SERVO-THRUST SYNCHRONIZATION

Beginning with Gearbox No. 50 001

Figure 1 shows, in addition to component parts numbered 1 through 8, a cross-sectional view of the Porsche servo-thrust synchronization with the two corresponding gears, either of which couples with the output shaft by pushing the sliding sleeve to left or right, respectively.

The clutch carrier (3) is firmly attached to the gear and carries the synchronizing ring (4), slider (5a), stop (6), and the two brake band segments (7). The assembly is kept in place by the locking ring (8). Located between the two gears, which rotate freely on the output shaft, is the sliding sleeve (1); the sleeve is free to move sideways even though it is in constant lock with the output shaft by way of the three-pronged spider (2).

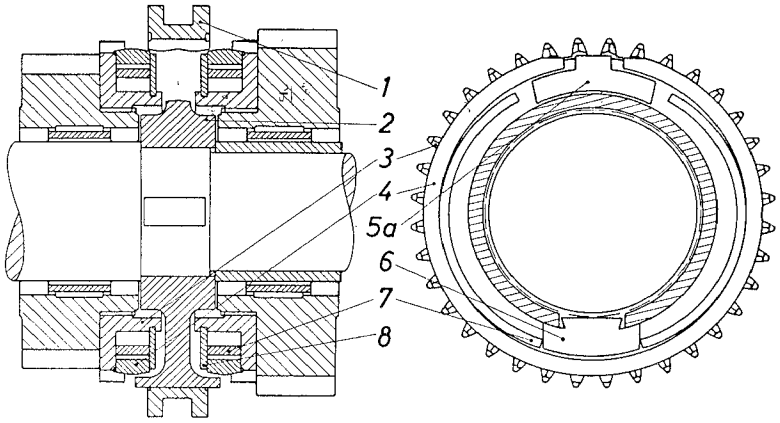

Fig. 1

The Porsche synchronization operates on the servo-thrust principle. The frictional force, which is created by pushing the sliding sleeve onto the synchronizing ring, is multiplied by the servo-thrust mechanism located within the synchronizing ring without creating additional resistance to the gearshift lever. The synchronization components automatically control the extent of the servo action required in each particular instance, thus resulting in quick shifts with little effort.

When a shift is made with the gears at standstill, the selector fork moves the synchronizing ring from the center position and engages it with the gear teeth in the synchromesh drive ring of the respective gear. In the above process the synchronizing ring compresses to fit inside the sliding sleeve and then comes to rest in a groove machined on the inner surface of the sliding sleeve. This requires only the amount of force needed to overcome the static resistance of the synchronizing ring, which results from the tension of the ring and the angle inclination of the cone.

It is not possible to push the sliding sleeve beyond the clutch carrier because the travel space between gearbox front cover and the intermediate plate has been appropriately limited and, in addition, gears of the 1st and 2nd speed are larger than the inside diameter of the sliding sleeve.

When a shift is made with the car in motion, entirely different conditions prevail. The synchronizing mechanism must equalize the difference in rotation speed existing between the output shaft and gear 2 (countergear) of the gear to be engaged; it must also prevent that the sliding sleeve comes into contact with the toothed drive ring on the clutch carrier prior to equalization of the rotation speed.

The mechanical connection between the engine and gearbox must be positively broken whenever shifts are made; that is to say, the clutch must be fully disengaged. This is necessary because the clutch plate represents part of the mass to be synchronized and, thus, must be accelerated or slowed down, as the case may be.

As illustrated in Fig. 2. the friction contact between the sliding sleeve (1) and the synchronizing ring (4) causes the synchronizing ring to slip somewhat, with one of its ends coming to rest against the slider (5a). The slider pushes against one of the brake band segments (7) which, in turn, presses against the inner surface of the sliding sleeve (4), with the stop (6) acting as its anchor. As a result, radial thrust is exerted upon the sliding sleeve (4) by the brake band segment (7) and by the stop which pivots on its base.

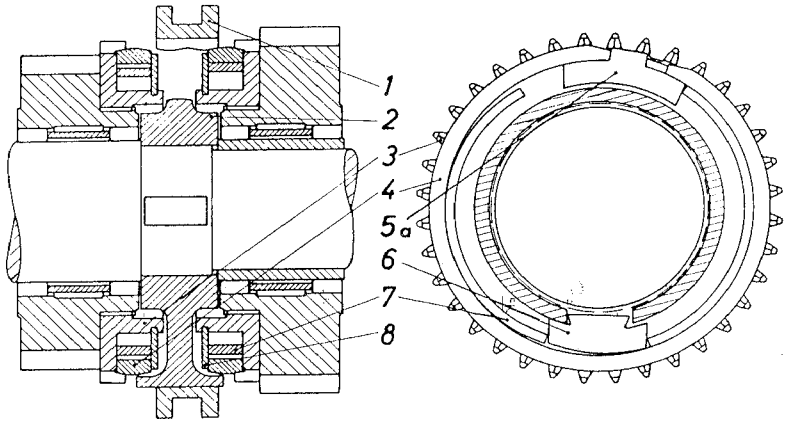

Fig. 2

At the beginning of the synchronization process, the frictional forces existing between the sliding sleeve and synchronizing ring were caused only by the spring tension of the synchronizing ring. As the synchronization process continued, the servo-thrust mechanism came into action and began to exert an additional and increasing radial thrust upon the synchronizing ring.

Thus, the synchronization utilizes a servo-thrust coming from within and exerted upon the sliding sleeve via the brake band segments. The servo-thrust mechanism is so designed that the servo effect governs itself and prevents a self-lock.

As long as there is a difference in rotation speed between the sliding sleeve, with its coupled output shaft, and the gear to be engaged, the radial thrust of the servo mechanism prevents a reduction of the diameter of the synchronizing ring and, in this way, prevents an engagement of the sliding sleeve. On the other hand, the frictional forces at the synchronizing surfaces decrease in proportion to a decrease in rotation speed difference existing between the sliding sleeve and respective gear.

When rotation speed of both parts equalize, the servo-thrust mechanism relaxes, the brake band segment is relieved and creases to exert resistance towards the necessary diameter reduction of the synchronizing ring, thus making it possible to push the sliding sleeve over the synchronizing ring with very little effort until the synchronizing ring is caught in the arresting groove inside the sliding sleeve (Ref. Fig. 3). A shift lock in respective gear positions is no longer necessary.

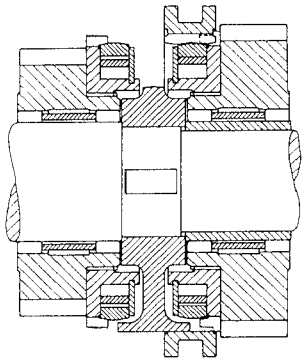

Fig. 3

All forward speeds of the gearbox are equipped with identical synchronization and servo-thrust components, with the exception of the 1st speed which is used for starting. Care was taken to ensure that the frequently shifted 1st speed engages with little effort when the car is not in motion. This has been accomplished by installing in the synchronization mechanism of the 1st gear only one brake band segment and by changing the shape of the slider.

Figure 4 illustrates the synchronization at time of engagement of 1st speed, with engine running and car standing still. Due to the fact that the idle rpm of the engine are low and the clutch plate rpm drop after clutch is disengaged, it is very easy for the synchronization mechanism to slow down the gear for engagement. The slipping synchronizing ring with one end presses the slider which rests with its tab against the clutch carrier. Since the tab is slanted, the slider is raised against the inner surface of the synchronizing ring whose frictional contact is increased just enough to permit a clash-free, effortless engagement of the gear.

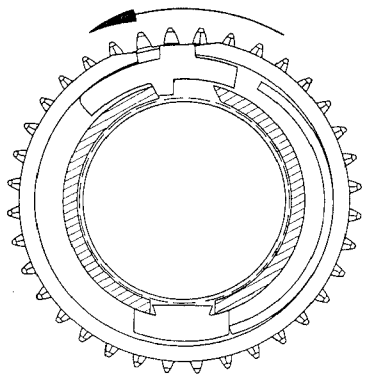

Fig. 4

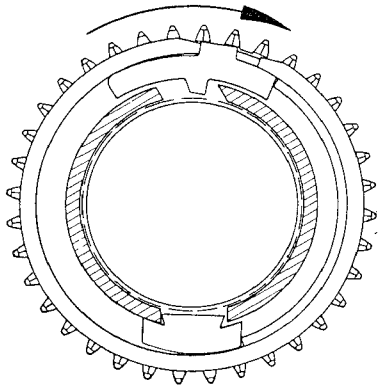

Fig. 5

Figure 5 illustrates the synchronization mechanism at time of engagement of 1st speed with car in motion. Contrary to engagement of 1st speed with car standing still, the gear is not slowed down but has to be accelerated. Therefore, the normal brake band segment has been installed on the side of the servo-thrust mechanism which is to function in this case to ensure the full benefit of the servo-thrust effect obtained in all other gears.