Manual gearbox, general

As standard, the Cayenne and the Cayenne S is fitted with a 6-speed manual gearbox (for USA and Latin America only Tiptronic available).
The gearbox is a new development and takes the specific off-road requirements into consideration.
The manual gearbox for the Cayenne and Cayenne S only differ in the clutch bell housing to adapt the gearbox to the different engine flange.

The following features distinguish this gearbox:

- Self-adjusting clutch
- Die-cast aluminum transmission case
- Three-shaft transmission
- Low shifting forces through
- cable gearshift and
- single/double/triple synchronization
- Porsche Drive-Off Assistant (description in group 4, Chassis and suspension)

3_07_04

Contents

Manual gearbox G 48/20

1360 Dual-mass flywheel/clutch

The working cycles and firing order of the engine cause speed fluctuations resulting in irregularities which lead to torsional vibrations along the entire drive train. These torsional vibrations may cause all moveable, non-driven parts with play to rattle, chatter or bounce (sliding gearwheels, parts of the synchronization system). This may result in annoying transmission noise, especially at low engine speeds and high transmission oil temperatures. As with previous Porsche vehicles, the Cayenne has a dual-mass flywheel (DMF) to prevent these noises.

Clutch

To increase the service life of the clutch, the Cayenne is fitted with a self-adjusting system, whereby the clutch wear is compensated. Lining wear adversely affects the pedal properties and the pedal forces. Furthermore, the use of a self-adjusting system can greatly reduce the wear volume of the clutch linings.

Transmission ratio

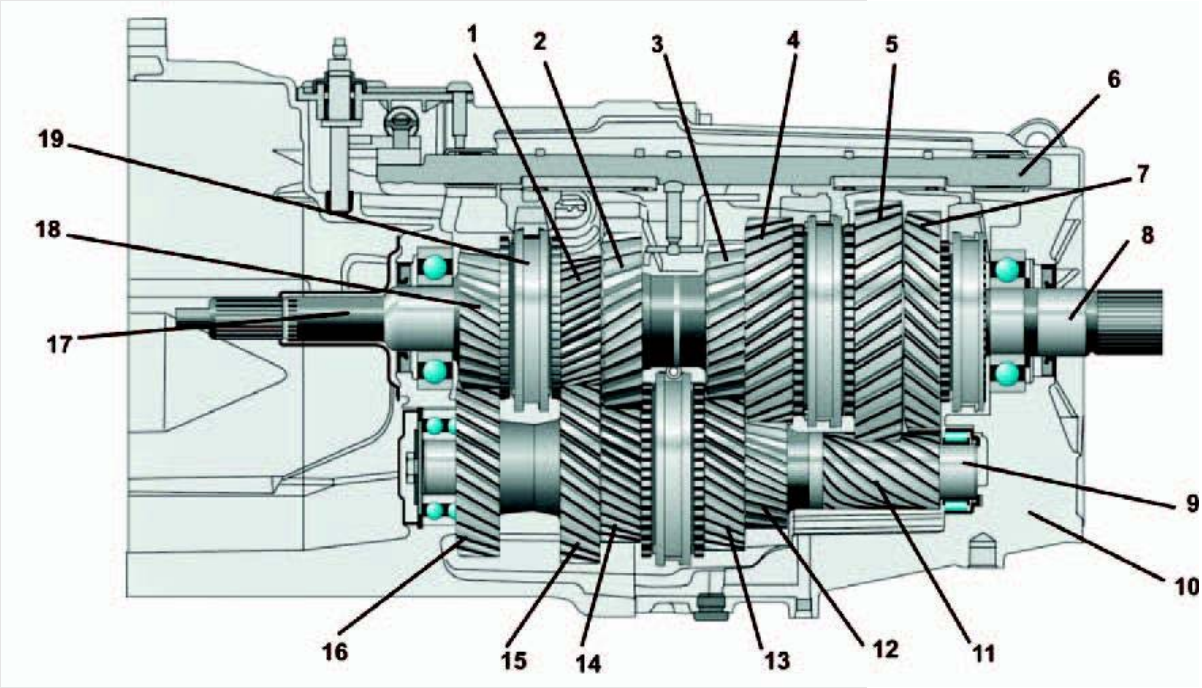
	Z_1	Z_2	i_z	i_k	i_g	i_A	i_g	V_1	V_6
1. Gear	46	13	3,538	1,3226	4,68	4,100	19,188	7,0	45,5
2. Gear	44	23	1,913	1,3226	2,53	4,100	10,373	13,0	84,5
3. Gear	37	29	1,276	1,3226	1,69	4,100	6,929	19,5	126,6
4. Gear	34	37	0,919	1,3226	1,22	4,100	5,002	27,0	175,3
5. Gear	-	-	direct	-	-	4,100	4,100	32,9	213,9
6. Gear	31	49	0,633	1,3226	0,84	4,100	3,444	39,2	254,6
R. Gear	23:13	42:23	3,231	1,3226	4,273	4,100	17,519	7,7	50,0

Z_1 = Number of teeth of first gearwheel in power flow of corresponding gear
Z_2 = Number of teeth of second gearwheel in power flow of corresponding gear
i_z = Gear ratio
i_k = Constant mesh of countershaft assembly (41/31)
i_g = Overall ratio of manual gearbox
i_A = Final drive ratio
V_1 = Calculated vehicle speed at 1000 rpm
V_6 = Calculated vehicle speed at 6500 rpm

With standard tires 235/65 R17, rolling circumference 2249 mm, (rdyn 358 mm)

Cross section of transmission

The 6-speed manual gearbox G48/20 is an in-line transmission with fully synchronized gears. It has an input shaft, a countershaft and an output shaft.
All sliding gears have needle roller bearings and are positioned on the countershaft and output shaft.
The 5th gear is directly connected.
Gear shifting takes place through radial and axial movement of a central selector shaft with shift fingers, which engage in the respective selector forks.



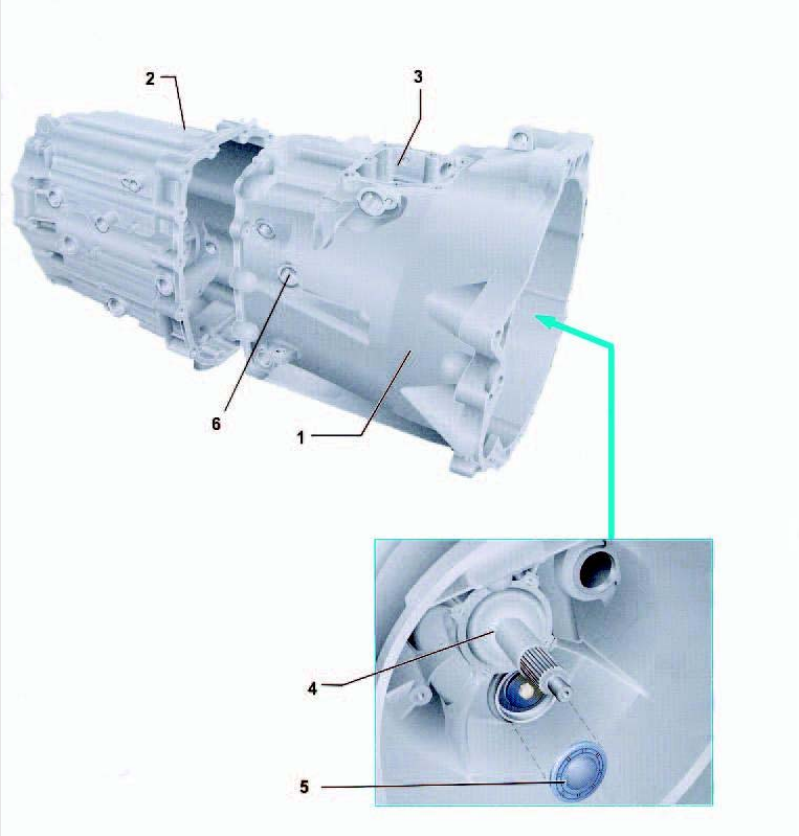
3_09_04

1 - Sliding gear, 6th gear
2 - Fixed gear, 3rd gear
3 - Fixed gear, 4th gear
4 - Sliding gear, 2nd gear
5 - Sliding gear, 1st gear
6 - Central selector shaft
7 - Fixed gear, 4th gear
8 - Sliding gear, 2nd gear
9 - Sliding gear, 1st gear
10 - Central selector shaft
11 - Fixed gear 1/reverse gear
12 - Fixed gear, 2nd gear
13 - Sliding gear, 4th gear
14 - Sliding gear, 3rd gear
15 - Fixed gear, 6th gear
16 - Fixed gear, constant mesh
17 - Input shaft
18 - Input shaft gear, constant mesh
19 - Sliding sleeve

3435 Transmission case

The transmission case is manufactured from die-cast aluminum and consists of two pieces, the clutch bell housing and the transmission rear section.
The clutch bell housing flange is shaped differently depending on the engine variant.

1 - Clutch bell housing
2 - Transmission rear section
3 - Mount for gearshift module
4 - Locating bearing
5 - Countershaft seal
6 - Mounts for bearing bolts for the selector forks



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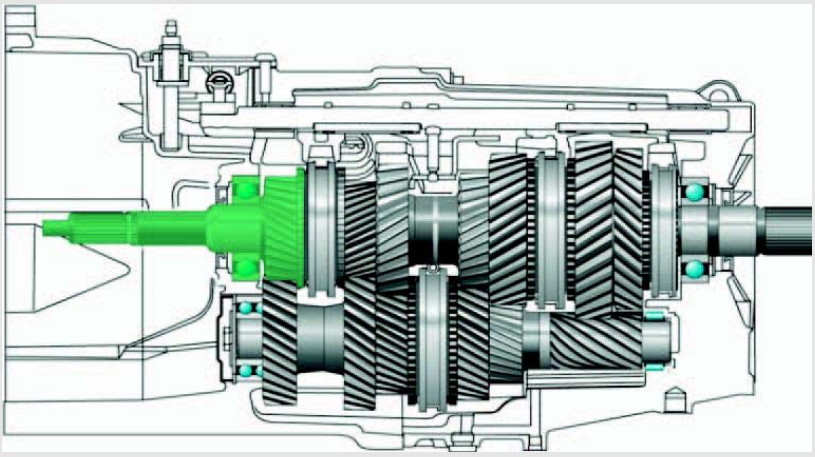
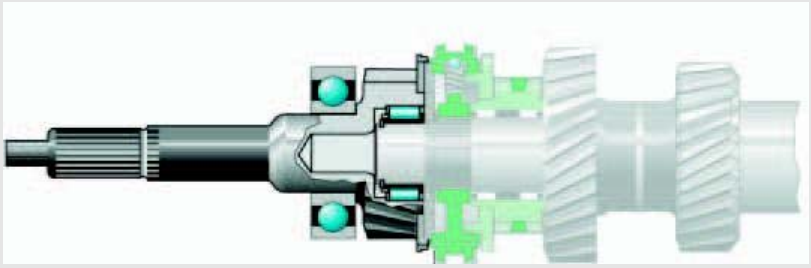


3_11_04

The input shaft is mounted with a grooved ball bearing as a fixed bearing in the clutch bell housing.
A cylindrical roller bearing acts as a movable bearing between the input and output shaft. It is located in the hole of the input shaft.
The input shaft gear of the constant mesh is part of the input shaft.



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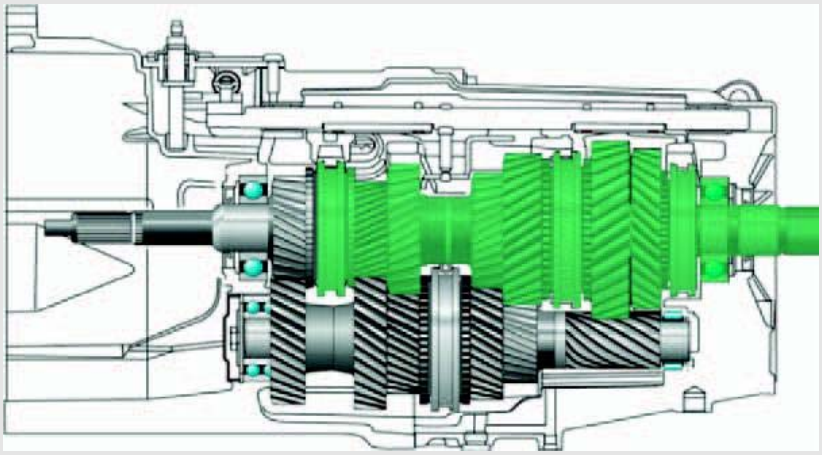
3559 Output shaft



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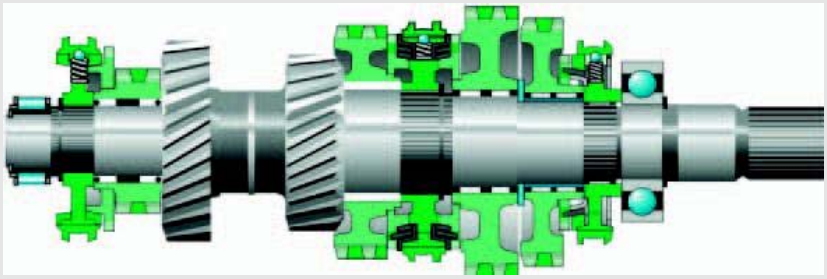
The fixed bearing of the output shaft is a grooved ball bearing, located in the transmission rear section. A cylindrical roller bearing acts as a movable bearing between the input and output shaft.

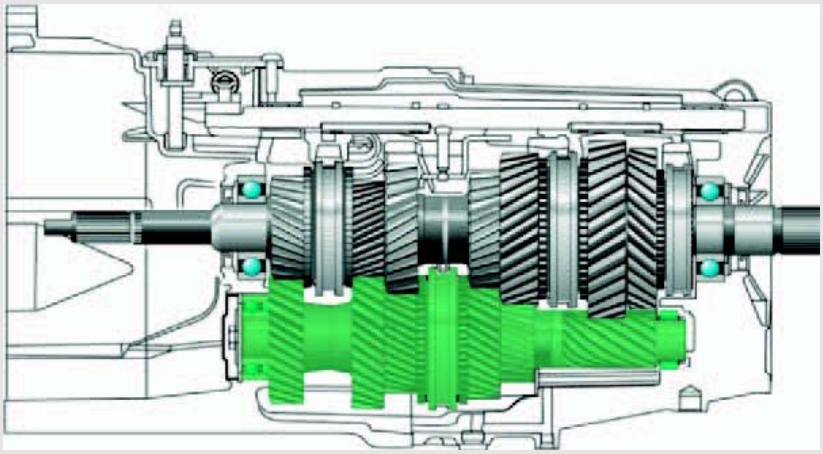


3_14_04

The synchronizer hubs of the 1st/2nd gear, the 5th/6th and the reverse gear are permanently connected to the output shaft through splines.

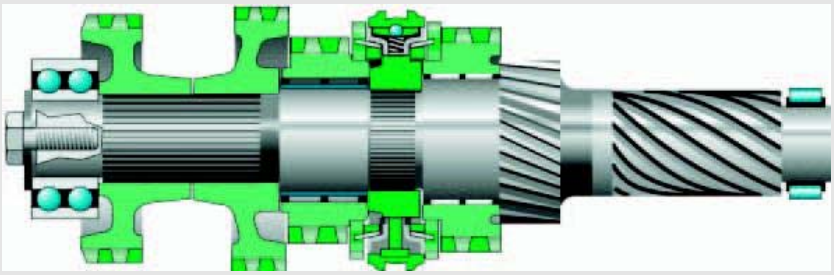
Countershaft

The countershaft is mounted on both a fixed and a sliding bearing.
The double grooved ball bearing is located in the clutch bell housing and the cylindrical roller bearing is in the transmission rear section.



3_15_04

The fixed gears of the 1st and 2nd gear are part of the countershaft.
The sliding gears for the 3rd and 4th gear have needle roller bearings. The sliding gear of the 6th gear and the constant mesh are permanently connected to the countershaft through splines.
The synchronizer hubs of the 3rd/4th gear are also permanently connected to the countershaft through splines.

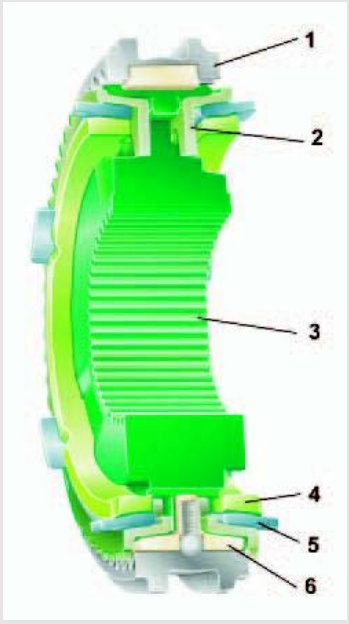


3_16_04

35 Synchronization

Before a gear can be shifted, the speed of the sliding gear must be synchronized with that of the synchronizer hubs. In order to increase the overall size of the friction surfaces for synchronization and consequently reduce the shifting forces, triple synchronization is used on 1st/2nd gear, and double synchronization is used on 3rd/4th gear and reverse gear. 5th/6th gear is synchronized through a friction cone.

1 - Shift sleeve
2 - Outer ring with locking gear
3 - Synchronizer hub
4 - Inner ring
5 - Intermediate ring
6 - Pressure piece

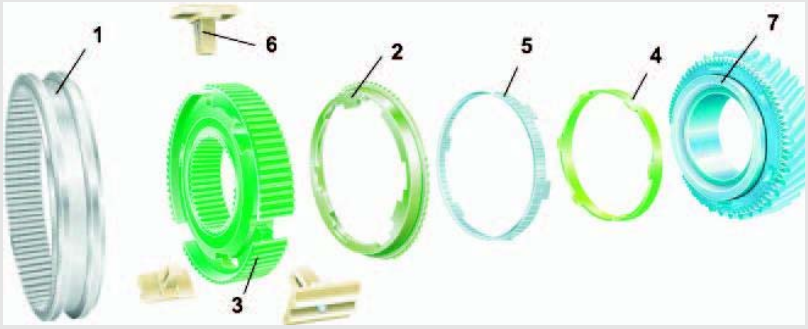


3_17_04

Triple synchronization

The synchronizer hub (3) is connected to the outer and inner ring (2 and 3) through the cams on the synchronizing rings. They run at the speed of the output shaft. The intermediate ring (5) is connected to the sliding gear (7) and turns at the same speed.

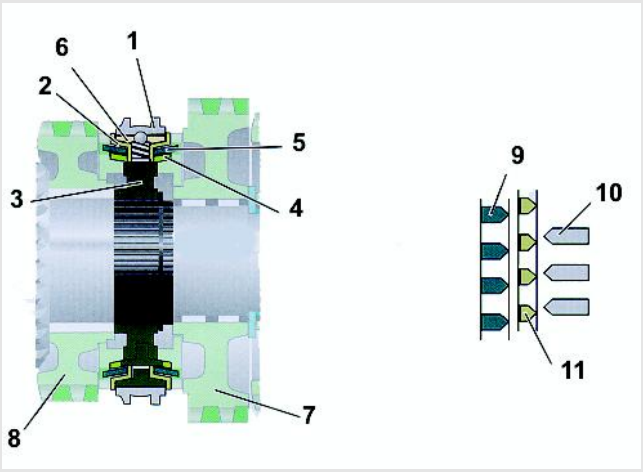
1 - Shift sleeve
2 - Outer ring with locking gear
3 - Synchronizer hub
4 - Inner ring
5 - Intermediate ring
6 - Pressure piece
7 - Sliding gear



3_18_04

The speed synchronization of shift sleeve (1) and sliding gear (7) takes place through the triple synchronization whereas when shifting of 1st/2nd gear it is through frictional contact. The locking gear blocks the shifting process until the shift sleeve runs at the same speed as the corresponding sliding gear.

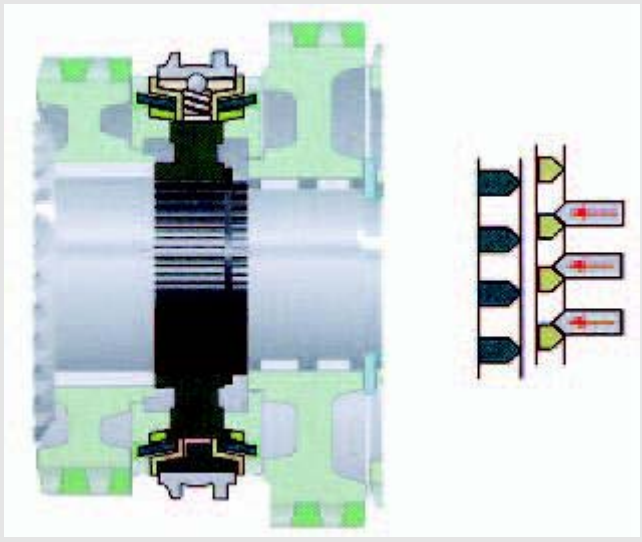
Idle-speed setting



3_19_04

1 - Shift sleeve
2 - Outer ring with locking gear
3 - Synchronizer hub
4 - Inner ring
5 - Intermediate ring
6 - Pressure piece
7 - Sliding gear, 1st gear with friction cone and shift toothing
8 - Sliding gear, 2nd gear with friction cone and shift toothing
9 - Shift toothing of sliding gear
10 - Toothing of sliding sleeve
11 - Locking gear of outer ring

Synchronization process

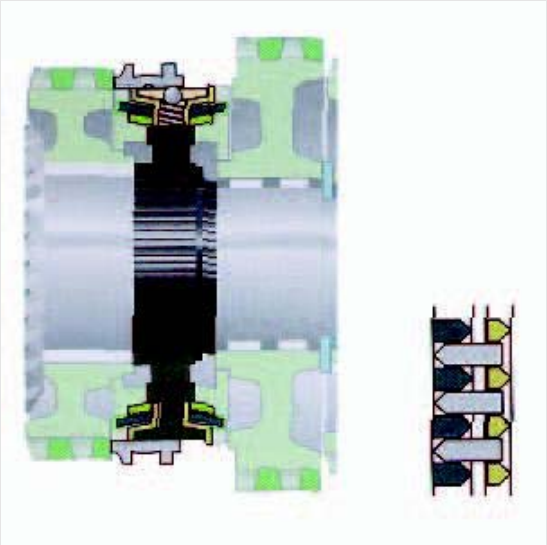


3_20_04

The shift sleeve (1) is moved in the direction of the sliding gear (7) through the selector fork of 1st/2nd gear. This moves the pressure pieces (6) through the shift sleeve axially against the synchronizing unit. The friction surfaces of the individual rings and the friction cone of the sliding gear make contact and the synchronization of the differing speeds between output shaft and the sliding gear begins.

The friction causes the outer ring with locking gear (2) to turn by one tooth width. This locking gear prevents further rotation of the shift sleeve on the shift toothing of the sliding gear.

Selected gear

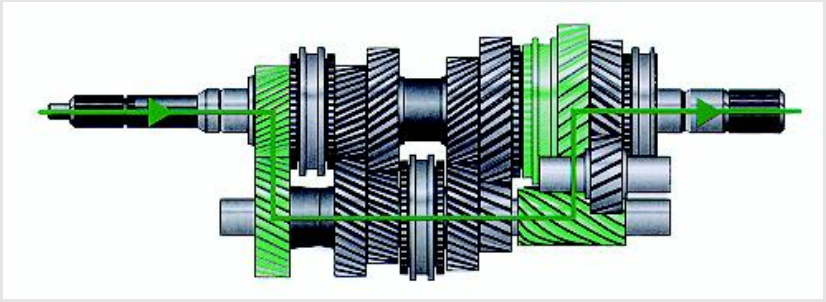


3_21_04

Once the speed between output shaft and sliding gear is the same, the friction ceases. The inclination of the teeth turns the outer ring through the sliding sleeve back to its initial position. The lock is released and the sliding sleeve can be pushed through the pressure piece onto the shift toothing of the shift gear. This creates an interlocking connection between output shaft and sliding gear.

Power flow of individual gears

The engine torque is directed through the input shaft in the gearbox. The power flow is transmitted via the constant mesh gear pair (always in use) to the countershaft. Depending on the gear selected, the power flow is directed from the countershaft via the respective gear pair to the output shaft. The 5th gear is directly connected. This means that the power flow does not pass through the countershaft, but directly from the input to the output shaft. The connection is made through the shift sleeve.



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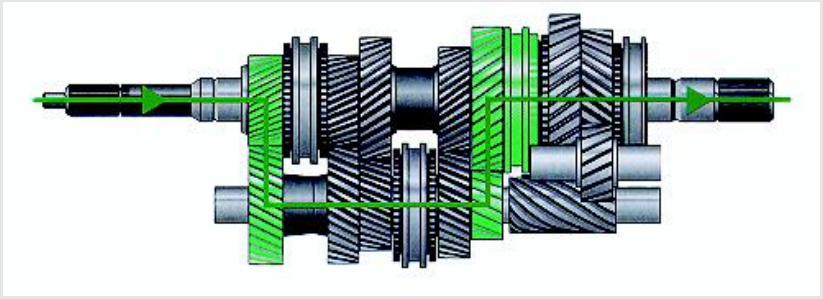
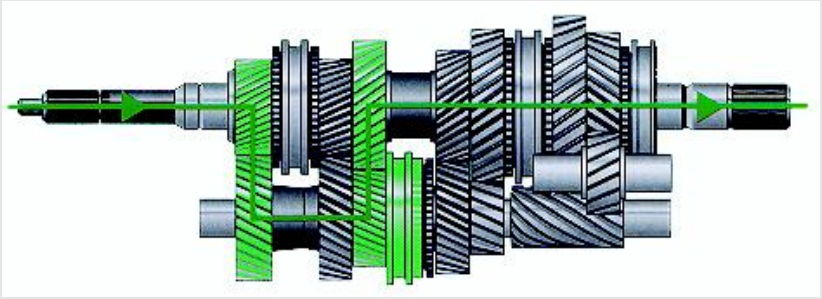
Power flow, 1st gear



3_23_04

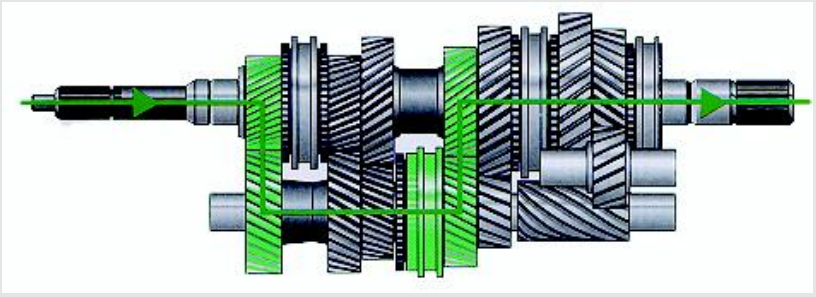
Power flow, 2nd gear



3_24_04

Power flow, 3rd gear

Power flow, 4th gear



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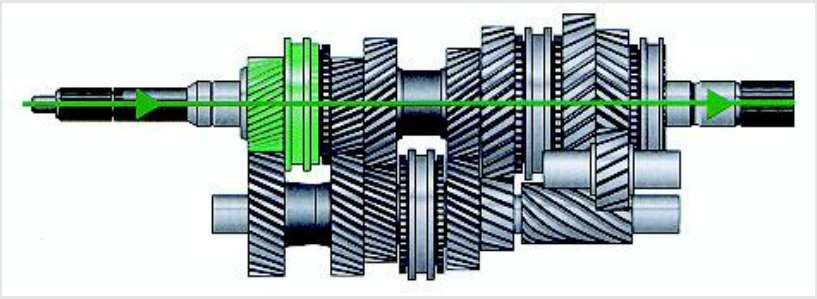
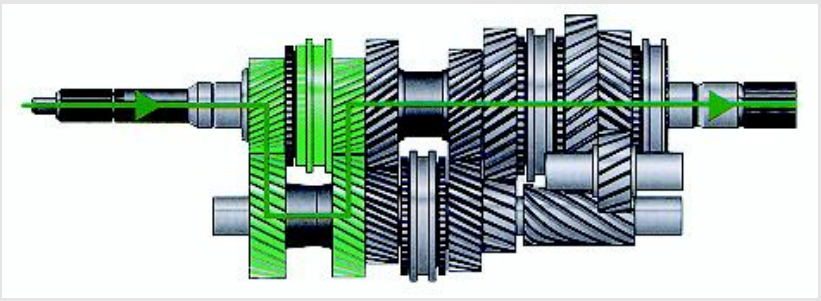
Power flow, 5th gear



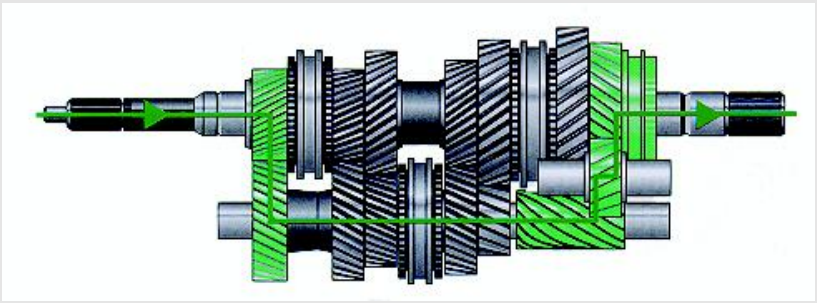
3_26_04

Power flow, 6th gear



3_27_04

Power flow, reverse gear



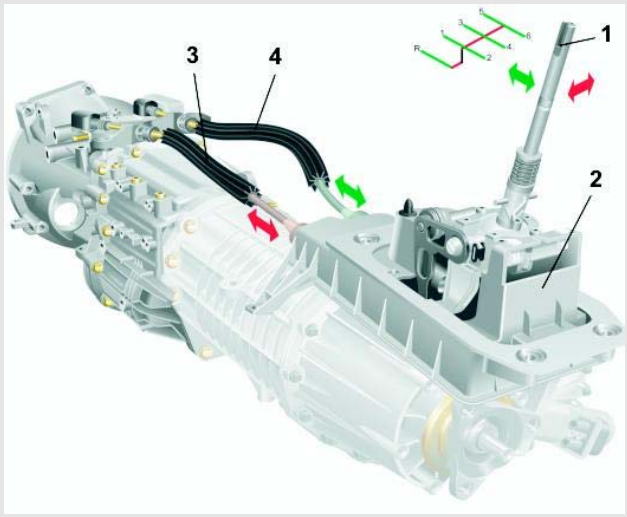
3_28_04

3404 Shift mechanism

As on the Porsche sports cars, a 4-gate shift pattern is also implemented on the Cayenne.

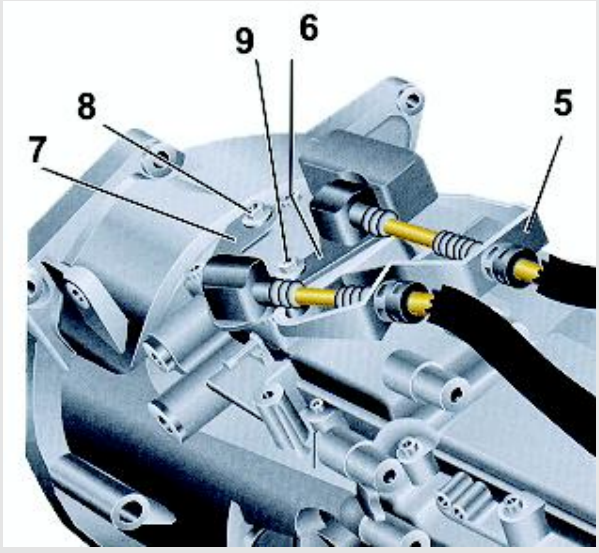
3427 Shift mechanism (external)

The 6-speed manual gearbox of the Cayenne is, as on the Porsche sports cars, equipped with a cable gearshift. Two cables, one selector cable and one shift cable, provide the connection between the manual gear lever in the vehicle and the gearbox. The external shift mechanism includes the manual gear lever (1) with the shift housing (2), the cables (3 and 4), the abutment (5) and the shift and selector lever (6 and 7). In the shift housing (2), the shift and selection movements of the manual gear lever (1) are converted to axial movements of the cables.



3_29_04

1 - Manual gear lever
2 - Shift housing
3 - Selector cable
4 - Shift cable
5 - Abutment
6 - Gear lever
7 - Selector lever
8 - Selector turning shaft
9 - Shift turning shaft

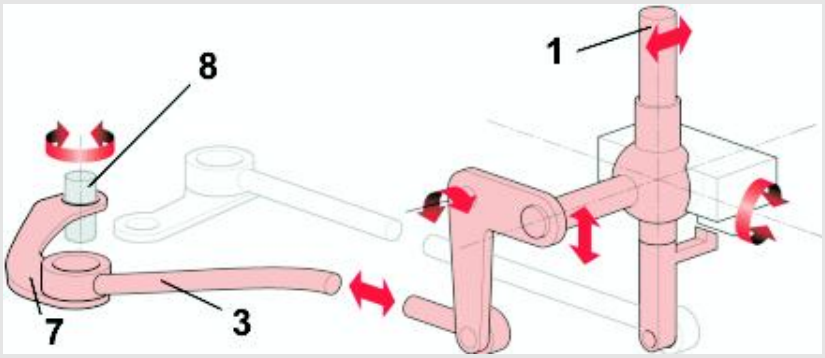


3_30_04

On the external shift module, the axial movements of the cables are converted to rotary movements of the shift and selector turning shafts (8 and 9).

The selection movement

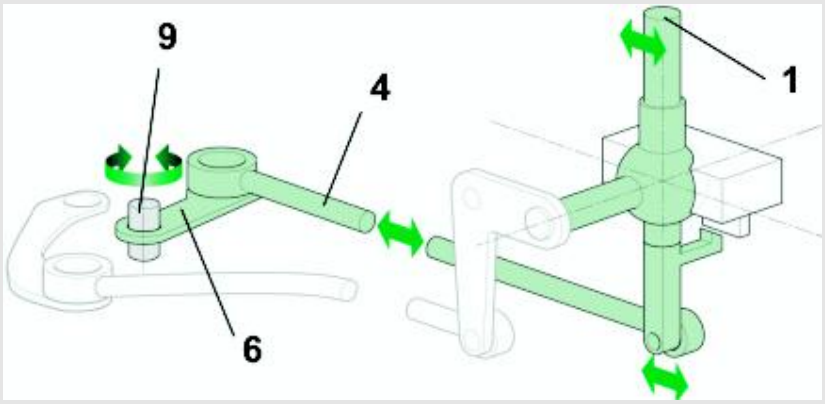
1 · Manual gear lever
3 · Selector cable
7 · Selector lever
8 · Selector turning shaft



3_31_04

The mechanism of the manual gear lever (1) transmits the selection movement (right/left) onto the selector cable (3) and converts it to a forward and backward movement.
The external mechanism on the shift module converts the movement of the selector cable (3) to a rotary movement. This rotary movement is directed via the shift turning shaft (8) into the shift module.

1 · Manual gear lever
4 · Shift cable
6 · Gear lever
9 · Shift turning shaft

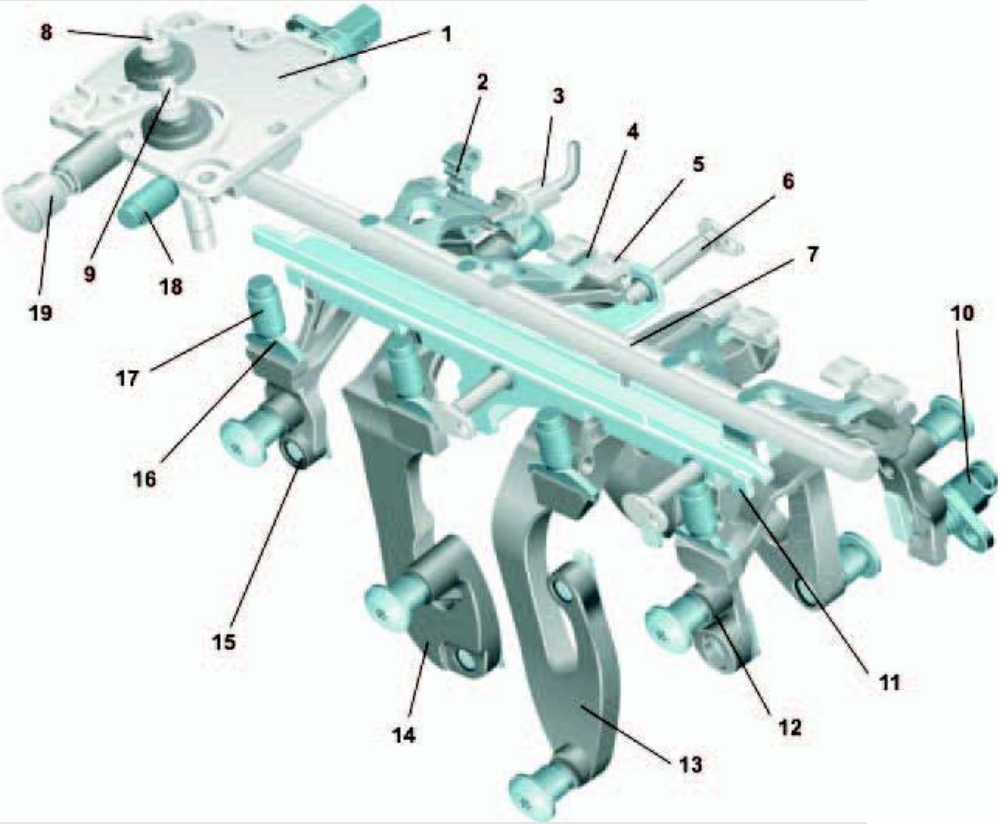


3_32_04

The forward and backward movement of the manual gear lever (1) is transmitted to the shift cable (4).
On the shift module, the axial movement of the shift cable (4) through the gear lever (6) is converted to rotary movement and this is transmitted via the shift turning shaft to the shift module.

The internal shift mechanism basically consists of three subsystems.

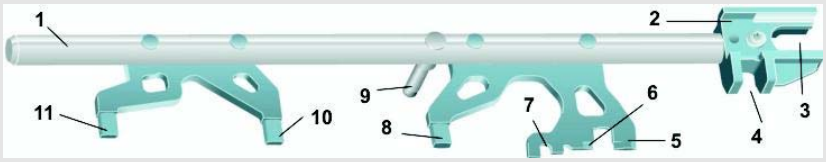
- The shift module
- The shift actuation in the gearbox
- The interlock mechanism



3_33_04

1 - Shift module
2 - Gate
3 - Arrester pin
4 - Shift finger, 3rd/4th gear
5 - Shift dog of selector fork
6 - Mount of interlock rail
7 - Central selector shaft
8 - Selector turning shaft
9 - Shift turning shaft
10 - Switch for reversing lights
11 - Interlock rail
12 - Selector fork, reverse gear
13 - Selector fork, 1st/2nd gear
14 - Selector fork, 3rd/4th gear
15 - Selector fork, 5th/6th gear
16 - Recess for arrester
17 - Arrester
18 - Arrester
19 - Arrester

Central selector shaft

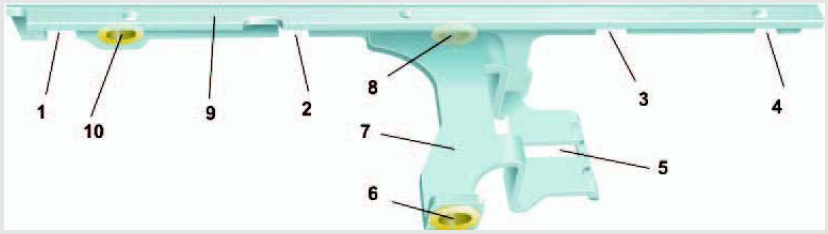


3_34_04

1 - Central selector shaft with riveted shift fingers
2 - Central driver
3 - Opening for rotary movement
4 - Opening for axial movement
5 - Shift finger, 5th/6th gear
6 - Shift finger for gate
7 - Mount for plastic clip (arrester)
8 - Shift finger, 3rd/4th gear
9 - Pin for interlock mechanism
10 - Shift finger, 1st/2nd gear
11 - Shift finger, reverse gear

Interlock

The interlock mechanism consists of the interlock rail and interlock bar.



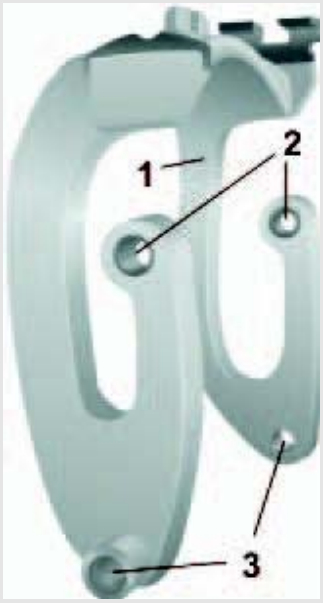
3_35_04

1 - Recess for interlock rib of selector fork for reverse gear
2 - Recess for interlock rib of selector fork, 1st/2nd gear
3 - Recess for interlock rib of selector fork, 1st/2nd gear
4 - Recess for interlock rib of selector fork, 5th/6th gear
5 - Recess for pin for interlock
6 - Mount
7 - Interlock bar
8 - Mount
9 - Interlock rail
10 - Mount

Selector forks

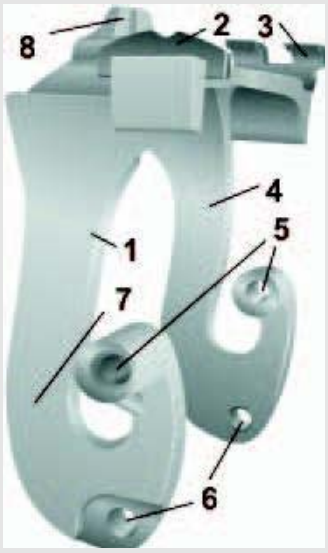
The selector forks are in die-cast aluminum.

The asymmetric design of the shank ensures that through the shift dog despite one-sided force application a uniform transfer of force takes place at both sliding blocks. This prevents tilting of the shift sleeves.



3_36_04

1 · Selector fork, 1st/2nd gear
2 · Mount for sliding block
3 · Mount



3_37_04

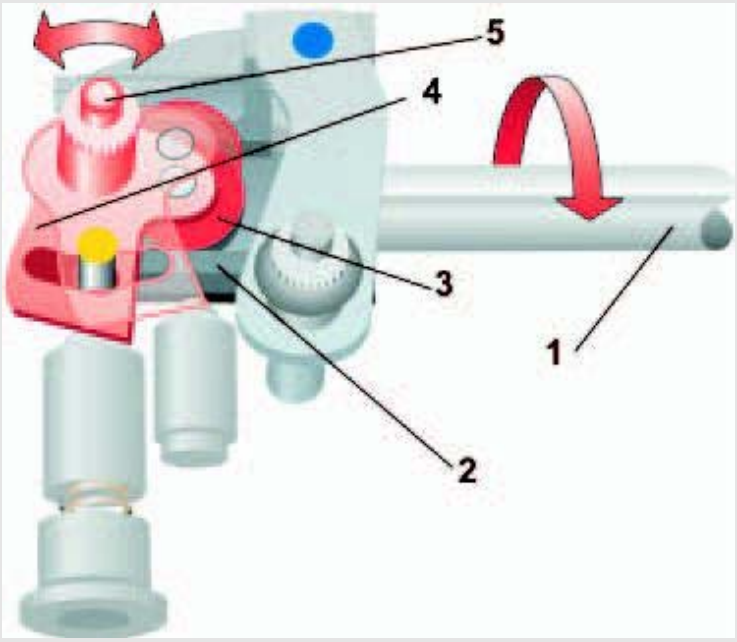
1 · Selector fork, 1st/2nd gear
2 · Stop for arrester
3 · Shift dog for shift finger
4 · Shank
5 · Mount
6 · Mount for sliding block
7 · Shank
8 · Interlock rib with recess for interlock mechanism

Shift module

The shift module is a unit, which converts the movement of the cables into radial movement (selection) or axial movement (shifting) and transmits this to the central selector shaft.

Selection movement

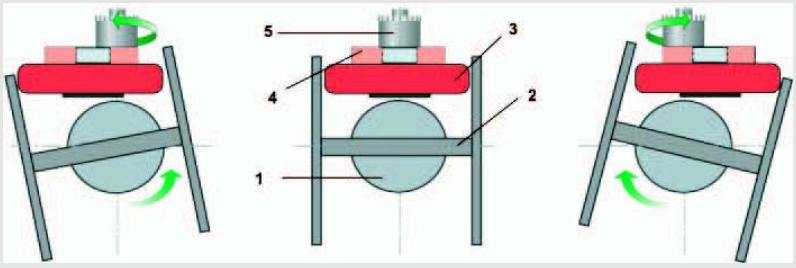
1 - Central selector shaft
2 - Central driver
3 - Selector disk
4 - Selector lever
5 - Selector turning shaft



3_38_04

The selector turning shaft (5) is permanently connected to a selector lever (4). A selector disk (3) is secured on this, which engages with the central driver (2) that is permanently connected to the central selector shaft (1). Depending on the rotation of the selector turning shaft (5), an off-center movement of the selector disk (3) takes place with a consequential levering action on the central driver (2). The central selector shaft (1) is turned.

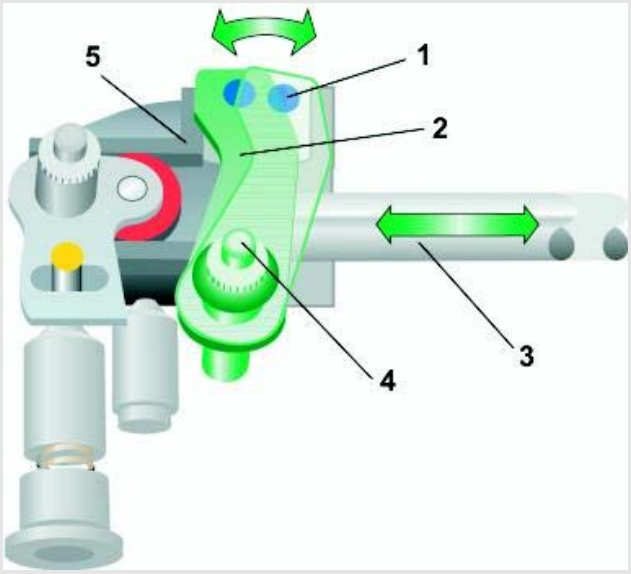
Anticlockwise rotation | Neutral position | Clockwise rotation



3_39_04

The shift movement

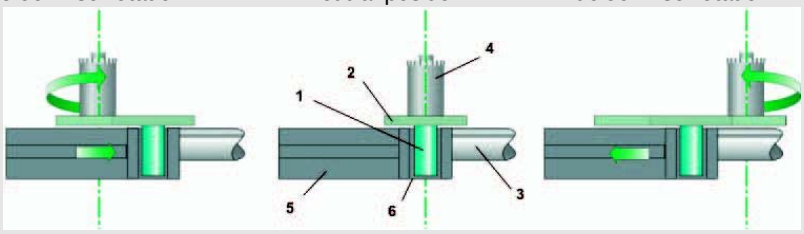
The shift turning shaft (4) is permanently connected to a gear lever (2). The guide pin (1) of the gear lever (2) engages in a groove (6) of the central driver (5).
As the shift turning shaft (4) turns, the levering action of the gear lever (2) pushes the central selector shaft (3) axially.



3_40_04

1 - Guide pin
2 - Gear lever
3 - Central selector shaft
4 - Shift turning shaft
5 - Central driver

Clockwise rotation Neutral position Anticlockwise rotation



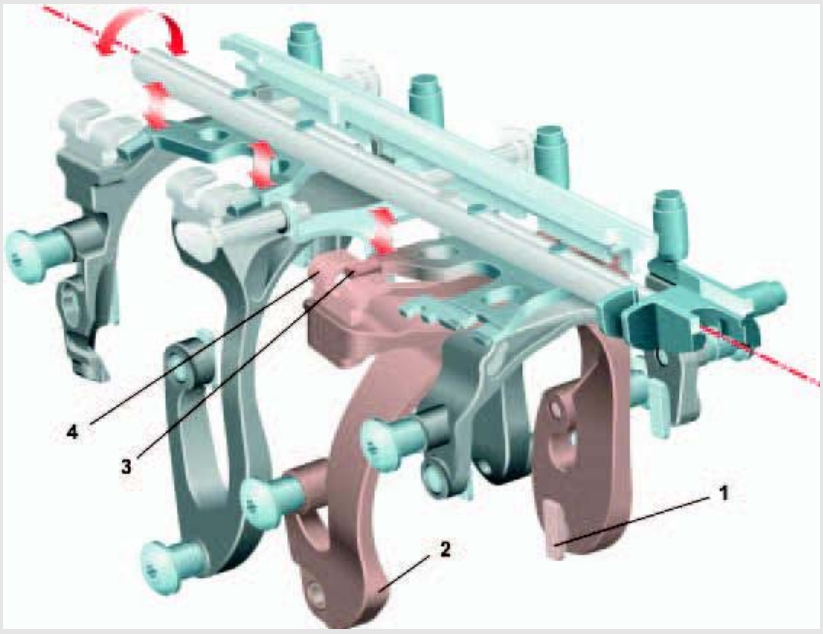
3_41_04

1 - Guide pin
2 - Gear lever
3 - Central selector shaft
4 - Shift turning shaft
5 - Central driver
6 - Groove

Shift actuation in the gearbox

Shift fingers (3) are secured at various angles to the central selector shaft. Through the radial movement of the central selector shaft, the shift fingers engage in the shift dog of the respective selector fork depending on the gate selected (1st/2nd, 3rd/4th, 5th/6th or reverse gear).

1 · Sliding block
2 · Selector fork, 3rd/4th gear
3 · Shift finger
4 · Shift dog

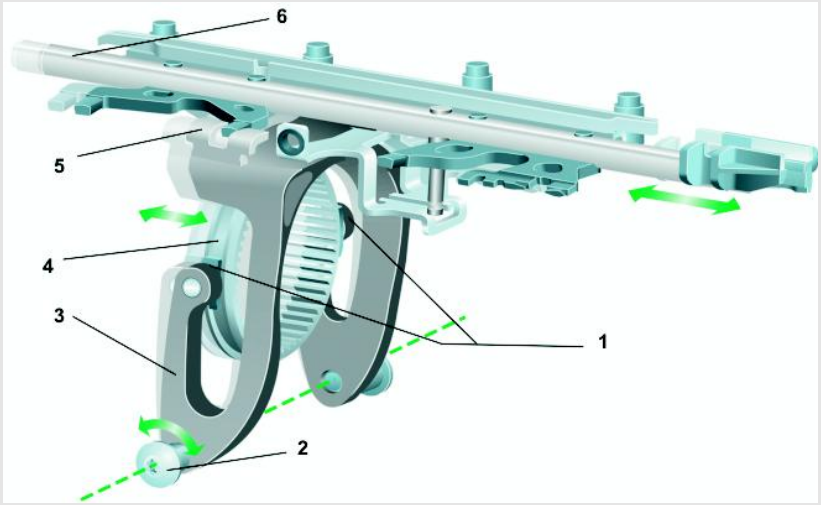


3_42_04

Shift movement

The axial movement of the central selector shaft (6) causes a tilting movement of the selector fork (2) through the corresponding shift dog (4). The mount of the selector fork is the pivotal point of this tilting movement.

1 · Sliding block
2 · Mount
3 · Selector fork
4 · Sliding sleeve
5 · Shift dog
6 · Central selector shaft

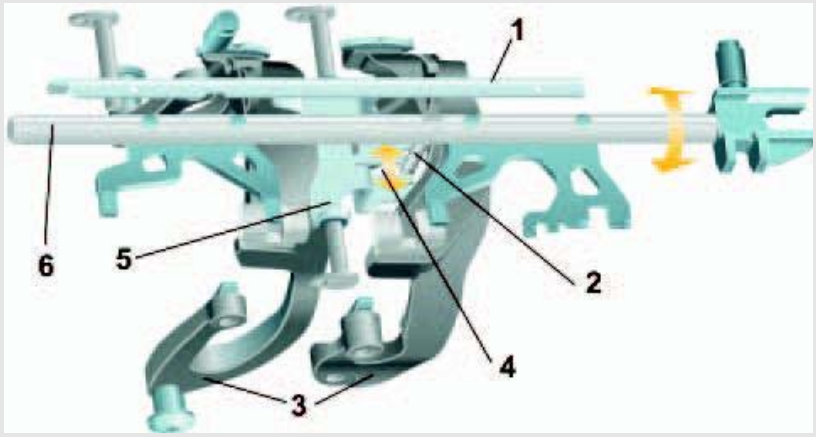


3_43_04

The tilting movement of the selector fork is passed on to two sliding blocks (1) as an axial movement.
The sliding blocks engage in the shift sleeve (4) guided on the synchronizer hub. The shift sleeve is pushed from the neutral position towards the sliding gear and, depending on the gear selected, forms an interlocking connection between the gear and the output shaft or countershaft.

3530 Interlock

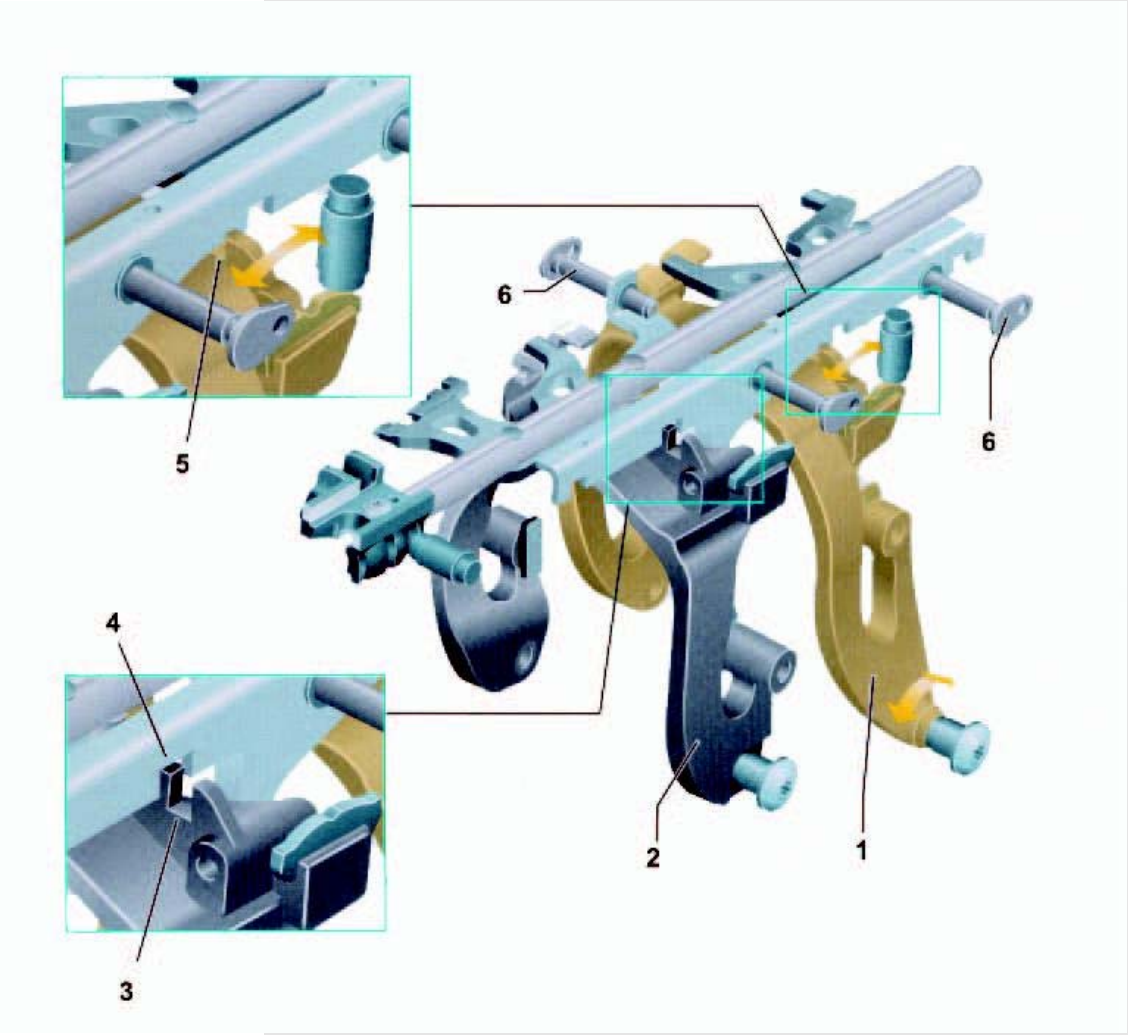
The purpose of the interlock is to prevent unintentional shifting of multiple gears. The interlock takes place through the interlock rail (1). It is an active system. The selection movement of the central selector shaft (6) activates the interlock through the interlock rail.



3_44_04

1 - Interlock rail
2 - Pin
3 - Selector forks
4 - Recess for interlock bar
5 - Interlock bar
6 - Central selector shaft

The rotary movement of the central selector shaft (6) is converted to a linear transversal movement of the interlock rail (1) through the pin (2) for the interlock, which engages in the recess of the interlock bar (5). That means, that the interlock rail is pushed transversely to the selector forks (3).
The recesses on the interlock rail and on the interlock ribs of the selector forks are arranged so that only one selector fork remains movable and the others are blocked.



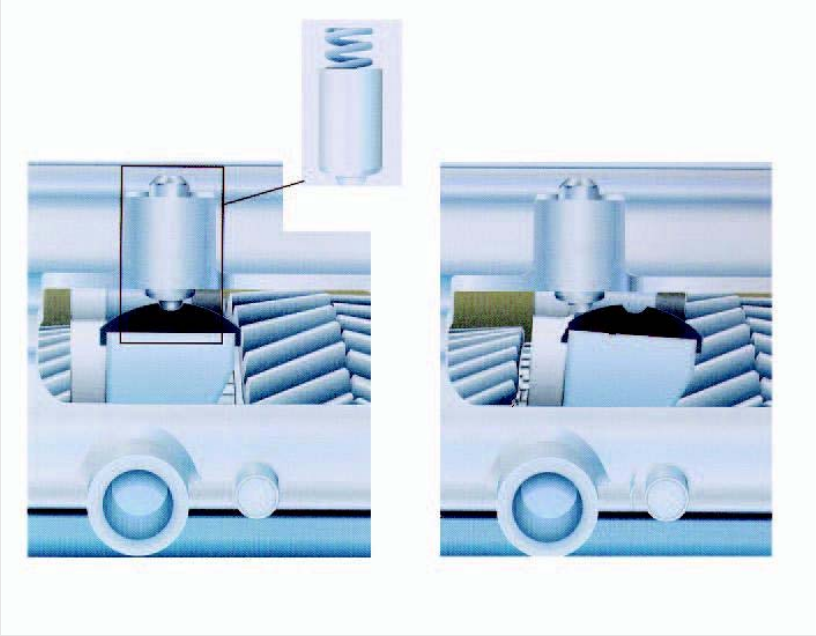
3_45_04

1 - Enabled, selected selector fork
2 - Blocked selector fork with recess
3 - Blocked interlock rib with recess
4 - Interlock rail with recess (blocked)
5 - Movable interlock rib
6 - Mount

The recess of the interlock rib allows the selected selector fork to be pushed longitudinally along the interlock rail. That means, that gear can be shifted whereas the other selector forks remain blocked.
The interlock prevents unintentional simultaneous shifting of multiple gears.

3530 Arrester

The arrester ensures reliable shifting of the respective gears. Each selector fork is responsible for the shifting of two gears and has a neutral position.



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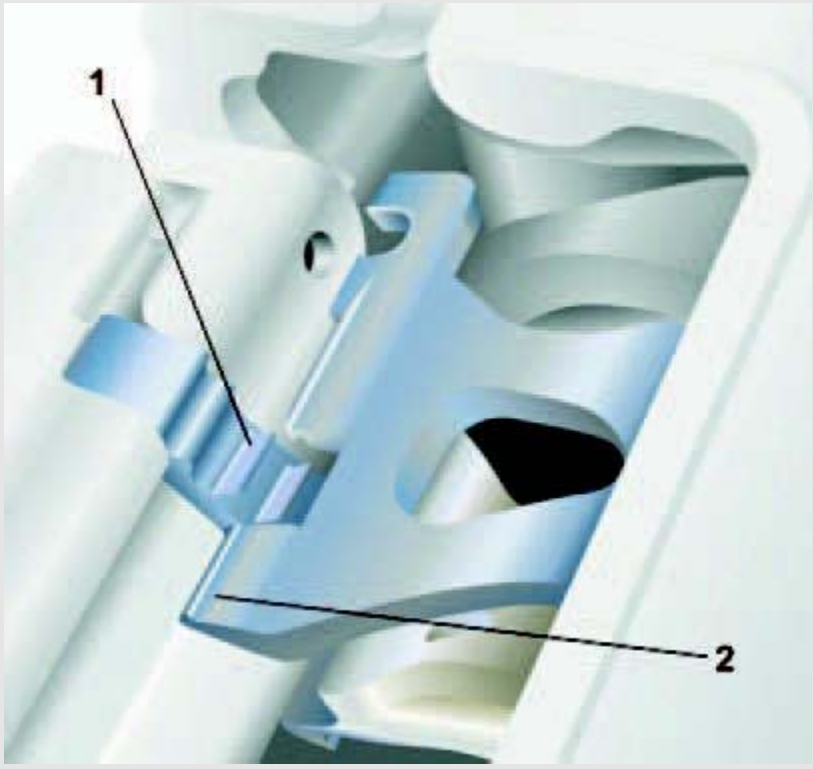
This arresting also provides additional force in the shift direction, which supports the movement of the shift sleeve.

3513 Gearshift gate

The gearshift gate minimizes the transversal play of the manual gear lever.



3_47_04

A guide finger (2) secured on the central selector shaft, depending on the selected shift gutter, engages in the respective guide groove of the gearshift gate (1). This reduces the selector lever play and supports the central selector shaft against rotational forces.

Thus, the gearshift gate holds the central selector shaft in the selected shift position and secures the position of the manual gear lever in the respective shift gutter (in the selected gear).