

## Chapter 17

## STARTER MOTOR, ROTAX, TYPE C4703

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## LEADING PARTICULARS

<b>Starter motor, Type C4703</b> ....	<i>Ref. No.</i> 37F/5800
<i>Voltage</i> ....	24-volt
<i>Current, on load</i> ....	210 amp.
<i>Rating</i> ....	1½ min. at 400 lb/ft.
<i>Brush grade</i> ....	CM5H
<i>Brush spring pressure</i> ....	24+4 oz. -0
<i>Brush length—</i>	
<i>New</i> ....	0.755 in.
<i>Minimum permissible</i> ....	0.572 in.
<i>Commutator diameter—</i>	
<i>New</i> ....	1.510 in.
<i>Minimum permissible</i> ....	1.375 in.
<i>Jaw</i> ....	12-teeth
<i>Weight</i> ....	46 lb.
<i>Resistance of windings at 20°C</i>	
<i>Armature</i> ....	0.00231 ohm
<i>Field coils—series</i> ....	0.00231 ohm
<i>shunt</i> ....	16.50 ohms
<i>Direction of rotation (viewed from jaw end)</i> ....	Clockwise
<i>Jaw to hand turning gear ratio</i> ....	49 to 1
<i>Jaw to motor turning gear ratio</i> ....	113 to 1
<i>Clutch setting</i> ....	675 lb/ft.
<i>Jaw travel</i> ....	0.328 in. (max.)

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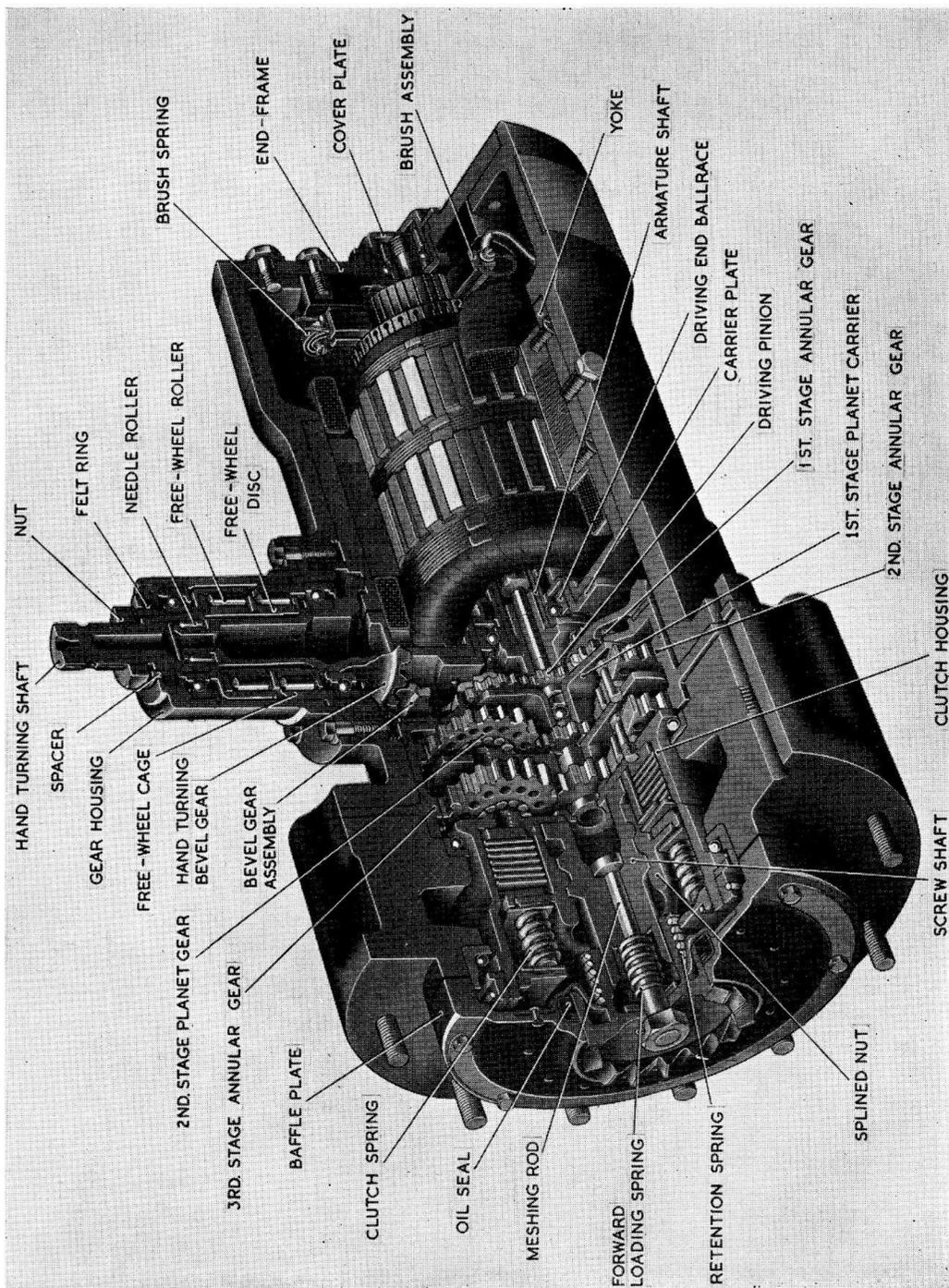


Fig. 1. Part sectional view of C4703 starter

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## Introduction

1. The Type C4703 starter motor is designed for use on aircraft requiring a starting torque of not more than 400 lb/ft. at a speed of approximately 40 r.p.m. Although primarily intended for electric starting, the machine is fitted with hand starting gear which is contained within a housing bolted on to the motor housing. Rotation of the starter jaw is in a clockwise direction, viewed from the jaw end of the machine.

## DESCRIPTION

2. The starter is of conventional design and is shown in part section in fig. 1. It has a 24-volt d.c. motor driving the starter jaw through an epicyclic gear to give an overall speed reduction of 113 to 1. Between the epicyclic gear and the jaw, a multiple plate clutch is included to protect the motor from damage through overload. The motor and gearing housings are light alloy castings. A third casting, mounted at right angles to the motor housing, accommodates the hand starting gear, which is coupled to the epicyclic gears through a bevel wheel drive.

### Motor

3. The motor is a four-pole compound-wound machine and is housed in an alloy casting. Its series-parallel windings and its speed limiting windings are wound one on each of the four field poles, and are connected directly to the wave-wound armature. The laminated field poles are bolted to a steel yoke which is secured by three bolts within the motor housing. The driving end of the housing serves as a casing for the reduction gear train (para. 7).

4. The motor housing carries an end plate, which forms the motor end frame at the commutator end, and a terminal block for the aircraft electrical connections. A removable cover, mounted at the centre of the end frame, gives access to the armature shaft retaining nut, and a removable cover strip encircles the motor housing at the commutator end to prevent the ingress of foreign matter through the four brush inspection apertures.

5. The brushgear assembly is carried on the motor end frame, which also houses the ball race for the commutator end of the armature

shaft. The brushes are maintained in contact with the commutator by involute springs bearing directly on the end of the brushes. The inner ends of the springs are secured in slotted pins on the brushgear mounting block by washers and split pins. The connections from the brushes are taken to the motor terminal block (not shown in fig. 1).

6. The ball-race for the driving end of the armature shaft is housed in a carrier plate bolted to the end of the yoke. A felt oil seal around the armature shaft, between the ball-race and the armature, is also housed on this carrier plate.

### Reduction gear

7. The armature driving pinion is splined and bolted to the armature shaft and drives the three planet gears of the first stage planet carrier, which, in turn, mesh with the teeth on the first stage of the annular gear. The second-stage sun gear is similar to, but heavier than, that of the first stage. The third stage sun gear drives four third-stage planet gears which mesh with the third stage of the annular gear. These planet gears are carried on the clutch housing. The three tracks of the annular gear are different, the first being smaller in diameter than the second and the third, which are of equal diameter, although the third has a greater tooth width than the second. The body of the annular gear has a large flange formed on it. This flange is clamped between the motor housing and the clutch housing.

### Clutch

8. The internally splined clutch barrel carries thirteen bronze plates which are keyed to it and stacked alternately with twelve steel plates keyed to the splined nut, mounted on a four-start quick thread on the screw shaft. The clutch housing (barrel) is carried in two rows of ball bearings arranged so that each row takes the axial thrust in one direction.

9. The clutch plates are pressure loaded by nine helical springs, which are held against the clutch plates by an externally threaded nut screwed into the clutch housing. Adjustment of this nut allows the correct clutch pressure loading to be effected.

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### Starter jaw

10. The 12-toothed starter jaw is resiliently mounted on the outer end of the screw shaft. It is loaded towards the forward position by a spring on the meshing rod which extends from the centre of the screw shaft. A retention spring which encircles the inner end of the jaw body prevents the jaw from falling into engagement unnecessarily when the starter is mounted in a vertical position.

### Clutch housing

11. The housing for the clutch assembly and the starter jaw assembly has two internal radial flanges which act as abutments for the track rings of the two uncaged ball races supporting the clutch. This casting is provided with twelve threaded holes to carry the bolts which pass through the annular gear flanges and the motor housing for bolting the machine together. These bolts extend beyond the end of the machine to provide the means for securing the starter to the engine.

### Hand starting gear

12. The hand starting gear is contained in a gear housing bolted on the side of the motor housing. It consists of a hand turning shaft, which, through a free wheel device, drives a bevel wheel engaging with the bevel gear assembly of the starter reduction gear. When the shaft is turned in one direction the shaft and free wheel rollers rotate freely (fig. 2a) but when turned in the other direction the rollers ride up the ramps of the teeth on the free wheel discs, thereby engaging and driving the bevel wheel (fig. 2b).

### OPERATION

13. When the aircraft starter switch is operated, the motor of the starter unit is energized and the armature rotation is transmitted to the clutch via the reduction gear and thence to the screw shaft on which the starter jaw is carried. When the splined nut commences to rotate, the starter jaw and screw shaft are checked from turning with it by the friction of the oil seal. This causes the jaw to be fed outwards by the quickthread until it reaches its extended position. At this point the screw shaft is forced to overcome the friction of the seal and rotate, because no further linear movement is possible. Because of the jaw being in engagement with the mating jaw on the engine, the engine will be turned. When the engine commences to fire it will increase speed until the engine jaw overruns the starter jaw to throw the latter out of engagement. In the event of the engine backfiring, the starter clutch will slip and thus prevent the starter motor from damage.

14. Under cranking conditions the starter may be run continuously for thirty seconds but a period of forty-five seconds must be allowed to elapse between each run. In the event of the engine failing to start, the cause of the trouble should be investigated. Continued efforts to start might result in damage.

### INSTALLATION

15. The starter is mounted by means of the twelve bolts at the jaw end of the unit. Electrical connections are made to two terminals on the starter motor housing.

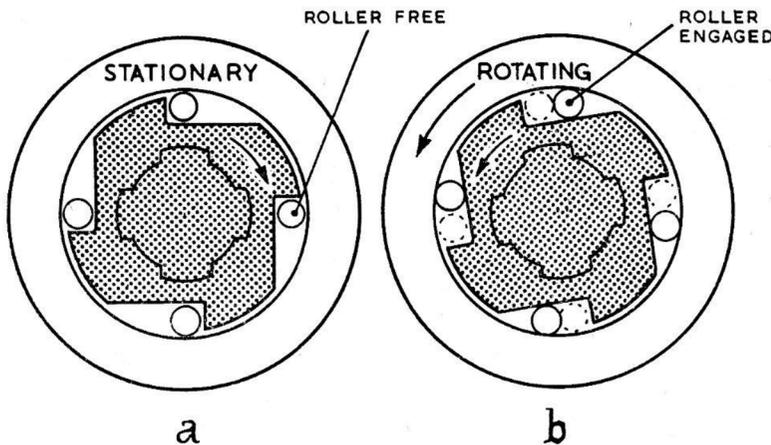


Fig. 2. Operation of free-wheel device

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**SERVICING**

16. This starter should be serviced in accordance with the general chapter in A.P.4343, Vol. 1, Sect. 15, and the instructions given in the relevant Servicing Schedule.

**Brushgear**

17. The minimum length beyond which brushes must not be used is 0.572 in., the length when new being 0.755 in. Brushes should be renewed at periods prescribed in the relevant Servicing Schedule, and whenever examination reveals that they will not remain serviceable for the period that must elapse before the next servicing.

18. Brush spring pressure, measured with a spring balance, should be between 24 and 28 oz.

**Lubrication**

19. The bearings, gearbox and hand cranking mechanism are lubricated during manufacture with grease XG-275, and the clutch with grease XG-285; they should not normally require lubrication except when the starter is dismantled during repair.

**Jaw travel**

20. The dimension from the mounting face to the jaw tooth end face is 1.609 in. with the jaw retracted; with the jaw extended, the dimension is between 1.906 in. and 1.937 in. The jaw travel should not exceed 0.328 in.

**Insulation resistance test**

21. The insulation resistance, when measured with a 250-volt insulation resistance tester between all live parts and the frame, should be not less than 0.5 megohm (for R.N.), or 0.05 megohm (for R.A.F.).

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