Chapter 5

STARTER MOTORS, ROTAX, C1200 SERIES

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF APPENDICES

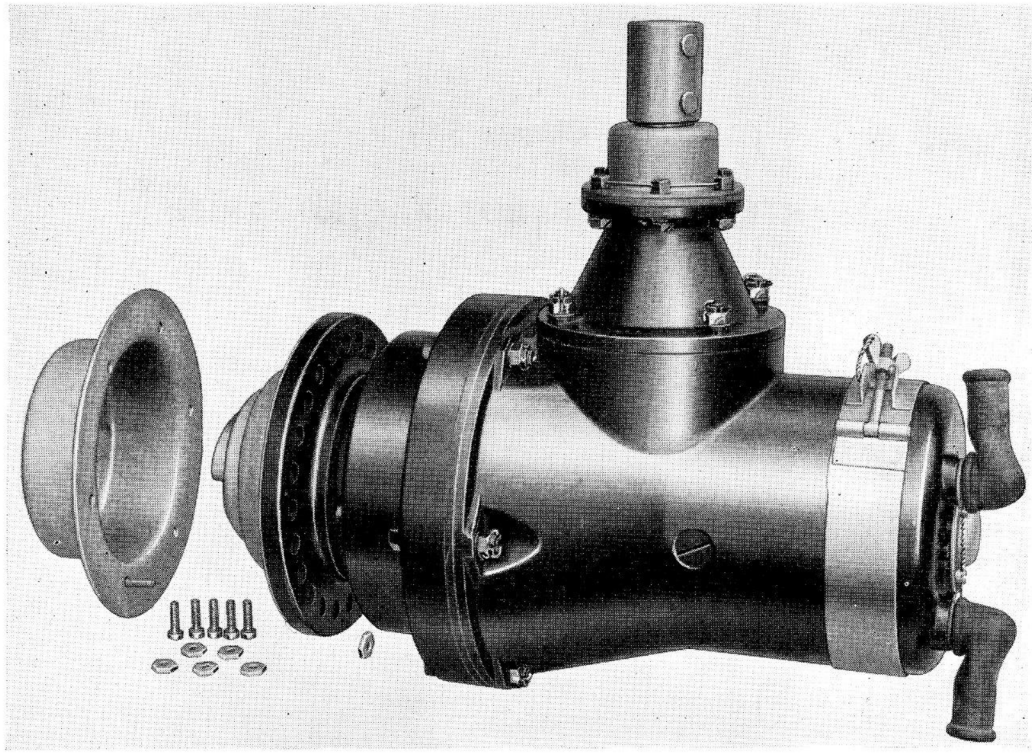

Fig. 1. External view of starter, showing transit cover

Introduction

1. The Type C1200 series of starter motors can be operated electrically through reduction gearing at a ratio of 90:1, and manually at a ratio of 18:1. Either method of operation can be used individually or together, the starting handle being intended for emergency use. Should the engine backfire, or the motor be operated when the engine is not free to turn, a clutch prevents damage to the starter. Safety release devices are also incorporated to protect the operator from shock through backfiring. Information on individual starter motors in the C1200 series will be found in Appendices to this chapter.

KEY TO FIG. 2

1 INTERMEDIATE GEAR
2 INTERMEDIATE GEAR
3 DRIVEN BEVEL GEAR BEARING
4 DRIVEN BEVEL GEAR
5 HAND CRANK SHAFT BEARING
6 CRANK HOLDER
7 CRANK HOUSING
8 DRIVING BEVEL GEAR
9 BRUSH GEAR
10 BRUSH RING SECURING SCREW
11 COMMUTATOR END BEARING
12 BEARING SECURING NUT
13 BEARING COVER
14 BEARING COVER SECURING SCREW
15 TERMINAL BUSH
16 WINDOW STRAP ASSEMBLY
17 FIELD COIL ASSEMBLY
18 YOKE
19 MOTOR CASING
20 YOKE FIXING SCREW
21 POLE-PIECE SCREW
22 SEALING PLATE
23 ARMATURE SHAFT BEARING
24 DRIVING PINION
25 SUN GEAR ASSEMBLY
26 ANNULUS
27 CLUTCH SPRING
28 SPRING LOCATING RING
29 CLUTCH PLATES
30 SCREW SHAFT AND SPLINED NUT ASSEMBLY
31 STARTING JAW
32 LEATHER OIL SEAL WASHER
33 METAL OIL SEAL WASHER
34 CLUTCH ADJUSTING NUT
35 CLUTCH BEARING
36 PLANET GEAR ASSEMBLY

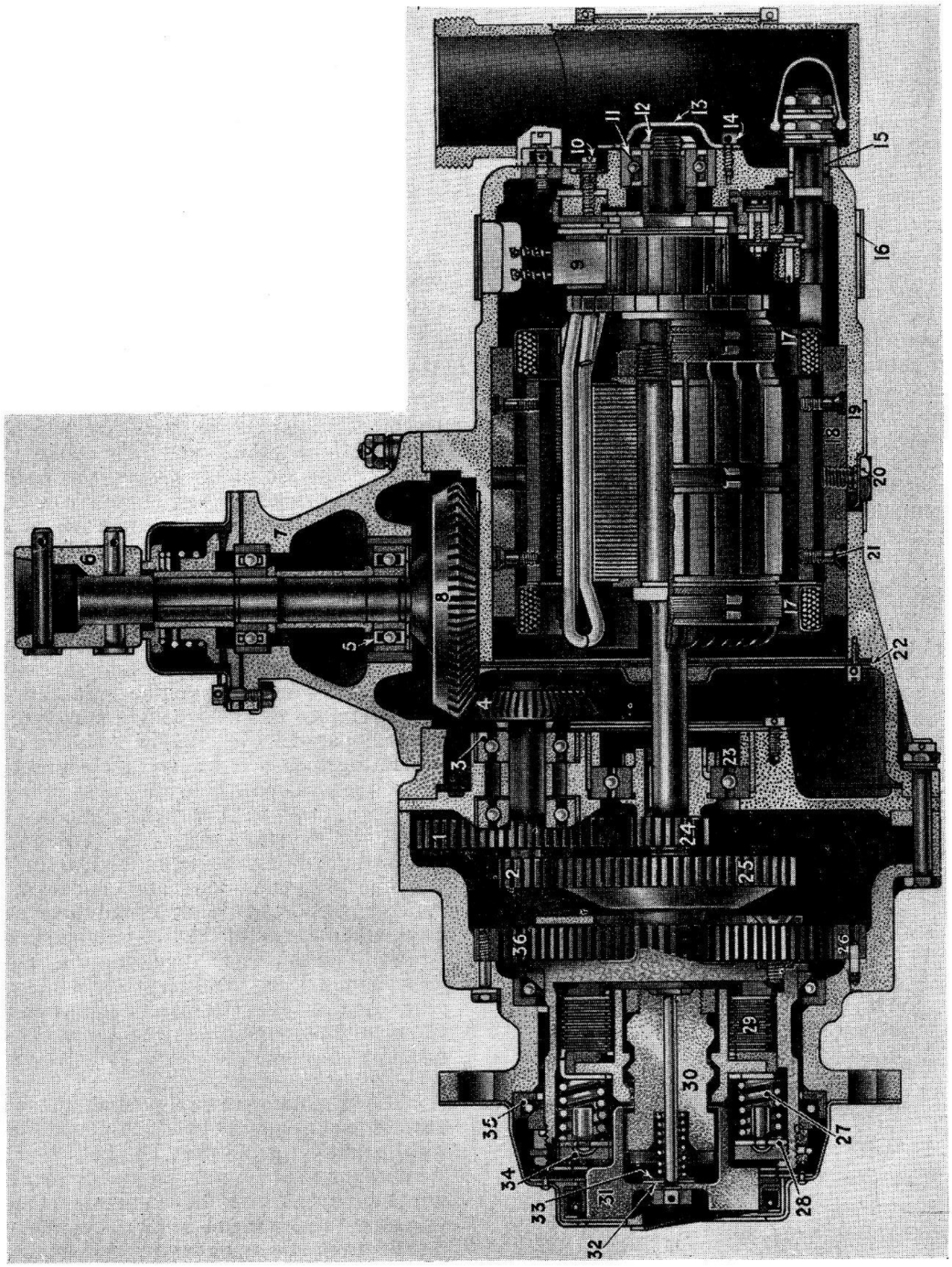

Fig. 2. Sectional view of starter

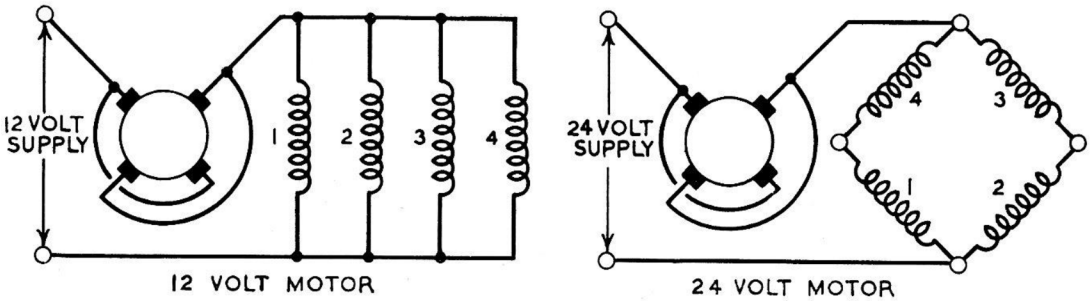

Fig. 3. Motor field connections

DESCRIPTION

2. An external view of the starter is given in fig. 1, and a sectional drawing in fig. 2. There are four principal assemblies, namely, the motor casing, the partition plate, the clutch housing and the hand cranking shaft unit. The partition plate and the clutch housing are bolted together, and the cranking shaft is secured to the side of the motor casing. The latter houses the motor, the commutator end being that remote from the starting jaw.

Clutch assembly

3. The clutch housing assembly comprises the epicyclic gearing, the driving barrel containing the clutch plates, a quick-thread screw and splined nut, also the 3-tooth starting jaw and clutch cover.

Intermediate gearing

4. The intermediate gearing between the motor and the sun gear wheel of the epicyclic reduction gearing in the clutch housing is carried on a partition plate fitted between the motor casing and the clutch housing.

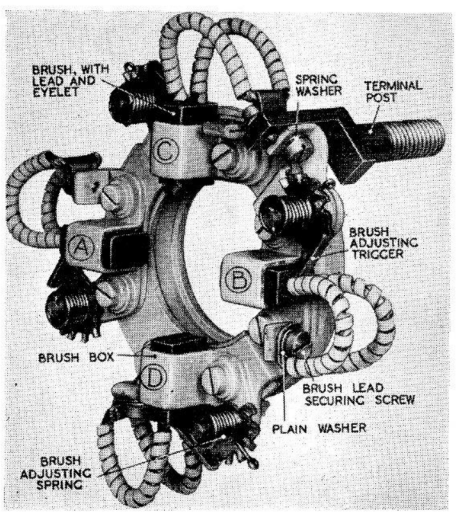

Fig. 4. Brush gear

Motor

5. The motor is a 4-pole, series-wound machine, supported in a casing which is bolted to the geared unit. The yoke is a sliding fit in the motor casing, the leading edge being marked with an arrow and tapered to facilitate assembly. Each of the pole-pieces is held in the bore of the yoke by two csk/hd. screws secured by peening.

6. The field coils are located behind the poles, the four securing screws passing through holes in the motor casing and yoke ring before screwing into the poles. In 24-volt machines the field coils are connected in series-parallel *(fig.* 3). The coils are connected together in series, and the connection to the terminal post is made at the junction of coils 1 and 2. The connection to the brush gear is taken from the junction of coils 3 and 4 via the terminal lug. In 12-volt machines the coils are connected in parallel, the "start" ends of all four coils being taken to one of the two terminal posts. At the "finish" ends connection is made to a terminal lug connected to the brush gear. Thus in 24-volt motors four wires are taken to the terminal lug, whereas in 12-volt machines only two.

7. The armature is wave-wound, the conductors being carried in 21 insulated slots, with a pitch of 5 slots. A ball bearing pressed into the motor casing carries the armature spindle at the commutator end. Adjusting washers and a distance ring are fitted between the commutator and the bearing. A castellated ring nut locked by a cotter pin holds the spindle endwise. The bearing cover is secured to the motor casing by four ch/hd. screws locked by wire.

8. At the end opposite the commutator the spindle is carried in a ball bearing pressed into the partition plate. The main driving gear wheel is keyed to the spindle.

9. The four brushes mounted on the brush gear ring (fig. 4) are connected together in diametrically opposed pairs, those marked A and B being electrically connected together by a base plate. The field coil terminal lug is connected to box A by the brush lead securing screw. Box D is mounted on a further base plate which is brought outside the ring and bent upwards to form a lug at a point between boxes B and C, the second terminal post being connected to this lug.

10. The brush lead from box C is held by a screw tapped in the inner end of the terminal post. The brushes are spring-loaded and the triggers are notched for spring pressure adjustment. The brush gear ring, with the exception of the face abutting the motor casing, is coated with insulating paint. The outer faces of the brush lead securing lugs and the inside of the brush boxes are not painted.

11. The assembly is retained on a spigot on the end wall of the motor casing by four screws locked by wire. Brush windows covered by a felt-lined steel strap gives access to the brushes.

Crank shaft assembly

12. The crank shaft assembly unit includes the hand cranking shaft, its bearings, the crank shaft housing and the ratchet device.

Sealing plate

13. In order to prevent oil from the reduction gears entering the motor, an internal sealing plate encloses the armature, field and brush gear. It is secured to a ledge in the casing by six wire-locked ch/hd. screws. A paper jointing washer coated with insulating varnish is fitted between the plate and the casing.

OPERATION

Electrical

14. A typical wiring diagram is given in fig. 5, in which it can be seen that the closing of the battery circuit to the starter actuates the electric motor. The armatures shaft is fitted with a driving pinion and the motor torque is transmitted through the reduction gear unit

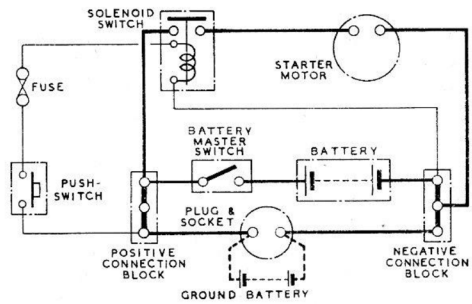

Fig. 5. Typical wiring diagram

to the driving barrel containing the clutch mechanism. This clutch is set to transmit the correct driving power to the screw shaft, which in turn projects the starter jaw into mesh with the engine jaw.

15. If, due to climatic or any other conditions, the engine is not free to turn over, the setting of the clutch is such that no damage will occur should the starter be engaged to the engine.

16. A simple mechanism controls the engagement of the starter jaw to the engine so that it does not commence to rotate until it is fully engaged. The design of the starter jaw provides for instant demeshing upon the starting of the engine.

Manual

17. When manually operated, the cycle is identical with electric starting, except that, due to the difference of speed in hand and motor cranking, only a part of the reduction gearing is employed. The manual energy is transmitted through the driving barrel and thereafter the procedure is the same as when the machine is electrically operated.

INSTALLATION

Fitting to engine

18. Remove the transit cover (fig. 1) and the cover plate on the engine flange. See that the jaws on both engine and starter are of similar design, and for the same direction of rotation. Ensure that the outermost point of the engine jaw is recessed $\frac{1}{16}$ in. from the outer face of the fixing flange. With the jaw tapped back to its innermost position, measure the projection of the starter jaw from the mounting flange. The difference between these two measurements should give the

clearance between the jaws when they are out of mesh. This should be $\frac{3}{32}$ in. minimum.

19. After removing any oil that may be deposited between the jaw and the leather oil seal, which may prevent the jaw meshing, check that the projection of the jaw is satisfactory by turning the hand cranking shaft. The jaw should travel outwards approximately $\frac{11}{32}$ in. before commencing to rotate. Ensuring that the hand crank coupling sleeve is in the correct position, fit the starter flange over the studs in the engine flange and fit and lock the retaining nuts. An arrow on the edge of the starter fixing flange marks the direction of rotation, which is determined when viewing the unit from the starting jaw end.

Wiring

20. Remote control (fig. 5) is employed in order to reduce the length of heavy-duty cable. In order to minimize voltage drop in the coil due to current flowing in the main circuit when the relay contacts close, coil circuits should be connected to the supply as near the battery as possible. The illustration gives the general sense of the connections only; the relevant Aircraft Handbook should be consulted for details of particular installations.

STARTING

21. Instructions for starting the engine will be found in the relevant Aircraft Handbook. With manual or electrical operation, the engagement of the starting jaw is entirely automatic, operation of the starting switch or starter handle being all that is necessary.

Failure to start

22. If the engine fails to start readily, the cause of the trouble should be investigated immediately to prevent premature exhaustion of the battery. If the motor is run for more than 10 to 20 seconds at a time, it will tend to overheat.

23. An excessive priming charge may be cleared by turning the engine against the normal direction of rotation. Using the propeller, first turn the engine one-third to one-half of a revolution in the normal direction in order to free the starter jaw, and then turn in the opposite direction.

SERVICING

24. These starters should be serviced in accordance with the general chapter in A.P.4343, Vol. 1, Sect. 15, and the relevant Servicing Schedule.

Lubrication

25. Ball bearings are packed half full of grease XG–275 (Ref. No. 34B/9100512) on manufacture. Plain bearings, clutch and gears should be lubricated with grease XG–285 (Ref. No. 34B/9100517).

Brush gear

26. ◀The minimum length beyond which brushes must not be used is 0·500 in. when the commutator is at its minimum permissible diameter of 1·375 in., the new length being 0·750 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.

27. Brush spring pressure should be between 18 and 24 oz., measured when the trigger arm is level with the top of the brush box.

Armature spindle sealing ring

28. Should the ring become worn, grease may leak through to the motor; it is advisable to renew a worn ring immediately. When doing this it is not necessary to extract the rivets securing the dished steel retaining ring.

Starting jaw and oil seal washer

29. If the leather oil seal in the clutch cover around the starting jaw and the leather sealing rod on the meshing rod behind the starting jaw are worn or damaged, new ones should be fitted. Neglect will result in oil seeping through into the motor.

30. The tension on the spring holding the oil seal in contact with the starting jaw must be sufficient to prevent rotation of the jaw whilst it is engaging with the engine jaw. Oil between the jaw and the oil seal washer must be removed, or the jaw may fail to mesh, thus allowing the motor to operate without turning the engine. The jaw travel should be approximately $\frac{11}{32}$ in.

Insulation resistance test

31. ◀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.).▶

Appendix 1

STARTER MOTOR, ROTAX, TYPE C1215

LEADING PARTICULARS

Starter motor, Type C1215	**Ref. No. 37F/2000**
Voltage	12 *d.c.*
Time rating	30 *sec.*
Resistance values—	
Armature	0·00125 *ohms* ± 10 *per cent*
Field	0·0011 *ohms* ± 10 *per cent*
Direction of rotation (viewed from jaw end)	*Anti-clockwise*
Brush spring pressure	18 *to* 24 *oz.*
Brush grade	*CM5H*
Clutch setting	550 ± 50 *lb. ft.*
Overall dimensions—	
Height to top of terminals	11·75 *in.*
Length	14·406 *in.*
Width (dia.)	7 *in.*
Weight	34 *lb. (approx.)*

1. The starter motor, Type C1215, is generally similar to that described and illustrated in the main chapter. Rotation is anti-clockwise when viewed from the jaw end, and the motor is wound for use on 12 volts d.c.

Appendix 2

STARTER MOTOR, ROTAX, TYPE C1216

LEADING PARTICULARS

Starter motor, Type C1216	**Ref. No. 37F/2002**
Voltage	12 *d.c.*
Time rating	30 *sec.*
Resistance values—	
Armature	0·00125 *ohms* ± 10 *per cent*
Field	0·0011 *ohms* ± 10 *per cent*
Direction of rotation (viewed from jaw end)	*Clockwise*
Brush spring pressure	18 *to* 24 *oz.*
Brush grade	*CM5H*
Clutch setting	550 ± 50 *lb. ft.*
Overall dimensions—	
Height to top of terminals	11·75 *in.*
Length	14·406 *in.*
Width (dia.)	7 *in.*
Weight	34 *lb. (approx.)*

1. The starter motor, Type C1216, is generally similar to that described and illustrated in the main chapter. Rotation is clockwise when viewed from the jaw end, and the motor is wound for use on 12 volts d.c.

Appendix 3

STARTER MOTOR, ROTAX, TYPE C1217

LEADING PARTICULARS

Starter motor, Type C1217	**Ref. No. 37F/2006**
Voltage	24 *d.c.*
Time rating	30 *sec.*
Resistance values—	
Armature	0·0055 *ohms* ± 10 *per cent*
Field	0·005 *ohms* ± 10 *per cent*
Direction of rotation (viewed from jaw end)	*Clockwise*
Brush spring pressure	18 *to* 24 *oz.*
Brush grade	*CM5H*
Clutch setting	550 ± 50 *lb. ft.*
Overall dimensions—	
Height to top of terminals	11·75 *in.*
Length	14·406 *in.*
Width (dia.)	7 *in.*
Weight	34 *lb. (approx.)*

1. The starter motor, Type C1217, is generally similar to that described and illustrated in the main chapter. Rotation is clockwise when viewed from the jaw end, and the motor is wound for use on 24 volts d.c.

Appendix 4

STARTER MOTOR, ROTAX, TYPE C1218

LEADING PARTICULARS

Starter motor, Type C1218	**Ref. No. 37F/2004**
Voltage	24 *d.c.*
Time rating	30 *sec.*
Resistance values—	
Armature	0·0055 *ohms* ± 10 *per cent*
Field	0·005 *ohms* ± 10 *per cent*
Direction of rotation (viewed from jaw end)	*Anti-clockwise*
Brush spring pressure	18 *to* 24 *oz.*
Brush grade	*CM5H*
Clutch setting	550 ± 50 *lb. ft.*
Overall dimensions—	
Height to top of terminals	11·75 *in.*
Length	14·406 *in.*
Width (dia.)	7 *in.*
Weight	34 *lb. (approx.)*

1. The starter motor, Type C1218, is generally similar to that described and illustrated in the main chapter. Rotation is anti-clockwise when viewed from the jaw end, and the motor is wound for use on 24 volts d.c.

Appendix 5

STARTER MOTOR, ROTAX, TYPE C1231

LEADING PARTICULARS

Starter motor, Type C1231	**Ref. No. 37F/2008**
Voltage	24 *d.c.*
Time rating	30 *sec.*
Resistance values—	
Armature	0·0024 *ohms* ± 10 *per cent*
Field	0·0017 *ohms* ± 10 *per cent*
Direction of rotation (viewed from jaw end)	*Clockwise*
Brush spring pressure	18 *to* 24 *oz.*
Brush grade	*CM5H*
Clutch setting	675 ± 50 *lb. ft.*

1. The starter motor, Type C1231, is basically similar to that described and illustrated in the main chapter. Rotation is clockwise when viewed from the jaw end, and the motor is wound for use on 24 volts d.c. It is designed, however, to provide a greater torque, and the clutch setting is increased to 675 ± 50 lb. ft.

Appendix 6

STARTER MOTOR, ROTAX, TYPE C1247/2

LEADING PARTICULARS

Starter motor, Type C1247/2	**Ref. No. 37F/2011**
Voltage	24 *d.c.*
Time rating	3 *sec. with rest of* 1 *min.*
Resistance values—	
Armature	0·0024 *ohms* ± 10 *per cent*
Field	0·0017 *ohms* ± 10 *per cent*
Direction of rotation (viewed from jaw end)	*Clockwise*
Brush spring pressure	18 *to* 24 *oz.*
Brush grade	*CM5H*
Clutch setting	675 ± 50 *lb. ft.*
Overall dimensions—	
Height to top of terminals	11·978 *in.*
Length	15·062 *in.*
Width (dia.)	7 *in.*
Weight	34 *lb. (approx.)*

1. The starter motor, Type C1247/2, is basically similar to that described and illustrated in the main chapter. Rotation is clockwise when viewed from the jaw end, and the motor is wound for use on 24 volts d.c. It has a similar motor to that in the Type C1231, providing for a higher starting torque than earlier types, and a clutch setting of 675 ± 50 lb. ft., but incorporates several additional modifications.

2. The gearing assembly is modified, and an extra steel plate has been embodied in the clutch assembly. The starting gear meshing rod and spring have been strengthened, and a twelve-toothed jaw replaces the three-toothed jaw used previously.

Appendix 7

STARTER MOTOR, ROTAX, TYPE C1256

LEADING PARTICULARS

Starter motor, Type C1256	**Ref. No. 37F/2012**
Voltage	24 *volts d.c.*
Clutch setting	675 *lb. ft.* ±50 *lb. ft.*
Time rating	3 *sec. with rest of* 1 *min.*
Resistance values—	
Armature	0·0024 *ohm* ±10 *per cent*
Series field	0·0024 *ohm* ±10 *per cent*
Shunt field	16·8 *ohm* ±10 *per cent*
Rotation (viewed from jaw end)	*Anti-clockwise*
Gear ratio—	
Motor to jaw	90:1
Hand crank to jaw	18:1
Brush spring pressure	18 *to* 24 *oz.*
Brush grade	*CM5H*
Overall dimensions—	
Length	15·437 *in.*
Width (dia.)	7·000 *in.*
Height (to hand crank shaft end)	11·134 *in.*
Weight	37·75 *lb.*

1. The starter motor, Type C1256, is basically similar to that described and illustrated in the main chapter. Rotation is anti-clockwise, when viewed from the jaw end, and the motor is wound for use on 24 volts d.c.

2. The starter motor differs from that described in the main chapter in that it is a compound wound machine, incorporating series and shunt fields, the resistance of the windings being as given in the Leading Particulars.

3. A higher torque load is provided through the clutch assembly of 675 lb. ft. ±50 lb. ft., using a twelve tooth jaw for driving the associated driven member.

4. The dimension from the mounting face to the tip of the jaw teeth is 1·609 in. with the jaw in the retracted position, and 1·952—1·921 in. in the fully extended position. The jaw travel dimension is 0·343 in. (max.)