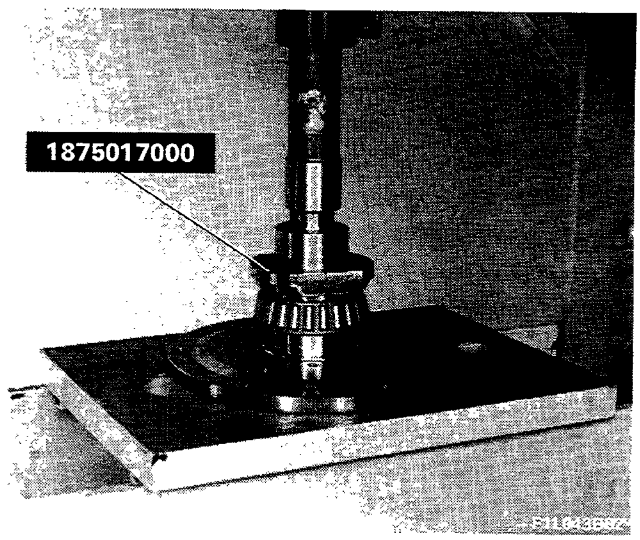
Whenever it is necessary to replace the crown wheel also replace the pinion from the spur gear/pinion set.



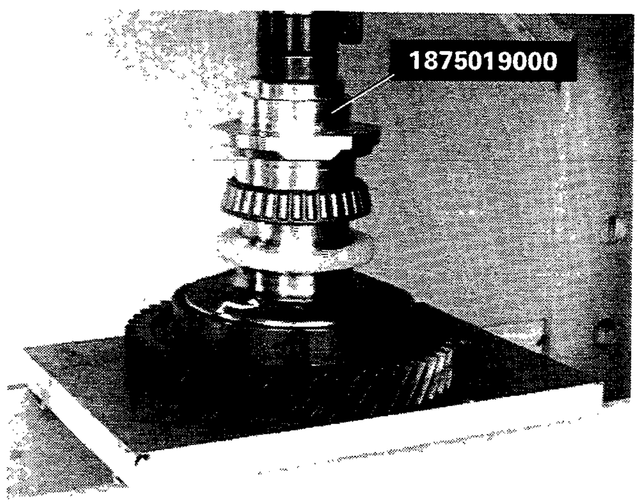
Central differential unit

Replace parts as necessary in case of defects, noise, broken teeth or play in satellite shafts.

ASSEMBLY

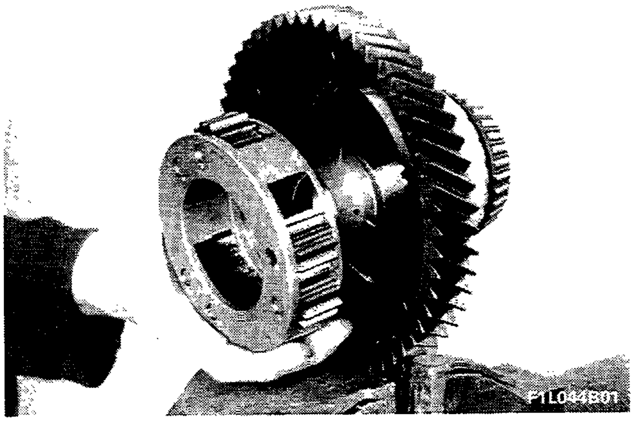


Fitting roller bearing in seat on differential half

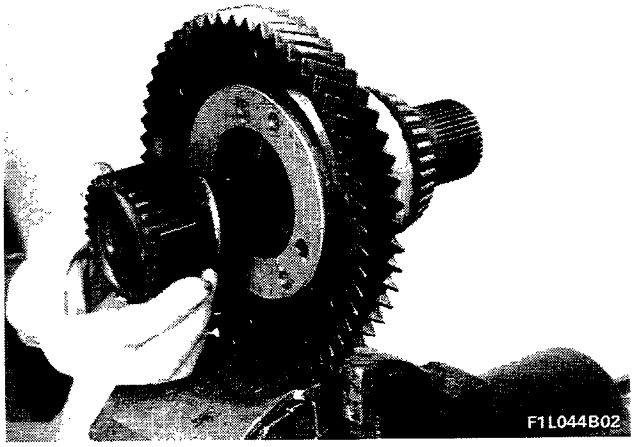


Fitting roller bearing in seat on differential half

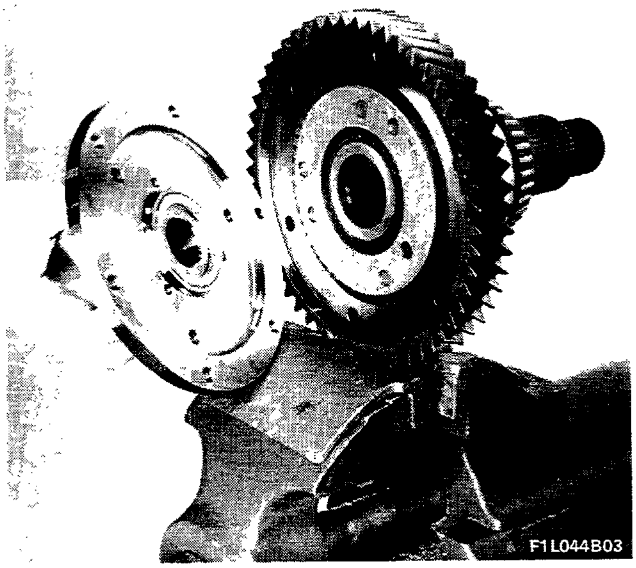
21-27.



Fitting satellite carrier housing

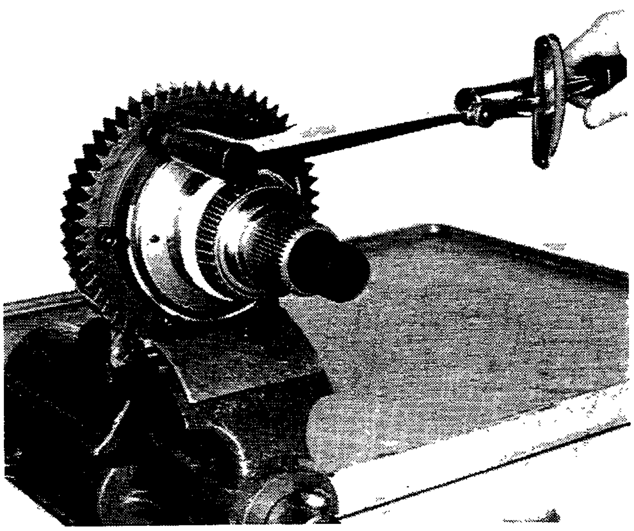


Fitting pinion

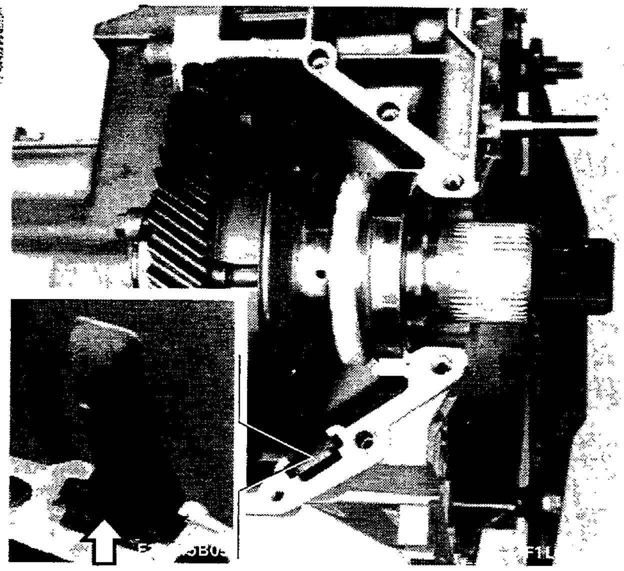


Fitting differential housing

3,5 daNm



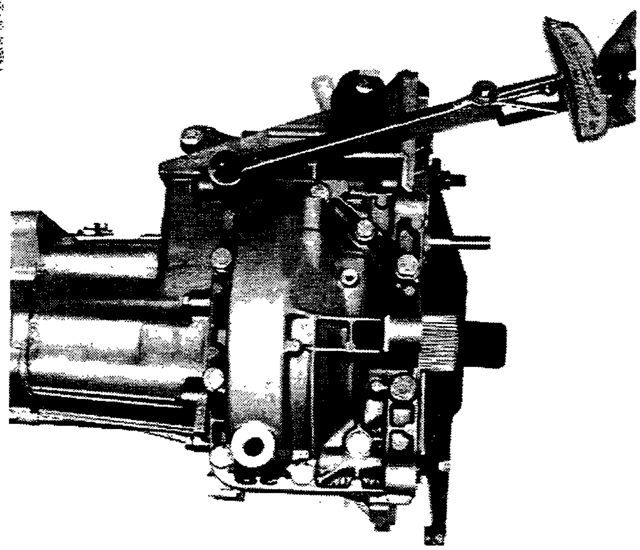
Torque tightening differential half



Installing differential assembly

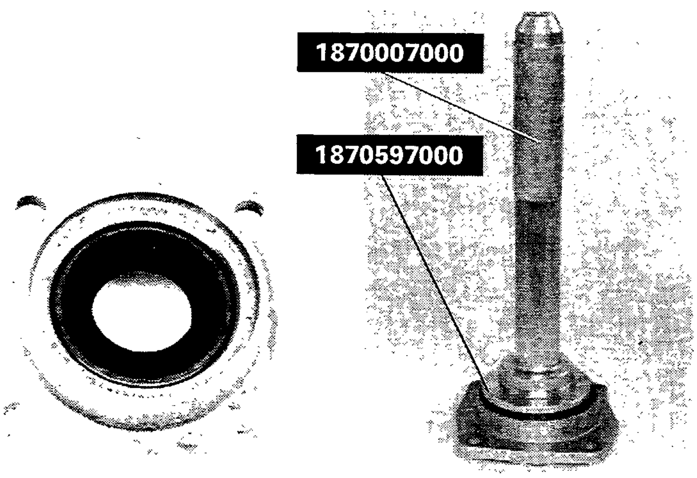
Before installing differential cover, ensure that the magnet is in its seat.

2,5 daNm



Installation and torque tightening of differential cover

Spread LOCTITE (573) on contact surfaces between differential cover and bell housing.



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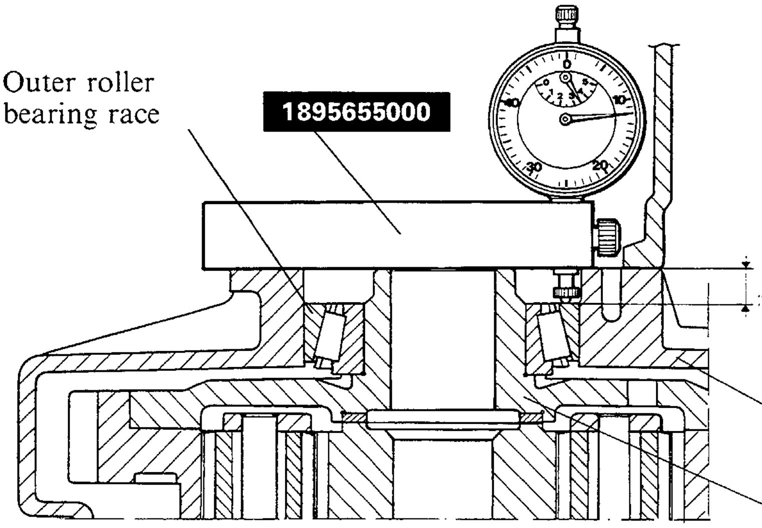
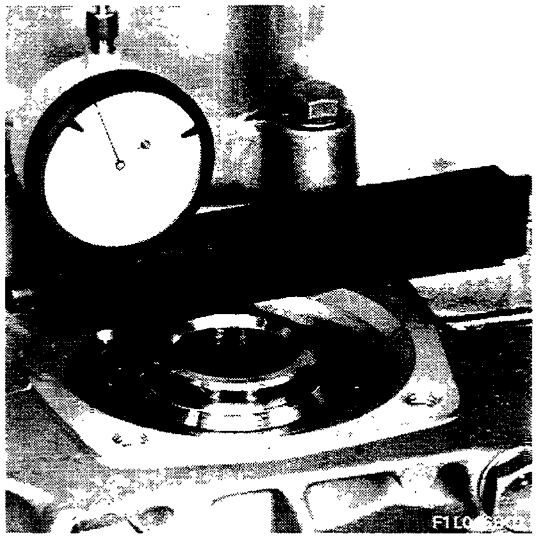
Fit gasket to differential housing cover

DIFFERENTIAL ADJUSTMENT

Calculation of differential housing bearing shim thickness "S".

$$S = P - H + 0.12$$

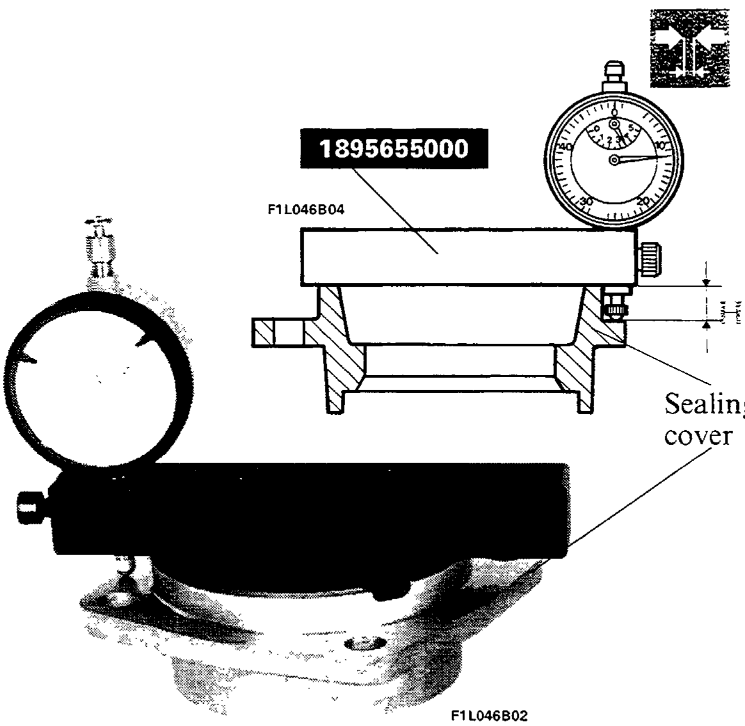




Calculation of "P"

Height between cover rest plane and outer roller bearing race.

NOTE *Position the outer bearing race in its seat.*



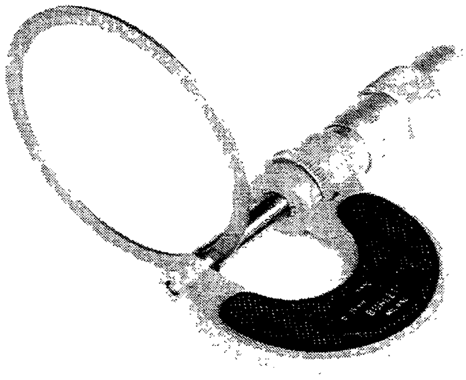
Calculation of "H"

Thickness of sealing cover.

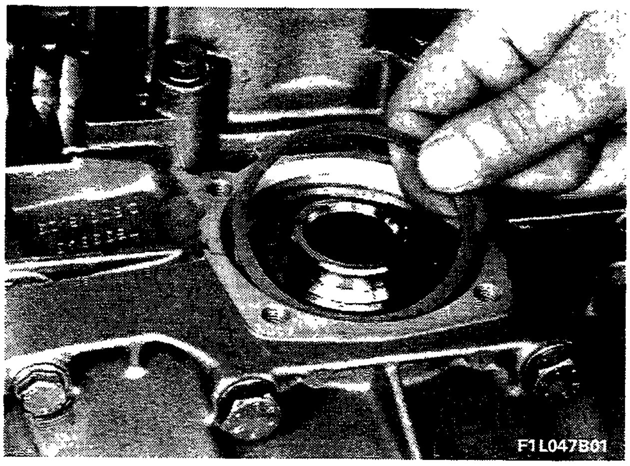
NOTE *After calculating the exact shim thickness, combine shims supplied to obtain a value as near to the calculated value as possible.*
If the thickness obtained does not correspond to one of the shims or the sum of two shims, fit the next thickness up.

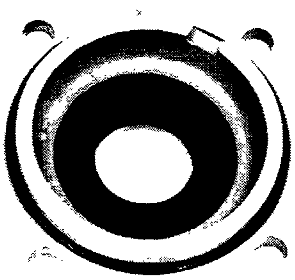
"0.12" - Fixed number

Corresponding to the specified interference for adjustment of differential housing bearings.
Shims come in the following sizes: 1.00 - 1.05 - 1.10 - 1.15 - 1.20 - 1.25 - 1.30 - 1.35 - 1.40 - 1.45 - 1.50 - 1.55 - 1.60 mm.



Fitting shims





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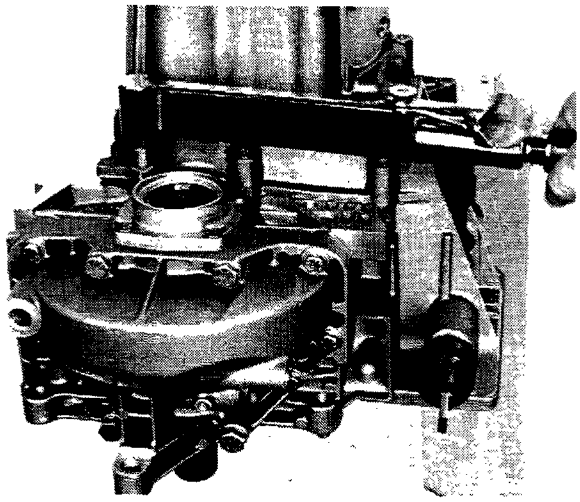
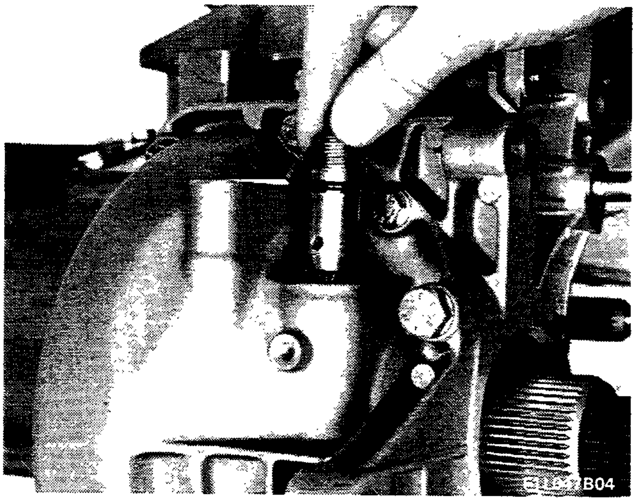
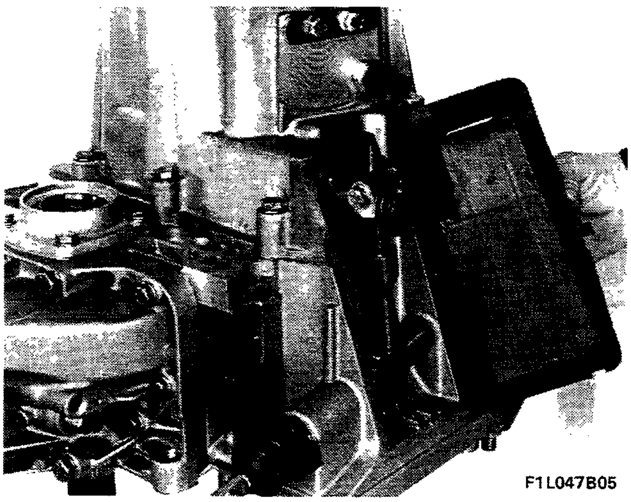


Fitting and torque closure of sealing cover complete with gasket



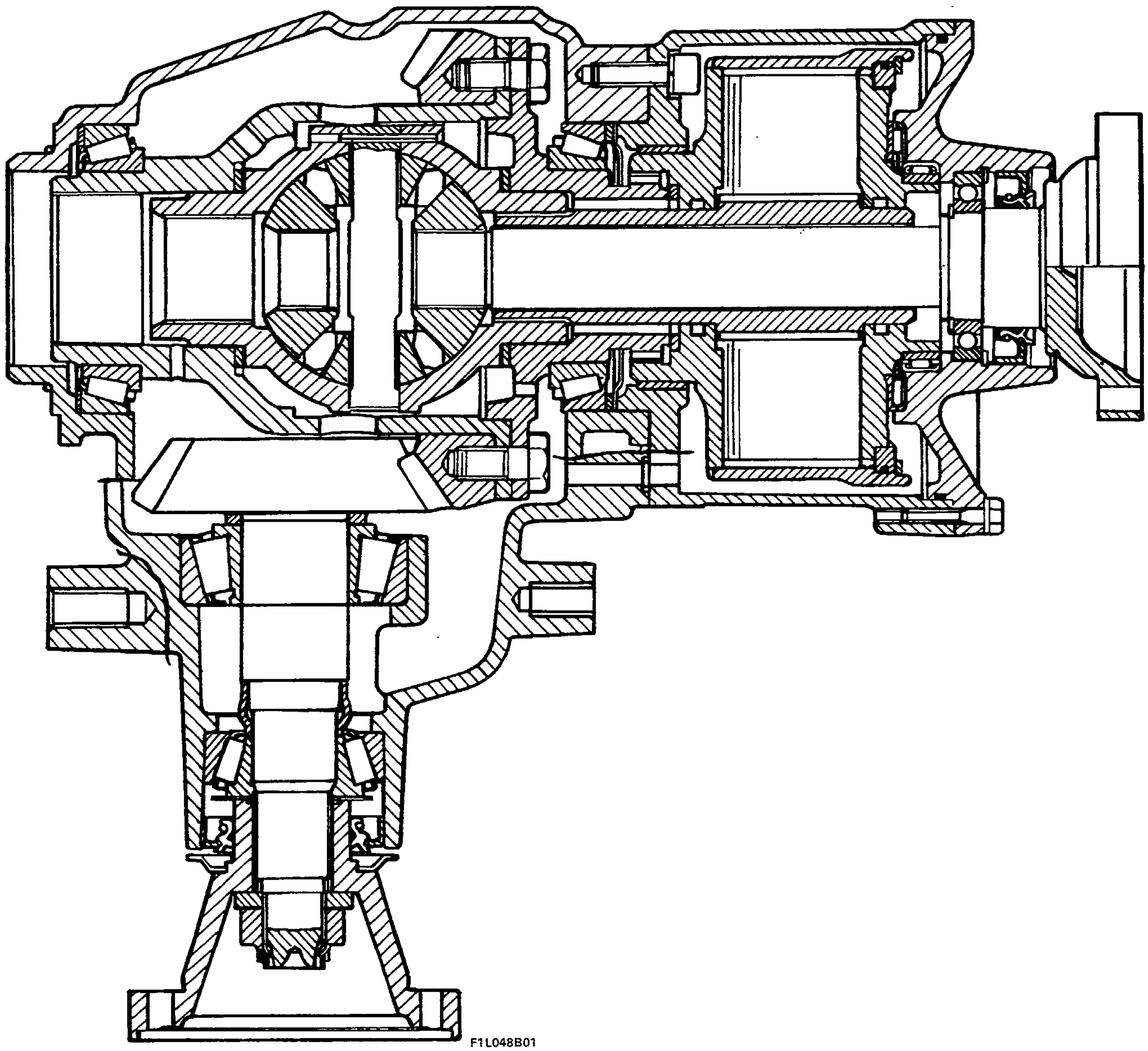
Fitting milometer gear



F1L047B05

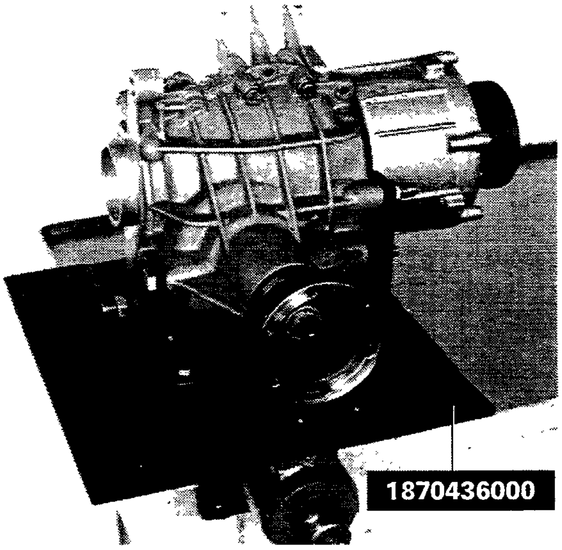
Fitting side cover and reverse switch

21-27.

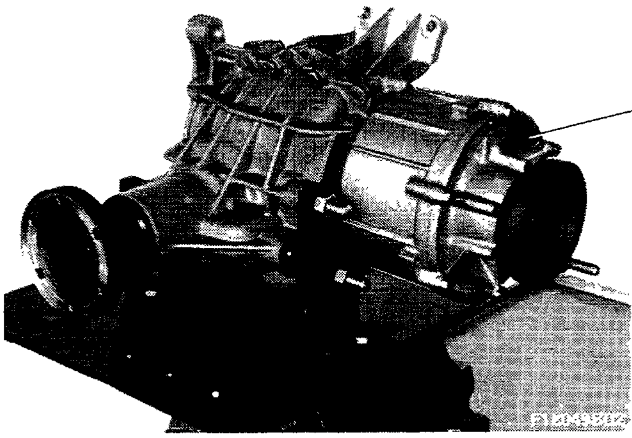


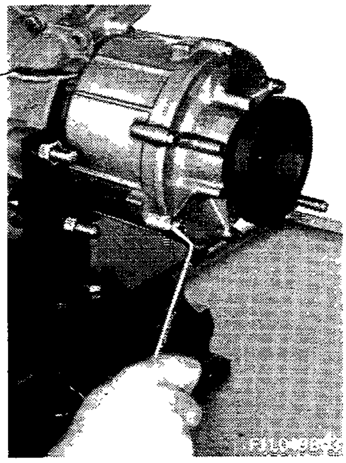
Longitudinal section through front differential - transmission unit

DISASSEMBLY AND CHECKS

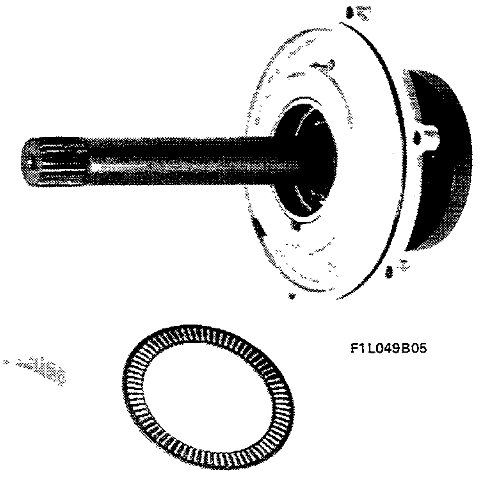


Installing front differential - transmission unit on overhaul stand 1870436000





Removing cover for "Ferguson" viscous coupling complete with intermediate shaft



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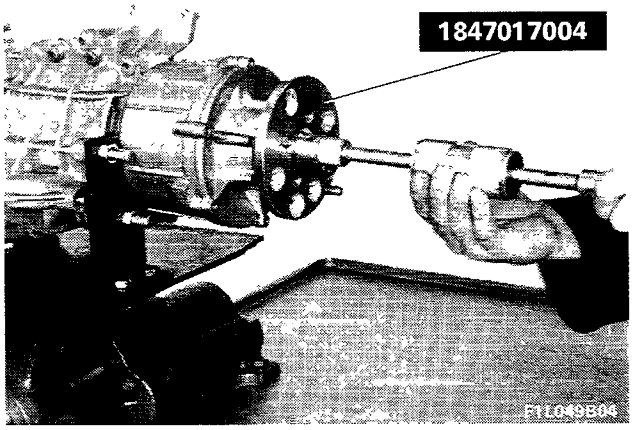
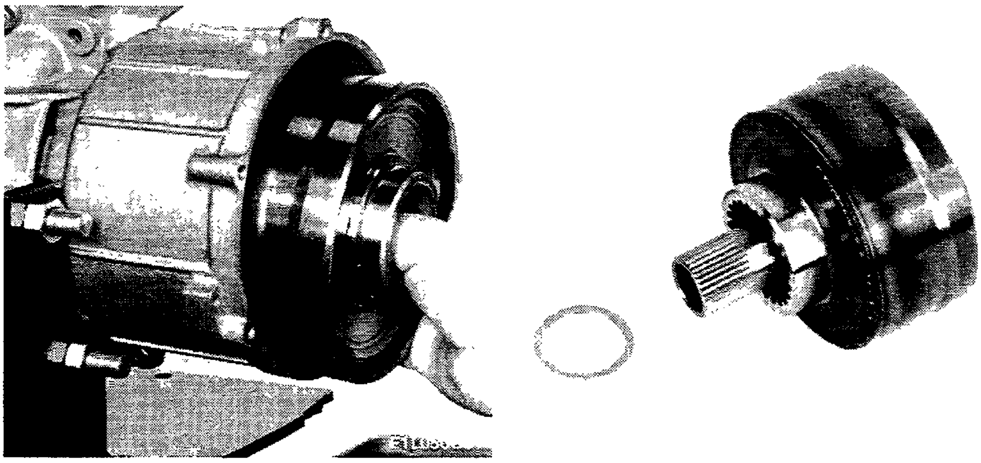
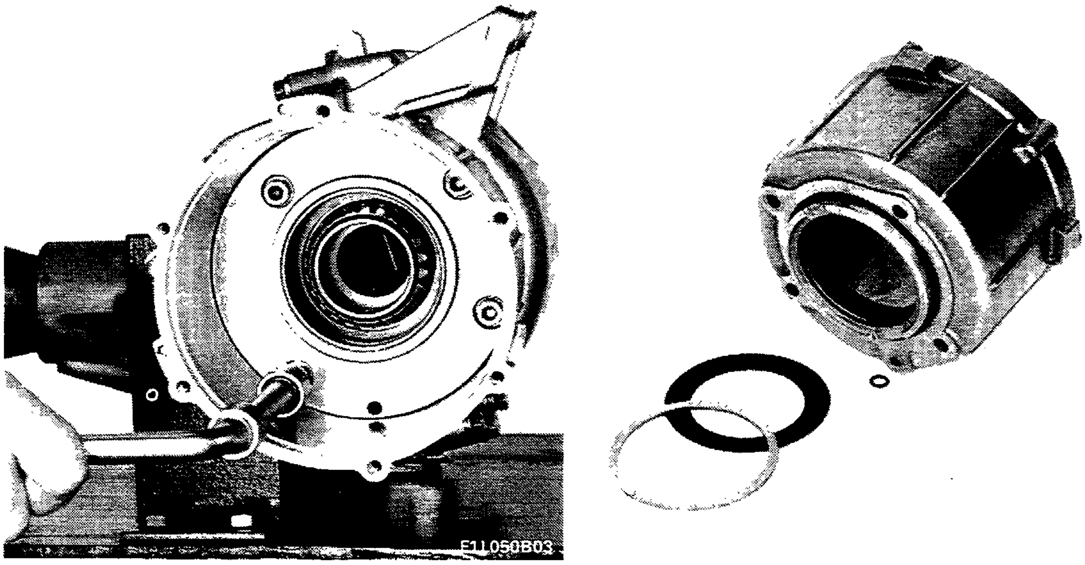


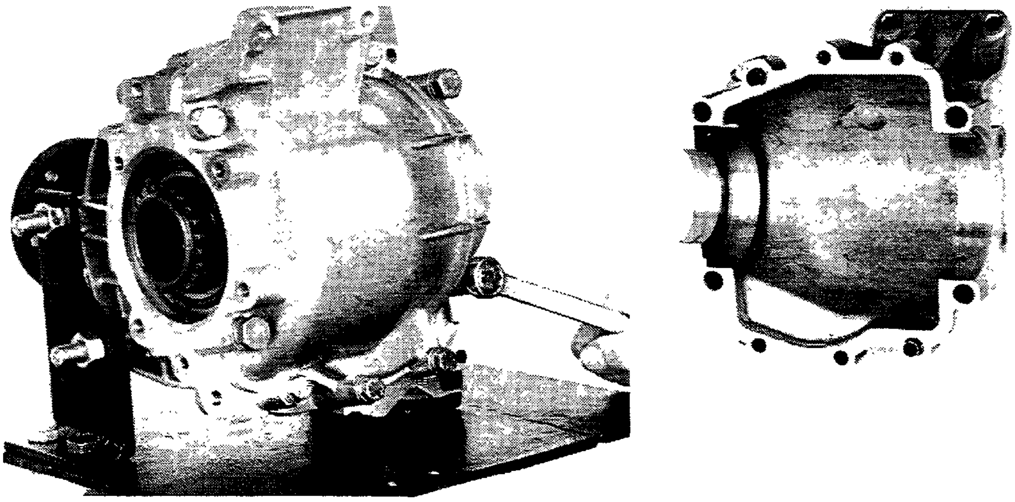
21-27.



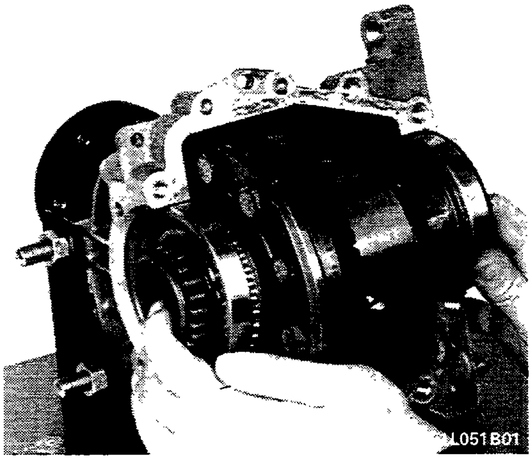
Removing "Ferguson" viscous coupling complete with shim

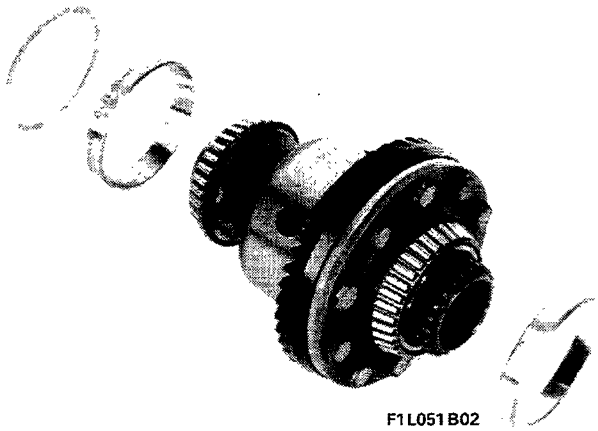


Removing "Ferguson" housing complete with gaskets, thrust rings and cups



Removing differential housing cover

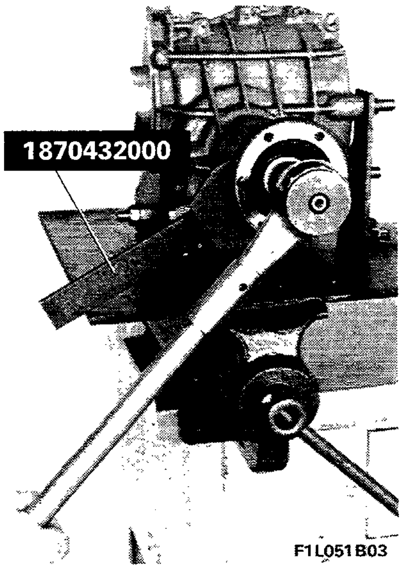


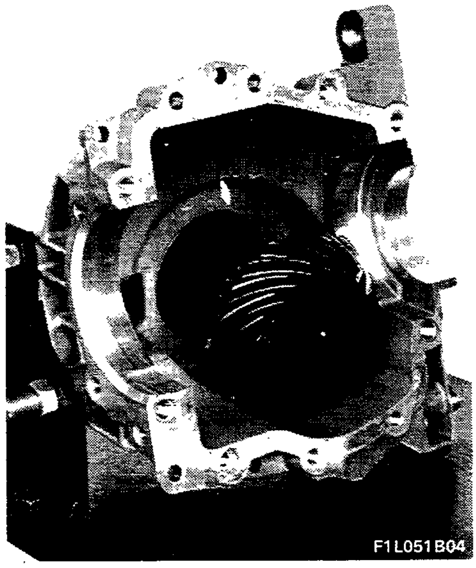


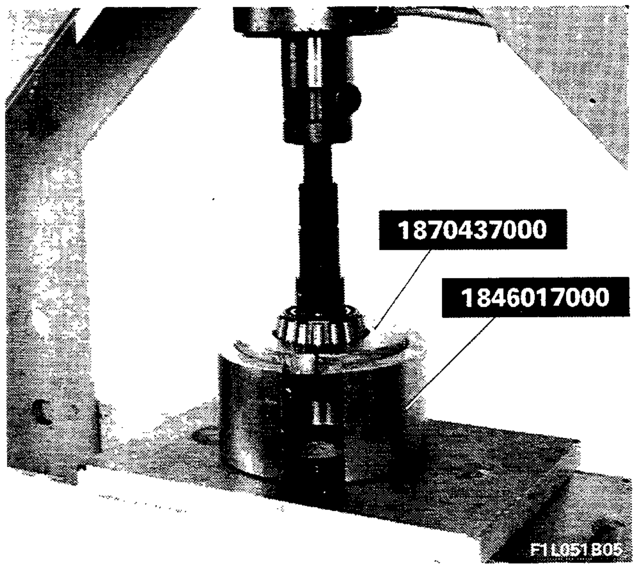
Removing front transmission unit from housing

Removing bevel pinion retaining nut and extracting pinion complete with bearings and flange

NOTE *When removing the pinion retaining nut, prevent the flange from rotating using tool 1870432000, as shown in the diagram.*

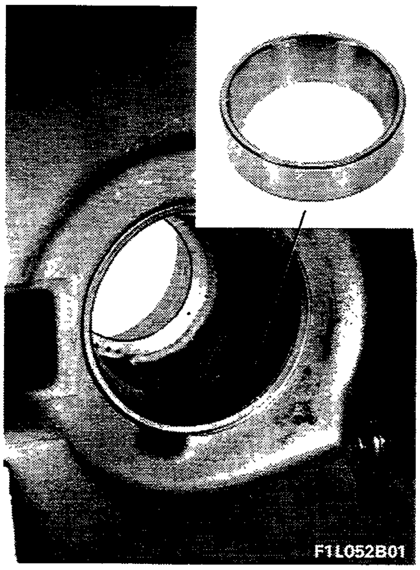


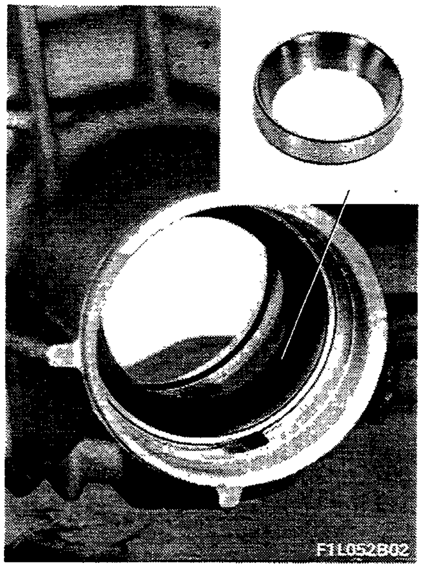




Removing inner race of rear bevel pinion bearing using hydraulic press

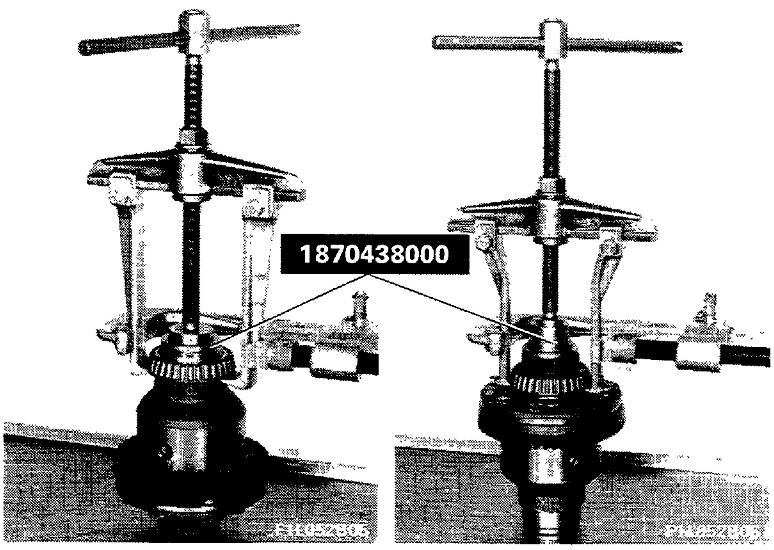
21-27.



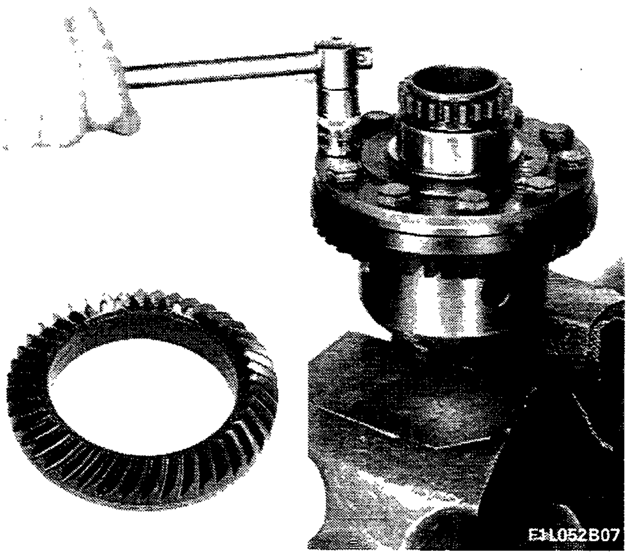


Removing outer races of bevel pinion roller bearings

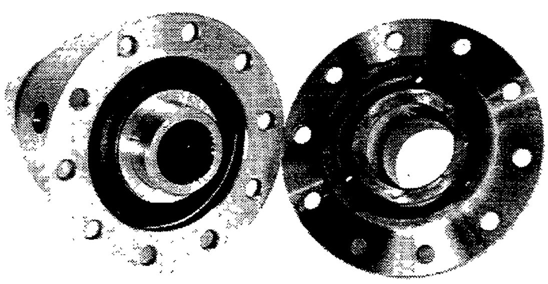
Remove outer races using a steel driver.

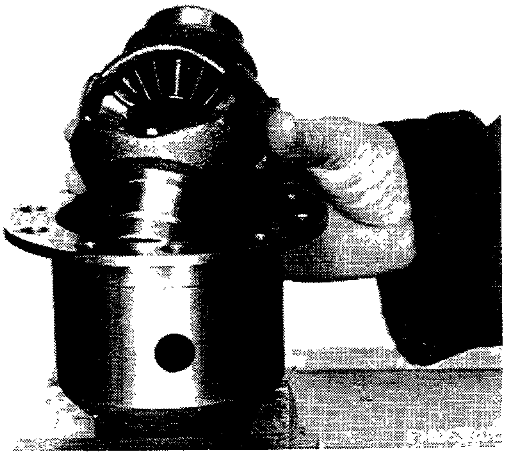


Removing roller bearings from differential unit

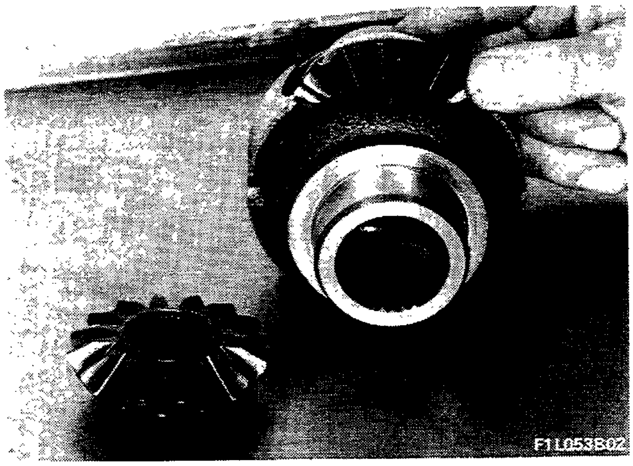


Removing ring gear from differential unit and disassembly of differential halves



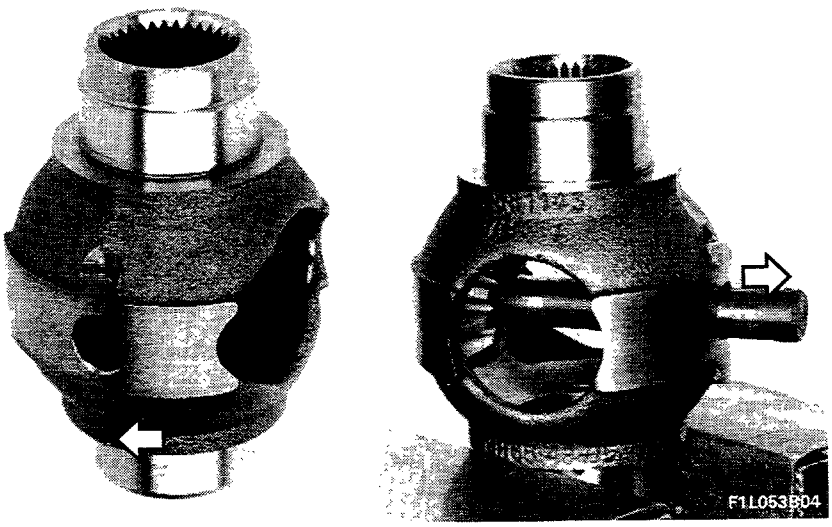


Removing front differential from differential half

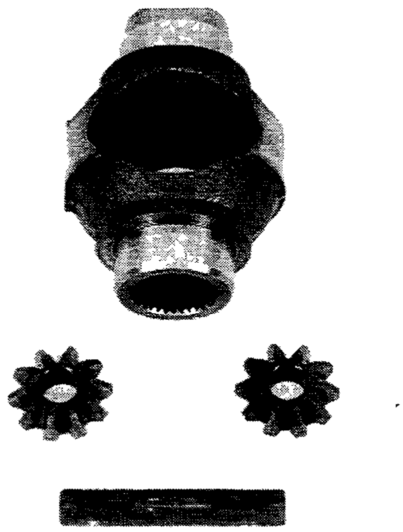


Removing planet wheels from housing

NOTE *Planet wheels are fitted in differential housing without shims. It is not therefore possible to adjust clearance between satellite and planet gears.*



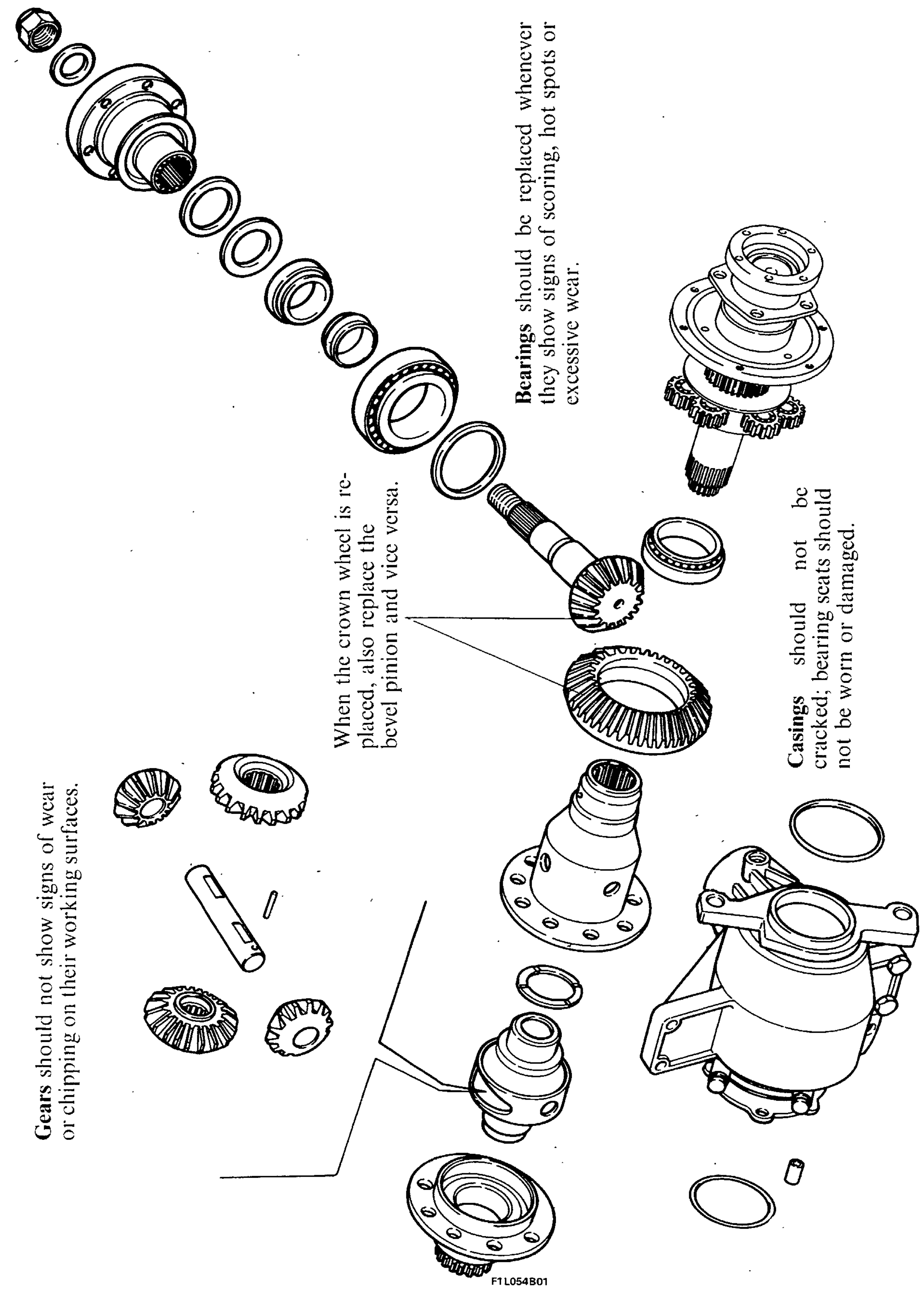
Extraction of retaining pin and removal of satellite carrier shaft



Removing satellites from housing

NOTE *Install satellite and planet gears in housing by carrying out removal operations in reverse order.*

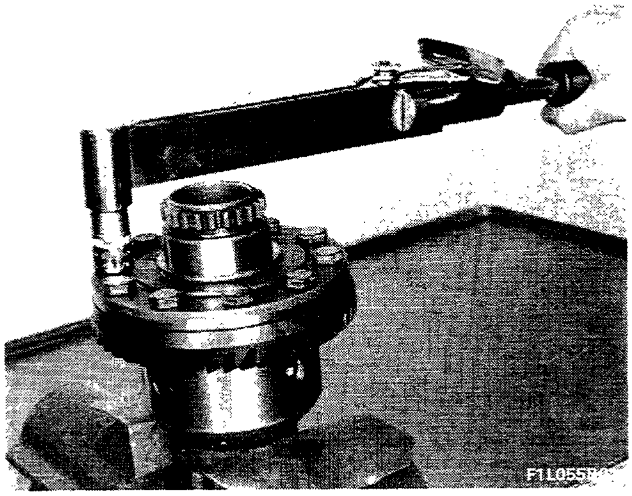
21-27.



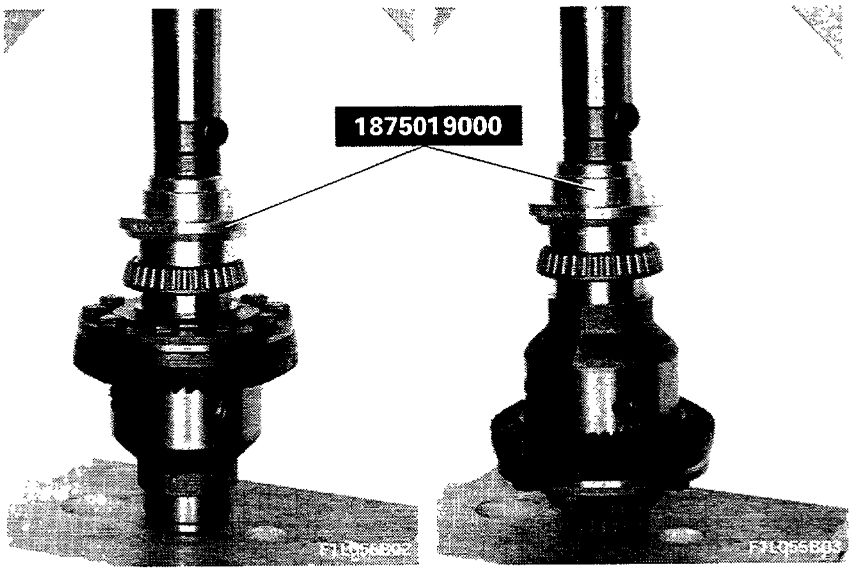
Components of front differential - transmission unit

FITTING AND ADJUSTMENT

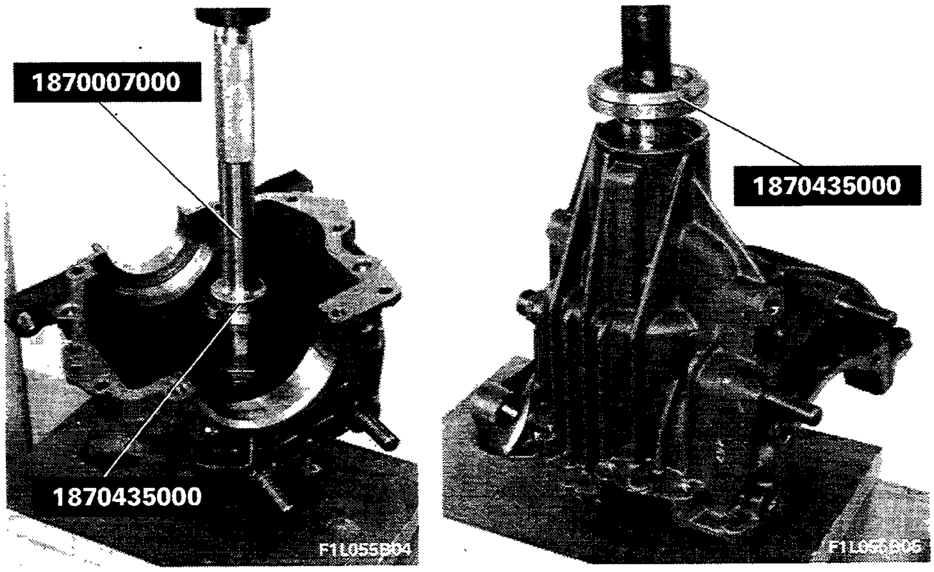
8,8 daNm



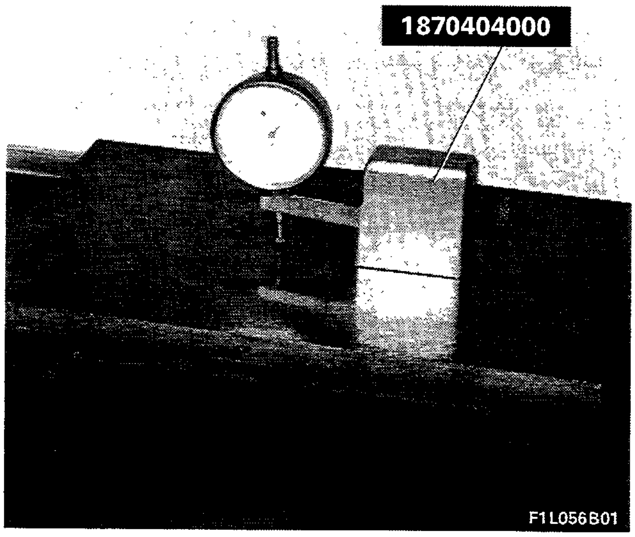
Fitting and torque closure of ring gear and differential halves



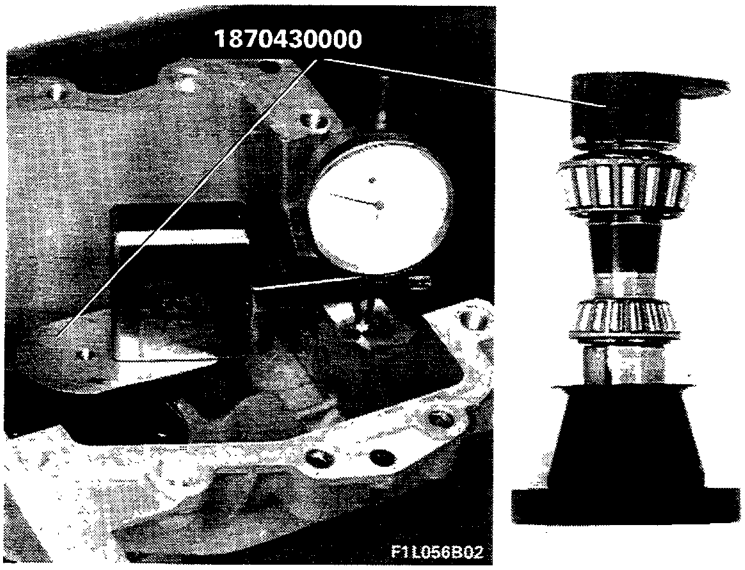
Fitting roller bearings in seats on differential halves



Fitting outer races on bevel pinion roller bearings

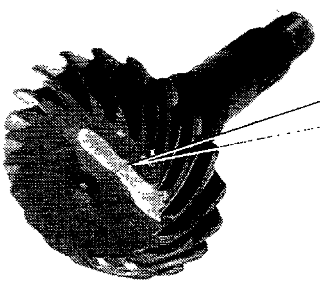


Zeroing centesimal gauge installed on stand 1870404000 using surface plate



Calculating thickness of thrust ring for rear bevel pinion bearing

To fit dummy pinion 187043000, proceed as for installation of bevel pinion but leave out the rubber spacer between front and rear bearings.
Tighten nut and flat washer to secure tool. Adjust bearings and tighten fully.



Bevel pinion

1st case - centesimal value of difference between actual and nominal installation gaps.
(e.g.: -2, 0, +3)

2nd case - Actual installation gap in millimetres.
(e.g.: 80.45 - 80.5 - 80.52).
Always obtain value expressed as in first case by subtracting 80.50 mm front this measurement.
(e.g.: 80.45 - 80.50 = - 0.05 mm = -5 hundredths)
(80.52 - 80.50 = + 0.02 mm = + 2 hundredths).

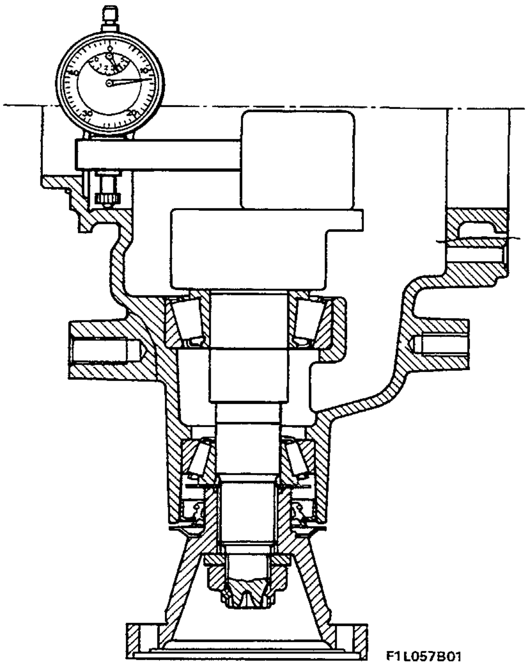
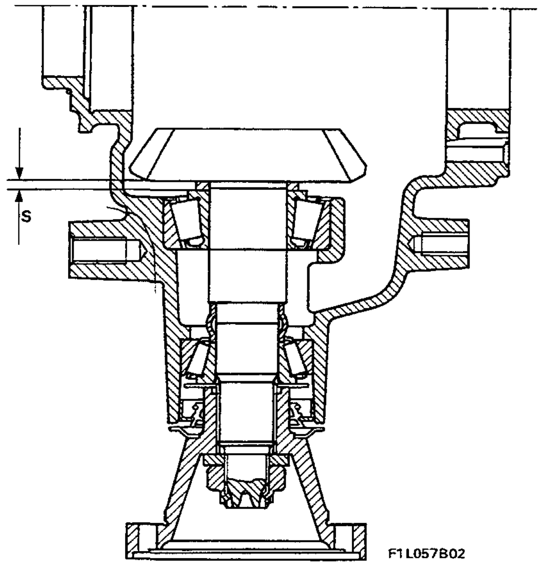


Diagram showing application of dummy pinion 1870430000 and gauge for calculation of thickness S of thrust ring for rear bevel pinion bearing



Bevel pinion installation diagram

Thrust rings for rear bevel pinion roller bearings are supplied in the following sizes: 2.55 - 3.35 mm in steps of 0.02 mm.

CALCULATION OF THICKNESS OF THRUST RING FOR REAR BEVEL PINION BEARING

If "**a**" is the reading on the gauge and "**b**" the value stamped on the bevel pinion at the factory, thickness "S" of thrust ring to be fitted is given by the following equation:

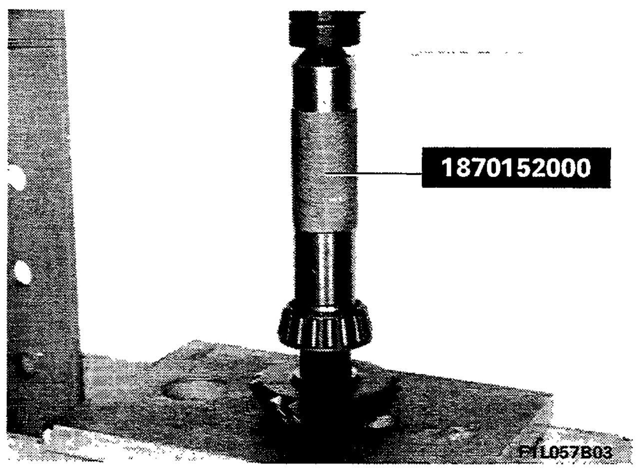
$$S = a - (+b) = a - b$$
$$S = a - (-b) = a + b$$

in other words:
- if the number stamped on the pinion is preceded by a (+) thrust ring thickness is obtained by subtracting this number from the reading on the gauge;
- if the number marked on the pinion is preceded by a (-) ring thickness is obtained by adding the number to the gauge reading.

Example: let **a** = 2.90 (gauge reading);
and let **b** = - 5 (number written on pinion);
then: $S = a - (-b)$;
$S = 2.90 - (-0.05)$;
$S = 2.90 + 0.05$;
$S = 2.95$

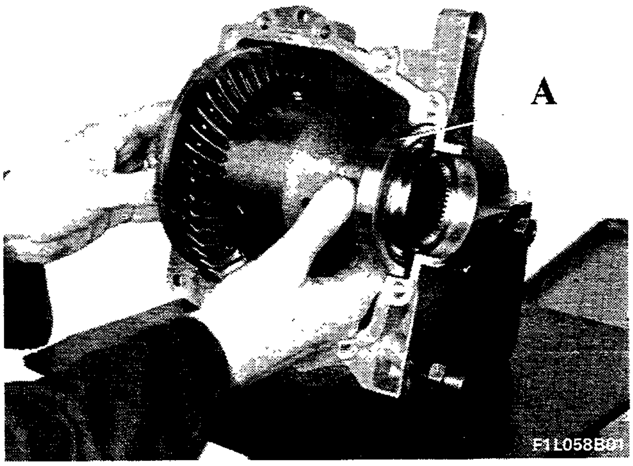
In this case, we need to fit a thrust ring of 2.95 mm thickness.

If the calculated value does not correspond to the one of the spare thrust rings, fit the next size up.



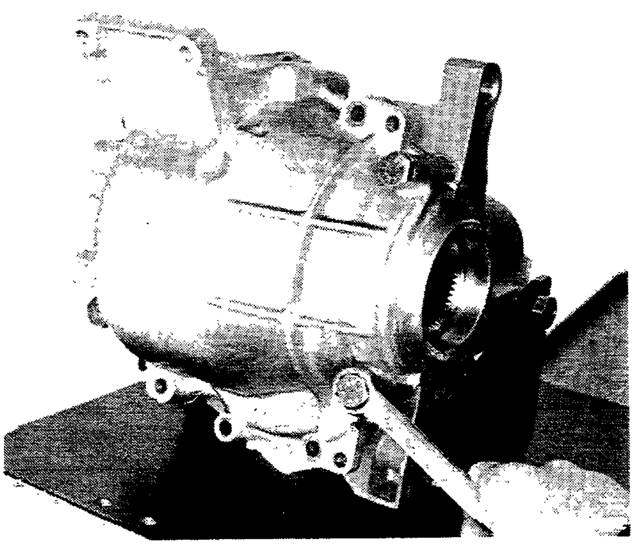
Fitting rear roller bearing inner race to bevel pinion.

BEVEL PINION ROLLING TORQUE

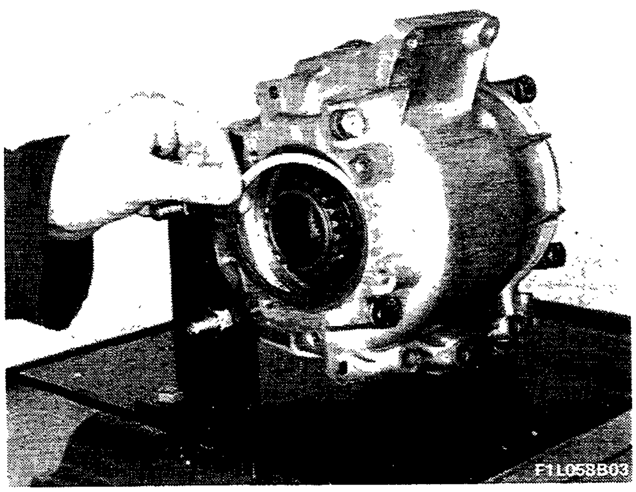


Fitting differential unit complete with ring gear in bell housing

Position shim (A) of known thickness between bell housing and bearing.

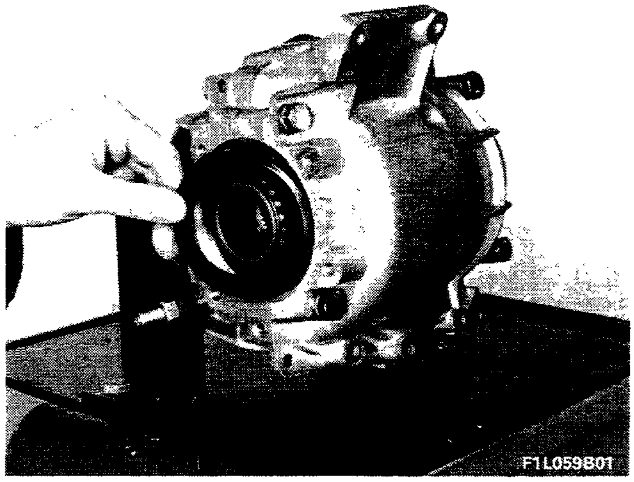


Fitting cover for differential unit bell housing and

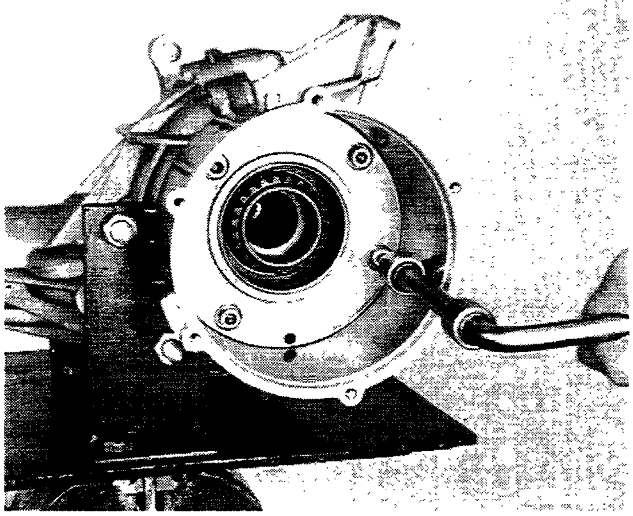


Fitting shim

Position shim of known thickness between bearing and "Ferguson" housing.

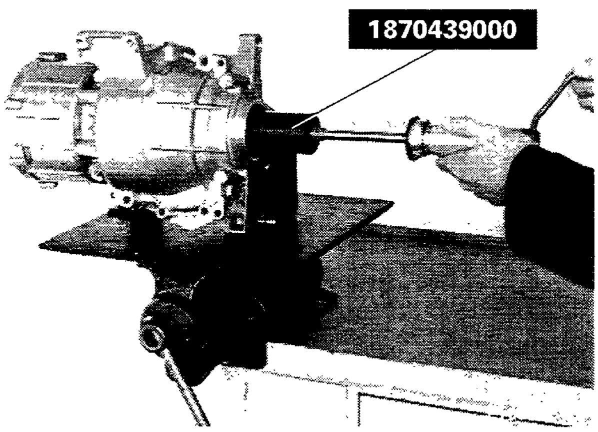


Fitting cup



Fitting "Ferguson" housing

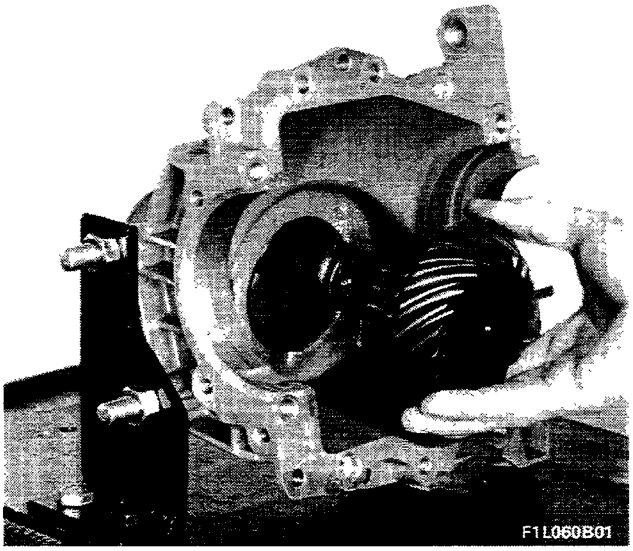
0,12÷0,15 daNm



Ring gear rolling torque

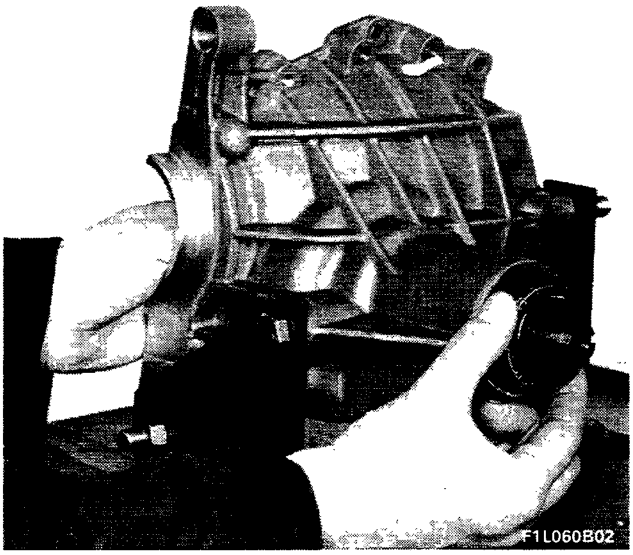
If the rolling torque is too high, reduce shim thickness. Otherwise increase thickness.
Then remove differential unit.

21-27.

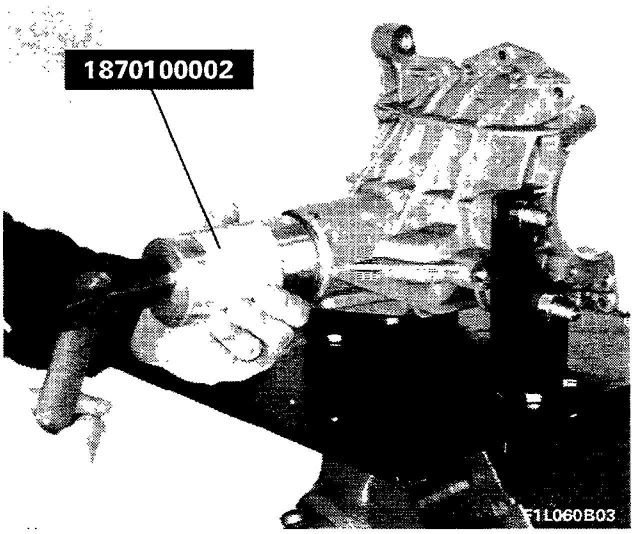


BEVEL PINION ROLLING TORQUE

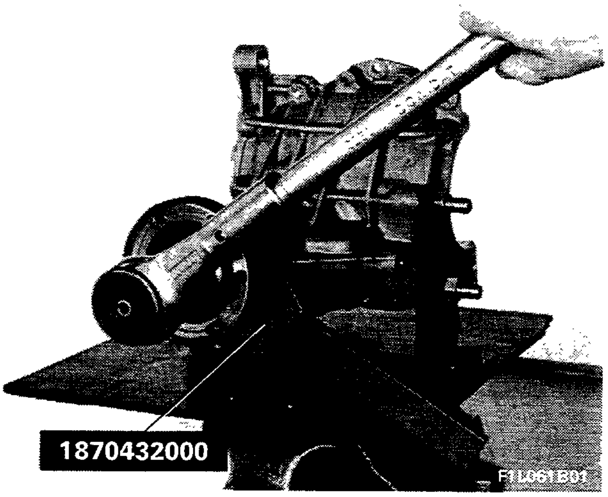
Fitting bevel pinion complete with rubber spacer



Fitting roller bearing inner race, sleeve side



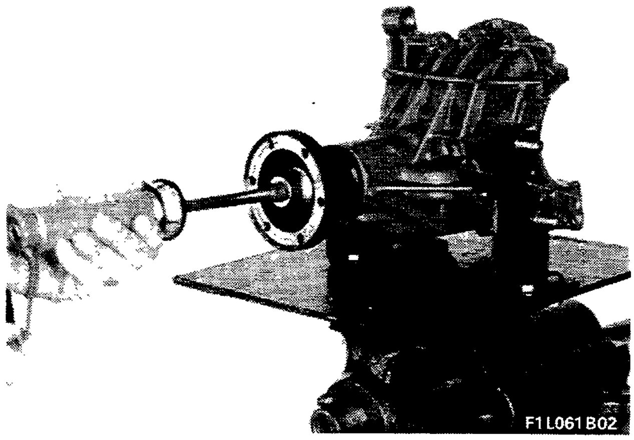
Fitting bevel pinion gasket



Tightening nut retaining sleeve to bevel pinion

Tighten nut to a torque of 17-28 daNm to produce a rolling torque of 0.08-0.12 daNm at pinion. Since this type of differential is fitted with a rubber spacer, remember when installing that bevel pinion retaining nut must never be slackened, otherwise the rubber spacer must be replaced.

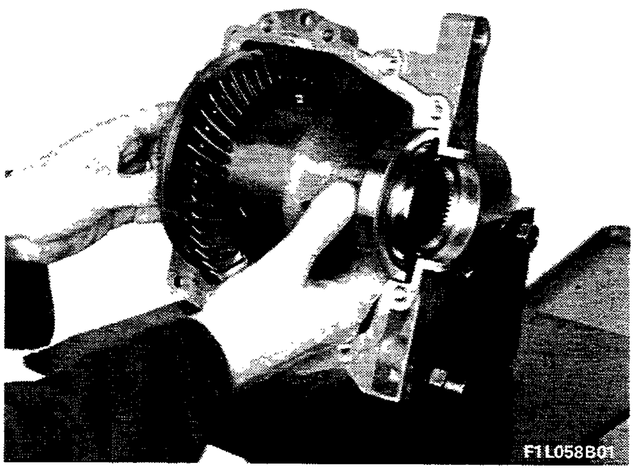
0,08÷0,12 daNm



Checking bevel pinion rolling torque

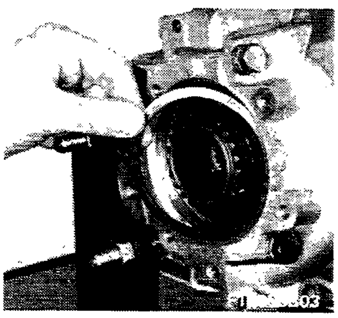
If maximum bevel pinion rolling torque is exceeded during preloading, installation and checks must be repeated using a new rubber spacer.

CHECKING PINION-CROWN WHEEL BACKLASH



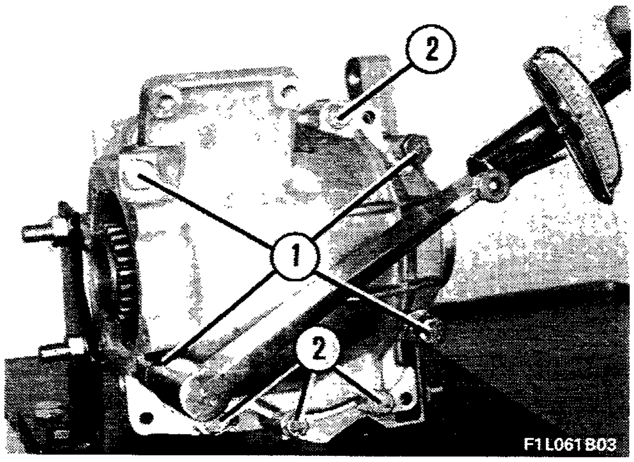
Fitting differential unit and shim

1	5 daNm
2	2,5 daNm

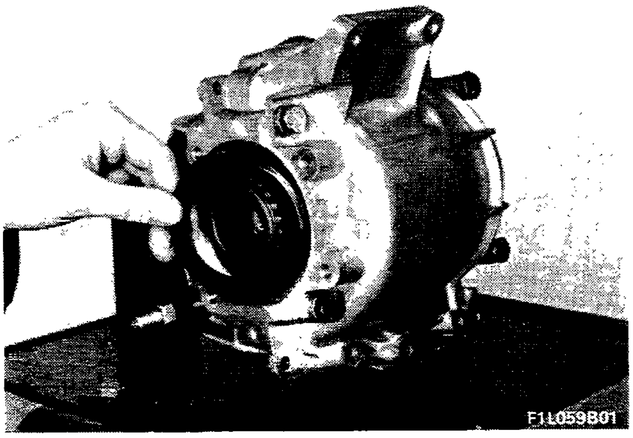


Fitting differential bell housing and shim

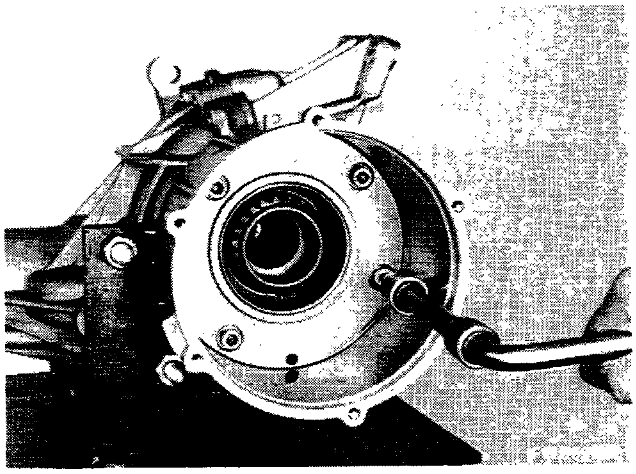
NOTE *Shim thickness must be as calculated previously.*



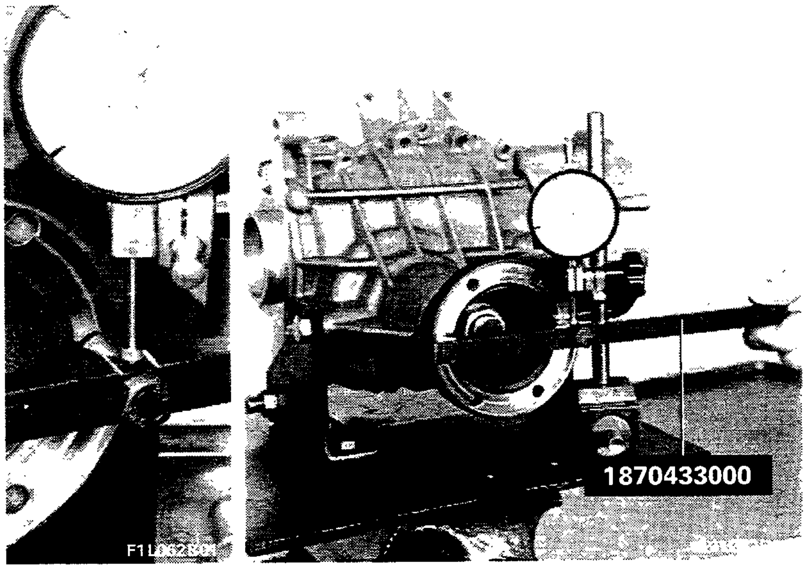
21-27.



Fitting cup



Fitting "Ferguson" housing

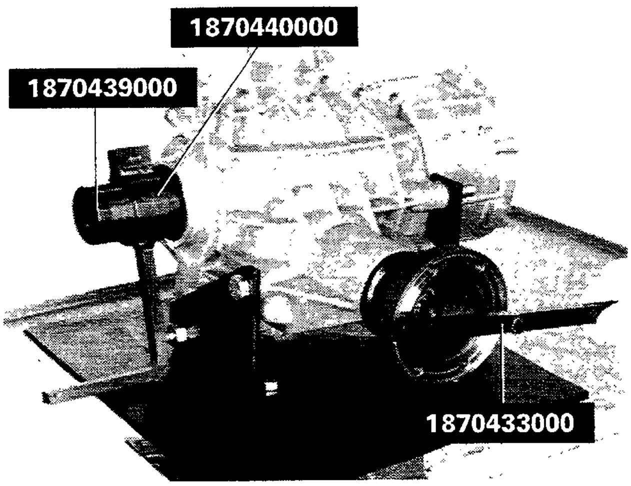


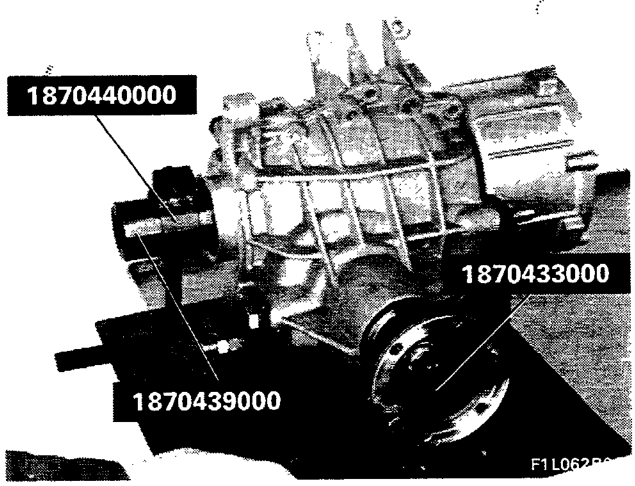
0,08 ÷ 0,15

Checking and adjusting pinion-crown wheel backlash

If backlash is lower or higher than specified value, gap between crown wheel and pinion must be altered by fitting shims of different thickness. Take care to keep overall value as calculated during adjustment of crown wheel rolling torque.

CHECKING AND ADJUSTING BEVEL PINION AND CROWN WHEEL TOOTH CONTACT PATTERN



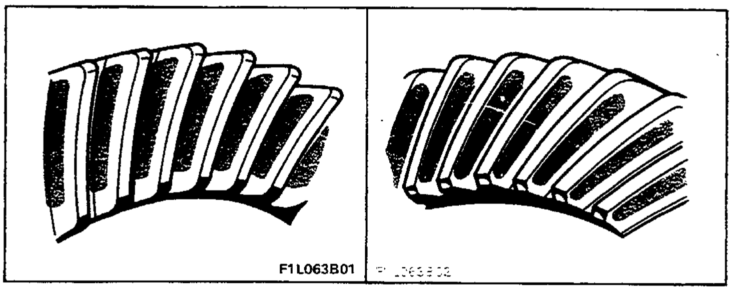


Checking bevel pinion-crown wheel tooth contact pattern on drive and coast surfaces

DRIVE SIDE COAST SIDE

Exact mesh

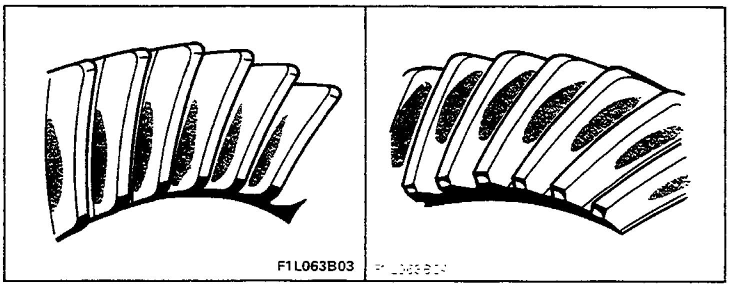
The contact pattern should be evenly spread over both faces of the tooth. i.e. the drive and coast sides.



F1L063B01

Inexact mesh

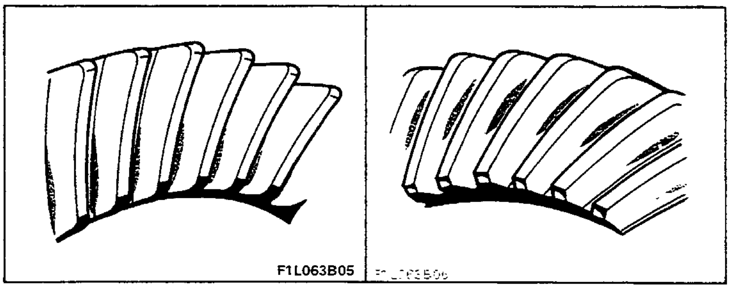
Drive side: contact on the tooth tip and towards the middle area.
Coast side: contact on tooth heel and towards the middle area.
Move the pinion further from the crown wheel by decreasing thrust ring thickness



F1L063B03

Inexact mesh

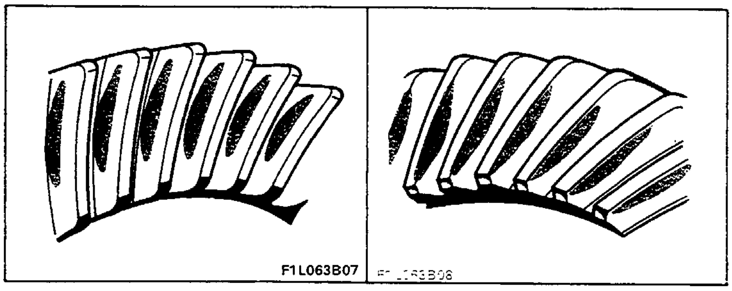
Drive side: contact on top, localised on side of tooth at bottom.
Coast side: contact on heel, localised on side of tooth at bottom.
Move the pinion further from the crown wheel by decreasing thrust ring thickness.



F1L063B05

Inexact mesh

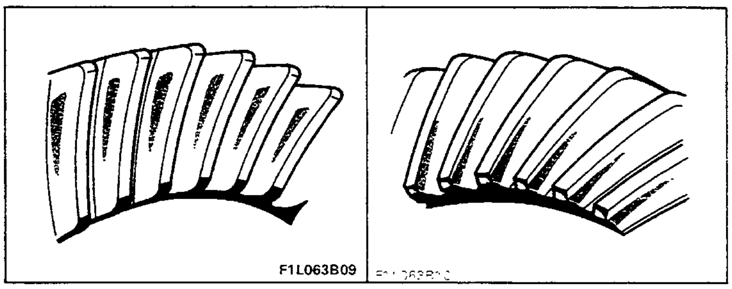
Drive side: contact on heel and towards middle of tooth.
Coast side: contact on tip and towards middle of tooth.
Move pinion closer to crown wheel by increasing thrust ring thickness.



F1L063B07

Inexact mesh

Drive side: contact on heel, localised on crest of tooth.
Coast side: contact on tip, localised on crest of tooth.
Move pinion closer to crown wheel by increasing thrust washer thickness.

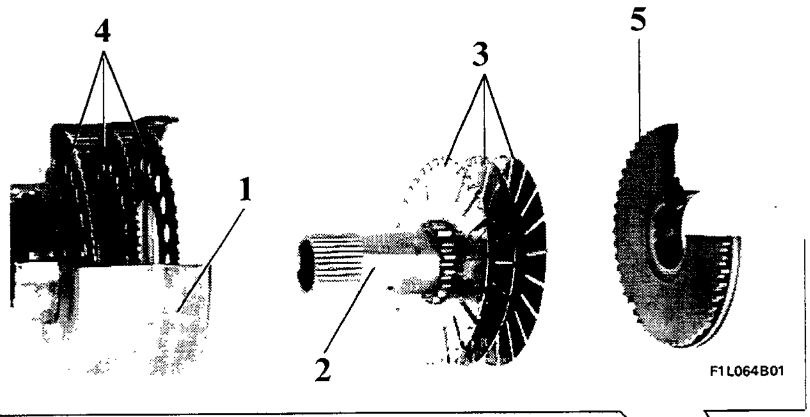


F1L063B09

The unit must be removed again in all the above cases. The pinion-crown wheel backlash must be readjusted when the unitis fitted again.

21-27.

"FERGUSON" VISCOUS COUPLING



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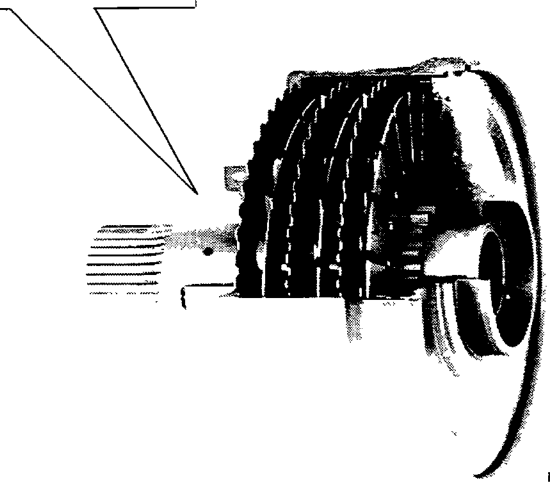


F1L064B02

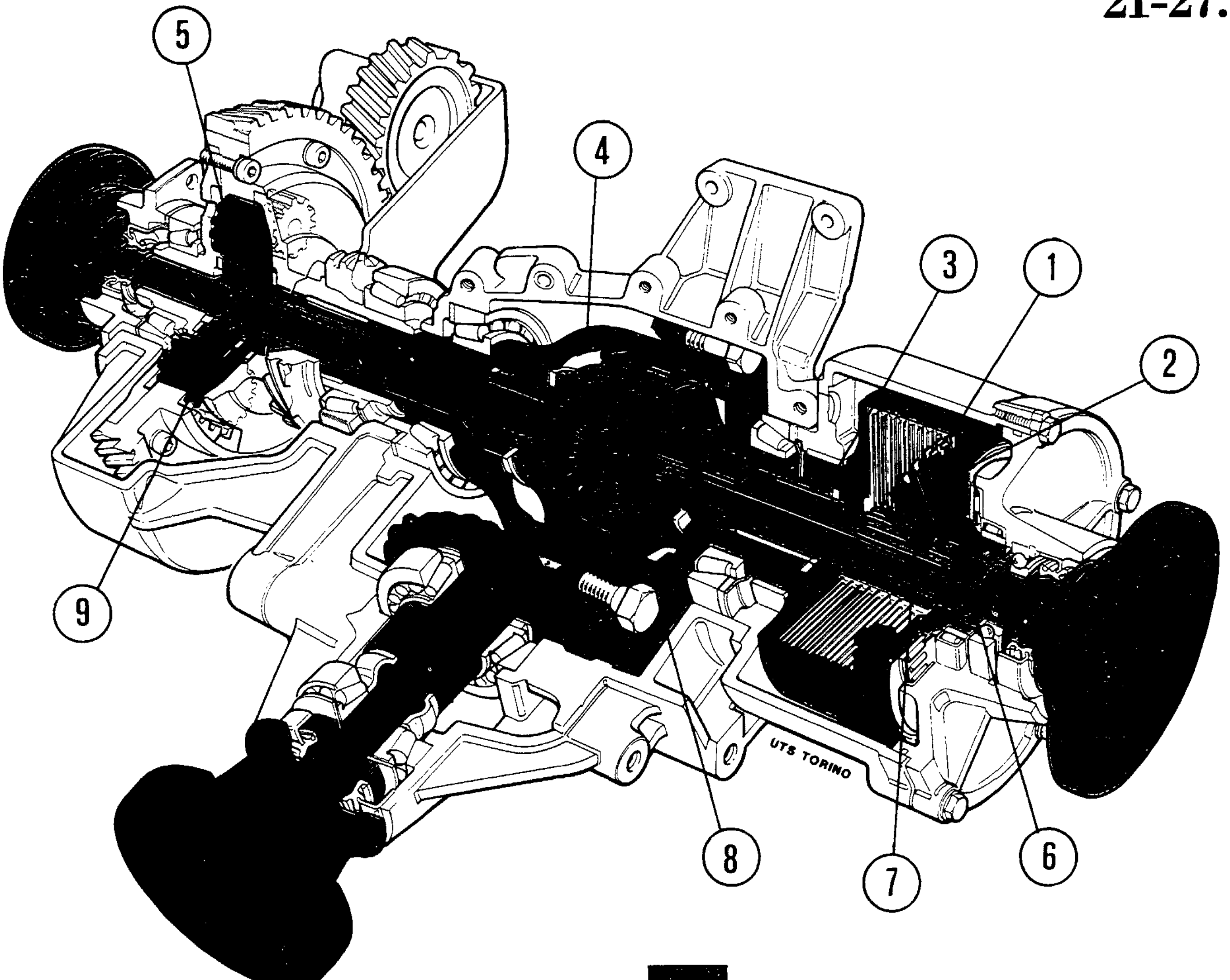
General remarks

The "Ferguson" viscous coupling applied to the central differential restricts front axle slide in relation to the rear axle and vice versa by transferring part of the torque from front to rear axle when slide occurs.
Loss of grip by one of the axles is prevented or at least restricted in this way and optimal torque distribution over front and rear axles is obtained despite the loss of grip even in poor driving conditions.
The viscous coupling offers the advantage of permanent operation, without manual intervention, and of not transmitting anomalous signals to the various transmission components.

This coupling is maintenance free and cannot be overhauled. It must therefore be replaced if found to be defective

The "Ferguson" viscous coupling consists of:
1. Outer casing
2. Inner hub
3. Series of plates integral with hub
4. Series of plates integral with outer casing
5. External housing cover

The coupling is filled with a special ultra-high viscosity, silicone-based fluid.



Transmission of drive to rear axle

Transmission of drive to front axle

Operation

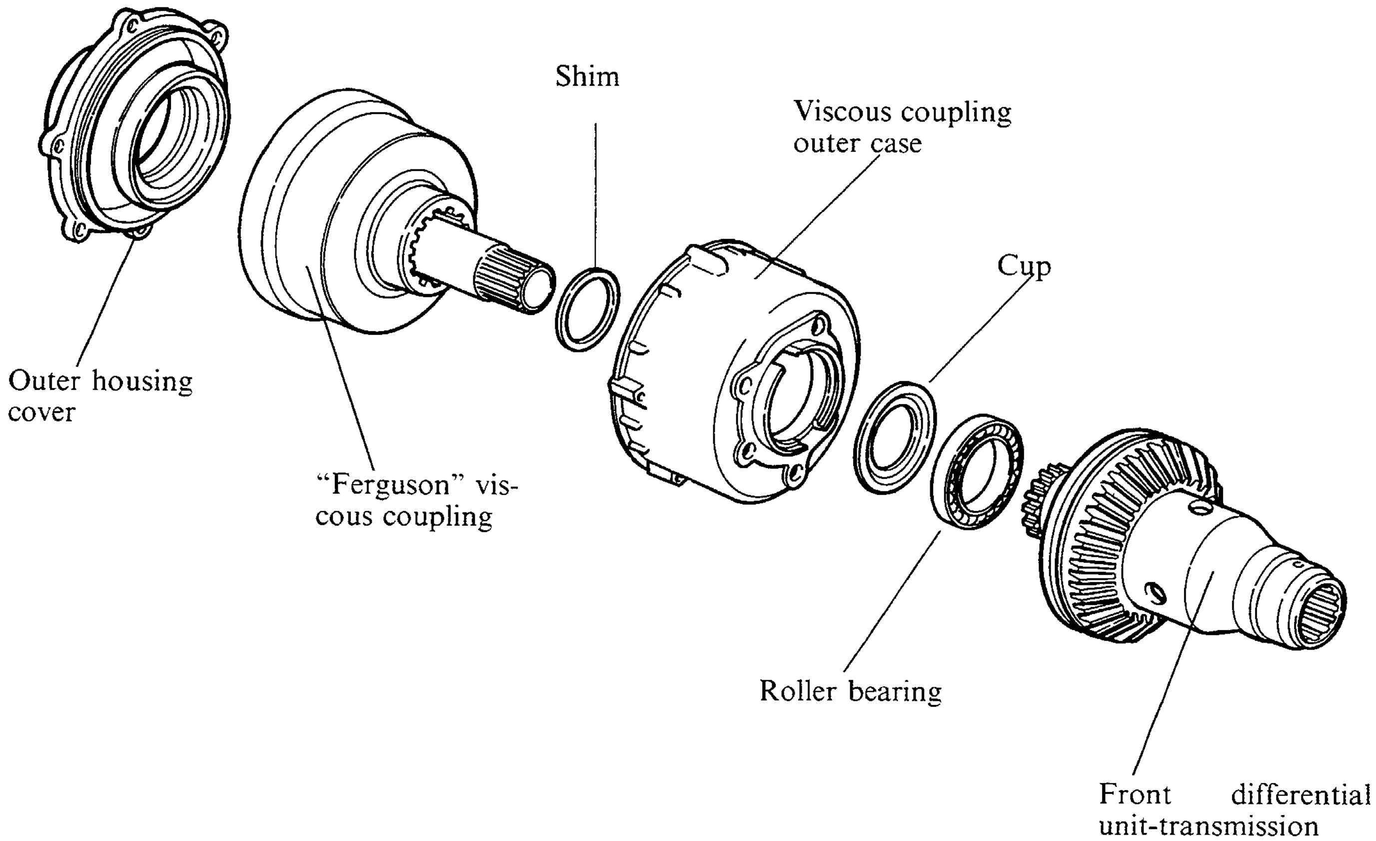
The outer casing (1) and integral plates (2) receive the drive via a spur toothed fitting (3), from the transmission cover (4), connected to the satellite carrier housing (5) (rear axle) of the central differential or torque distributor.
The hub (6) and integral plates (7) receive drive via differential casing (8), from pinion (9) (front axle) of central differential.
When front and rear axles are turning at the same speed, all parts of the viscous coupling turn at the same speed. When the axles start to turn at different speeds (cornering, bumpy road, slippery road) the two sets of plates (2 and 7) also tend to move at different speeds but are slowed by the viscous fluid thus restricting slide between the axles. As a result of the difference between the speeds of plates (2 and 7), the viscous fluid is "cut", i.e. subjected to a cutting force. This force increases with increasing speed difference.
The cutting force acting on the opposing plates leads to a considerable increase in torque on the axle that tends to turn at a lower speed (normally the axle with the best grip) with benefits in terms of traction and stability.
Even during small skids, the torque crossing the viscous coupling (i.e. the torque that the viscous coupling takes from the faster axle and yields to the slower axle) is high.

21-27.

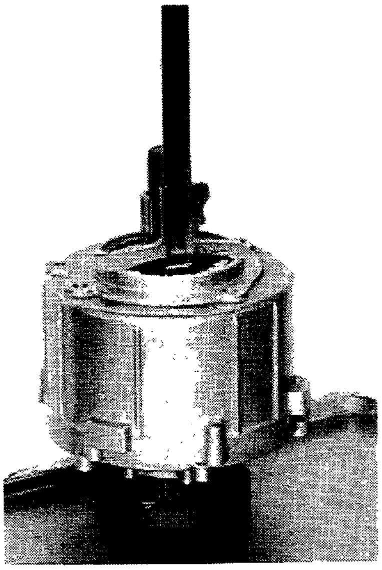
All else being equal, it is possible to increase or decrease torque transfer by varying plate number and size and/or fluid viscosity.
The viscous coupling may lock, i.e. transmit very high torques with no slide. In other words, a very high torque may cross the viscous coupling that has been taken from the faster axle and yielded to the slower axle even when there is no slide.
This happens when the unit runs for a long time with high slide and the heat produced raises the temperature of the viscous fluid (150° - 200°C).
The air present inside the viscous coupling forms an emulsion with the fluid to bring about an increase in pressure (about 90 bar). This brings about an abrupt change in the properties of the viscous coupling and makes slide between the plates impossible.
The viscous coupling is designed to stand up to the above conditions for short periods. If subjected to such conditions for long periods as a result of high stress or defective operation (such as disconnecting the rear transmission and driving the car as if it only had two drive wheels) the viscous coupling could become damaged.

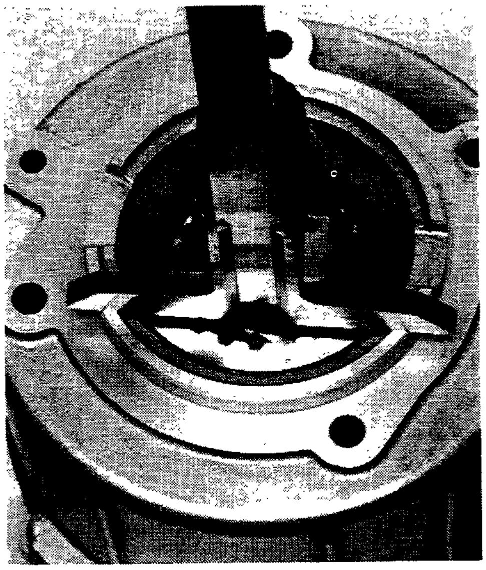
⚠ *In the case of breakdown or accident, the car must be towed using a bar so that the wheels can turn or loaded onto a breakdown truck.*

Components of "Ferguson" viscous coupling



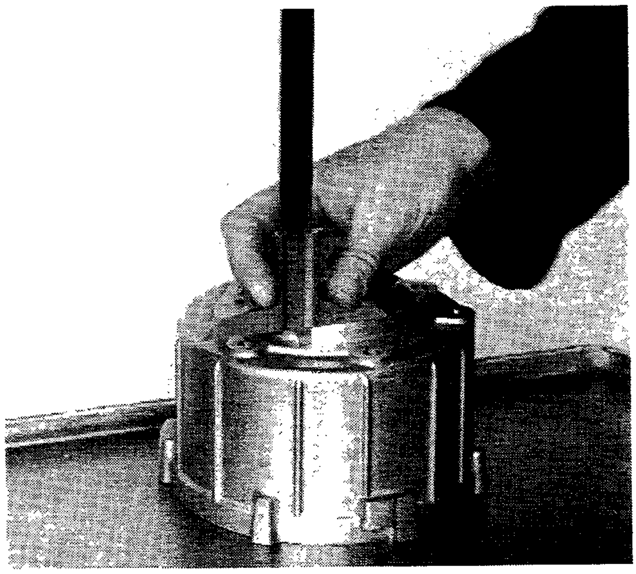
ADJUSTMENT



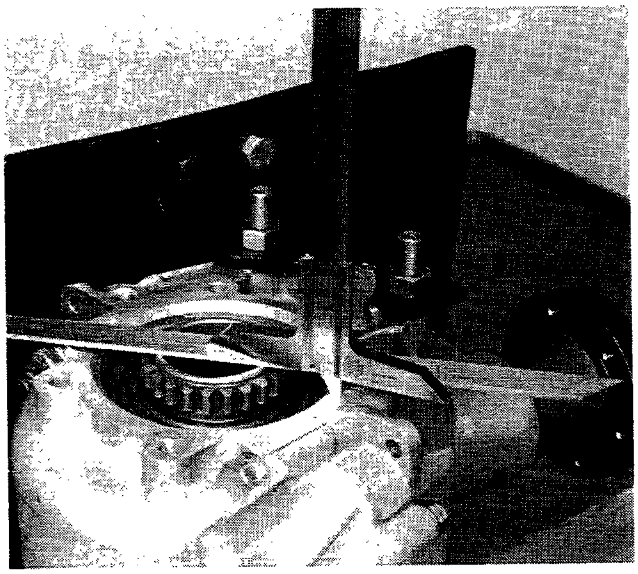


Calculating shim thickness "S"

Fit the viscous coupling and cover on the housing and use a depth gauge to measure the gap between the outer edge of the housing and the rest plane of the shim on the viscous coupling. You will therefore obtain dimension "X".



Measure the gap between the outer edge of the viscous coupling housing and the rest surface on the differential unit support housing. You will therefore obtain dimension "Y".



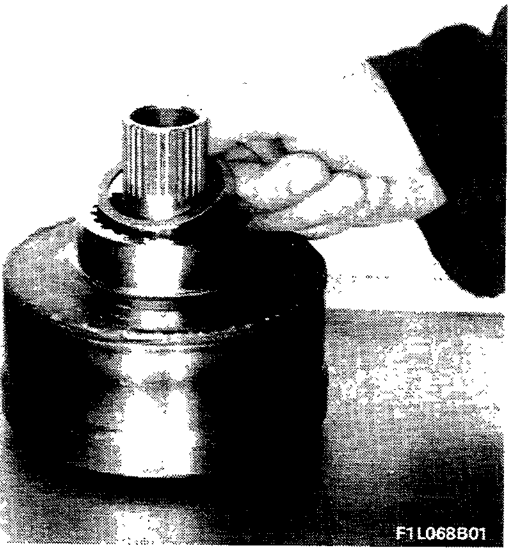
Measure the gap between the meshed gear and rest plane on differential unit bell housing. You will obtain dimension "Z".

Thickness "S" of shim for adjustment of clearance between viscous coupling and gear is obtained using the following equation:

$$S = X - Y - Z - (0.13 - 0.25 \text{ mm})$$

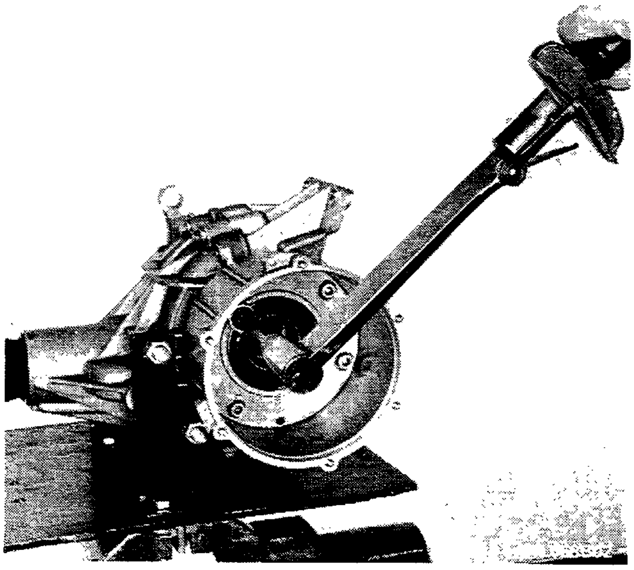
Where 0.13 - 0.25 mm is the clearance between viscous coupling and gear.

21-27.



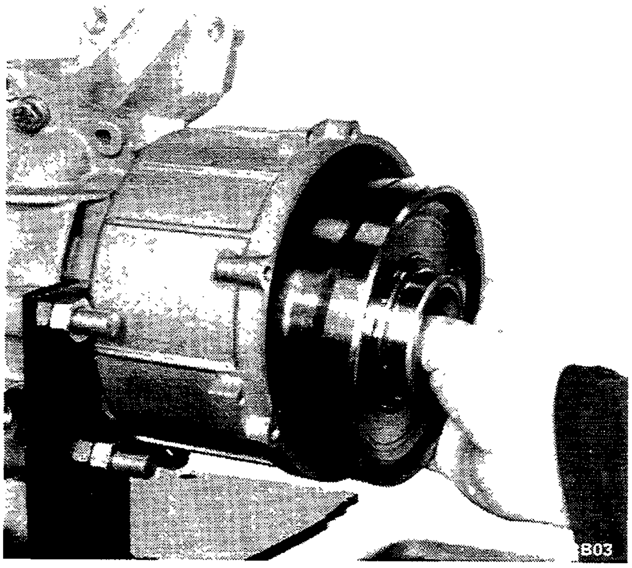
Fitting shim to "Ferguson" viscous coupling

Shims are supplied as spares in the following sizes:
2.45 - 3.05 mm in 0.05 mm steps.



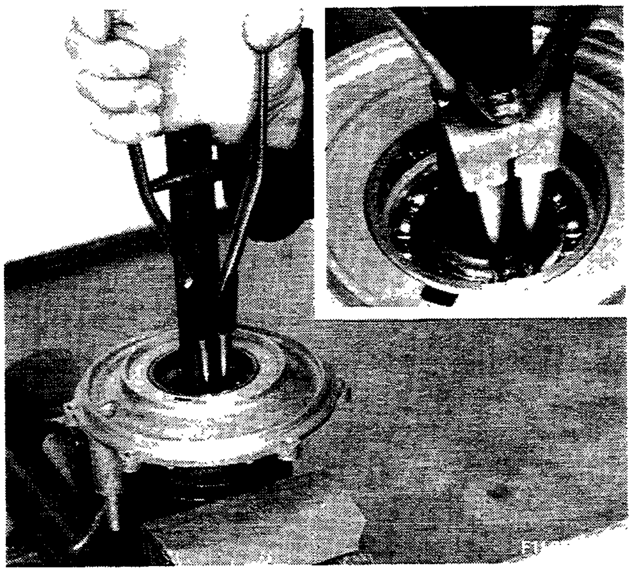
2,5 daNm

Fitting and torque tightening of outer "Ferguson" coupling housing

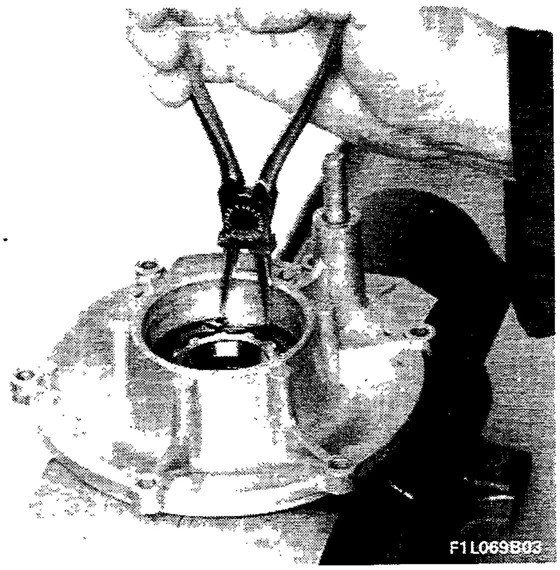


Fitting "Ferguson" viscous coupling complete with shim

"FERGUSON" HOUSING COVER

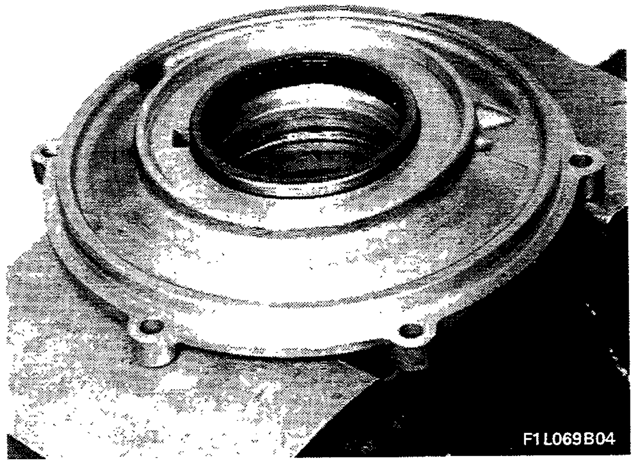


Removing-fitting intermediate shaft retaining ring

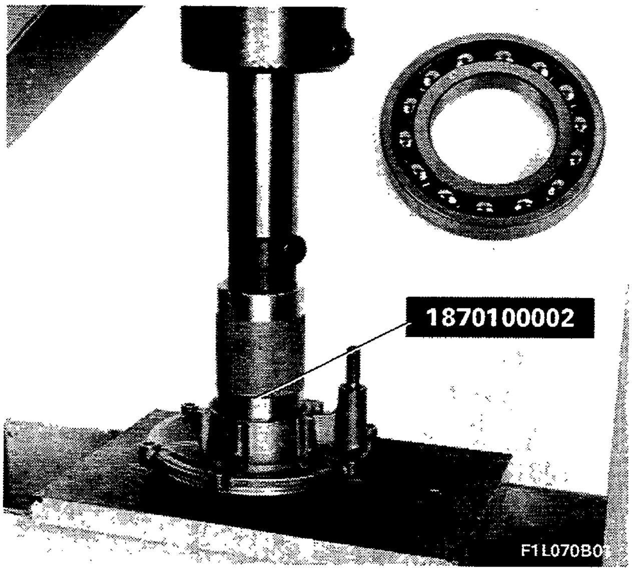


Removing-fitting retaining ring for intermediate shaft mounting ball bearing

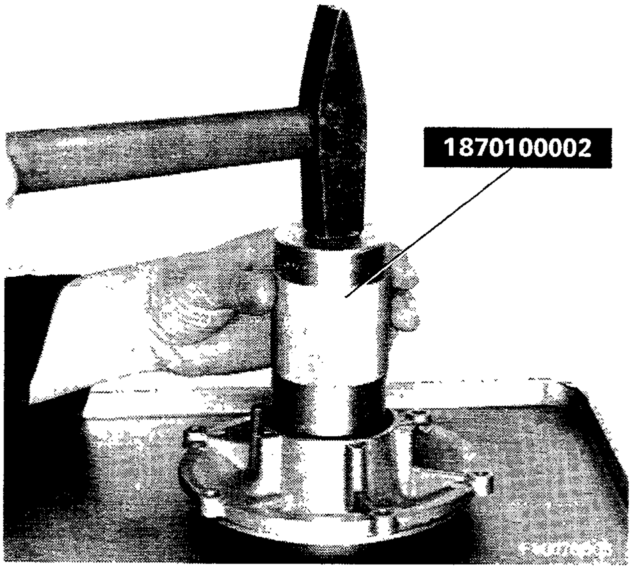
Remove the bearing using a driver.



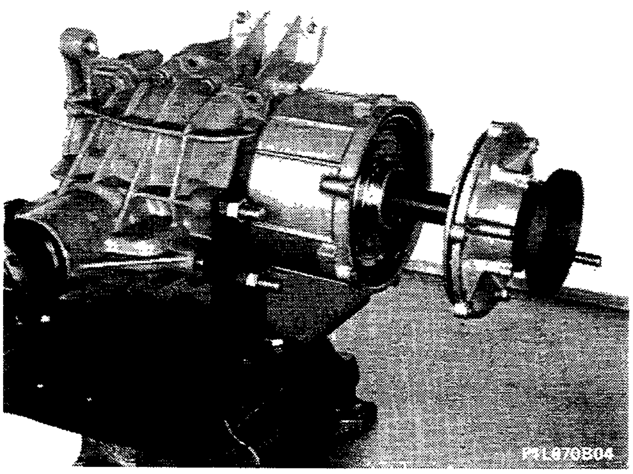
Removing-fitting "Ferguson" coupling mounting roller bearing



Fitting intermediate shaft mounting ball bearing using hydraulic press

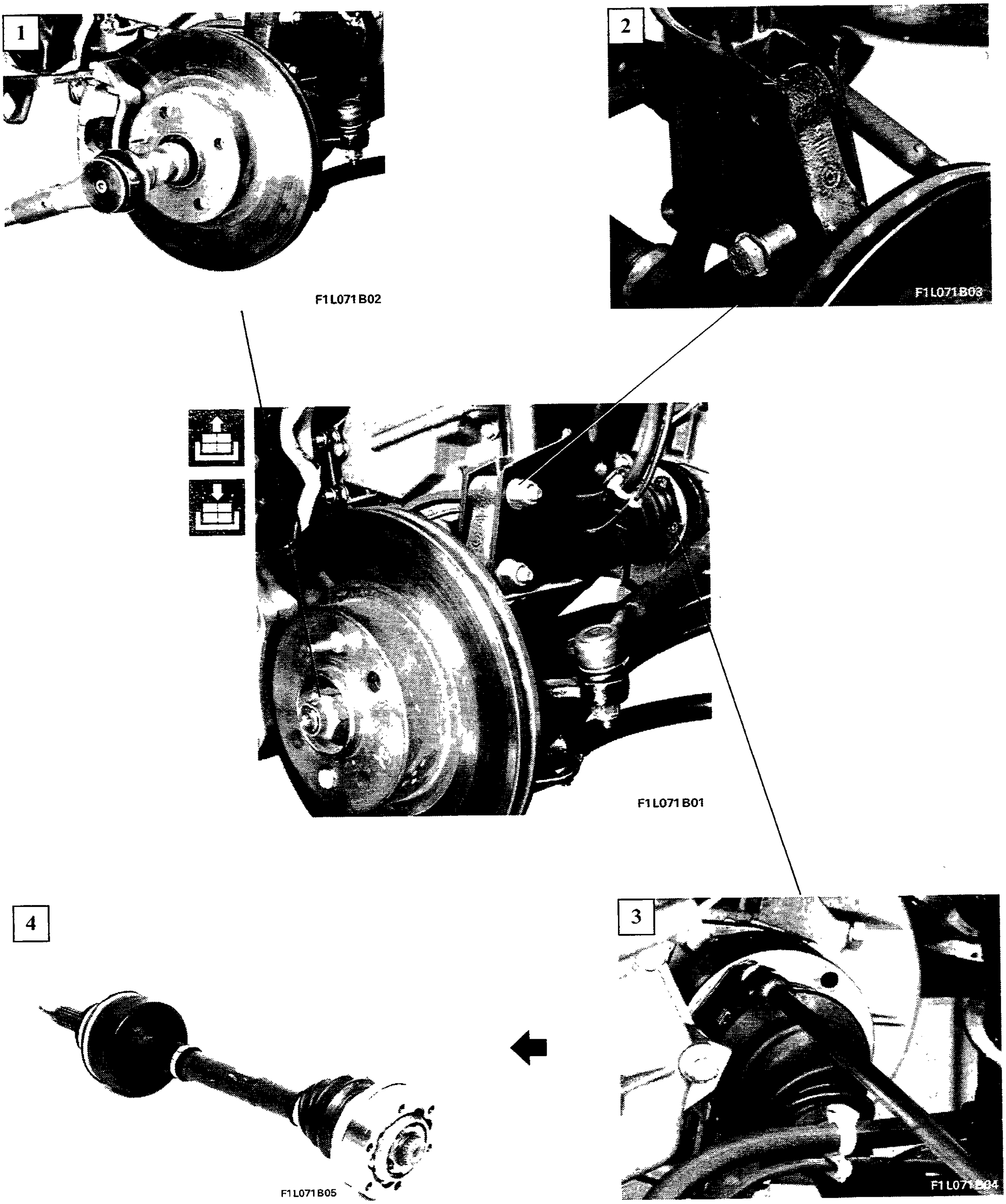


Fitting intermediate shaft seal



Fitting "Ferguson" housing cover complete with intermediate shaft

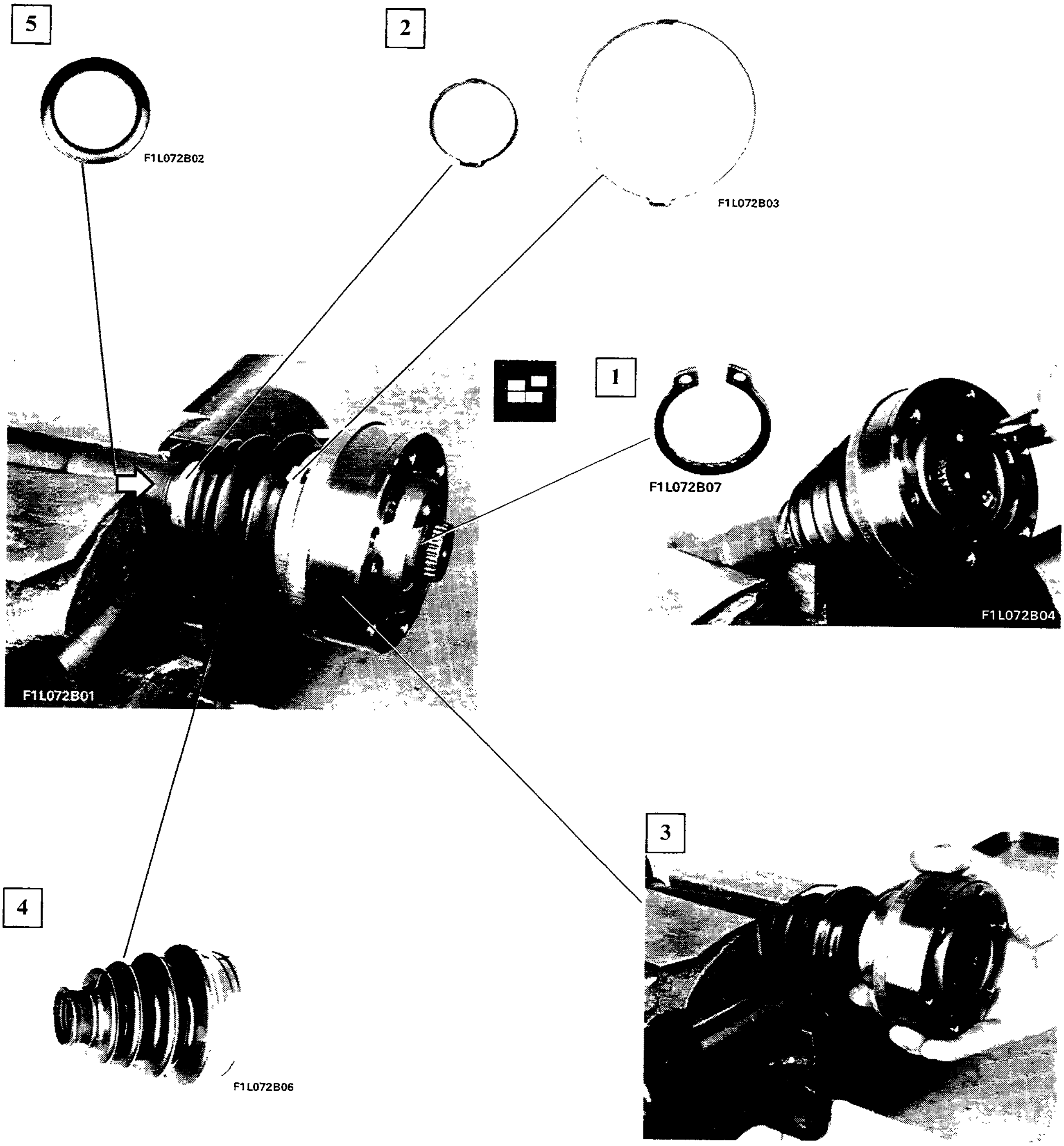
REMOVAL - REFITTING



The numbers next to the illustrations indicate the order of operations.

21-27.

DISASSEMBLY AND CHECKS

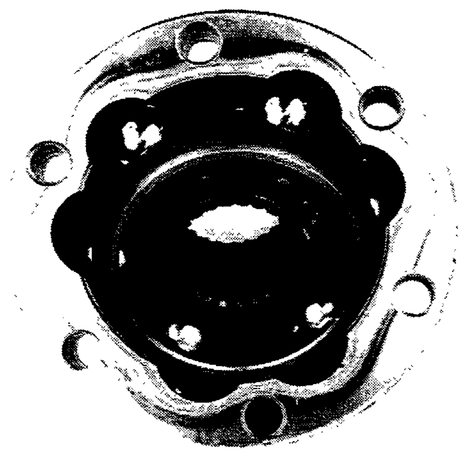


Removing gearbox side constant velocity joint

Removing constant velocity joint retaining ring [1] two boot retaining clips [2] constant velocity joint [3] protective boot [4] and lastly, withdraw the rubber washer (cup) [5].

Gearbox side constant velocity joint

Thoroughly wash constant velocity joints with petrol or diesel and check that the balls and their seats are smooth and show no signs of binding or scoring.
Upon reassembly the gearbox side constant velocity joints must be fitted to the shaft as indicated in the table below.

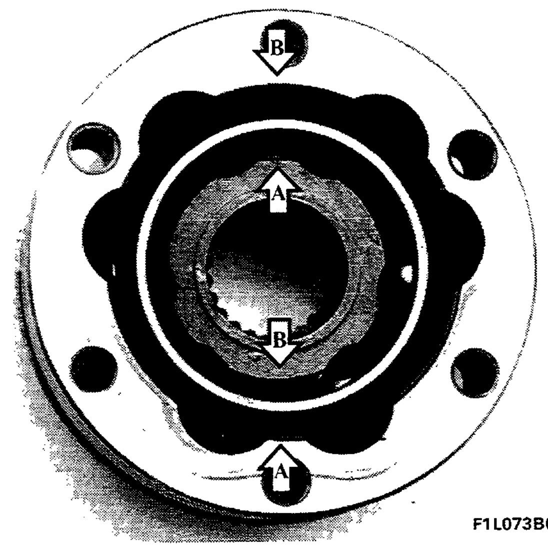


F1L073B01

Shaft classification		Joint classification	
Category	Colour	Category	Colour
A	Dark blue	A	Dark blue
C	Red	B	White

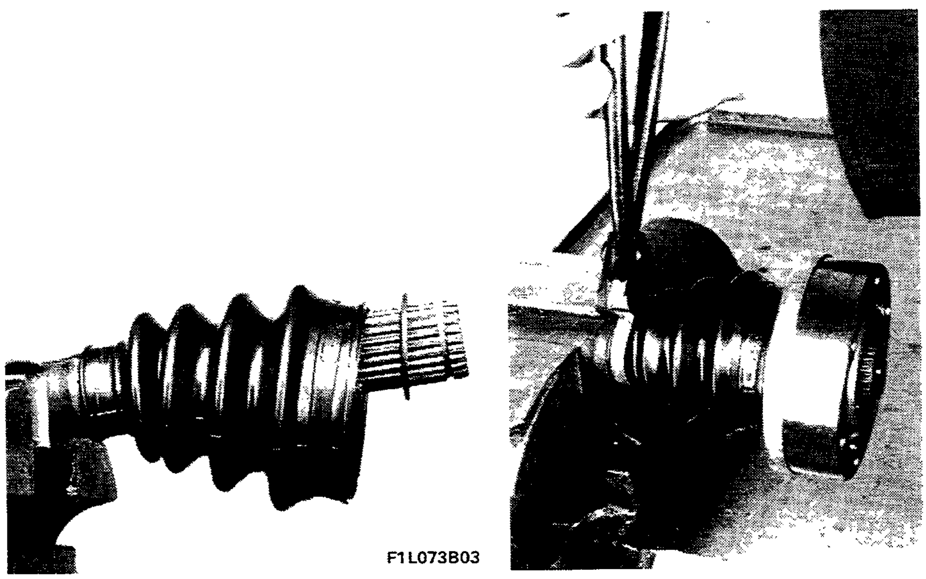
Positioning gearbox side constant velocity joints

If the balls come out of their seats when the joints are withdrawn, consult references shown in diagram to refit. The joint will lock otherwise.



F1L073B02

A. Smallest distance between ball seats
B. Greatest distance between ball seats



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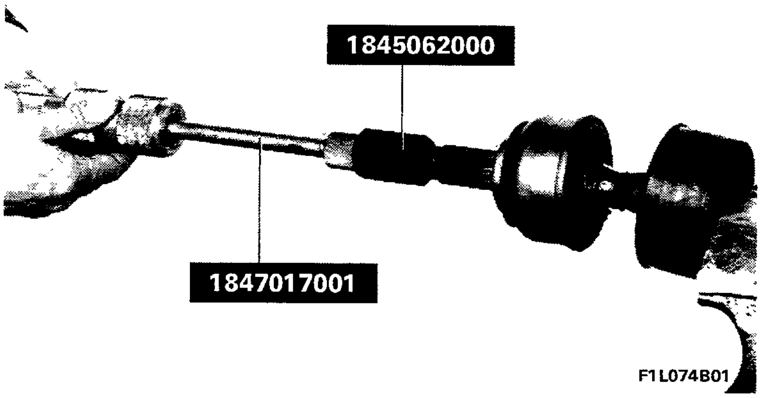
Fitting protecting boot, rubber washer and closing retaining clips



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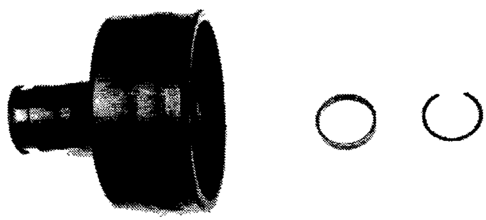
Removing wheel side constant velocity joint

Remove boot retaining clips before removing joint. This operation is destructive.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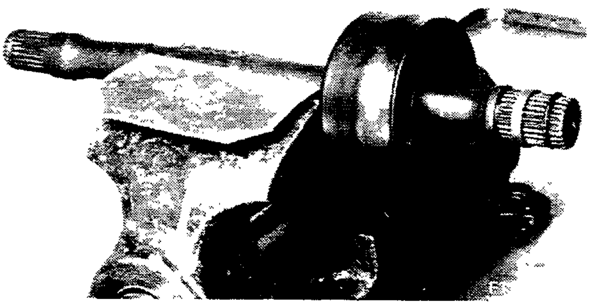
Removing retaining ring, spacer and boot

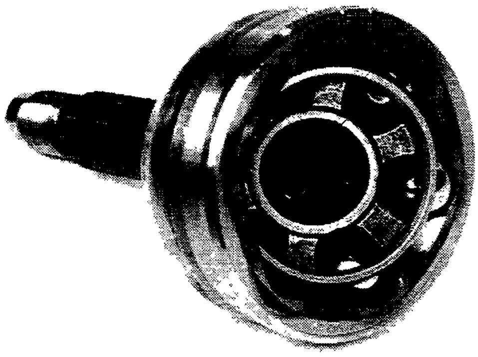
It is advisable to renew the boot whenever it is removed.
Pack constant velocity joint and protective boot with TUTELA MRM2 grease.



During assembly, use an adjustable clip to compress the constant velocity joint retaining ring.
Position the constant velocity joint on the half shaft and hammer into its seat.

Wheel and drive shaft side constant velocity joint

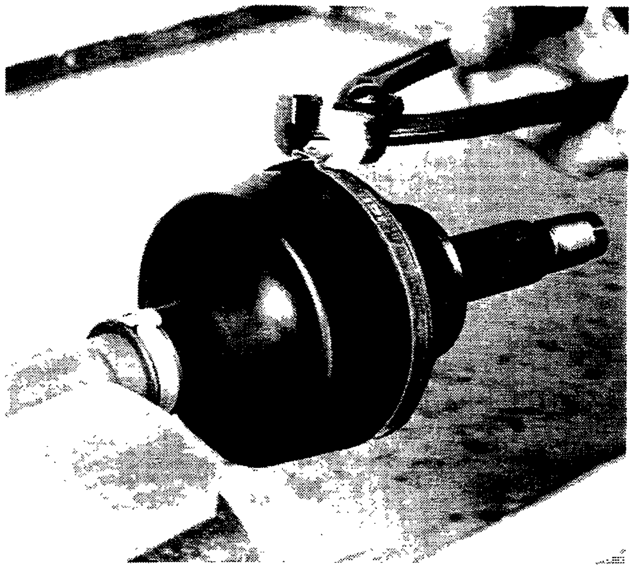
Carefully wash constant velocity joints with diesel or petrol and check that the balls and seats are perfectly smooth and free from binding or scoring.
When installing, fit wheel side constant velocity joints to shaft as indicated in the table below.


F1L074B05

Shaft classification		Joint classification	
Category	Colour	Category	Colour
A	Dark blue	A	Dark blue
		B	White
C	Red	C	Red

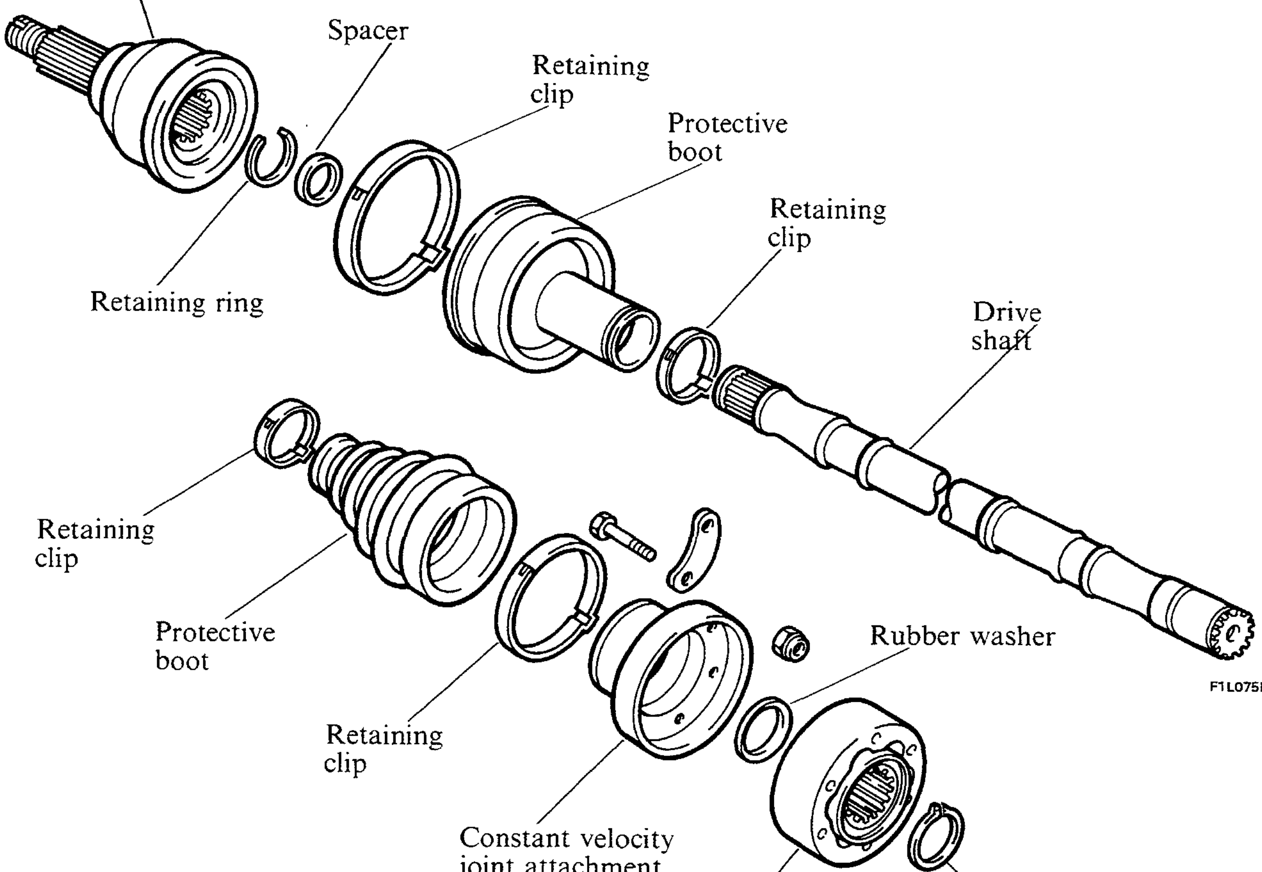
Category B joints can be fitted to both drive shaft categories


F1L074B05



Fitting wheel side boot retaining clip

Fix drive shaft during power unit removal-installation in order to avoid damaging the boot.



Drive shaft assembly components

21-27.

PART	Thread	Tightening torque
		daNm

MECHANICAL GEARBOX - DIFFERENTIAL

Bolt retaining clutch release sleeve support cover	M 6 x 1	0.75
Bolt retaining left side cover to housing	M 8 x 1.25	2.5
Bolt retaining gear casing to support	M 8 x 1.25	2.5
Bolts retaining rear cover to gear casing	M 8 x 1.25	2.5
Bolt retaining differential cover to bell housing (length 55 mm)	M 8 x 1.25	2.5
Bolt retaining differential cover to bell housing (length 80 mm)	M 10 x 1.25	5
Bolt retaining gear rod spring	M 8 x 1.25	2.5
Magnetic plug	M 22 x 1.5	4.6
Main shaft gear lock collar	M 22 x 1.5	15
Lay shaft gear lock collar	M 22 x 1.5	15
Bolt retaining main rear bearing retaining plate	M 8 x 1.25	2.5
Bolt retaining secondary rear bearing retaining plate	M 8 x 1.25	2.5
Self-locking screw securing 1st and 2nd speed forks	M 8 x 1.25	2.5
Self-locking screw securing 3rd and 4th speed dog	M 8 x 1.25	2.5
Self-locking screw retaining 3rd and 4th speed fork	M 8 x 1.25	2.5
Self-locking screw retaining 5th speed and reverse dog	M 8 x 1.25	2.5
Bolt retaining reverse lever assembly	M 8 x 1.25	2.5
Self-locking screw retaining 5th speed fork	M 8 x 1.25	2.5
Bolt retaining gearbox shaft bushing on housing	M 6 x 1	0.75
Self-locking nut retaining gear lever to inner shaft	M 8 x 1.25	2.5
Bolt retaining outer shaft gear lever	M 8 x 1.25	2.

PART	Thread	Tightening torques daNm
Bolt retaining milometer support	M 6 x 1	1
Socket screw retaining spur gear	M 8 x 1.25	3.5
Reversing light switch bolt	M 12 x 1	3
Socket screw retaining drive shaft joints to front differential	M 8 x 1.25	4.2

MECHANICAL GEARBOX OUTER CONTROL

Bolt retaining rear gear engagement reaction rod rubber block	M 6 x 1	0.6
Bolt retaining gear lever ball joint to rod	M 6 x 1	0.9
Bolt retaining gear lever to floating support	M 6 x 1	0.6
Bolt retaining rubber bushing to gear engagement rod (rubber coupling)	M 6 x 1	0.9
Bolt retaining gear engagement rod ball joint to gear output shaft	M 6 x 1	0.9
Bolt retaining end of gear engagement reaction rod to rubber bush	M 6 x 1	0.9
Bolt retaining support bracket of rubber bushing anchoring reaction rod to gearbox	M 8 x 1.25	2
Nut retaining support for rubber bushing joining reaction rod to gearbox bracket	M 8 x 1.25	1.3

ENGINE-GEARBOX FASTENERS

Bolt for stud on support retaining gearbox assembly to engine	M 12 x 1.25	8.5
Nut retaining bell housing to engine	M 12 x 1.25	8
Bolt retaining bell housing to engine	M 12 x 1.25	8.5
Bolt retaining flywheel cover to bell housing	M 6 x 1	0.8

21-27.

PART	Thread	Tightening torques daNm
Bolt retaining starter motor to bell housing	M 8 x 1.25	2.2
Bolt retaining bell housing to engine	M 12 x 1.25	5.5

FRONT DIFFERENTIAL: TRANSMISSION

PART	Thread	Tightening torques daNm
Bolt retaining viscous coupling support	M 8 x 1.25	2.5
Bolt retaining viscous coupling support cover	M 6 x 1	0.75
Bolt retaining cover for front differential-transmission support housing cover	M 8 x 1.25	2.5
Bolt retaining cover for front differential-transmission support housing cover	M 10 x 1.25	5
Staked nut for locking bevel pinion	M 20 x 1.5	17 - 28 ▲
Ring gear retaining bolt	M 10 x 1.25	8.8

FASTENERS RETAINING FRONT DIFFERENTIAL TO DISTRIBUTOR

PART	Thread	Tightening torques daNm
Union for adjustable fitting retaining oil delivery lines to bevel pinion support	M 16 x 1.5	3.5
Fitting straight end section for retaining oil delivery line to bevel pinion support	M 16 x 1.5	3.5
Nut retaining front differential link to sump	M 10 x 1.25	5.1
Bolt retaining bevel pinion support to gearbox	M 12 x 1.25	8.8
Bolt retaining bevel pinion support	M 8 x 1.25	2.5

▲ Tighten nut as indicated on page 61