CA 45F STARTER MOTOR

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DESCRIPTION

This is a direct drive, co-axial motor with four pole, four brush arrangement. Two stage pinion engagement ensures that the pinion is fully in mesh with the flywheel ring gear prior to full power being applied to the starter. A centrifugal overspeed device is incorporated, which means that the drive pinion is automatically disengaged from the flywheel should the armature speed become excessive. This device will operate even if the starter switch is held in the on position. The operating solenoid is integral with the starter, and is co-axially mounted in the drive end housing A bush bearing with a built in oil wick reservoir is fitted at the drive end. To minimise the possibility of the starter pinion jamming on the ring gear, a recoil device is fitted to the commutator end of the armature shaft.

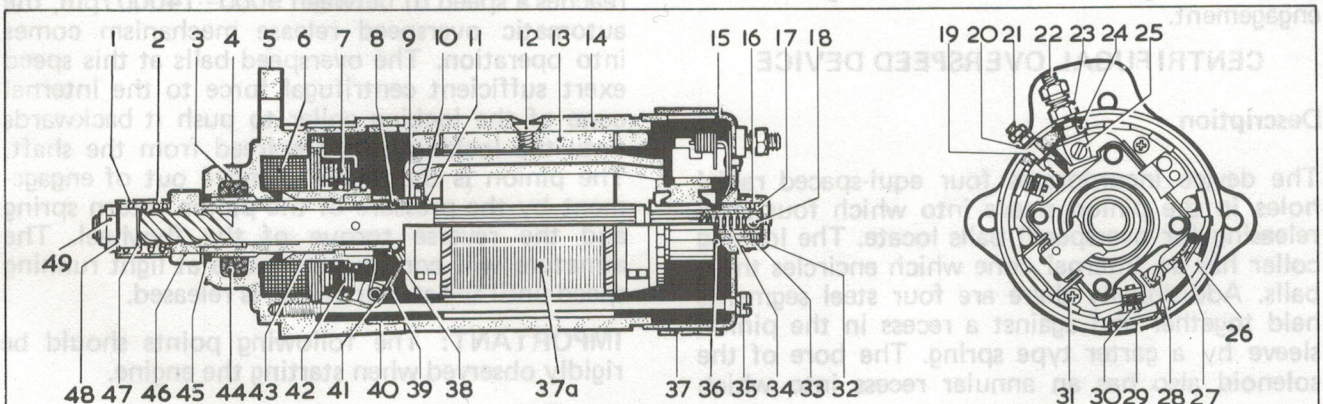
OPERATION

In the following text the figures in brackets refer to Fig. 1 unless otherwise stated.

When the starter switch is operated current flows through the coil of the ST relay and closes the relay contacts. The solenoid (6) is then energised and its hollow plunger (43) moves forward, pushing pinion (46) towards the engine flywheel teeth. At the same time, the movement of the plunger closes the first stage contacts (7), connecting the battery to the field and armature windings via a heavy duty resistor (40). The resistor reduces the volts to the windings with the result that the armature rotates at low speed.

This combination of forward and rotary movement partially engages the pinion with the engine flywheel. The pinion, being prevented from rotating by the inertia of the flywheel is then pushed fully into mesh by the action of the helix on the slowly rotating armature shaft. Shortly before the fully engaged position is reached, collar (10), carried on the end of the pinion sleeve, trips a trigger (39) on the solenoid. This causes a second set of contacts (42) to close and short circuit the resistor, applying full battery voltage to the windings and full starting torque is exerted.

When the pinion is engaged it is locked in position by a special locking device consisting of steel balls (8) located in holes in the pinion sleeve. These balls drop into recesses in the armature shaft when the pinion reaches its fully engaged position, and a spring loaded collar (38) slides over and holds them firmly in position. Hence, the pinion cannot be ejected prematurely but will remain in mesh until the starter button is



1 HELIX COVER
2 PINION SPRING
3 SPRING
4 LUBRICATOR CORE PLUG
5 DRIVE END SHIELD
6 SOLENOID ASSY.
7 1ST CONTACT
8 LOCKING BALLS
9 LOCK COLLAR SPRING
10 TRIP COLLAR
11 CIRCLIP
12 POLE SCREW
13 POLE SHOES
14 YOKE
15 COMMUTATOR END SHIELD
16 SHIM WASHERS
17 CIRCLIP
18 STEEL BALL
19 INSULATING BUSH
20 TERMINAL NUT
21 SOLENOID TERMINAL
22 MAIN TERMINAL
23 TERMINAL NUT
24 INSULATING BUSH
25 SCREW
26 SPACER
27 RESISTOR RIVET
28 RESISTOR FLEXIBLE LEAD
29 CORE PLUG
30 FIELD TERMINAL SCREW
31 SELF TAPPING SCREWS
32 END CAP
33 THRUST WASHER
34 RECOIL SPRING
35 THROUGH BOLTS
36 SHIMS
37 COMMUTATOR COVER
37a ARMATURE
38 LOCK COLLAR
39 TRIGGER
40 RESISTOR
41 TRIGGER SPRING
42 2ND CONTACT
43 SOLENOID PLUNGER
44 LUBRICATOR WICK
45 DUST SCRAPER RING
46 PINION ASSY.
47 SHIM WASHER
48 THRUST WASHER
49 PINION STOP NUT

Fig. 1 *Section view of 12 volt starter*

released, or the overspeed device releases the locking mechanism. See "Overspeed Protection Device".

On rare occasions, the pinion and flywheel may meet tooth to tooth; this will not affect engagement under normal conditions, as the pinion will continue to rotate until the teeth slide into mesh. If the gear teeth are worn and burrs are present rotation of the pinion may be prevented and the pinion may even be held against the flywheel teeth when the starter button is released. In order to overcome this difficulty, the starter incorporates an armature recoil mechanism comprising a steel ball (18) and recoil spring (34) fitted at the commutator end of the armature shaft.

Whenever the pinion is prevented from rotating, the action of the helix on the slowly rotating armature shaft will be to force the armature back against the recoil mechanism, compressing the recoil spring; as soon as the starter button is released, the spring thrusts the armature forward. At the same time, rotary motion, opposite to the normal direction of rotation is imparted to the armature by the helix inside the stationary pinion. When the armature reaches the end of its forward movement, its momentum is sufficient to rotate the pinion slightly, freeing it from the burrs. The pinion then returns to its disengaged position under the influence of the pinion return spring; its radial position will now be slightly retarded, so that there is little likelihood of the gears meeting tooth to tooth during the next engagement.

CENTRIFUGAL OVERSPEED DEVICE

Description

The device incorporates four equi-spaced radial holes in the pinion sleeve into which four steel releasing (or overspeed) balls locate. The locking collar has an internal cone which encircles these balls. Additionally there are four steel segments held together and against a recess in the pinion sleeve by a garter type spring. The bore of the solenoid also has an annular recess into which the segments become latched by the magnetic flux of the solenoid during the starting cycle.

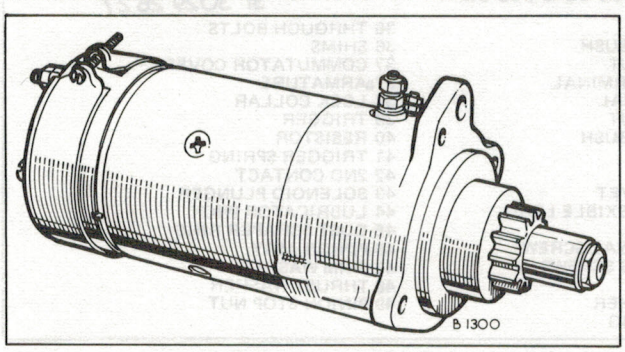


Fig. 2 *CA45F starter motor*

Operation

Refer to Fig. 3. When the starter switch is operated the starter solenoid coil is energised and its plunger moves forward carrying with it the four segments and garter spring. These form a shoulder and push the pinion toward the engine flywheel teeth. During the forward travel of the pinion, a taper on the sleeve forces the segments and garter outwards and they become magnetically latched in the recess in the solenoid plunger by the surrounding flux, thus allowing uninterrupted movement of pinion and sleeve assembly. The segments remain there until the starter switch is released.

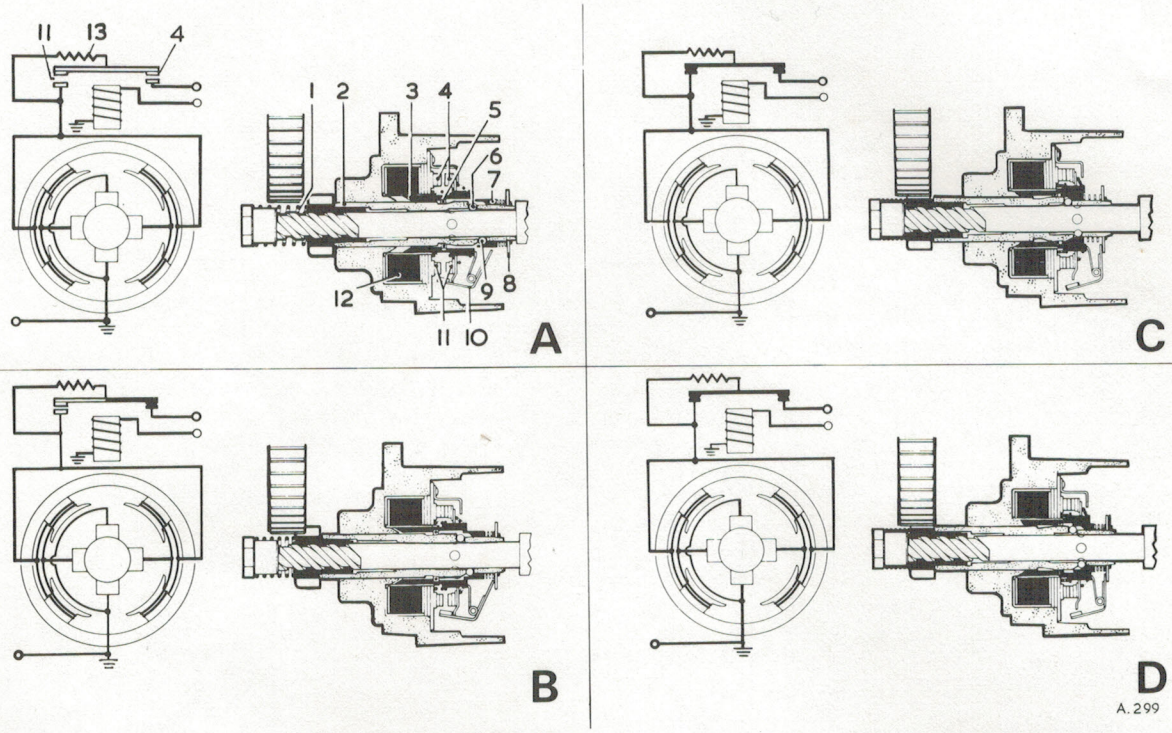
Once the engine has started, normal function is for the starter button to be released, de-energising the solenoid. The magnetic flux is thus cancelled. the solenoid plunger moves back taking with it the four segments and garter spring. Simultaneously the pinion disengages from the flywheel, the locking collar moves back under force of its return spring, releases the locking balls and the pinion flies back to rest. The garter spring returns the segments to their original position on the pinion sleeve ready for the next start.

If the starter is driven by the engine due to the starter switch being held closed, and the armature reaches a speed of between 9000–14000 rpm, the automatic overspeed release mechanism comes into operation. The overspeed balls at this speed exert sufficient centrifugal force to the internal cone of the locking collar to push it backwards until the locking balls are freed from the shaft. The pinion is then able to move out of engagement by the pressure of the pinion return spring and the reverse torque of the flywheel. The armature will continue to rotate at light running speed until the starter switch is released.

IMPORTANT: The following points should be rigidly observed when starting the engine.

1. Ensure that all engine controls are correctly set.

2. Press the starter button firmly and release it immediately the engine fires. The automatic ejection of the starter pinion by the overspeed device does not occur until high rotation speeds of the starter are reached. These high speeds lead to excessive wear on the bearings and brushes and would considerably shorten the service life of the starter if this device were relied on during every normal start. It is stressed that the driver must regard the overspeed device as an energency measure only.



1 PINION RETURN SPRING
2 PINION SLEEVE
3 SOLENOID PLUNGER
4 1ST CONTACTS
5 SEGMENTS
6 OVERSPEED BALLS
7 LOCK COLLAR
8 TRIP COLLAR
9 LOCKING BALLS
10 TRIGGER
11 2ND CONTACTS
12 SOLENOID
13 RESISTOR

"A" AT REST POSITION

The segments (5) are contracted to form a shoulder which carries the pinion sleeve (2) forward when the solenoid (12) is energised.

"B" ENGAGING POSITION

Solenoid plunger (3) moves forward and the 1st contacts (4) close bringing the dropper resistor (13) into circuit. Pinion engages and armature rotates slowly.

"C" CRANKING POSITION

Pinion fully engaged, and locking balls (9) retained by lock collar (7). 2nd contacts (11) close thereby shorting the resistor (13) and full battery power is applied to the starter.

"D" OVERSPEED POSITION

Centrifugal force acting on the overspeed balls, (6) pushes the lock collar (7) rearwards. The segments are held in the expanded position by the solenoid magnetic flux, allowing the pinion to be pushed out of mesh by the reverse torque of the ring gear.

Fig.3 *Operation sequence*