

DIFFERENTIAL AND DRIVE SHAFT UNIT

GROUP 17

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Differential

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Axle shafts

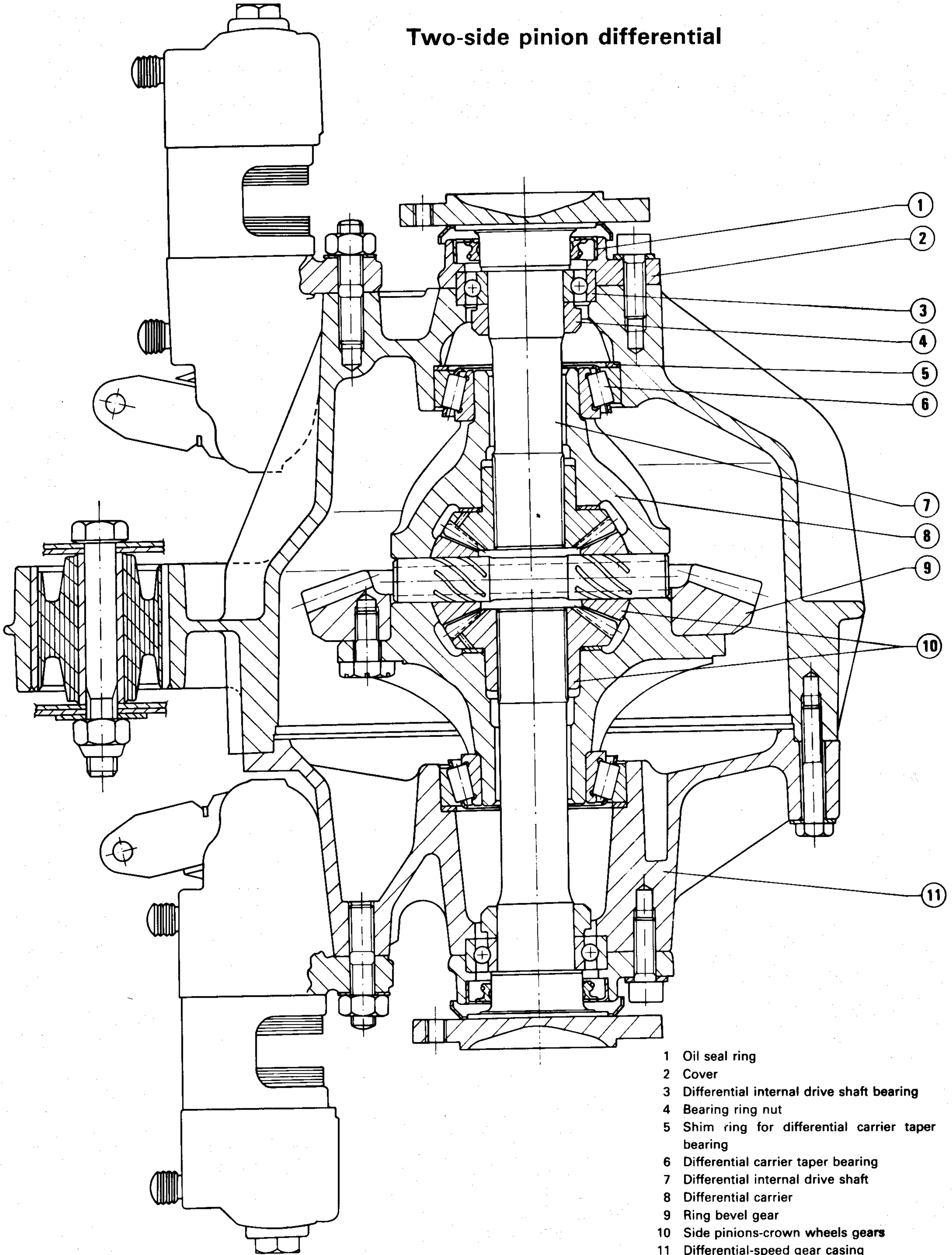
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DIFFERENTIAL AND DRIVE SHAFT UNIT

DESCRIPTION

The differential system is composed by a crown wheel and pinion of hypoid type and a crown wheel-side pinion unit with two, four, or four slip limited side pinions according to motorizations (see: Group 00 - Complete Car - Use of Units in Car).

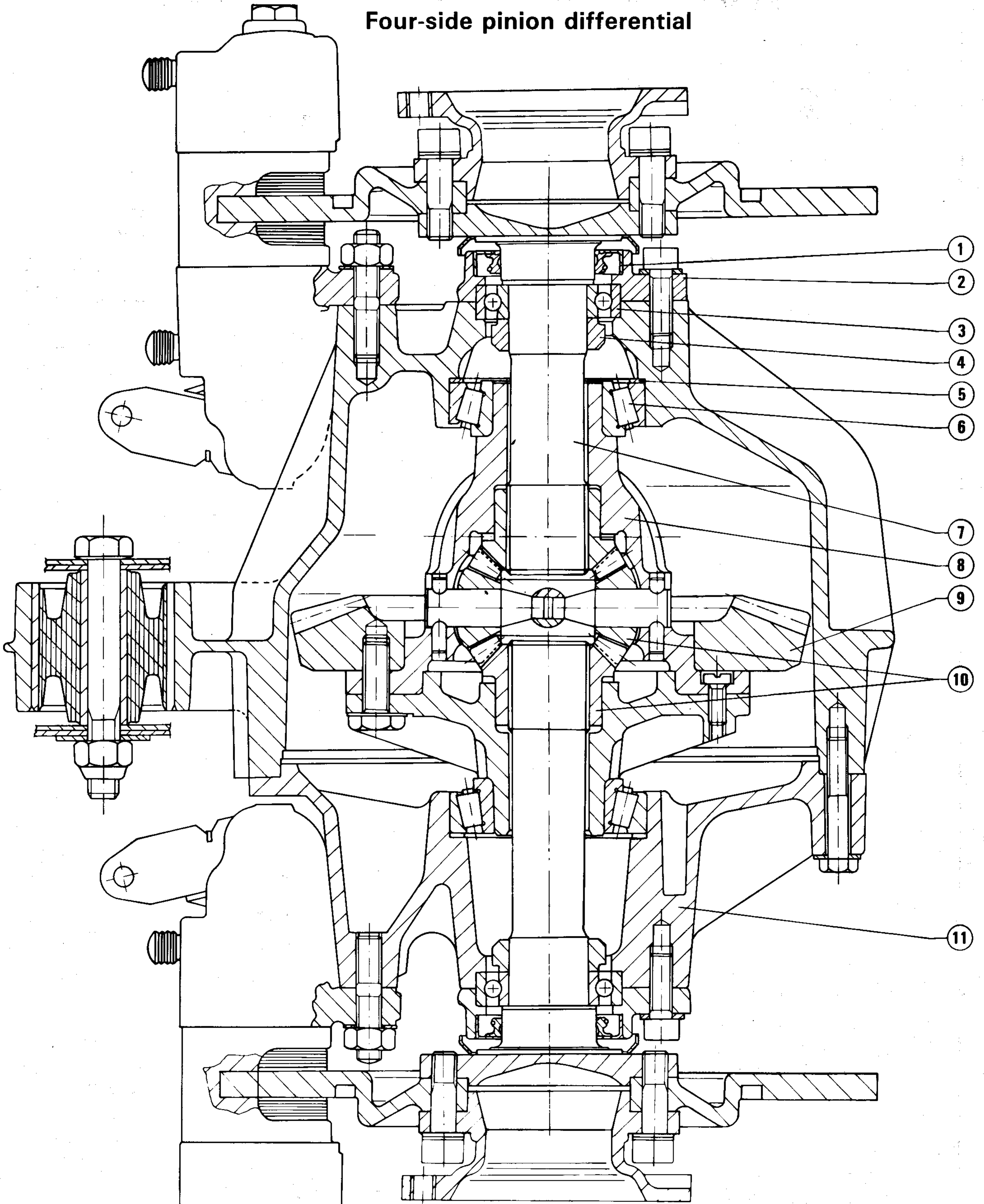
Two-side pinion differential



- 1 Oil seal ring
- 2 Cover
- 3 Differential internal drive shaft bearing
- 4 Bearing ring nut
- 5 Shim ring for differential carrier taper bearing
- 6 Differential carrier taper bearing
- 7 Differential internal drive shaft
- 8 Differential carrier
- 9 Ring bevel gear
- 10 Side pinions-crown wheels gears
- 11 Differential-speed gear casing

DIFFERENTIAL AND DRIVE SHAFT UNIT

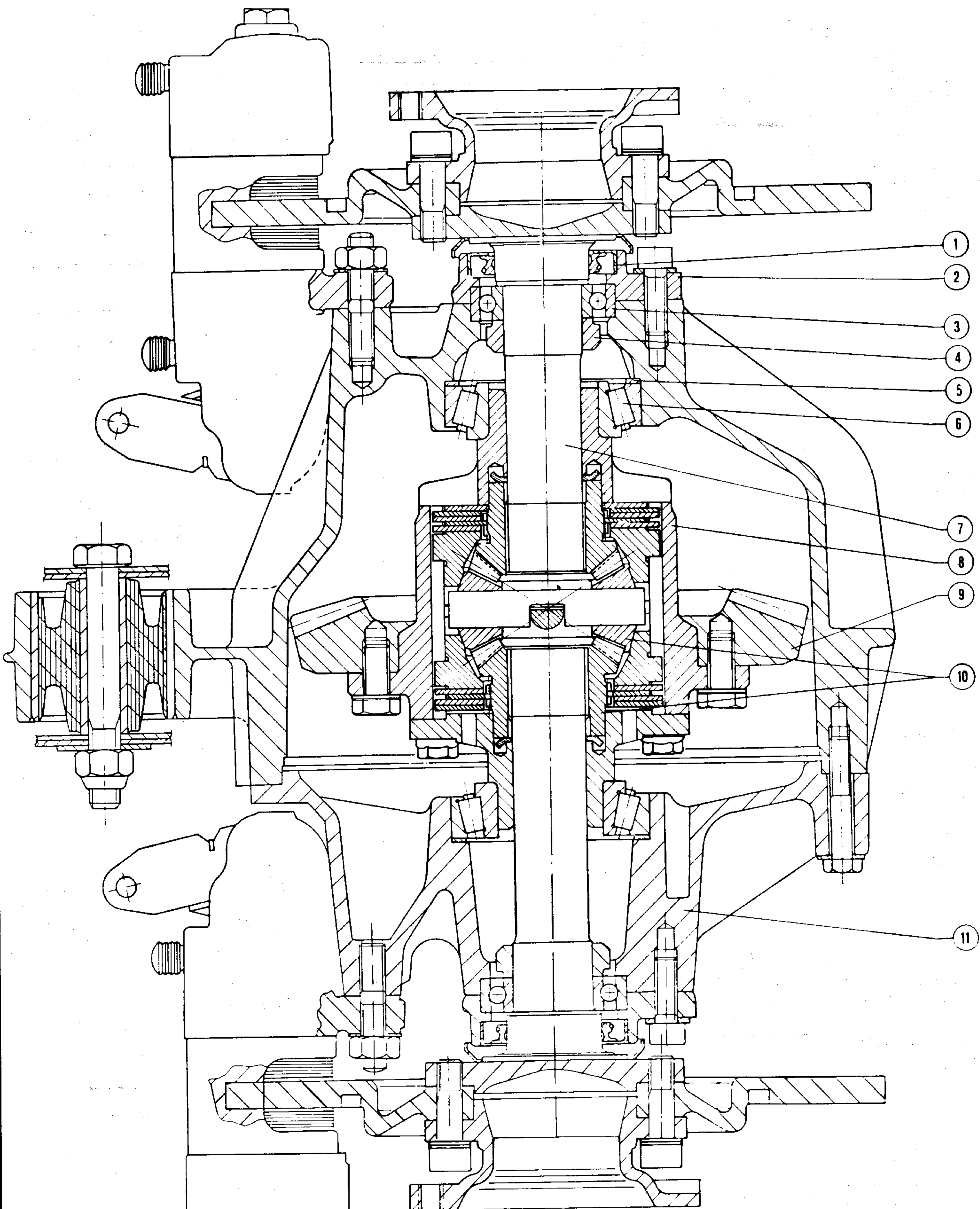
Four-side pinion differential



- | | |
|--|--------------------------------------|
| 1 Oil seal ring | 6 Differential carrier taper bearing |
| 2 Cover | 7 Differential internal drive shaft |
| 3 Differential internal drive shaft bearing | 8 Differential carrier |
| 4 Bearing ring nut | 9 Ring bevel gear |
| 5 Shim ring for differential carrier taper bearing | 10 Side pinions-crown wheels gears |
| | 11 Differential-speed gear casing |

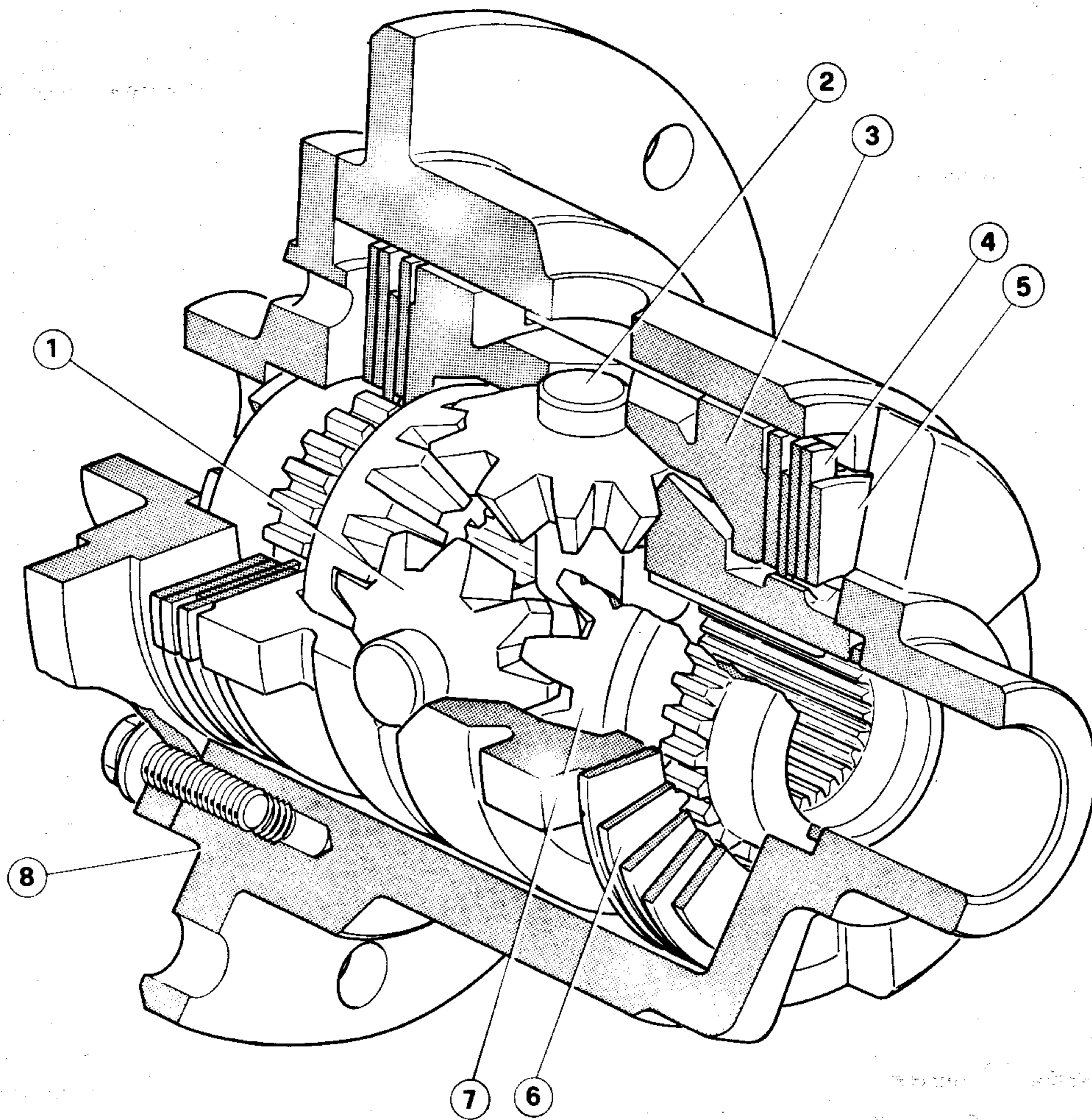
DIFFERENTIAL AND DRIVE SHAFT UNIT

Slip limited - four - side pinion differential (25% slip value)



- | | |
|--|--------------------------------------|
| 1 Oil seal ring | 6 Differential carrier taper bearing |
| 2 Cover | 7 Differential internal drive shaft |
| 3 Differential internal drive shaft bearing | 8 Differential carrier |
| 4 Bearing ring nut | 9 Ring bevel gear |
| 5 Shim ring for differential carrier taper bearing | 10 Side pinions-crown wheels gears |
| | 11 Differential-speed gear casing |

DIFFERENTIAL AND DRIVE SHAFT UNIT



- | | | | |
|---|------------------|---|------------------|
| 1 | Side-pinion | 5 | Spacer |
| 2 | Spider | 6 | Internal segment |
| 3 | Thrust ring | 7 | Crown wheel |
| 4 | External segment | 8 | Differential box |

The differential box (8) is internally equipped with 4 longitudinal splines in which the thrust rings (3) and the external segments (4) are inserted; thus they are only allowed to move axially as to the differential box. The internal segments (6) are anchored on the splined hubs of the Crown wheels (7). The thrust rings have wedge-shaped millings on the internal front-side in which the spider's extremities (2) are housed. One side-pinion gear (1) is inserted on each spider's extremities and meshes with the

crown wheel unit.

The slip limited action is caused by the friction between the internal and external segment's surfaces.

This friction occurs when an axial load is given by the displacement of the shim rings, the supporting surfaces of which are oblique to the spiders.

This special mechanical action generates axial expansion forces on the thrust rings subsequent to the reaction forces due to

a variation of the wheel stall torque.

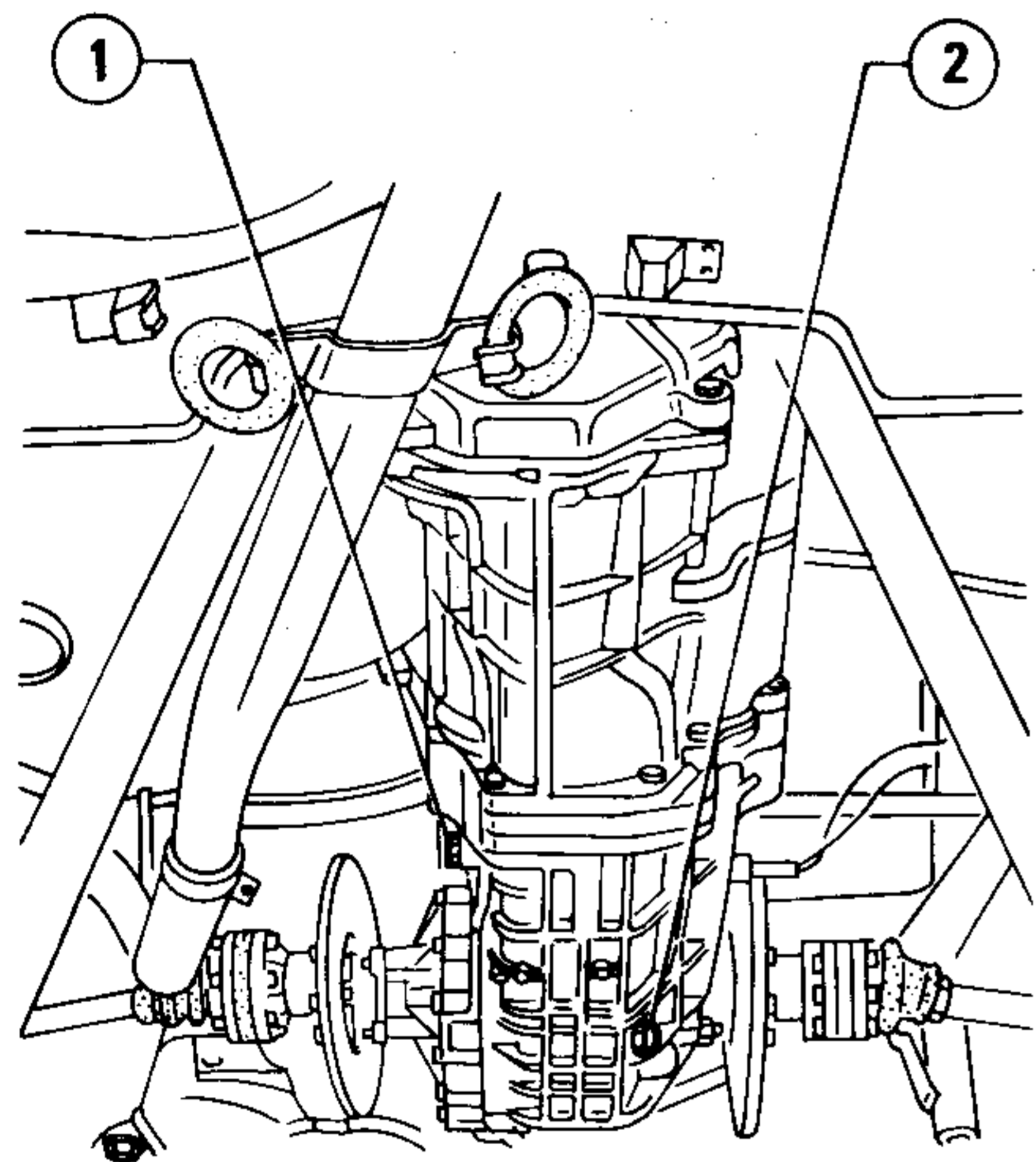
The result is a higher load on the segments. As the external segments are connected with the differential box and the internal segments are connected with the crown wheel units, the relative motion between the differential box and the axle shaft is thus limited.

The slip limiting effect is proportional to the engine torque variation as well as to the different speed torque variations.

REMOVAL AND INSTALLATION OF CLUTCH-SPEED GEAR-DIFFERENTIAL UNIT

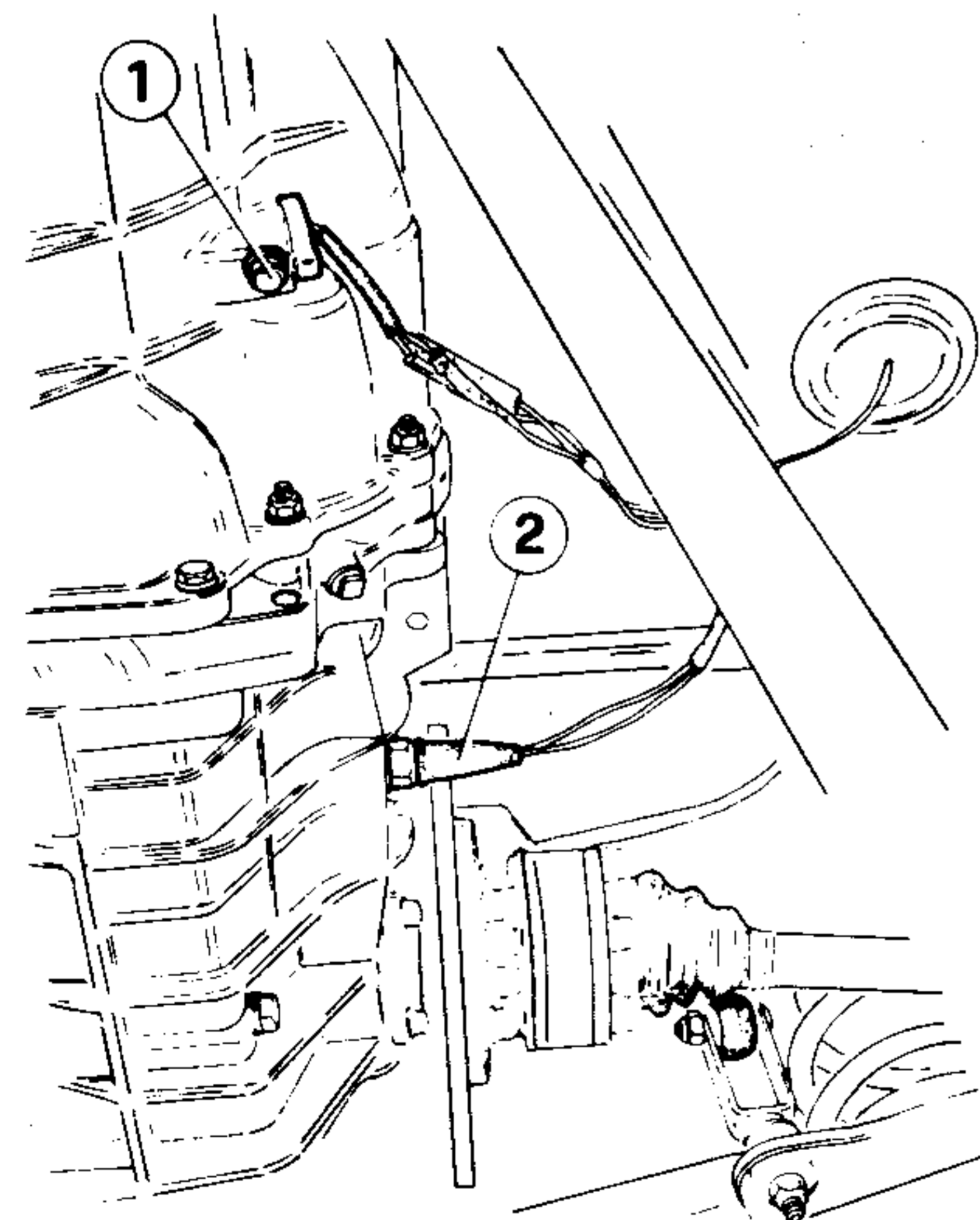
REMOVAL

1. Set car on a lift and block front wheels with suitable safety chocks.
2. Raise car and, according to operations to be carried out, unscrew plug (2) and drain oil from the unit concerned, then tighten plug.



- 1 Filling plug
- 2 Oil drain plug

3. Disconnect connection (2), unscrew screw (1) and remove odometer pulse transmitter.



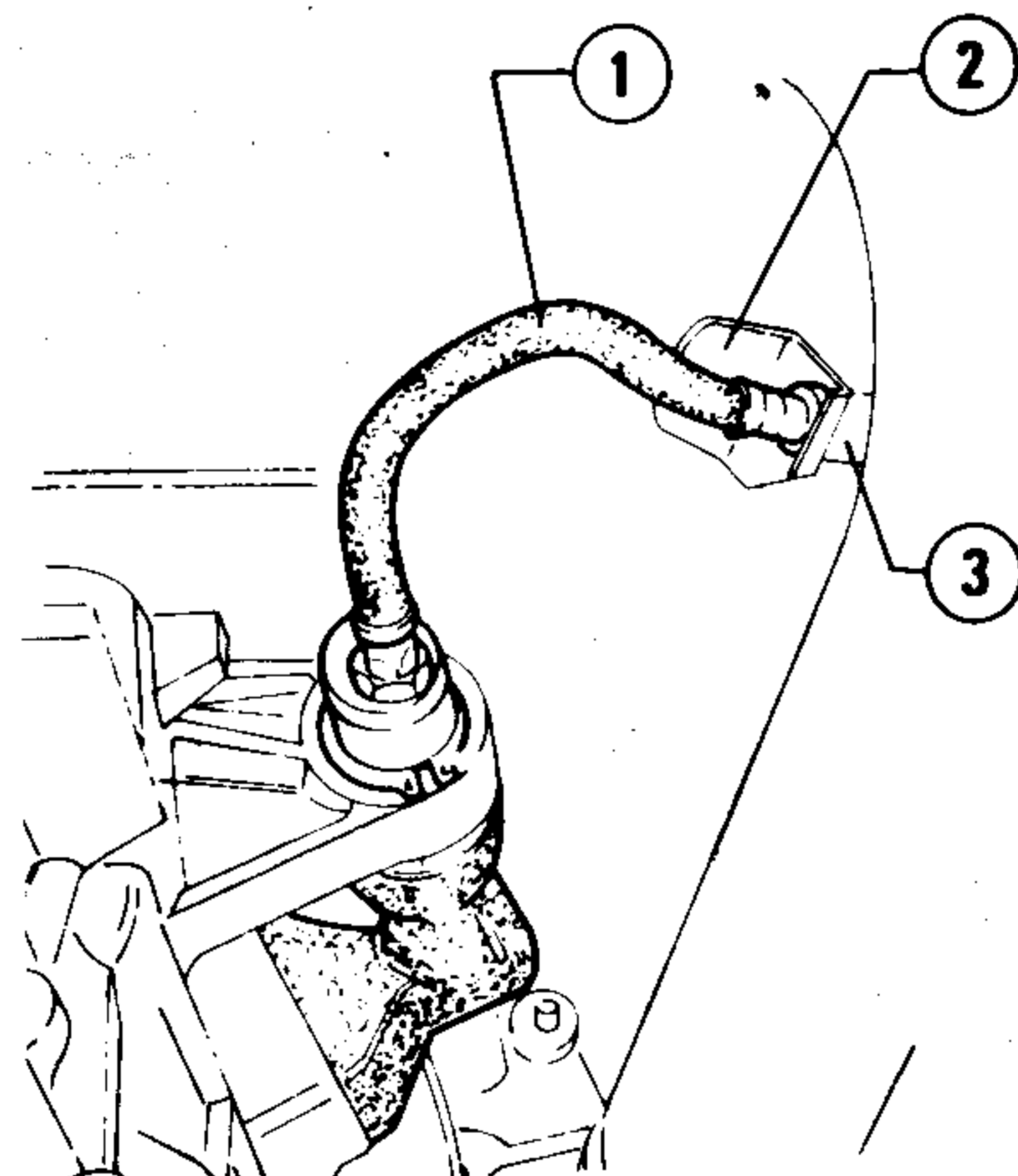
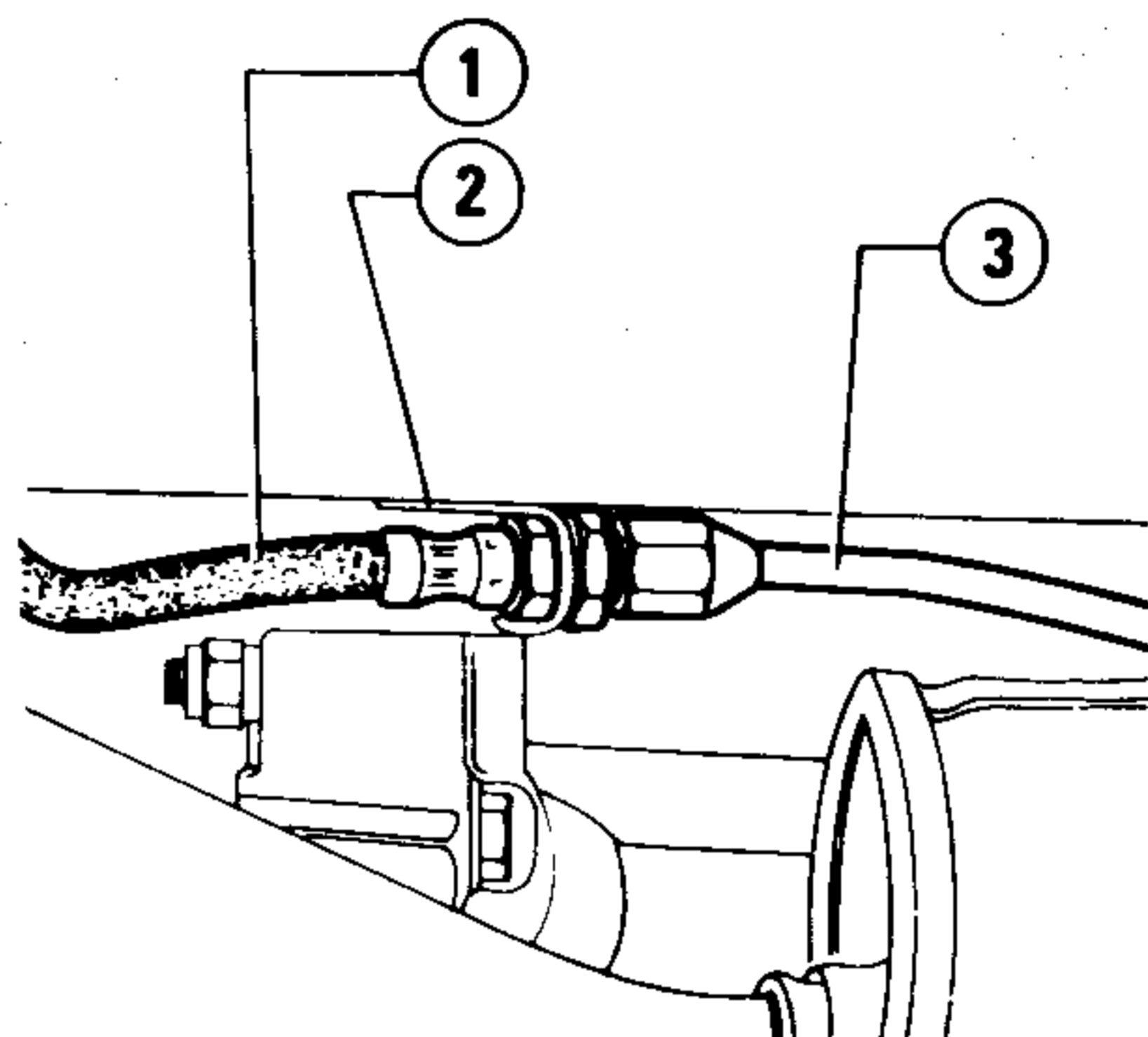
- 1 Screw securing odometer pulse transmitter to gearbox
- 2 Connection for reverse lights switch cable

4. Remove exhaust system (refer to: Group 04 - "Exhaust System Removal")

of the "WORKSHOP MANUAL - engines").

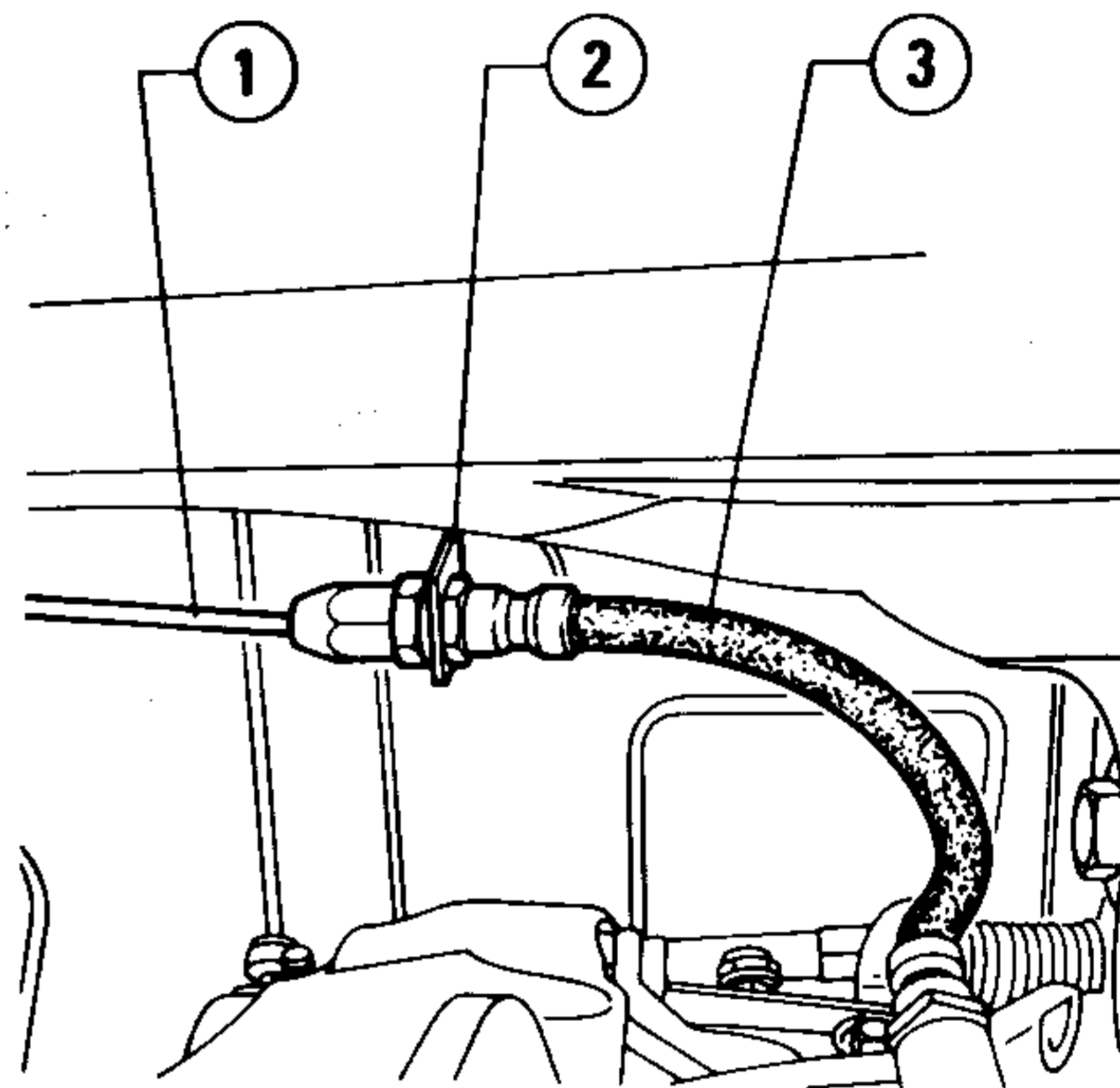
5. Clutch and brake piping detachment.

- a. Unscrew union and detach hose (1) and pipe (3) of clutch system from bracket (2) on body.



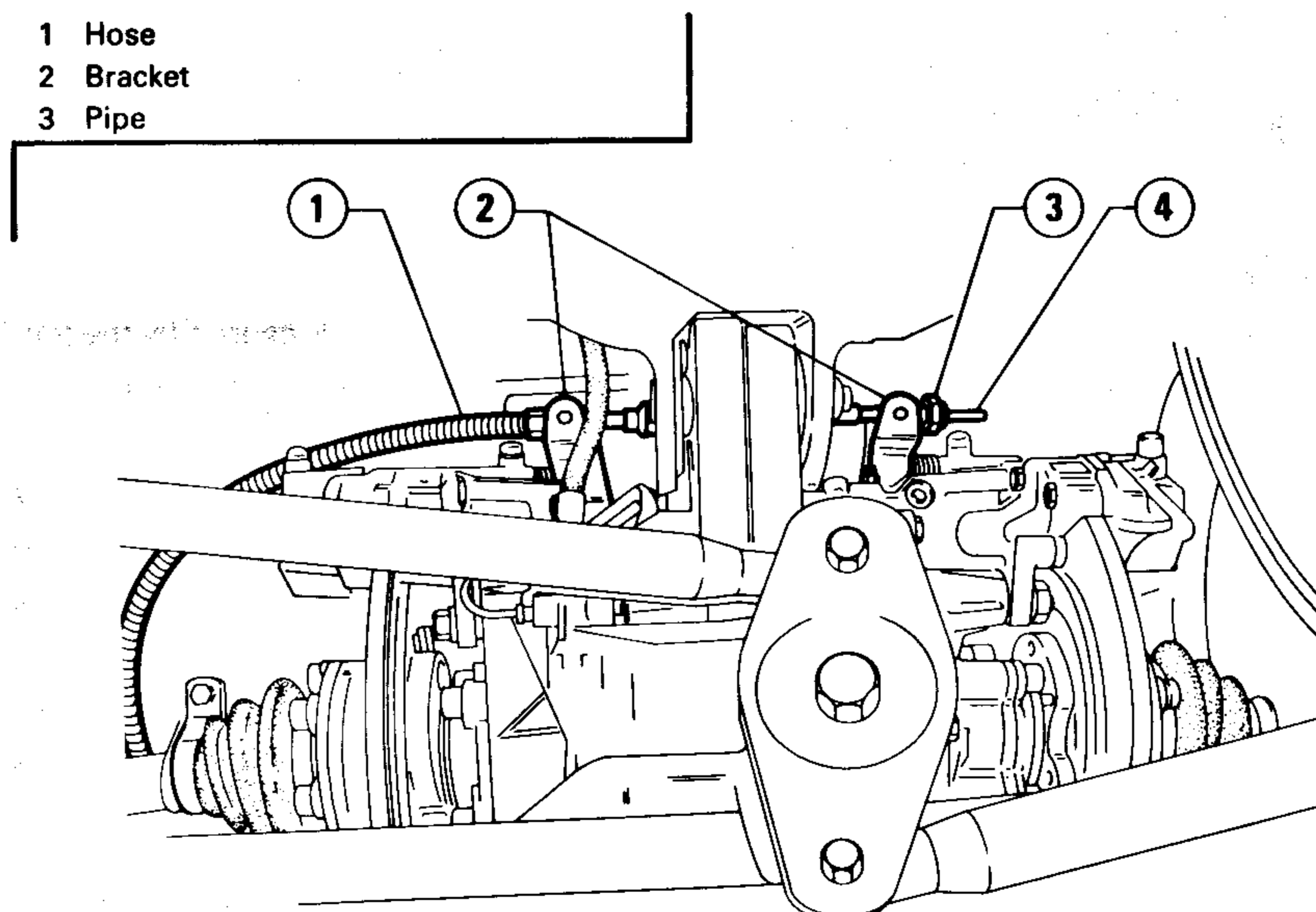
- 1 Hose
- 2 Bracket
- 3 Pipe

- b. Unscrew union and detach brake system hose (3) from bracket (2) on body.



- 1 Pipe
- 2 Bracket
- 3 Hose

6. Unscrew and remove lock nut (4) and nut (3); then withdraw cable (1) from seats on levers (2).



- 1 Parking brake cable
- 2 Rear brake caliper levers

- 3 Adjusting nut
- 4 Securing lock nut

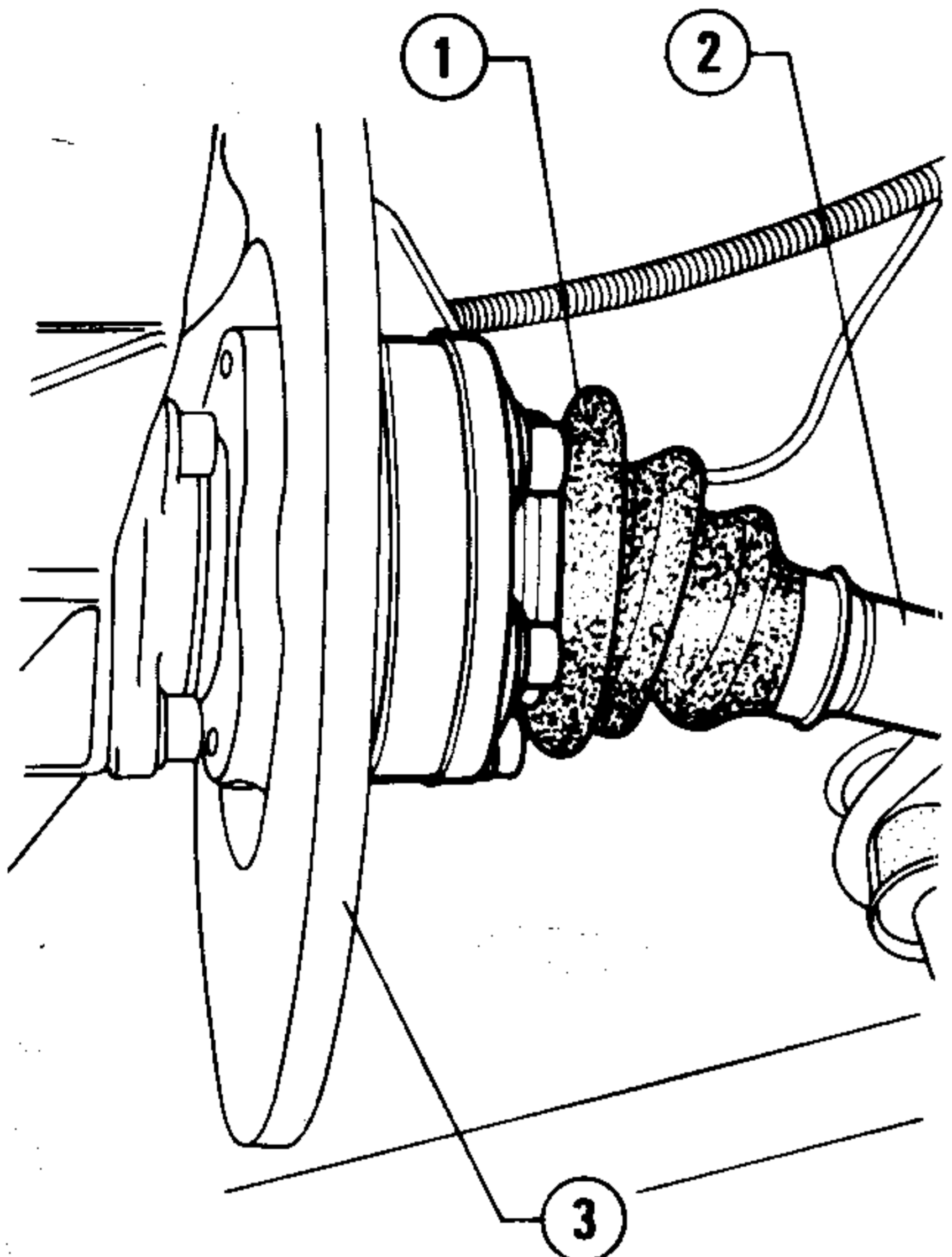
DIFFERENTIAL AND DRIVE SHAFT UNIT

7. Drive shafts detachment-differential side

- a. Unscrew screws (1) recovering the related plates and disconnect external drive shafts (2) from internal drive shafts

WARNING:

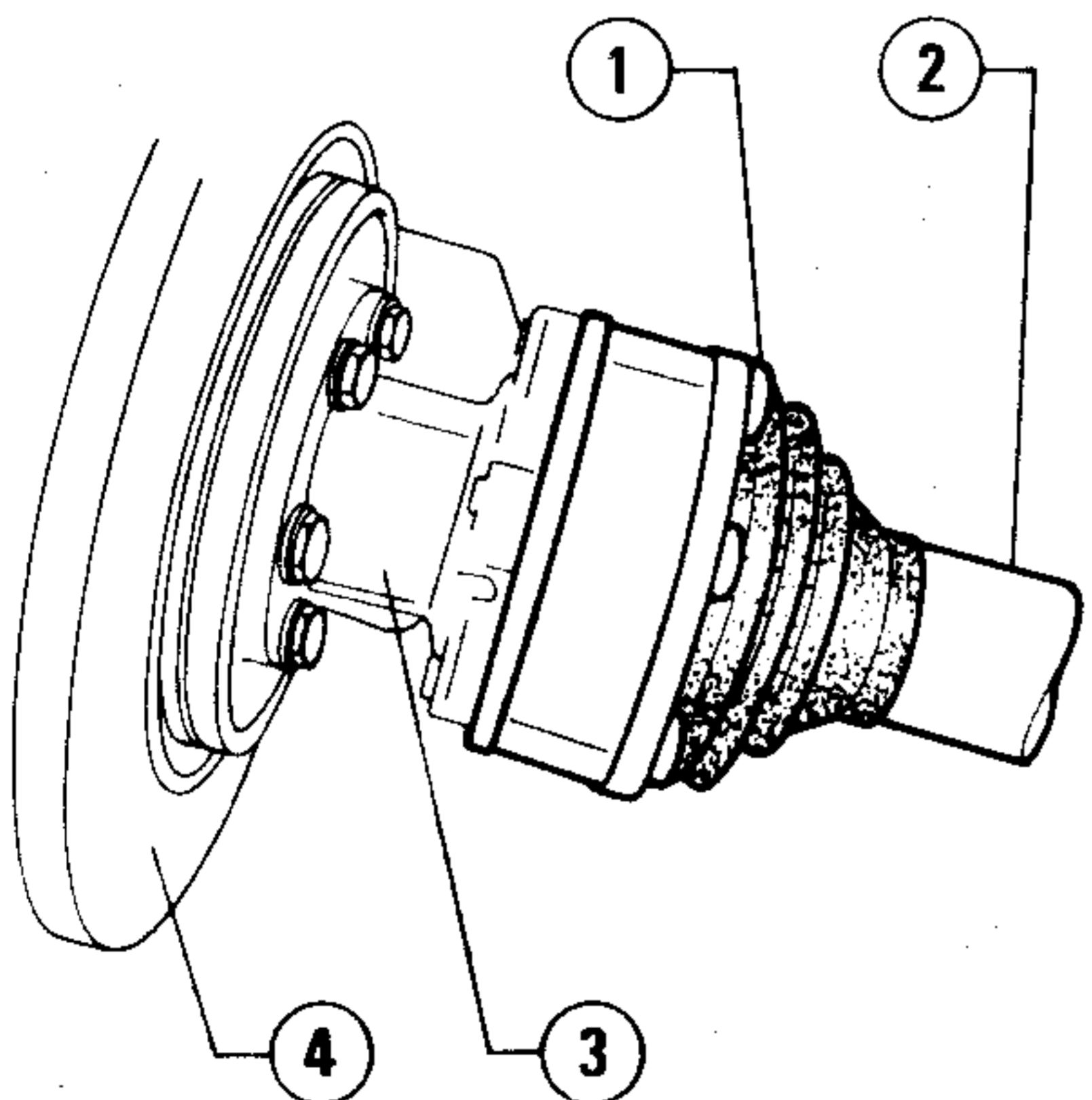
During this operation, support brake disk



- 1 External drive shaft-brake disk securing screw
2 External drive shaft
3 Brake disk

- b. Still supporting brake disk, withdraw pads (refer to Group 22 - Service Brakes - Rear Brakes. Pads Replacement of the "WORKSHOP MANUAL mechanical units") and remove disk.

For models with differential equipped with four side pinions, a spacer (3) is interposed between drive shafts (2) and brake disks (4), unscrew screws (1) and disconnect drive shafts from spacers.



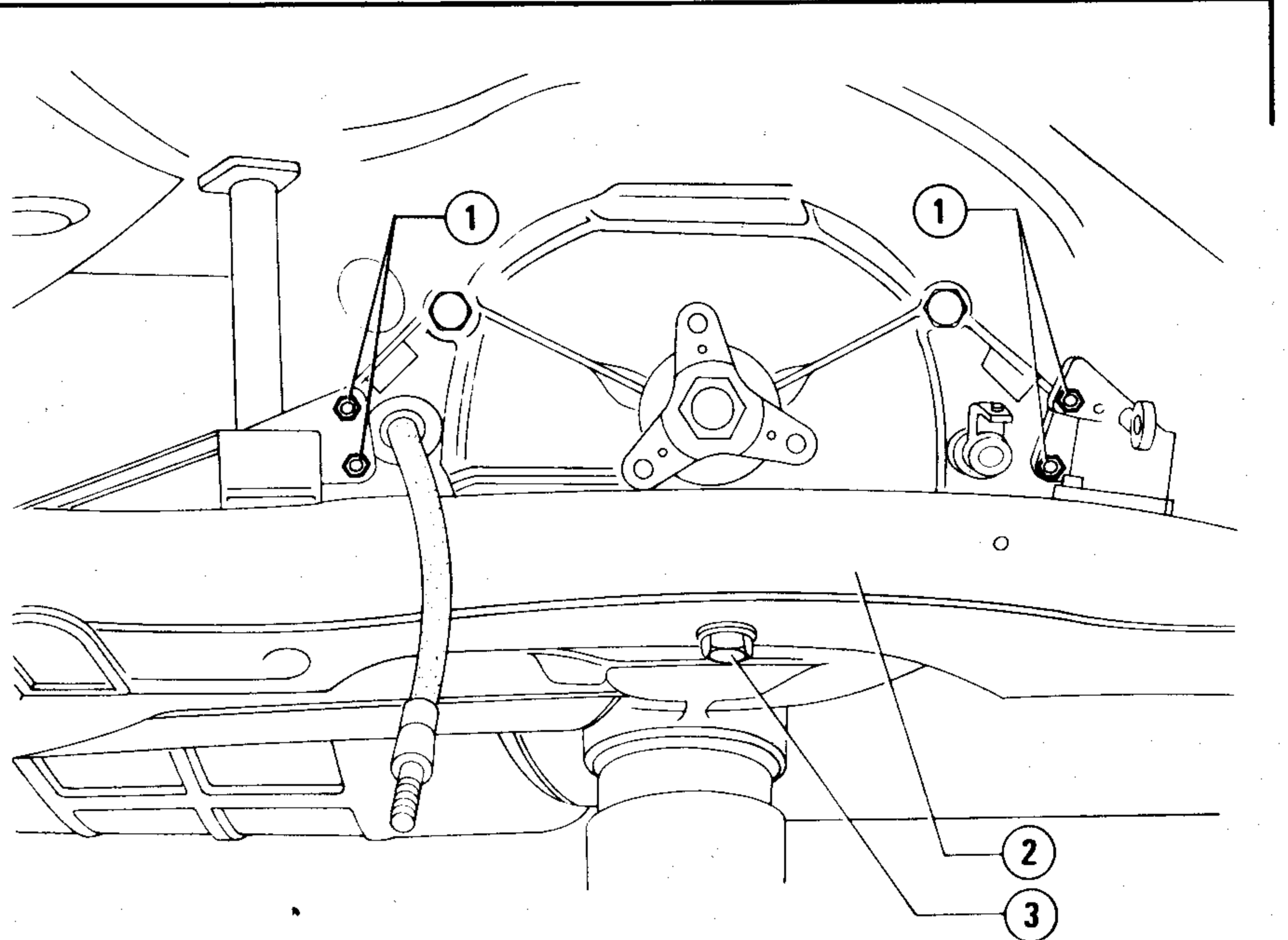
- 1 External drive shaft-spacer securing screw
2 External drive shaft
3 Spacer
4 Brake disk

- c. Lift external drive shafts and secure them suitably to anti-roll bar

8. Disconnect propeller shaft from clutch shaft fork, remove gear selection and engagement rod and detach isostatic control

from speed gear rear lever as per: Group 13 - "Outer-Linkage - Speed Gear Control Assembly-Removal".

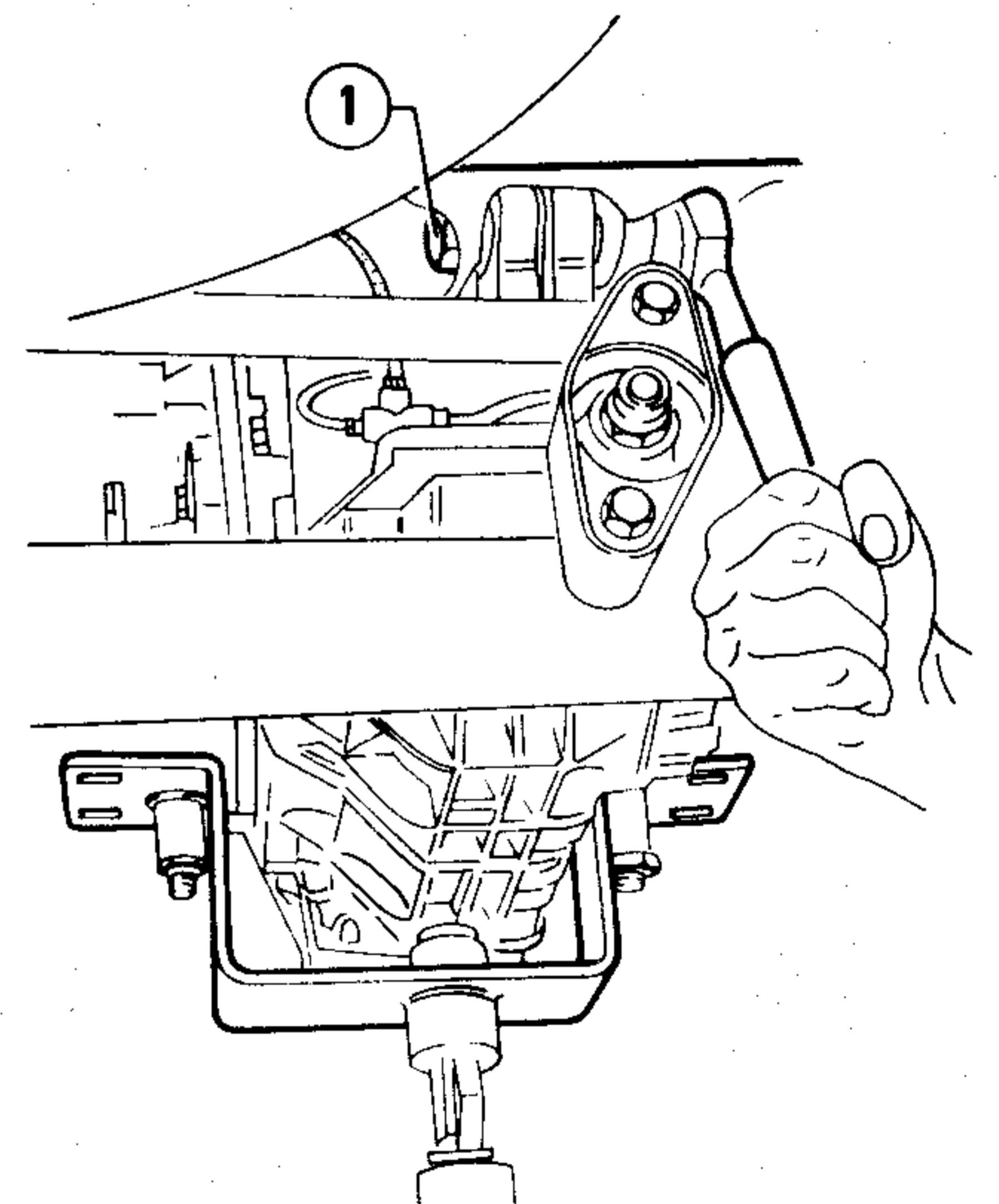
9. Detach the unit from lateral supports on cross member (2) by unscrewing and removing bolts (1).



- 1 Bolts
2 Cross member

10. Position a column lift (with support fitted with clamps to secure support itself to gearbox) under speed gear unit, in the vicinity of intermediate flange.

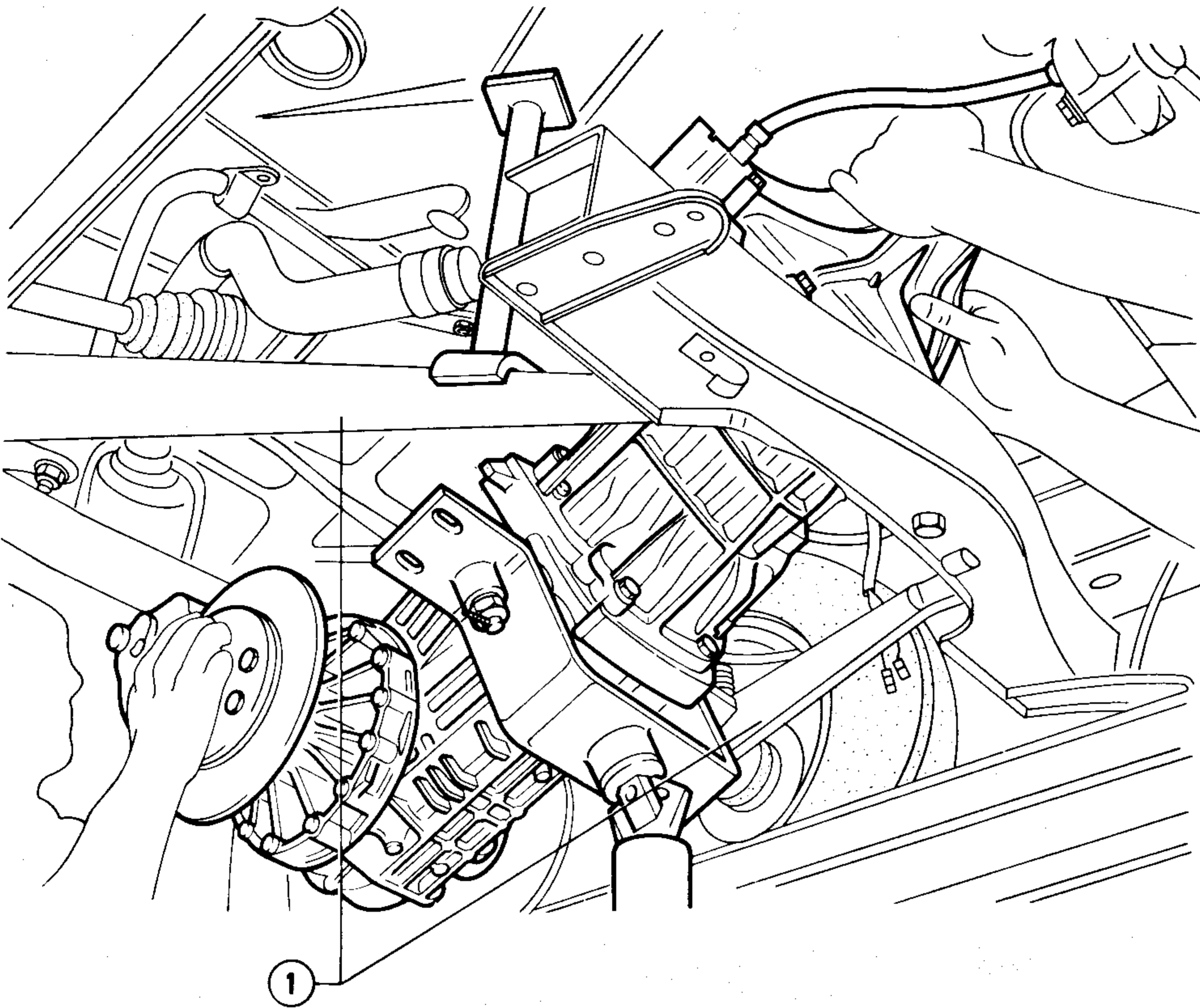
11. Lift the unit so as to unload the rear support rubber bushing, then unscrew and remove body securing bolt (1)



- 1 Bolt securing rear support rubber bushing

12. Operating on column lift, slowly lower the whole unit and, at the same time, withdraw it from front arms of De-Dion axle.

DIFFERENTIAL AND DRIVE SHAFT UNIT



1 De-Dion axle

13. Set the whole unit with support ① on stand ③ fitted with suitable brackets ②.

INSTALLATION

To install the whole unit, reverse the order of removal and comply with the following:

- Apply a coat of prescribed grease on threading of screws securing drive shafts to the differential shaft.

Grease:

ISECO Molykote BR2

- **Lubricate** the spherical seat of propeller shaft joint with same grease (5 cm³; 0.30 cu.in).

- Tighten to the following torques:

T: Tightening torques

Screws securing propeller shaft joint to clutch shaft fork

– Models with differential equipped with two side pinions

40 to 50 N·m

(4 to 5 Kg·m

28.9 to 36.1 ft·lb)

– Models with differential equipped with four side pinions

55 to 57 N·m

(5.6 to 5.8 Kg·m

40.5 to 41.9 ft·lb)

Screws securing external drive shafts to internal drive shafts

Models with differential equipped with two side pinions

29 to 35 N·m

(3 to 3.6 Kg·m

21.7 to 26. ft·lb)

Models with differential equipped with four side pinions

44 to 54 N·m

(4.5 to 5.5 Kg·m

32.5 to 39.8 ft·lb)

Unions of brakes and clutch hydraulic system hoses

10 to 15 N·m

(1 to 1.5 Kg·m

7.2 to 10.8 ft·lb)

Unions of brakes and clutch hydraulic system pipes

8 to 10 N·m

(0.8 to 1 Kg·m

5.8 to 7.2 ft·lb)

Bolt securing rear support rubber bushing

72 to 89 N·m

(7.2 to 8.9 Kg·m

52.1 to 64.3 ft·lb)

Screws securing speed gear-differential unit to lateral support small block

18.6 to 23.5 N·m

(1.9 to 2.4 Kg·m

13.7 to 17.4 ft·lb)

Nut securing plate for Reverse speed engagement safety device

8.3 to 10.3 N·m

(0.9 to 1.05 Kg·m

6.5 to 7.6 ft·lb)

- Fill unit with the prescribed oil

Oil:

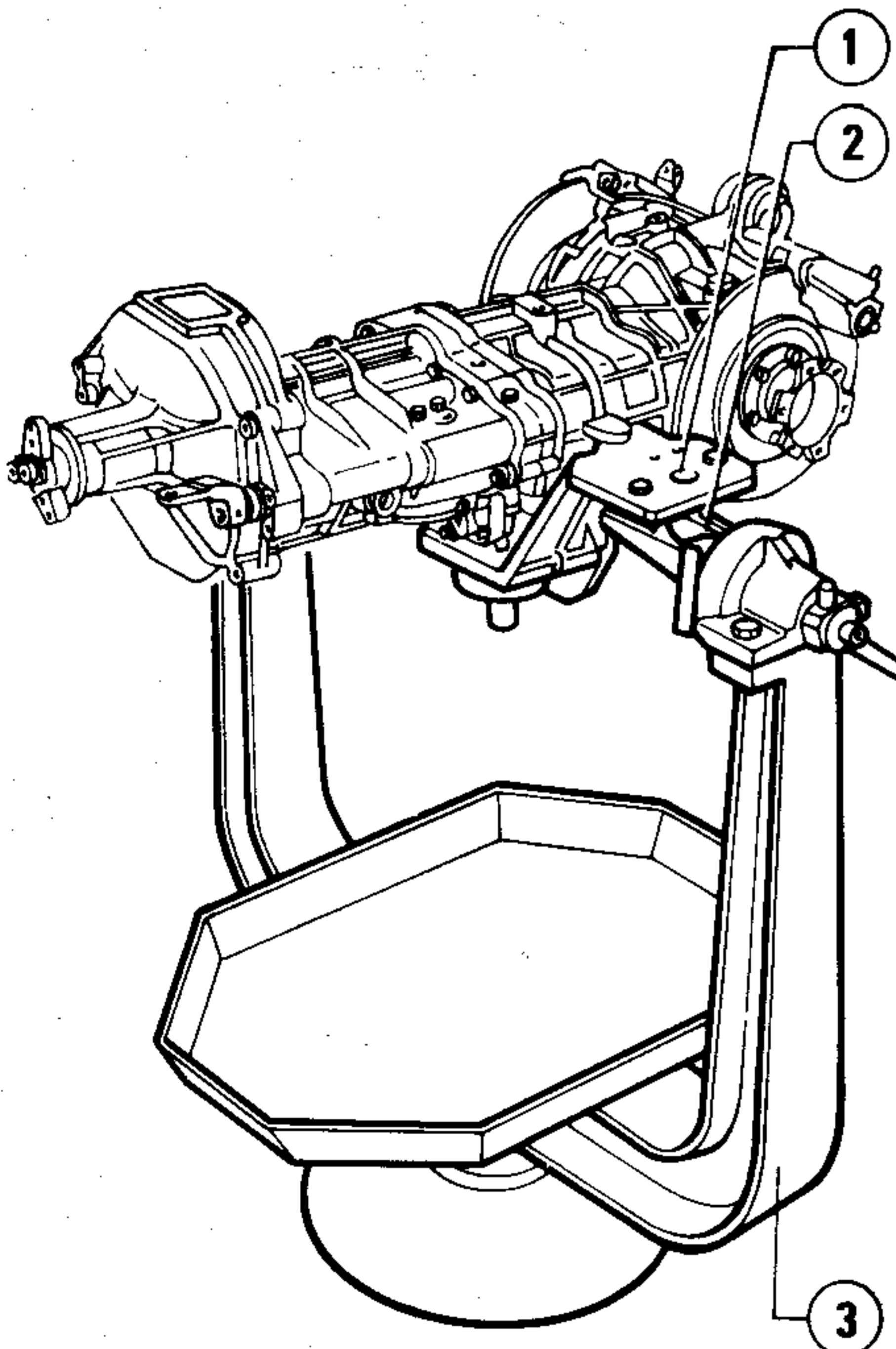
AGIP Rotra SX 75W90

IP Pontiax HDS 75 W 90

- Bleed air from brakes and clutch systems

(Refer to: Group 22 - "Brake system Bleeding" of the "WORKSHOP MANUAL - mechanical units" and Group 12 "Clutch System Bleeding").

- Adjust travel of parking brake lever (Refer to: Group 22 - "Parking Brake - Adjustment of Parking Brake Lever Travel of the "WORKSHOP MANUAL - mechanical units").

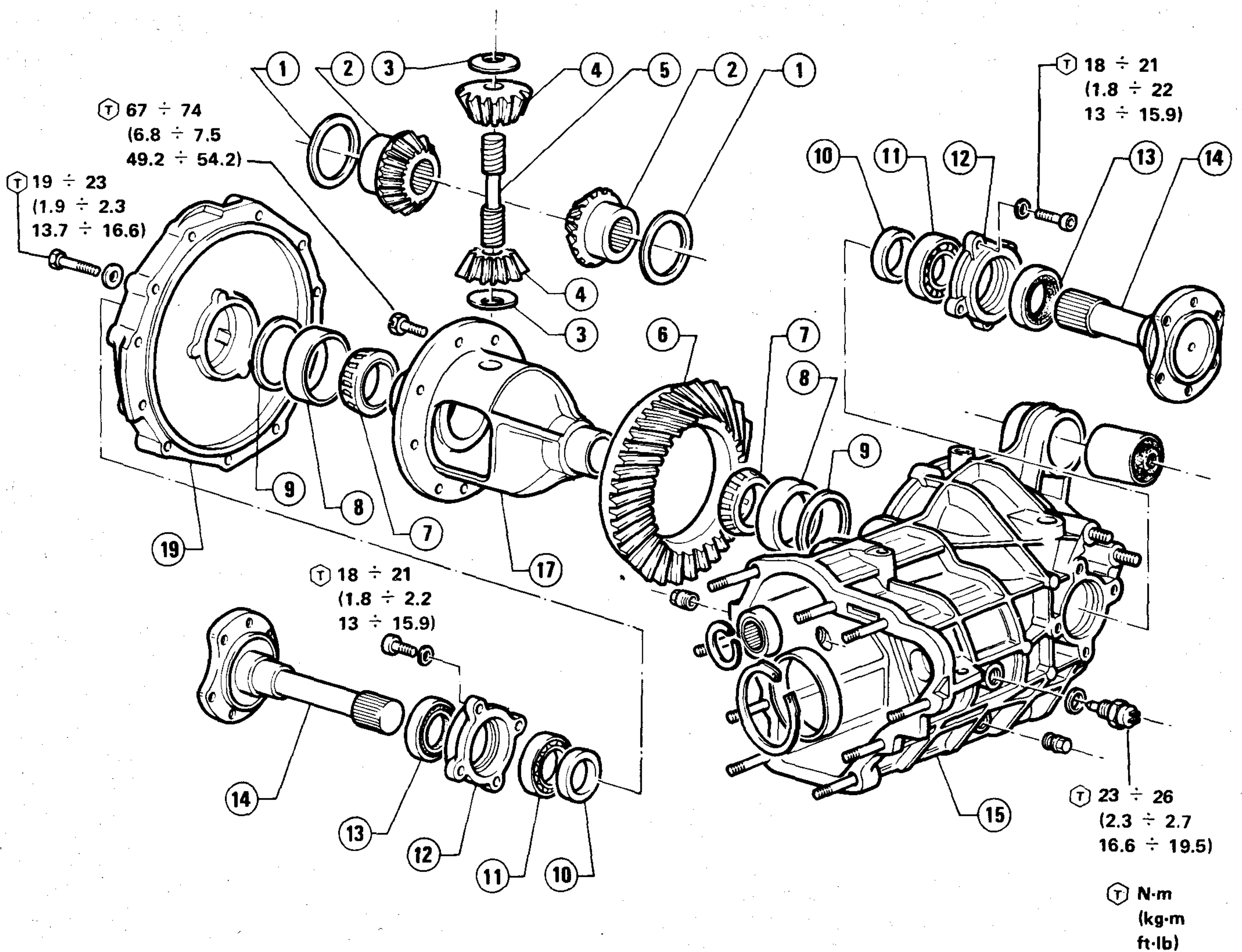


- 1 Support
- 2 Support bracket
- 3 Turning stand

DIFFERENTIAL AND DRIVE SHAFT UNIT

OVERHAUL AT BENCH OF DIFFERENTIAL UNIT

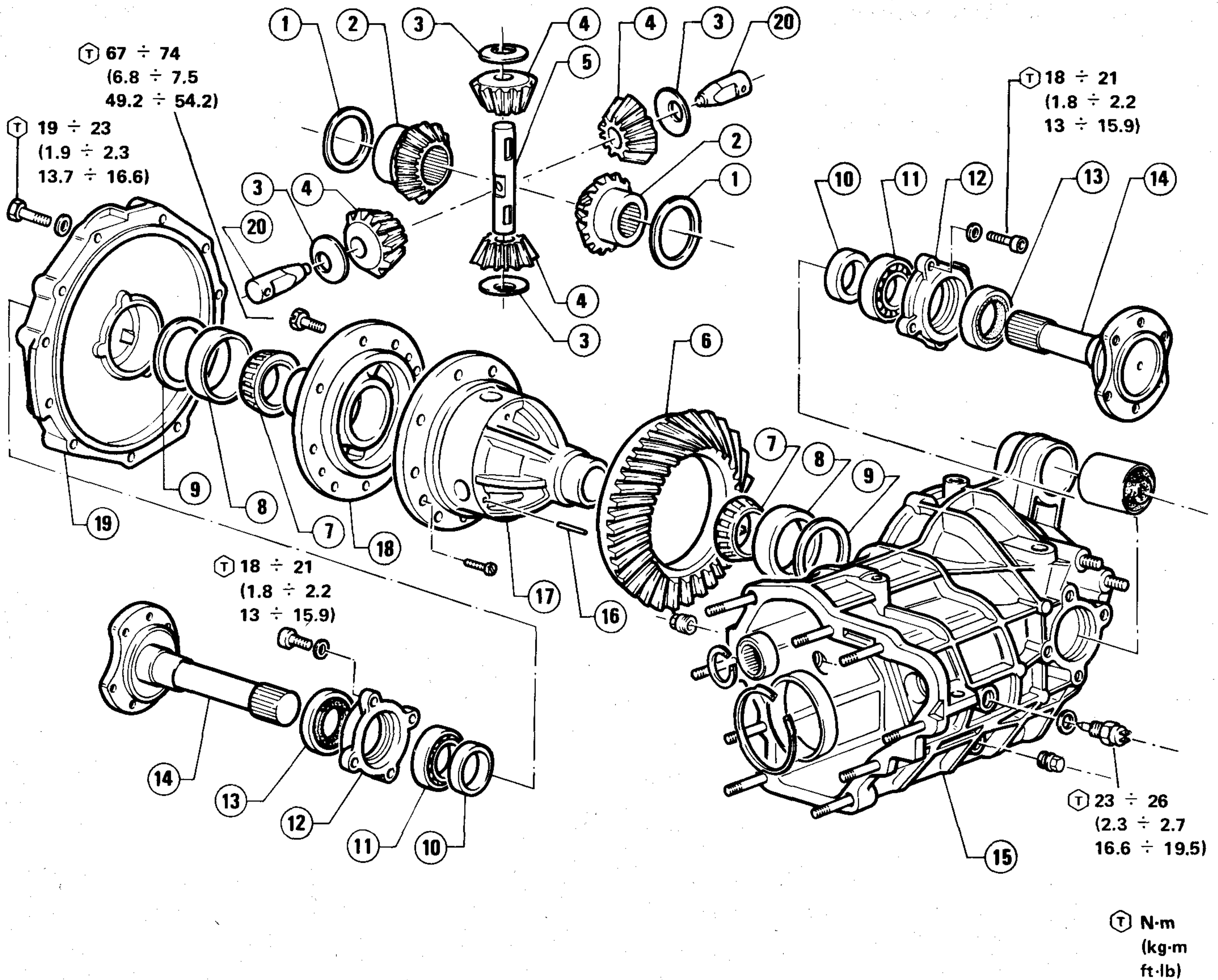
Two-side pinion differential



- 1 Shim ring
- 2 Crown wheel
- 3 Spherical washer
- 4 Side pinion
- 5 Side pinion holder shaft
- 6 Ring bevel gear
- 7 Differential carrier taper bearing
- 8 Differential carrier taper bearing external race
- 9 Differential carrier taper bearing shim ring
- 10 Bearing ring nut
- 11 Bearing of differential internal drive shaft
- 12 Cover
- 13 Oil seal ring
- 14 Differential internal drive shaft
- 15 Differential-speed gear casing
- 16 Differential carrier
- 17 Differential-speed gear casing cover

DIFFERENTIAL AND DRIVE SHAFT UNIT

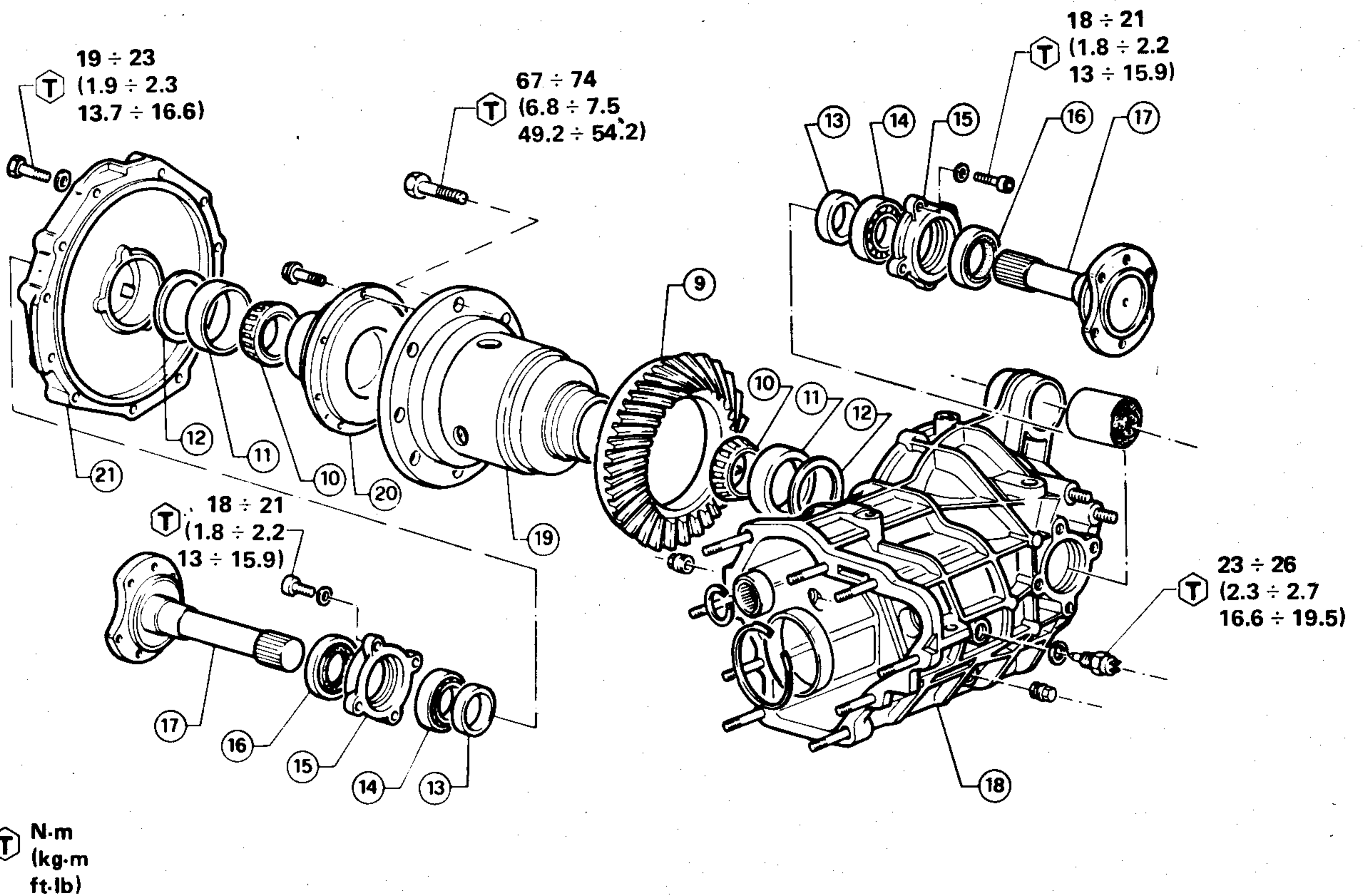
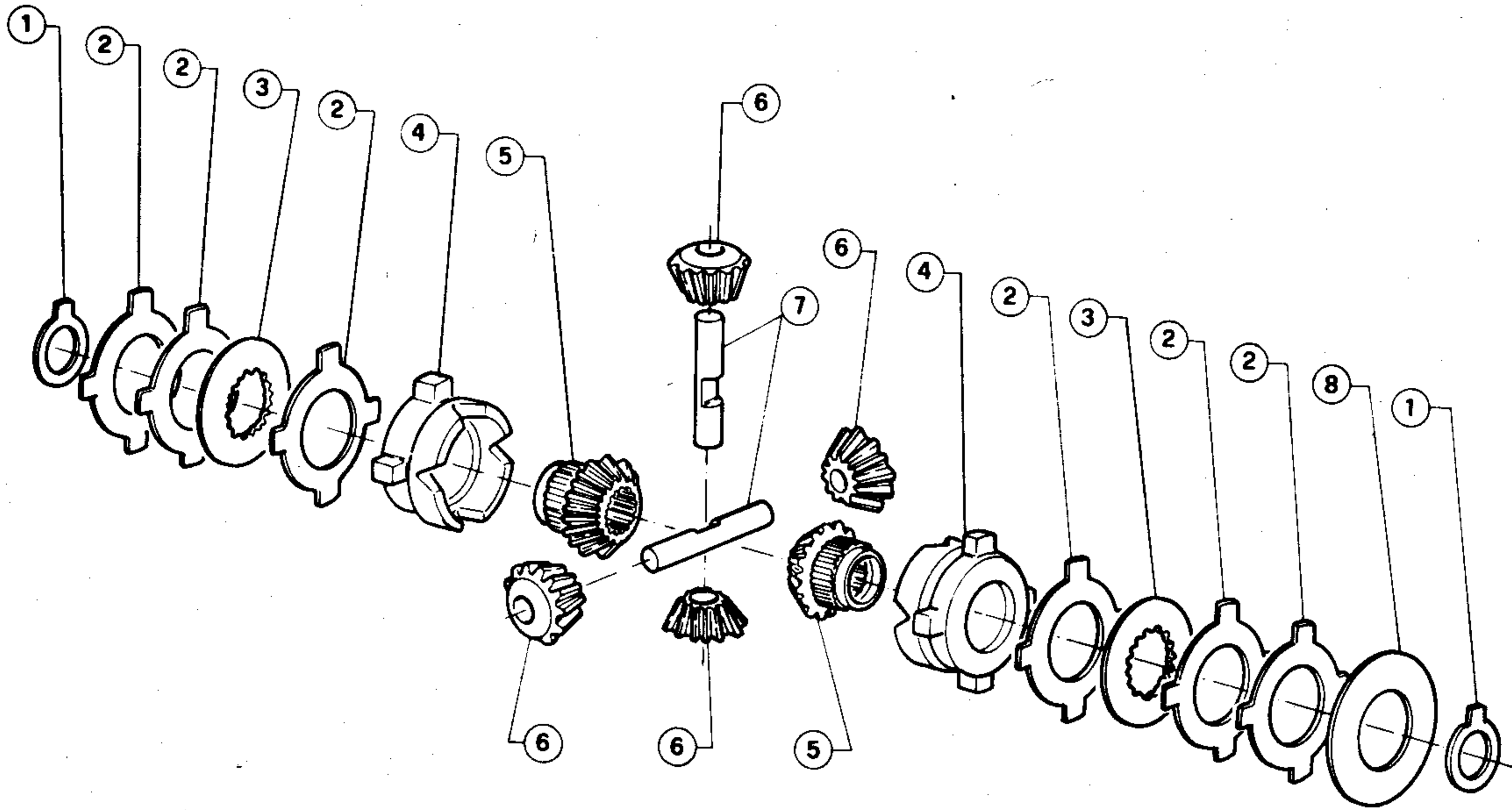
Four-side pinion differential



- 1 Shim ring
- 2 Crown Wheel
- 3 Spherical washer
- 4 Side pinion
- 5 Side pinion holder shaft
- 6 Ring bevel gear
- 7 Differential carrier taper bearing
- 8 Differential carrier taper bearing external race
- 9 Differential carrier taper bearing shim ring
- 10 Bearing ring nut
- 11 Bearing of differential internal drive shaft
- 12 Cover
- 13 Oil seal ring
- 14 Differential internal drive shaft
- 15 Differential-speed gear casing
- 16 Spring pin
- 17 Differential carrier
- 18 Differential casing cover
- 19 Differential-speed gear casing cover
- 20 Side pinion holder drive shafts

DIFFERENTIAL AND DRIVE SHAFT UNIT

Slip limited - four - side pinion differential



- | | |
|---|---|
| 1 Shim ring | 12 Differential carrier taper bearing shim ring |
| 2 External segment | 13 Bearing ring nut |
| 3 Internal segment | 14 Bearing of differential internal drive shaft |
| 4 Thrust ring | 15 Cover |
| 5 Crown Wheel | 16 Oil seal ring |
| 6 Side-pinion | 17 Differential internal drive shaft |
| 7 Spider | 18 Differential-speed gear casing |
| 8 Spacer | 19 Differential carrier |
| 9 Ring bevel gear | 20 Differential casing cover |
| 10 Differential carrier taper bearing | 21 Differential-speed gear casing cover |
| 11 Differential carrier taper bearing external race | |

DIFFERENTIAL AND DRIVE SHAFT UNIT

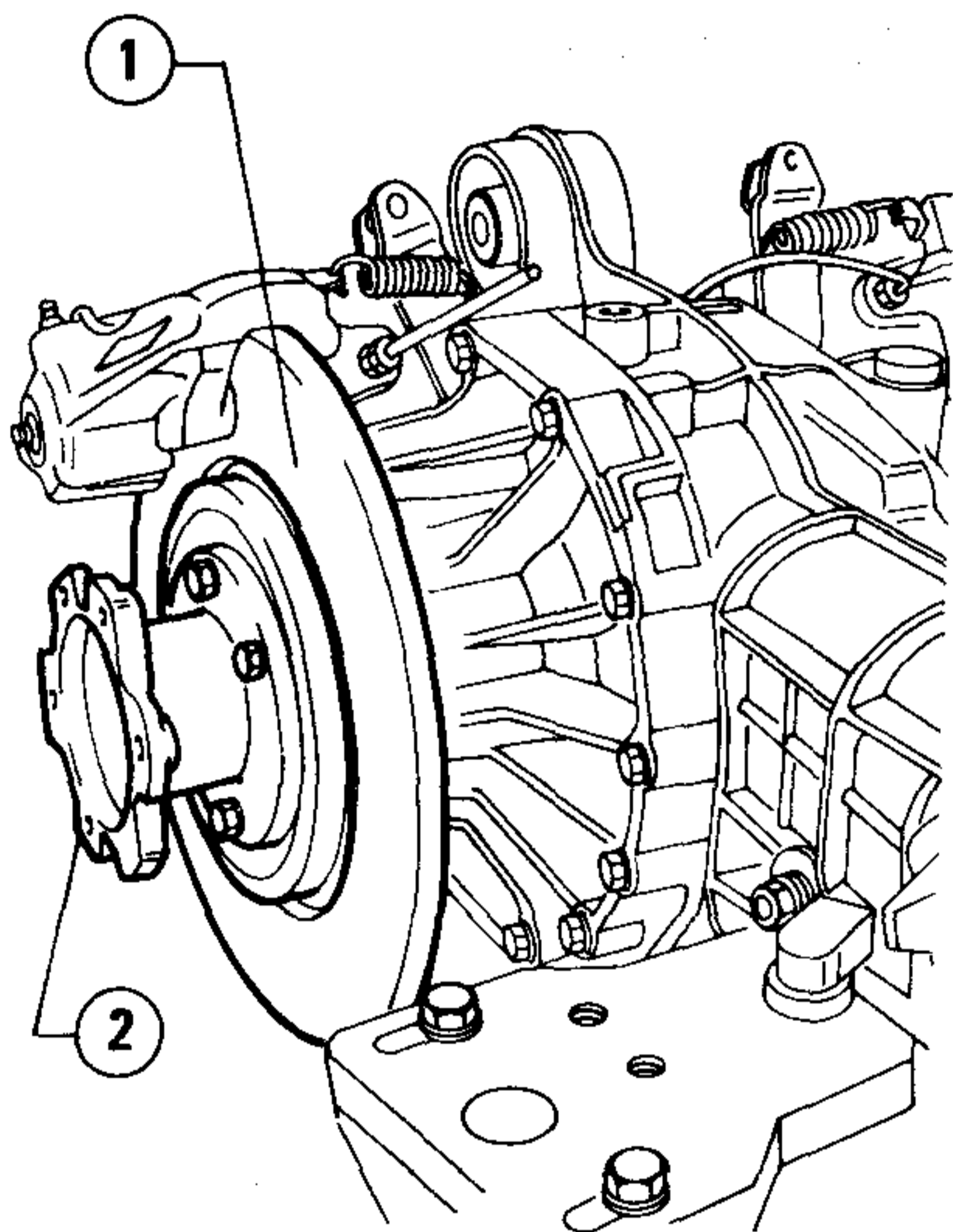
INTERNAL DRIVE SHAFTS

DISASSEMBLY

1. Removal of brake disks and spacers (only for models with differential equipped with four side pinions)

a. Operate on the parking brake control levers to prevent brake disks ① from rotating, then release the screws securing disks to spacers ②.

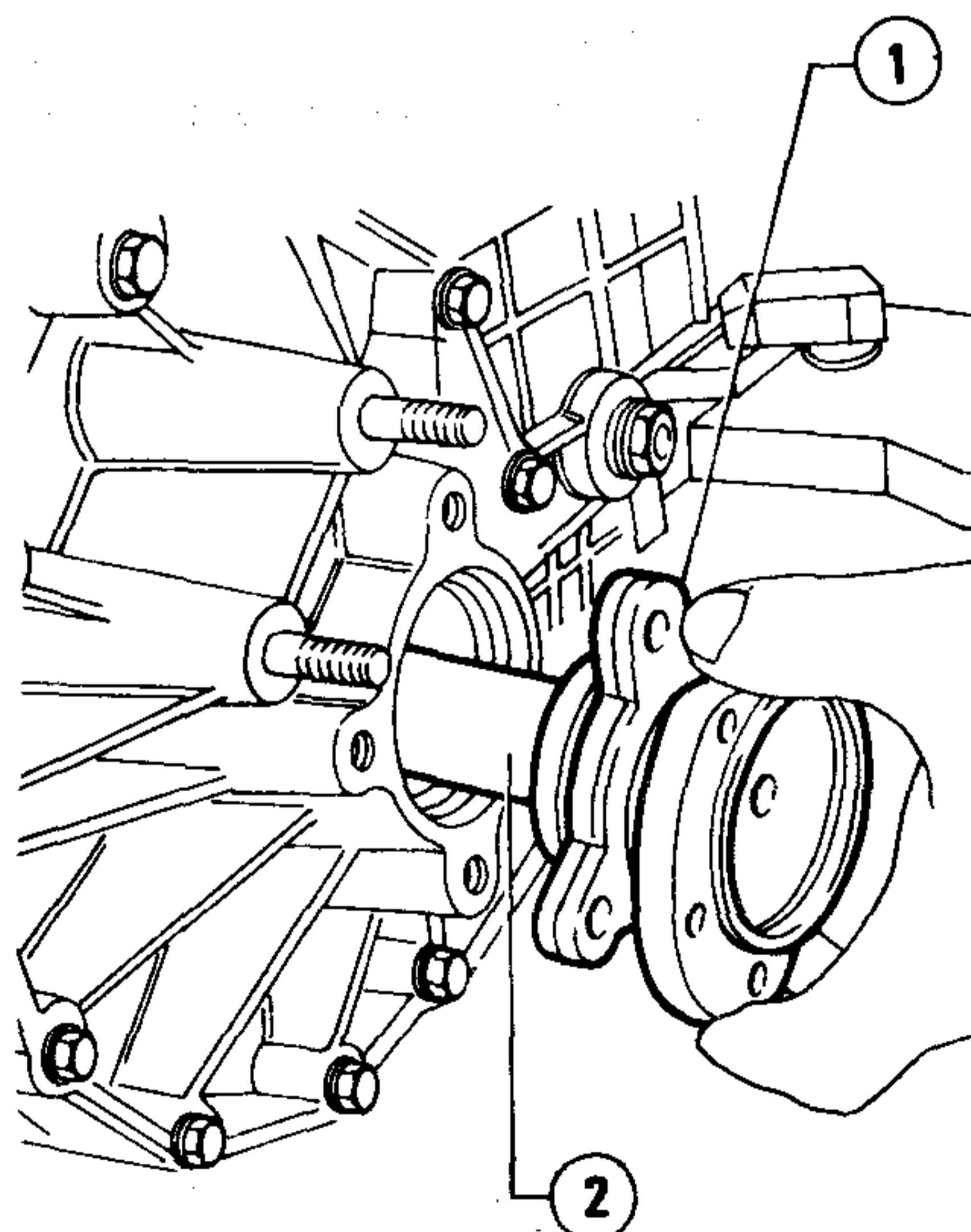
b. Remove spacers and brake disks from both sides.



- 1 Brake disk
- 2 Spacer

2. Removal of internal drive shafts.

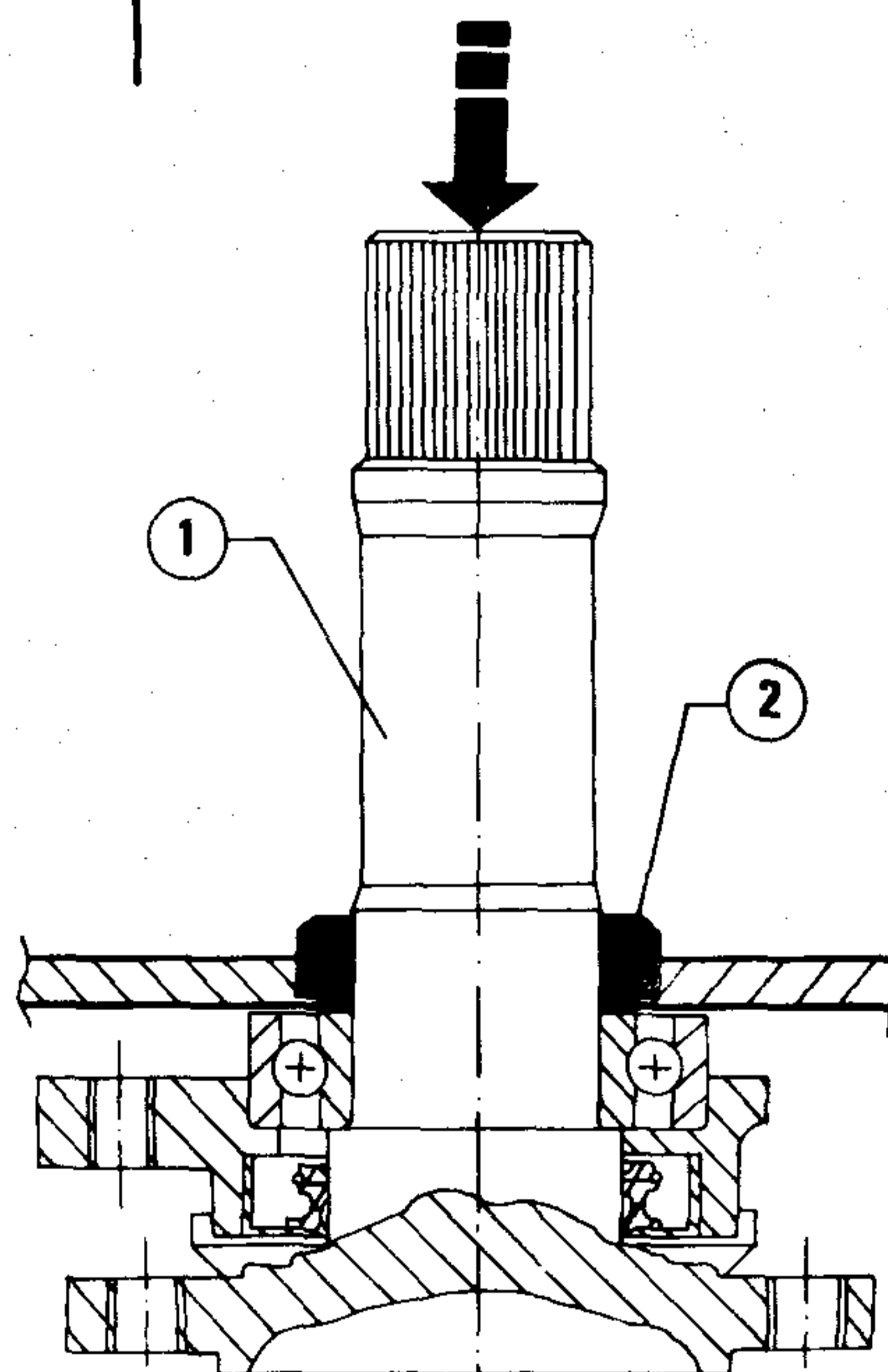
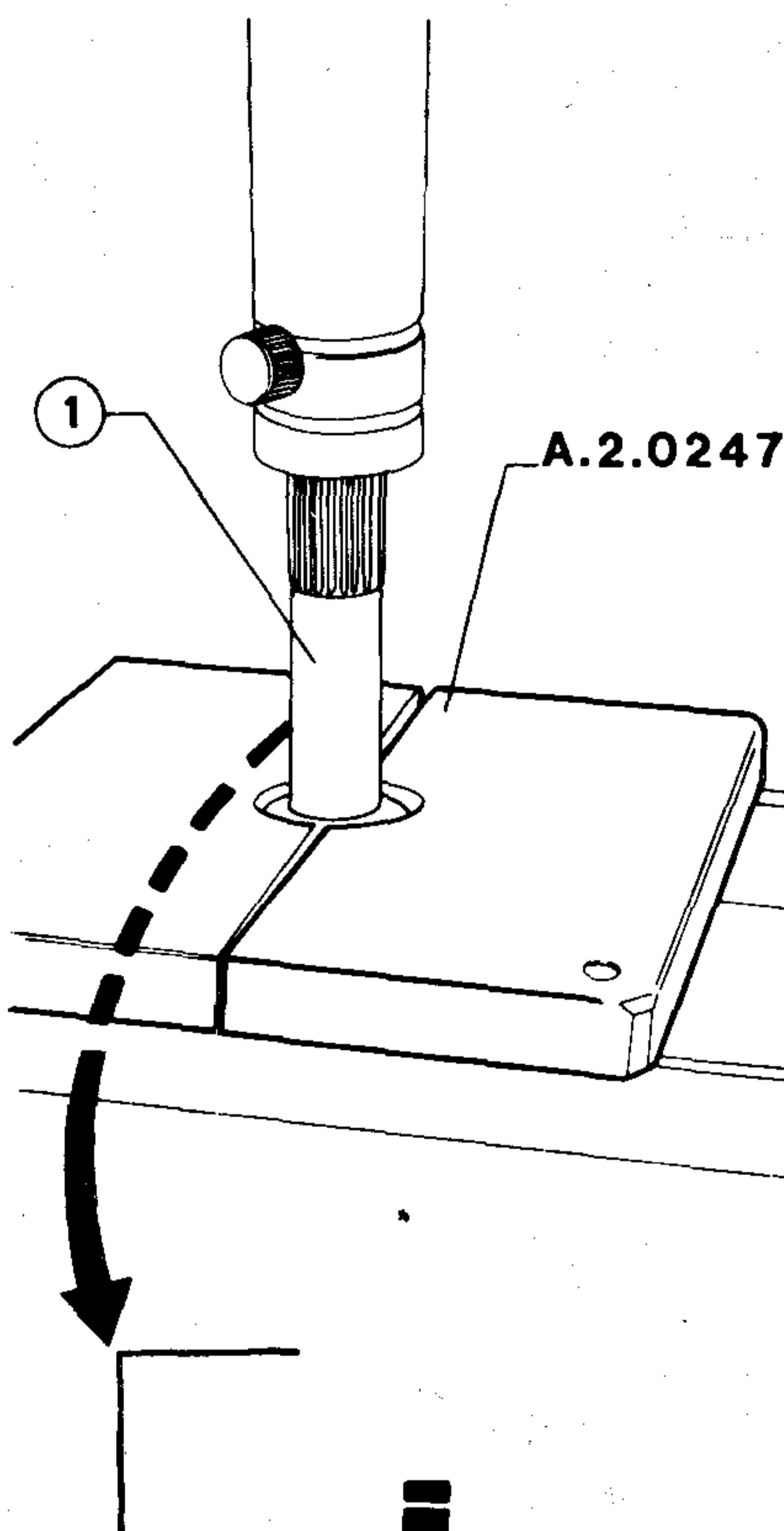
Release and remove securing screws of covers ① from both sides; then remove them from differential - speed gear casing together with the related drive shafts ②.



- 1 Drive shaft cover
- 2 Drive shaft

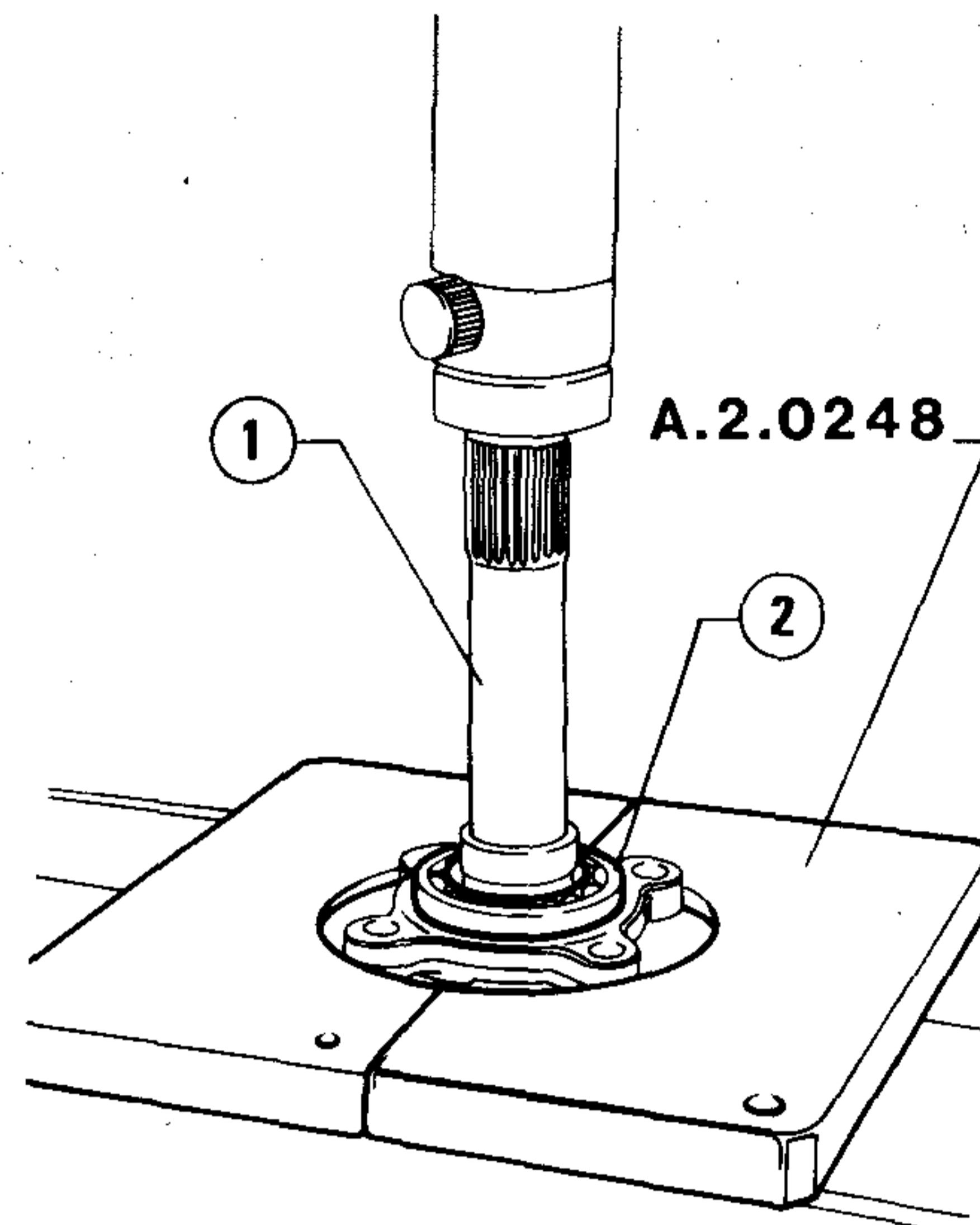
3. Disassembly of internal drive shafts

a. Withdraw ring nut ② from drive shaft ① by means of a press and plate A.2.0247.



- 1 Drive shaft
- 2 Bearing ring nut

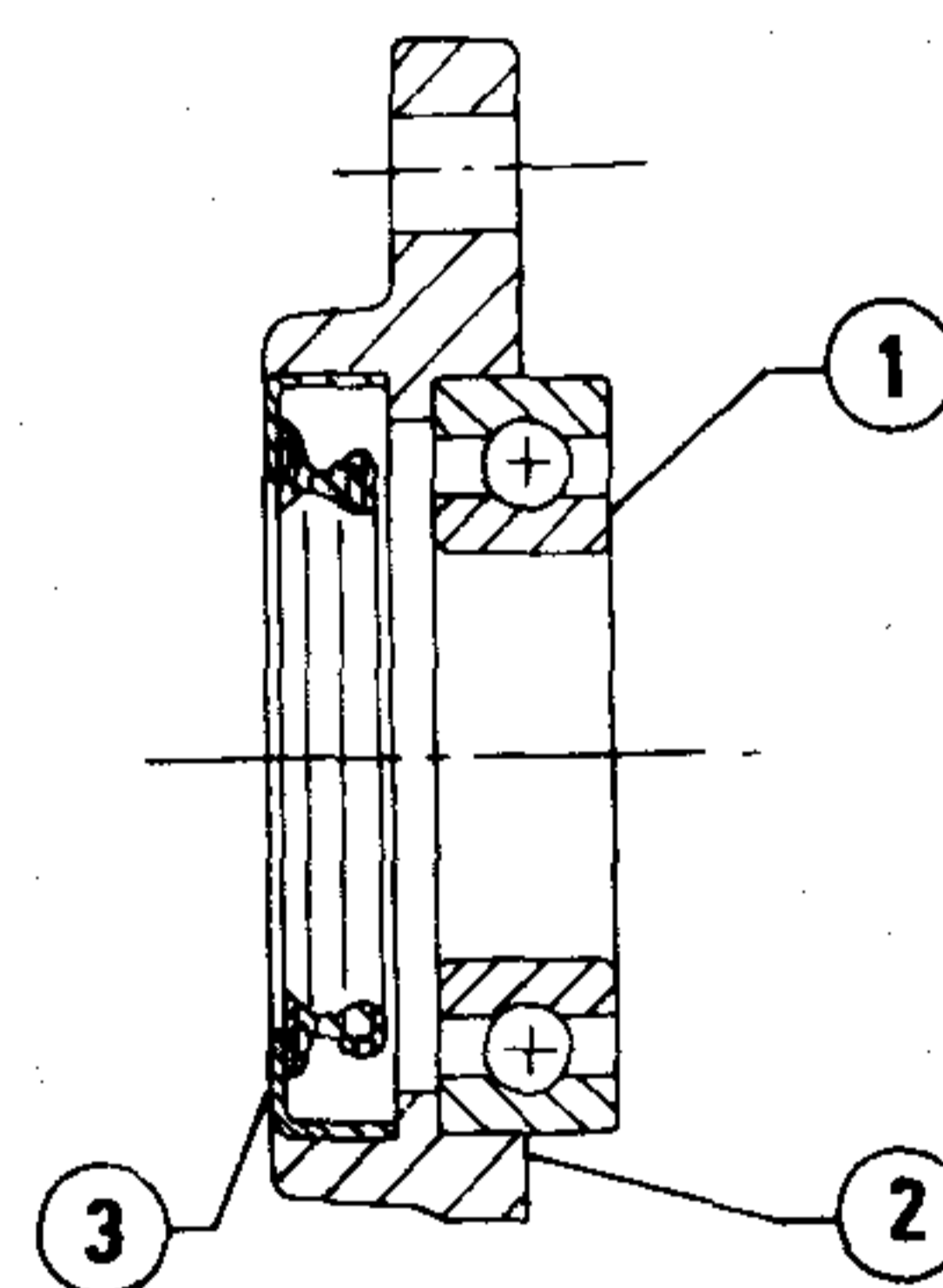
b. Withdraw drive shaft ① from bearing ② by means of a press and plate A.2.0248



- 1 Drive shaft
- 2 Bearing

4. Cover disassembly

Remove oil seal ring ③ from cover ② and remove bearing ① mounted without interference fit.



- 1 Ball bearing
- 2 Cover
- 3 Oil seal ring

CHECKS AND INSPECTIONS

Accurately wash components; in particular, remove traces of old sealant from mating surfaces between covers and differential-speed gear casing with denatured ethyl alcohol;

DIFFERENTIAL AND DRIVE SHAFT UNIT

then visually inspect component to identify possible superficial defects.

1. Bearings

Accurately examine the drive shafts ball bearings by rotating them slowly; if bearings are in good conditions, no noise shall be heard and no stickings nor excessive clearance be present.

2. Internal drive shafts

a. Verify that splined section profile mates with crown wheels correctly in particular, check that backlash "G" between splined section and crown wheels is within the prescribed values.

Backlash between splined profile and crown wheels:

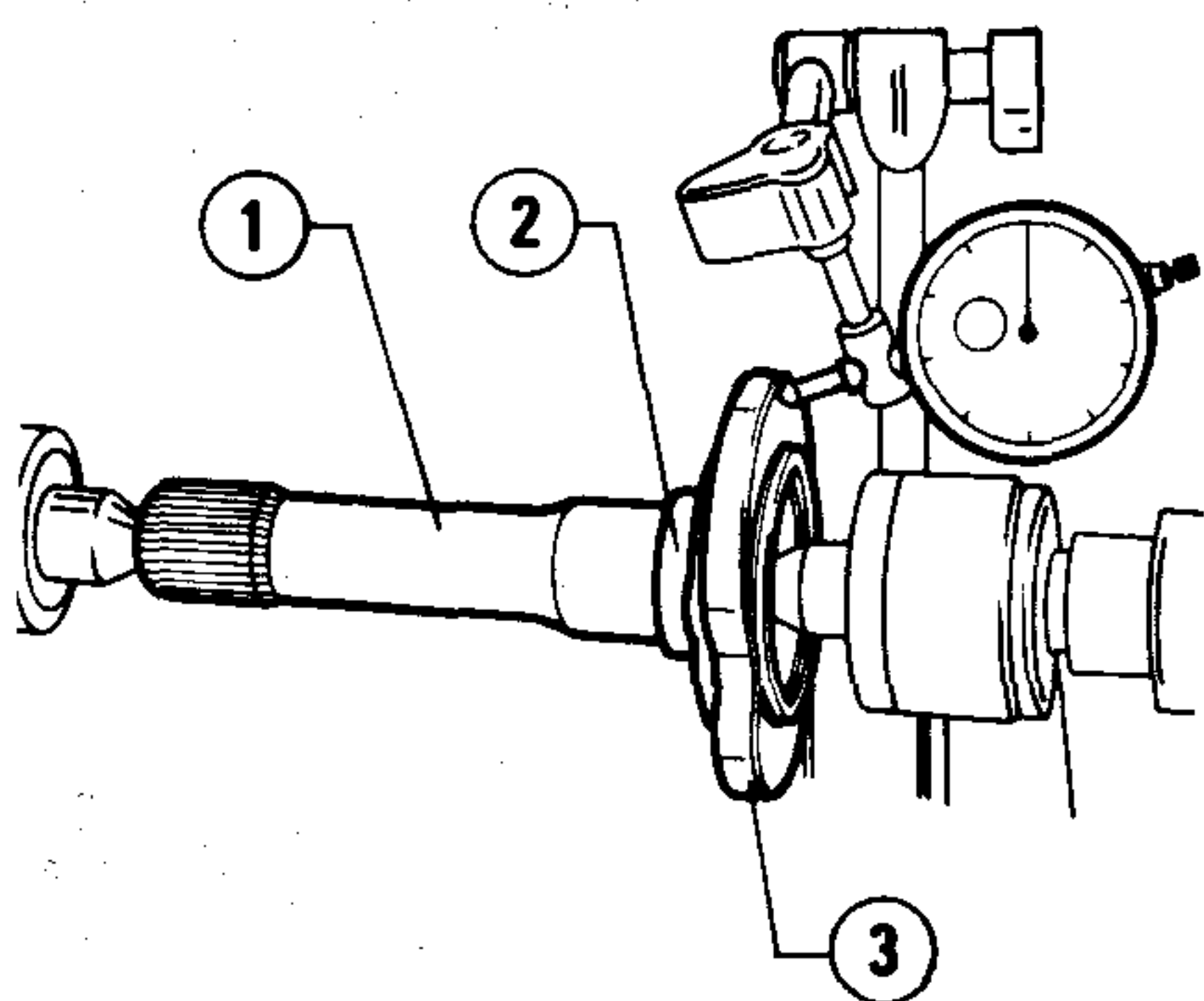
$$G = 0.07 \text{ to } 0.13 \text{ mm} \\ (0.00275 \text{ to } 0.0051 \text{ in})$$

b. Verify that squareness deviation of brake disk support plane (3) with respect to bearing seat (1) and oil seal ring seat (2) is lower than the prescribed "S" value:

$$S = 0.05 \text{ mm (0.00197 in)}$$

c. Verify that interference fit "I" between bearing ring nut and its seat on drive shaft is within the prescribed tolerance range.

$$I = 0.023 \text{ to } 0.057 \text{ mm} \\ (0.0009 \text{ to } 0.0022 \text{ in})$$



- 1 Bearing and ring nut seat
- 2 Oil seal ring work seat
- 3 Brake disk support plane

REASSEMBLY

1. Cover reassembly

a. Lubricate outer surface and internal lip of drive shaft oil seal ring with prescribed oil and grease, respectively.

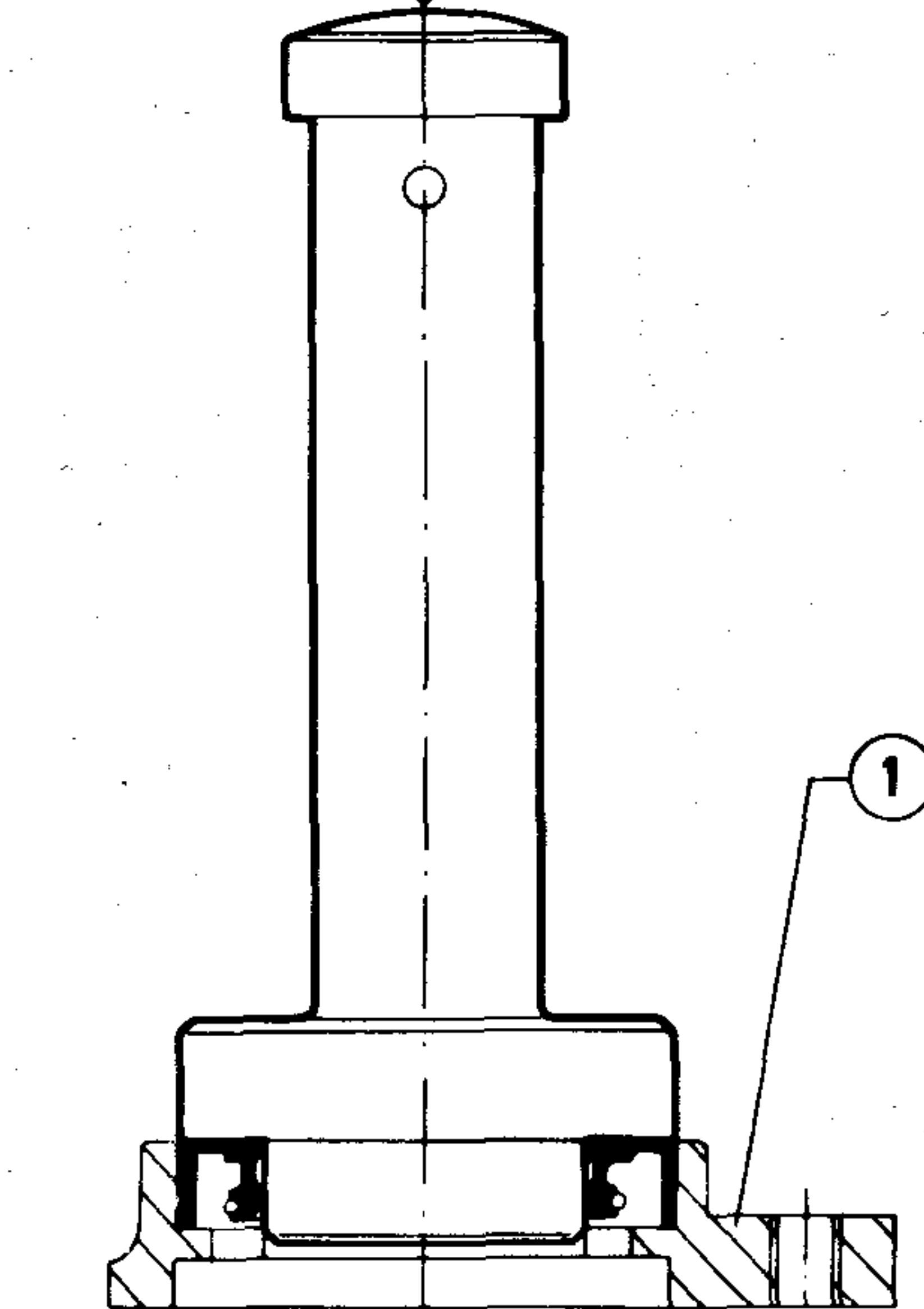
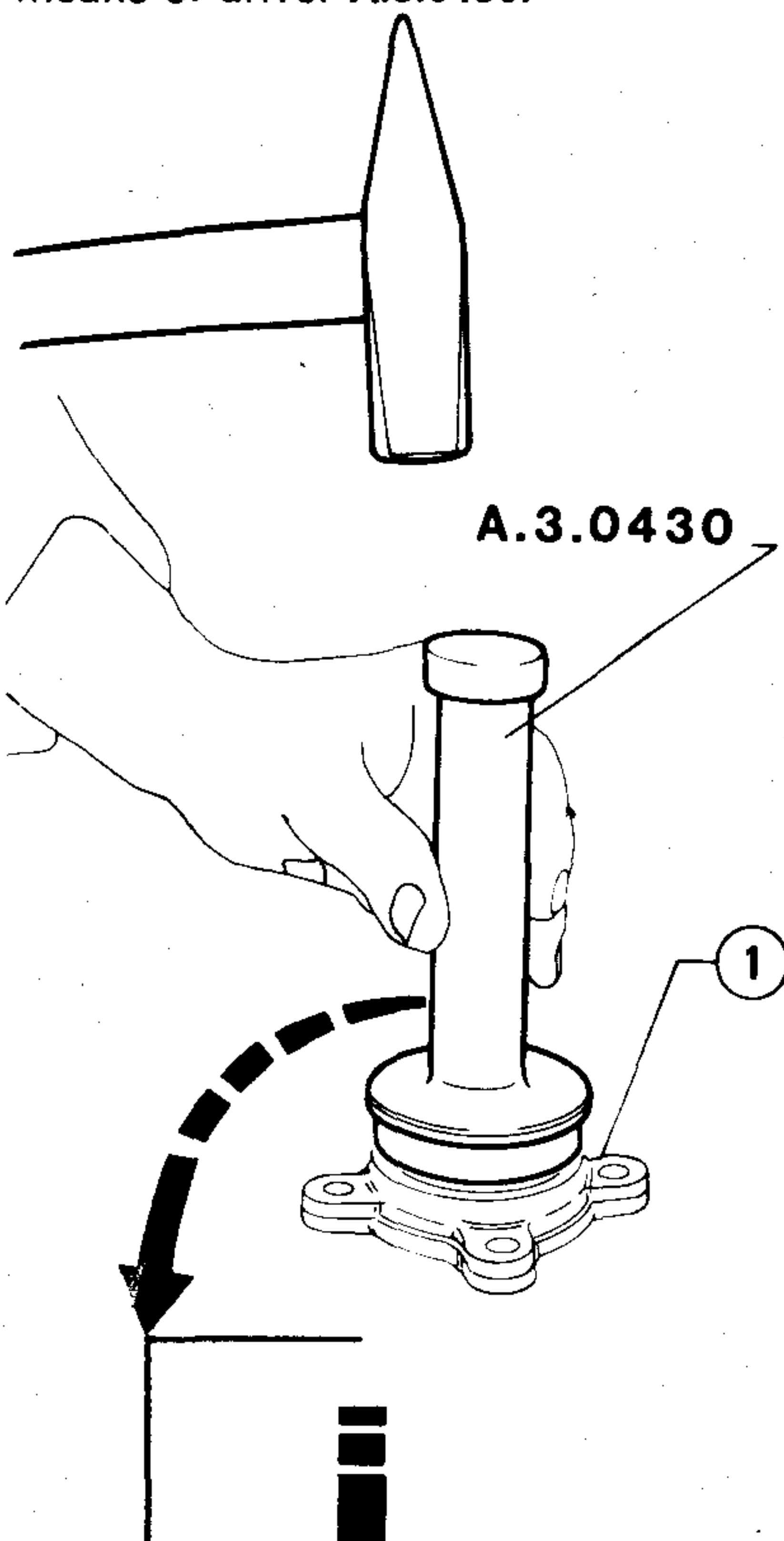
Oil:

AGIP Rotra SX 75W90
IP Pontiac HDS 75W90

Grease:

ISECO Molykote BR2

b. Install seal oil ring on cover (1) by means of driver A.3.0430.

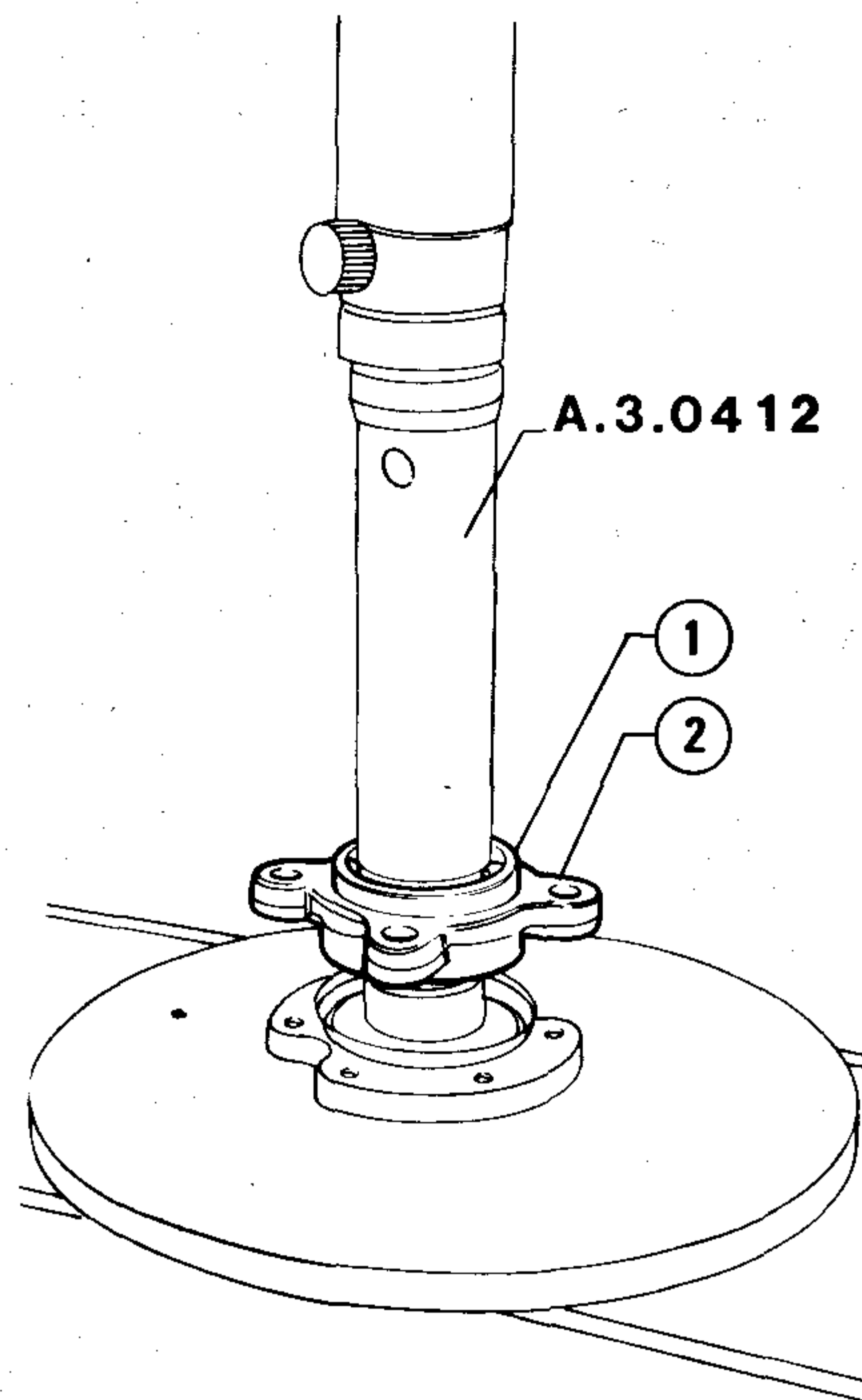


- 1 Drive shaft cover

c. Insert drive shaft bearing on cover

2. Reassembly of internal drive shafts

a. Fit cover (2) complete with bearing (1) on internal drive shaft by means of a press and tool A.3.0412.



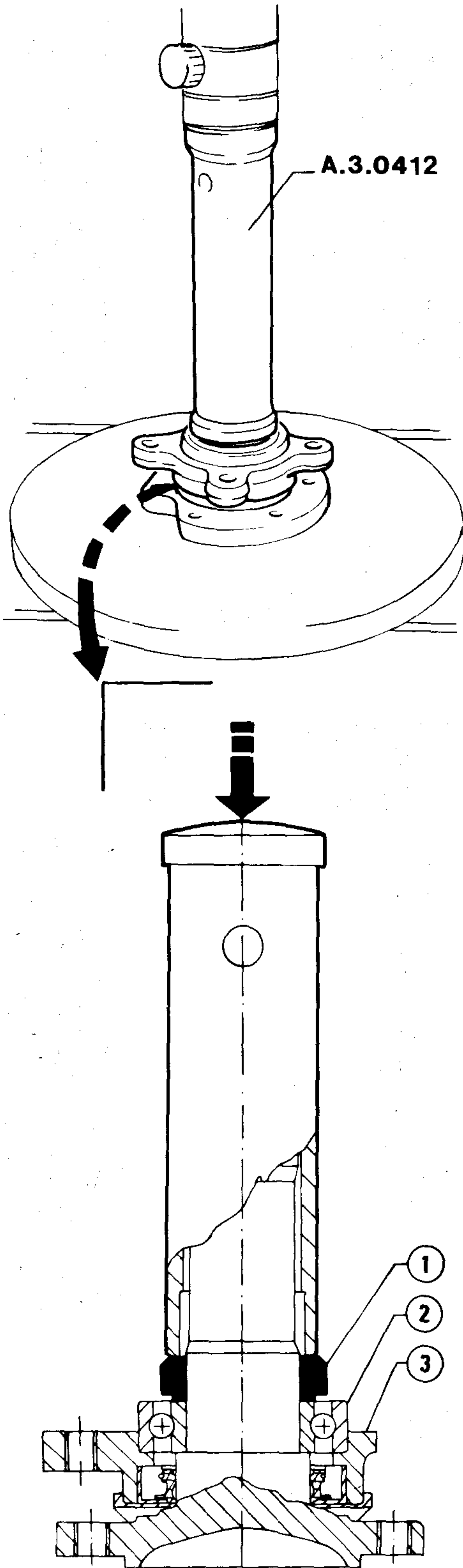
- 1 Ball bearing
- 2 Cover

b. Heat (190 °C; 374 °F) ring nut (1) of bearing (2), then insert it on drive shaft by means of a press and tool A.3.0412.

CAUTION:

Keep ring nut under pressure until complete cooling down; blow air to accelerate operation.

DIFFERENTIAL AND DRIVE SHAFT UNIT



- 1 Bearing ring nut
- 2 Ball bearing
- 3 Cover

3. Installation of internal drive shafts

- a. Lay a coat of prescribed sealant on cover mating surface

Sealant:

Sealing-compound LOWAC Perfect Seal

- b. Install covers complete with internal drive shafts on differential-speed gear casing, taking into account that the longer drive shaft must be positioned at cover side.
- c. Tighten the covers securing screws to the prescribed torque.

T: Tightening torque
Screws securing covers to speed gear-differential casing
18 to 21 N·m
(1.8 to 2.2 kg·m
13 to 15.9 ft·lb)

4. Installation of brake discs and spacers (only for models with differential equipped with four side pinions)

- a. Position the brake disks and the related spacers, then temporarily insert the securing screws.
- b. Stop brake disks rotation, and tighten the disks securing screws to the prescribed torque.

T: Tightening torque
Screws securing brake disks and spacers to internal drive shafts
50 to 55 N·m
(5.0 to 5.5 kg·m
36.1 to 39.8 ft·lb)

DIFFERENTIAL CARRIER

DISASSEMBLY

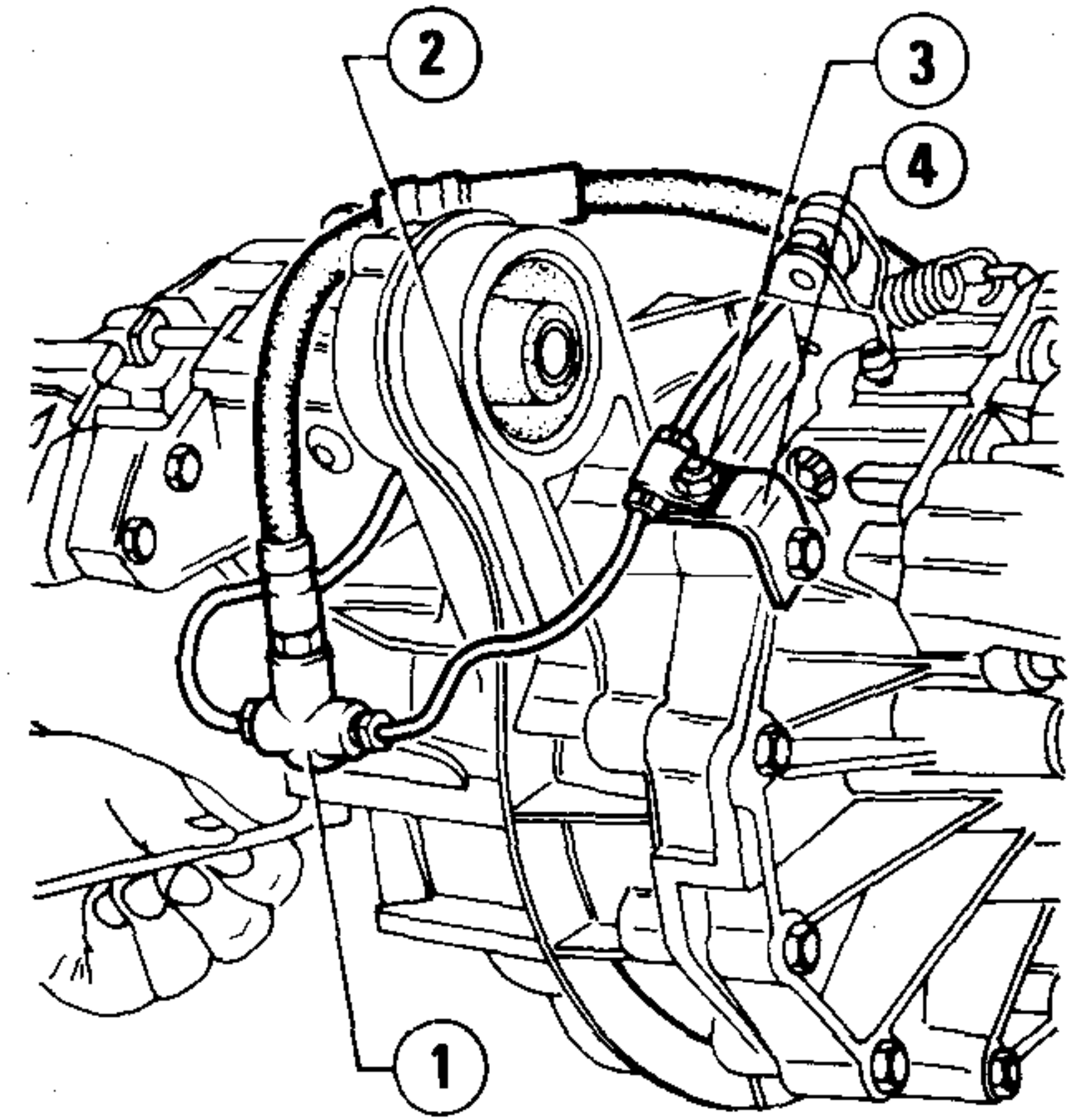
- 1. Removal of brake disks and internal drive shafts (refer to: "Internal Drive Shafts - Disassembly").

- 2. Removal of brake calipers and control system piping

- a. Detach control system pipes (2) from brake calipers.

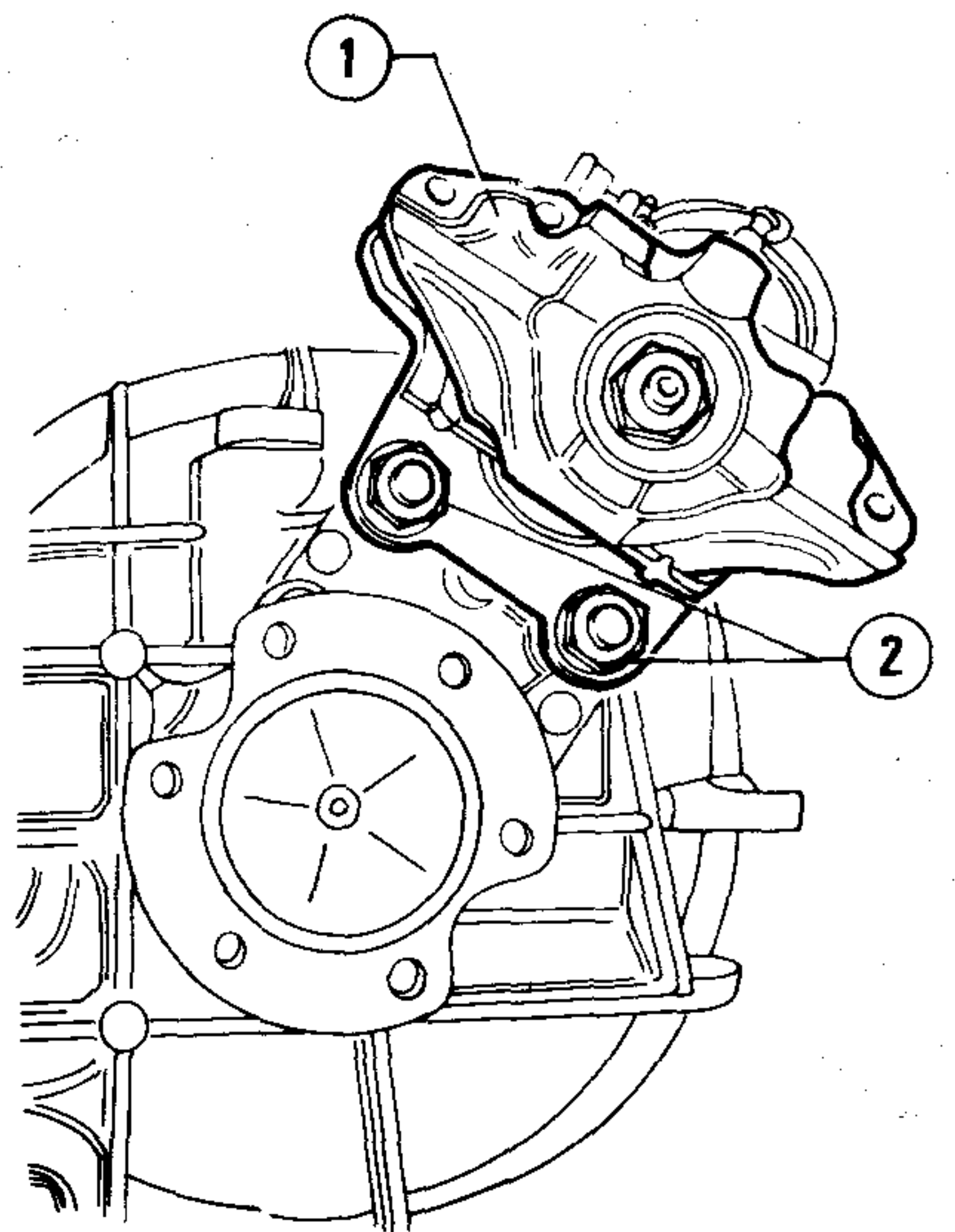
- b. Unscrew securing nut and remove union (1) from differential-speed gear casing.

- c. Unscrew clamp (4) securing nut (2); then remove piping.



- 1 Union tee
- 2 Pipe
- 3 Clamp securing nut
- 4 Piping support clamp

- d. Release and remove nuts (2) securing brake calipers (1) to differential-speed gear casing from both sides, then remove calipers.

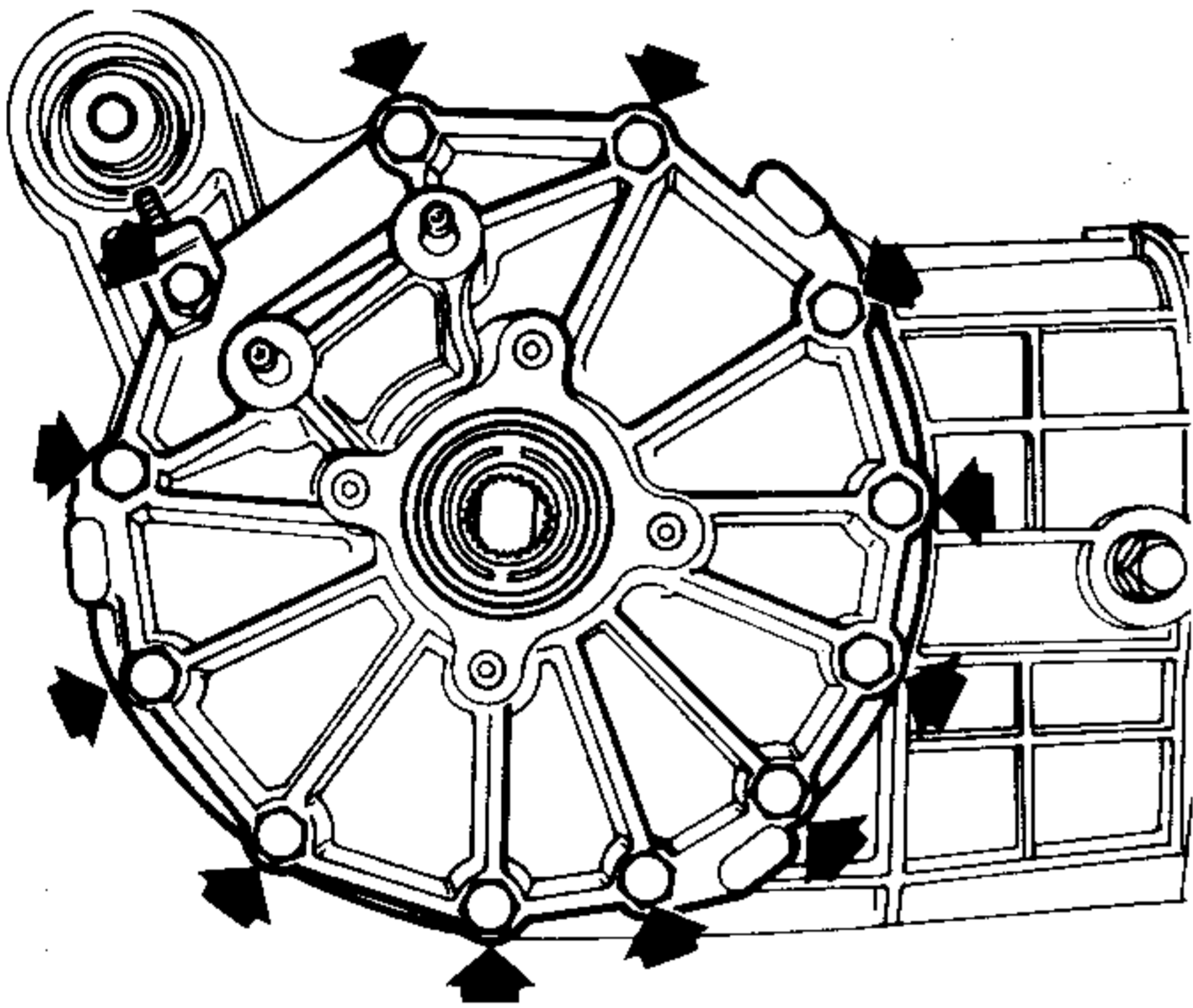


- 1 Brake caliper
- 2 Nuts

DIFFERENTIAL AND DRIVE SHAFT UNIT

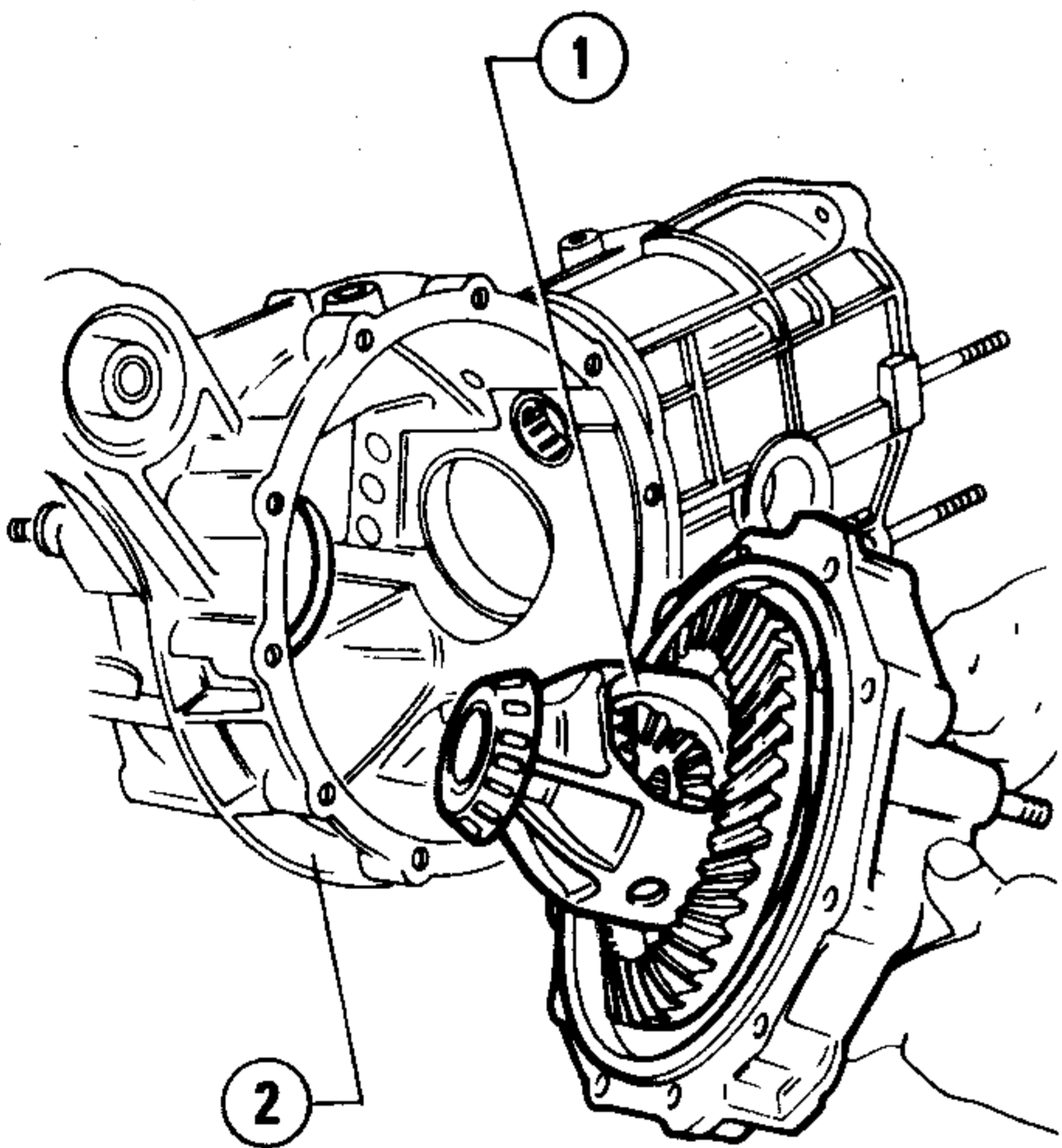
3. Removal of complete differential carrier

a. Unscrew and remove the screws securing differential-speed gear casing cover.



b. Remove cover together with the complete differential carrier (1).

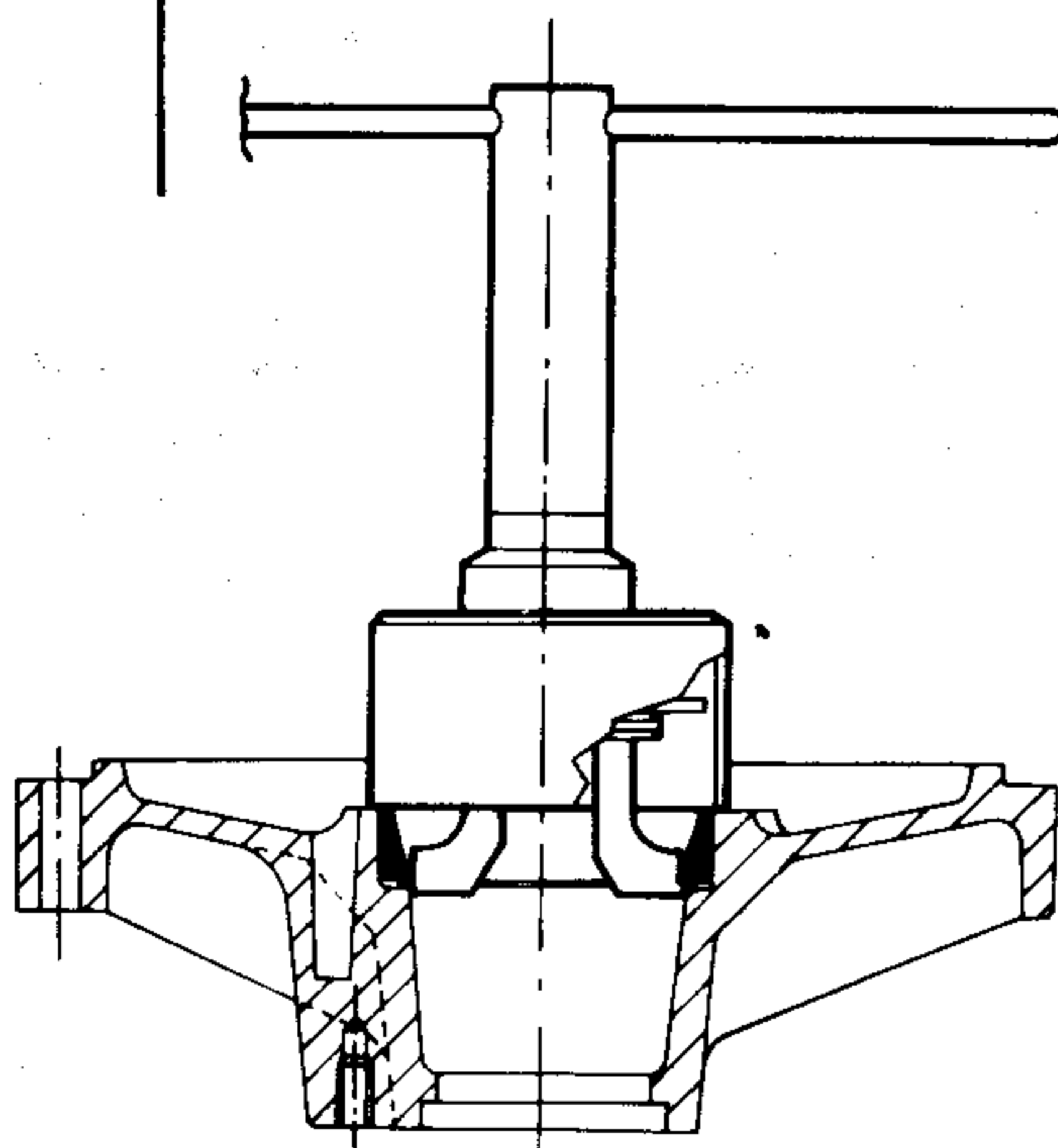
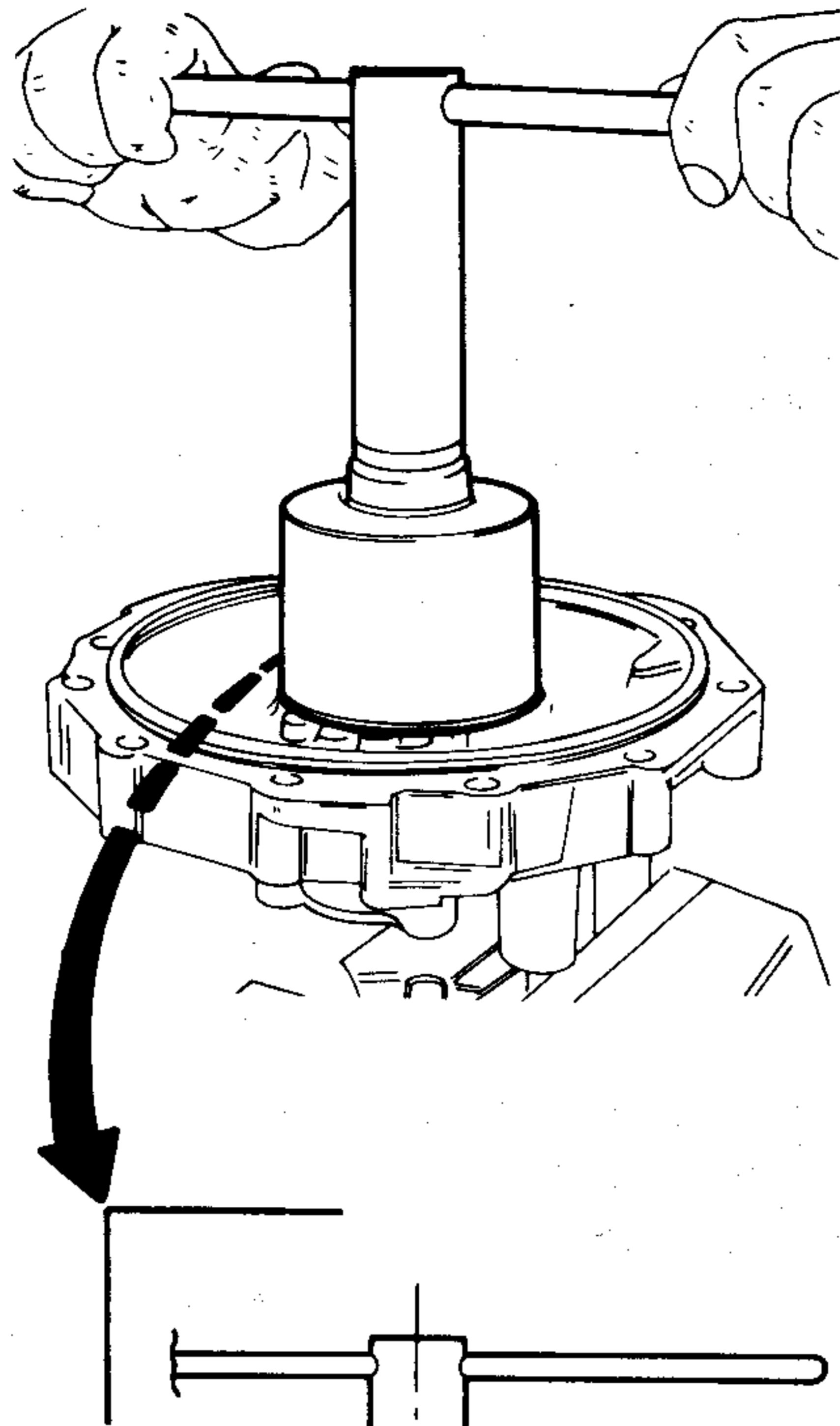
Take care not to drop differential carrier.



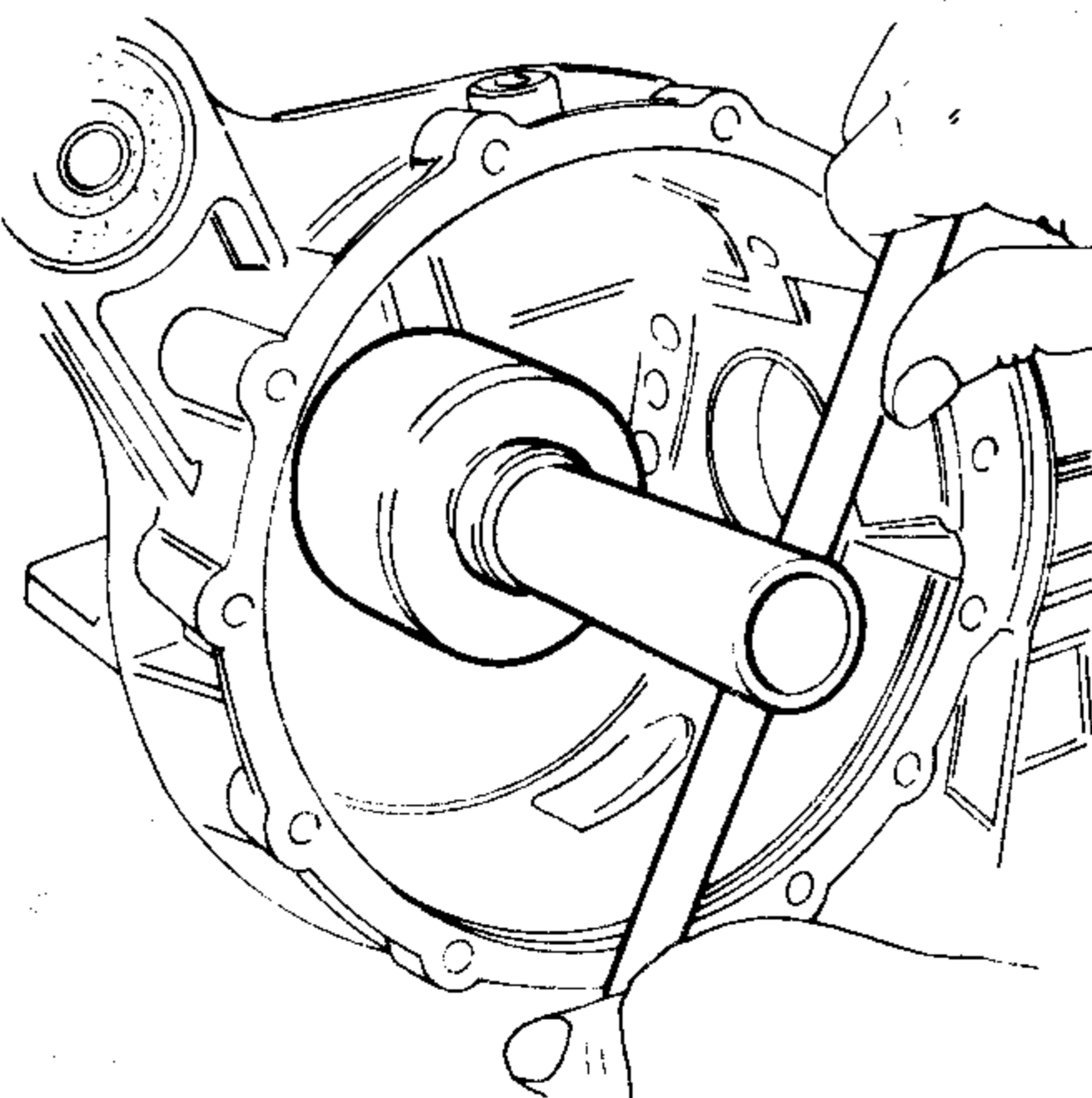
- 1 Differential casing
- 2 Differential-speed gear casing

4. Removal of differential carrier bearing external races

a. By means of an adjustable span puller, withdraw outer ring of differential carrier taper bearing from differential-speed gear casing cover, and remove the shim ring below.



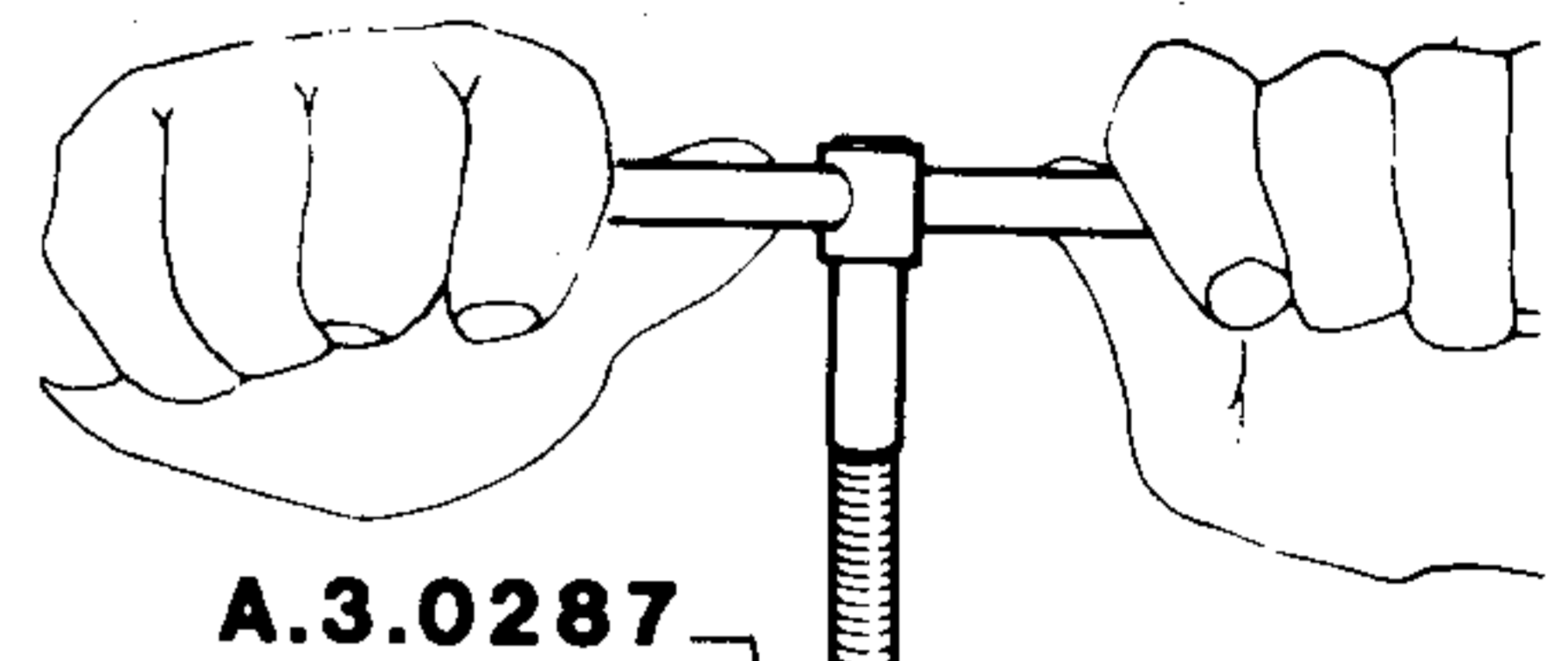
b. By means of same tool, withdraw outer ring of differential carrier taper bearing from differential-speed gear casing, and remove the shim ring below.



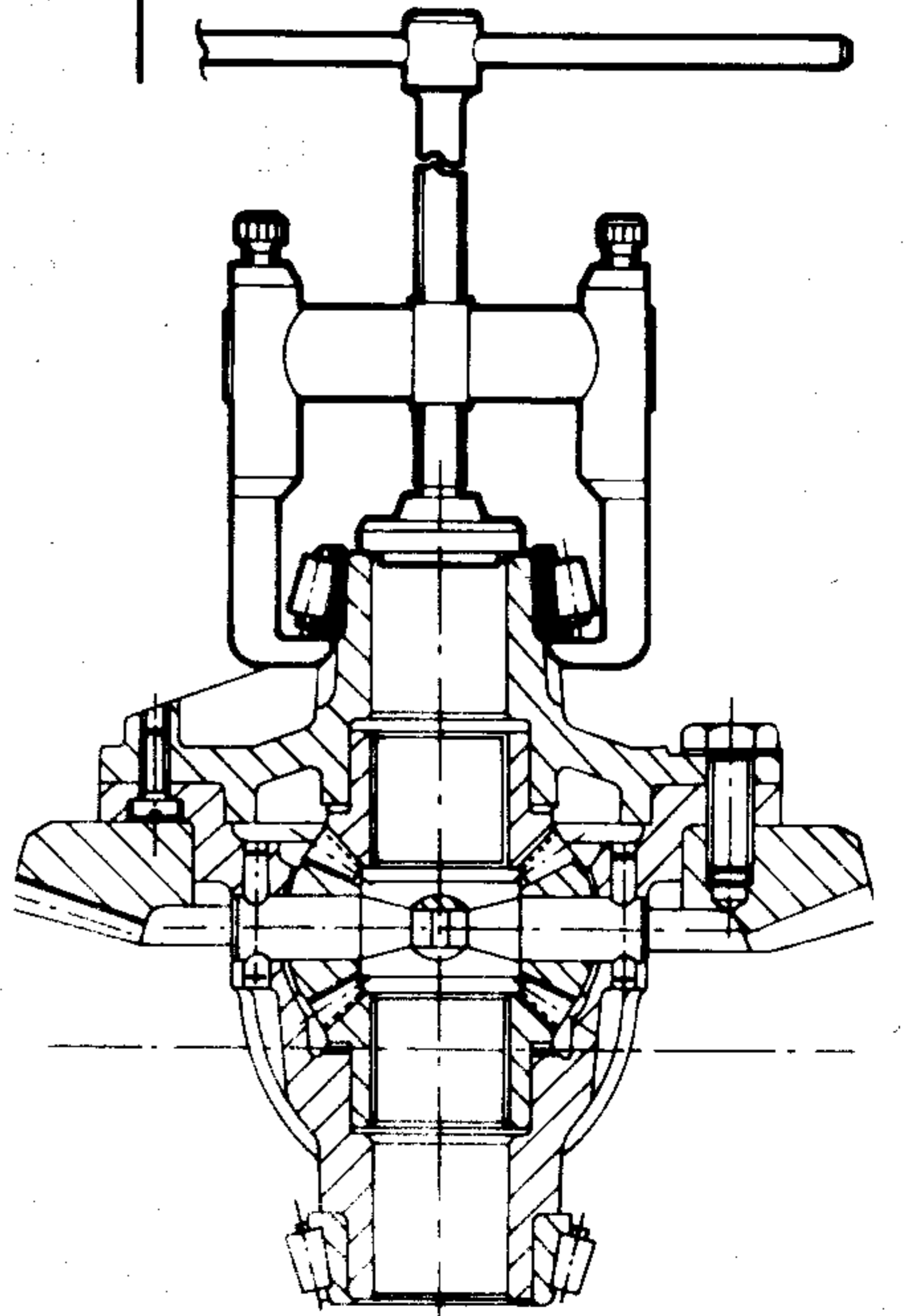
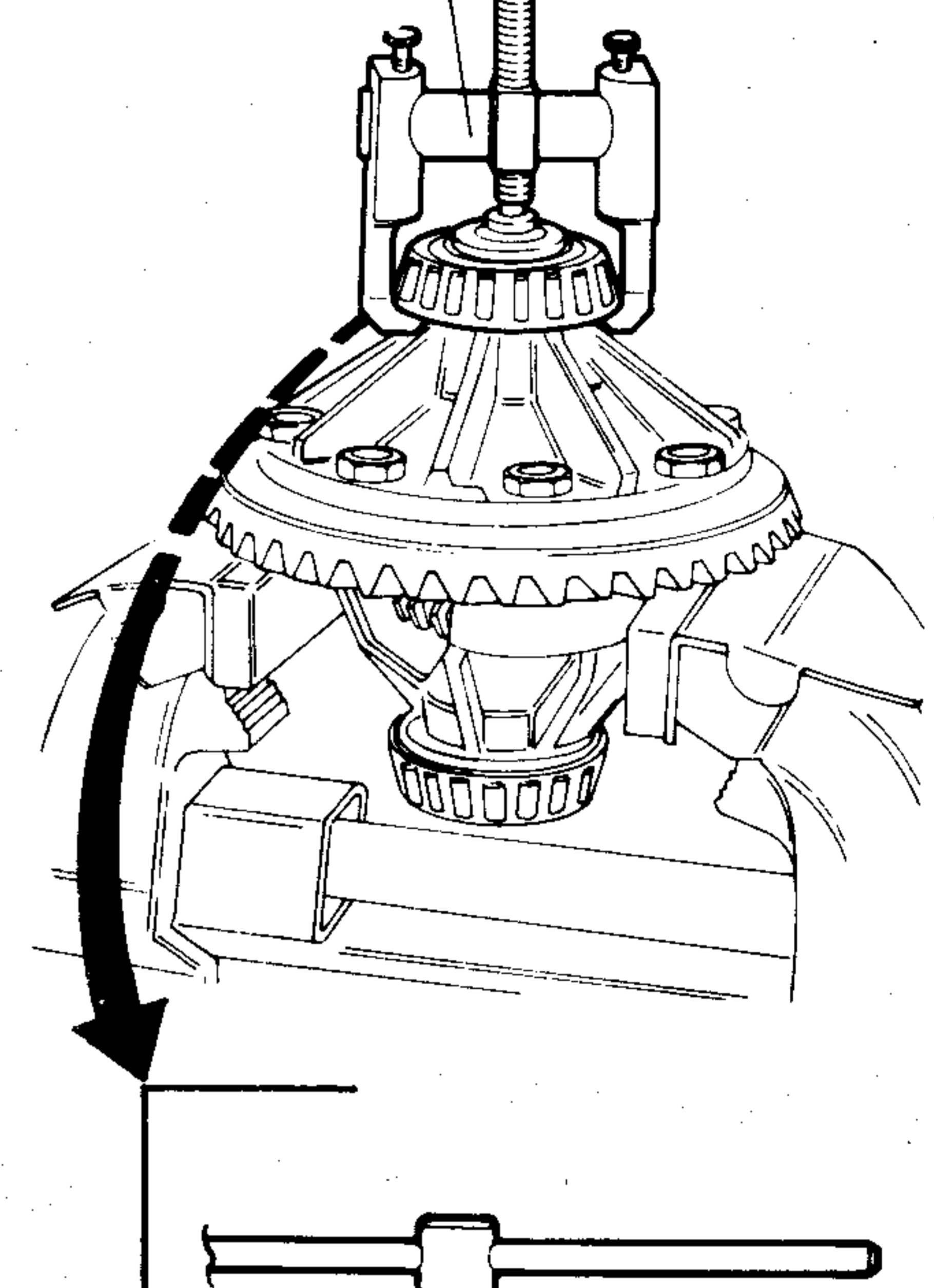
5. Removal of differential carrier ring bevel gear and taper bearings

a. Secure differential carrier on a vice fitted with jaws and, by means of tool A.3.0287, remove taper bearings internal rings.

If bearings are re-used, mark their assembly order so as to reinstall them with the related outer rings.

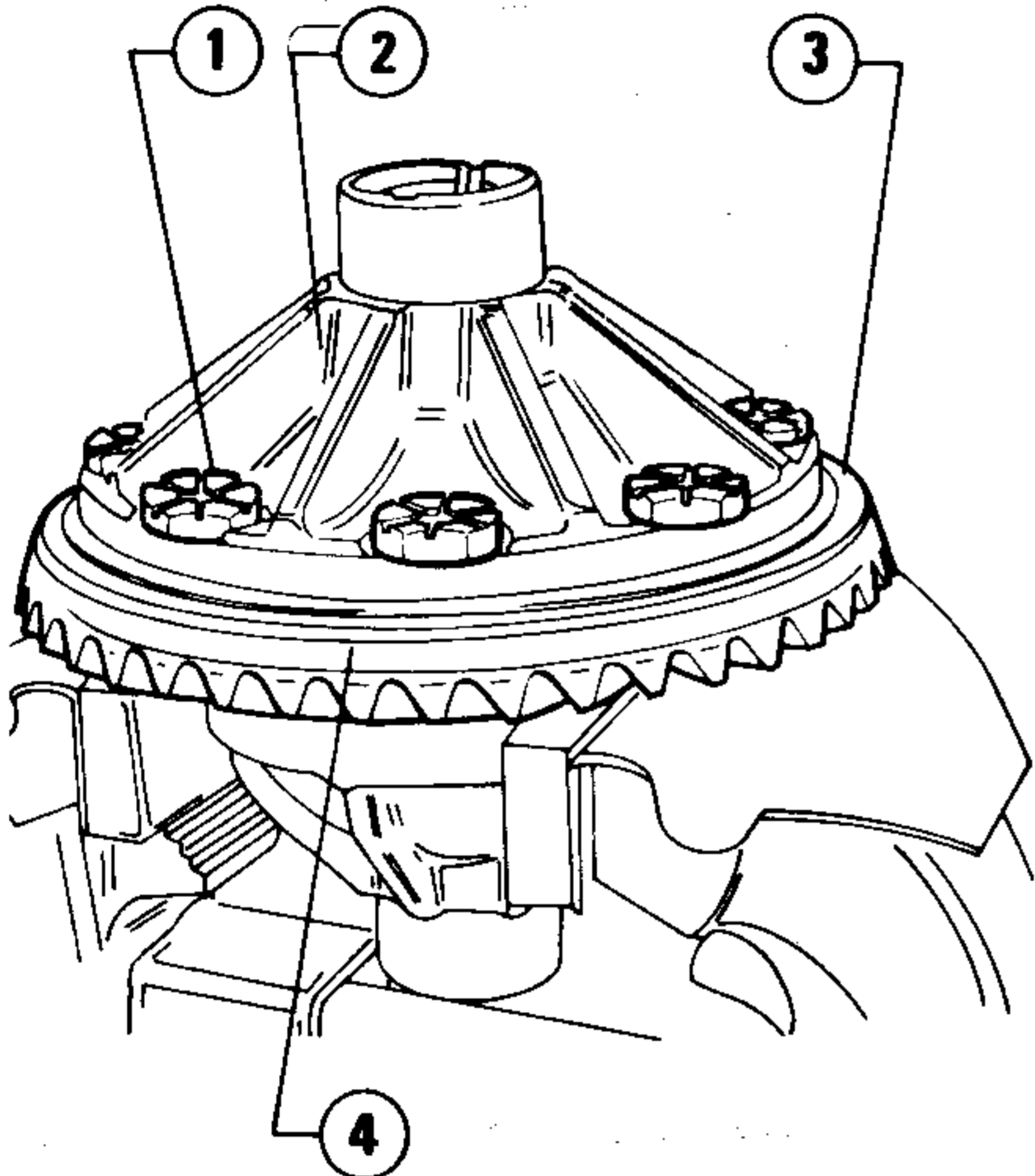


A.3.0287



DIFFERENTIAL AND DRIVE SHAFT UNIT

b. According to maintenance operations, carry out installation reference (4) between ring bevel gear (3) and differential carrier (2), then loosen and remove securing screws (1) and remove ring bevel gear.

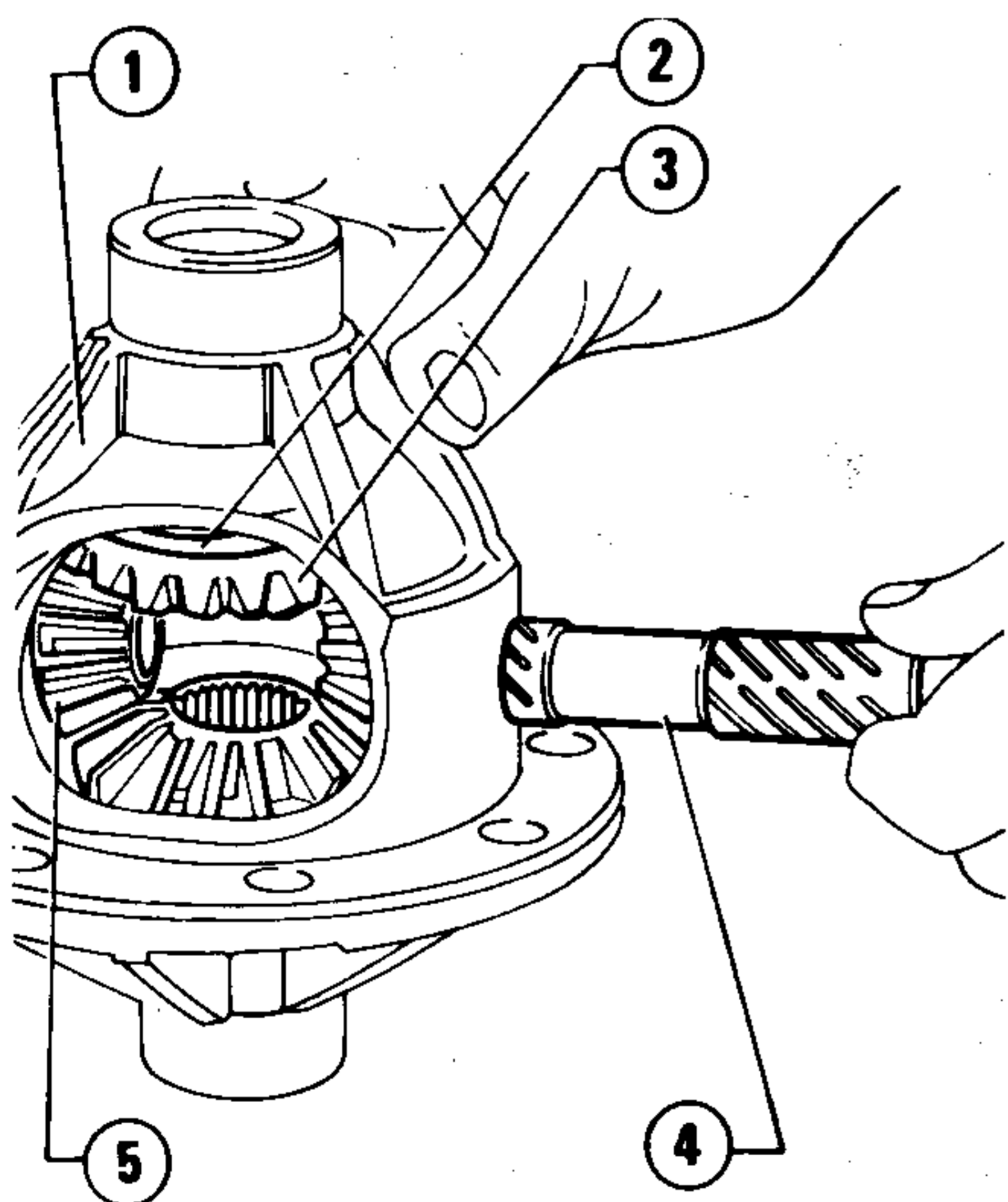


- 1 Screw
- 2 Differential carrier
- 3 Ring bevel gear
- 4 Installation refence

6. Differential carrier disassembly

Two-side pinion differential

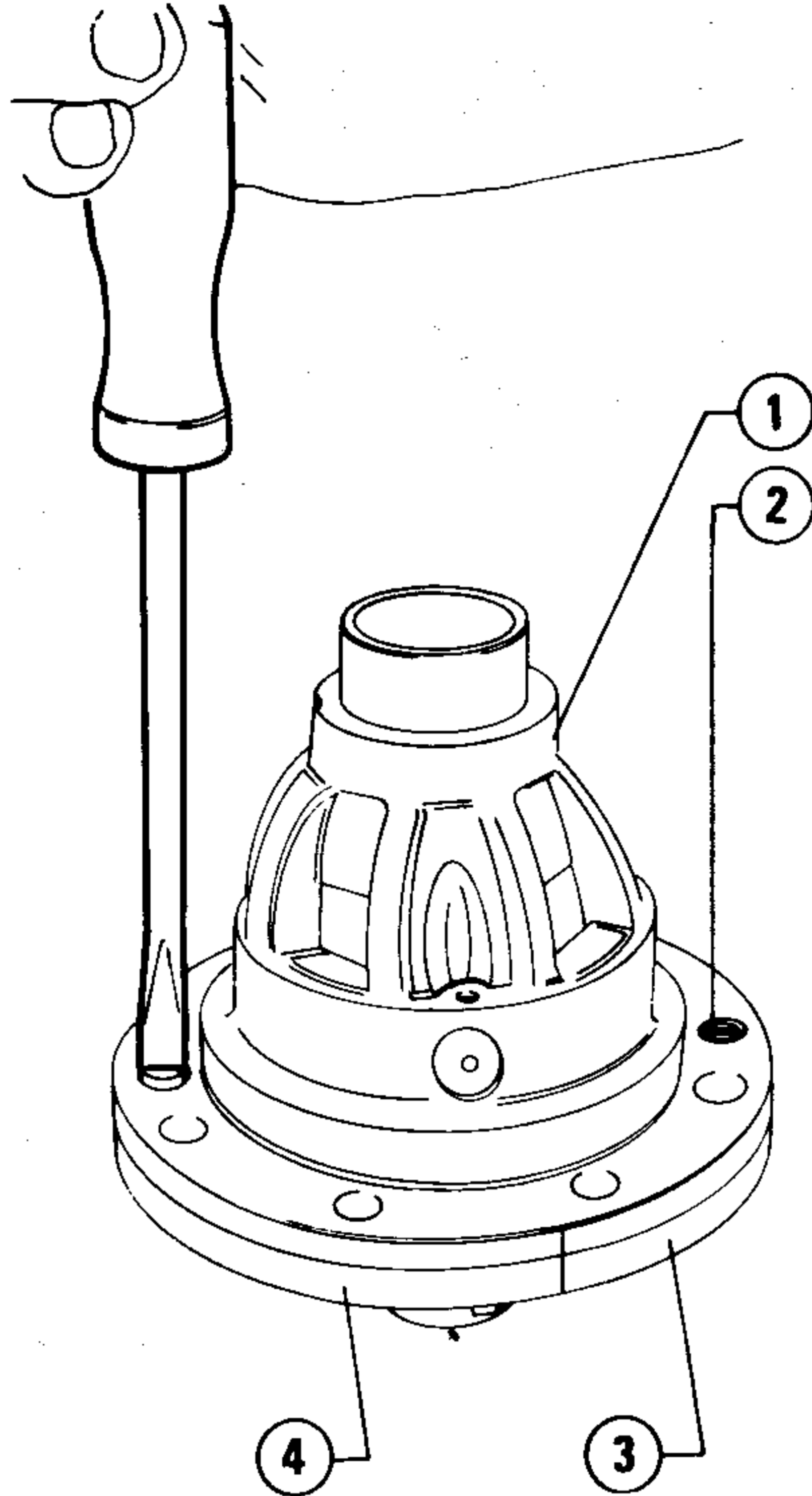
Withdraw side pinion holder shaft (4) and remove side pinions (5) with the related spherical washers and crown wheels (3) with shim rings (2) from differential casing (1).



- 1 Differential carrier
- 2 Shim ring
- 3 Crown wheel gear
- 4 Side pinion holder shaft
- 5 Side pinion gear

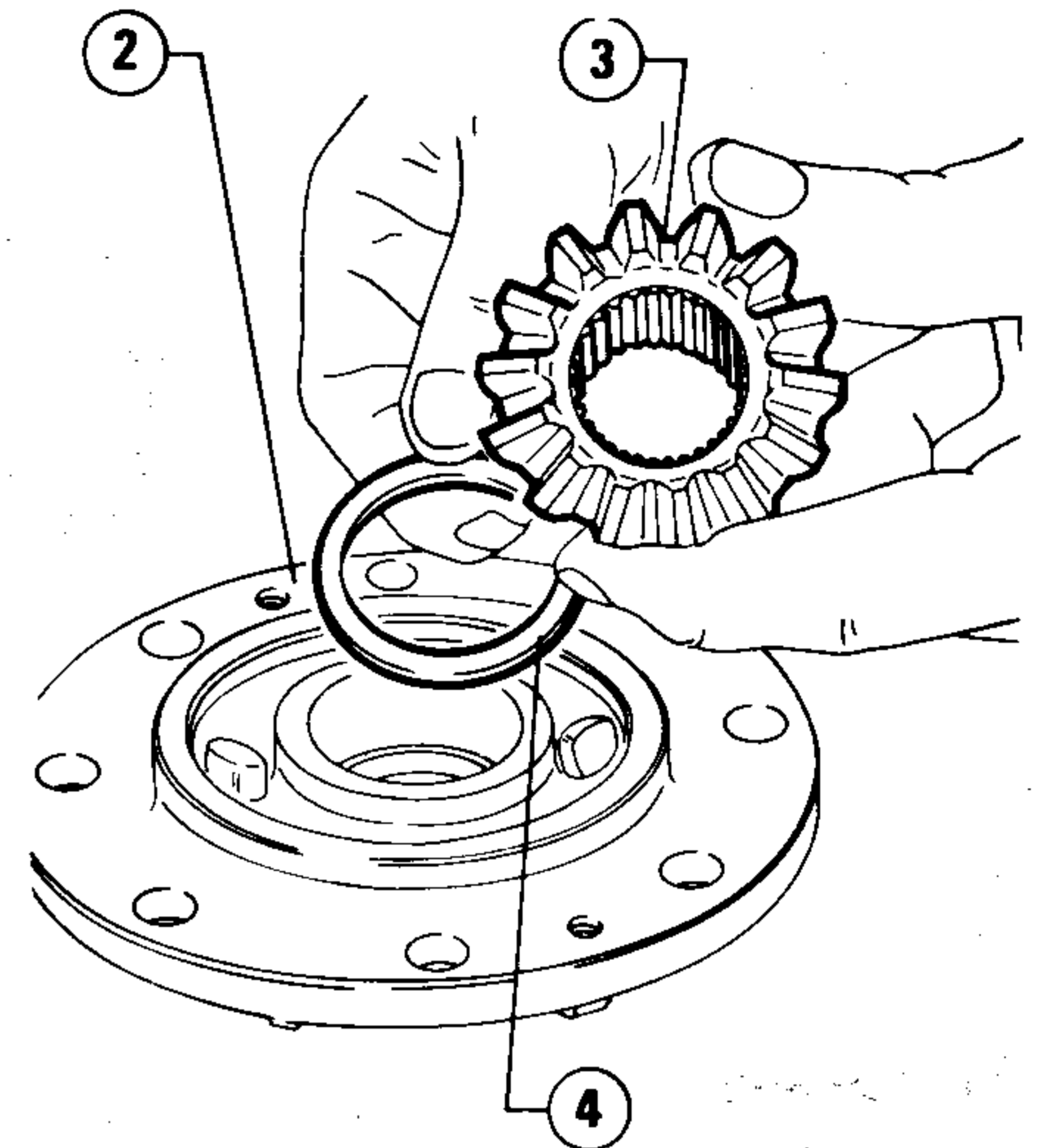
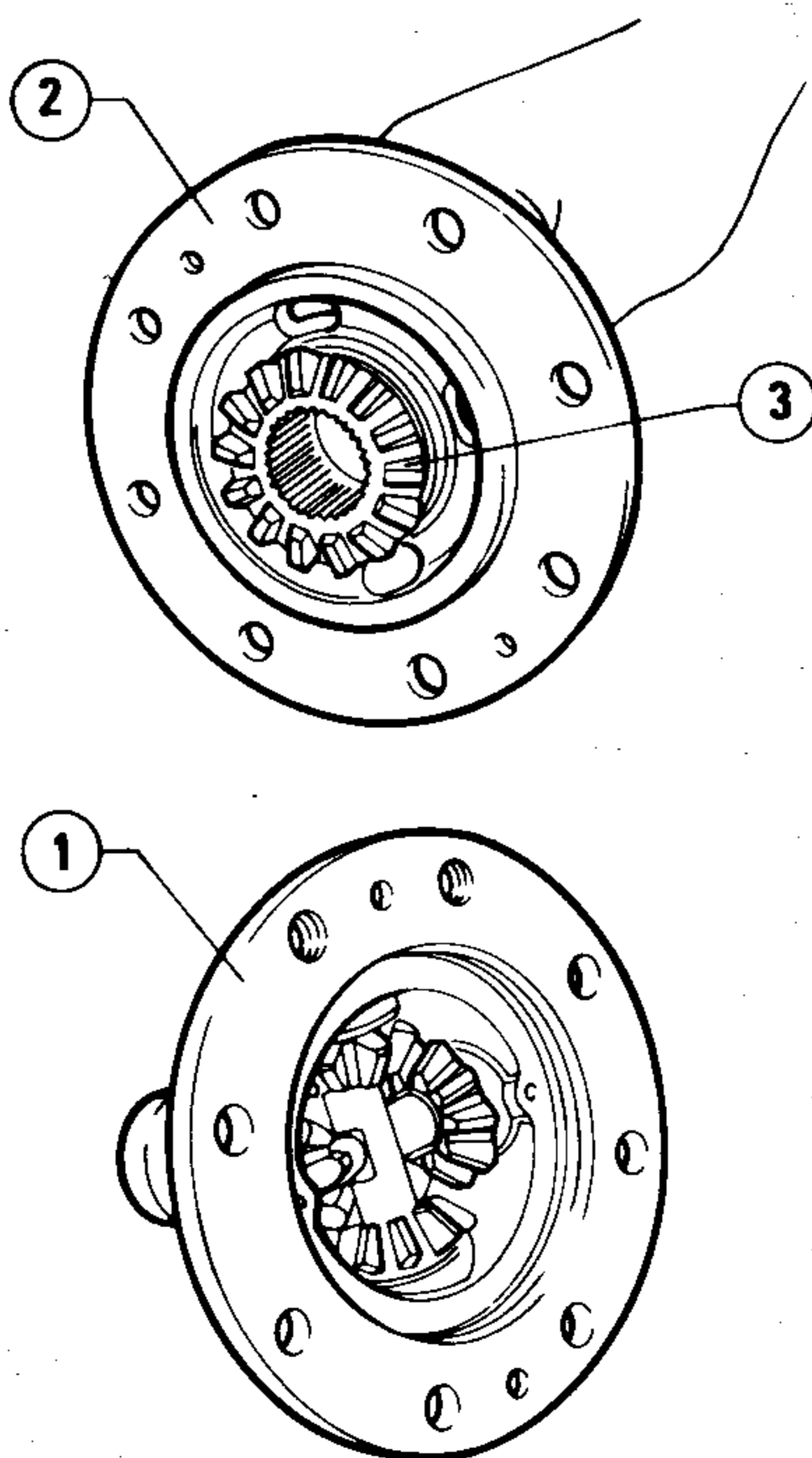
Four-side pinion differential

a. Carry out a reference notch (3) between differential casing (1) and related cover (2), then unscrew securing screws (2).



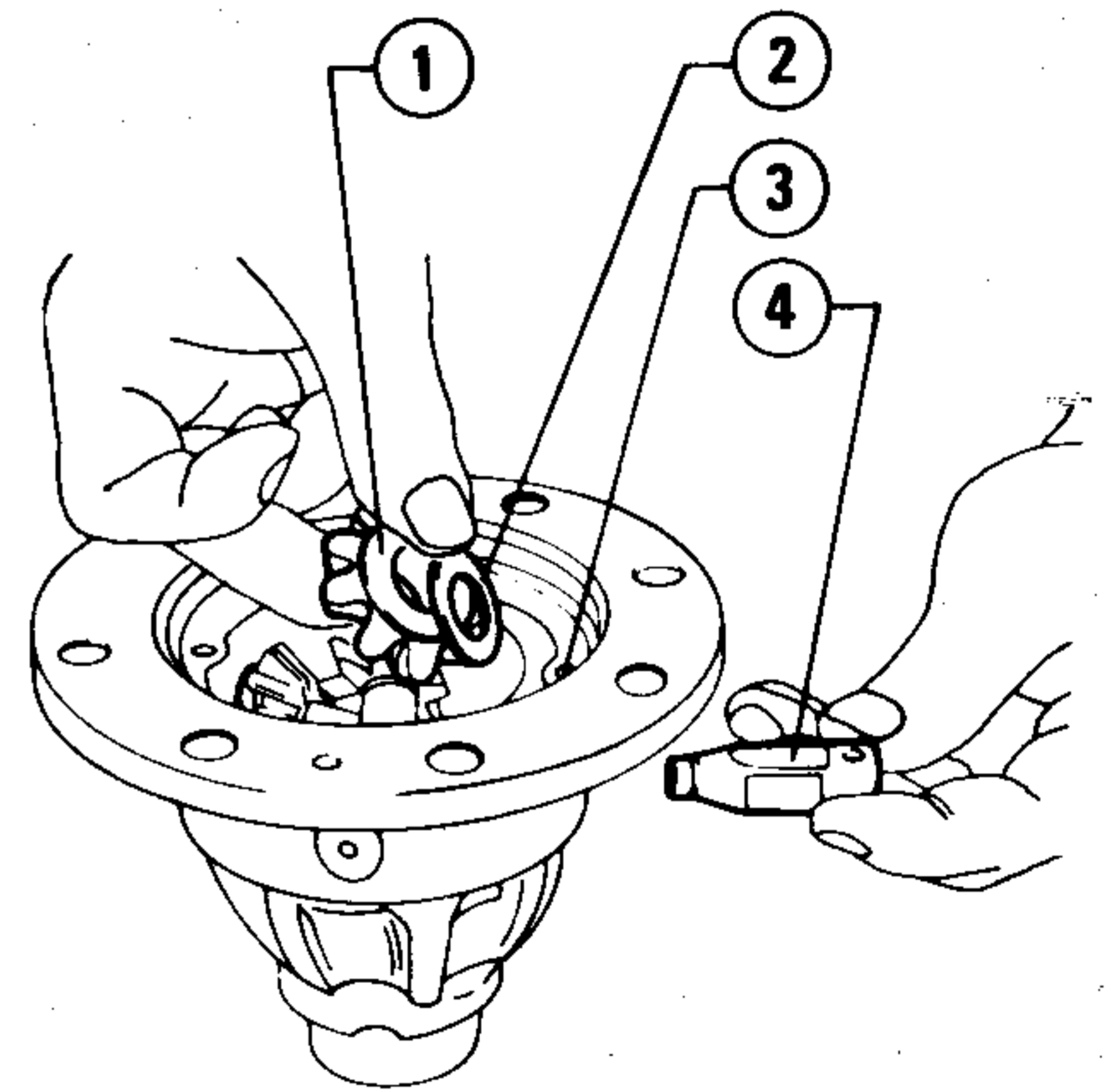
- 1 Differential carrier
- 2 Screw
- 3 Reference notch
- 4 Differential casing cover

b. Separate cover (2) from differential casing, recovering crown wheel gear (3) with related shim ring (4).



- 1 Differential carrier
- 2 Differential casing cover
- 3 Right crown wheel gear
- 4 Shim ring

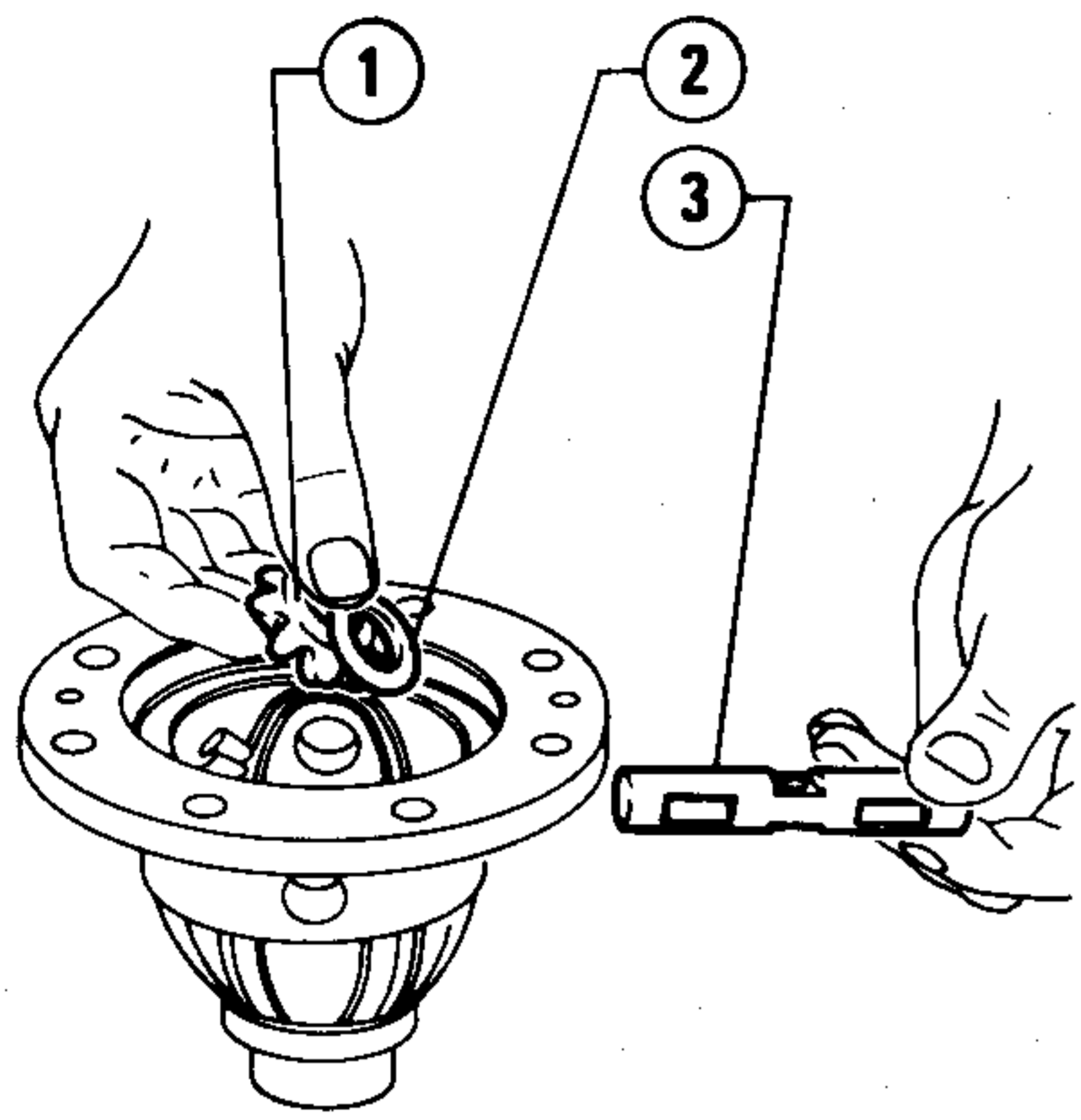
c. Remove the two spring pins securing shafts (4) supporting two of side pinion gears (1); then withdraw shafts and recover side pinions and shim spherical washers (2).



- 1 Side pinion gear
- 2 Spherical washer
- 3 Seat of shaft securing spring pin
- 4 Shaft

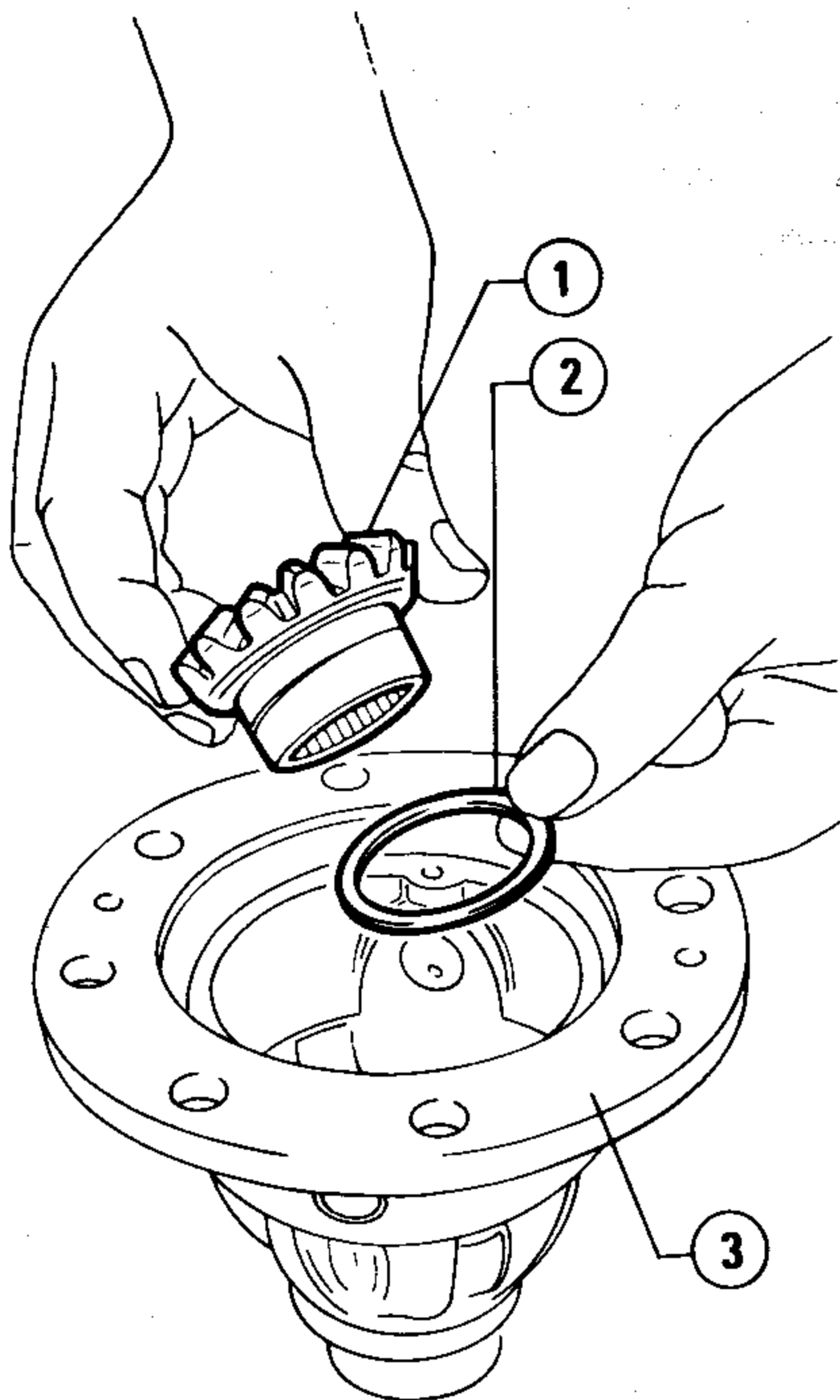
d. Withdraw shaft (3) supporting the other two side pinion gears (1) recover gears and related spherical washers (2).

DIFFERENTIAL AND DRIVE SHAFT UNIT

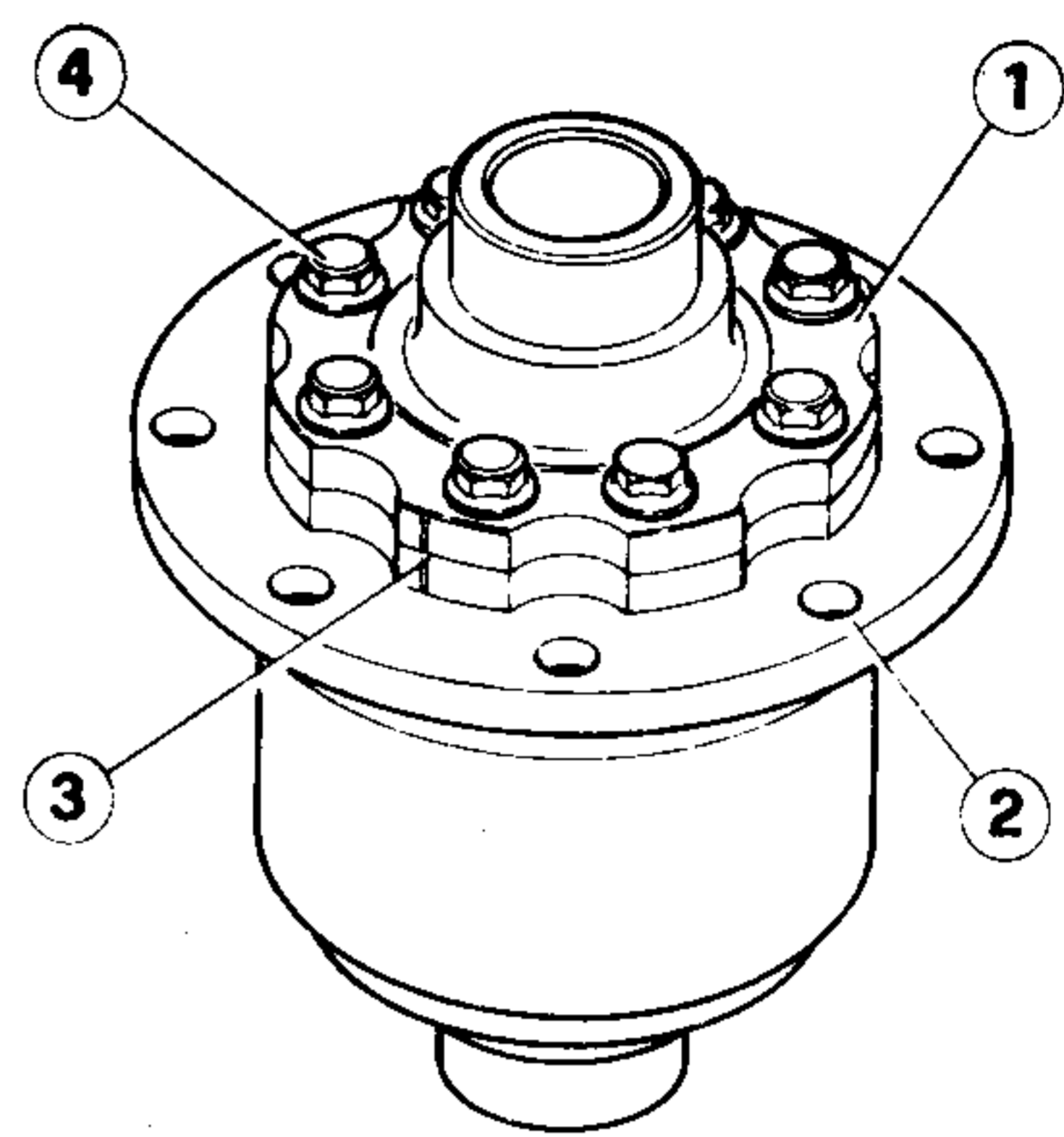


- 1 Side pinion gear
- 2 Spherical washer
- 3 Shaft

e. Withdraw crown wheel gear (1) with related shim ring (2) from differential carrier (3).



- 1 Left crown wheel gear
- 2 Shim ring
- 3 Differential carrier

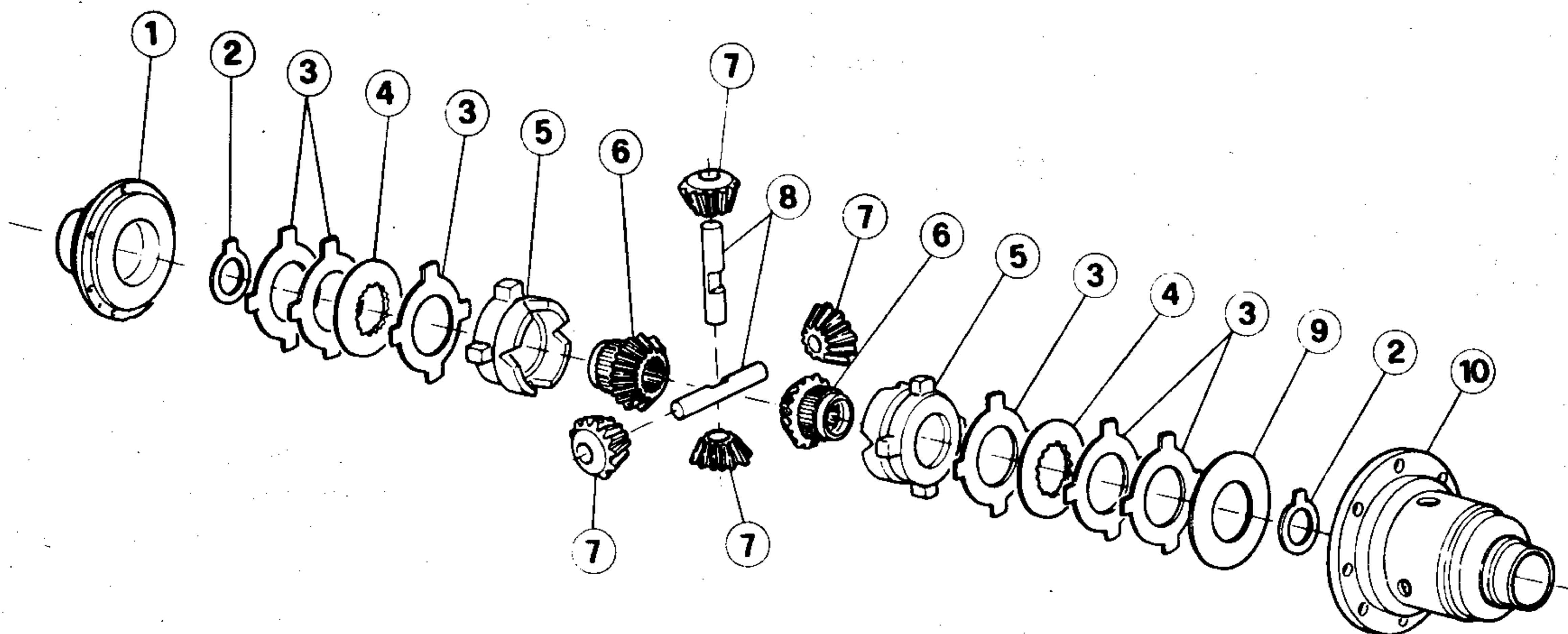


- 1 Cover
- 2 Differential box
- 3 Reference notch
- 4 Screws

b. Remove the cover (1) and withdraw all the components from the differential box (10).

Slip limited - four - side pinion differential

a. Make a reference notch (3) between the differential box (2) and its cover (1), then remove the fixing screws (4).



- 1 Cover
- 2 Shim washer
- 3 External segment
- 4 Internal segment
- 5 Thrust ring
- 6 Crown Wheel
- 7 Side-pinions
- 8 Spider
- 9 Spacer
- 10 Differential box

DIFFERENTIAL AND DRIVE SHAFT UNIT

CHECKS AND INSPECTIONS

Accurately wash all components; then execute the following checks.

a. Accurately examine the differential carrier taper bearings by rotating them slowly; if bearings are in good conditions, no noise shall be heard and no sticking be present.

Examine condition of races related to rolling elements making sure they are free from signs of uneven wear, scratches, grinding due to foreign matter scoring, seizing or overheating.

Replace the faulty elements taking into account that taper bearings must be replaced in pairs.

b. Verify that teeth of gears, side pinions and crown wheels are free from scratches and seizure signs, that they work along the whole surface, and meshing takes place without excessive clearance or sticking.

c. Verify side pinion holder shafts, crown wheel shim rings and spherical washers, checking they are free from scratches or wear signs.

d. Verify that no cracks or splinters are present on differential carrier

e. For slip limited differential only.

In the slip limited unit, check that the slip surfaces between the internal and external segments, the thrust rings, the spacer and the shim washers are not incised, worn or burnt. Verify that the internal segments are able to slip with ease on the crown-gear's toothings. Replace the shim washers and the worn segments. The spider's pins and its thrust cones must not have meshing or incisions.

REASSEMBLY

1. Differential carrier reassembly

Two-side pinion differential

a. Lay a coat of oil on the working surfaces of components to be reassembled.

b. Position crown wheel gears together with the related shim rings of same thickness (removed during disassembly or new) and differential carrier.

c. Insert side pinions with related spherical washers opposite differential carrier crown wheels, rotate gears until holes of side pinions holder shaft mates the seats of the two side pinions, then insert side pinions holder shaft.

d. Verify that clearance "G" between teeth of side pinions and crown wheels gears is within the prescribed values; if not so, change thickness of shim rings.

Clearance between side pinions and crown wheels teeth

$$G = 0.01 \text{ to } 0.11 \text{ mm} \\ (0.00039 \text{ to } 0.00433 \text{ in})$$

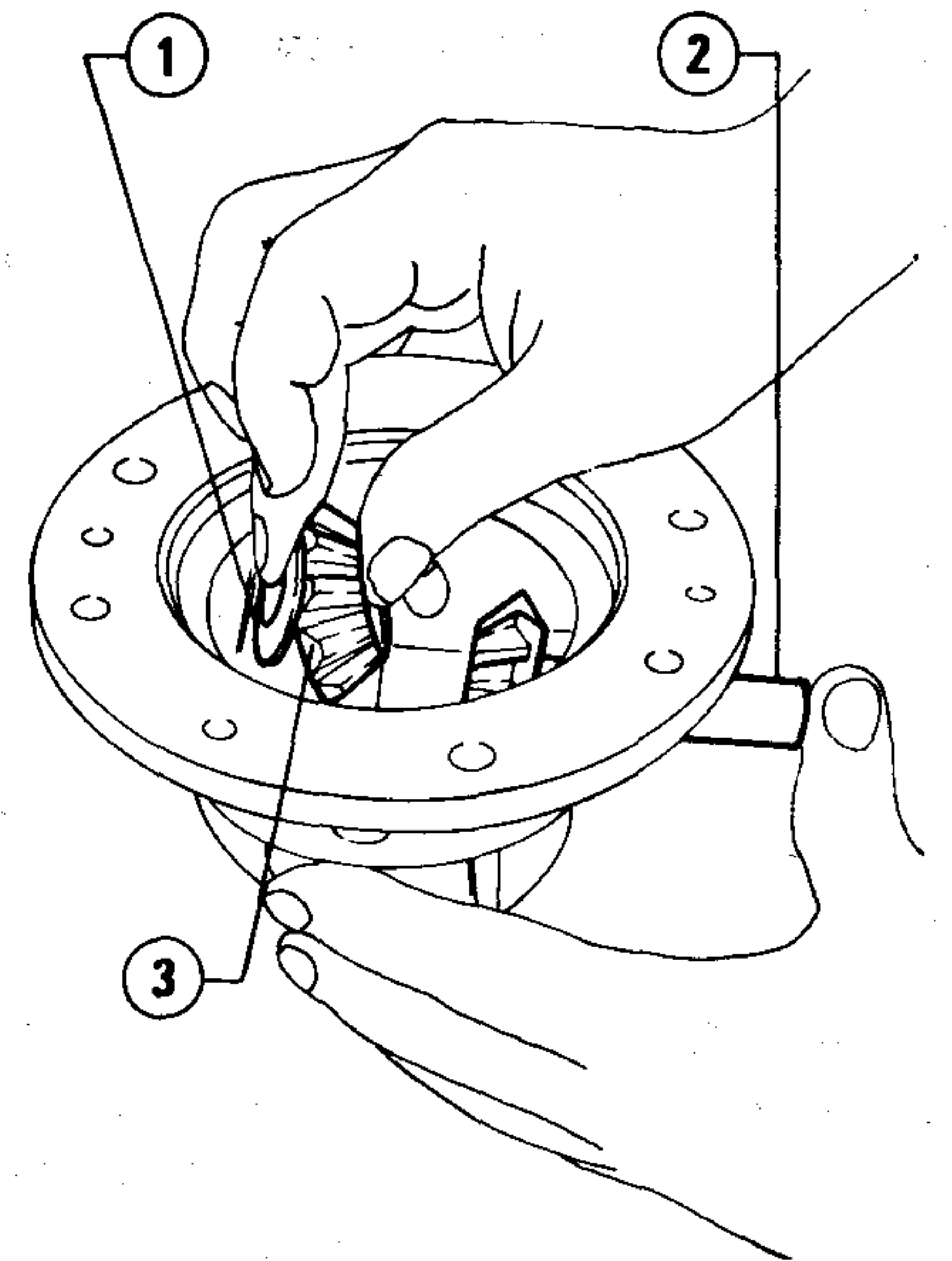
With differential carrier mounted, a certain resistance to gears rotation must take place.

Four-side pinion differential

a. Lay a coat of oil on the working surfaces of components to be reassembled.

b. Position the left crown wheel gear with the related shim ring of same thickness (removed during disassembly or new) into differential carrier.

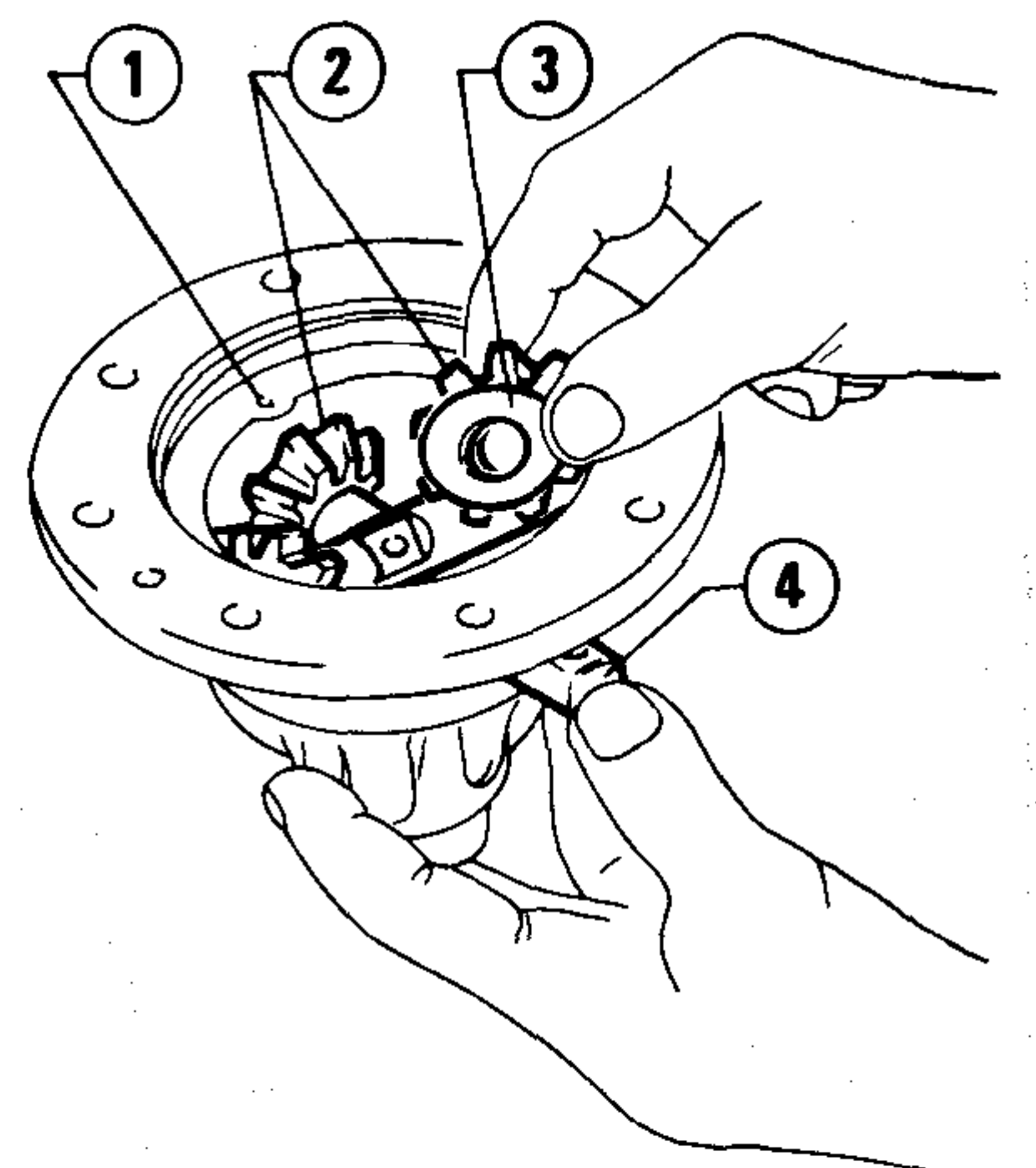
c. Insert shaft (2) and two side pinion gears (3) complete with the related spherical washers (1).



- 1 Spherical washer
- 2 Shaft
- 3 Side pinion gear

d. Install shafts (4) with the remaining side pinion gears (2) and the related spherical washers (3), taking care to insert shaft pin into central hole of side pinions holder shaft previously installed.

In addition, verify that seats (1) of shafts spring pins are aligned with those of differential carrier.



- 1 Spring pin seat
- 2 Side pinion gears
- 3 Spherical washer
- 4 Shaft

DIFFERENTIAL AND DRIVE SHAFT UNIT

e. Verify that clearance "G" between teeth of side pinions and crown wheel gears is within the prescribed values; if not so, replace shim ring of crown wheel gear.

Clearance between teeth of side pinions and crown wheel

$$G = 0.08 \text{ to } 0.15 \text{ mm}$$

$$(0.003 \text{ to } 0.0059 \text{ in})$$

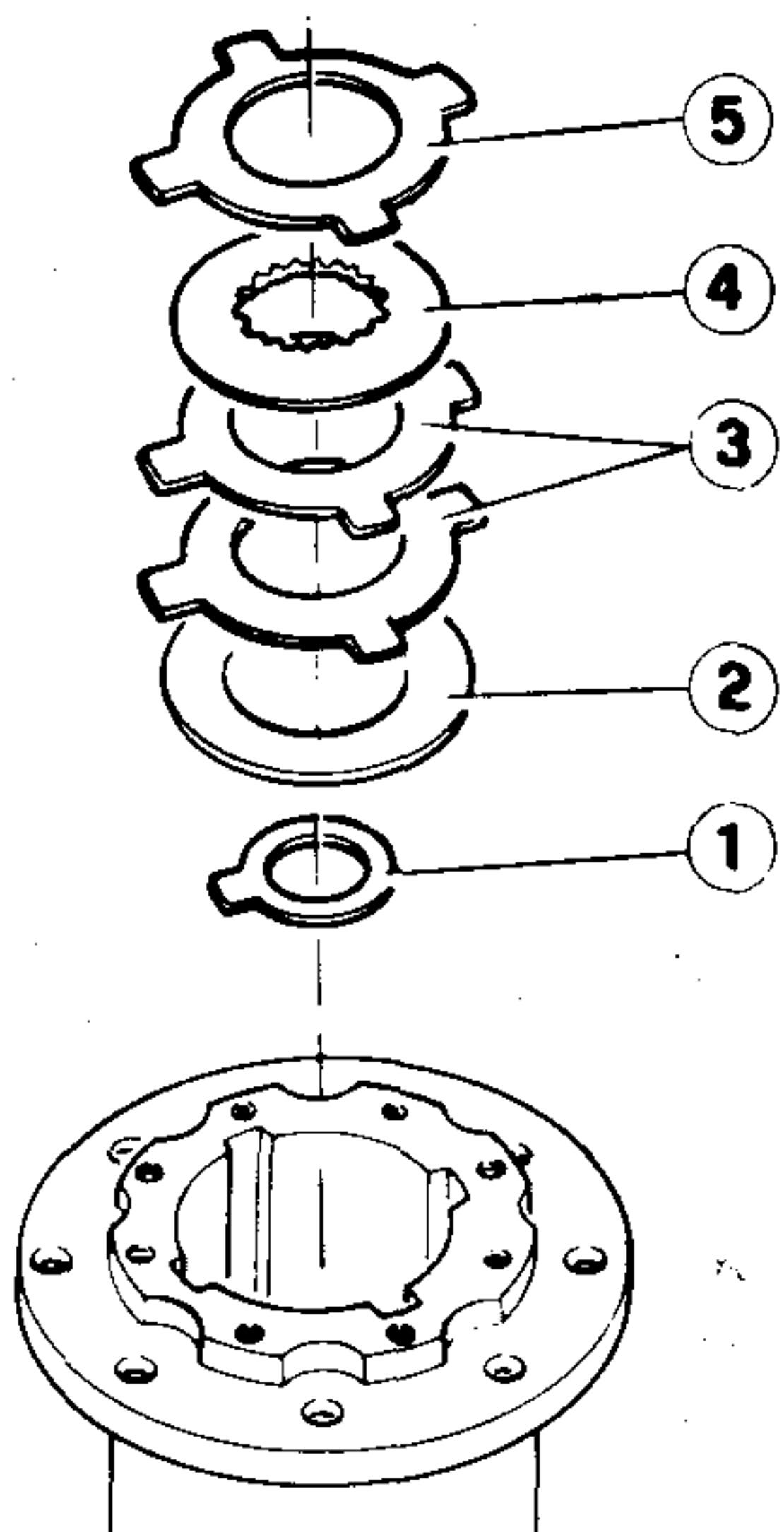
f. Once carried out clearance check and the possible adjustments, refit spring pins securing side pinions shafts.

g. Install the remaining crown wheel gear and the related shim ring into differential carrier cover, then install cover on differential carrier securing it with the related screws, complying with the positioning notch performed during disassembly.

h. Once carried out the differential carrier reassembly, make sure that gears rotation occurs with a certain resistance but without stickings. In the event of incorrect functioning, replace the last shim ring mounted.

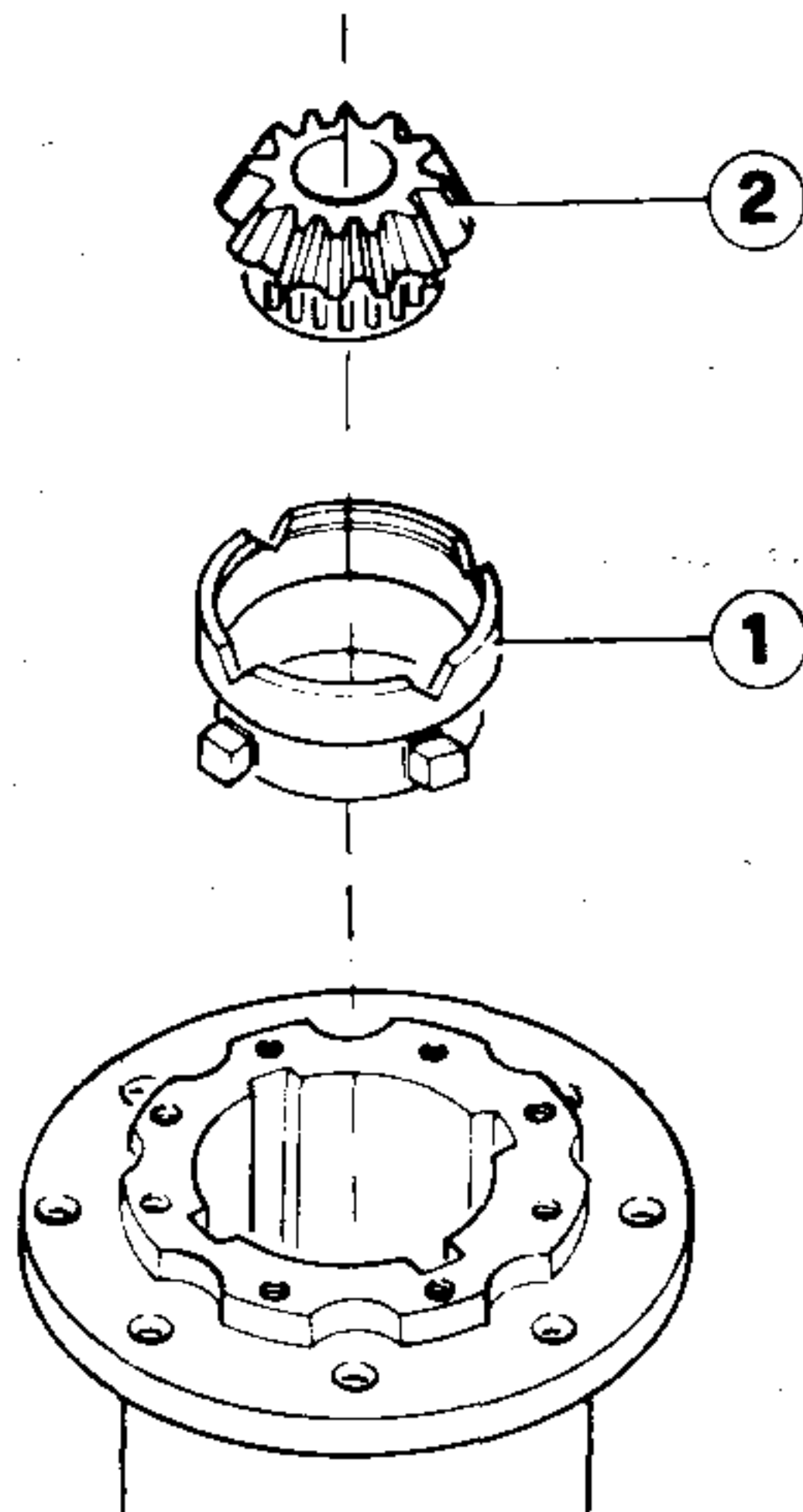
Slip limited - four - side pinion differential

a. Insert the shim ring (1) into the differential box, with the wrought metal surface towards the crown-wheel unit; subsequently insert the spacer (2), the two external segments (3), the internal segment (4) and the external segment (5).



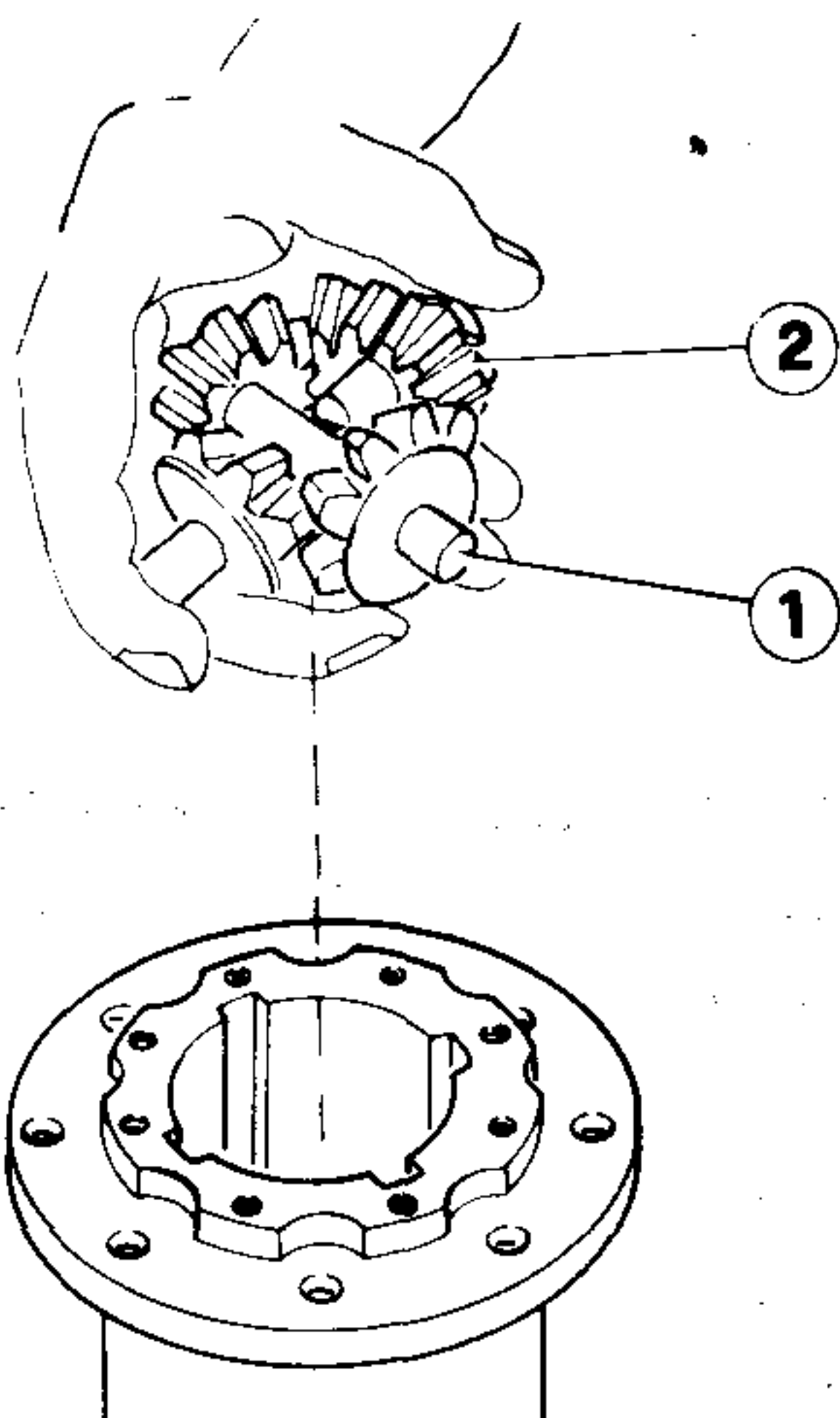
- 1 Shim washer
- 2 Spacer
- 3 External segments
- 4 Internal segment
- 5 External segment

b. Insert the thrust ring (1) and the crown-wheel (2).



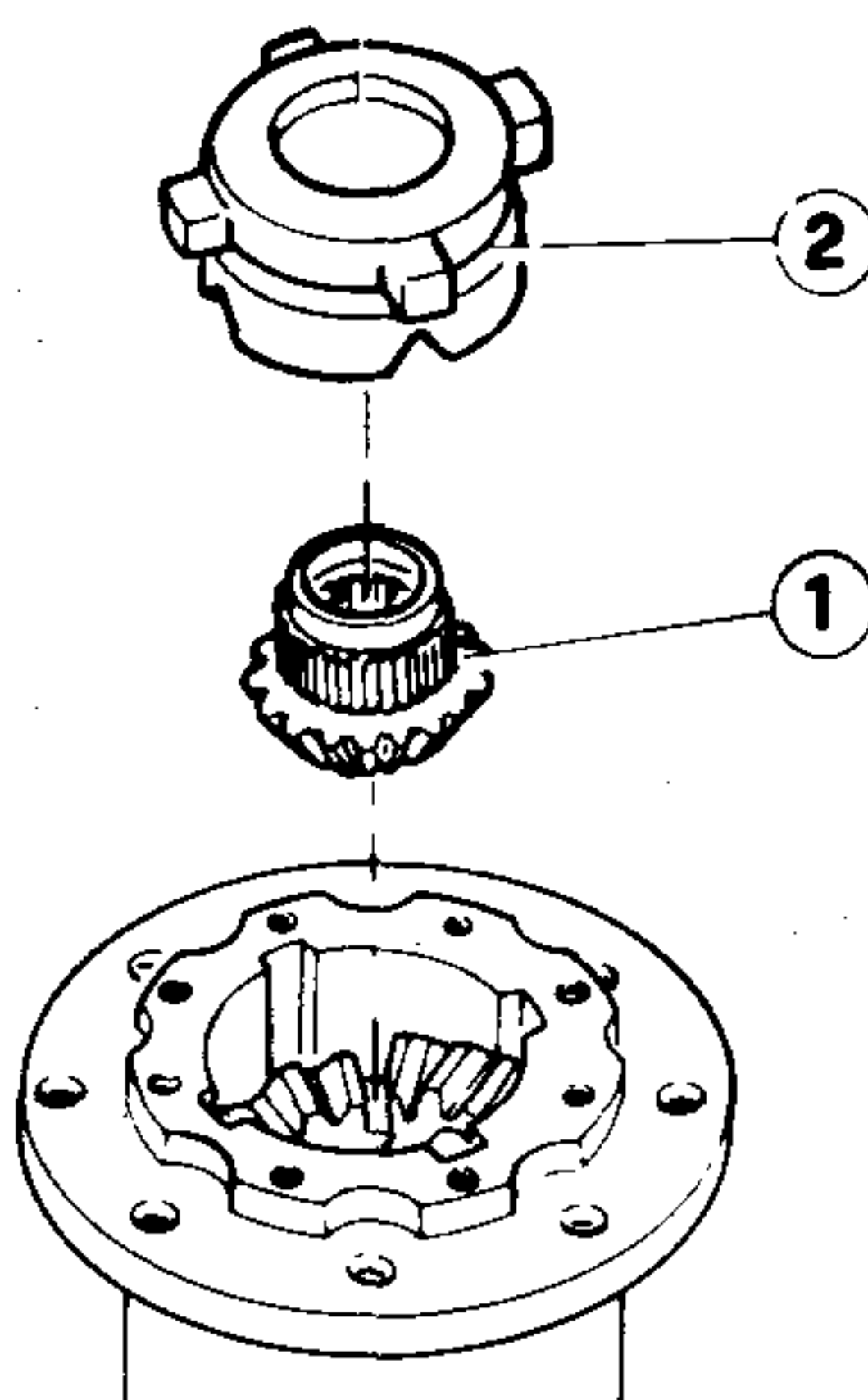
- 1 Thrust ring
- 2 Crown Wheel

c. Insert the side-pinions (2) with the spider (1).



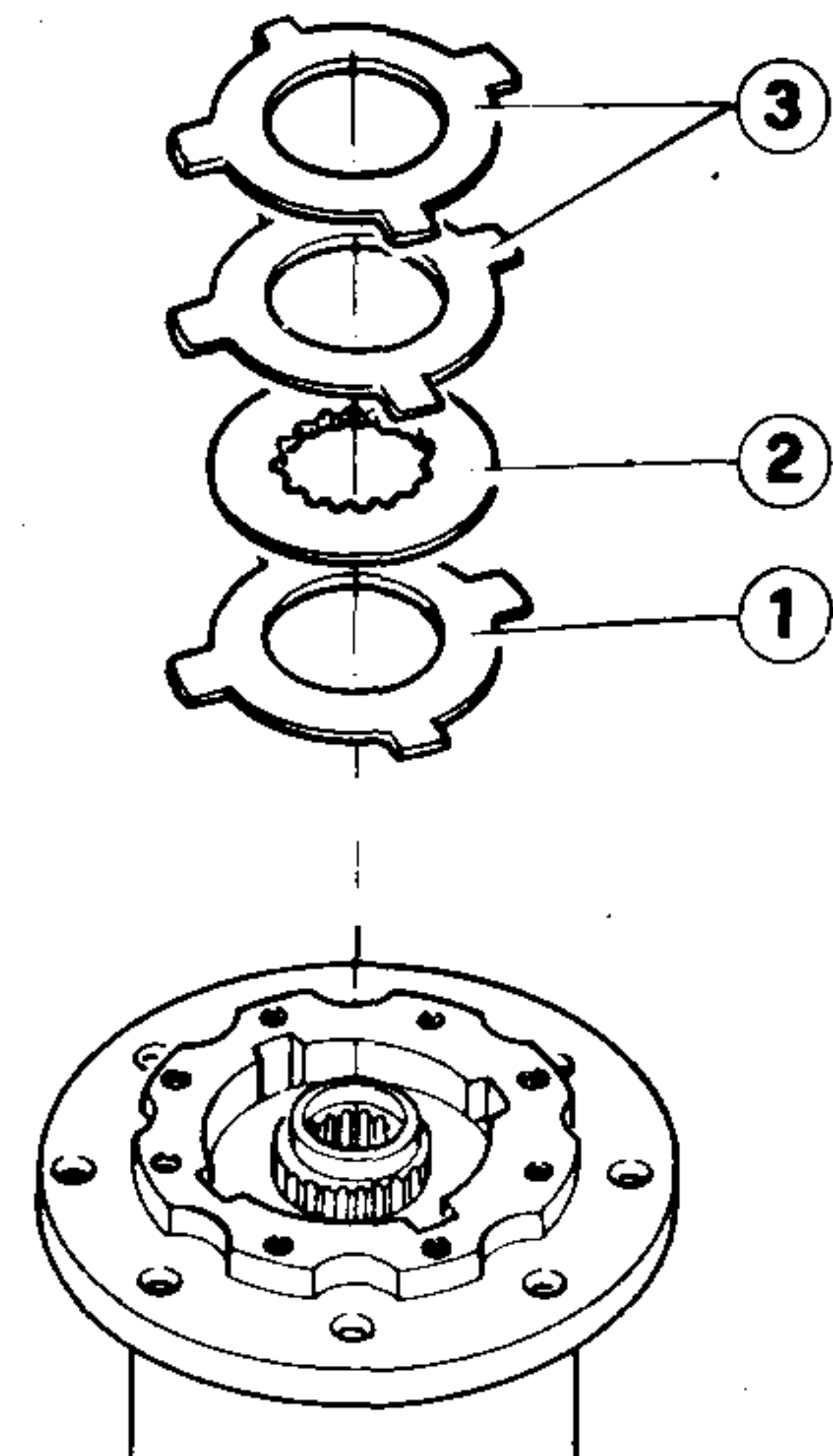
- 1 Spider
- 2 Side-pinions

d. Insert the crown-wheel (1) and the thrust ring (2).



- 1 Crown Wheel
- 2 Thrust ring

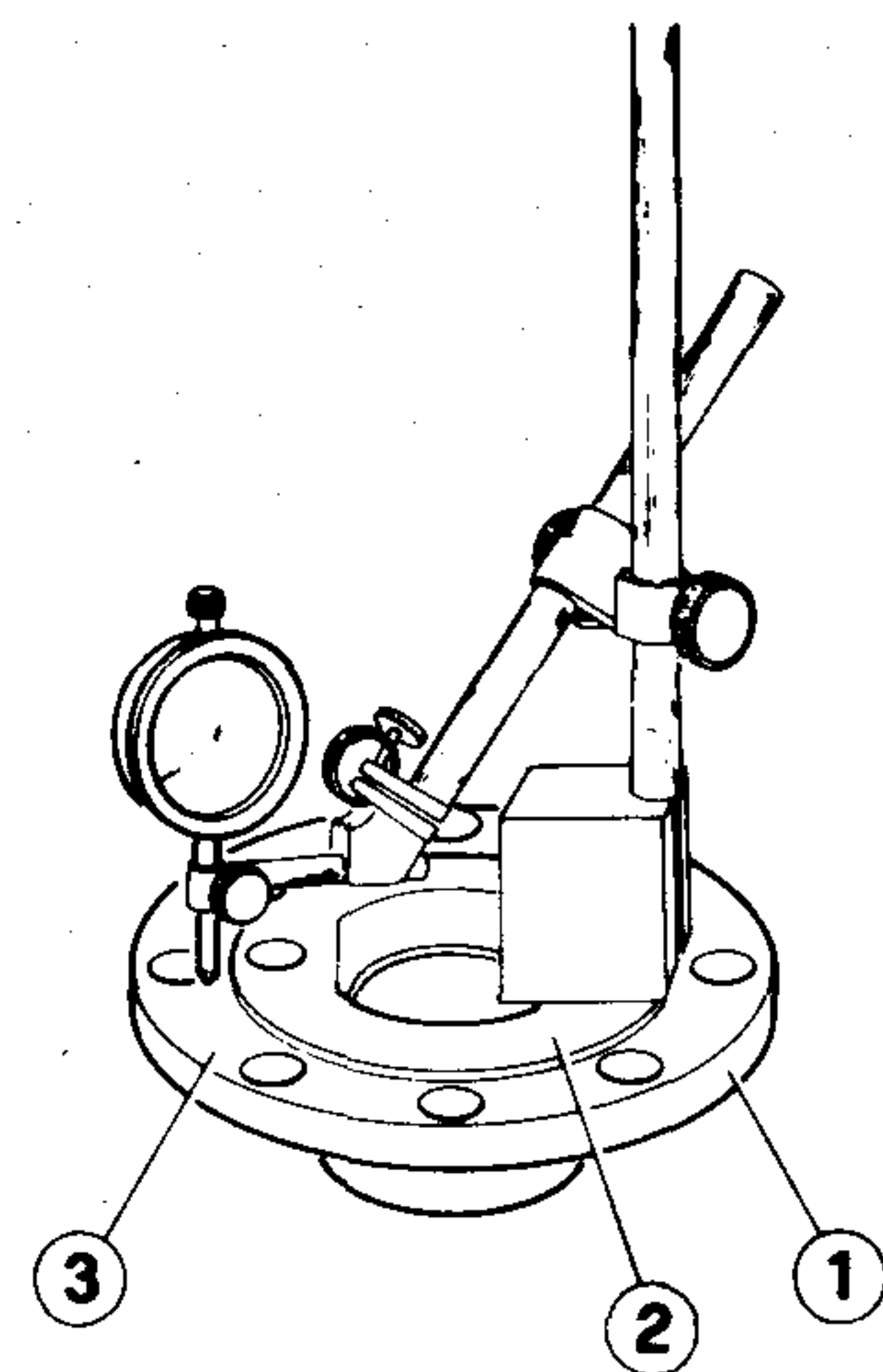
e. Insert the external segment (1), the internal segment (2) and the two external segments (3).



- 1 External segment
- 2 Internal segment
- 3 External segments

f. Check the clearance between the cover and the group of segments.

- Rest the supporting base of a (suitably preloaded) dial gauge on the contact surface (2) between cover (1) and segment pack, by operating on the cover of the limited slip differential carrier; zero set the dial gauge on the mating surface (3) between cover and carrier.



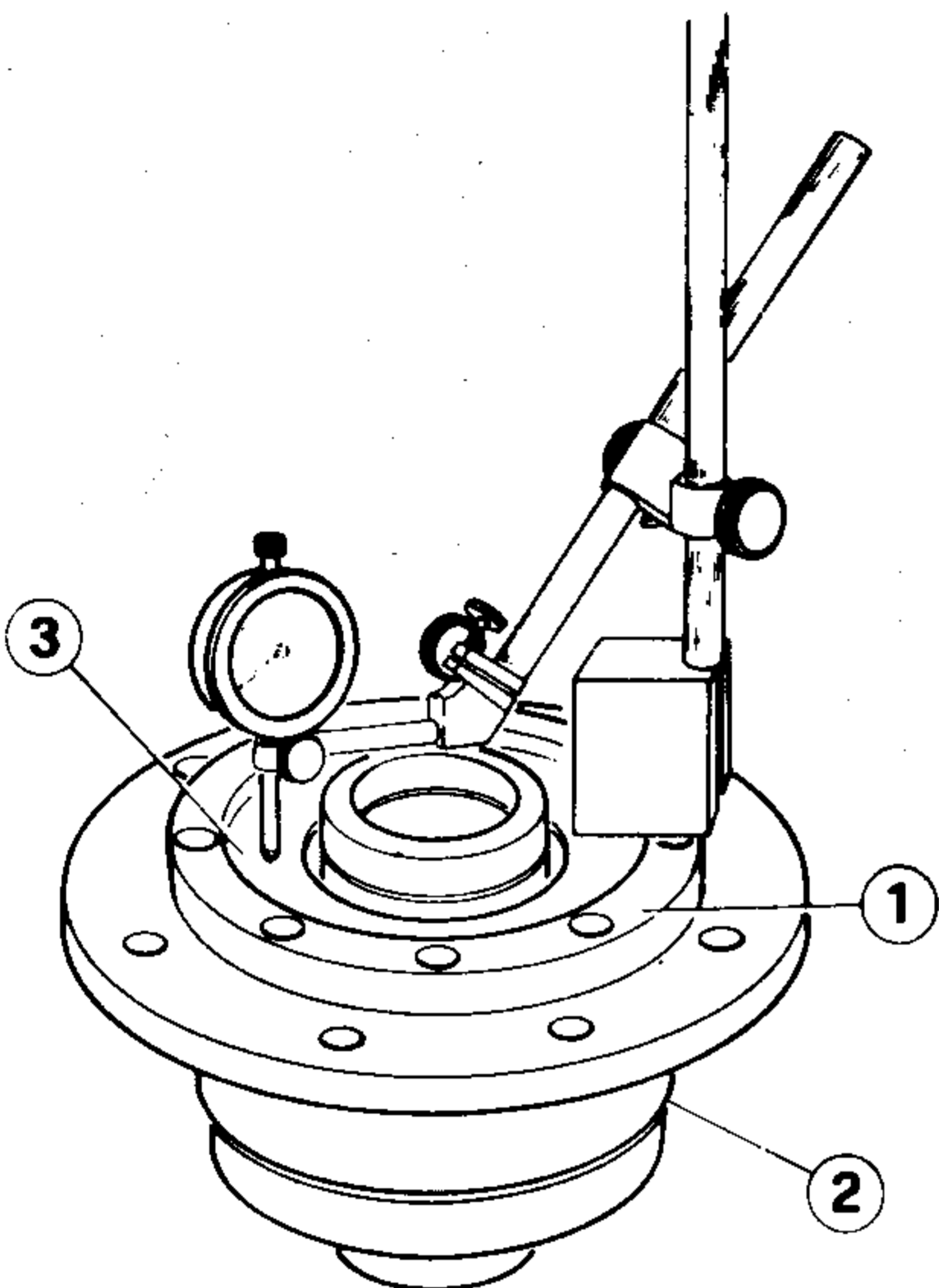
- 1 Cover
- 2 Cover-segment pack contact surface
- 3 Cover-carrier mating surface

DIFFERENTIAL AND DRIVE SHAFT UNIT

- Position the gauge supporting base on the mating surface ① between carrier ② and cover by operating on the limited slip differential carrier; have the gauge feeler contacting segment pack ③.

NOTE:

Apply a load of 10 Kg (22 lb) to the segment pack.



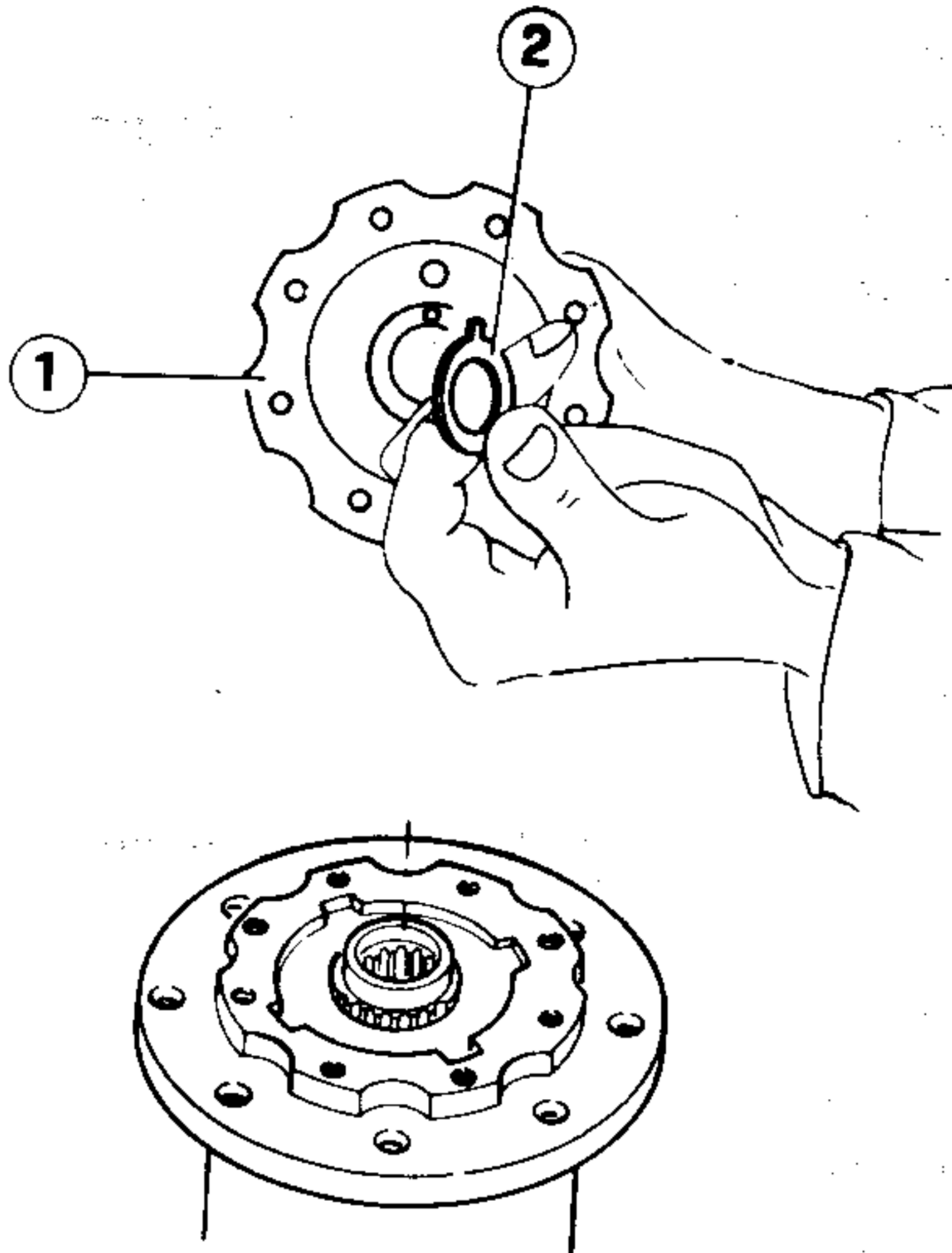
- 1 Carrier-cover mating surface
- 2 Carrier
- 3 Segment pack

- Read the value, with negative sign, of clearance G: it must be within the specified values.

Fitment clearance between cover and segment pack:

$$G = 0.1 \text{ thru } 0.2 \text{ mm} \\ (0.004 \text{ thru } 0.008 \text{ in})$$

- g. Install the shim ring ② on the cover ① with its wrought metal surface towards the crown-wheel gear. Mount the cover on the differential box aligning the reference notch previously made, and fasten the fixing screws.



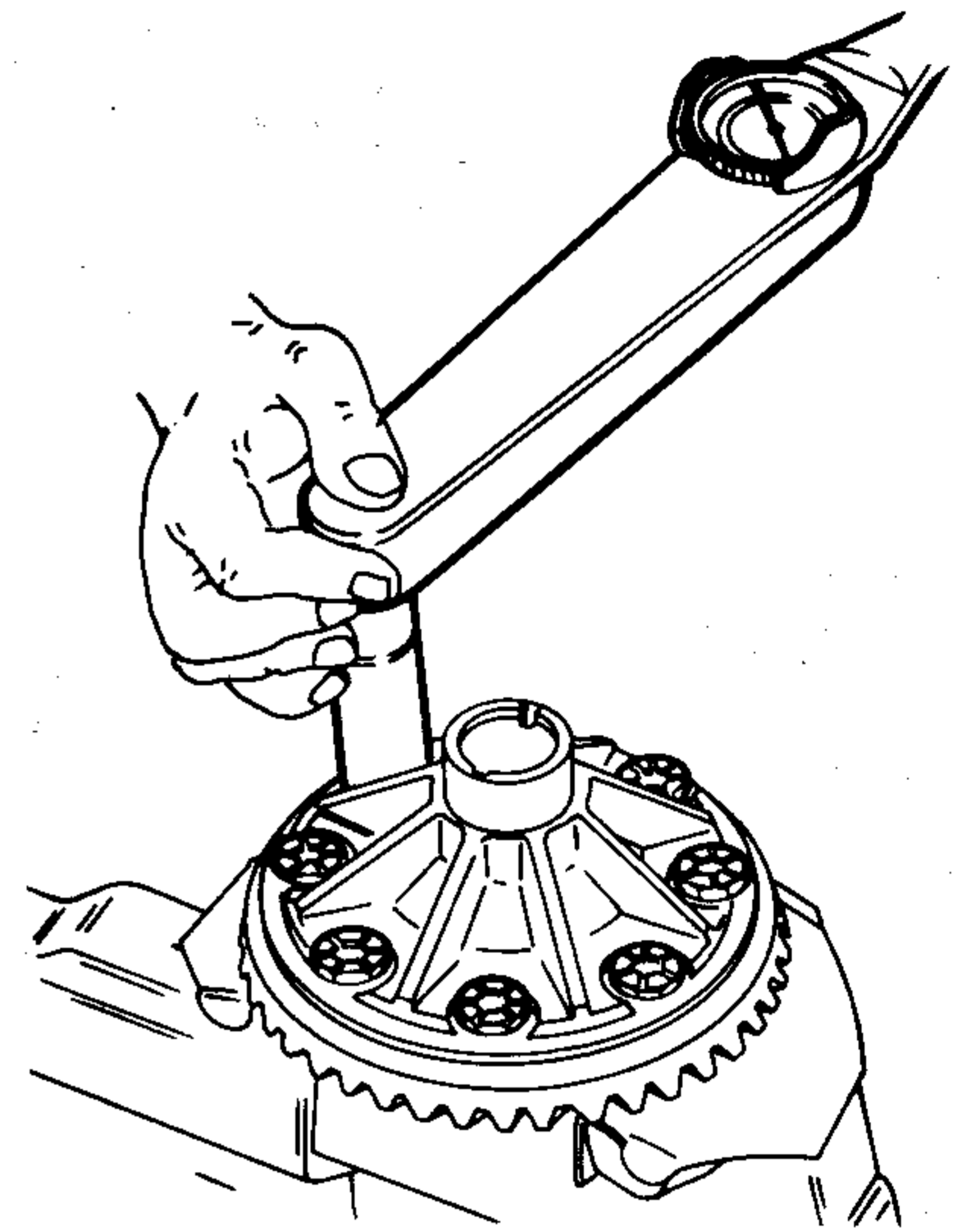
- 1 Cover
- 2 Shim ring

2. Ring bevel gear and taper bearings reassembly on differential carrier

- a. Install ring bevel gear on differential carrier after carefully cleaning the mating surfaces. Should the ring bevel gear be reused, comply with the reference notches carried out during disassembly.

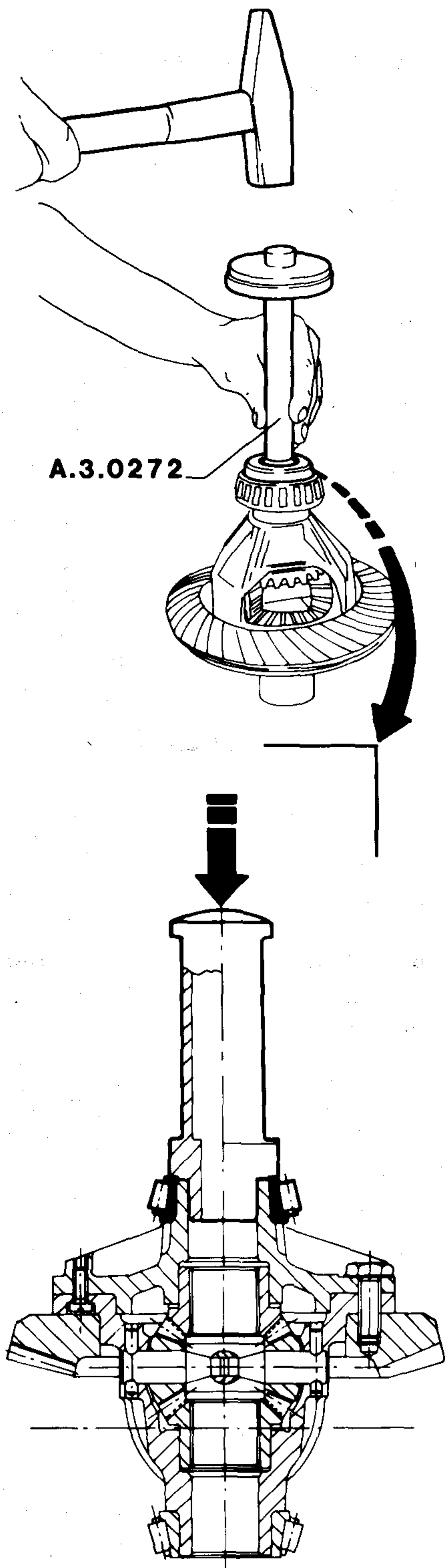
Replace the securing screws with spare ones since the presence is required of the fixing agent applied on screws on first installation. Tighten them, crosswise, to the prescribed torque.

- Ⓣ: Tightening torque
Screws securing ring bevel gear to differential carrier (in oil)
67 to 74 N·m
(6.8 to 7.5 Kg·m
49.2 to 54.2 ft·lb)



- b. By means of tool A.3.0272, fit taper bearing internal rings on differential carrier hubs.

DIFFERENTIAL AND DRIVE SHAFT UNIT



All this, particularly valid when only the crown wheel and pinion is to be replaced, can be integrated by using dummy rods **A.2.0267** to be inserted at the same time of gear selector rods removal, so as to secure interlock plungers and detent balls.

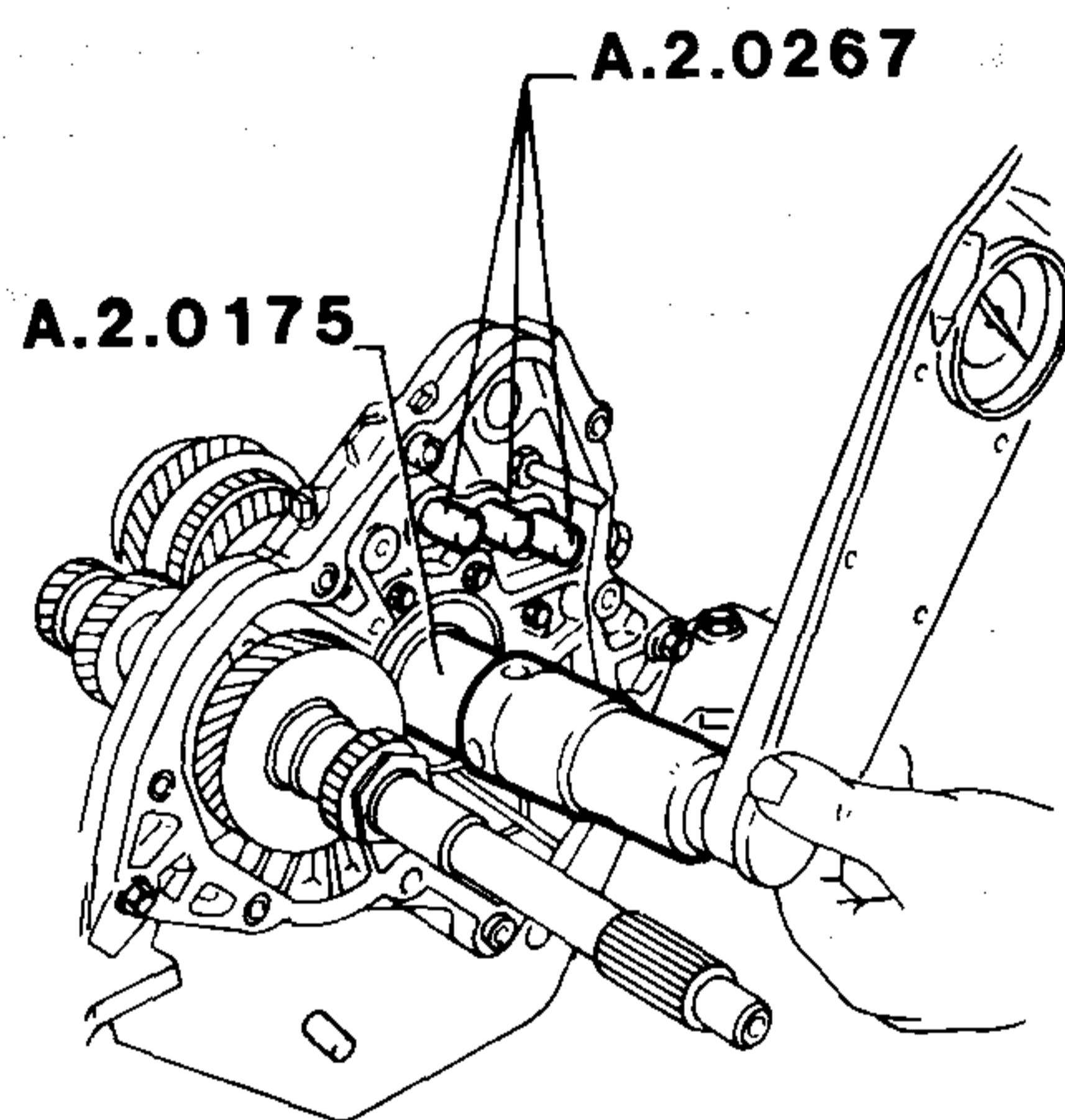
a. Set intermediate flange (complete with gearing and speed control devices) on an overhaul stand, then remove the following items:

- Rods and Forks (refer to Group 13- "Overhaul at Bench of Speed Gear Unit - Rods and Forks - Disassembly") taking care to make use of dummy rods **A.2.0267**.
- Pinion shaft securing nut, after removing the related calking
- Gear package composing reverse and 5th. speeds.

b. Install the following items on pinion shaft:

- Spacer **A.2.0175**.
- Pinion shaft nut, tightening it to the prescribed torque after engaging two speeds.

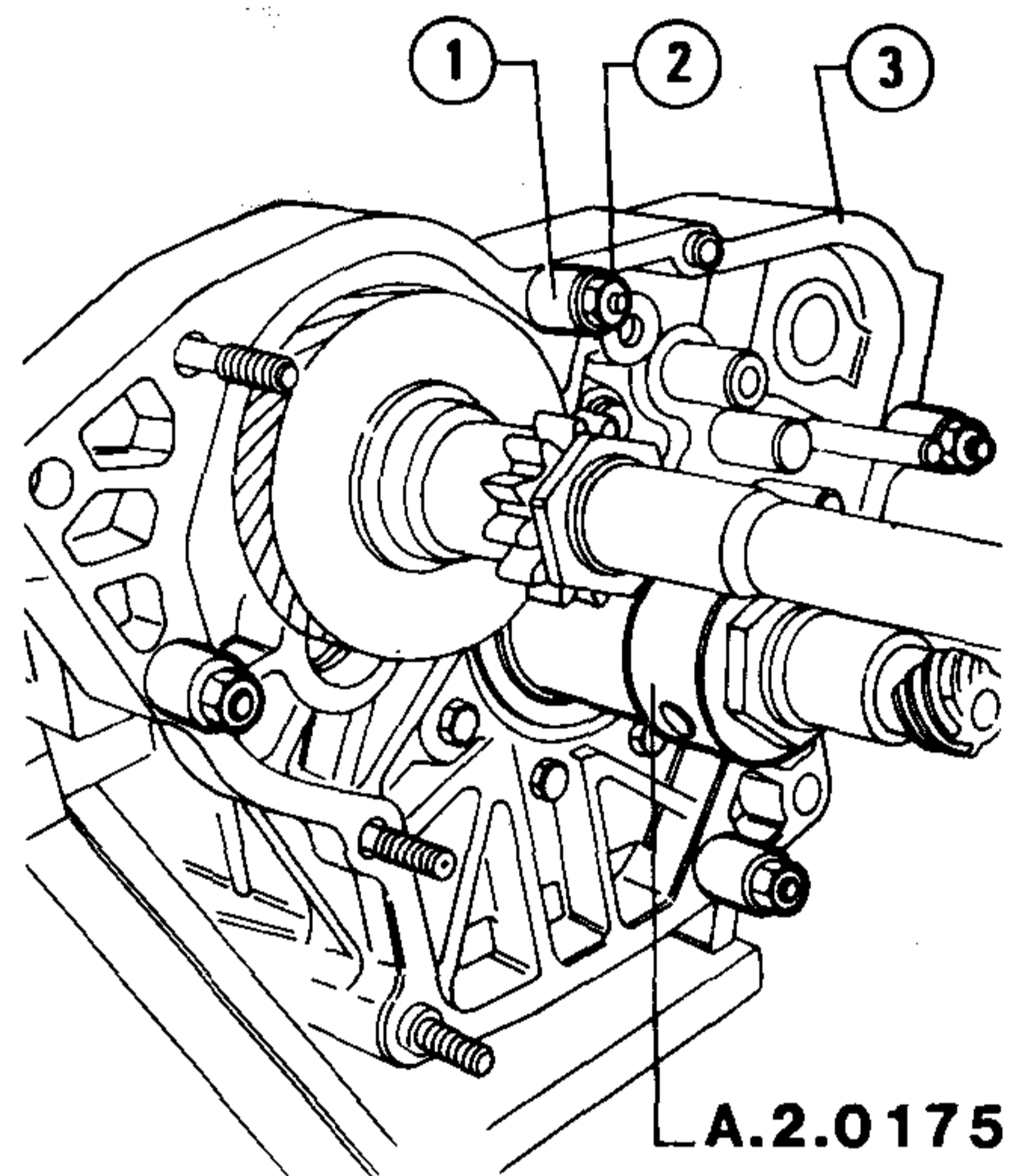
T: Tightening torque
Pinion shaft securing nut
 112 to 124 N·m
 (11.4 to 12.6 kg·m
 82.4 to 91.1 ft·lb)



c. Remove intermediate flange from overhaul stand and insert it on differential-speed gear casing. Apply spacers **1** in four points of intermediate flange **3** and secure it by tightening nuts **2** crosswise to the prescribed torque.

T: Tightening torque
Nuts securing spacers and intermediate flange to differential-speed gear casing.

112 to 124 N·m
 (11.4 to 12.6 kg·m
 82.4 to 91.1 ft·lb)



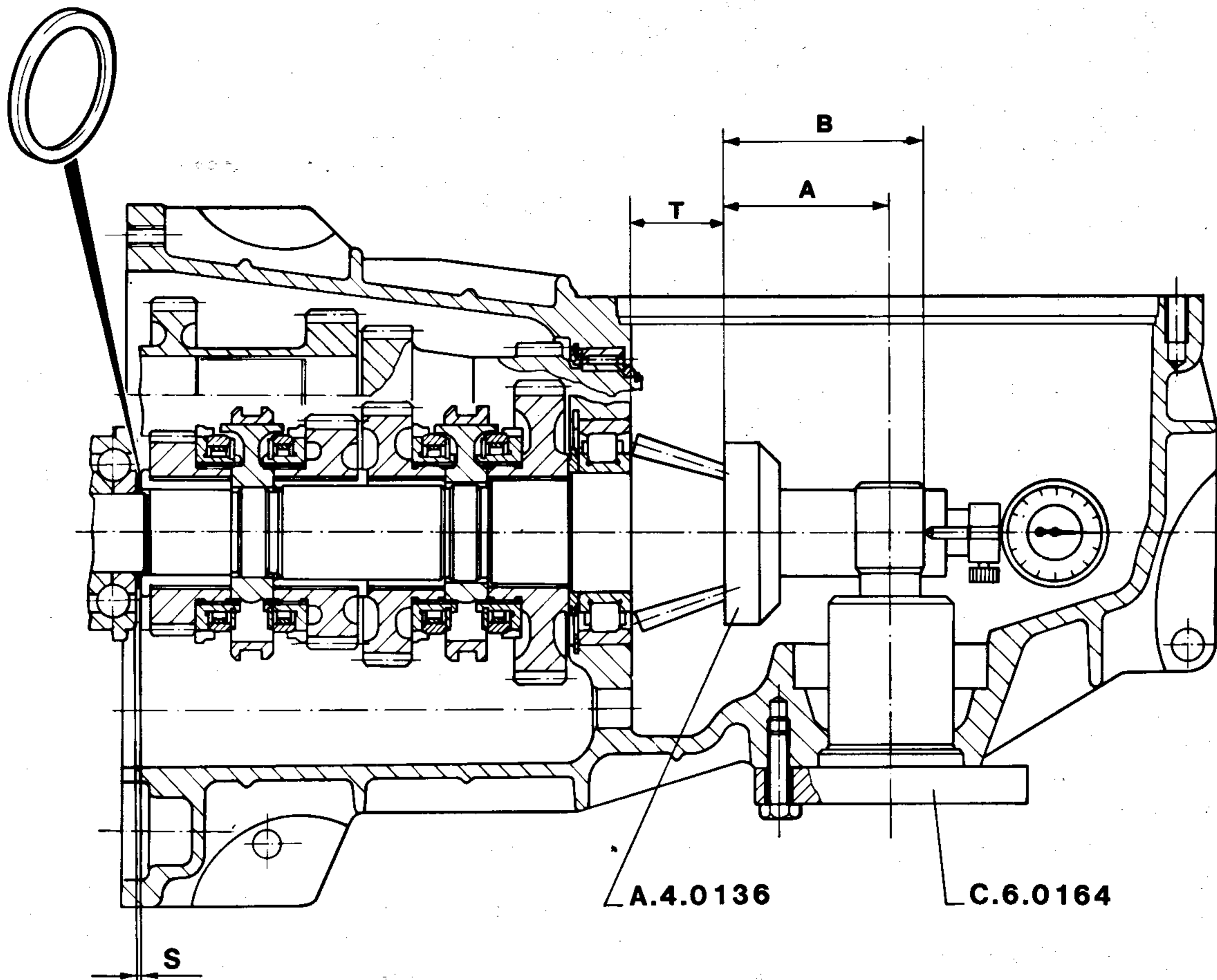
- 1 Spacer
- 2 Spacer securing nut
- 3 Speed gear intermediate flange

3. Preparation of speed gear intermediate flange

To ease the adjustment operations, use is recommended of spacer **A.2.0175** in the place of the 5th and reverse speeds gear package.

DIFFERENTIAL AND DRIVE SHAFT UNIT

4. Adjustment of distance between pinion and ring bevel gear axis.



A = Nominal distance between pinion and ring bevel gear axis

| | |
|---|--|
| { | 56.5 ± 0.03 mm (2.2244 ± 0.0012 in) for models with pinion head height T = 42 mm (1.65 in) |
| | 62.6 - 0.03 mm (2.4646 ± 0.0012 in) for models with pinion head height T = 36 mm (1.42 in) |

The real distance between pinion and ring bevel gear axis must be equal to the nominal value plus or minus the value indicated on pinion head.

B = nominal distance between pinion head and external generatrix of tool control pin

S = ± L - (± C) where:

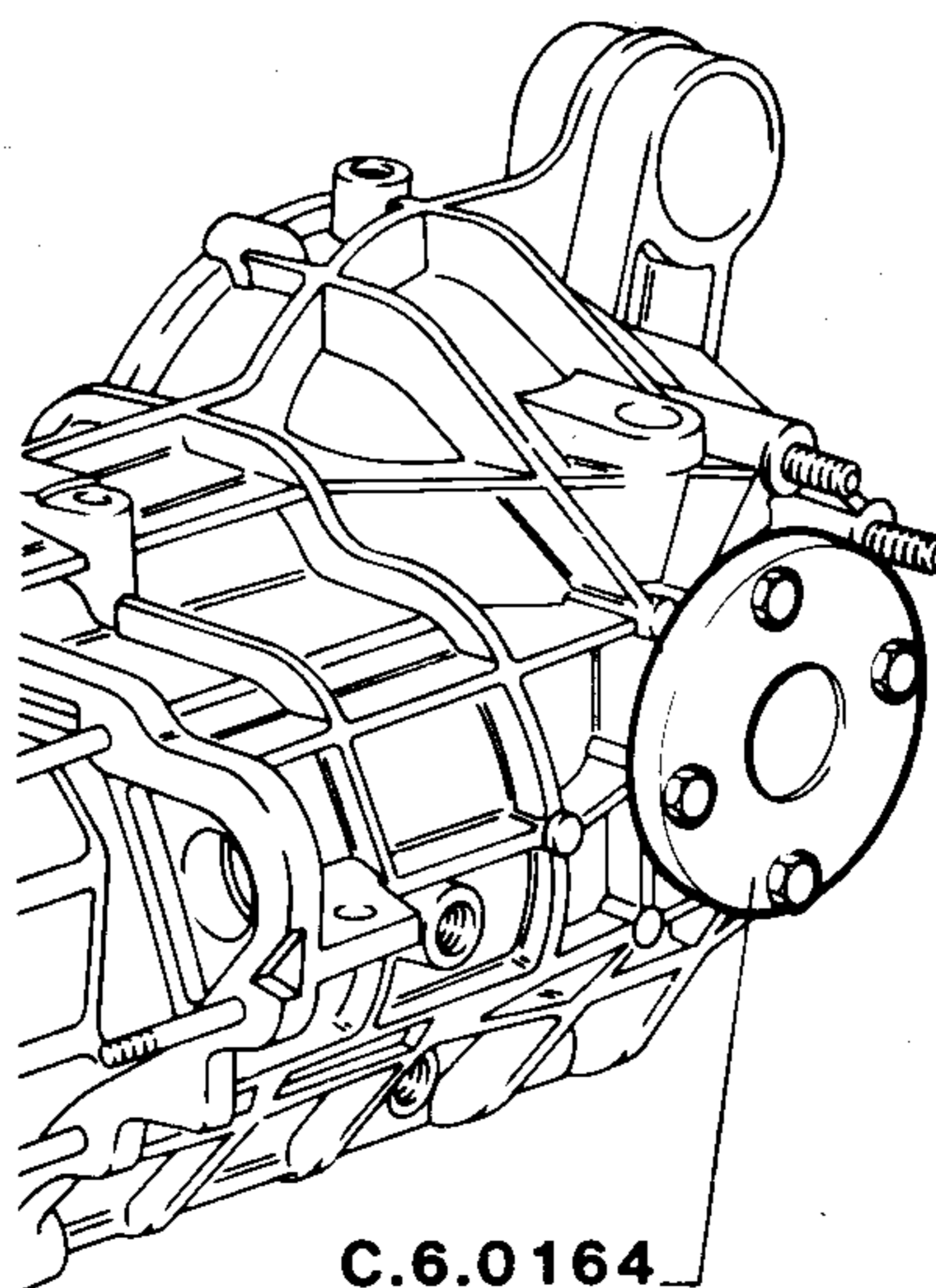
S = Shim thickness

L = Value of ring bevel gear axis deviation measured with centesimal gauge

C = value printed on pinion head

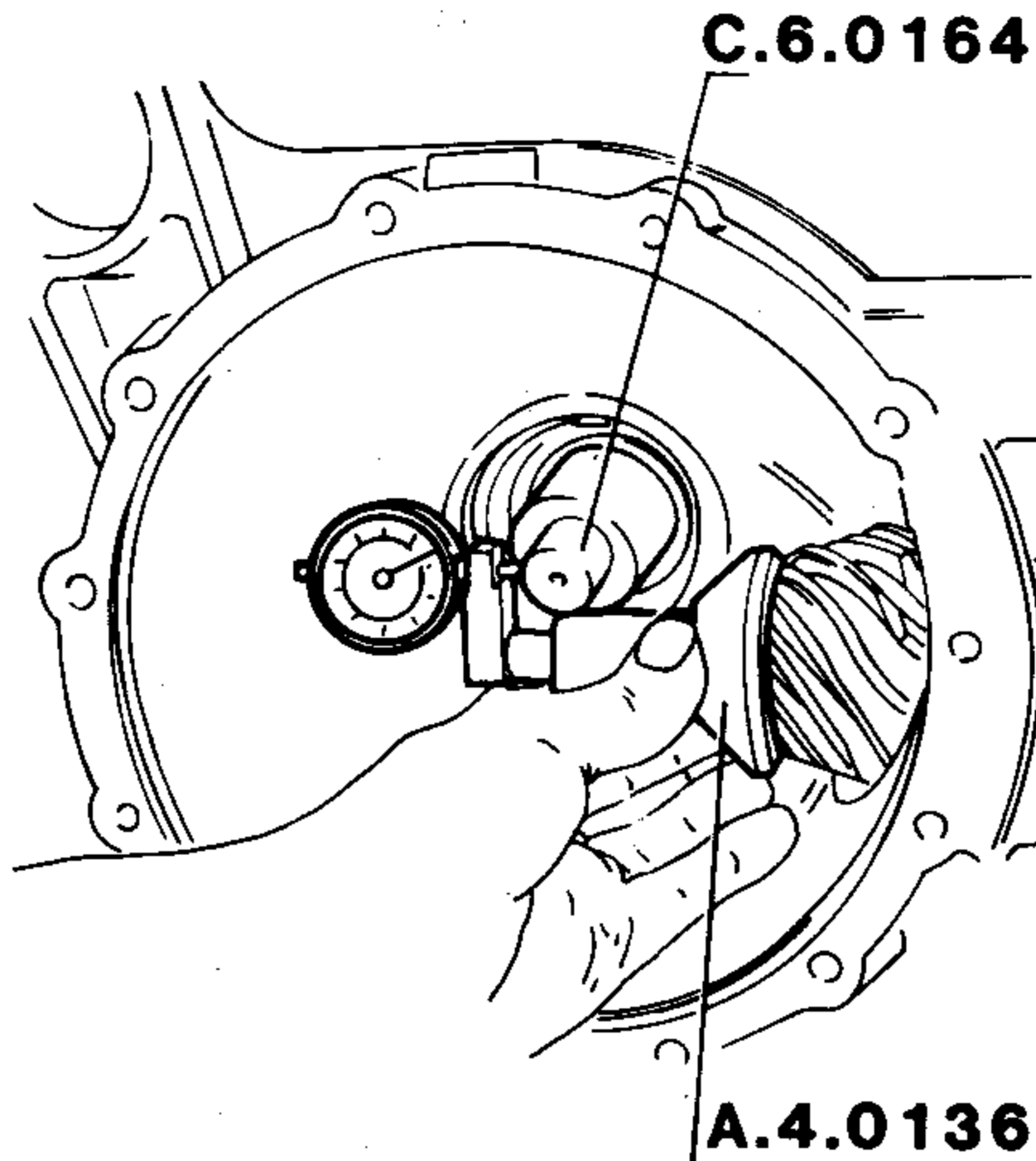
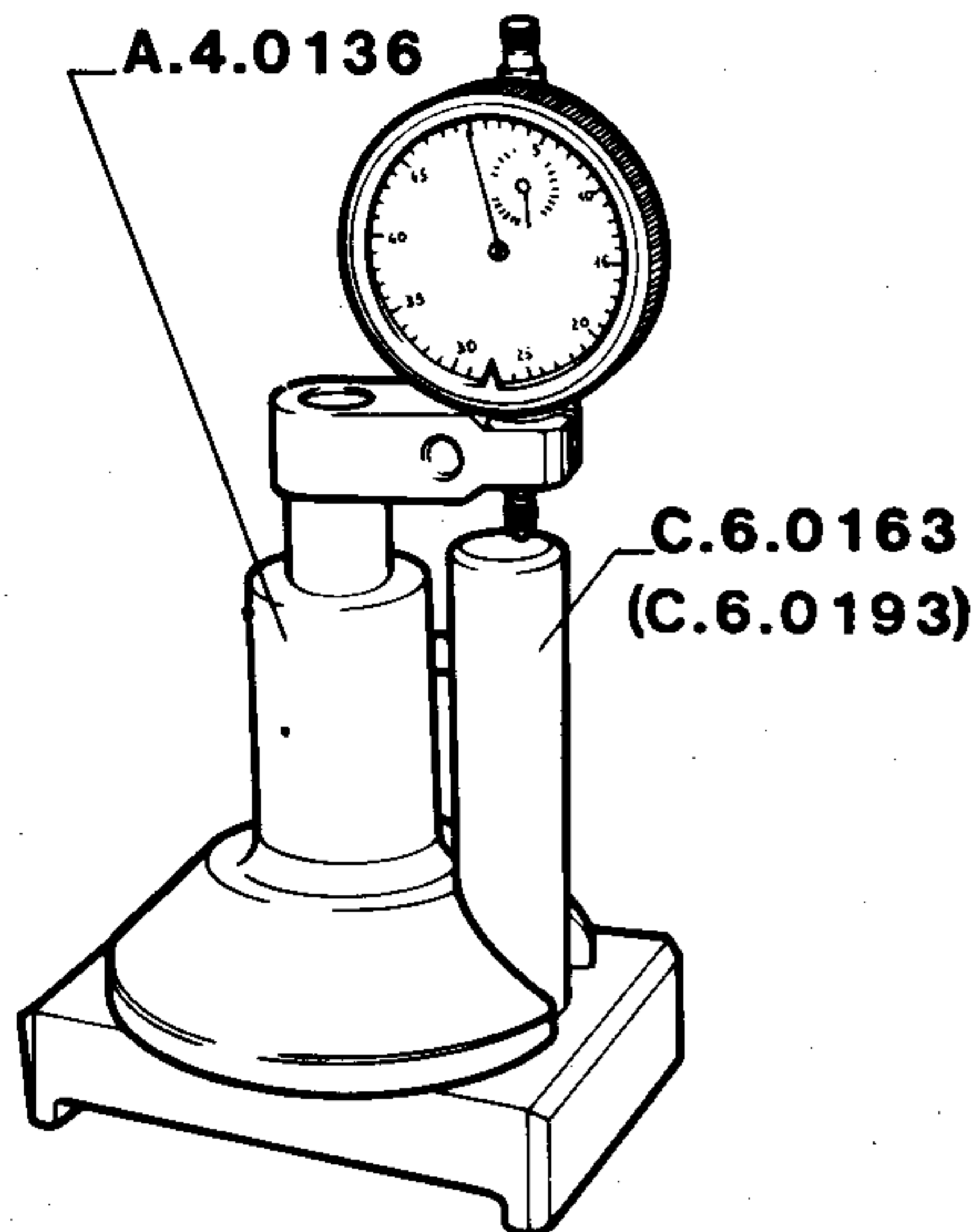
Comply with the following procedure to determine the distance between pinion and ring bevel gear axis, i.e. the thickness of shim ring to be interposed between 4th speed gear and intermediate flange.

a. For the ring bevel gear axis reference, mount tool **C.6.0164** on outer box (seat of differential taper bearing outer ring).



b. Install a centesimal gauge on support **A.4.0136** and zero it to the nominal value on reference gauge **C.6.0163** (pinion head height T = 42 mm (1.65 in)) or **C.6.0193** (pinion head height T = 36 mm (1.42 in))

DIFFERENTIAL AND DRIVE SHAFT UNIT



c. Read the "C" dimension, positive or negative, marked on pinion head.

d. Rest support A.4.0136 with comparator on pinion head and read on instrument the "L" deviation, positive or negative with respect to dimension "B" (nominal distance between pinion head and pin external generatrix of tool C.6.0164 for the ring bevel gear axis reference).

This reading, shall correspond in both value and sign to the dimension marked on pinion head

e. If this condition does not occur, set pinion to the installation correct position varying shim "S" located on pinion shaft between intermediate bearing race and 4th speed gear bush.

To determine the required "S" shim, execute the following calculation.

$$S = \pm L - (\pm C)$$

- Add shims to move pinion closer to ring bevel gear axis
- Remove shims to move pinion away from ring bevel gear axis.

f. Select the shim nearest to the value determined, within the spare shims range.

Example:

$$\begin{aligned} L &= +0.39 \\ C &= +0.13 \\ S &= \pm L - (\pm C) \\ &= 0.39 - (0.13) \\ &= +0.26 \end{aligned}$$

Shim thickness calculated:
S = 0.26 mm

Shim thickness selected:
S = 0.25 mm

g. At the end of adjustment operation, remove intermediate flange complete with the related shafts and tool C.6.0164 mounted on differential-speed gear casing.

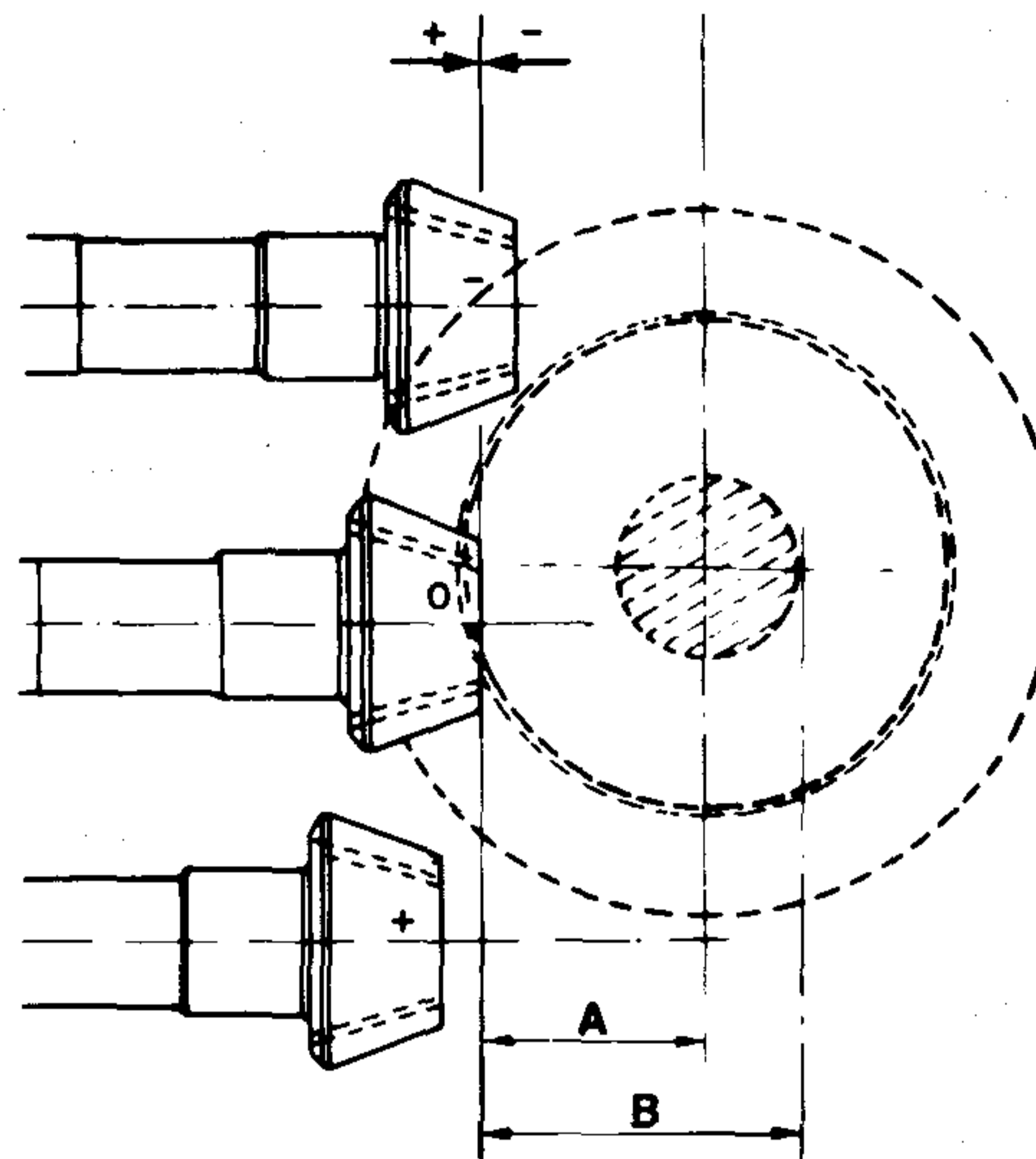
DIFFERENTIAL AND DRIVE SHAFT UNIT

PRACTICAL EXAMPLE

HOW TO READ VALUE (IN HUNDRETHS OF MM) STAMPED ON THE PINION HEAD

DISTANCE BETWEEN RING BEVEL GEAR AXIS AND PINION HEAD

- less than nominal distance
- + greater than nominal distance
- 0 equal to nominal distance



A : Nominal dimension

B : Nominal check dimension corresponding to centesimal gauge set to zero on reference gauge

CONTROL AND SUBSEQUENT CORRECTION OF DISTANCE BETWEEN PINION AND RING BEVEL GEAR AXIS

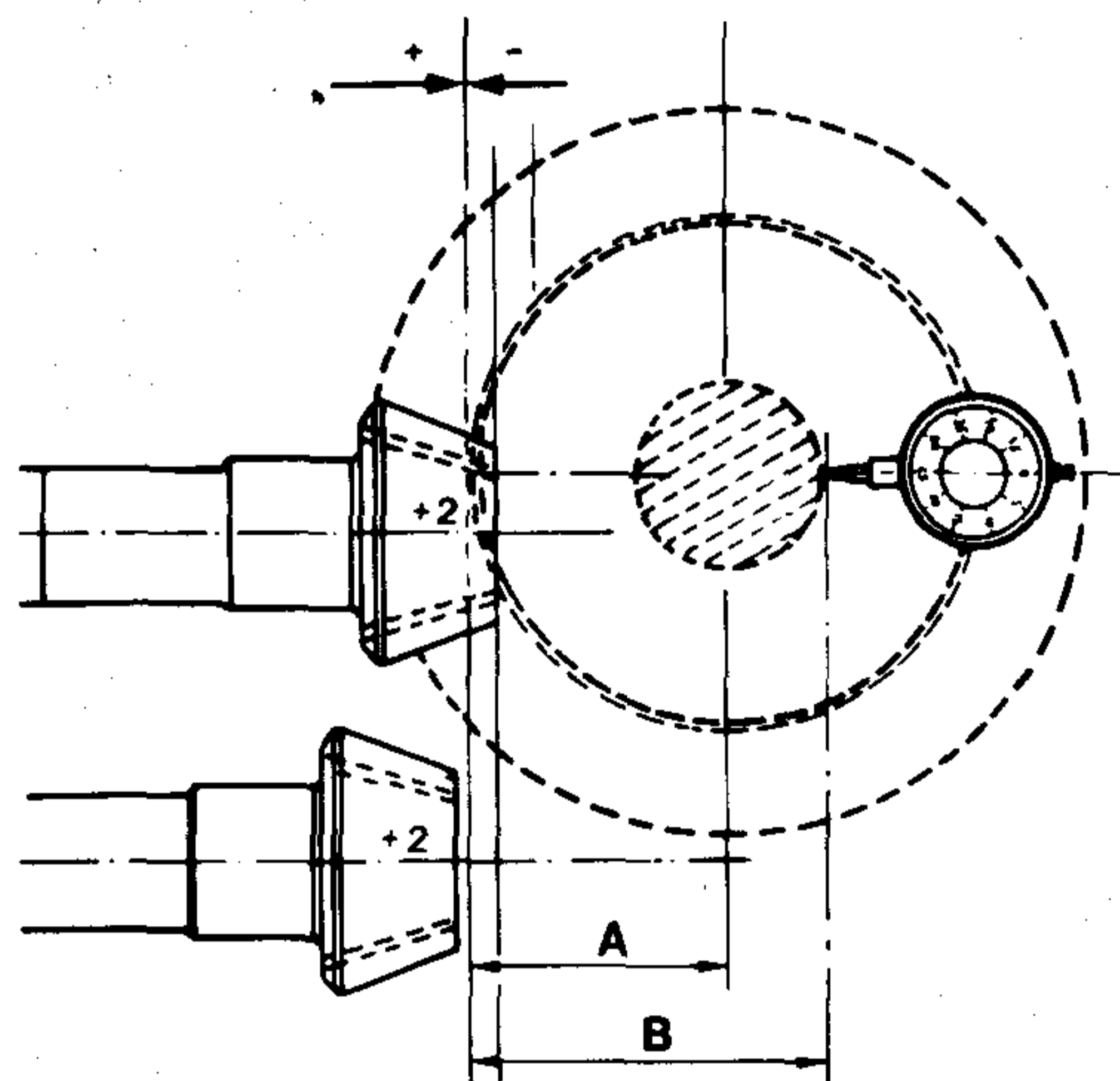
$$S = (\pm \text{ reading on dial gauge})$$

minus

$$(\pm \text{ Dimension on pinion})$$

$$S = (-4) - (+2) = -6$$

Value (expressed in hundredths of mm) by which the pinion must be moved from the ring bevel gear, by removing shims placed under pinion head.



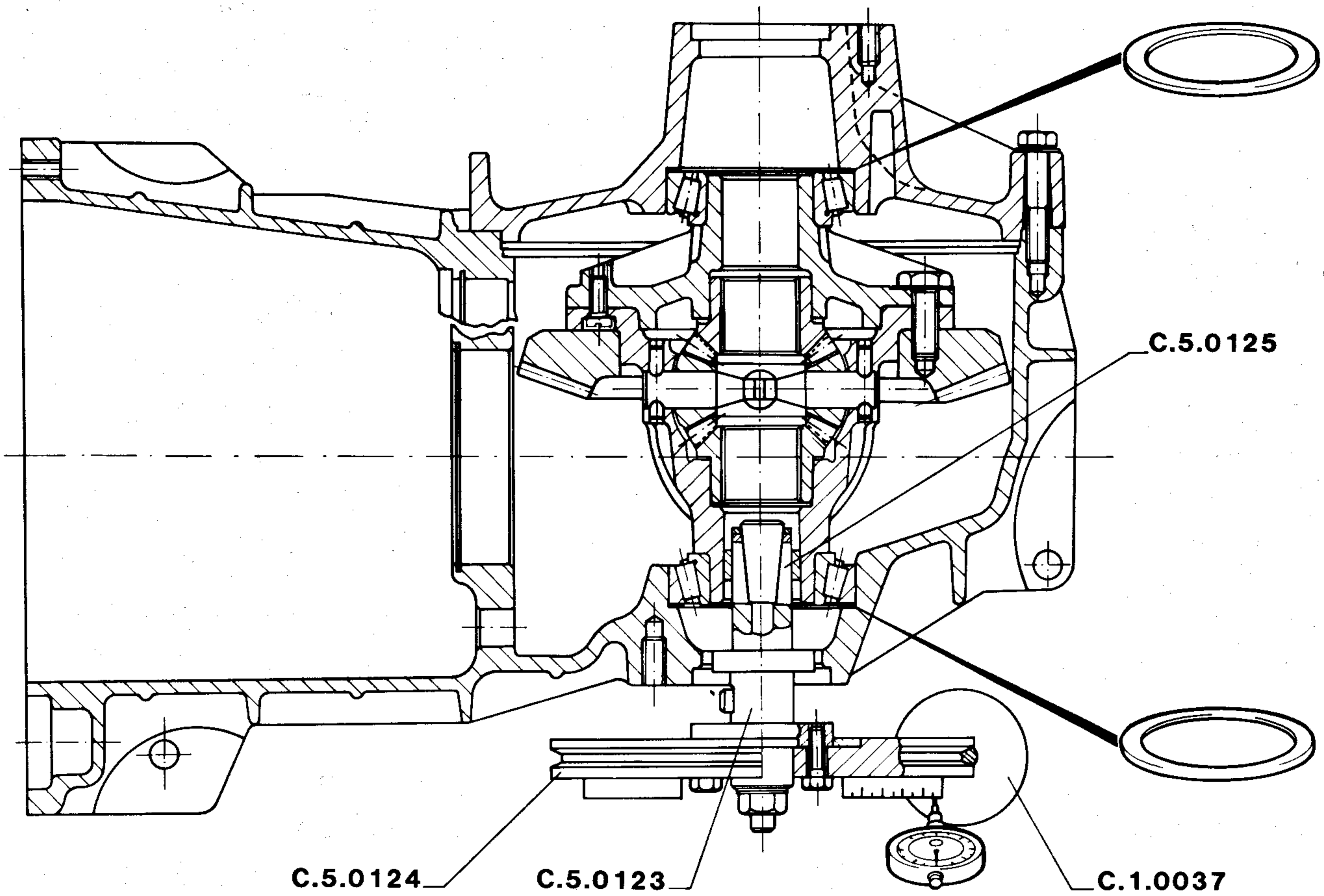
- 4 Check reading expressed in hundredths of mm
- 6 Thickness correction S expressed in hundredths of mm

RANDOM SEQUENCE

| | Reading on centesimal gauge | Dimension on pinion | Correction to be made |
|----------|-----------------------------|---------------------|-----------------------|
| 1st Case | - 4 | + 2 | - 6 (subtract shims) |
| 2nd Case | + 4 | - 2 | + 6 (ladd ") |
| 3rd Case | - 2 | + 4 | - 6 (subtract ") |
| 4th Case | + 2 | - 4 | + 6 (ladd ") |
| 5th Case | - 4 | - 2 | - 2 (subtract ") |
| 6th Case | + 4 | + 2 | + 2 (ladd ") |
| 7th Case | - 2 | - 4 | + 2 (ladd ") |
| 8th Case | + 2 | + 4 | - 2 (subtract ") |

DIFFERENTIAL AND DRIVE SHAFT UNIT

5. Adjustment of differential casing bearing preload



Operate as follows to determine total preload of differential casing bearings.

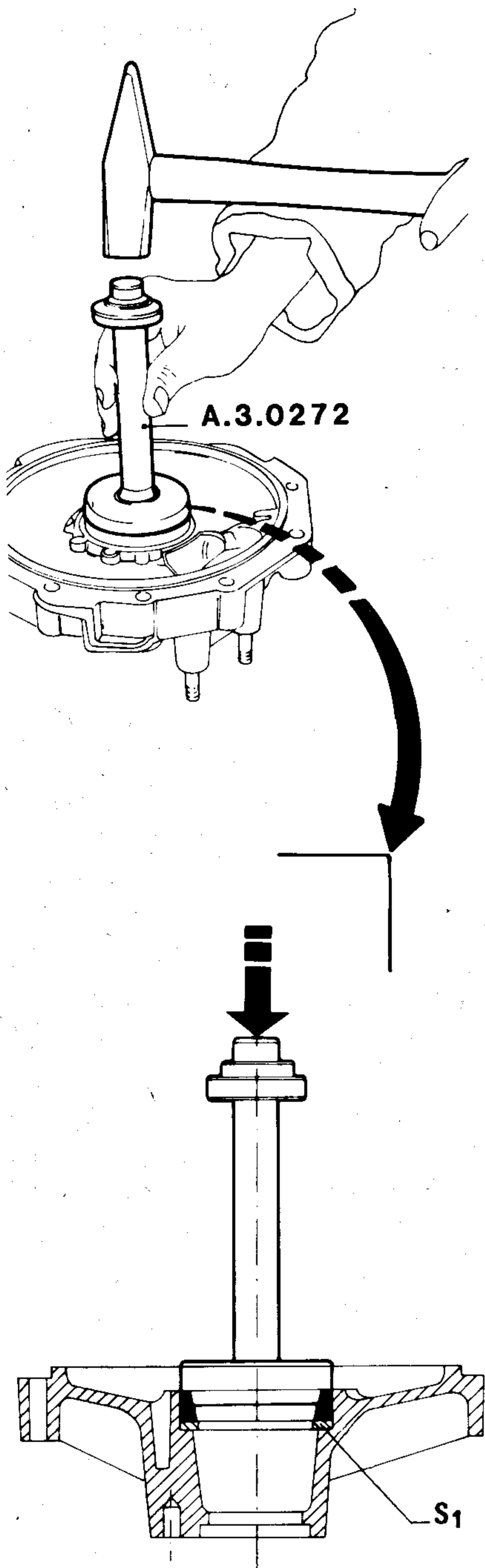
- a. Insert the shim ring (1.7 to 1.8 mm (0.067 to 0.071 in) thickness

into the related seat on differential-speed gear casing; then, by means of tool A.3.0272, fit outer ring of differential casing taper bearing.

CAUTION:

Take particular care during installation so that ring mates perfectly with cover.

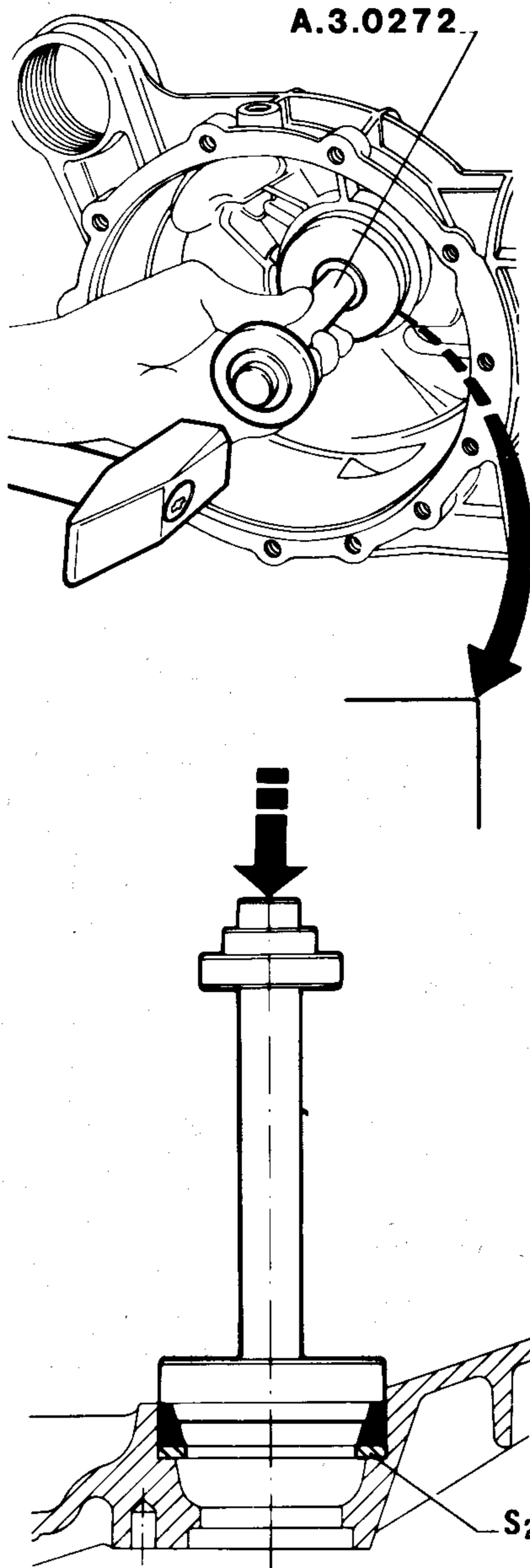
DIFFERENTIAL AND DRIVE SHAFT UNIT



b. Insert the shim ring, removed during disassembly, into the related seat on differential-speed gear casing cover, then, by means of same tool **A.3.0272**, fit outer ring of differential casing taper bearing.

CAUTION:

Take particular care during installation so that ring mates perfectly with cover.



c. Insert the whole differential casing inside the differential-speed gear casing; install cover and tighten the screws cross-wise to the prescribed torque.

T: Tightening torque

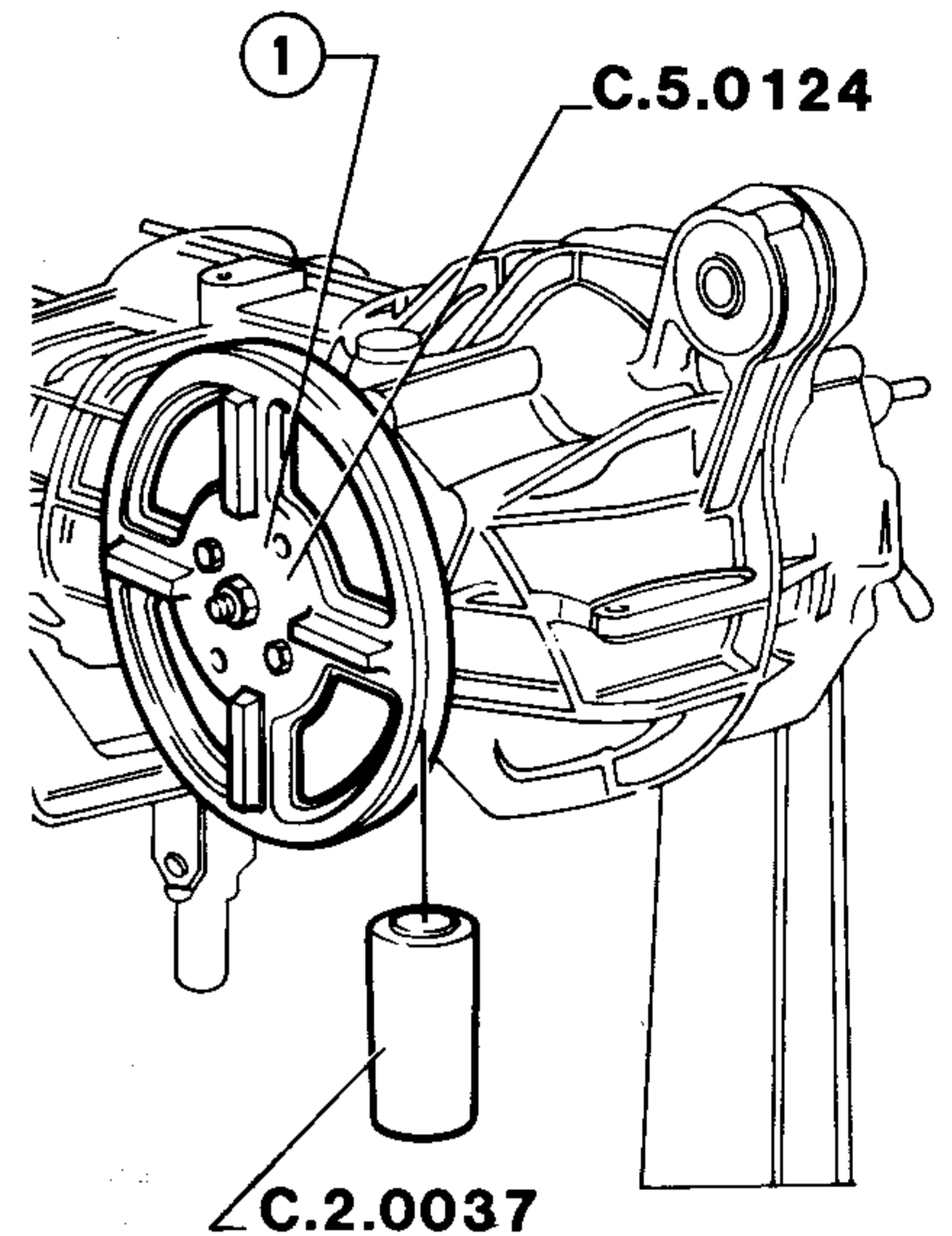
Differential - speed gear casing cover securing screws

19 to 23 N·m
(1.9 to 2.3 kg·m
13.7 to 16.6 ft·lb)

d. Install tool **C.5.0123** complete with spring bush **C.5.0125** and sheave **C.5.0124** in the seat of the left internal drive shaft. Secure tools by screwing nut ①.

e. Operating on sheave, rotate differential casing a few times in both directions so as to bed bearings.

f. Wind cable supporting weight **C.2.0037** on sheave **C.5.0124**; then verify that weight lowers correctly without stopping or pulling sheave too rapidly.



1 Nut

T: Static rolling torque of ring bevel gear taper bearings

- For new bearings:
98 to 196 N·cm
(10 to 20 kg·cm
0.72 to 1.45 ft·lb)
- For reused bearings
49 to 68 N·cm
(5 to 7 kg·cm
0.36 to 0.51 ft·lb)

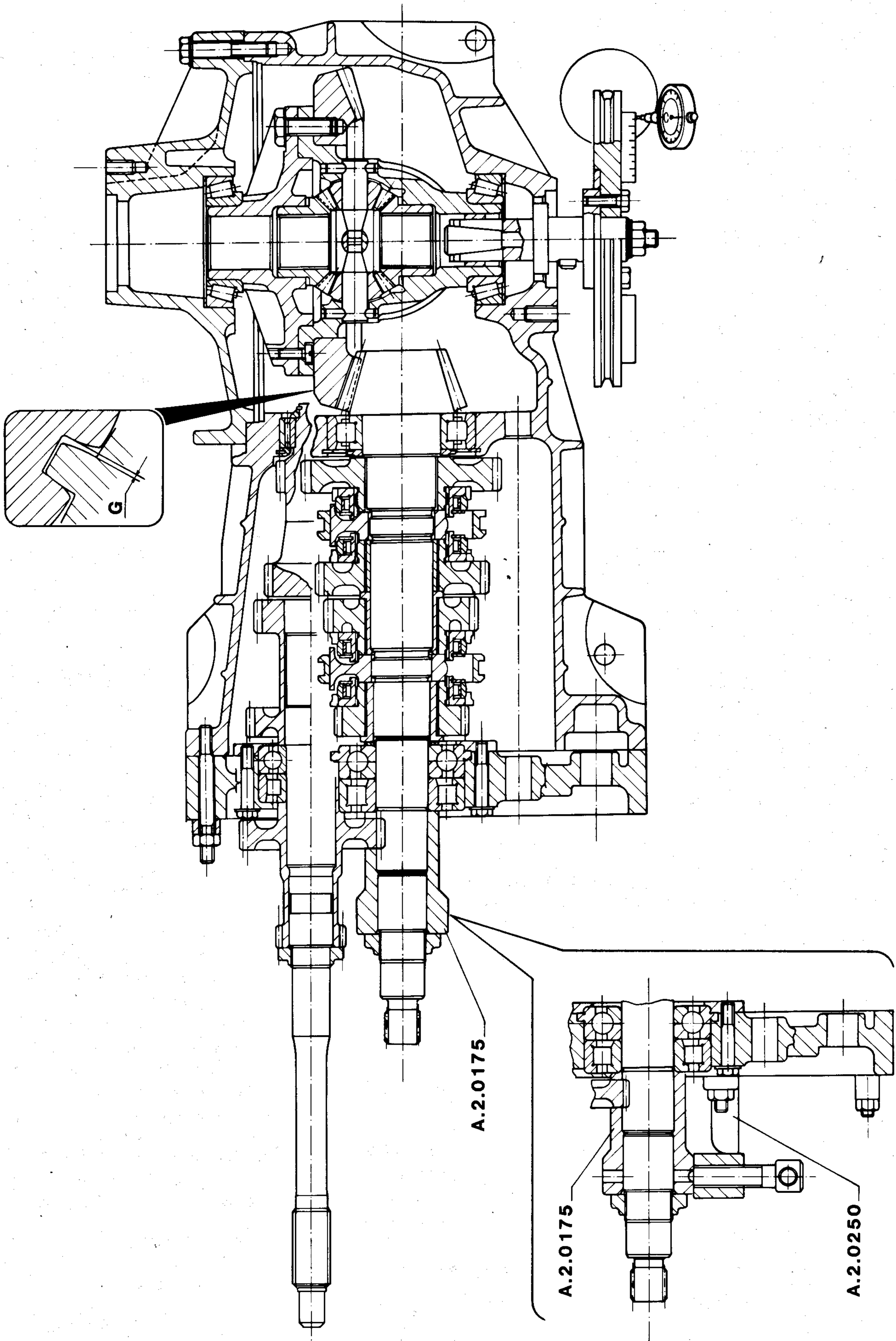
g. Should weight do not lower in the above mentioned conditions, remove cover and, by means of an adjustable span puller remove outer ring of differential casing taper bearing (refer to: "Disassembly" - step 4.) thus gaining access to shim ring to vary its thickness; by increasing or decreasing it until correct rolling torque is obtained.

Thickness must be increased if weight lowers too rapidly, while it must be decreased if weight does not lower.

h. Remove the test weight and keep sheave **C.5.0124** mounted, complete with securing hub for the next adjustment of crown wheel and pinion teeth backlash.

DIFFERENTIAL AND DRIVE SHAFT UNIT

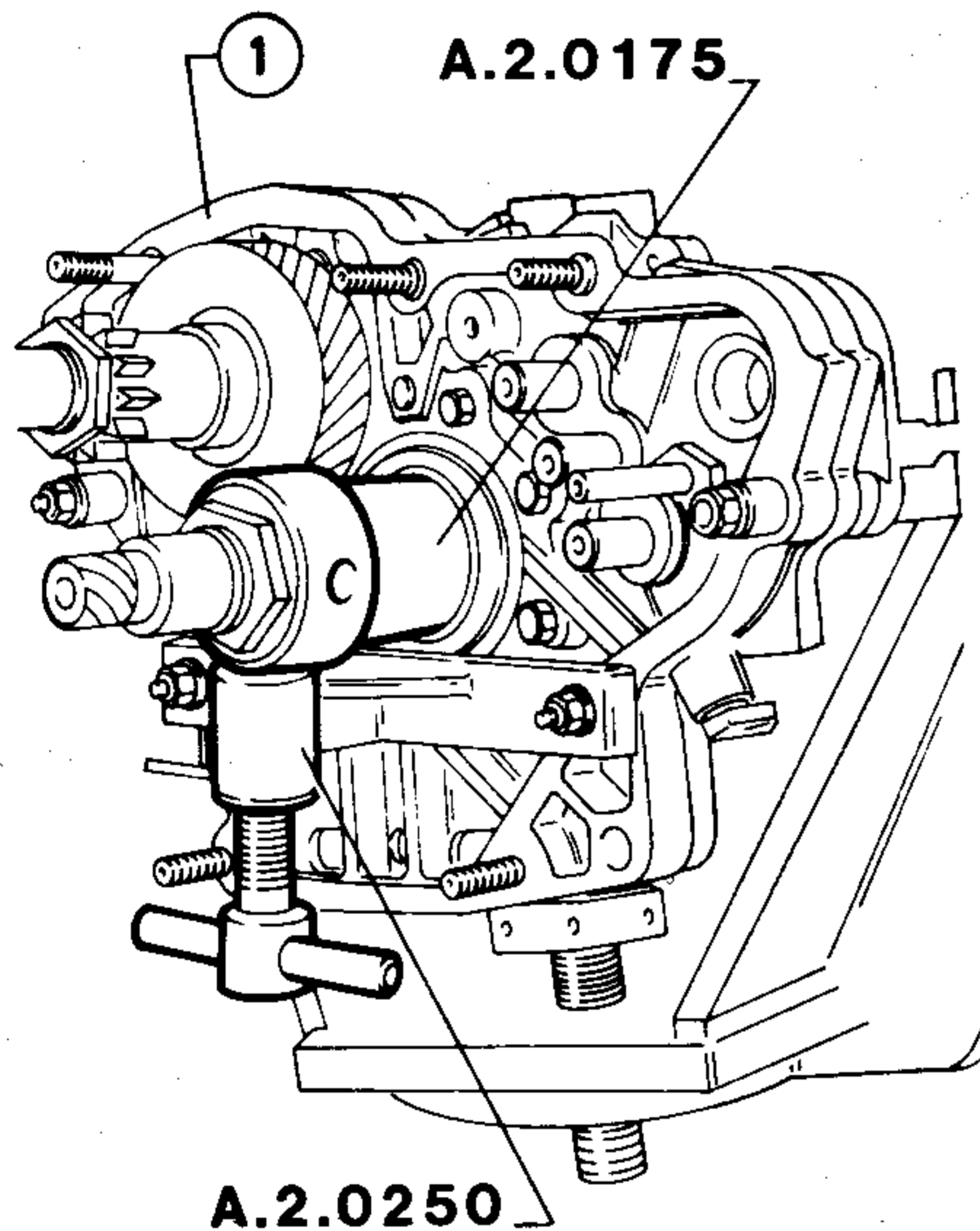
6. Adjustment of crown wheel and pinion teeth clearance.



DIFFERENTIAL AND DRIVE SHAFT UNIT

Determine and adjust clearance of crown wheel and pinion teeth by following the procedure here below.

- a. Install intermediate flange ① suitably preset, on differential-speed gear casing (refer to: step 3. - "Preparation of Speed Gear Intermediate Flange").
- b. Install tool A.2.0250 on intermediate flange ①, tighten the tool screw until inserting it into one of the holes of tool A.2.0175 on pinion shaft; this allows pinion rotation to be blocked.

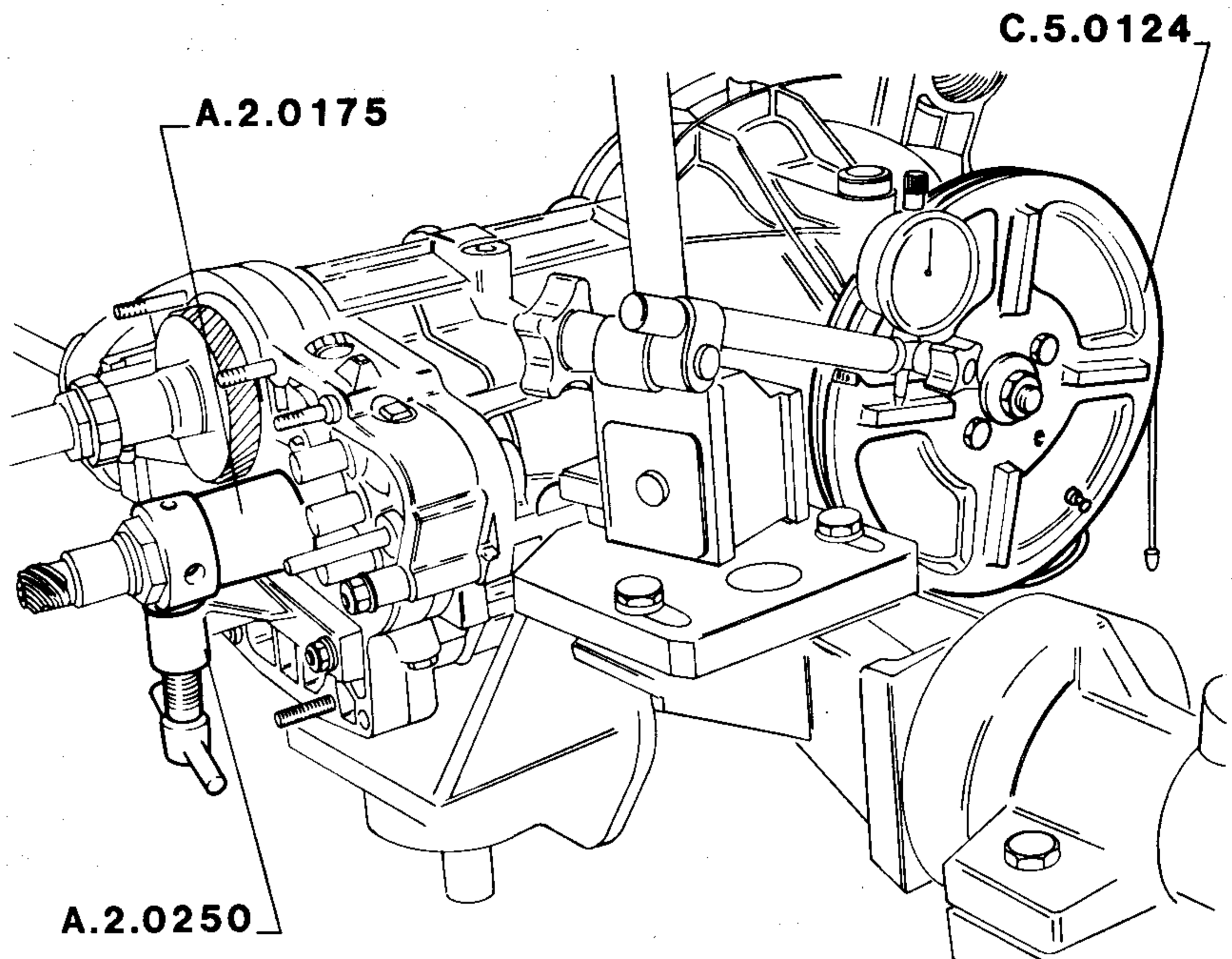


1 Speed gear intermediate flange

- c. Set the magnetic base of a centesimal gauge on support of differential-speed gear unit and position probe on one of the four spokes of sheave C.5.0124 in correspondence with average radius of ring bevel gear; then reset the centesimal gauge.

When in this position, the centesimal gauge gives the real backlash of crown wheel and pinion, in correspondence with average radius.

Ring bevel gear average radius "R"
 $R = 77 \text{ mm (3.03 in)}$



- d. With pinion blocked, move sheave C.5.0124 by the deviation amount allowed by teeth backlash; then, by means of centesimal gauge, verify that backlash "G" on the ring bevel gear average radius is that prescribed.

Clearance "G" between pinion and ring bevel gear

$$G = 0.10 \text{ to } 0.20 \text{ mm} \\ (0.0039 \text{ to } 0.0079 \text{ in})$$

Backlash verification is to be performed in four positions of ring bevel gear by rotating differential casing by means of sheave C.5.0124, releasing and blocking pinion via tool A.2.0250.

- e. Should backlash of crown wheel and pinion, measured with centesimal gauge, be different from that prescribed, vary shims interposed between outer rings of differential casing taper bearing and the related shoulders on differential-speed gear casing and on cover.
 - If backlash is lower than the prescribed value, the ring bevel gear must be moved away from pinion and, as a consequence, it is necessary to increase the shim thickness on the opposite side of ring bevel gear and to by the same amount, the shim thickness on ring bevel gear side (cover).
 - If backlash exceeds the prescribed

value, the ring bevel gear must be moved closer to pinion and, as a consequence, it is necessary to decrease the shim on the opposite side of ring bevel gear and to increase by the same amount, the shim thickness on the ring bevel gear side (cover).

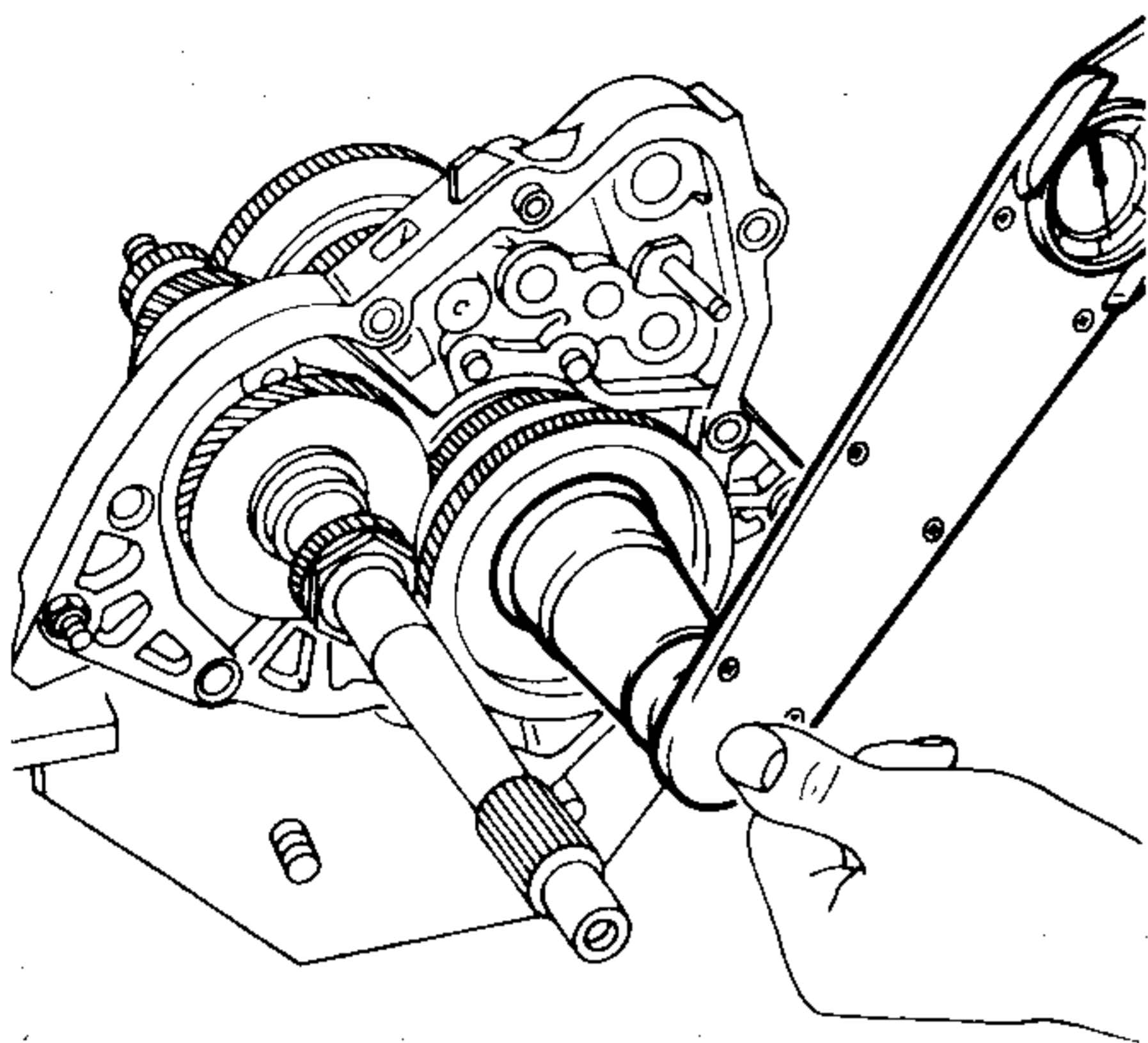
Since the increase of a ring shim thickness is equal to a decrease on the opposite one, a deviation of ring bevel gear is obtained, without altering preload of bearings.

- f. At the end of adjustment, remove the intermediate flange from differential speed gear casing complete with the related shafts, and sheave C.5.0124 complete with hub and spring bush.

7. Reassembly of speed gear intermediate flange.

- a. Set intermediate flange on an overhaul stand, engage two speeds, unscrew the nut on pinion shaft and remove spacer A.2.0175.
- b. Lubricate, then insert the 5th speed gear bush, on pinion shaft, with the related cage with needles. Install driven gears of 5th and reverse speeds, then screw the securing nut and tighten it to the prescribed torque.

DIFFERENTIAL AND DRIVE SHAFT UNIT



T: Tightening torque
Nut securing bevel pinion shaft
 112 to 124 N·m
 (11.4 to 12.6 kg·m
 82.4 to 91.1 ft·lb)

- c. Withdraw dummy rods **A.2.0267** and, at the same time, insert the gear selector rods into the related seats.
- d. Complete the rods and forks reassembly operation. (Refer to Group 13 - "Overhaul at Bench of Speed Gear Unit Rods and Forks - Reassembly").

8. Reassembly of internal drive shafts
 (refer to: "Internal Drive Shafts - Reassembly").

9. Reassembly of brakes calipers and control system piping

- a. Reassemble brakes calipers and secure nuts tightening them to the prescribed torque (only for the models with differential equipped with four side pinions).

T: Tightening torque
Nuts securing brakes calipers to differential-speed gear casing
 46 to 52 N·m
 (4.6 to 5.3 kg·m
 33.2 to 38.3 ft·lb)

- b. Reconnect the control system piping unions to brakes calipers, by tightening them to the prescribed torque.

T: Tightening torque
Unions of brakes control system piping:
 8 to 10 N·m
 (0.8 to 1.0 kg·m
 5.8 to 7.2 ft·lb)

- c. Secure union tee of brake fluid piping to differential-speed gear casing.
- d. Secure right pipe to support clamp.

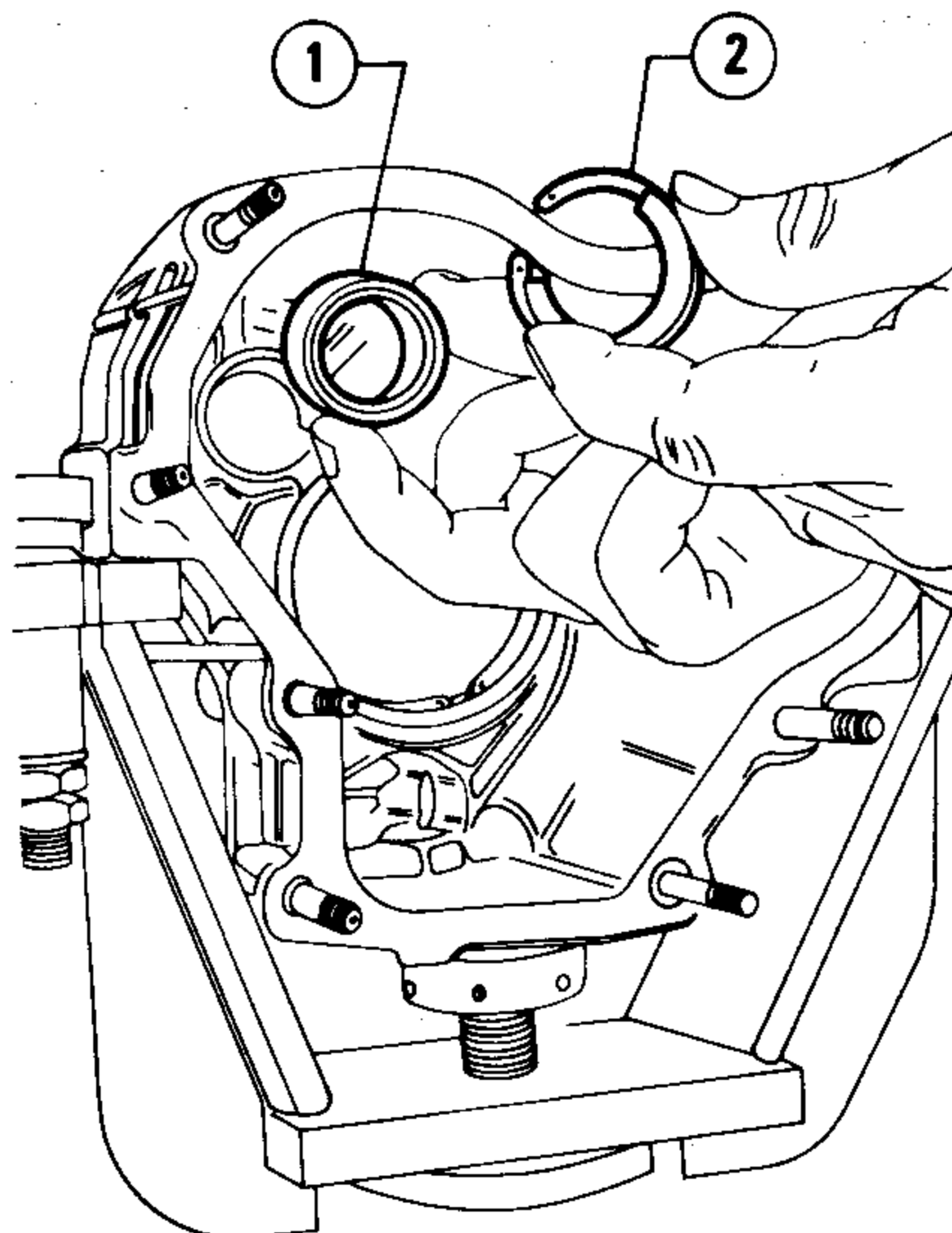
DIFFERENTIAL-SPEED GEAR CASING

CAUTION:
 The differential-speed gear casing is in aluminium alloy. Take the utmost care to prevent damaging it.

DISASSEMBLY

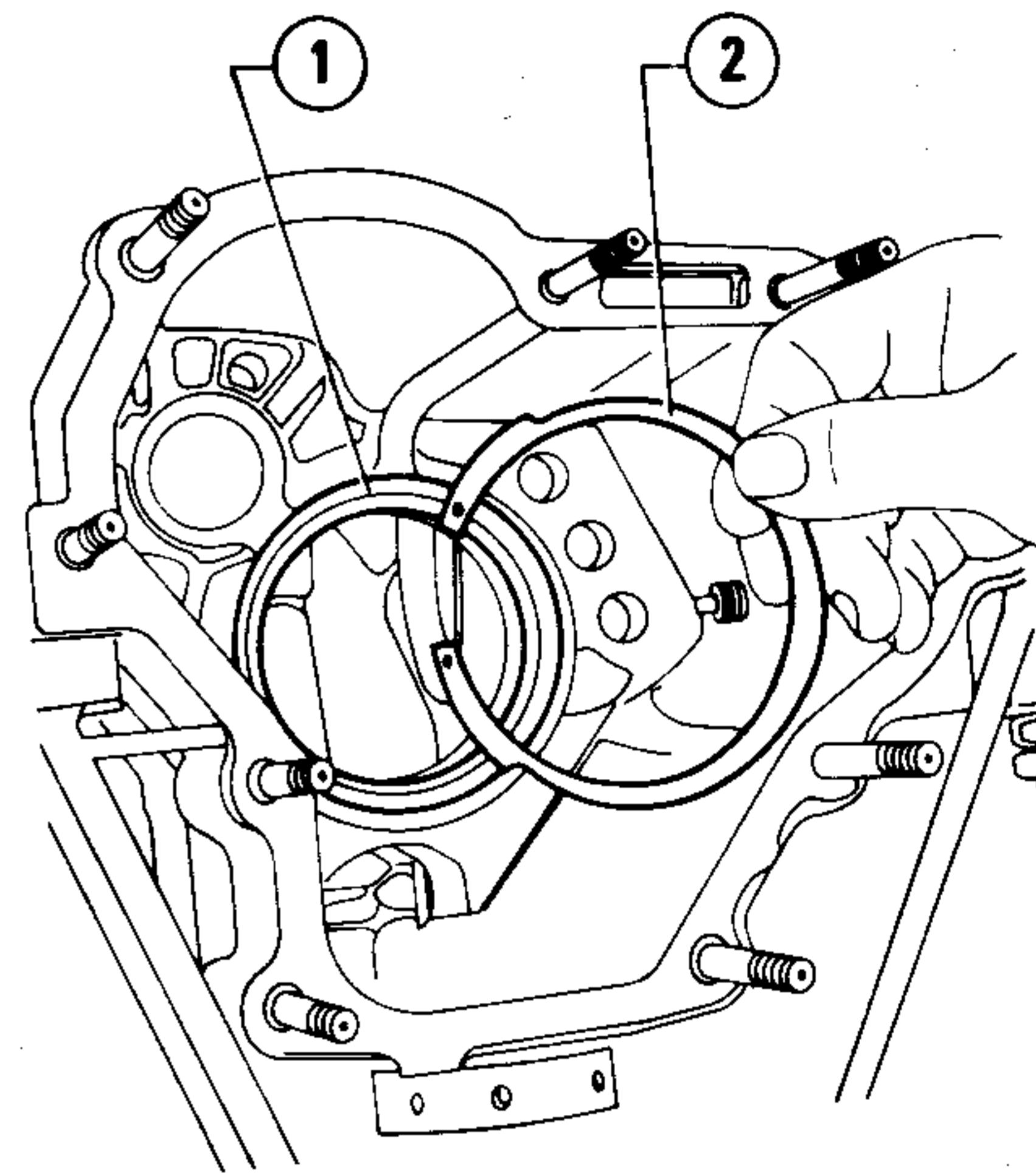
Once removed the speed gear intermediate flange from differential unit (refer to Group 13 - "Separation and Reconnection at Bench of Speed Gear Unit from/to Differential Unit - Separation"), disassemble it operating as follows.

1. Removal of main shaft rear bearing
 - a. Remove retaining ring (2) securing main shaft needle bearing (1).
 - b. Withdraw bearing from the related seat (no special tool is required, since this item is mounted without interference fit).



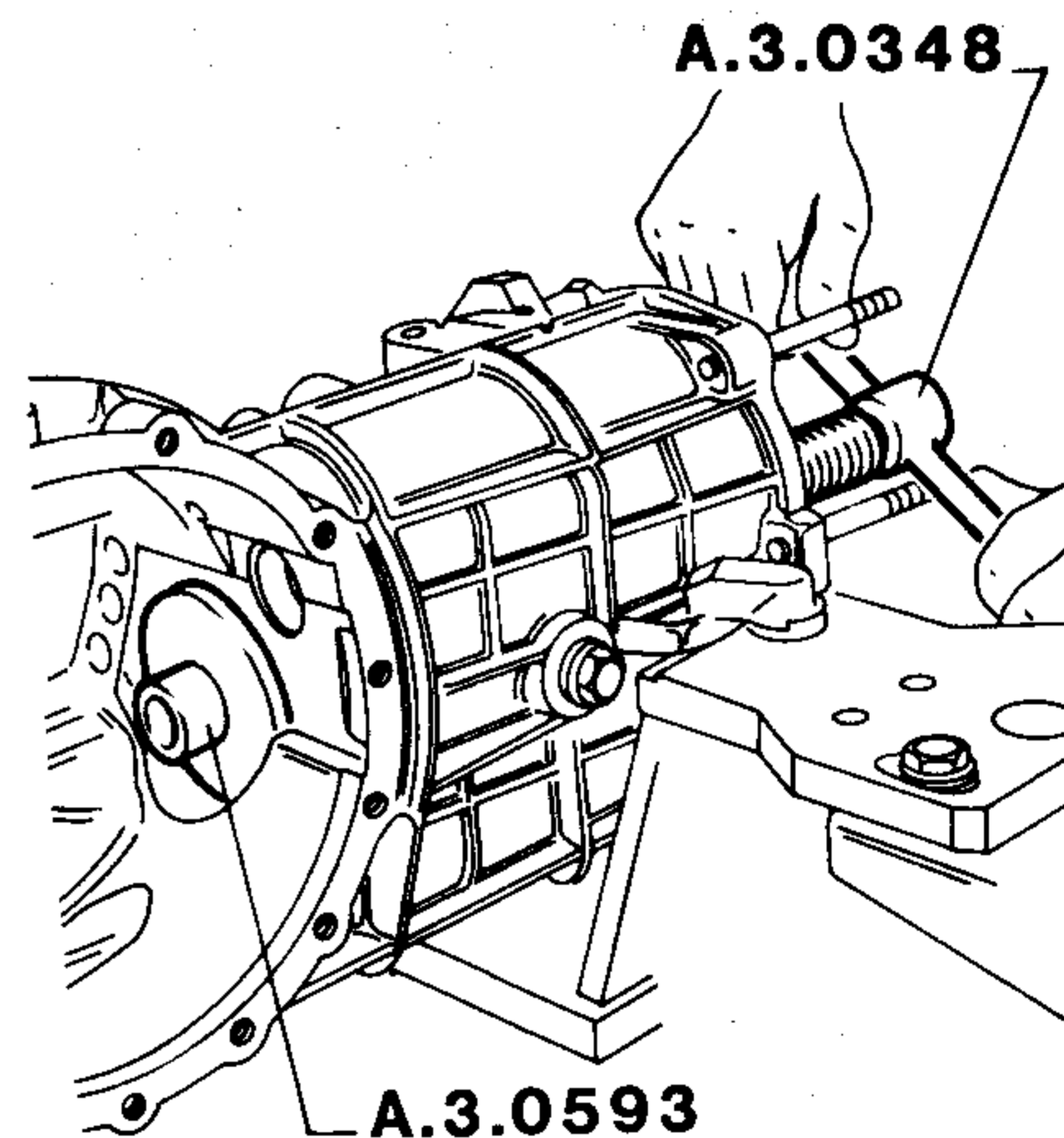
1 Needle bearing
 2 Retaining ring

2. Differential casing withdrawal (refer to: "Differential Casing - Removal" steps 1. to 3.)
3. Remove retaining ring (2) securing outer ring (1) of pinion shaft roller bearing.
 - a. Remove retaining ring (2) which secure outer ring (1) of pinion shaft roller bearing.



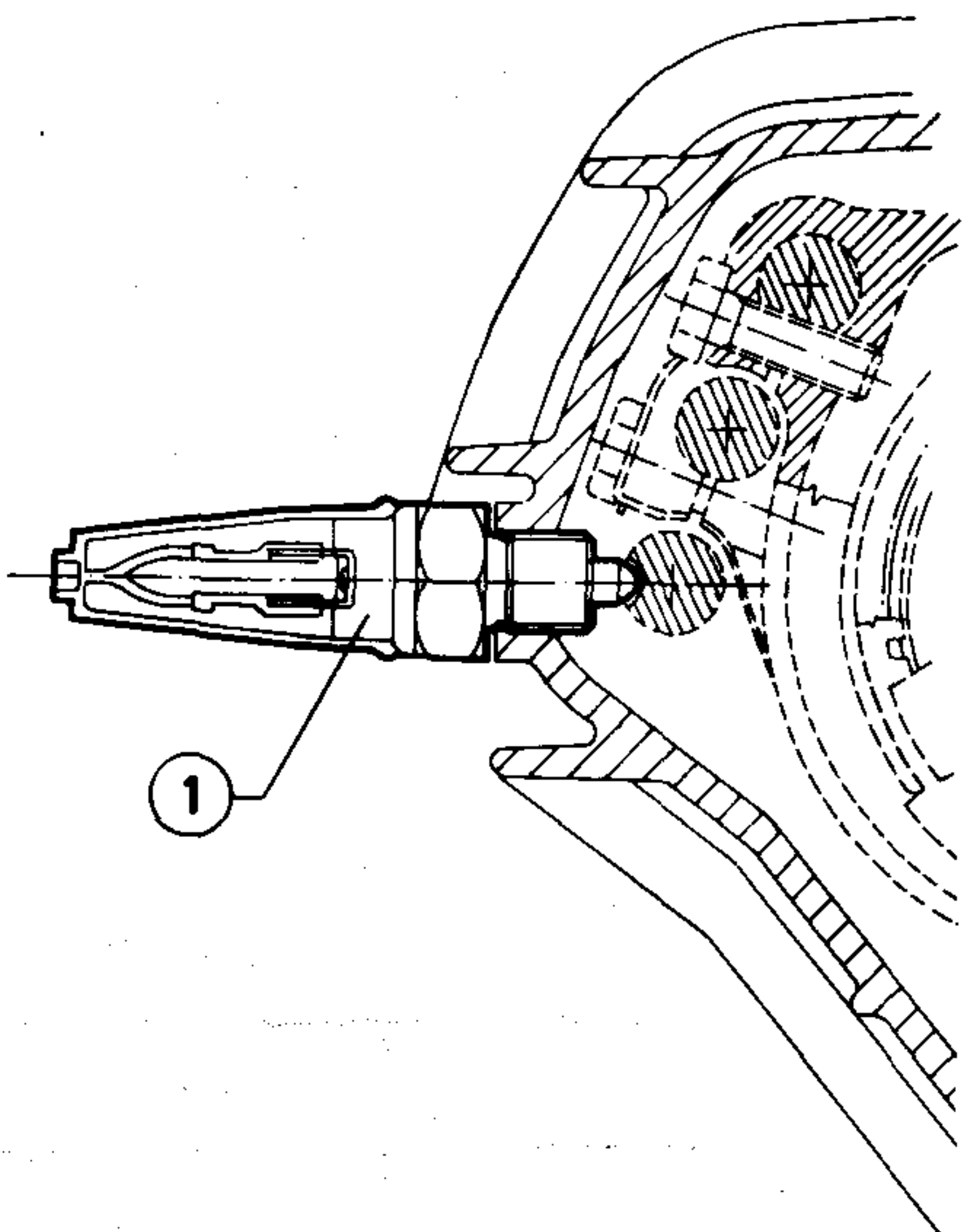
1 Pinion shaft bearing outer ring
 2 Retaining ring

- b. By means of tool **A.3.0348** fitted with bushing **A.3.0593**, withdraw outer ring of pinion shaft bearing.



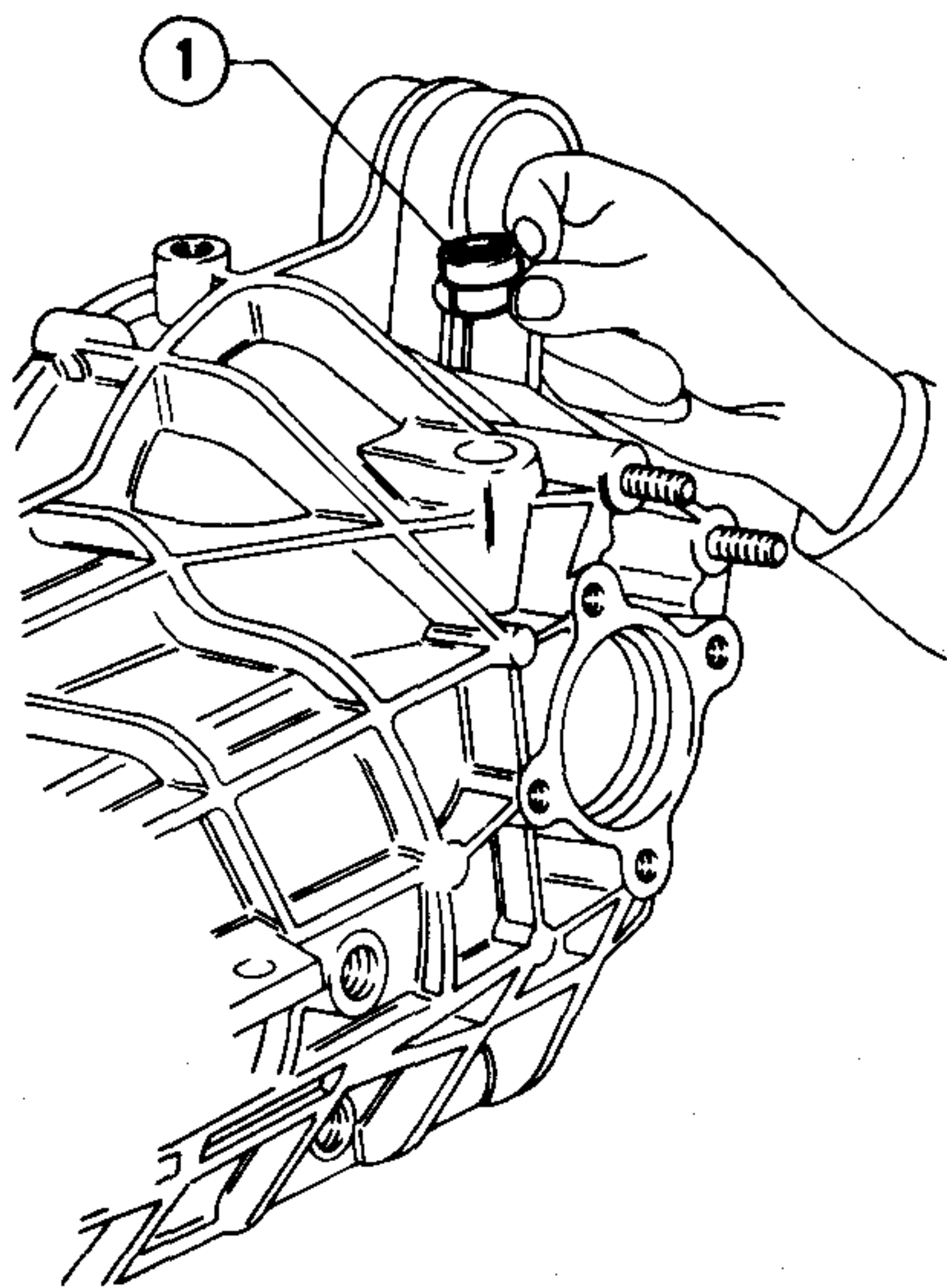
4. Unscrew and remove switch (1).

DIFFERENTIAL AND DRIVE SHAFT UNIT



1 Reverse speed engagement indicator switch

5. If necessary, unscrew and remove oil plugs, then remove plug ①



1 Oil drain plug

CHECKS AND INSPECTIONS

- Clean the casing with solvent and check against cracks, splinters or pitting.
- Check mating surfaces of casing and check against notches, roughness or sealant traces.
- Verify that threadings of cover securing screws are in good conditions.

- Examine needle bearing of main shaft verifying that rotation takes place without noise, slight stickings and excessive clearance.
- Verify that race of pinion shaft roller bearing is free from excessive wear, scratches or seizing.

REASSEMBLY

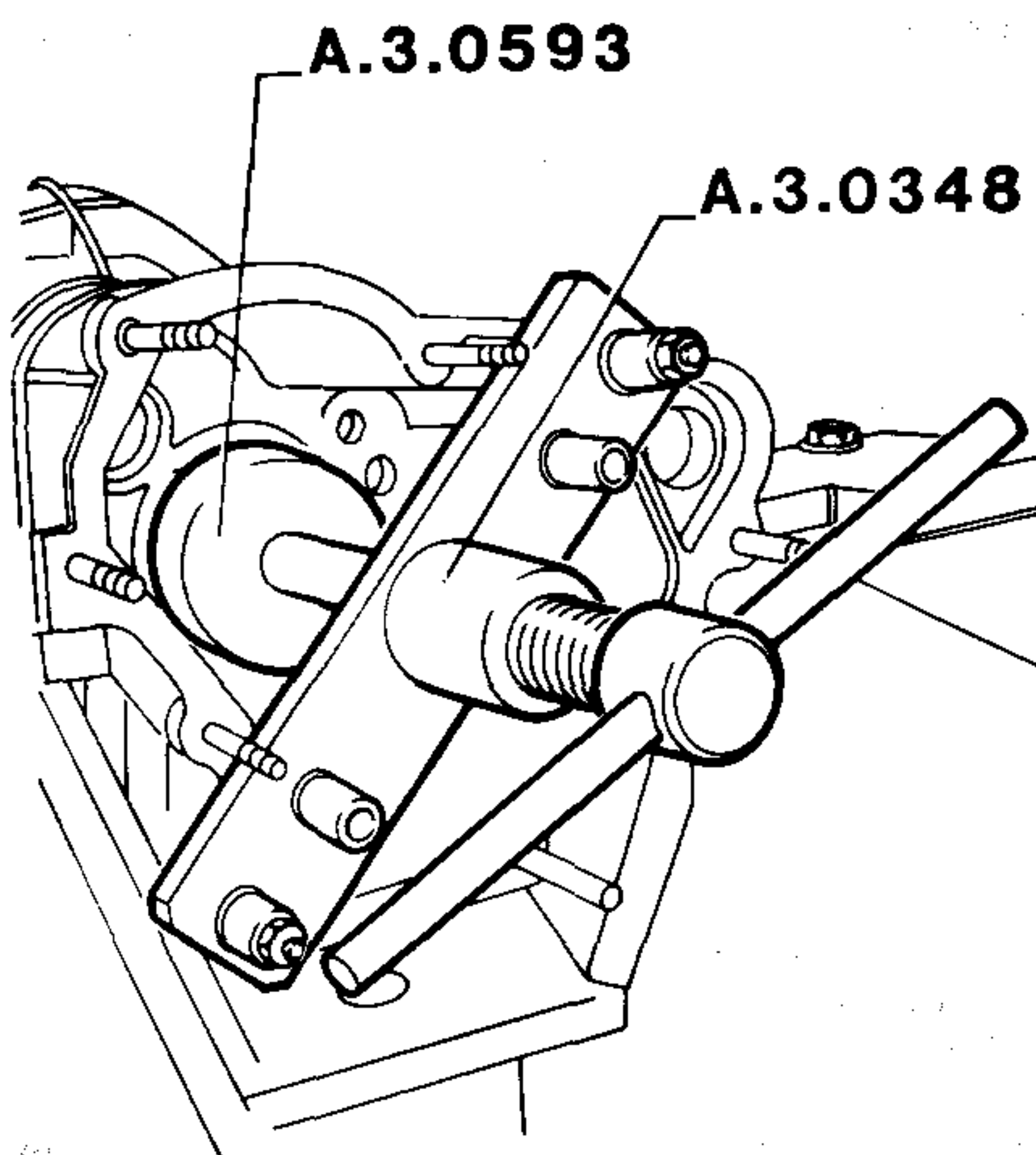
- If previously removed, mount oil plugs and the reverse speed engagement indicator switch.

T: Tightening torque
Reverse speed engagement indicator switch

23 to 26 N·m
(2.3 to 2.7 kg·m
16.6 to 19.5 ft·lb)

- Reassembly of pinion shaft bearing outer ring.
By means of tool **A.3.0348** fitted with bushing **A.3.0593**, insert outer race of pinion shaft bearing; then install retaining ring.

The replacement of pinion shaft bearing, involves the check and possible adjustment of distance between pinion and ring bevel gear axis refer to: "Differential Casing - Reassembly" step 4.)



- Reassembly of main shaft bearing
Reassemble needle bearing of main shaft and secure it with the related retaining ring.

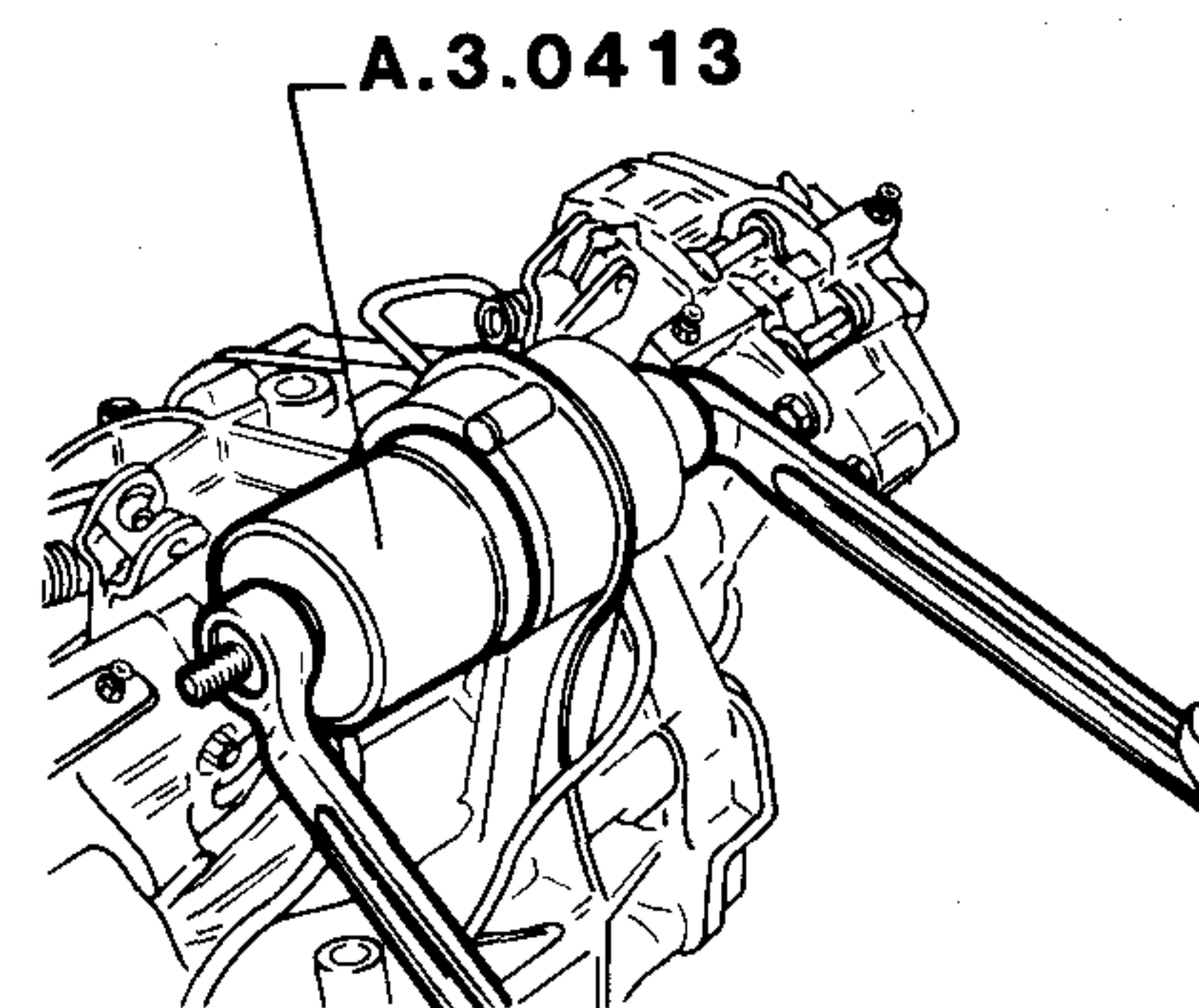
The retaining ring must be mounted with the beveling towards front side (speed gear).

- Differential casing Reassembly (refer to: "Differential Casing-Reassembly" step 1.).
- Once the differential-speed gear casing has been reassembled, install intermediate flange complete with speed gear shafts, install the speed gear-clutch casing and, then, the clutch unit.
(Refer to: Group 13 - "Separation and Reconnection at Bench of Speed Gear Unit from/to Differential Unit - Reconnection").

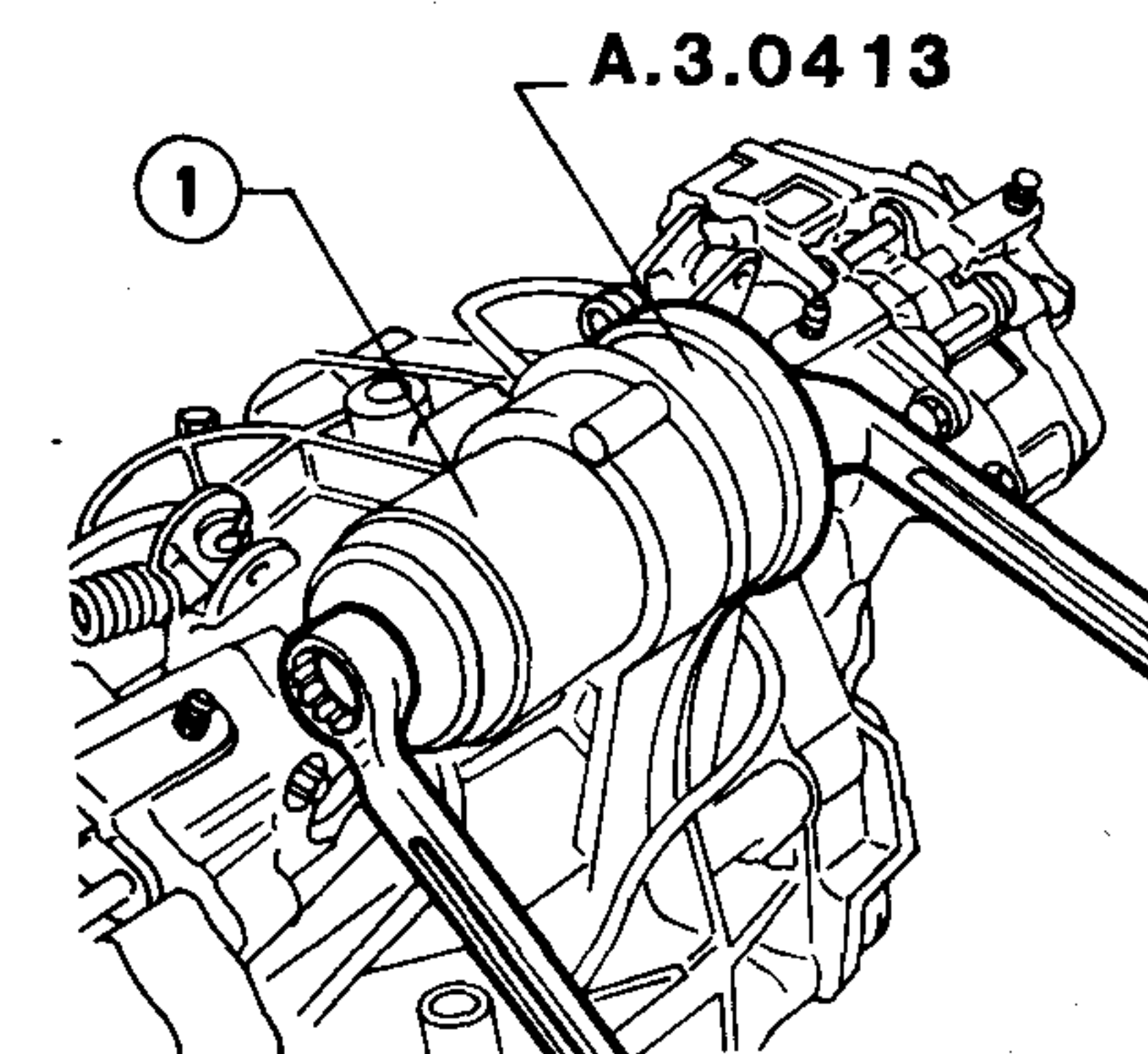
RUBBER BUSHING REPLACEMENT

Set the clutch-speed gear-differential unit on an overhaul stand, then operate as per figure making use of tool **A.3.0413** to replace the rubber bushing securing the unit to body.

Withdrawal



Insertion



DIFFERENTIAL AND DRIVE SHAFT UNIT

SERVICE DATA AND SPECIFICATIONS

SERVICE DATA

Refer to Group 13 - "Service Data and Specifications - Service Data".

GENERAL SPECIFICATIONS

FLUIDS AND LUBRICANTS

| Application | Type | Denomination | Q.ty |
|--|--------|---|--|
| Differential roller bearing | GREASE | AGIP Grease 33 FD IP Autogrease FD (Std.No. 3671-69833) | — |
| Outer rings of differential taper bearing | | | — |
| Threading of screws securing drive shaft to differential shaft | GREASE | ISECO Molykote BR2 (Std.No. 3671-69841) | — |
| Spherical seat of propeller shaft rear joint | | | — |
| Internal lip of seal rings | | | 5 cm ³ (0.30 cuin) |
| Filling of differential-speed gear casing | OIL | AGIP Rotra SX 75W90 IP Pontiax HDS 75W90 (Std.No. 3631-69412) | 2.570 kg (5.66 lb) (1) 2.070 kg (4.56 lb) (2) |
| Outer surface of seal rings | | | — |

- (1) For models **Alfetta**
For cars with high top-up plug of models: **Giulietta** **GTV 20** and **GTV 6 25**
- (2) For models **Alfa 90** and **Alfa 75**
For cars with low top-up plug of models: **Giulietta** **GTV 20** and **GTV 6 25**

SEALANTS AND SURFACE FIXING AGENTS

| Application | Type | Denomination | Q.ty |
|---------------------------------------|------------------|---|------|
| Mating surface of drive shafts-covers | SEALING COMPOUND | LOWAC Perfect Seal (Std. No. 3522-00011) | — |

DIFFERENTIAL AND DRIVE SHAFT UNIT

CHECKS AND ADJUSTMENTS

| | Type of differential | two side pinions | four side pinions |
|--|----------------------|-------------------------------|-------------------------------|
| Application | | | |
| Installation clearance between side pinions and crown wheels teeth | G mm (in) | 0.05 to 0.20 (0.002 to 0.008) | 0.08 to 0.15 (0.003 to 0.006) |

Shim washer correction shim "S" between 4th speed engagement bush and bearing internal ring.

$$S = \pm L (\pm C)$$

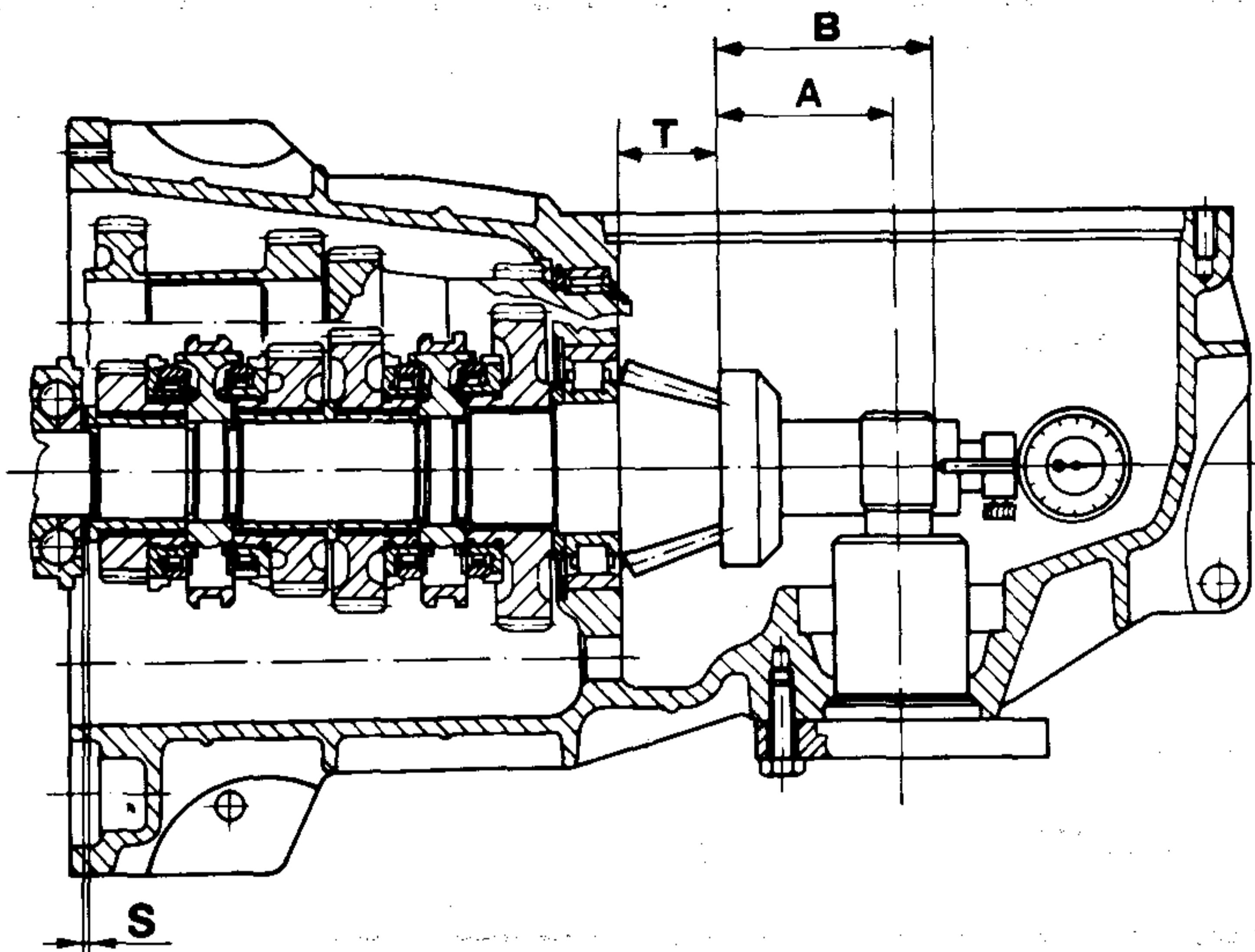
where:

L = Deviation value of ring bevel gear axis measured with centesimal gauge

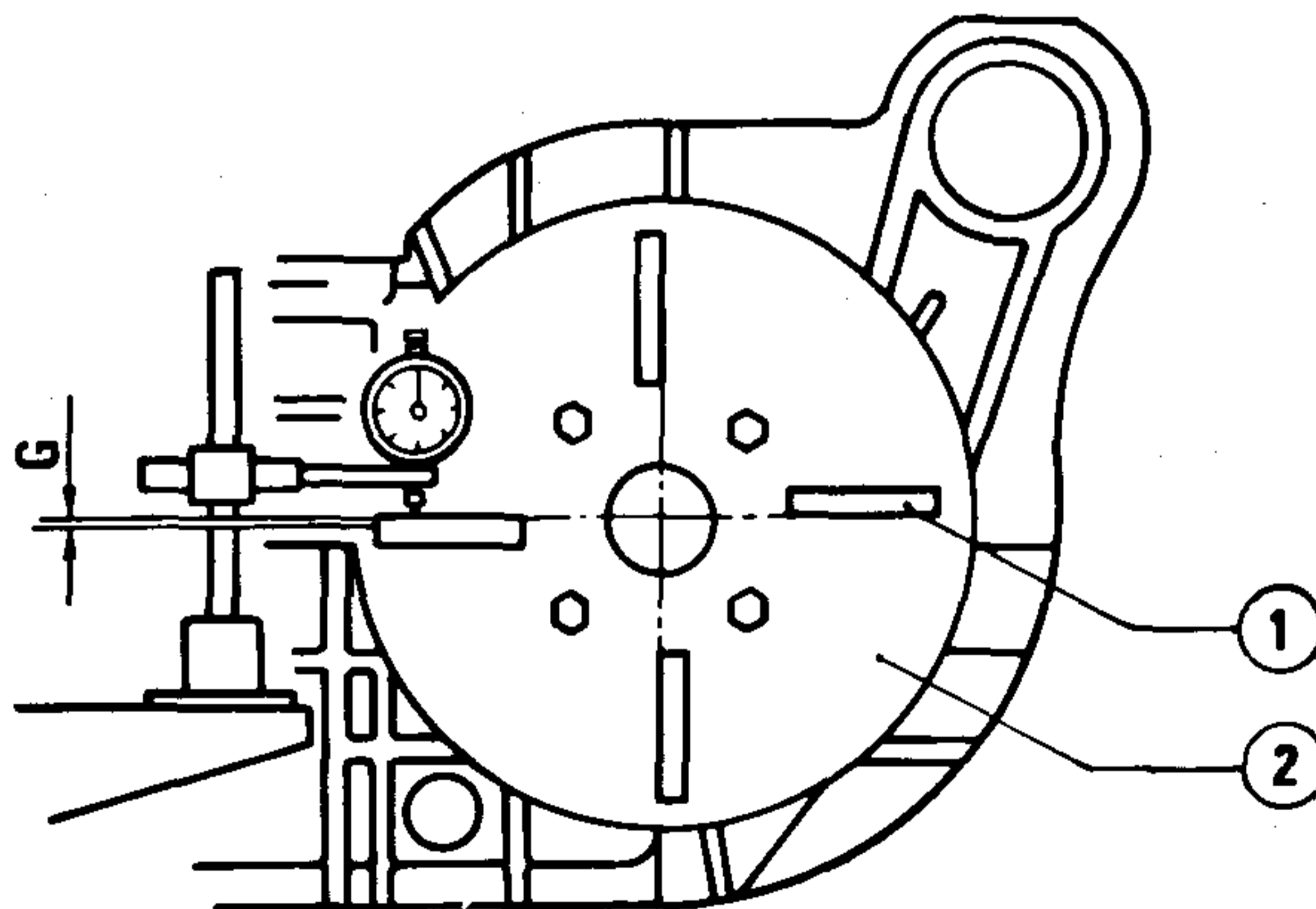
C = Value marked on pinion head

The real dimension must correspond to the nominal dimension the algebraic value marked on pinion head (in hundredths)

T = Pinion head height



| | Pinion type | Pinion head height T = 42 mm (1.65 in) | Pinion head height T = 36 mm (1.42 in) |
|--|-------------|--|--|
| Application | | | |
| Nominal dimension between ring bevel gear axis and pinion head | A mm (in) | 56.5 ± 0.03 (2.22 ± 0.001) | 62.6 ± 0.03 (2.46 ± 0.001) |
| Dimension of tool C.6.0164 for gauge resetting | B mm (in) | 66.5 (2.62) | 72.6 (2.86) |
| Installation clearance between ring bevel gear and pinion | G mm (in) | 0.10 to 0.20 (0.004 to 0.008) | |



- 1 Graded spoke
- 2 Tool sheiw

| | | |
|--------------------------------|-----------|-----------|
| Ring bevel gear average radius | R mm (in) | 77 (3.03) |
|--------------------------------|-----------|-----------|

DIFFERENTIAL AND DRIVE SHAFT UNIT

| Application | |
|--|-----------------------------------|
| Clearance between splined section of drive shafts and differential crown wheels G mm (in) | 0.07 to 0.13 (0.00275 to 0.0051) |
| Squareness deviation of brake disk support plane with respect to bearing and oil seal ring seats S mm (in) | 0.05 (0.00197) |
| Installation interference fit for drive shaft bearing retaining ring nut I mm (in) | 0.023 to 0.057 (0.0009 to 0.0022) |

SHIM RINGS

Shims "S" for pinion - ring gear axis
Minimum shim
 $S_{min} = 0.08 \text{ mm}$

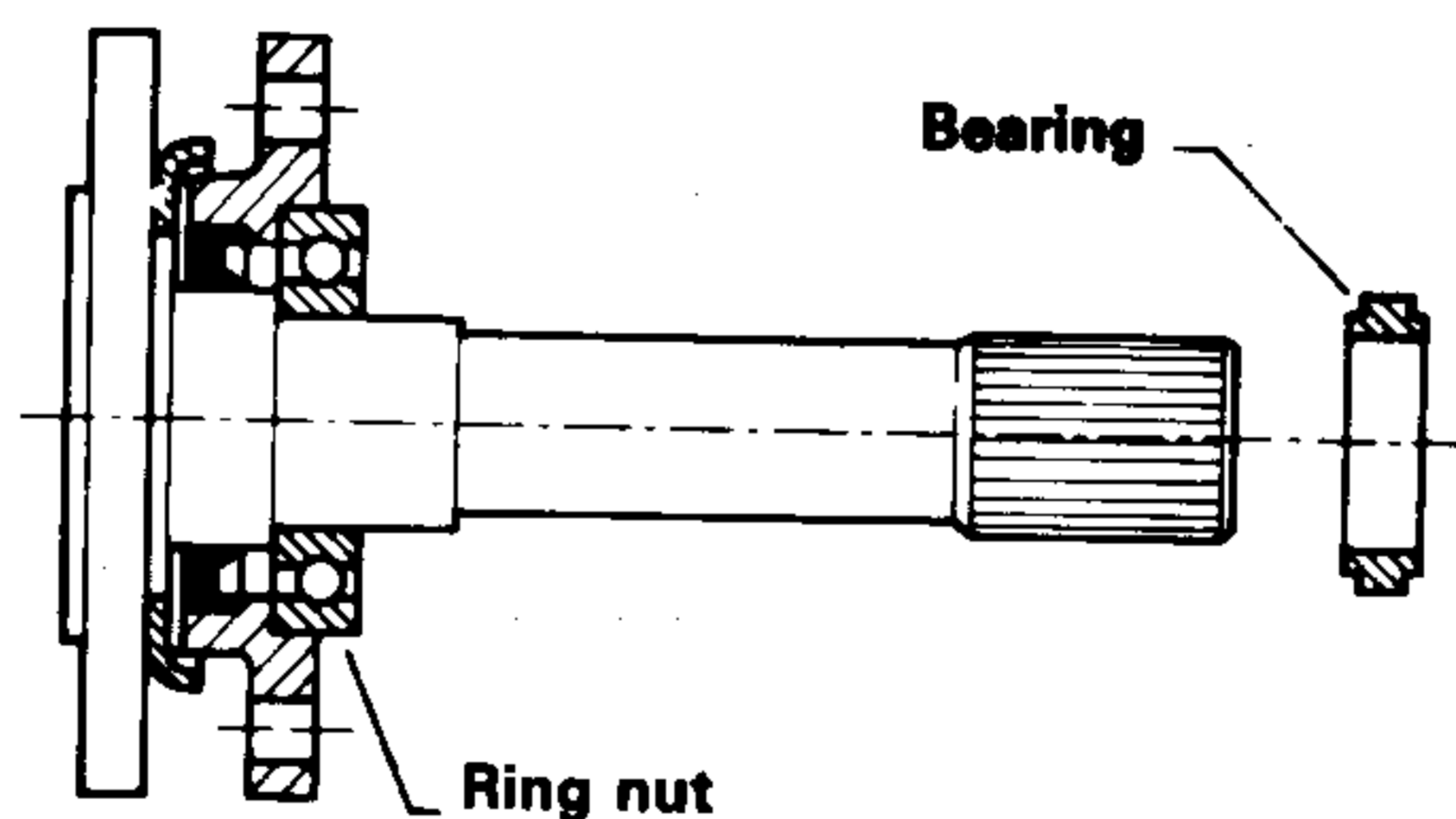
The remaining shims increase progressively by 0.05 mm each time, starting from 1.15 mm up to 2.50 mm.

Shims "S" for preload of the differential casing bearings.

The shims increase progressively by 0.25 each time, starting from 1.350 mm up to 2.600 mm

HEATING TEMPERATURES

| Application | Measurement Unit | °C (°F) |
|-------------------------------------|------------------|-----------|
| Differential shaft bearing ring nut | | 190 (374) |



ROLLING TORQUES

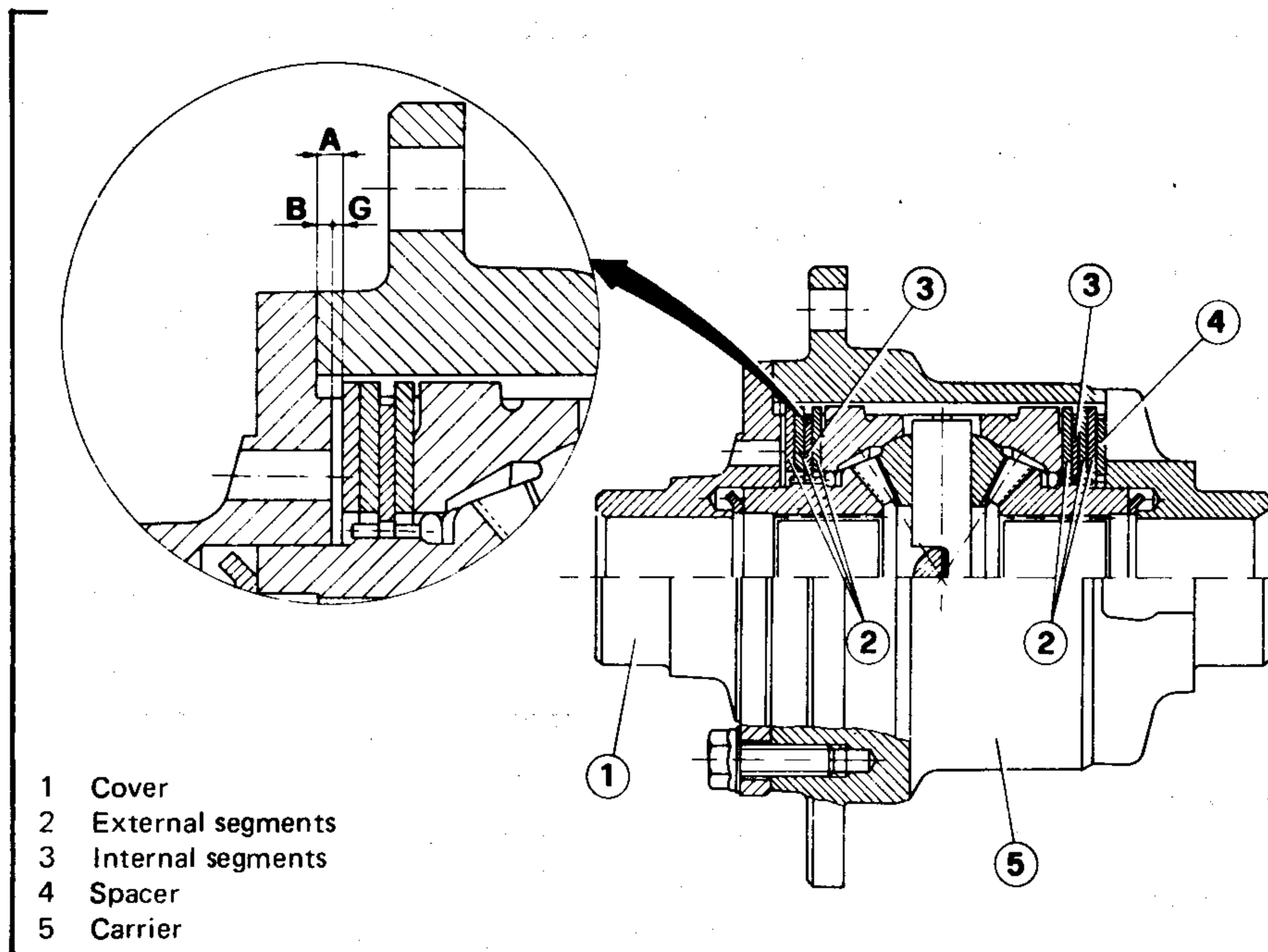
| Item | Measurement Unit | N-cm | Kg-cm |
|--|------------------|-----------|----------|
| Differential carrier (to determine static preload of taper bearings) | | | |
| — Re-used bearings | | 49 to 68 | 5 to 7 |
| — New bearings | | 98 to 196 | 10 to 20 |

DIFFERENTIAL AND DRIVE SHAFT UNIT

LIMITED SLIP DIFFERENTIAL

Fitment clearance between cover and pack of segments

$$G = A - B = 0.1 \text{ thru } 0.2 \text{ mm} \\ (0.004 \text{ thru } 0.008 \text{ in})$$



- 1 Cover
- 2 External segments
- 3 Internal segments
- 4 Spacer
- 5 Carrier

To check that clearance **G** is within the specified tolerances, proceed as follows:

1. Rest the supporting base of a (suitably preloaded) dial gauge on the contact surface ② between cover ① and segment pack, by operating on the cover of the limited slip differential carrier; zero set the dial gauge on the mating surface ③ between cover and carrier.

2. Position the gauge supporting base on the mating surface ① between carrier ② and cover by operating on the limited slip differential carrier; have the gauge feeler contacting segment pack ③.

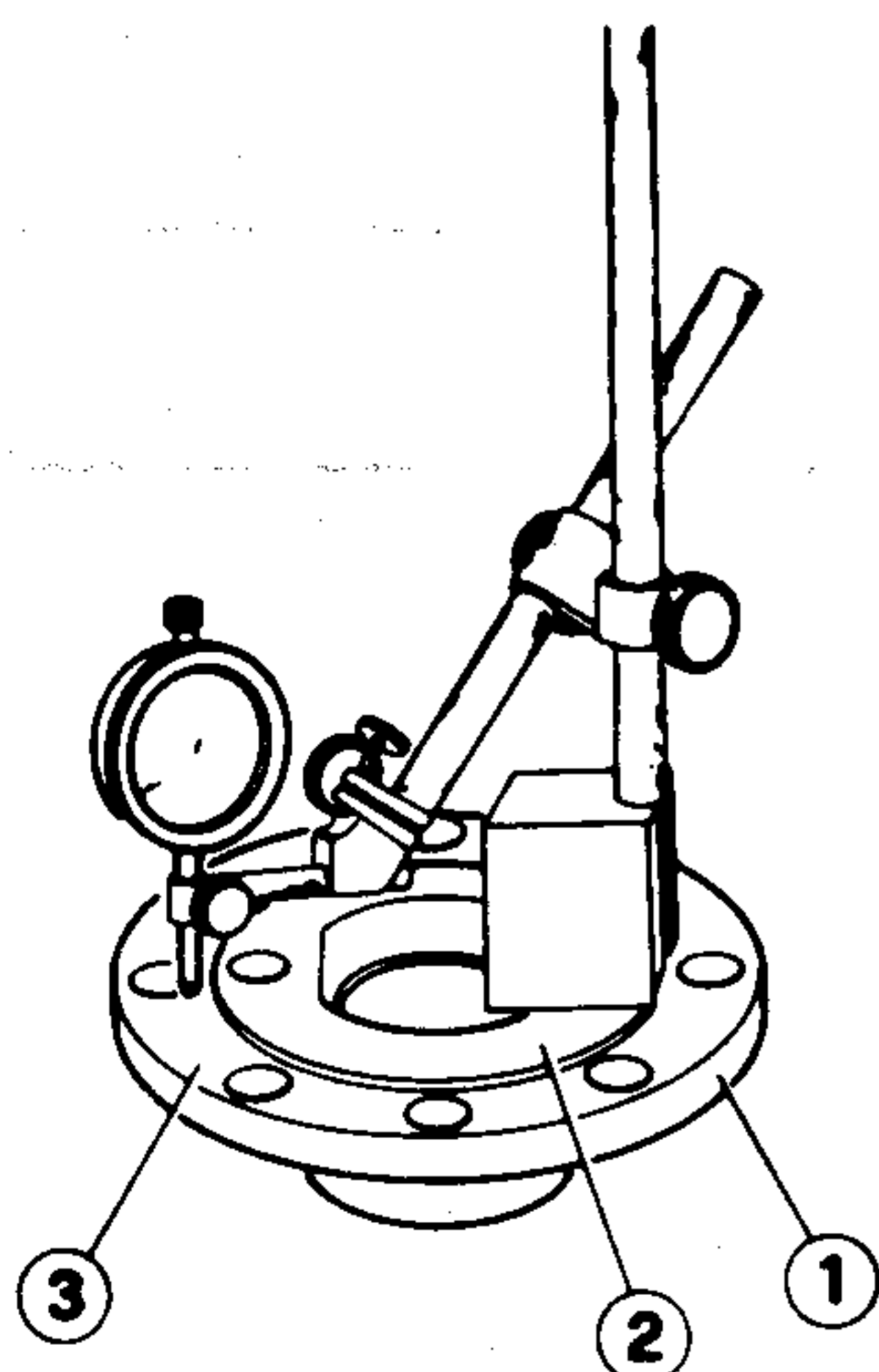
3. Read the value, with negative sign, of clearance **G**: it must be within the specified values.

Fitment clearance between cover and segment pack:

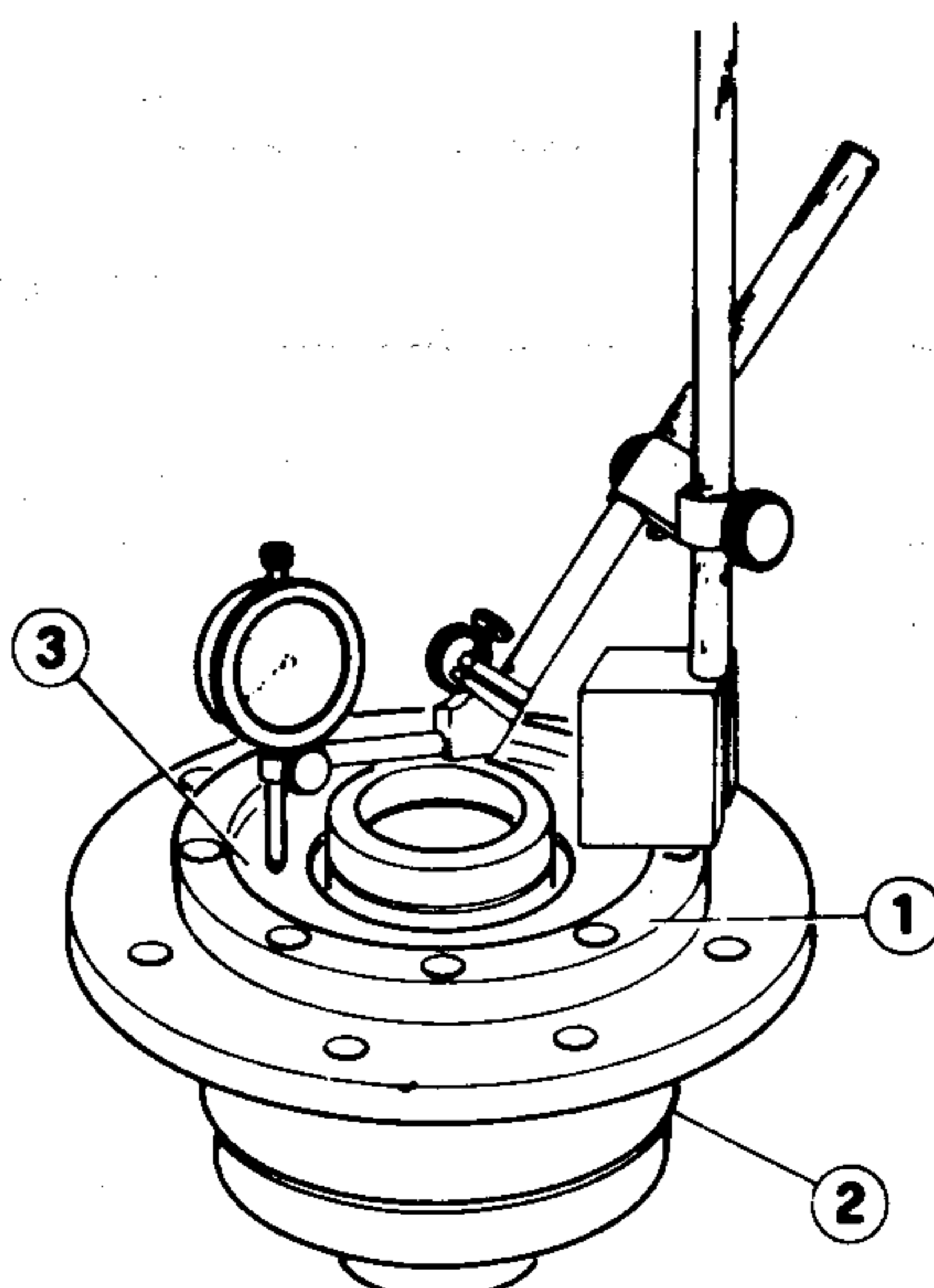
$$G = 0.1 \text{ thru } 0.2 \text{ mm} \\ (0.004 \text{ thru } 0.008 \text{ in})$$

NOTE:

Apply a load of 10 Kg (22 lb) to the segment pack.



- 1 Cover
- 2 Cover-segment pack contact surface
- 3 Cover-carrier mating surface



- 1 Carrier-cover mating surface
- 2 Carrier
- 3 Segment pack

DIFFERENTIAL AND DRIVE SHAFT UNIT

TIGHTENING TORQUES

[N·m (kg·m; ft·lb)]

| Application | Two side pinions differential | Four side pinions differential | Slip limited - four - side pinion differential |
|--|--------------------------------------|--|--|
| Screws securing spacers and brake discs to internal drive shafts | | 49 to 54 (5 to 5.5; 36.1 to 39.8) | |
| Screws securing propeller shaft joint to clutch shaft fork | 39 to 49 (4 to 5; 28.9 to 36.1) | 55 to 57 (5.6 to 5.8; 40.5 to 41.9) | |
| Screws securing external drive shafts to internal drive shafts (1) | 29 to 35 (3 to 3.6; 21.7 to 26.0) | 44 to 54 (4.5 to 5.5; 32.5 to 39.8) | |
| Screws securing covers to differential speed gear casing | | 18 to 21 (1.8 to 2.2; 13.0 to 15.9) | |
| Screws securing ring bevel gear to differential carrier (in oil) | | 67 to 74 (6.8 to 7.5; 49.2 to 54.2) | |
| Pinion shaft securing nut | | 112 to 124 (11.4 to 12.6; 82.4 to 91.1) | |
| Nut securing spacers and intermediate flange to differential-speed gear casing | | 112 to 124 (11.4 to 12.6; 82.4 to 91.1) | |
| Securing screws of differential speed gear casing cover | | 19 to 23 (1.9 to 2.3; 13.7 to 16.6) | |
| Nuts securing brakes calipers to differential-speed gear casing | | 45 to 52 (4.6 to 5.3; 33.3 to 38.3) | |
| Unions of brakes and clutch control system piping: — Pipes — Hoses | | 8 to 10 (0.8 to 1; 5.8 to 7.2) 10 to 15 (1 to 1.5; 7.2 to 10.8) | |
| Reverse speed engagement indicator switch (on speed gear-differential casing) | | 23 to 26 (2.3 to 2.7; 16.6 to 19.5) | |
| Nut securing plate for Reverse speed engagement safety device | | 8.3 to 10.3 (0.9 to 1.05; 6.5 to 7.6) | |
| Bolt securing rear support rubber bushing of clutch-speed gear-differential unit | | 71 to 89 (7.2 to 8.9; 52.1 to 64.3) | |
| Screws securing speed gear-differential unit to lateral support small block | | 18.6 to 23.5 (1.9 to 2.4; 13.7 to 17.4) | |

(1) Use the grease prescribed: ISECO Molykote BR2

DIFFERENTIAL AND DRIVE SHAFT UNIT

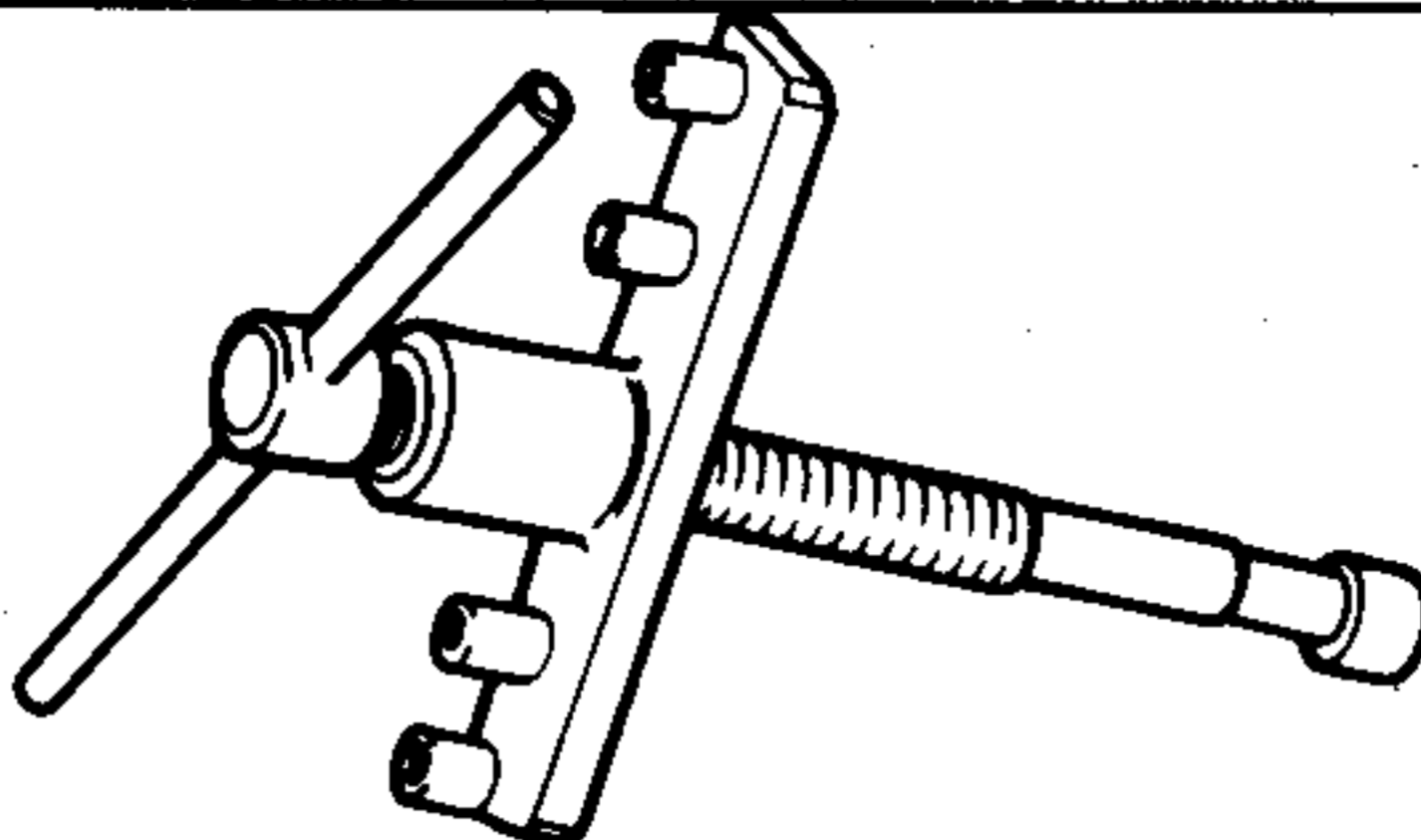
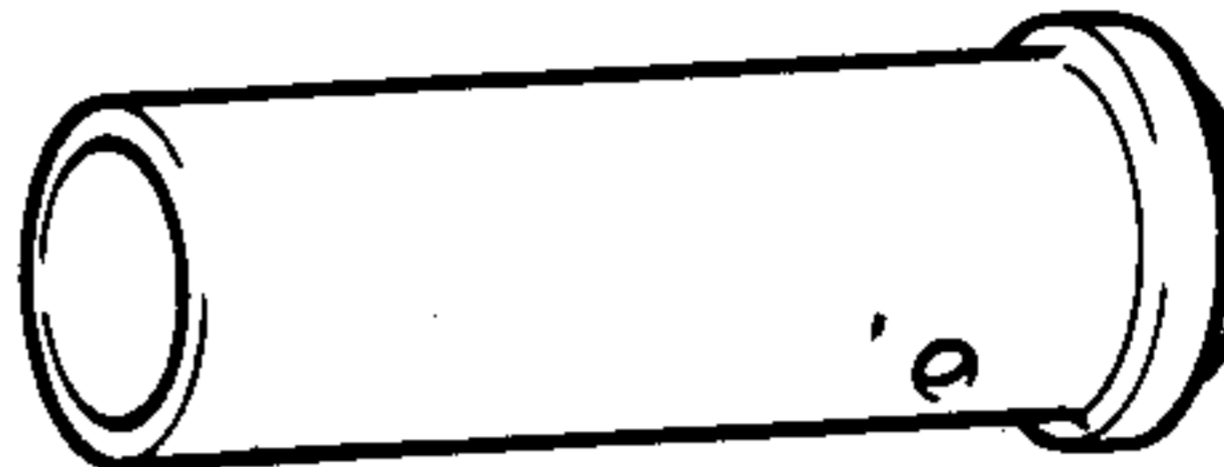
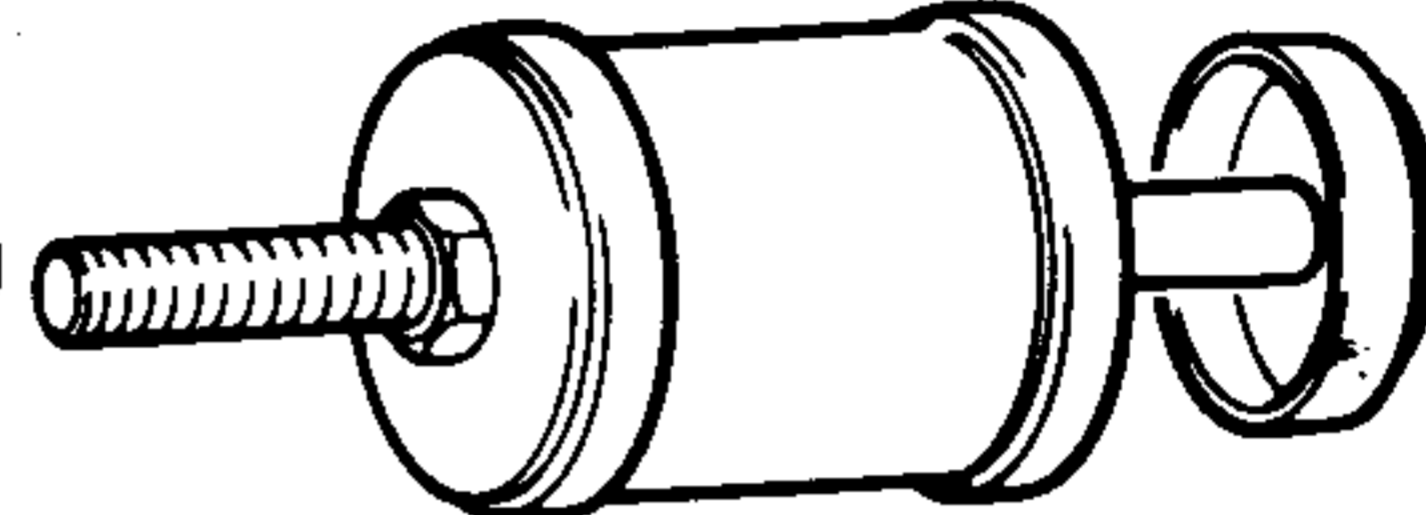
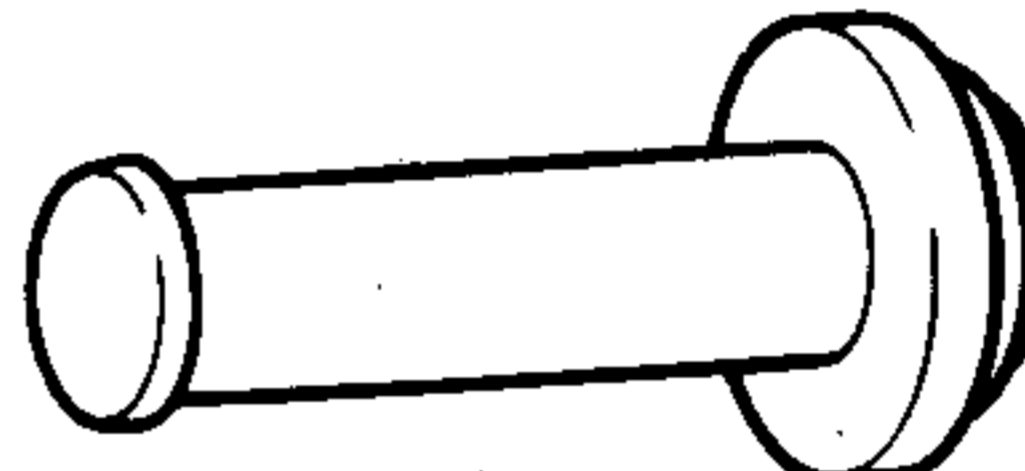

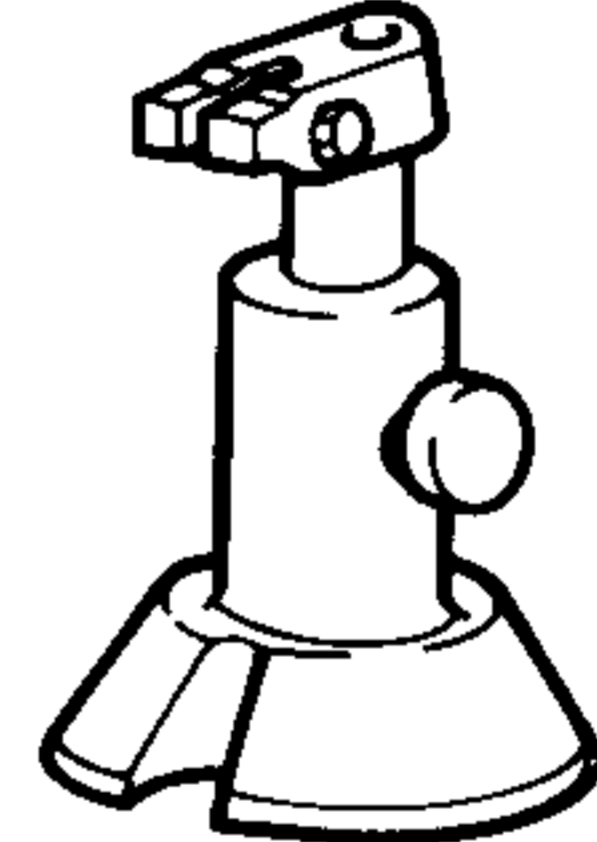
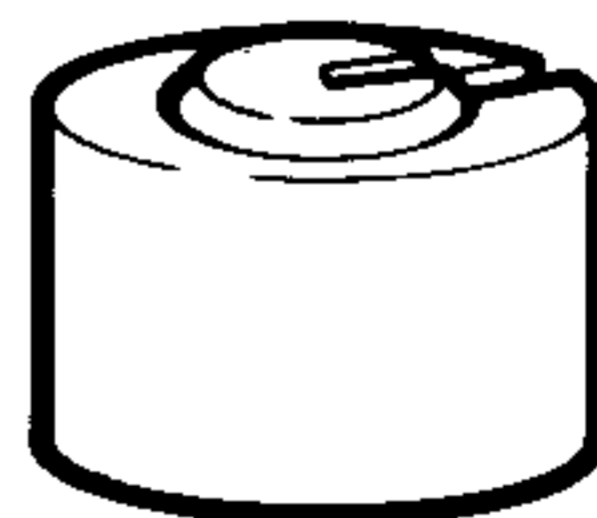
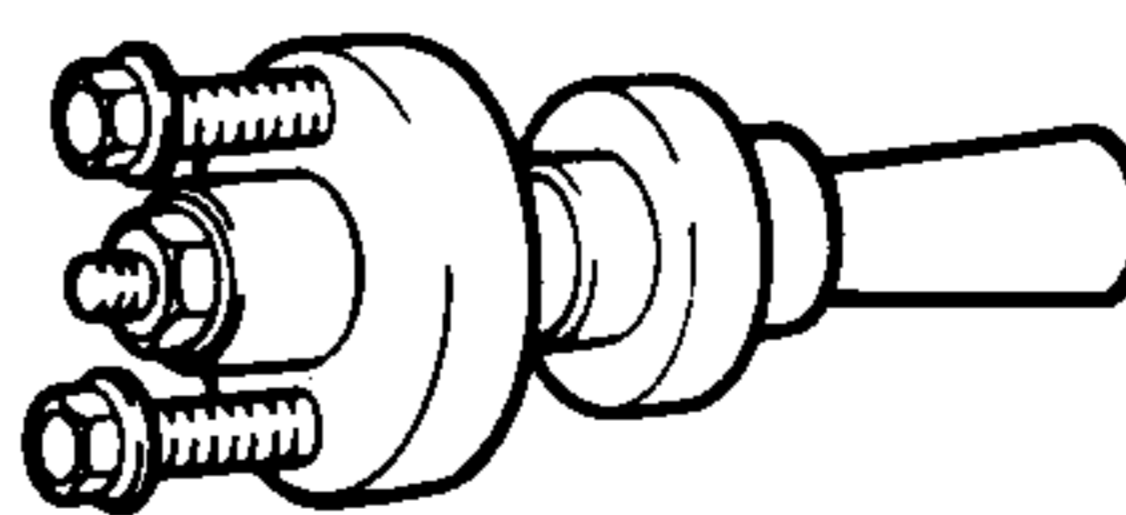
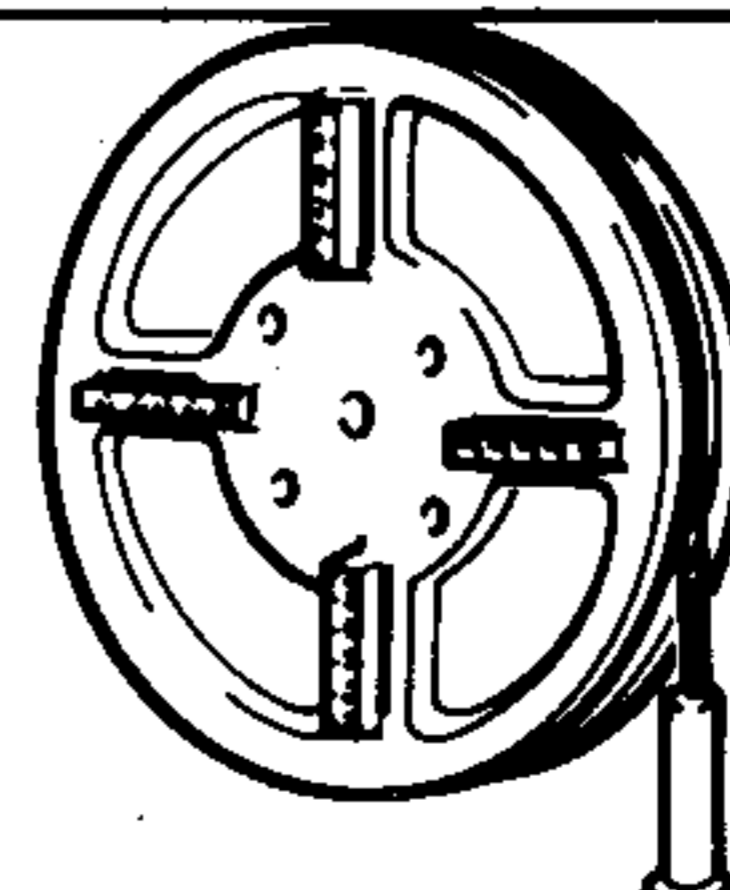
TROUBLE DIAGNOSIS AND CORRECTIVE ACTION

In the event of malfunctions, refer to: Group 13 - "Trouble Diagnosis and corrective action" so as to identify the probable cause and define the corrective operations to be performed.

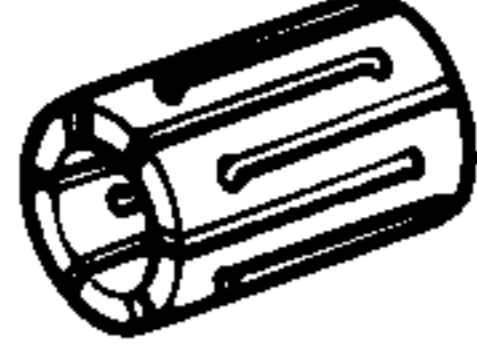
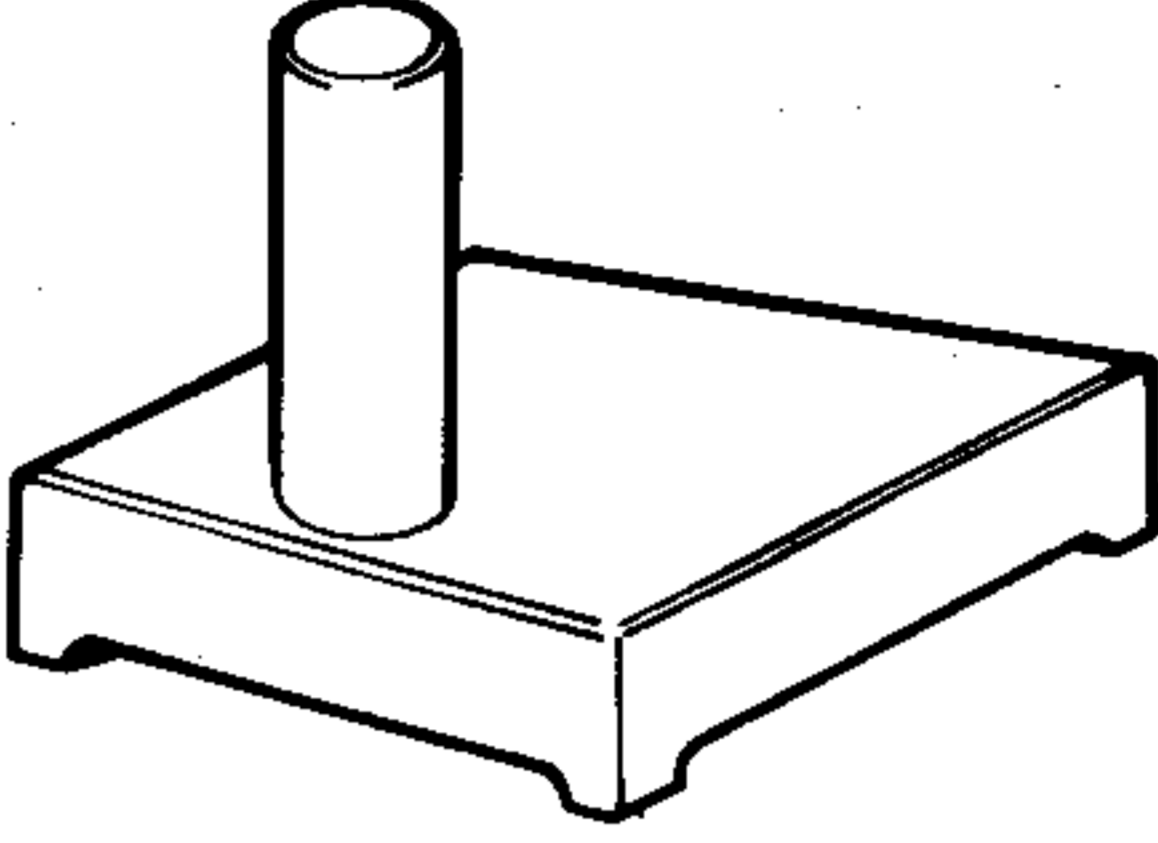
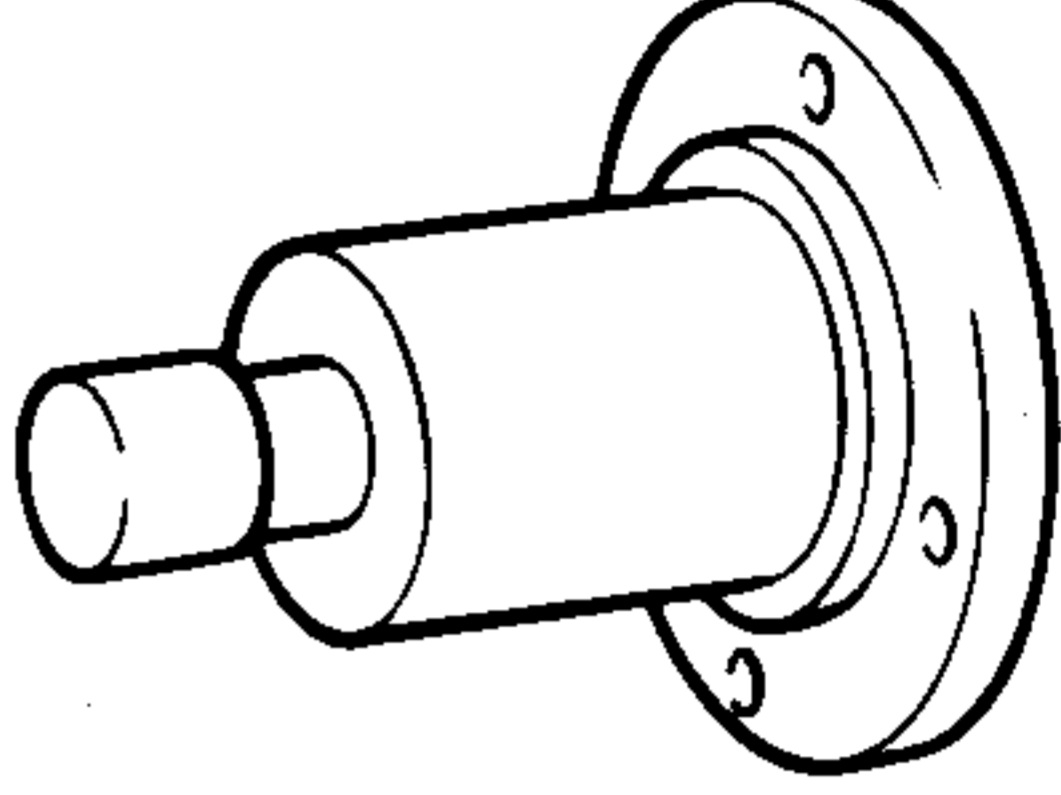
SPECIAL SERVICE TOOLS

| Tool Number | Tool name | Page Ref. |
|-------------|--|----------------------------------|
| A.2.0175 | Spacer for locking pinion shaft to intermediate flange (to be used with A.2.0250) | 17-16 17-22 17-23 |
| A.2.0247 | Plate for removing retaining ring nut of differential internal drive shaft bearing | 17-9 |
| A.2.0248 | Plate for removing differential internal drive shaft | 17-9 |
| A.2.0250 | Tool for locking pinion shaft (to be used with A.2.0175) | 17-22 17-23 |
| A.2.0267 | Dummy rods for striking rod balls and speed engagement detent balls. | 17-16 17-24 |
| A.3.0272 | Driver for internal and external rings of differential carrier taper bearings. | 17-15 17-16 17-20 17-21 |
| A.3.0287 | Adjustable span puller for differential carrier taper bearing inner races. | 17-12 |

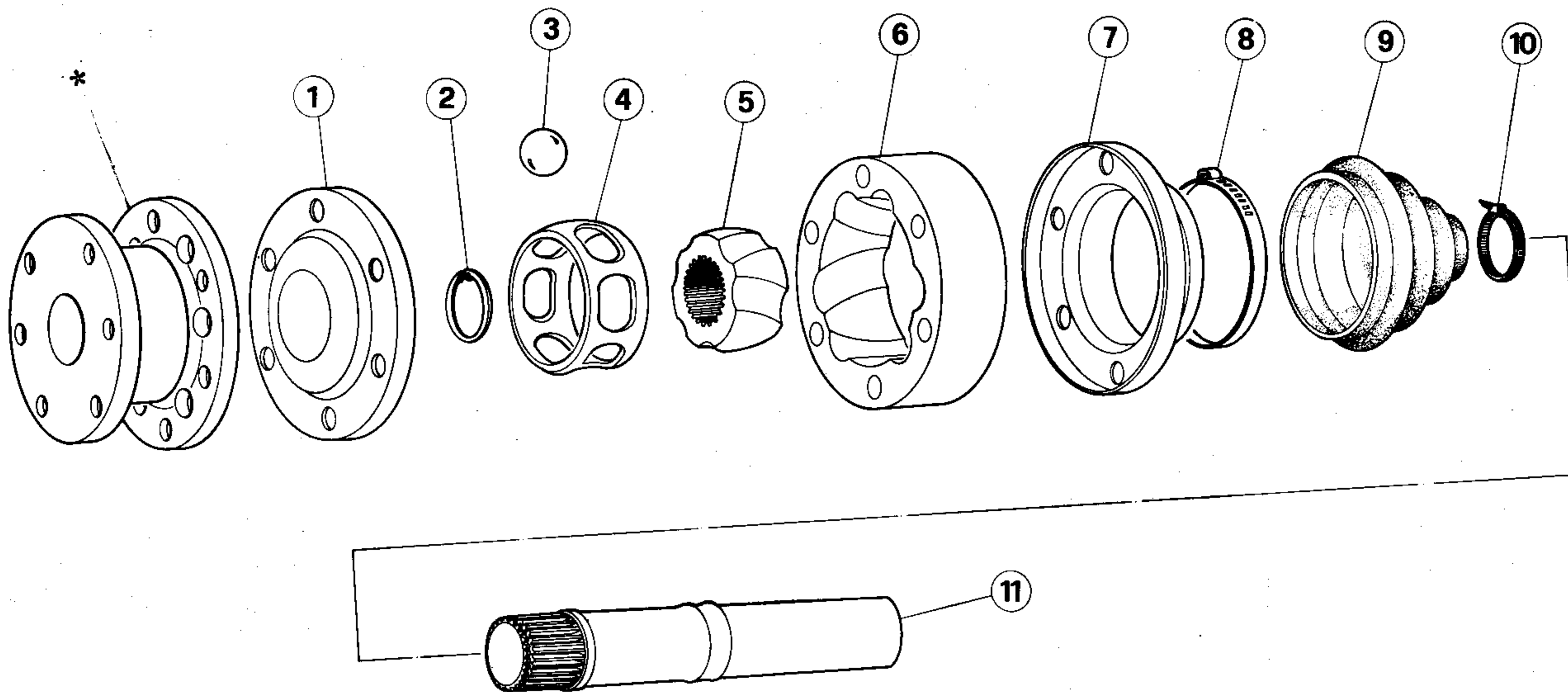
DIFFERENTIAL AND DRIVE SHAFT UNIT

| Tool Number | Tool name | Page Ref. |
|-------------------|---|-------------------------|
| A.3.0348 | Puller-driver for outer race of pinion shaft rear roller bearing (to be used with A.3.0593)  | 17-24 17-25 |
| A.3.0412 | Driver for insertion of bearing and ring nut on differential internal drive shaft  | 17-10 |
| A.3.0413 | Puller-driver of rear rubber bushing securing clutch-speed gear-differential unit to body  | 17-25 |
| A.3.0430 | Driver for insertion of oil seal ring on differential internal drive shaft covers.  | 17-10 |
| A.3.0593 | Bushing for pulling and driving outer race of pinion shaft rear roller bearing (to be used with A.3.0348)  | 17-24 17-25 |
| A.4.0136 | Support of dial gauge for pinion setting (to be used with C.6.0164 und C.6.0163)  | 17-17 17-18 |
| C.2.0037-100/2000 | Weights for checking bearings preload n.7 items - (to be used with C.5.0124, C.5.0123 and C.5.0125)  | 17-20 17-21 |
| C.5.0123 | Tool for checking preload of differential casing bearings (to be used with C.5.0124, C.2.0037 and C.5.0125)  | 17-20 17-21 |
| C.5.0124 | Sheave for checking preload of differential casing bearings (to be used with C.5.0123, C.2.0037 and C.5.0125)  | 17-20 17-21 17-23 |

DIFFERENTIAL AND DRIVE SHAFT UNIT

| Tool Number | Tool name | Page Ref. |
|--|--|--|
| C.5.0125 | Spring bush for checking preload of differential casing bearings (to be used with C.5.0123, C.5.0124 and C.2.0037) |  17-20 17-21 |
| C.6.0163 (pinion head height T = 42 mm (1.65 in)) C.6.0193 (pinion head height T = 36 mm (1.42 in)) | Reference gauge for revetting of pinion position check centesimal gange (to be used with A.4.0136) |  17-17 |
| C.6.0164 | Tool for checking pinion position |  17-17 17-18 |

AXLE SHAFTS



- 1 Outer cover
- 2 Retaining ring
- 3 Ball
- 4 Cage

- 5 Inner race
- 6 Outer race
- 7 Inner cover
- 8 Outer clip

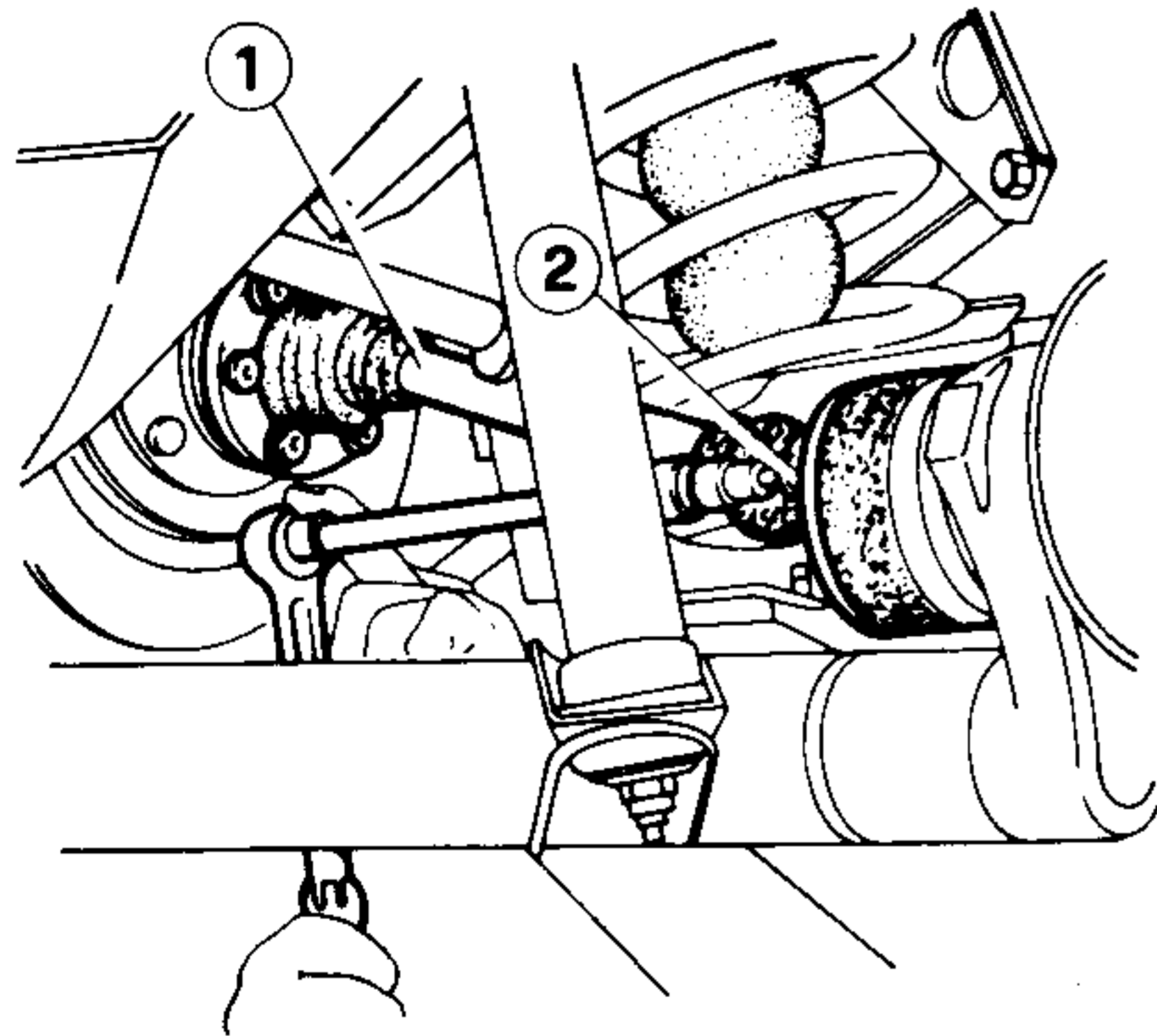
- 9 Bellows
- 10 Inner clip
- 11 Axle shaft
- * Spacer

NOTE:

For use of the spacer (*), refer to Unit 00 - Use of Units in Car.

REMOVAL

1. Place car on a lift with gear selector lever in neutral position.
2. Back off screws (2), retrieving associated lock plates and disconnect outer axle shafts (1) from wheel shafts.

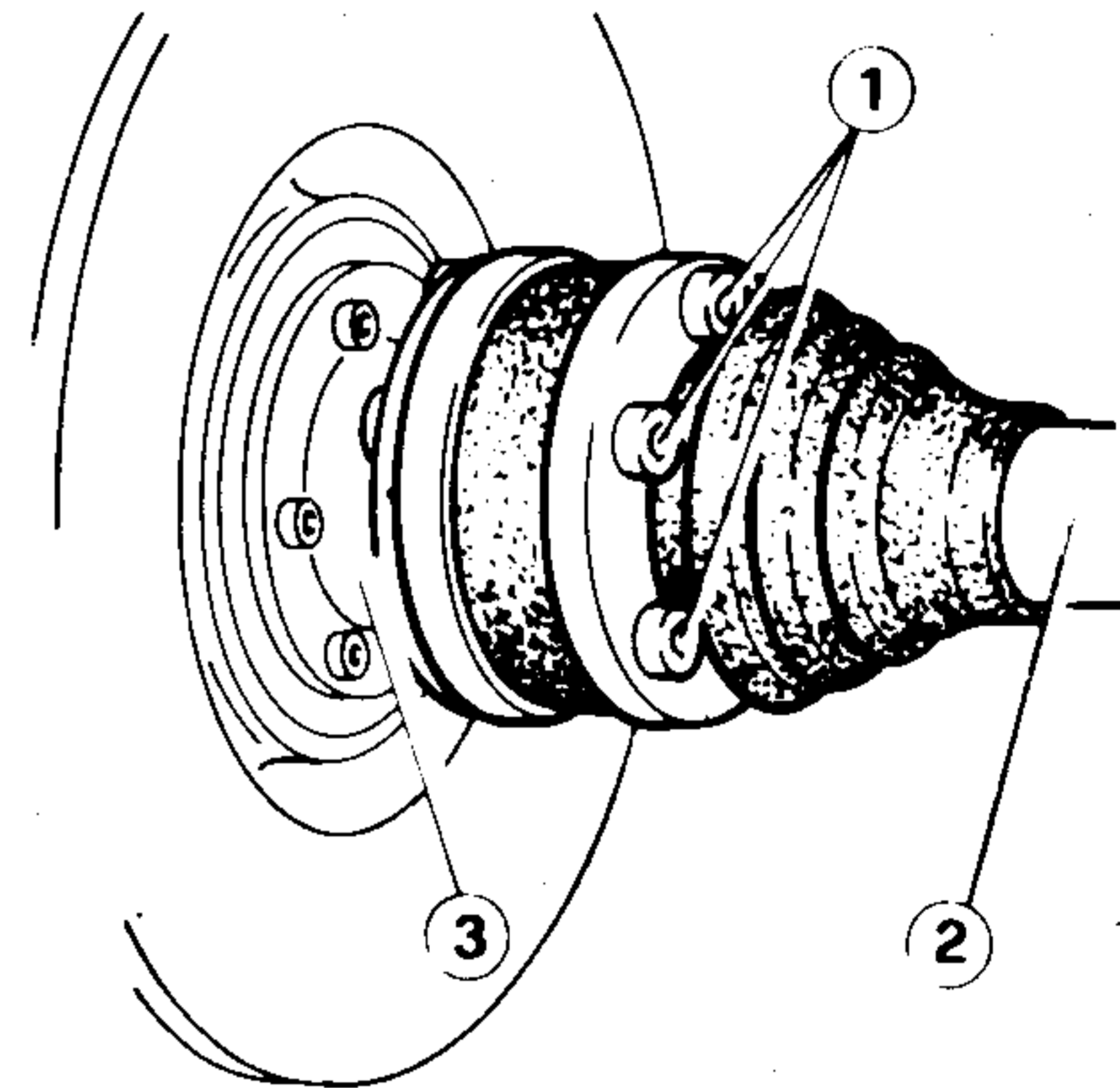
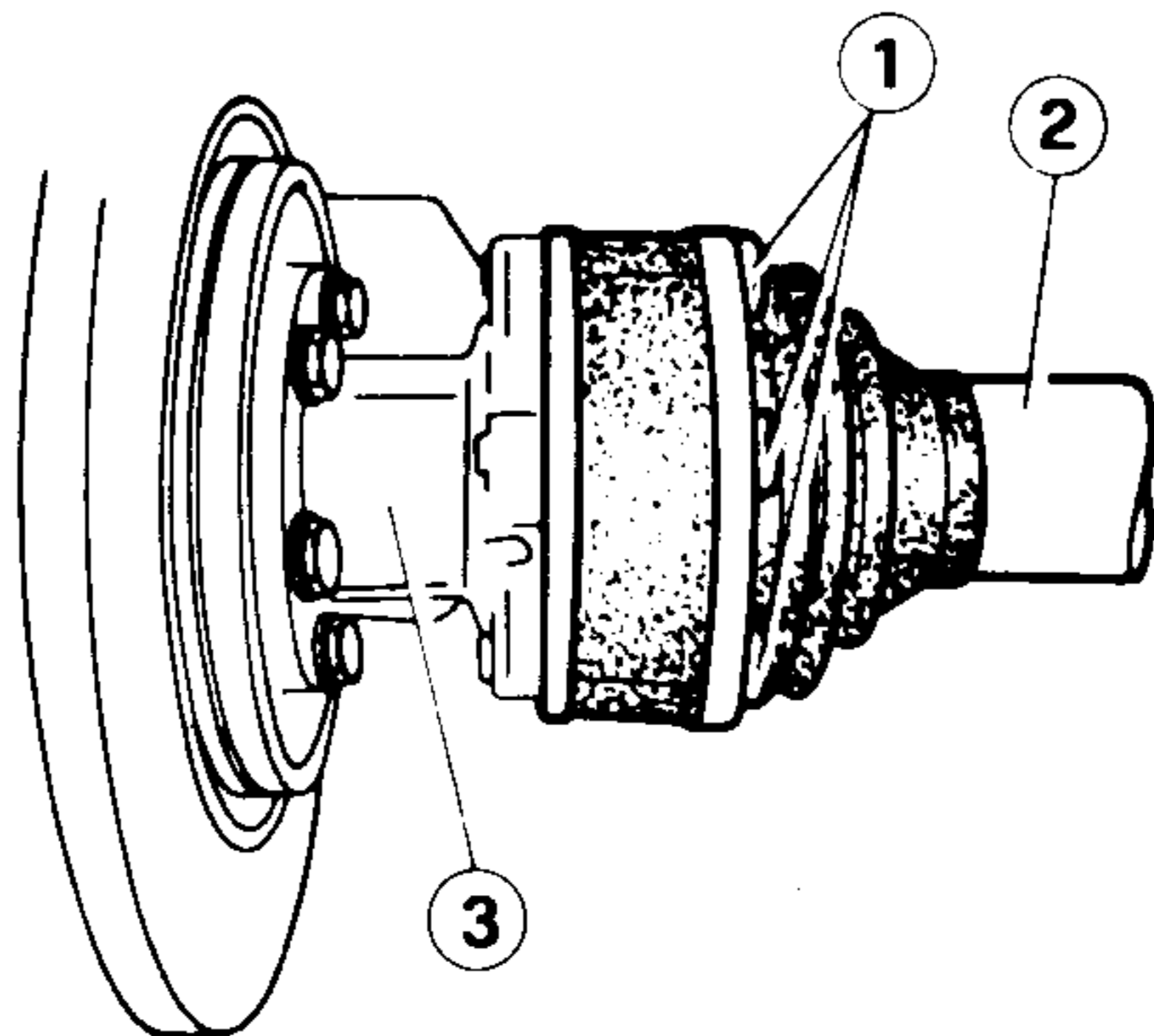


- 1 Axle shaft
- 2 Axle shaft/wheel shaft screws

WARNING:

Do not damage axle shaft joint bellows.

3. Remove the axle shafts.
 - For cars equipped with spacer. Back off screws (1), retrieving associated lock plates and remove external axle shafts (2) from spacer (3).



- 1 Axle shaft/spacer screws
- 2 Axle shaft
- 3 Spacer

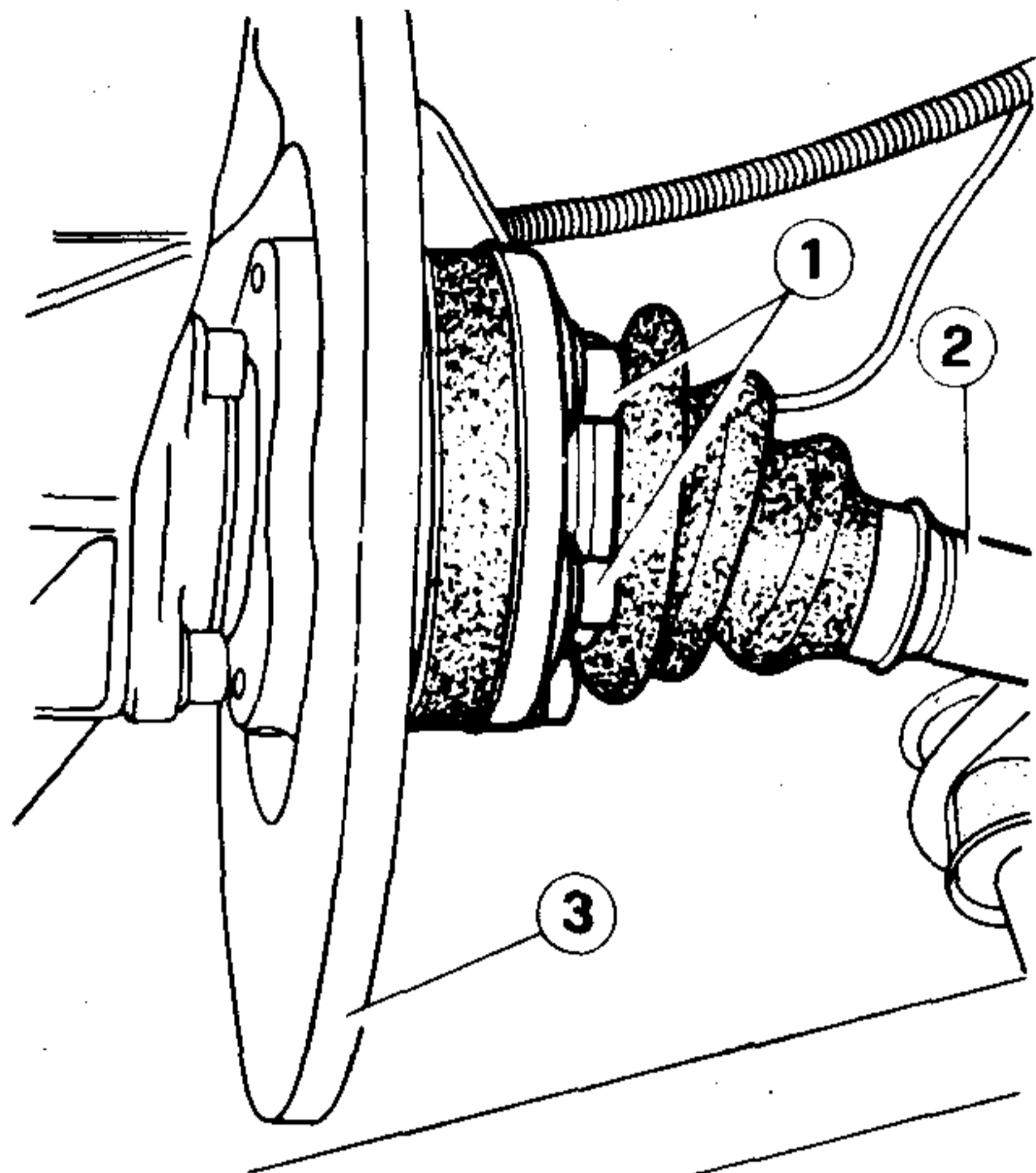
DIFFERENTIAL AND SHAFT UNIT

- For all other models

WARNING:

Take care to prevent brake disc from falling off.

Back off screws ①, retrieve associated lock plates and remove axle shafts ②.

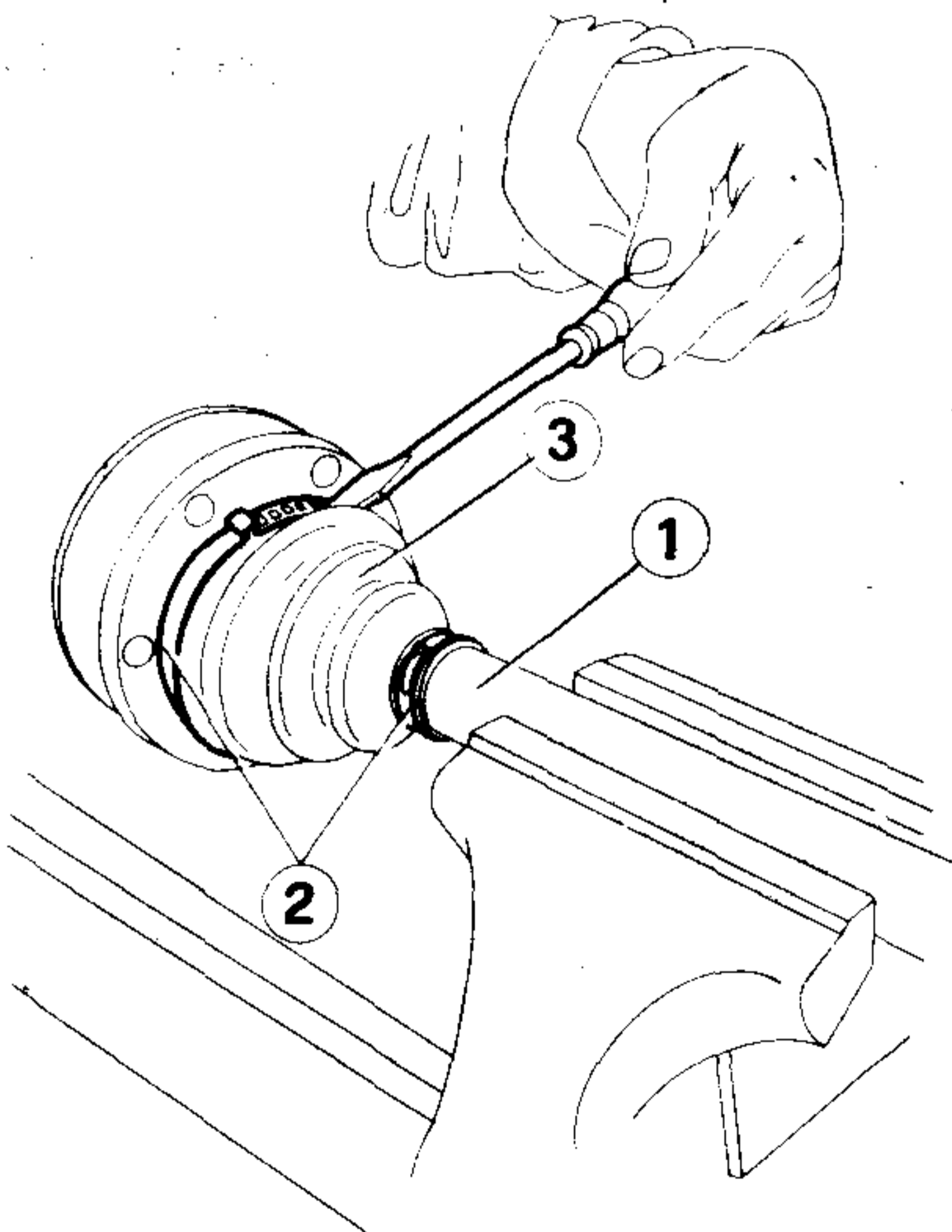


- 1 Axle shaft screws
- 2 Axle shaft
- 3 Brake disc

DISASSEMBLY

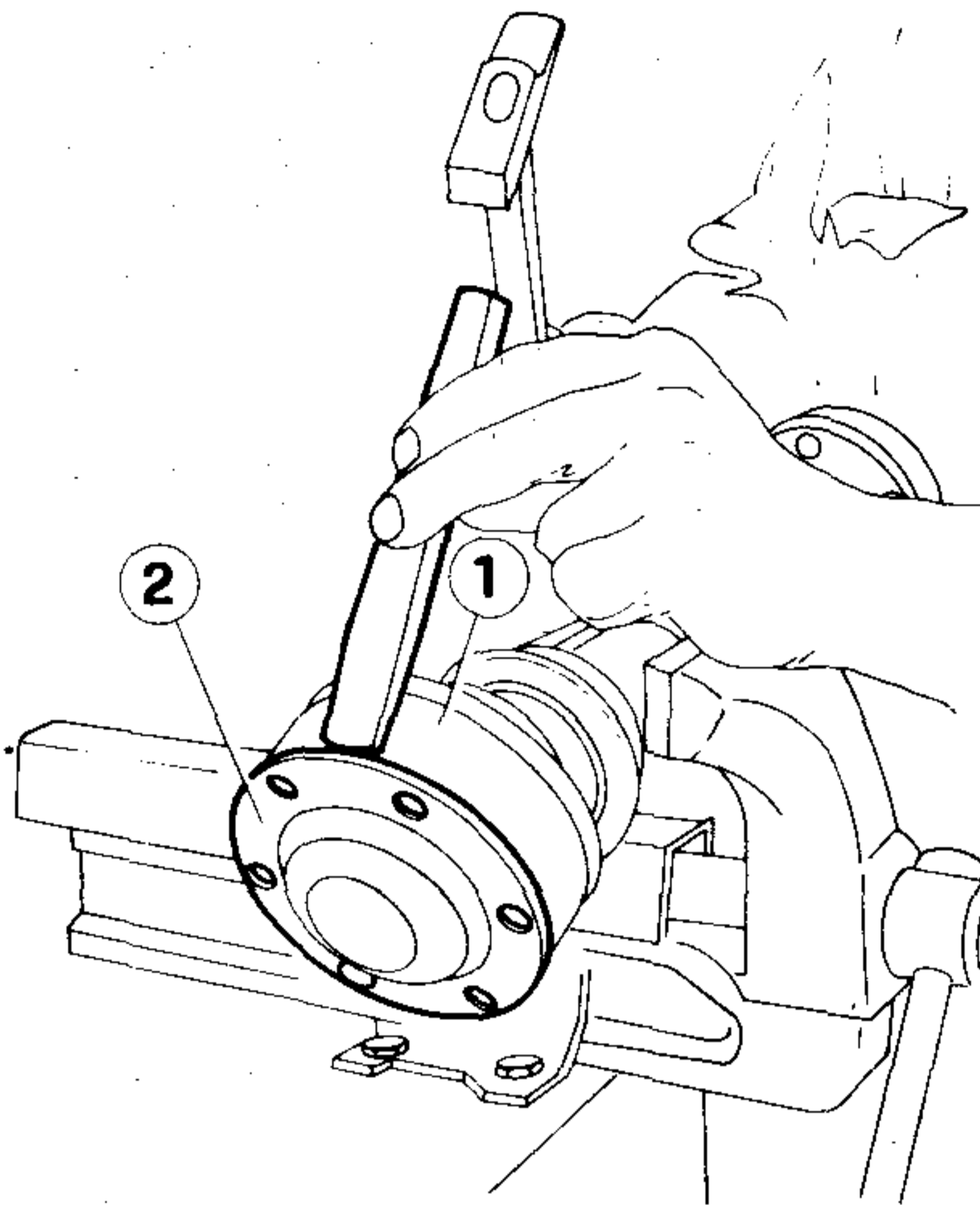
Each axle shaft is provided with two identical constant velocity U-joints, one at each end; overhaul procedure is the same for both joints.

1. Clamp axle shaft in a vice ①, remove bellows clips ② and take off bellows ③.



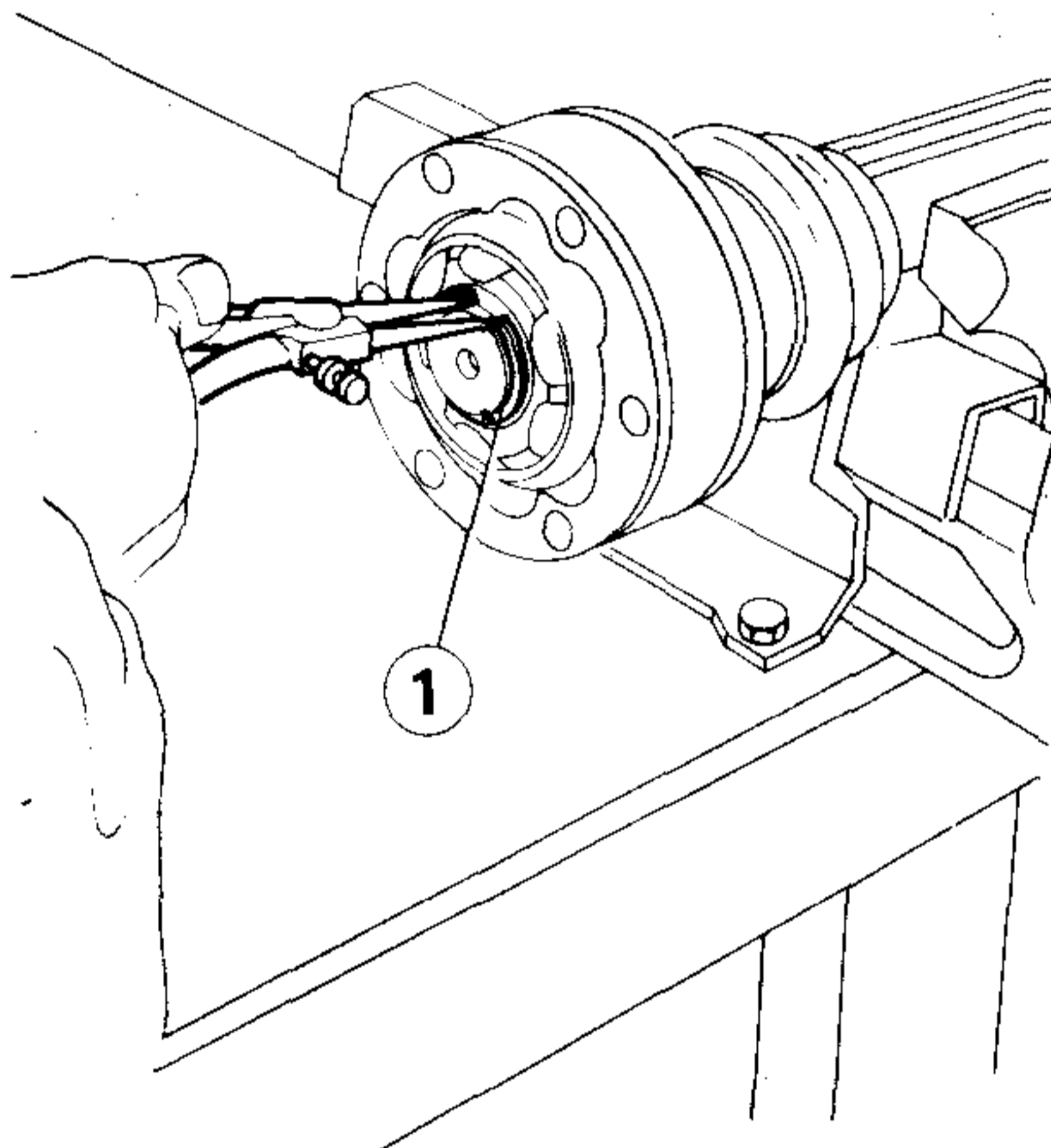
- 1 Axle shaft
- 2 Clips
- 3 Bellows

2. Take out outer cover ② from joint ①.



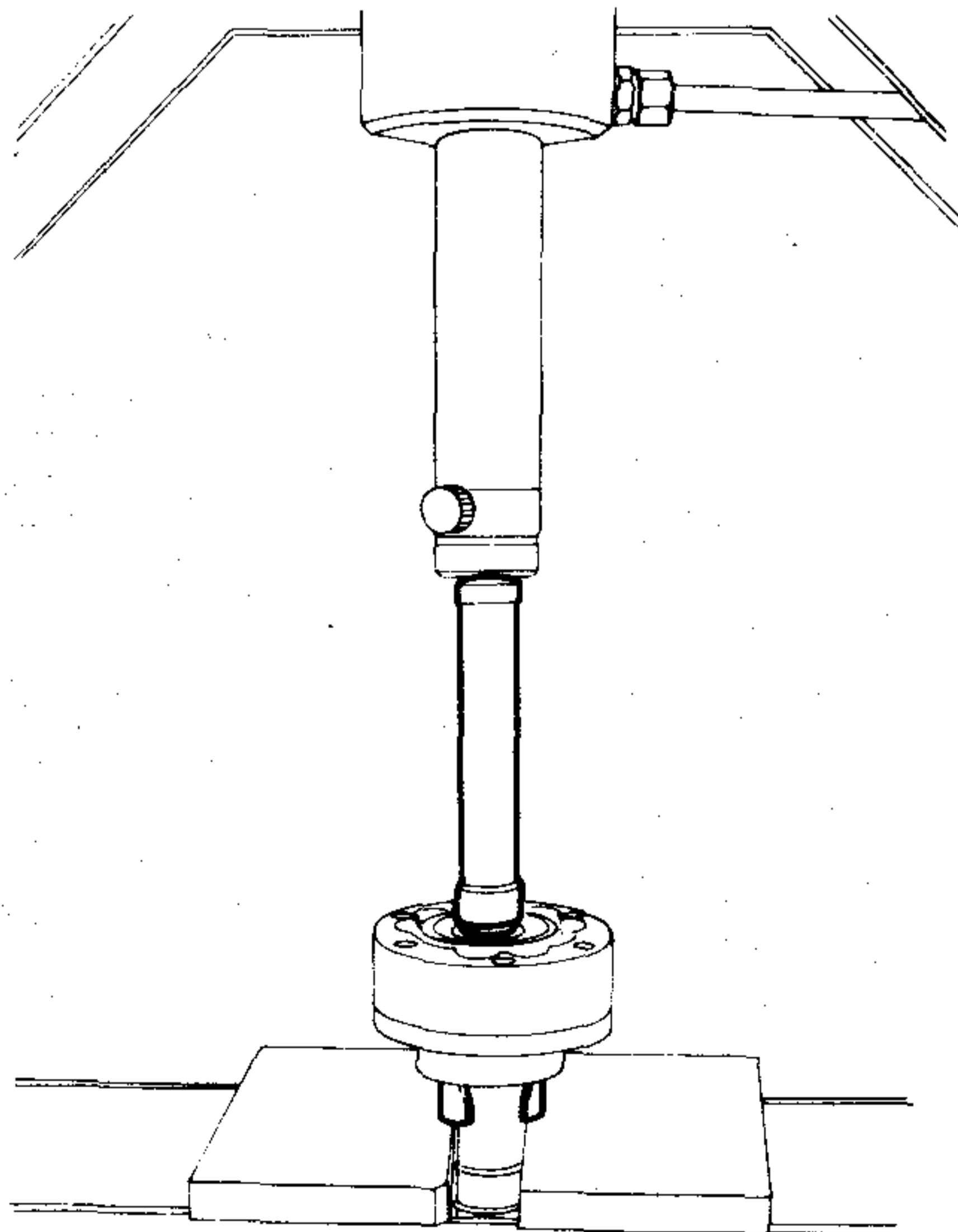
- 1 Constant velocity U-joint
- 2 Outer cover

3. Remove retaining ring ①.



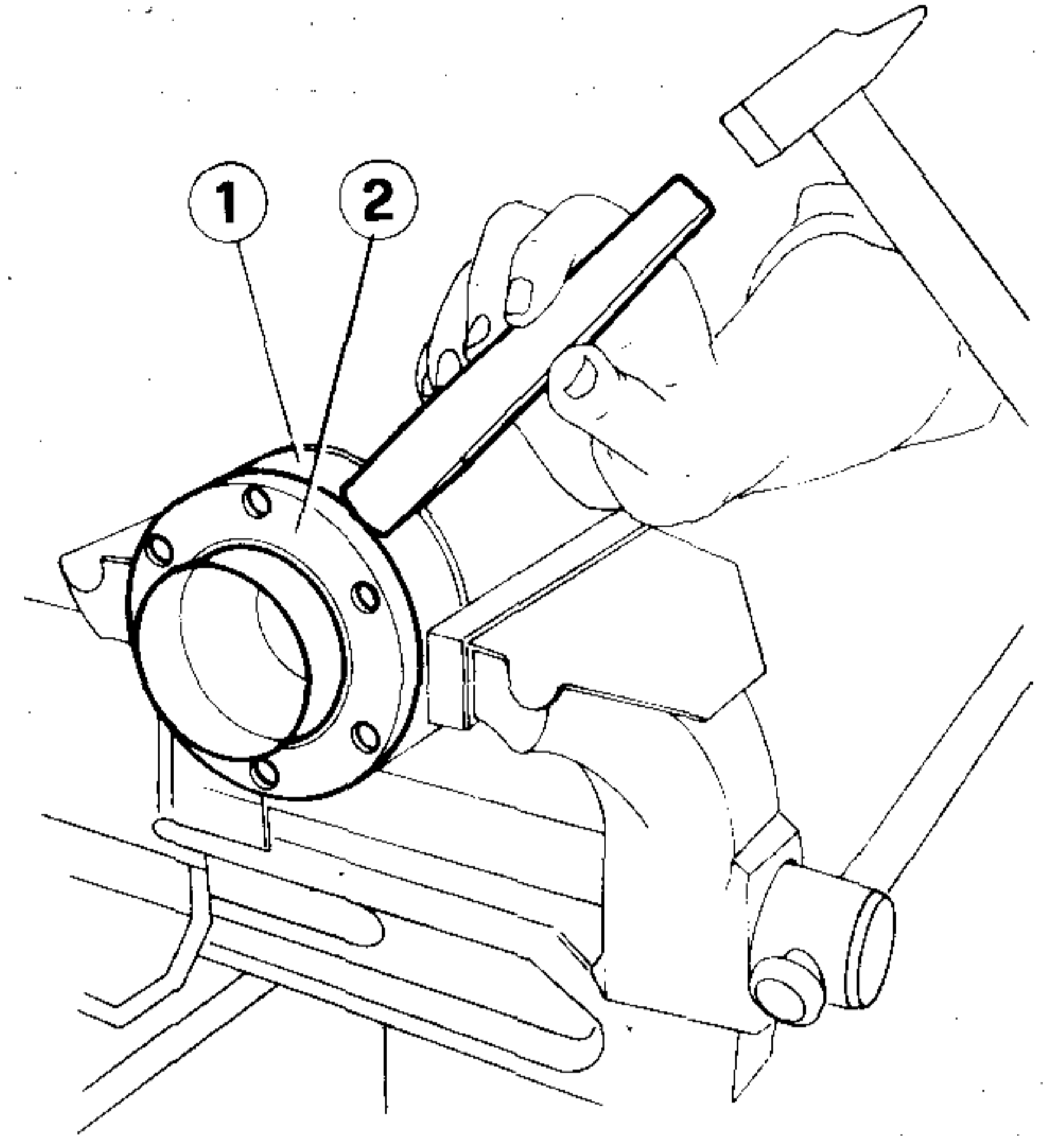
- 1 Retaining ring

4. Using two half plates, a punch and a base on a suitable press, remove constant velocity U-joint from axle shaft.



5. Slide bellows off axle shaft.

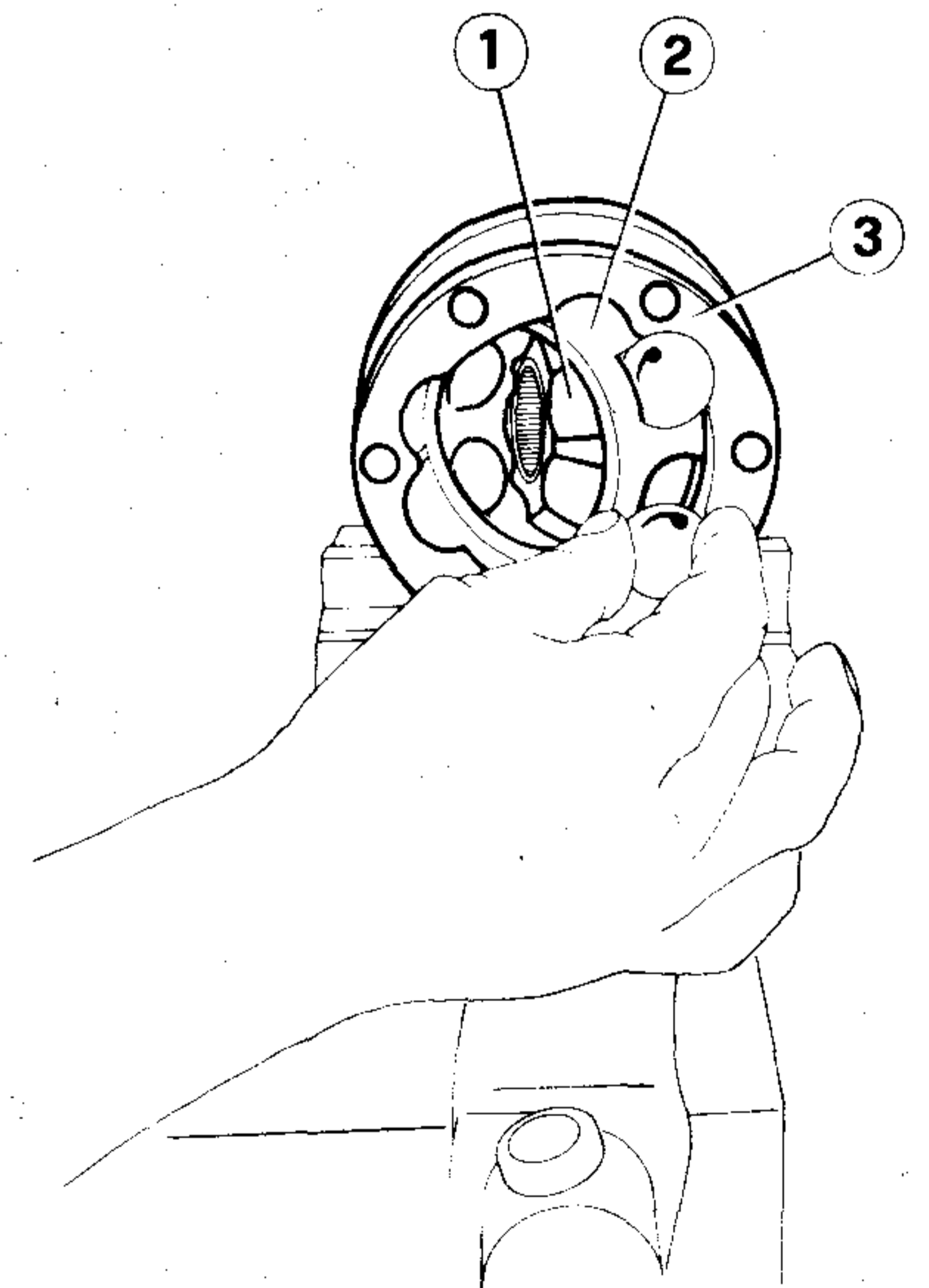
6. Clamp U-joint ① in a vice provided with protective jaw liners and take off inner cover ②.



- 1 Constant velocity U-joint
- 2 Inner cover

7. Apply suitable reference marks to inner race ①, cage ② and outer race ③ to facilitate subsequent installation.

8. Take out balls and disassemble constant velocity U-joint.



- 1 Inner race
- 2 Cage
- 3 Outer race

DIFFERENTIAL AND SHAFT UNIT

INSPECTION

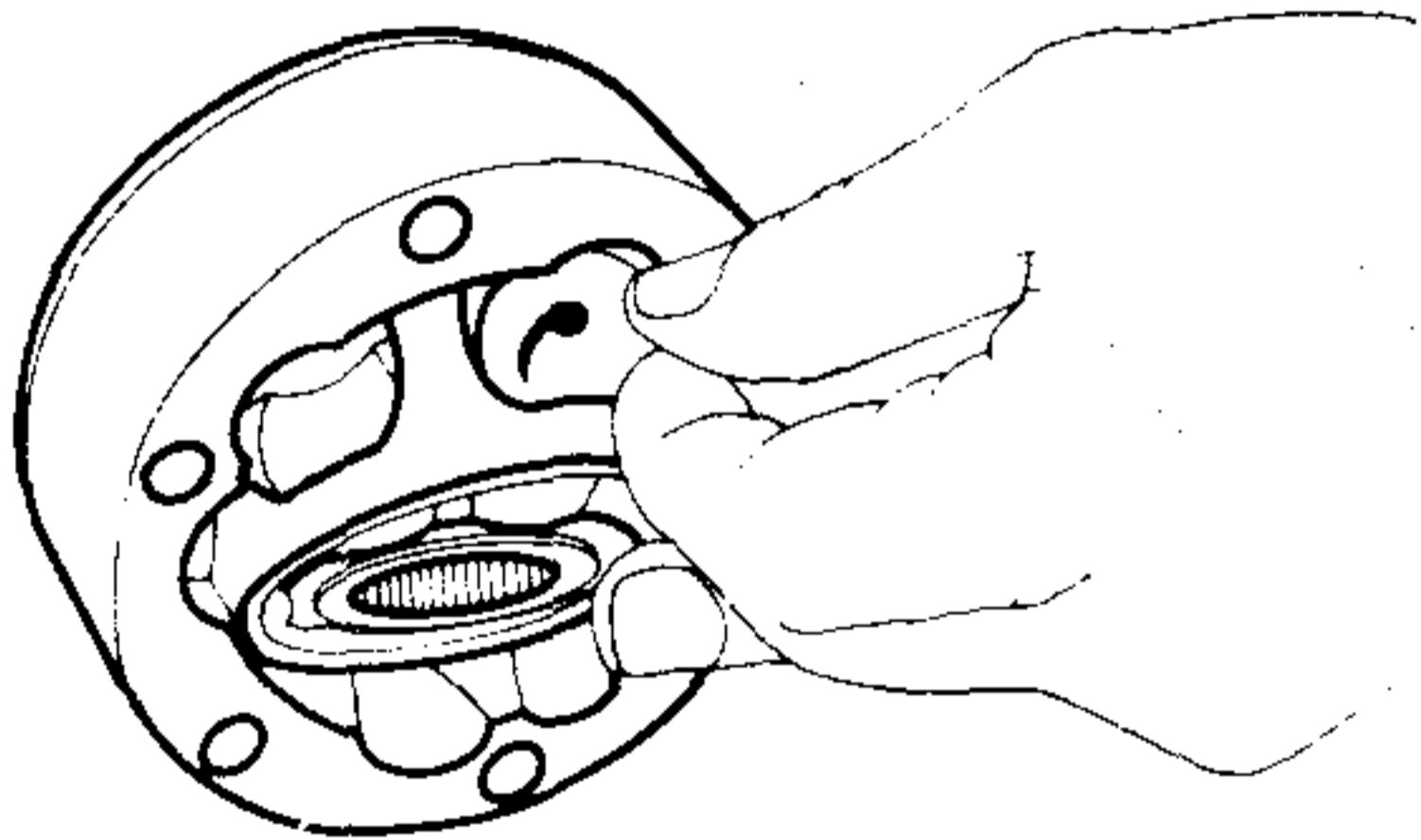
1. Thoroughly clean joint parts.
2. Check working surfaces and balls for dents and abrasion marks caused by foreign matter; replace U-joint if necessary.

Bellows failure causes loss of grease and ingress of foreign matter which could jeopardize constant velocity U-joint efficiency. Therefore, replace joint bellows without hesitation.

3. Check U-joints for excessive play causing noise during sudden torque reversal; this fault appears during overhaul giving rise to chatter.

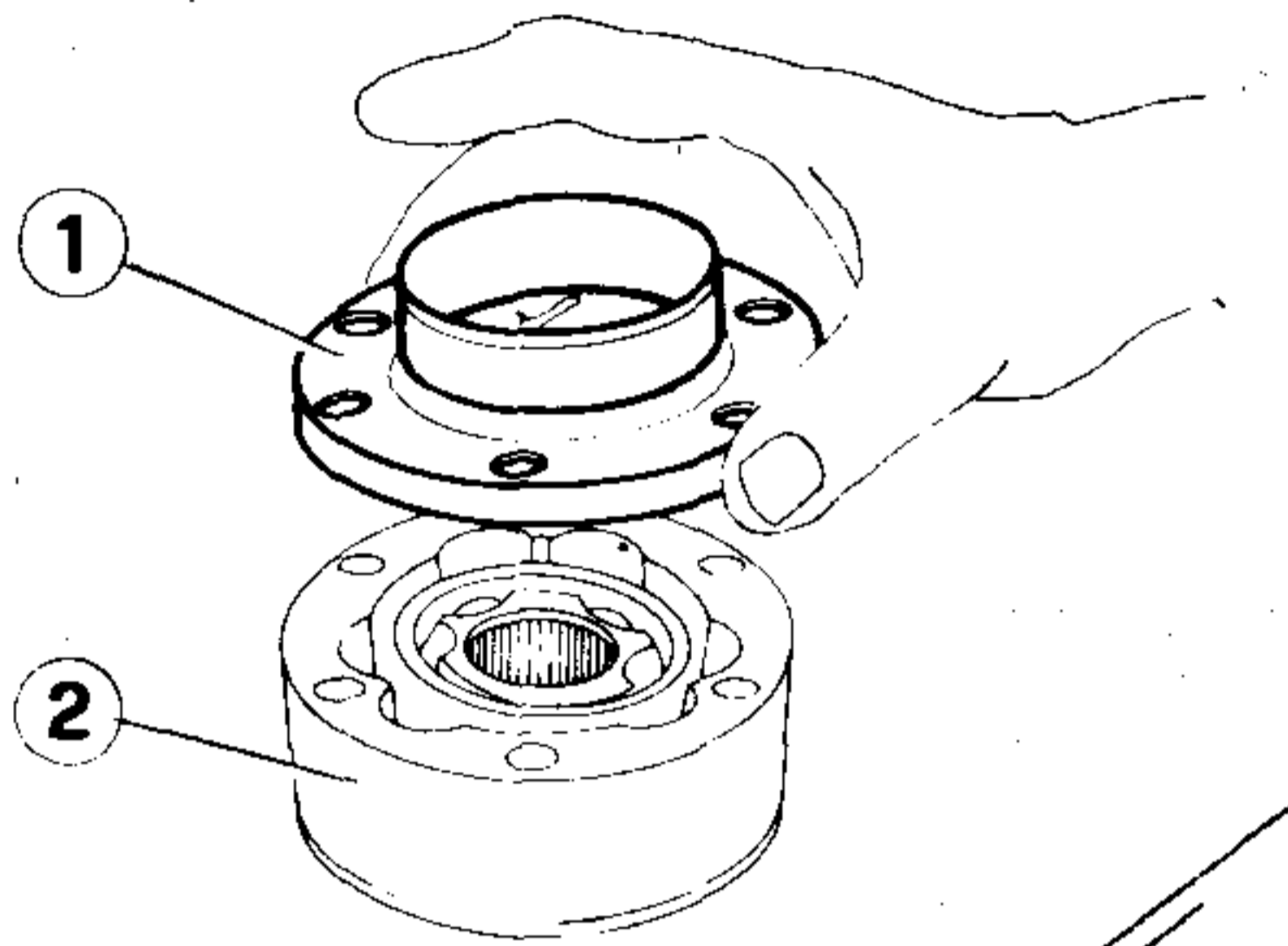
ASSEMBLY

1. Thoroughly lubricate cage, inner race and balls using recommended grease (ISECO Molykote VN 2461 C or OPTIMOL Olistamoly 2LN584) and pack joint inner chamber with the same type of grease.
2. Install inner race and cage reversing disassembly sequence and line up reference marks applied on disassembly.
3. Insert balls as shown in figure and check U-joint for correct operation.



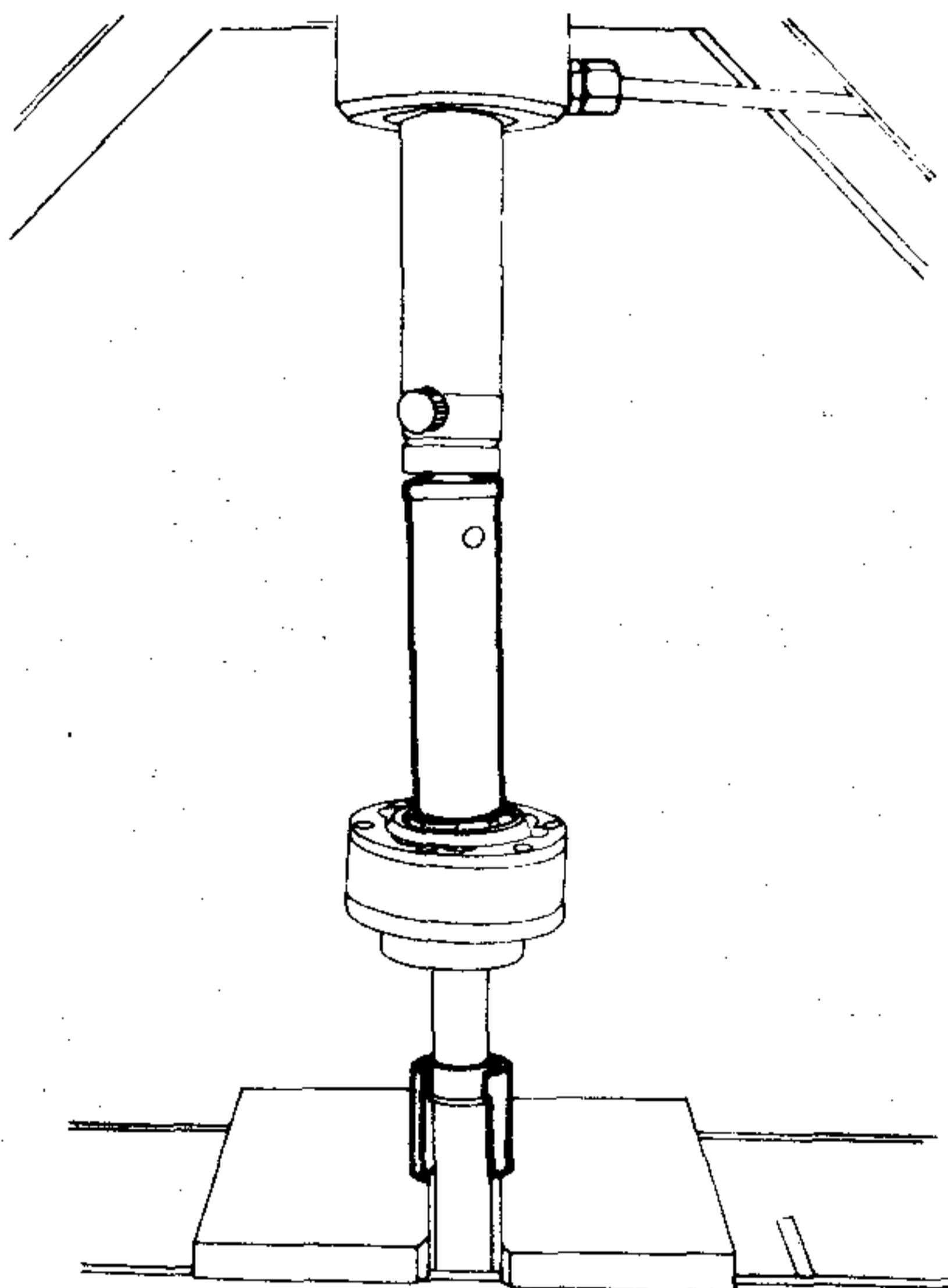
4. Install bellows on axle shaft after taping to prevent damage.

5. Apply the specified jointing compound (DIRING Curil K2) to mating surfaces of cover and joint and install inner cover (1) on joint (2) lining up the holes.



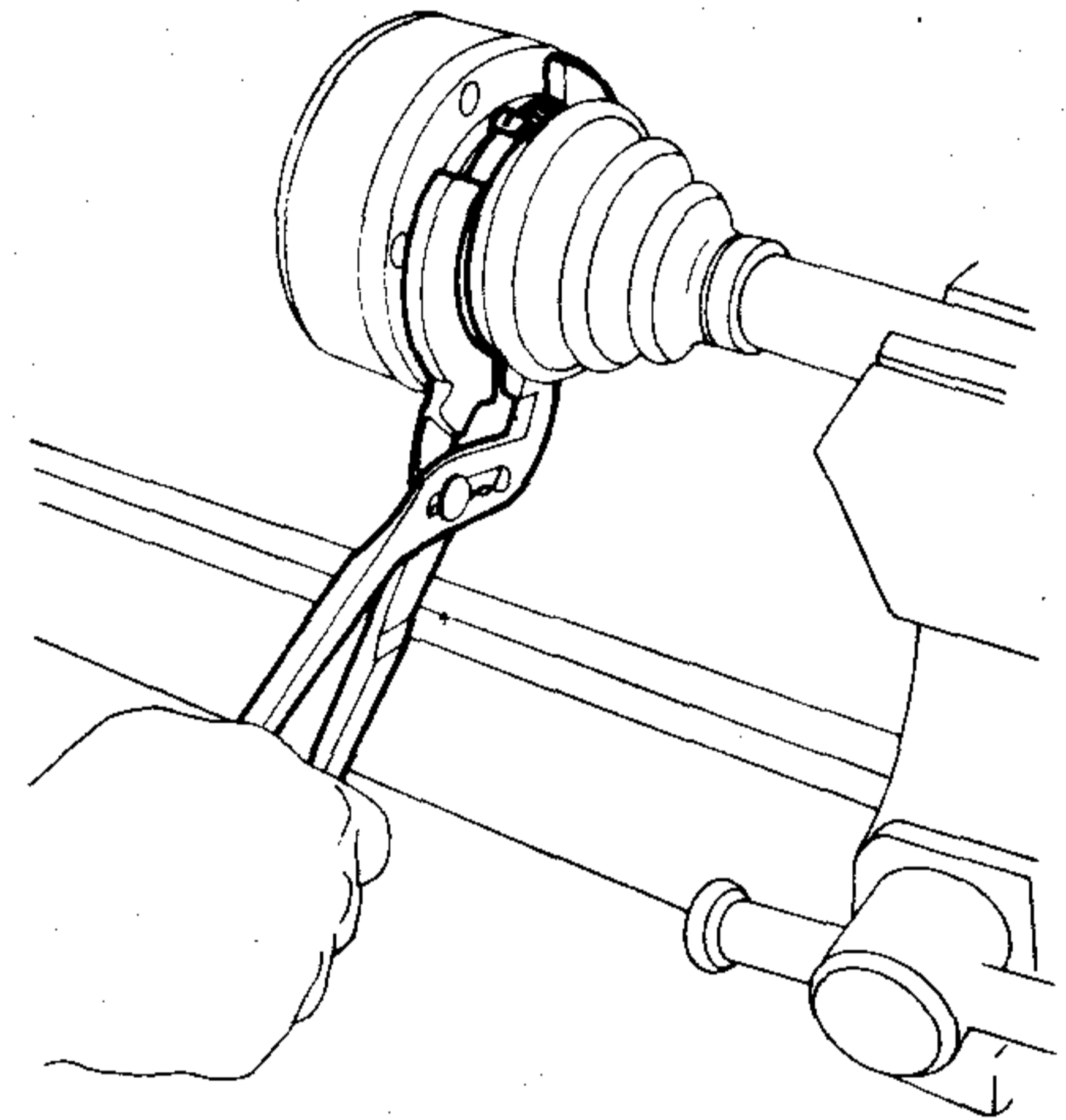
- 1 Inner cover
- 2 Constant velocity U-joint

6. Reverse the disassembly sequence to press constant velocity U-joint fully home on axle shaft at the press.



7. Pack joint with grease as per para. 1 (quantity: see Inspection Specifications - Fluids and Lubricants) ensuring that an equal amount of grease is provided on both sides of the row of balls.

8. Install retaining ring on axle shaft end and check for correct position.
9. Apply jointing compound as per para. 5 to mating surfaces of outer cover and joint and install cover lining up the holes.
10. Apply the recommended type of jointing compound (BOSTON Bostik 475 or USM 475) to mating surfaces of bellows and inner cover and install bellows.
11. Install and tighten bellows clips without cutting bellows.



INSTALLATION

Reverse removal sequence to install axle shafts and adhere to the instructions given below.

- Lubricate axle shaft retaining screw threads using the recommended type of grease (ISECO Molykote BR 2).
- Tighten screws to the specified torque (see: Inspection Specifications - Tightening Torques).

INSPECTION SPECIFICATIONS

GENERAL REQUIREMENTS

FLUIDS AND LUBRICANTS

| Description | Type | Recommended product | Quantity | |
|---|--------|--|-------------------------|----------------------------|
| | | | Axle shafts with spacer | Axle shafts without spacer |
| Axle shaft screw thread | GREASE | ISECO: Molykote BR2 Part. No. 3671-69841 | — | — |
| Axle shaft constant velocity U-joint Apply an equal amount of grease on both sides of row of balls | GREASE | ISECO: Molykote VN2461C OPTIMOL: Olystamoly 2LN584 Part No. 3671-69843 | 120 g 4.23 oz. | 70 g 2.47 oz. |

SEALANTS

| Description | Type | Recommended product |
|--|-------------------|--|
| C. V. U-joint inner and outer cover surface | Jointing compound | DIRING: Curil K2 Part. No. 3522-00031 |
| C.V. U-joint inner cover and bellows surface | Jointing compound | BOSTON: Bostik 475 U.S.M. 475 Part. No. 3521-00034 |

DIFFERENTIAL AND SHAFT UNIT

TIGHTENING TORQUES

[N·m (kg·m; ft·lb)]

| Description | Axle shafts with spacer | Axle shafts without spacer |
|--|---|---------------------------------------|
| Cap screws, axle shaft to differential and wheel shaft | | 29 to 35 (3 to 3.6) (21.4 to 25.8) |
| Cap screws, axle shaft to spacer and wheel shaft | 44 to 54 (4.5 to 5.5) (32.5 to 39.8) | |

TROUBLESHOOTING

| Trouble | Cause | Remedy |
|------------------------------------|---|---|
| Chatter during hard torque changes | <ul style="list-style-type: none"> • Excessive clearance between races and balls • Lack of grease and leakage through bellows | <p>Replace joint</p> <p>Lubricate and replace bellows</p> |