Contents

The demands made on the vehicle's power supply are increasing steadily. For instance, the required generator/alternator power outputs increased about 5-fold between 1950 and 1980. In the meantime the amount of power needed in the vehicle has more than doubled again. In the coming years, the need for electrical energy in the vehicle will rise at an ever faster pace. The increasing demand for electrical energy stems from the large amount of electrical equipment which has become an integral part of every modern-day vehicle. This stems from the ECUs for electronic systems, and from all the safety, comfort and convenience electronics and their components.

The generator (more correctly termed the "alternator") is the vehicle's electricity generating plant. On the one hand, the increasing number of electrical loads demands higher alternator outputs. On the other hand, considering the restricted installation space under the hood, the equipment providing this power should under no circumstances become larger and heavier in the process. Bosch therefore has developed alternators which not only comply with these demands, but which at the same time are quieter, more long-lived, and able to withstand higher loading than their predecessors. Wear-free electronic voltage regulators are a prerequisite for coping with the extensive engine-speed changes and fluctuations in loading which are characteristic for vehicle operations. Extremely lightweight and requiring a minimum of space, these regulators maintain the alternator voltage output constant across the engine's complete speed range.

The starter motor must at all times be ready to crank the engine, and during the course of its life must successfully complete thousands of starting operations. Taking a passenger car which is mainly operated in town traffic, this can equate to about 2000 engine starts per year for an average annual mileage of 15,000 km (10,000 miles). As with its alternators, Bosch was successful in increasing starter-motor output while at the same time making the unit lighter and smaller. The application of reduction-gearing in combination with permanent-magnet techniques was decisive here. All Bosch starters are highly reliable while ensuring maximum operational dependability.

Although the individual components "Alternator with voltage regulator" and "Starter motor" are subject to their own operating conditions, they are highly dependent on each other. For this reason, development activities are concentrating on their effective interplay. This manual from the Bosch "Yellow Jacket" series deals with the design and construction of the most important components, as well as with their essential characteristics and differences and their importance in the vehicle's electrical system.

Direct-drive starter motors for cars

Application

The Series D78 pre-engaged starter motors have a permanent-magnet excitation field. They are suitable for use in cars with small gasoline engines up to approx. 1.6 *l* capacity.

Design

The design and internal configuration of the Series D78 can be seen in Figure 5.

This model has a DC motor with six-pole permanent-magnet excitation and four carbon brushes. Power transmission is by way of a roller-type overrunning clutch which is driven directly by the armature shaft.

The two basic models available (D78-S and D78-M) differ primarily by virtue of the length of the electric motor. In addition, the D78-M has flux concentrators which increase the short-circuit torque.

Reduction-gear starter motors for cars

Application

For gasoline engines with capacities above 1.4 *l* and for car diesel engines, it is advisable due to considerations of weight and it is preferable to fit the R70, R74 and R78 series of reduction-gear start motors for reasons of weight and space restrictions. They are available with open or closed end shields.

Design

Design and internal configuration can be seen in Figure 6. These starter motors have a tough planetary reduction gear of the type previously described with three planet gears. They provide the high starting torque required by gasoline engines up to a capacity of approx. 6 *l* and for diesel engines up to a capacity of approx. 3 *l*.

In order to cover the range of power outputs required by modern car engines, there are

5 Series D78 direct-drive starter motor

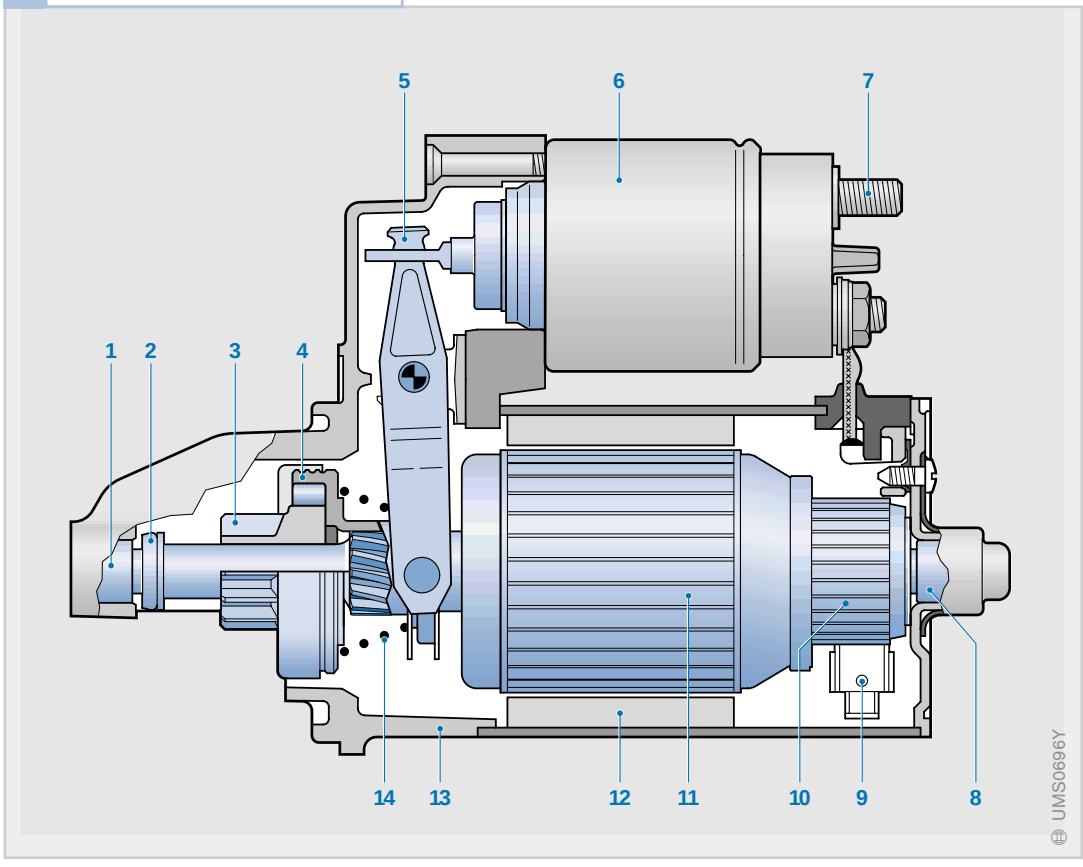

Fig. 5
1 Drive shaft
2 Stop ring
3 Pinion
4 Roller-type overrunning clutch
5 Pinion-engaging lever
6 Solenoid switch
7 Electrical connection
8 Commutator bearing
9 Brush holder
10 Commutator
11 Armature
12 Magnet
13 Stator housing
14 Meshing spring

three type ranges with varying stator housing diameters available. Common to all models are the integral solenoid switch, six-pole permanent-magnet excitation field and four carbon brushes. The permanent magnets used ensure that demagnetization does not occur even under unfavorable conditions. The more powerful types also have flux concentrators that increase the short-circuit torque and no-load speed.

The use of planetary reduction gears with transmission ratios between 3.38 : 1 and 5.67 : 1 enables optimum starting-system compatibility with the requirements of the engine and vehicle electrical system in question. The standard internal gear is made of glass-fiber reinforced polyamide plastic, while an alternative planetary gear with a sound-insulated internal gear made of sintered steel is also available.

The bearings in the planetary gear and the drive end shield are fitted with sintered bushes on the smaller models (up to R70-M, R74-M) but are also available with needle-rolling bearings as an option for higher performance.

Starter motors for commercial vehicles

Starter motors for commercial vehicles are nowadays generally fitted with a reduction gear in order to utilize the weight and size advantages compared with direct-drive starter motors.

The use of lighter materials and optimized manufacturing methods has made it possible to reduce the overall weight by as much as 40% compared with conventional direct-drive starter motors.

The area of application for reduction-gear starter motors with electromagnetic excitation is primarily diesel engines with capacities between 2.5 and approx. 16 *l*.

6 Type R70 reduction-gear starter motor

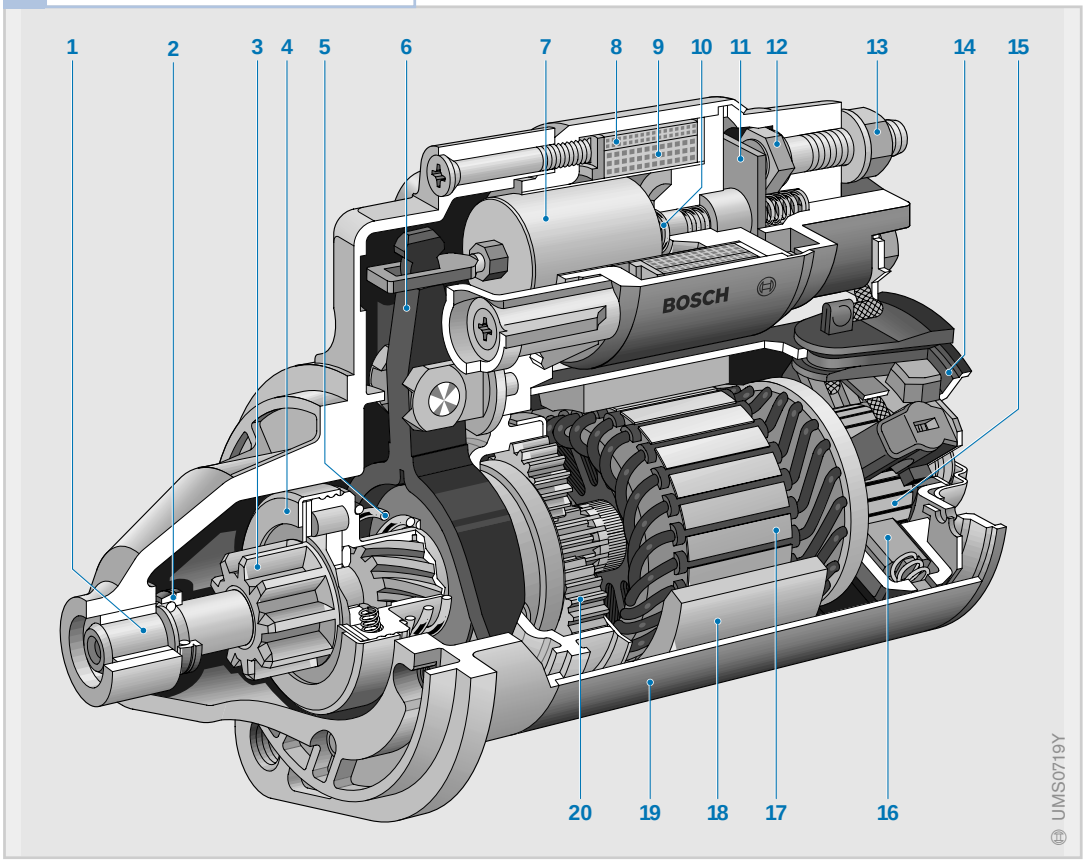

Fig. 6

1 Drive shaft
2 Stop ring
3 Pinion
4 Roller-type overrunning clutch
5 Meshing spring
6 Pinion-engaging lever
7 Solenoid switch
8 Hold-in winding
9 Pull-in winding
10 Return spring
11 Switch contact
12 Switch contact
13 Electrical connection
14 Commutator end shield
15 Commutator
16 Brush holder
17 Armature
18 Magnet
19 Stator housing
20 Planetary gear