Starter

General

The starter, which is used to crank the engine, must overcome the combined resistance of the compression, piston friction, and bearing friction. In order to be able to provide the considerably large torque required for this purpose, the starter draws a very high current.

Construction and Function

The design of the starter is similar to that of the generator. The main difference lies in the fact that the starter is a current consumer and the generator a current producer.

The overrunning clutch coupling, mounted on the starter drive, breaks the connection between engine and starter as soon as the peripheral speed of the flywheel exceeds that of the starter pinion.

The driver, coupled with the pinion by the overrunning clutch, is mounted on the long helical spline of the armature shaft. The rotation of the armature and spline pushes the pinion forward to engage the flywheel ring gear. The forked end of the solenoid lever is held between two spring loaded washers in the middle of the driver sleeve on which the starter gear is mounted. The forked end of the actuating lever engages between the two actuating rings to advance the pinion. The pinion is also advanced by the inertia action of the helical spline. The commutator end of the starter is closed by an end cap. The starter is actuated electromagnetically by a solenoid switch mounted on the starter and in turn actuated by the ignition/starter switch mounted on the instrument panel.

Engaging

After the starter has been switched on, the actuating lever is first moved against spring pressure without the field and armature windings switched on. The actuating lever pushes the driver and pinion toward the ring gear by the actuating ring on the pinion side and against the coil spring; the driver and pinion thereby turn on the helical spline. Should the pinion be in line with a tooth space in the process, it meshes instantly.

Shortly before the pinion meshes fully, the switch mounted on the starter is closed so that the starter armature begins to rotate. As the starter shaft accelerates the starter pinion is fully engaged with the ring gear by the worm action of the helical spline shaft. When the pinion gear reaches the end stop on the starter shaft it is firmly seated and the starter begins to drive the flywheel through the overrunning clutch. When the solenoid switch closes the actuating lever stops but the driver continues forward tensioning the coil spring nearest the armature.

Should the advancing pinion come against a tooth, the actuating lever compresses the coil spring at the pinion end, until the switch closes. The pinion being turned passes the tooth face and engages the succeeding tooth space under pressure exerted by the coil spring. Because of the long helix no axial pressure that would jam the mechanism occurs. The solenoid switch mounted on the starter contains one actuating and one holding coil. Both coils are in action while actuating the plunger. When the starter current is switched on, the actuating coil is short-circuited, and the holding coil alone remains energized.

Disengaging

The overrunning clutch used to protect the armature from damage is connected to the pinion gear. When the pinion gear speed exceeds the armature speed it is free to rotate on the roller and ramp type overrunning clutch. As shown in Fig. 19 the rollers become jammed against the shaft and couple the pinion gear to the armature when driving. The rollers are pushed back into the larger gap when driven by the engine. When the gear is stationary, springs push the rollers into the engaged position so that the pinion gear will be driven as soon as the starter is actuated. The pinion gear remains engaged with the flywheel ring gear as long as the starter is running and the solenoid is activated. The pinion gear is withdrawn from the starter ring gear only when the solenoid is released. The pinion gear is returned to the neutral position by the coil spring on the shaft and the solenoid return spring.