

STARTER, NO 3, MK 1, FV 546101 AND MK 2, FV 546165

TECHNICAL HANDBOOK - TECHNICAL DESCRIPTION

Note: These Pages 1-2 supersede Pages 1-2, Issue 1, dated 14 Nov 67. Heading and CONTENTS have been amended.

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Introduction

1. This regulation describes the Starter, No 3, Mk 1 and 2, which is a 6 in. axial type starter of CAV manufacture, fitted with a 13 toothed steel pinion.
2. Whilst these starters are completely interchangeable with those of another manufacturer, no components are interchangeable.

Description, see Fig 1

3. The motor is a waterproofed, 24V, 4 pole insulated-return machine having main series, auxiliary series, and shunt windings. The operating switch is two stage actuated by a solenoid, the coil of which is protected against overload by a thermal trip. The drive to the pinion which rotates clockwise from the drive-end is transmitted through a single step clutch mounted on the armature shaft (DE).
4. The starter is designed for cradle mounting and develops minimum lock torque of 90 lbf ft at 1880-1980A and a maximum h.p. of 15 at 3000 revs/min.
5. Positive engagement of pinion with flywheel is obtained by energising the auxiliary series and shunt windings through the first stage of the solenoid switch, resulting in an axial and slow rotary movement of the armature. Full power is transmitted by the pinion after the armature has moved axially for approximately 1 in., by means of a trip plate secured to the commutator which permits the second stage of the solenoid switch to make and energise the main series winding.

Yoke assembly

6. Three windings comprise the field system, the main series winding is wound on two of the four poles, the auxiliary series and shunt windings on the other two poles. The main series consists of two coils in parallel with each other and in series with the armature. The auxiliary series and shunt coils are in series and parallel respectively with the armature.
7. Poles pieces are numbered and assembled to correspond with numbers stamped on the yoke.

CE and DE shields, see Fig 3

8. These are dowelled to the yoke and secured by screws; sealing compound is applied to mating faces.
9. The CE shield is a casting consisting of a plate and bearing housing joined together by three arms. A hollow steel spigot pinned to the bearing housing supports the CE of armature shaft. At the top of the casting are mounted two plug type terminals and a three pin fixed plug.
10. The DE shield houses a steel backed, split, white metal bearing which carries the pinion sleeve; lubrication of the sleeve is by means of a spring loaded felt pad which presses against the sleeve through an aperture in the bearing; oil grooves ensure an oil supply to the whole bearing surface. The pad is supplied with oil by a wick stored in an oil reservoir cast integral with the DE shield which is filled with oil on overhaul. An oil seal is mounted in the nose of the DE shield.

Brush gear, see Fig 3

11. Brushes fitted in pairs are supported in box type holders formed in the arms of the two brush gear plates. The plates are mounted at right angles to each other and insulated from the CE shield and each other. The brushes are held against the commutator by helical springs exerting a pressure of 32-40 oz.

Armature, see Fig 4

12. This is a conventional, wave wound type, supported at both ends by oil retaining bronze brushes fitted to the bore of the pinion sleeve (DE) and the armature shaft (CE) respectively.
13. A spring loaded plunger screwed into the armature shaft and secured to the CE shield, retains the armature in a position out of line with the poles, the spring returning the armature to this position after axial movement.

Clutch, see Fig 4

14. The drive includes a spring loaded plate clutch consisting of five steel and five bronze plates, arranged alternately and splined to the inner and outer races. The function of the clutch is to prevent damage due to torque reversal and to permit the pinion to rotate freely without overspeeding the armature should the pinion remain in mesh after the starter switch is released. The clutch is adjusted to slip at 120-140 lbfft; wear is compensated for by fitting extra shims behind the clutch plates.

Solenoid switch, see Fig 5

15. A two stage solenoid switch, dowelled and secured by bolts to the CE shield; the moving contact is U shaped with arms unequal in length to engage the fixed contacts in two stages. Mounted between the leaf spring sleeve and the solenoid plunger nut is a trigger catch carrying the end of a spring loaded trigger. The trigger is operated by a trip plate attached to the commutator end of the armature.

16. As the armature moves axially, the trigger lifts to allow the second contact to make and energise the main series winding.

CE Cover

17. The cover encloses the CE shield, brush gear and solenoid switch, it is secured by four studs with nuts and washers and four hexagon headed screws. A flat neoprene gasket seals the joint between mating surfaces of cover and shield, and a blanking plug fitted at the top of cover permits the standard seal test to be carried out.

Modification record plate

18. The erasure of the appropriate number from the record plate fitted to the DE shield indicates embodiment of the following approval modifications:-

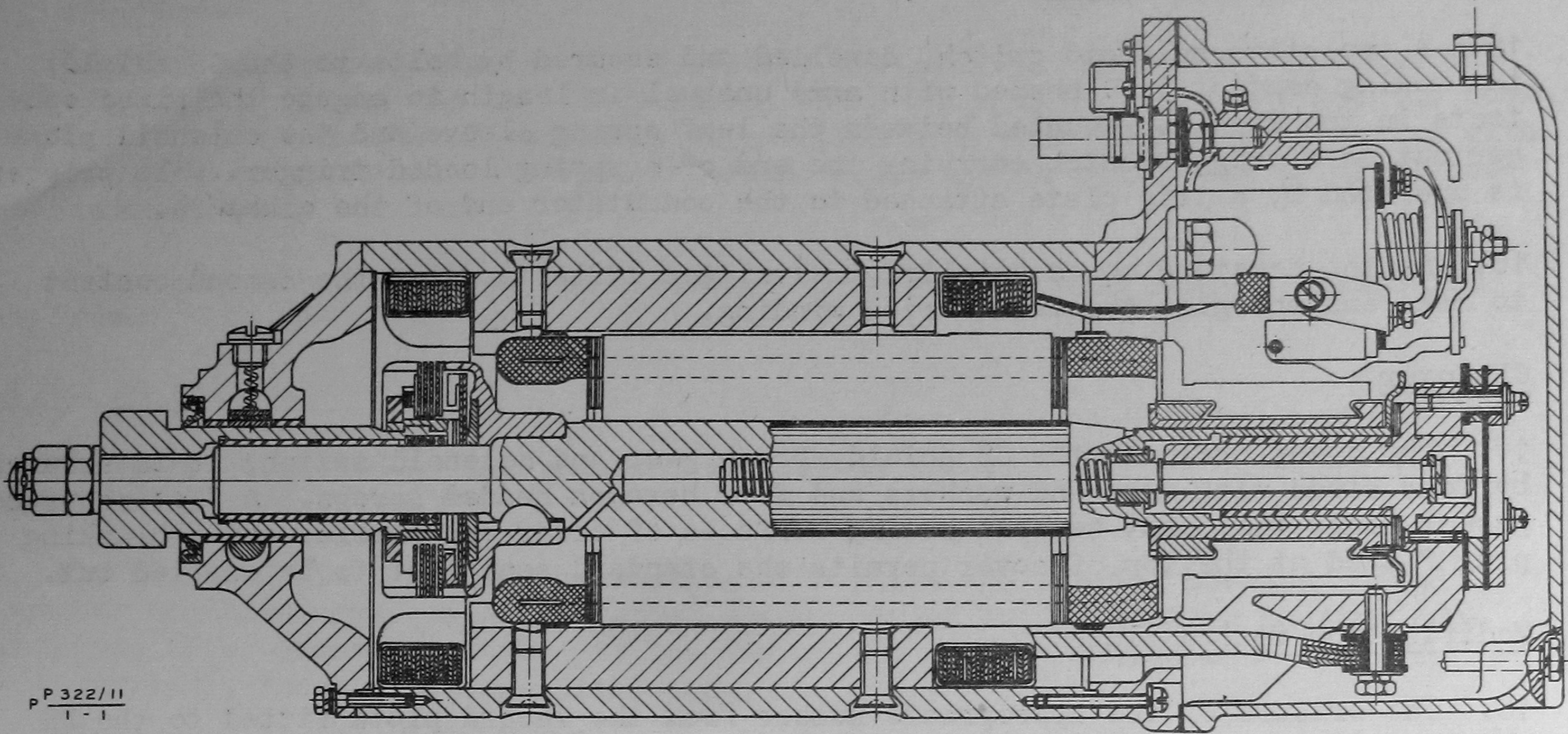
| Mod No | Detail |
|--------|--------------------------------------|
| 1) | Prevention of short circuits between |
| 2) | CE cover and live connections |

Operation, see Fig 2

19. Closing of the starter switch energises the solenoid coil, makes the **first** contact and completes the armature circuit through the auxiliary series and shunt windings. Further movement of the solenoid switch is prevented by the trigger catch. Under the influence of these windings, the armature moves axially with a slow rotary movement to bring the pinion into mesh with the flywheel.

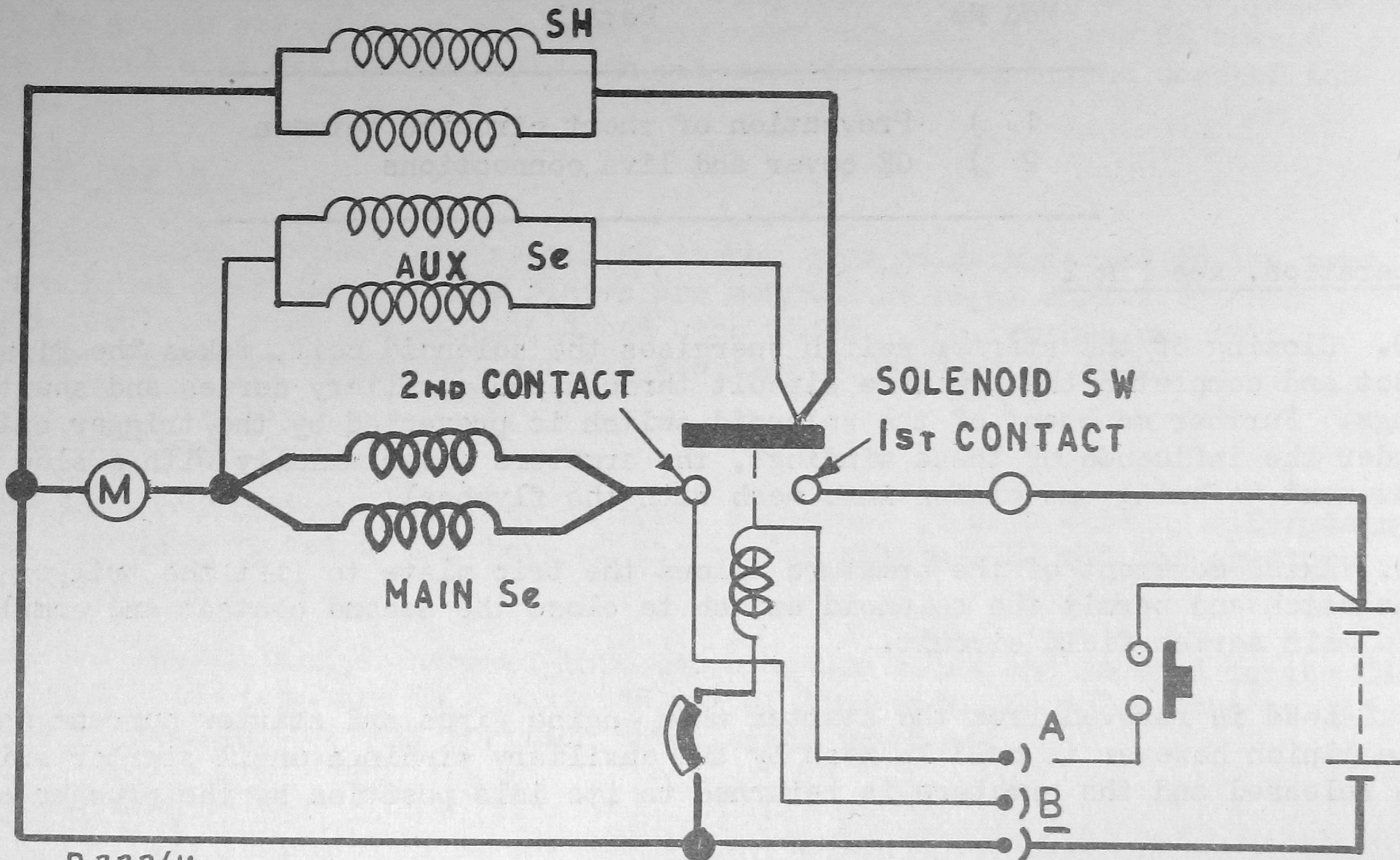
20. Axial movement of the armature allows the trip plate to lift the trigger off the catch and permit the solenoid switch to close the second contact and complete the main series field circuit.

21. Load is removed from the starter when engine fires and starter current falls; the pinion however is held in mesh by the auxiliary windings until starter switch is released and the armature is returned to its idle position by the plunger spring.



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Fig 1 - Sectional view



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Fig 2 - Circuit diagram

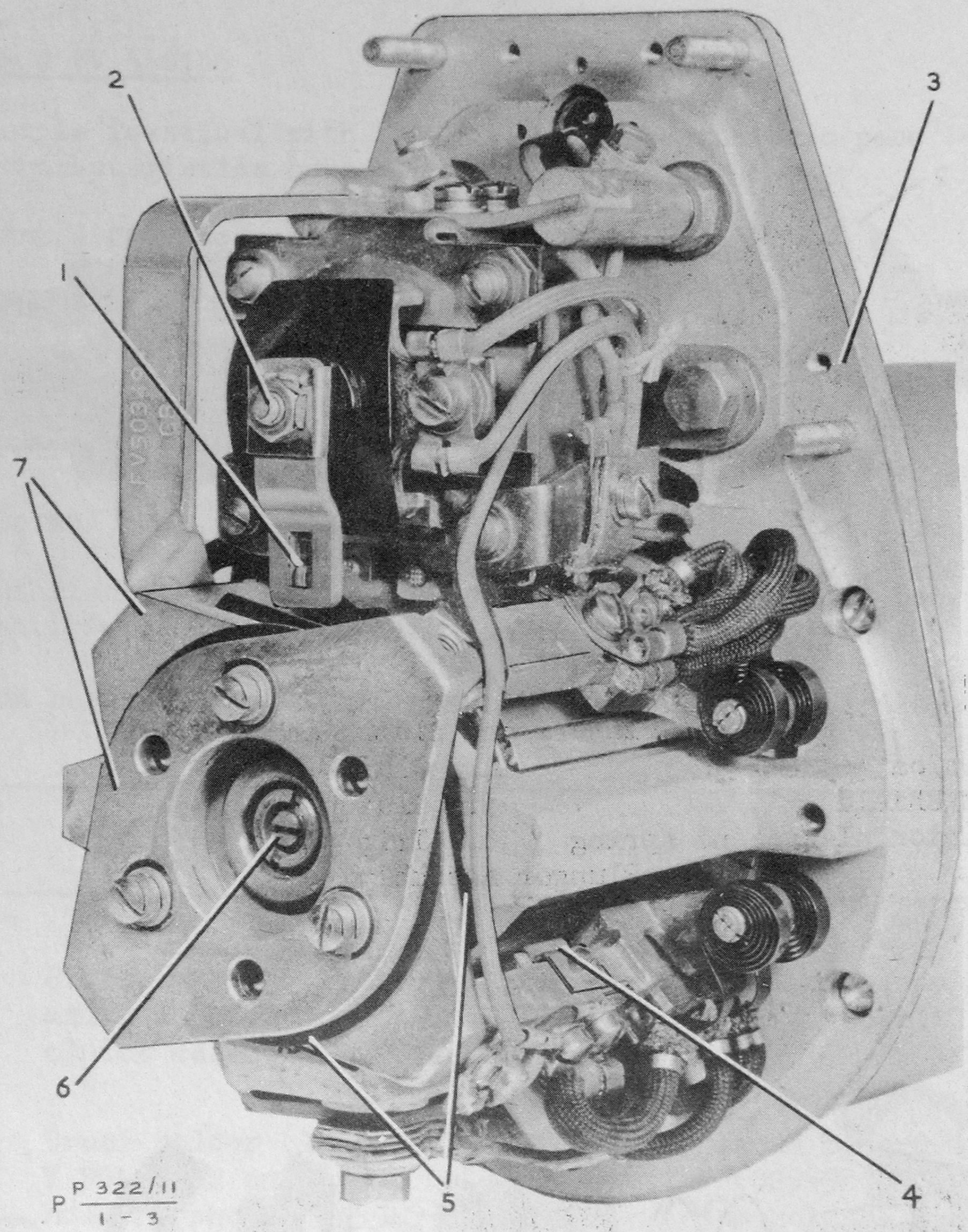
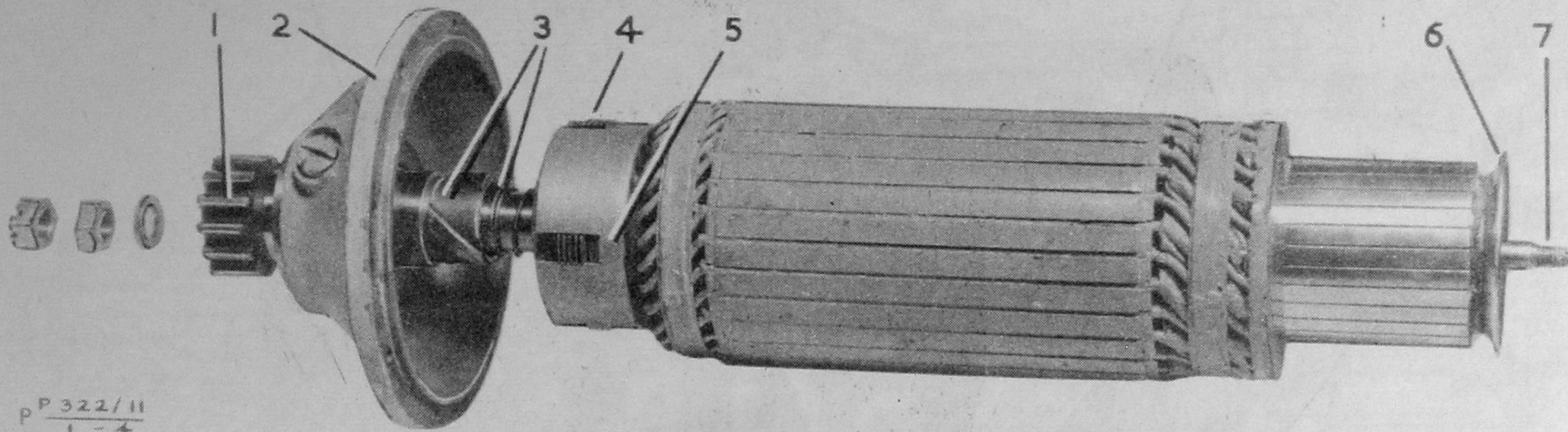


Fig 3 - CE assembly

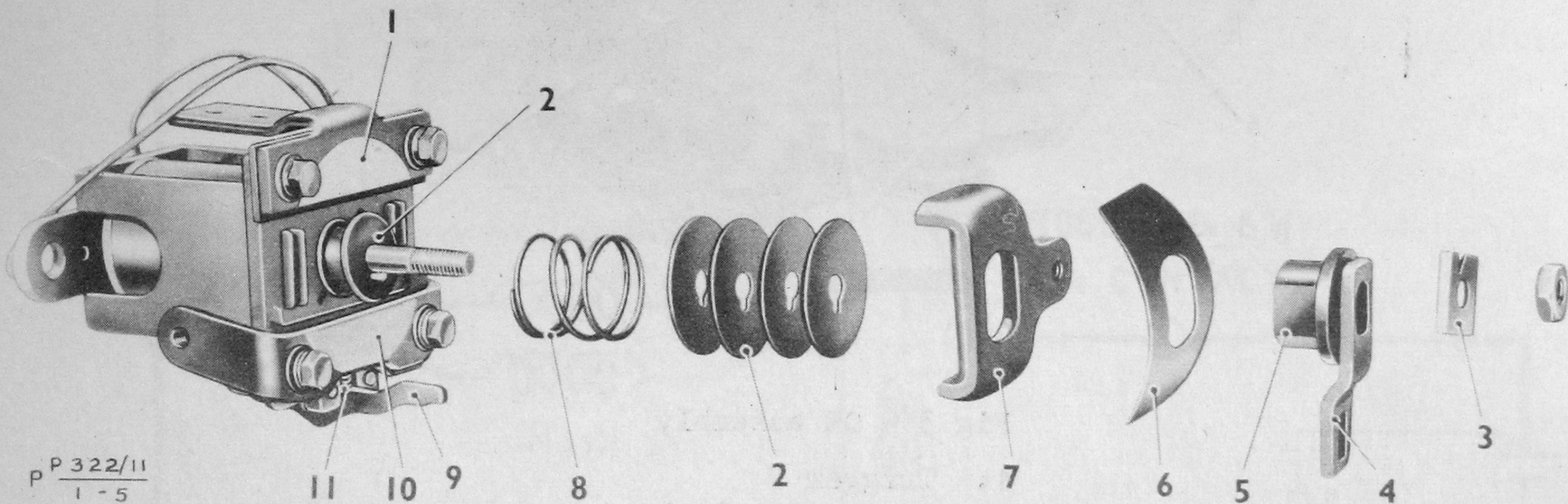
- 1. Trigger
- 2. Solenoid switch
- 3. CE Shield
- 4. Thermal trip
- 5. Insulating washer
- 6. Plunger assembly
- 7. Brush gear plate



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Fig 4 - Armature and clutch assembly

- | | |
|-----------------------------|---------------------|
| 1. Pinion | 4. Clutch plates |
| 2. DE Shield | 5. Clutch housing |
| 3. Pinion sleeve and spring | 6. Trip plate |
| | 7. Plunger assembly |



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Fig 5 - Solenoid switch

- | | |
|----------------------|--------------------|
| 1. First contact | 6. Leaf spring |
| 2. Insulating washer | 7. Bridge contact |
| 3. Locking plate | 8. Main spring |
| 4. Trigger catch | 9. Trigger |
| 5. Sleeve | 10. Second contact |
| | 11. Trigger spring |

Note: This Page 7 contains additional information. Delete END on Page 6.

Starter No 3, Mk 2 FV 546165

22. This starter is identical with the No 3 Mk 1 described in para 1-21 except that its functional characteristics have been improved.

23. The important differences are:-

- a. The cranked trip plate, item 6, shown at Fig 4, is replaced by a straight plate to give an earlier trip to the solenoid switch.
- b. The auxiliary field coils have been redesigned to obtain an increased forward pressure on the armature.
- c. The thermal trip, item 4, shown at Fig 3, is not fitted.
- d. This starter now has an operational tilt angle of $+45^{\circ}$ to -30° and will function satisfactorily at ambient temperatures up to $+100^{\circ}\text{C}$.

24. Modification record plate significance for the Mk 2 starter is:-

| Mod No | Detail |
|--------|--|
| 1 | Pinion spring Y 5549-100 is replaced by pinion spring Y 5586-485 and spacer Y 5586-487. Clutch assembly Y 5586-310 is replaced by clutch assembly Y 5586-488. |
| 2 | Brush holder (long) X 5549-167 is replaced by brush holder (long) V 5549-952 and brush holder (short) W 6029-98 is replaced by brush holder (short) V 5549-952D. New brush holders have integral separators. |

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END