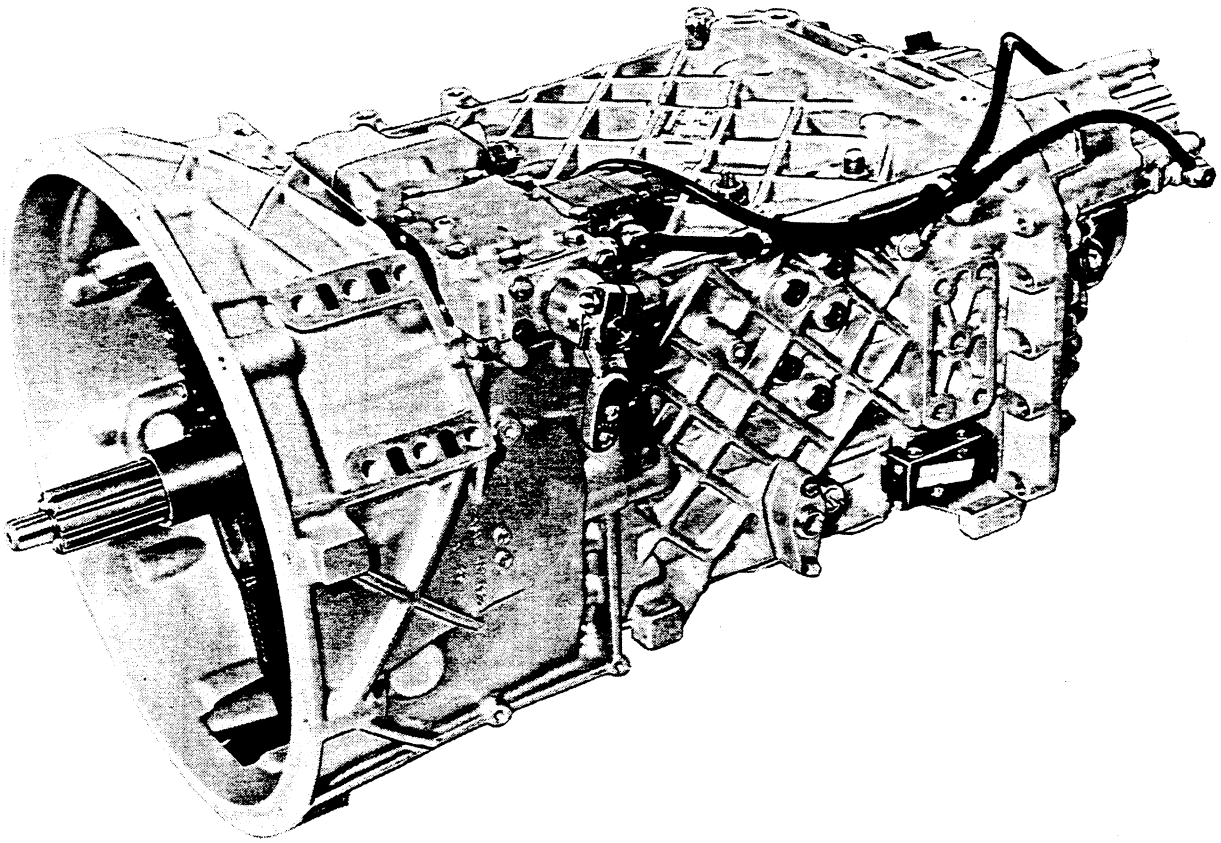
Picture of transmission 16 S 221



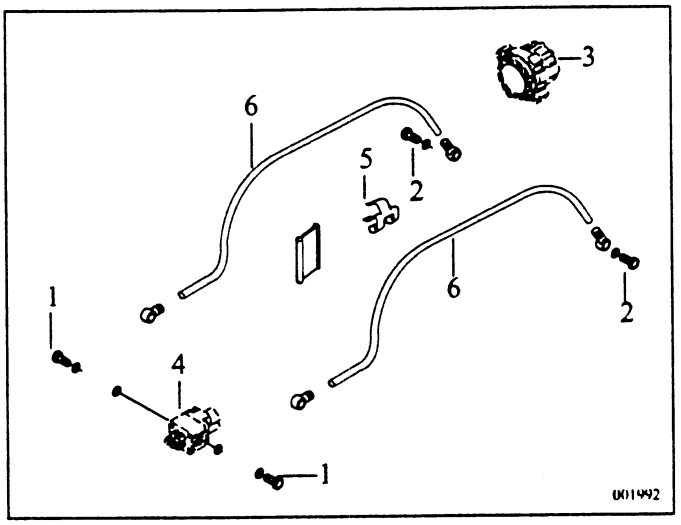
16 S 221 Removal/Range-change group

1. Removal of components/range-change group

1.1 Plastic pipes

NOTE: Label plastic pipes before removal to ensure correct assembly.

1 Unscrew banjo bolts (1) and (2) from range-change group cylinder (3) and shut-off valve (4). Loosen pipe (5) on housing and remove complete plastic pipes (6).



1.2 Output flange

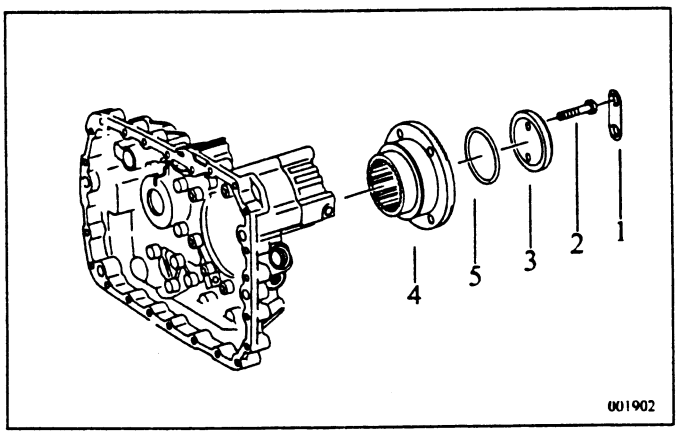
1 Lever off locking plate (1) from output flange (4).

2 Secure output flange to prevent turning.

3 Unscrew hex bolts (2) and remove disc (3).

4 Place pressure disc on planetary carrier and remove output flange (4) using 2 or 3-arm pullers

5 Remove O-ring (5).



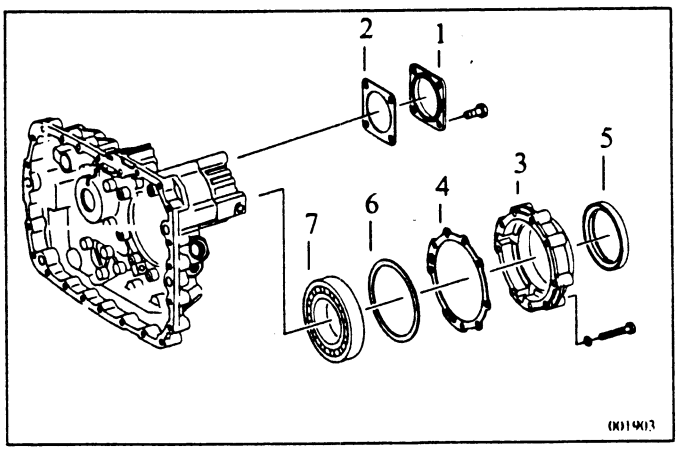
1.3 Cover

1 Unscrew hex bolts from cover (1) and remove together with gasket (2).

2 Remove cover (3) and gasket (4), shaft sealing ring (5), shim (6) and ball bearing (7).

3 Using plastic rod, drive ball bearing out of cover. Remove loose shim.

4 Using plastic rod, drive shaft sealing ring out of cover.



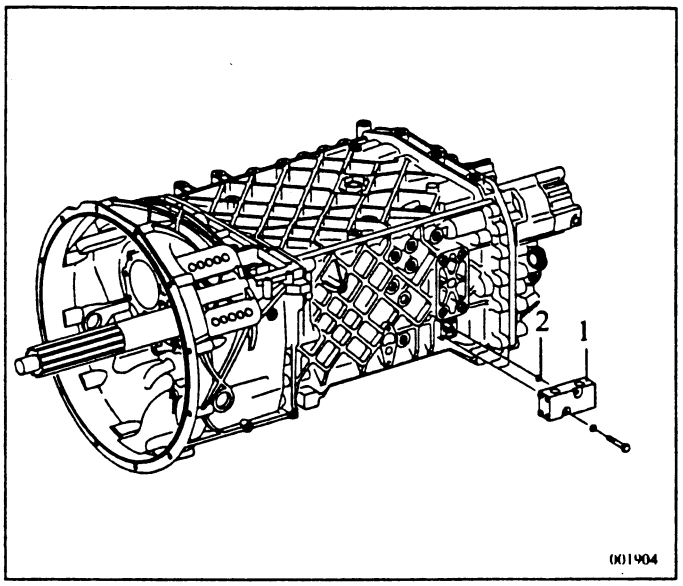
Removal/Range-change group 16 S 221

1.4 5/2-way valve

1 Unscrew 5/2-way valve (1) from housing section 2.

2 Remove O-ring (2).

NOTE: Do not dismantle 5/2-way valve, this is a complete unit.



1.5 Shift cylinder for range-change group

1 Unscrew hex bolts and loosen cylinder (1) from range-change group housing and pull cylinder off piston (2).

2 Remove O-rings (3) and (4) from cylinder.

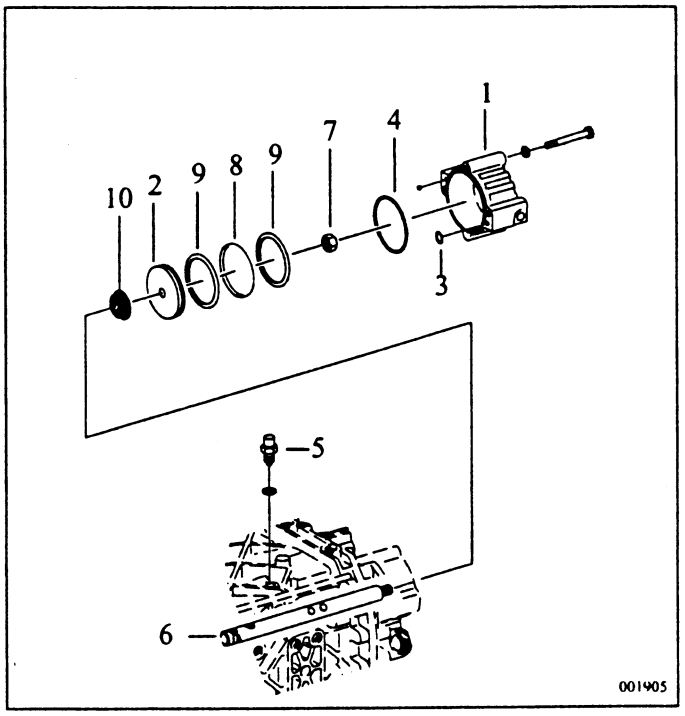
3 Remove detent plunger (5). Screw locking device 1X56 137 579 in empty hole, positioning locking element in selector rod (6). Tighten locking device. Tightening torque = 50 Nm.

4 Unscrew locking nut (7) from piston (2).

5 Remove piston together with guide ring (8) and grooved rings (9).

6 Remove guide ring and grooved rings from piston.

7 Pull cap collar (10) out of range-change group housing.



16 S 221 Removal/Range-change group

1.6 Housing/range-change group

1 Remove mechanical speedometer or impulse transmitter.

2 Remove articulated bolts (1) for shift fork (2).

3 Remove locking device 1X56 137 579.

4 Unscrew hex bolts from range-change group housing (3).

⚠ DANGER
Planetary gear train is not secured on main shaft. Block this to prevent it from falling.

5 Separate range-change group housing (3) from housing section 2 (5) without twisting and remove. Use pins to ensure correct orientation (4).

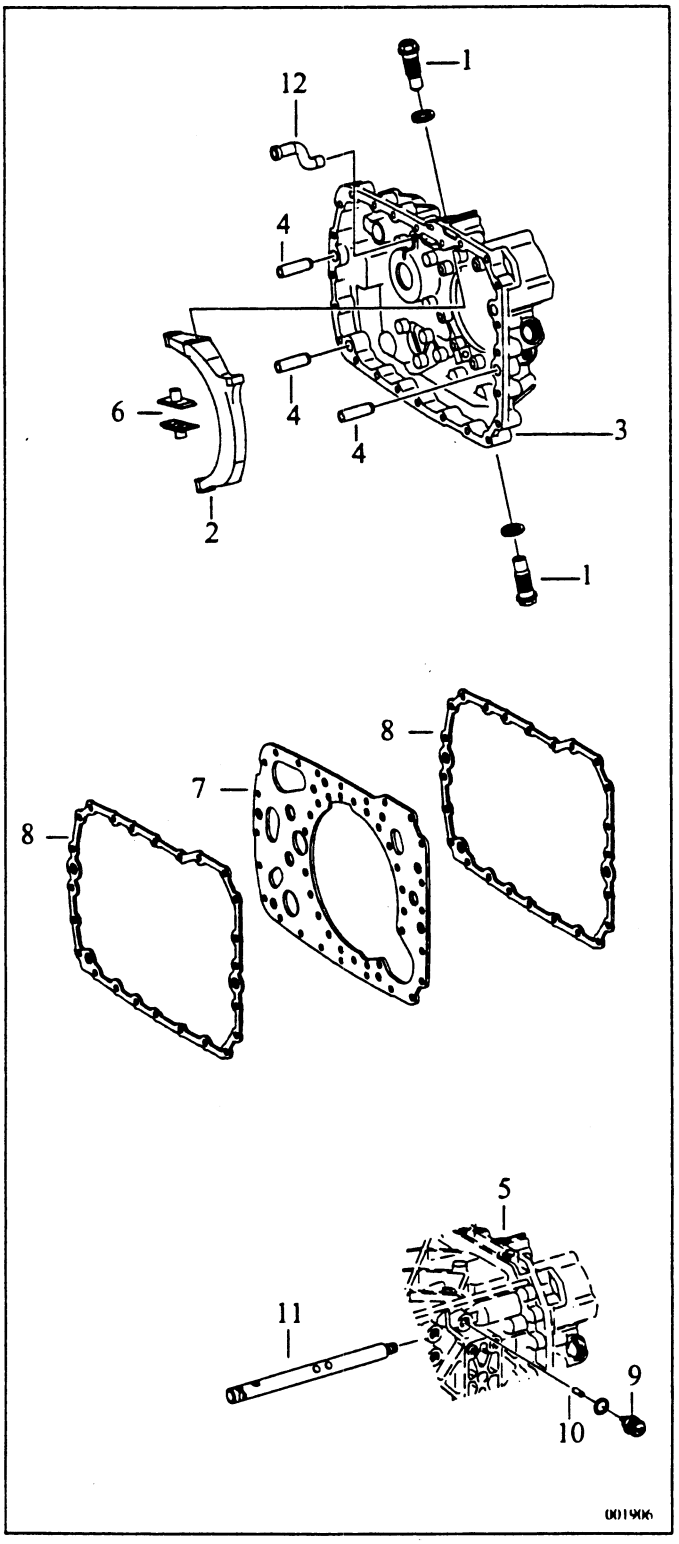
6 Remove shift fork (2) and fulcrum pads (6).

7 Remove intermediate plate (7) and gaskets (8).

8 Remove plug connection (9) together with sealing ring and pin (10).

9 Pull selector rod (11) out of housing section 2.

10 Remove splash tube (12).



Removal/Planetary gear train 16 S 221

1.7 Planetentrieb mit Synchronisierung

1.7 Planetary gear train with synchronizers

NOTE: Prevent planetary gear train from falling during removal.

1 Remove complete planetary gear train and synchronizers from main shaft.

1.7.1 Synchronizers

1. Place pressure disc onto planetary carrier. Attach 2 or 3-arm pullers to underneath of sliding sleeve (1) and pull off together with clutch body (2) and counting disc (3) with integrated bush. Use a cloth to catch pressure pieces (4) and pressure springs (5) held by the sliding sleeve.

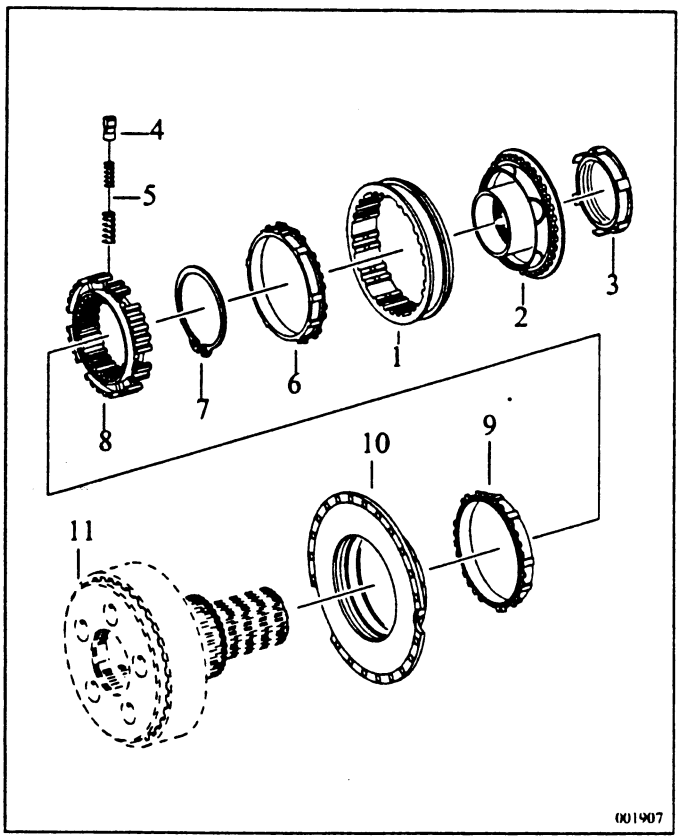
⚠ DANGER
Pressure pieces are spring loaded. Prevent them from jumping out.

2 Remove synchronizer ring (6).

3 Remove circlip (7).

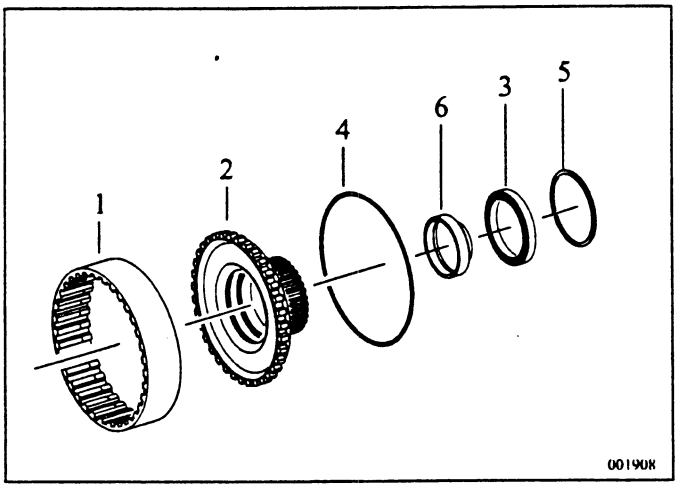
4 Place pressure disc on planetary carrier and using 2 or 3-arm pullers, pull off synchronizer body (8).

5 Remove synchronizer ring (9) and clutch body (10) from planetary carrier (11).



16 S 221 Removal/Planetary carrier

1.7.2 Ring gear



1 Clip circlip (7) from Section 1.7.1 onto ring carrier. Place pressure disc on planetary carrier and grip underneath of circlip using 2 or 3-arm pullers. Pull ring gear (1), ring carrier (2) and ball bearing (3) off together.

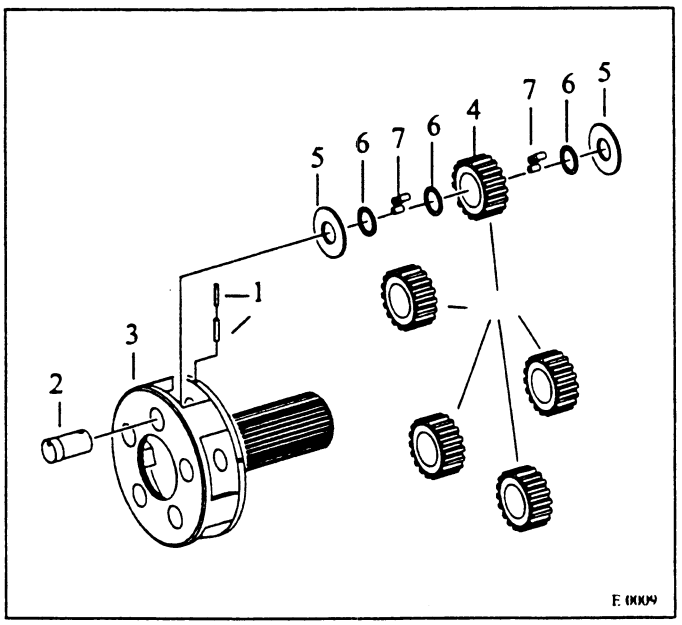
2 Take locking wire (4) out of annular groove on ring gear.

3 Using plastic hammer, remove ring carrier (2) from ring gear (1).

4 Remove snap ring (5) from ring carrier and take off ball bearing (3).

5 Take intermediate ring (6) off planetary carrier.

1.7.3 Planetary carrier



1 Drive slot pins (1) fully into planetary gear pin (2).

2 Using plastic rod, drive planetary gear pin out of planetary carrier (3) towards input.

3 Remove planetary gear (4) from planetary carrier together with thrust washers (5).

4 Remove shims (6) and cylindrical rollers (7) from planetary gear.

5 Drive slot pins (1) out of planetary pin.

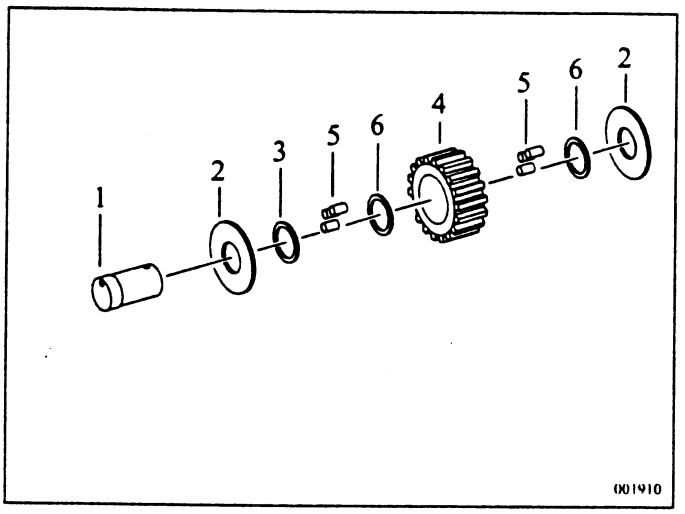
Repeat steps 1) to 5) for remaining planetary gears.

Assembly/Planetary carrier 16 S 221

1.8 Assembly of planetary gear train with range-change group synchronizer

1.8.1 Planetary carrier

NOTE: Always replace planetary gears in complete sets.



1 Coat sides of planetary gears and cylinder roller bearing raceways with grease.

2 Stand planetary gear pin (1) with collar downwards.

3 Slide thrust washer (2) over planetary gear pin. Ensure coated side (bright side) points towards planetary gear.

4 Slide shim (3) over planetary gear pin (either way up).

5 Place planetary gear (4) over planetary gear pin (1) and centre on pin.

6 Insert 14 cylindrical rollers (5) into planetary gear and slide shim (6) over planetary gear pin.

7 Grease the inside of the planetary carrier and insert remaining 14 cylindrical rollers.

8 Grease the cylindrical rollers and cover with shim.

9 Place thrust washer on planetary gear. Ensure coated side points to planetary gear.

16 S 221 Assembly/Planetary carrier

10 Lay planetary carrier (7) on its side.

11 Carefully remove planetary gear and thrust washers from planetary gear pin and slide into planetary carrier.

12 Line up planetary gear with hole in planetary carrier.

NOTE: Ensure "0" on upper end of planetary gear pin is pointing towards outside of planetary carrier. (Oil bore must point towards the internal radius of the planetary carrier).

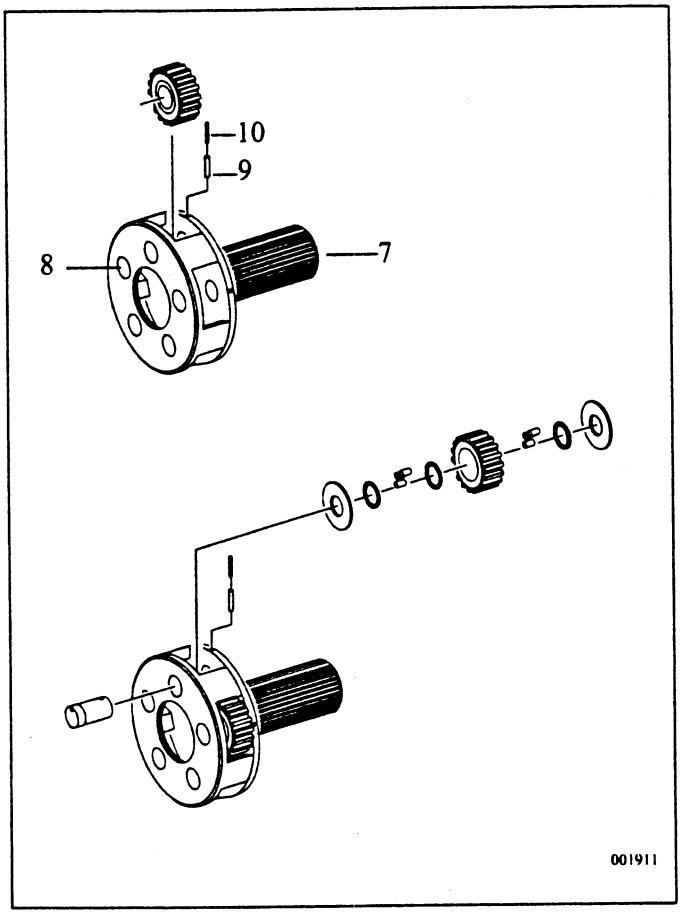
13 Align planetary gear pin correctly and insert into hole in planetary carrier.

14 Using plastic hammer, drive in planetary gear pin. Check alignment of slot pin hole.

15 Drive new slot pin (9) halfway into hole. Drive 2nd (new) slot pin (10) with slot offset 180° into 1st slot pin. Drive both slot pins approx. 0.5 mm into planetary carrier.

16 Check end float of planetary gear 0.4 to 1.3 mm.

Repeat steps 1) to 16) for remaining planetary gears.



1.8.2 Ring gear

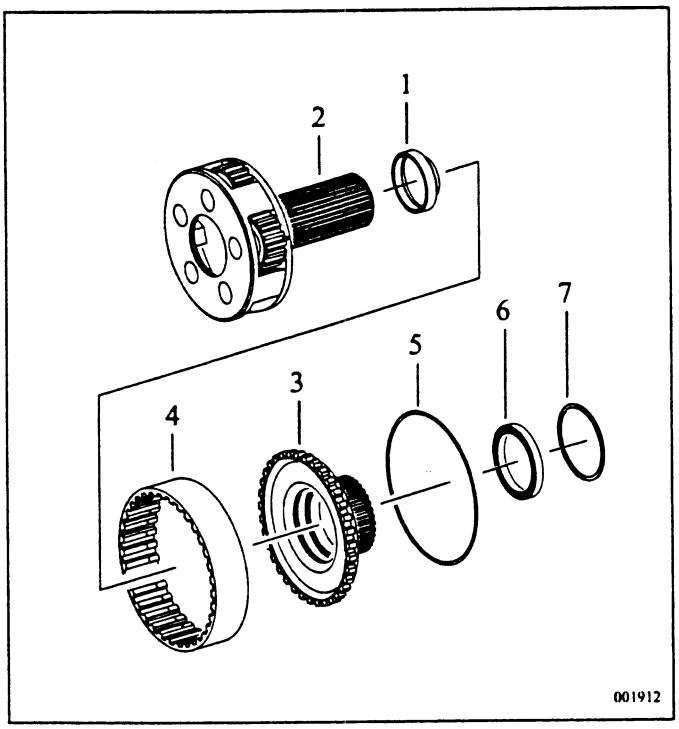
1 Place intermediate ring (1) onto planetary carrier (2). Ensure oil grooves point towards output end.

2 Drive ring carrier (3) into ring gear (4) until firmly seated.

3 Insert locking wire (5) into annular groove on ring gear. Ensure whole length of locking wire is correctly seated.

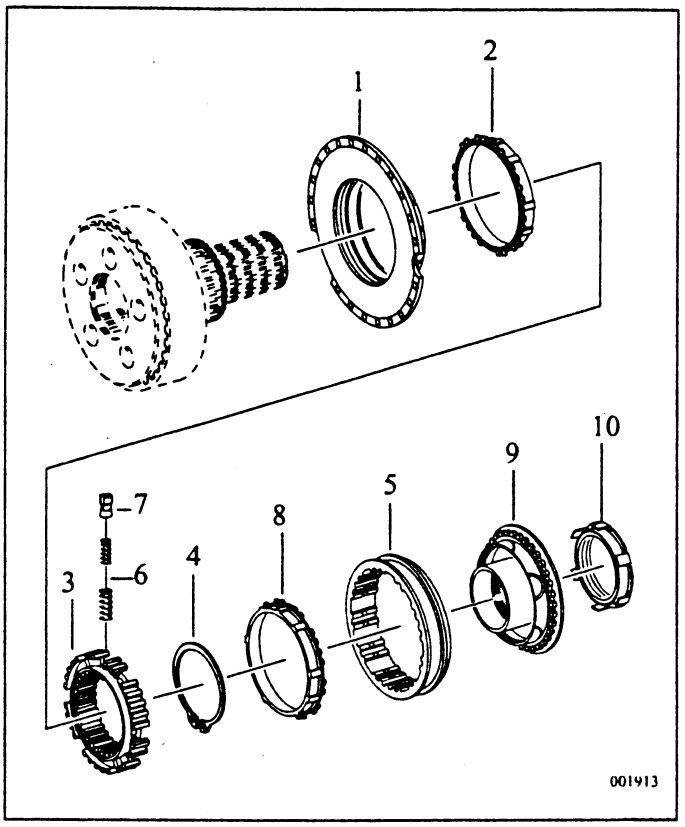
4 Place ball bearing (6) in ring carrier and insert snap ring (7). Select snap ring to give ball bearing end float of 0.0 to 0.1 mm. Snap rings are available in steps of 0.1 mm.

5 Heat complete ring gear to 60° C and place on planetary carrier. Turn ring gear to bring teeth into mesh. Ensure ring gear is firmly seated.



Assembly/Planetary carrier 16 S 221

1.8.3 Synchronizer



1 Check wear limit of synchronizer parts, see Section 6.

2 Place clutch body (1) and synchronizer ring (2) onto planetary carrier.

3 Heat synchronizer body (3) to approx. 120° C and push on until firmly seated. Ensure long hub points towards planetary carrier. Synchronizer ring cams must mesh with recesses in the synchronizer body.

4 Insert circlip (4) into annular groove. End float must be 0.0 to 0.1 mm. Circlips are available in 0.1 mm steps.

5 Place sliding sleeve (5) onto synchronizer body (3) with collar side pointing to output end and locate firmly.

NOTE: Recesses in sliding sleeve must line up with recesses in synchronizer body.

6 Fit new pressure springs (6) and pressure pieces (7) into synchronizer body (3) and, using suitable tool, insert into sliding sleeve (5).

7 Place synchronizer ring (8) onto synchronizer body (3).

NOTE: Synchronizer ring cams (8) must mesh with recesses in the synchronizer body (3).

8 Bring sliding sleeve (5) into centre position and press against synchronizer ring. You should clearly hear the pressure pieces clicking into place.

9 Heat clutch body (9) to approx. 120° C and push onto planetary carrier until firmly located.

10 Heat bush/counting disc (10) to approx. 120° C and push onto planetary carrier. Ensure disc lugs point towards planetary carrier.

16 S 221 Assembly/Range-change group

1.9 Assembly of range-change group/housing/output flange/piston

1 Place intermediate plate (1) over planetary carrier/clutch body (2).
2 Insert shift fork (3) and fulcrum pads (4) into sliding sleeve (5).
3 Place new gasket (6) on intermediate plate (1) and locate correctly.
4 Insert selector rod (11) from inside of housing and locate correctly. Rotate shift fork to engage with selector rod.
5 Insert splash tube (2) into the housing.
6 Place housing (7) on intermediate plate (1) and gasket and line up bolt holes. Check position of shift fork and line up with articulated bolt holes.

NOTE: If using a new housing (7), select correct ball (8) for shift pattern I or II and drive into open compressed air hole (9) of housing.

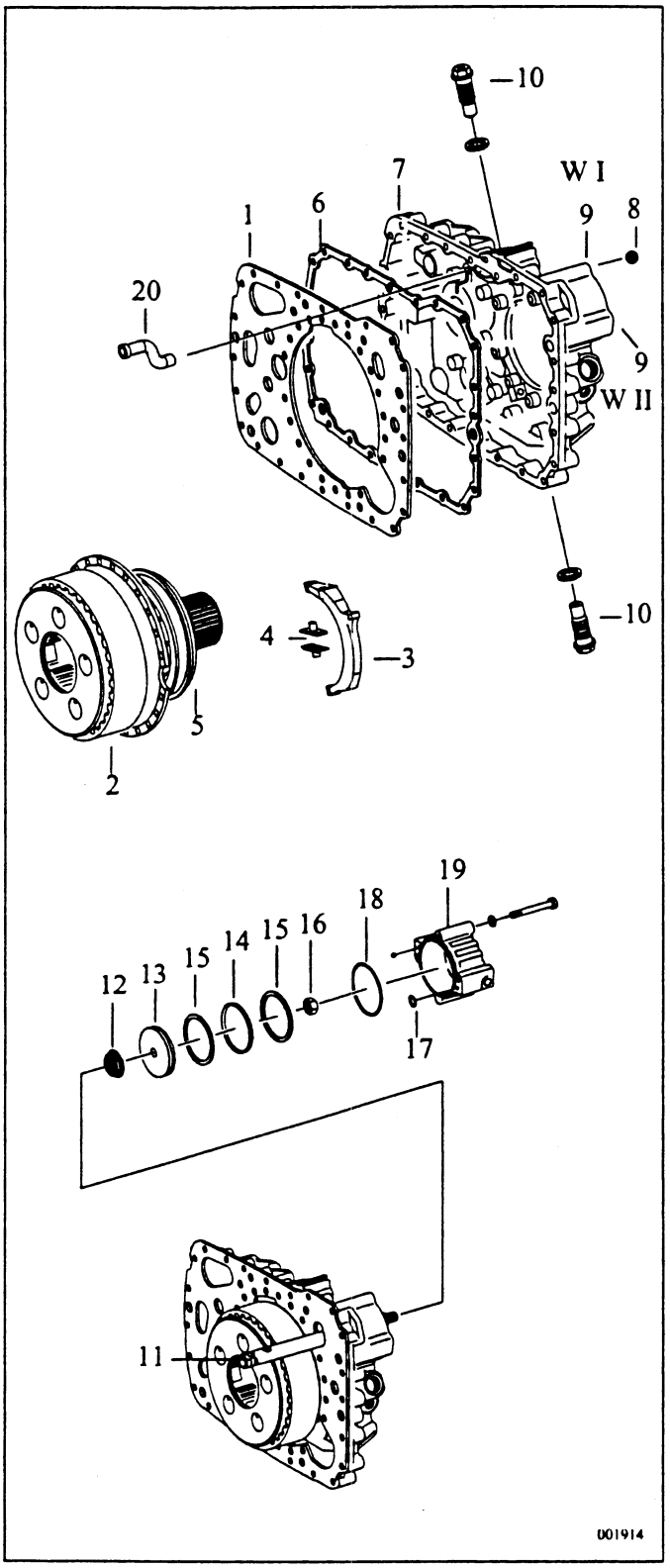
7 Coat articulated bolts (10) with Loctite No. 241, fit spring washers and screw in. Position shift fork (3).

NOTE: Articulated bolt tightening torque = 250 Nm. Tighten when range-change group is fitted.

8 Coat new cap collar (12) with de-natured alcohol, slide over selector rod (11) and, using soft rod, drive on until seated firmly.
9 Place piston (13) with guide ring (14) and new grooved rings (15) onto selector rod.
10 Screw locking nut (16) onto selector rod (11) and tighten manually until nut presses against piston.

NOTE: Locking nut tightening torque = 150 Nm. Tighten after range-change group is fitted. Renew locking nut. Make sure the thread does not have any traces of greases.

11 Grease new O-rings (17) and (18) and insert into annular grooves (on cylinder and housing).



Assembly/Range-change group 16 S 221

12 Carefully push cylinder (19) over piston with guide ring and piston sealing ring. Using 2 hex bolts, fix cylinder in place.

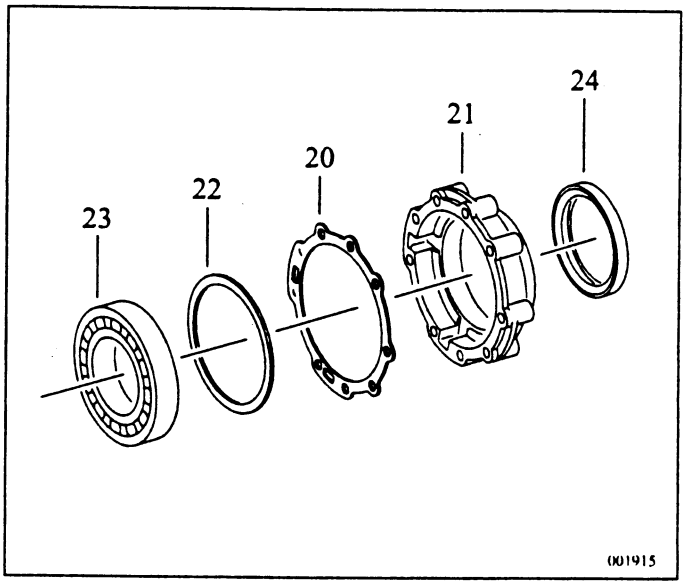
NOTE: Correctly line up for compressed air holes.

Measurement of ball bearing end float:

13 Fit cover (21) with new gasket (20) and measure depth of bearing seat in cover including gasket, e.g. 23.40 mm.

14 Measure depth of bearing seat in housing (7), (without gasket), e.g. 7.00 mm.

15 Measure width of ball bearing (23), e.g. 30.00 mm.



Example

23.40 mm depth of bearing seat in cover

+ 7.00 mm depth of bearing seat in housing
30.40 mm

- 30.00 mm width of ball bearing
= 0.40 mm clearance without shim

In this example you would use a 0.3 to 0.4 mm shim (22) to give end float of 0 to 0.1 mm.

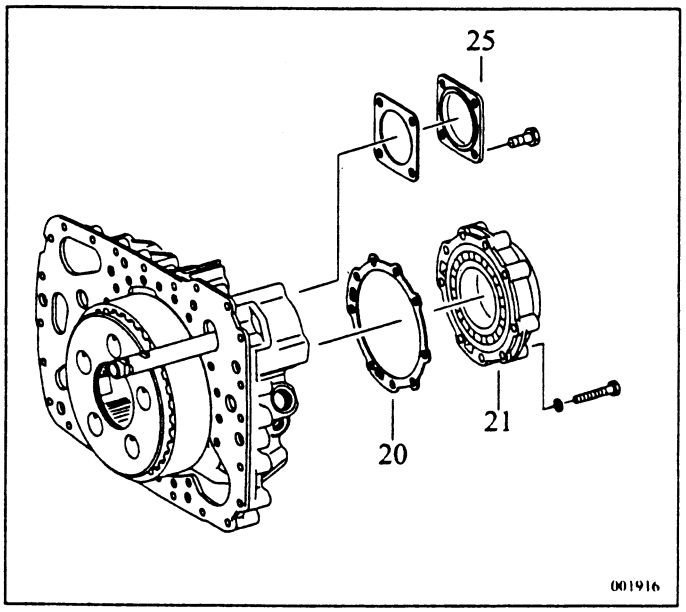
16 Heat cover (21) to approx. 60° C and insert correct shim (22) and ball bearing (23).

17 Drive in shaft sealing ring (24) with special tool 1X56 137 124.

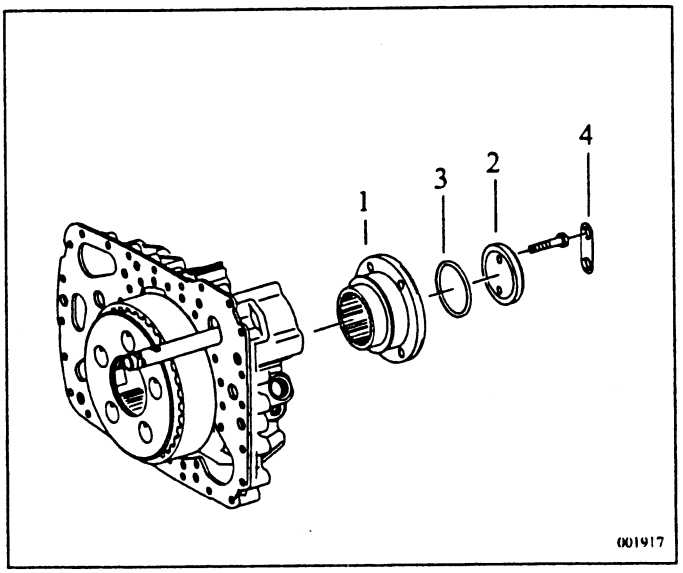
NOTE: Only use special tool for 12.5 mm wide ring. Installation dimension = 12.5 + 1.0 mm from edge of cover to shaft sealing ring. Thinly coat outside of shaft sealing ring with sealing compound. Lubricate outside of shaft sealing ring using soap wash.

18 Fix hex bolts with washers and screw cover (21) and new gasket (20) onto cylinder.
Tightening torque = 49 Nm.

19 Screw on cover (25) and new gasket.
Tightening torque = 79 Nm.



1.9.1 Output flange



1 Lightly oil shaft sealing ring in cover.

2 Heat output flange (1) to max. 70° C.

NOTE: Do not heat the output flange if it is to be fitted into the bearing.

3 Push output flange onto planetary carrier shaft until firmly seated.

4 Screw disc (2) firmly against output flange with two M12x75 hex bolts. Ensure output flange is firmly seated.

5 Remove disc and bolts.

6 Lightly oil new O-ring (3) and insert into gap between output flange and planetary carrier shaft.

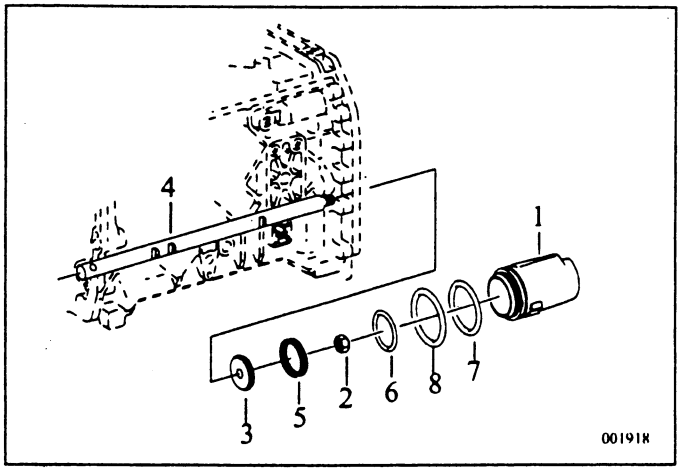
7 Insert disc (2) into output flange and screw against planetary carrier.
Tightening torque = 60 Nm.
If required, use flange locking device to prevent from turning.

8 Using special tool 1X56 137 246, drive new locking plate (4) over heads of bolts until firmly seated.

Removal/Shift housing 16 S 221

2 Removal of housing section 2 components

2.1 Splitter group cylinder



1 Remove cylinder (1) by hand.

2 Remove locking nut (2).

3 Remove spring (8) from housing.

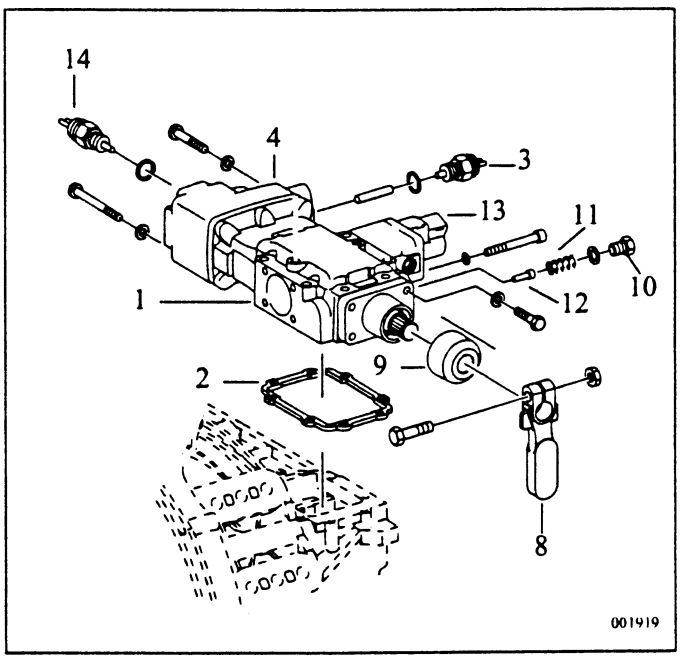
4 Remove piston (3) from selector rod (4).

5 Remove twin-grooved ring (5) from piston.

6 Remove two O-rings (6) and (7) from cylinder.

NOTE: There may be three O-rings in the cylinder.

2.2 Shift housing



1 Unscrew hex bolts from shift housing.

2 Take off complete shift housing (1) and gasket (2).

3 Remove plug connection (3) together with sealing ring and pin.

4 Unscrew cover (4) and remove together with gasket.

5 Remove shift detent (5) and washer (6) from detent element (7). See Figure 001920.

6 Loosen shift lever (8) and remove together with protective cap (9).

7 Remove screw plug (10) together with sealing ring, spring (11) and pin (12).

8 Unscrew shut-off valve (13) and remove together with O-ring.

NOTE: In the new version, remove switch (14) and the sealing ring.

16 S 221 Removal/Shift housing

9 Unscrew hex bolts from shift cover (12) and remove together with bush (13) and gasket.

10 Drive scraper ring (14), shaft sealing ring (15) and bearing bush (16) out of shift cover.

11 Drive pin (17) out in direction of sealing cover.

12 Remove cover (18) together with pressure springs (19) and O-ring (20) from shift housing.

13 Drive slot pins (21) out of detent element and remove pressure springs (22) and washers (23).

14 Remove slot pins (24) from driver (25) and shift shaft (26).

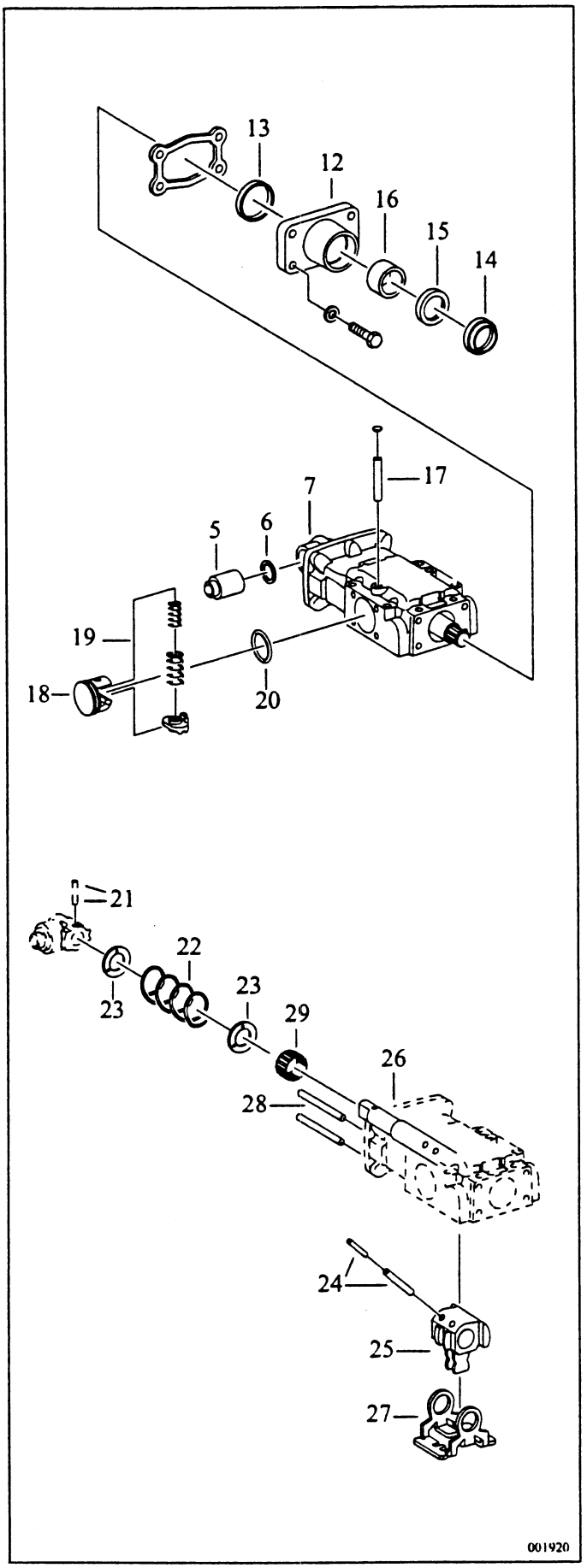
15 Pull shift shaft (26) out by hand towards shift output.

16 Remove locking piece (27) and drive out from shift housing.

17 Remove pins (28) if necessary.

NOTE: Clamp pins in vice using aluminium clamping jaws and remove by striking shift housing.

18 Remove needle sleeve (29) from shift housing.



Assembly/Shift housing 16 S 221

2.2.1 Assembly of shift housing

1 Drive new needle sleeve (1) into shift housing (2). Strike thicker side of needle sleeve.

2 Drive pins (3) into shift housing.

3 Insert driver (4) and locking piece (5) into shift housing.

4 Insert shift shaft (6).

5 Using special tool 1X56 119 916, drive new bearing bush (7) into shift cover.

6 Using special tool 1X56 119 916, drive shaft sealing ring (8) into shift cover. Sealing lip must point towards cover.

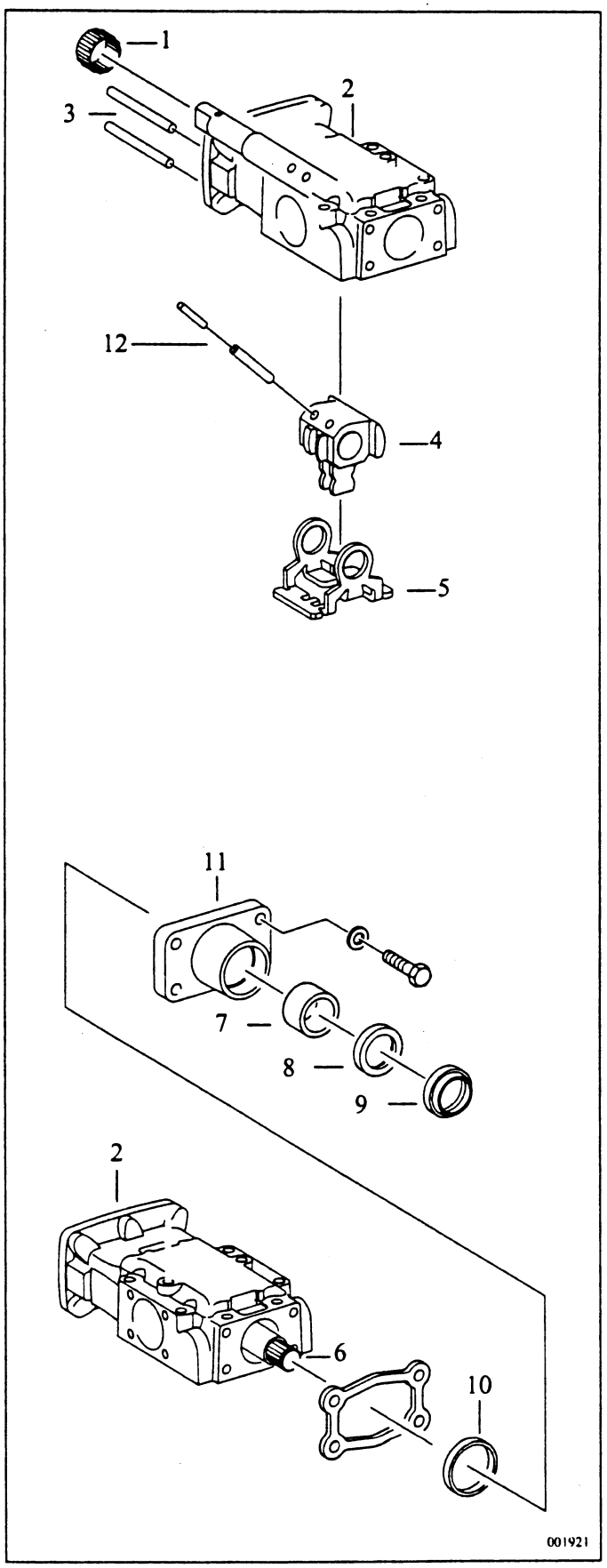
7 Using special tool 1X56 119 916, drive scraper disc (9) into shift cover. Sealing lip must point outwards.

NOTE: Smear outside of shaft sealing ring and scraper disc with sealing compound. Fill gap between shaft sealing ring and scraper disc with grease.

8 Push bush (10) into shift housing and slide shift cover (11) and new gasket over shift shaft (6) until firmly located.

9 Screw shift cover (11) onto shift housing. Tightening torque = 23 Nm.

10 Drive one slot pin (12) through driver (4) into shift shaft. Drive second slot pin (12) into first, with slot offset.



16 S 221 Assembly/Shift housing/Detent element

2.2.2 Detent element with pressure springs

1 Place washer (1), pressure spring (2) and second washer onto shift shaft (3). Drive in pins (8), if applicable.

2 Push detent element (4) onto shift shaft against spring and insert slot pins (5) with slots offset.

3 Insert shift detent (6) and washer (7) into detent element (4) and slide in between pins (8).

NOTE: End float between detent element and pins must be 0.1 mm. Adjust if required using washer (7) of different thickness. Washers are available in 0.1 mm steps. Grease shift detent (6) and pins (8).

4 Screw on cover (9) with new gasket.
Tightening torque = 23 Nm.

NOTE: In the new version, screw reverse gear switch (24) and new sealing ring (25) into cover (9).

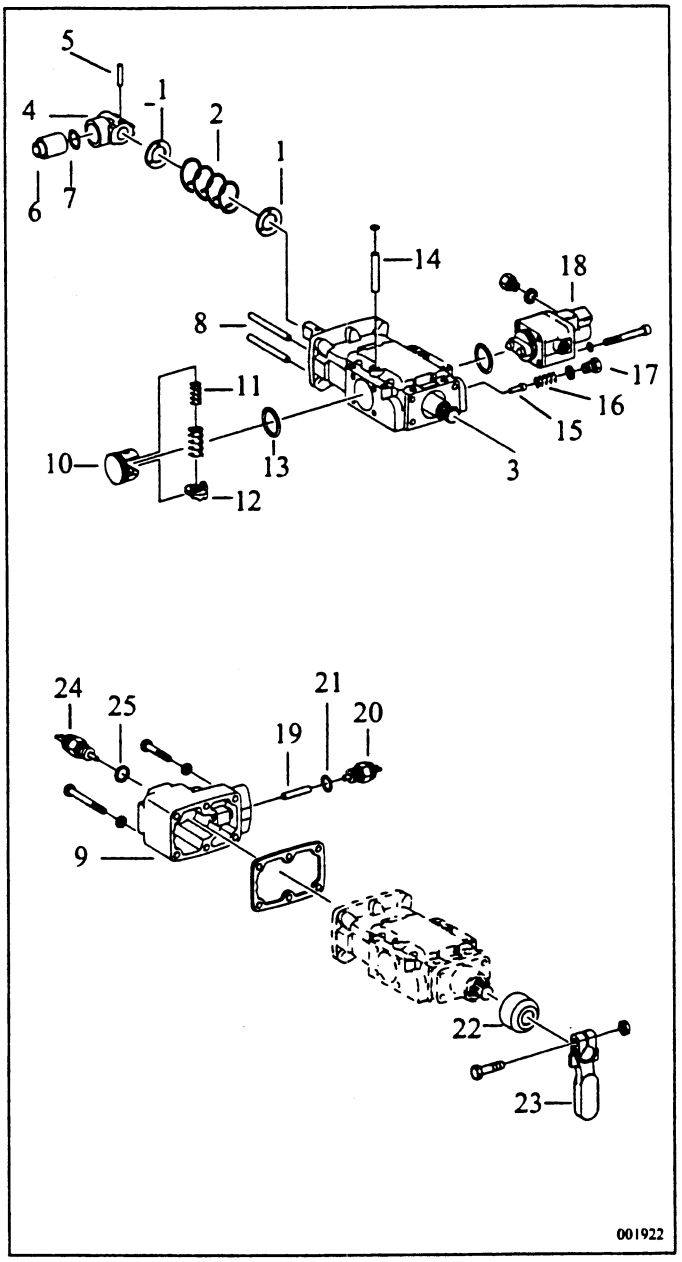
5 Insert cover (10) with pressure springs (11), detent element (12) and O-ring (13) into shift housing. Drive pin (14) into shift housing (countersink approx. 5 mm) and fit new sealing cover (countersink approx. 2 mm).

6 Fit pin (15), spring (16) and screw plug (17) with new sealing ring and screw into shift housing.

7 Fit shut-off valve (18) with new O-ring and screw onto shift housing.
Tightening torque = 23 Nm.

8 Insert pin (19) into cooler, fit switch (20) with new sealing ring (21) and screw in.
Tightening torque = 50 Nm.

9 Slide protective cap (22) over shift shaft (3) and position shift lever (23) onto shift shaft in accordance with shift version.
Tightening torque of hex bolt or nut on shift lever = 49 Nm.
Protective cap must sit on shift shaft without play.



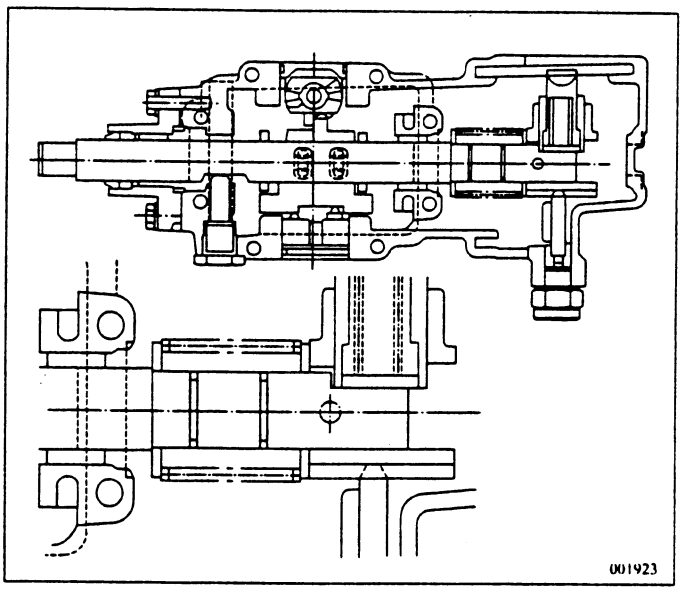
Shift mechanism 16 S 221

2.2.3 Shift patterns/shift mechanism left or right

Arrangement of spring pack: Q 1

Shift pattern I

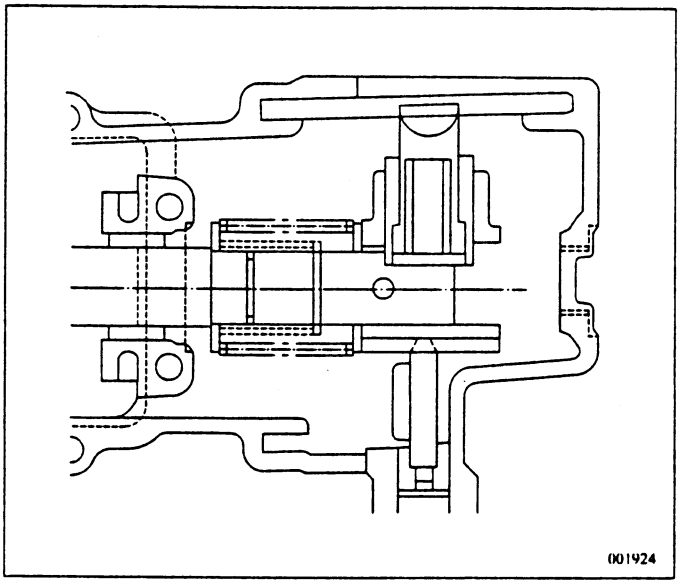
Turning shaft horizontal left.



Arrangement of spring pack: Q 2

Shift pattern I

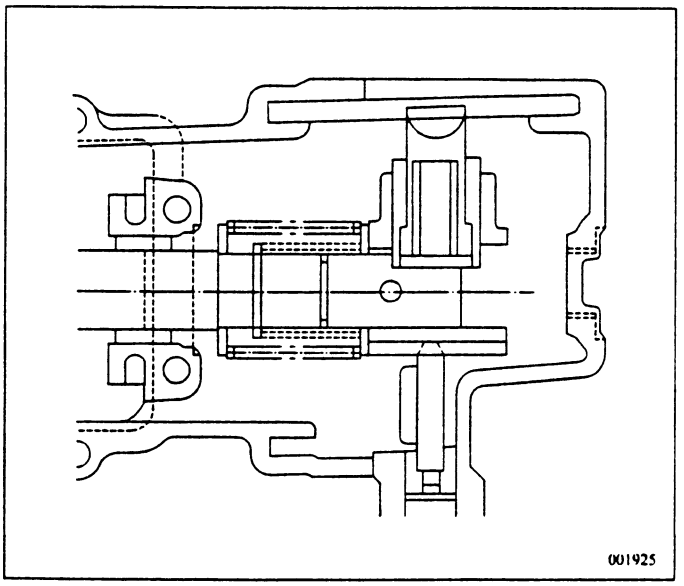
Turning shaft horizontal left.



Arrangement of spring pack: Q 3

Shift pattern I

Turning shaft horizontal left

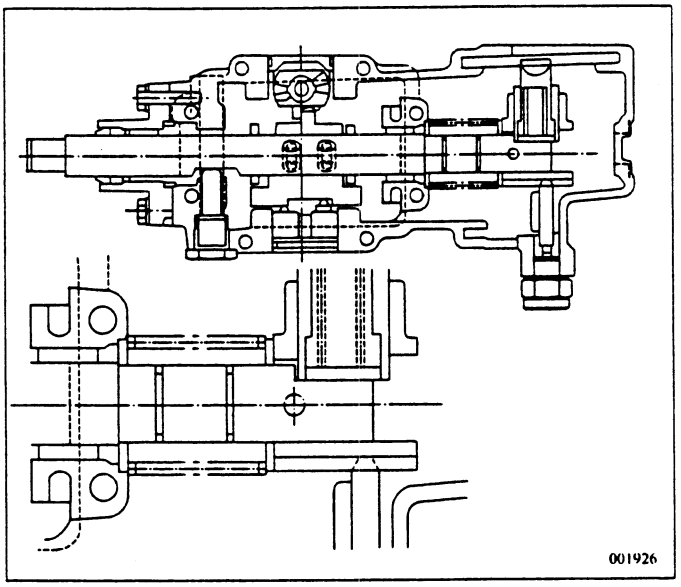


16 S 221 Shift mechanism

Arrangement of spring pack: Q 1

Shift pattern II

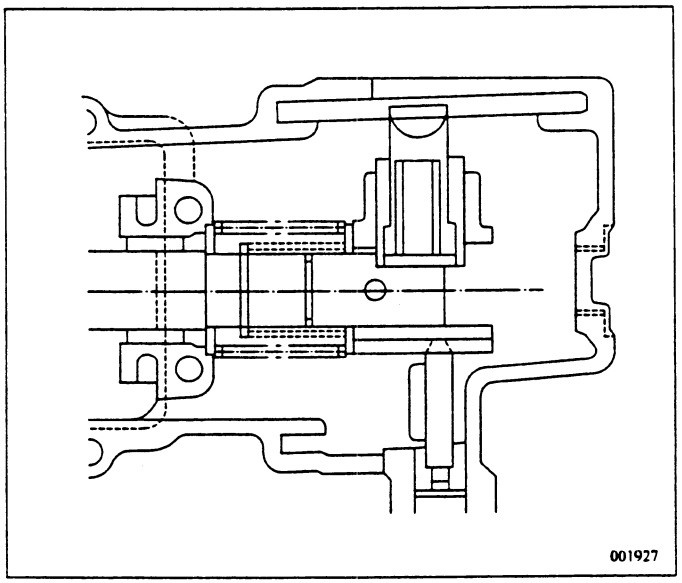
Turning shaft horizontal left



Arrangement of spring pack: Q 2

Shift pattern II

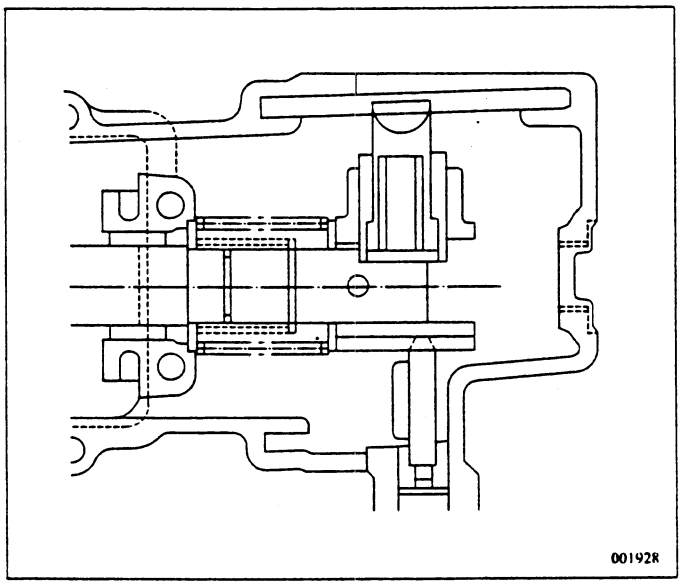
Turning shaft horizontal left



Arrangement of spring pack: Q 3

Shift pattern II

Turning shaft horizontal left

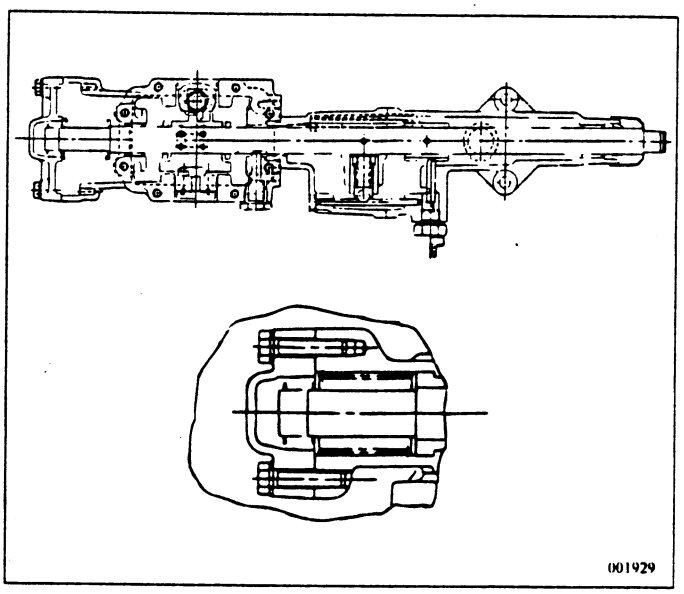


Shift mechanism 16 S 221

Arrangement of spring pack: Q 1

Shift pattern I

Turning shaft horizontal right



16 S 221 Shift mechanism