

June 18, 1940.

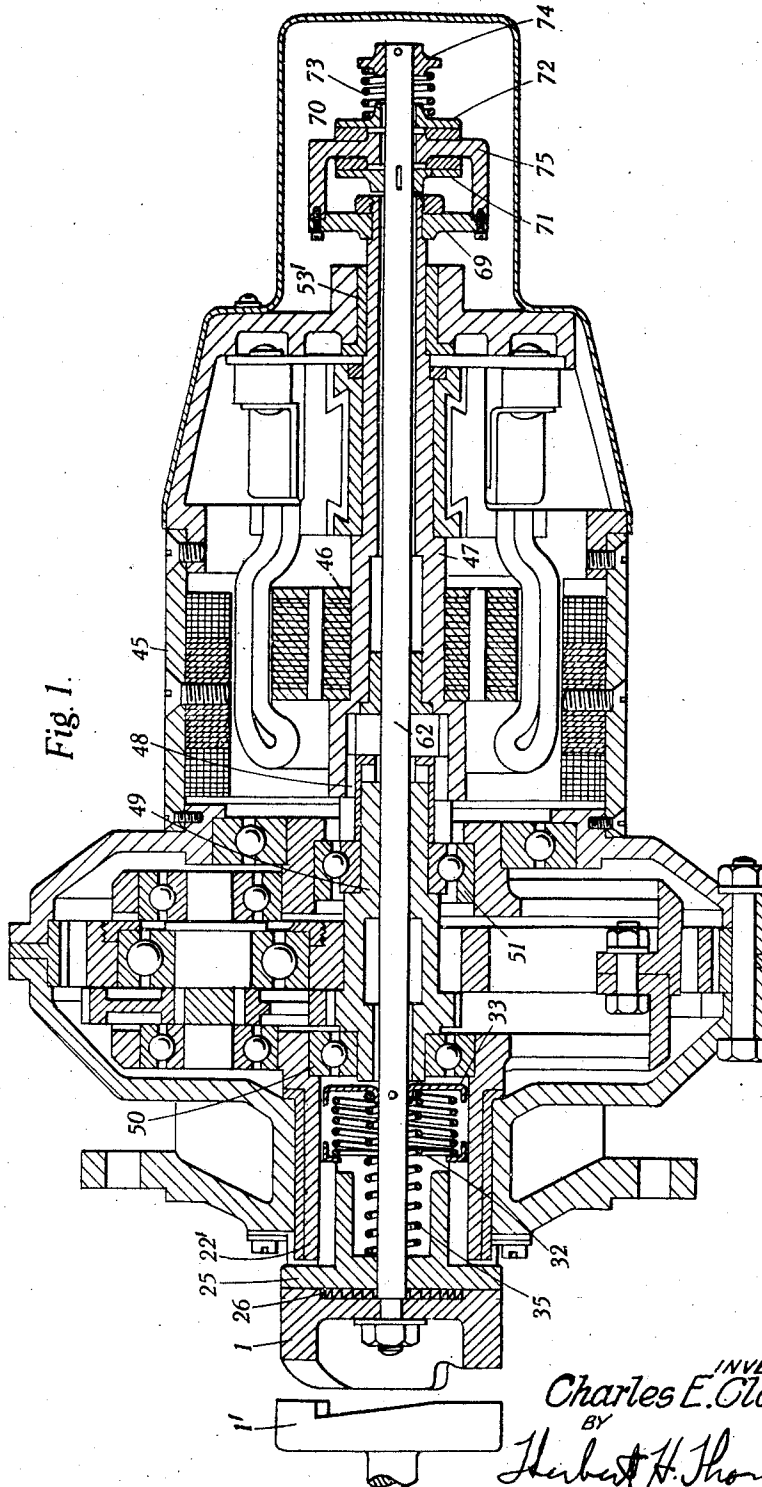
C. E. CLOUSTON

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ELECTRICALLY OPERATED ENGINE STARTER

Filed June 2, 1938

2 Sheets-Sheet 1



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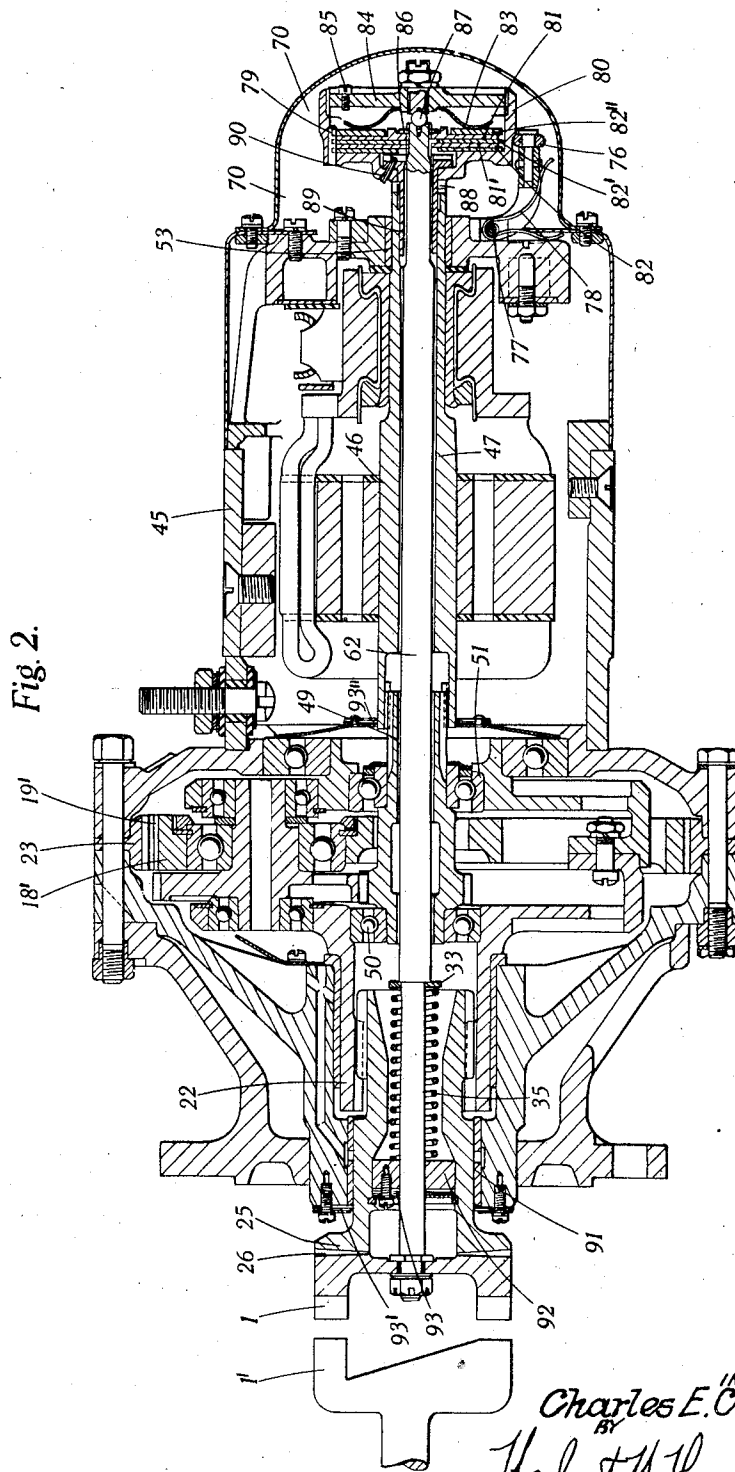
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UNITED STATES PATENT OFFICE

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ELECTRICALLY OPERATED ENGINE
STARTERCharles Edward Clouston, Osterley, England, as-
signor to Sperry Gyroscope Company, Inc., New
York, N. Y., a corporation of New YorkApplication June 2, 1938, Serial No. 211,425
In Great Britain June 3, 1937

6 Claims. (Cl. 290—48)

The present invention relates to electrically operated engine starters for internal combustion engines and the like wherein an engine-engaging member of an electric starter is normally disengaged from a cooperating member on the engine starter-shaft, but is brought into engagement therewith at the time of starting.

According to the present invention an electrically operated engine starter comprises a single electric motor which is effective both to bring the starter and engine into operative engagement and to crank the engine after engagement, and means enabling the starter clutch member to follow-up the engine clutch member should the engine overrun the motor during cranking.

Two embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a vertical longitudinal sectional view of one form of the engine-starter according to the invention; and

Fig. 2 is a vertical longitudinal sectional view of a modified form of the engine starter according to the invention.

Referring now to Fig. 1 of the drawings, the electric motor 45 is arranged so as normally to have its armature rearwardly offset from its field winding so that energisation of the motor results in forward axial movement of its armature, which movement is employed for effecting engagement of jaw clutches 1, 1'. Motor 45 has its armature 46 provided with a hollow armature shaft 47 journaled at its rear end in a bearing 53' and splined at its forward end upon a sleeve 48 which, in turn, is splined to a tubular shaft 49 that is journaled in anti-friction bearings 50 and 51.

Tubular shaft 49 transmits the torque of the motor armature 46 to reduction-gearing of the type disclosed in the prior patent to Hollis Walter No. 2,152,005, dated March 28, 1939, the final drive of which is brought out in sleeve 22' which is splined upon body portion 25 of the starter jaw clutch. This portion 25 is connected by ratchet toothing 26 to the head portion 1 of the clutch, the head 1 and body 25 of the clutch being held together by a spring 35.

The hollow armature shaft 47 on which the armature 46 of motor 45 is mounted, is continued through the bearing 53', and has secured thereto a disc or collar 69.

The starter jaw clutch 1 is secured to the longitudinal shaft 62 which extends right through the motor and projects beyond the end of the sleeve 47. On the projecting end of shaft 62

there is mounted a clutch device 70 which clutches shaft 62 to the sleeve 47. As shown, one plate 71 of this clutch is fixed on the shaft 62, and another plate 72 is slidable along said shaft and is urged towards plate 71 by a spring 73 which abuts at its farther end against a collar 74 which is pinned to shaft 62. Between plates 71 and 72 there is interposed the base of a cup-shaped member 75 which serves as an intermediate clutch plate, and is screwed to a disc 69 secured to sleeve 47. Plates 71, 72, are shown as faced with friction fabric, but clutch 70 may equally well be of the type using steel and phosphor-bronze plates running in oil. Due to the action of spring 73, a constant pressure is applied between clutch plates 71 and 72 causing them to grip plate 75, and also to be centralized on it; sleeve 47 and shaft 62 move together axially, but are capable of relative rotation when the clutch 70 slips.

Spring 35 abuts against a collar 33 pinned to shaft 62. The whole assembly of jaw clutch 1, ratchet clutch disc or body portion 25, shaft 62, sleeve 47 and armature 46 is normally held back by spring 32 so that the jaw clutch 1 is out of engagement with the engine jaw clutch 1'.

When current is supplied to the starter motor 45, its armature is at once pulled axially forwards into a central position relative to its field magnets, and jaw clutch 1 engages with the engine jaw clutch 1'.

When the engine jaw clutch 1' is engaged, the resistance which it offers to turning, prevents motor 45 from driving jaw clutch 1 through sleeve 47, clutch 70 and shaft 62, since clutch 70 is arranged to slip at quite moderate loads. The starter, however, drives engine jaw clutch 1' through the reduction gearing which turns sleeve 22', clutch disc 25 and ratchet toothing 26, this drive being at a low speed. Should the engine start up, the load on jaw clutch 1 will at once be removed, clutch disc 25 will be overrun, and clutch 70 cease to slip, so that there will be a direct high-speed driving connection from armature 46 through shaft 47, clutch 70, shaft 62 to jaw clutch 1. The jaw clutch 1 is then driven at high speed to keep in engagement with the engine, slip simultaneously occurring at the ratchet toothing 26.

It may be remarked that during the initial axial movement which brings jaw clutch 1 into engagement with the engine jaw clutch 1', there may also be rotation of the shaft 62 and jaw clutch 1. However the shock of engagement of rotating jaw clutch 1 with engine jaw clutch 1'

is very slight, since the inertia of jaw clutch 1 and shaft 62 is small. The slipping clutch 70 entirely insulates clutch 1 from the inertia effect of starter armature 46. Actually, very little rotation does actually take place in the circumstances mentioned, since the axial movement is so rapid.

Figure 2 shows a modified form of the invention in which spring 32 of Fig. 1 is omitted, the starter jaw clutch 1 being held out of engagement with jaw clutch 1' by a detent 76 pivoted on the electric motor housing at 77 and urged by a spring 78 against the inclined surface 79 of the clutch housing 80, so that clutch 76, and hence the armature 46 and the starter jaw clutch 1, are held out of engagement until and unless motor 45 is supplied with current, when the magnetic pull between armature 46 and the field of motor 45 overcomes the action of detent 76, and the starter jaw clutch 1 is carried forward into engagement with the engine jaw clutch 1'; detent 76 then exerts no force to disengage the two clutches 1, 1'. This is advantageous since spring 32, shown in Figure 1, might tend to throw jaw clutch 1 out of engagement with jaw clutch 1' if the endwise magnetic pull between the motor field and its armature weakened due to a decrease in armature current with increase in armature speed.

Figure 2 also shows a modified form of slipping clutch 70, in which metal plates 81 and 81', splined on shaft 62, are gripped between metal plates 82, 82' and 82'' pressed by a spring 83. Plates 82, 82' and 82'' are splined in the clutch housing 80 in which plate 84, against which spring 83 abuts, is screwed. Plate 84 is locked in position by a screw 85 arranged to lock the screw threads of 84 together and thus prevent relative movement between members 80 and 84. A collar 86 and ball thrust 87 secure the shaft 62 to the clutch housing 80 and ensure that said shaft shall move axially with armature 46, which is secured to clutch housing 80 by a dog-clutch 88 and a screwed sleeve 89, the sleeve 89 being prevented from rotating by the pin 90.

The body portion 25 of the starter jaw clutch 1 is shown as journaled in an anti-friction bearing 91 while spring 35 is provided with a thrust block 92 in the jaw clutch body 25. Grease seals 93, 93' and 93'' are fitted to retain lubricant in the gearing.

What I claim is:

1. An electrically operated engine starter comprising a single electric motor adapted to drive (i) a starter clutch member through a friction clutch capable of slipping at a predetermined load, and (ii) a driving member for said starter clutch member operated through reduction gearing, said member being formed with ratchet teeth to enable the former to run faster than the latter and ratchet thereover but to enable the latter to drive the former positively in one direction, the motor having an armature which is rapidly moved axially upon energisation of the

motor and serves to bring the starter clutch member portion into engagement with a clutch member on the engine shaft.

2. Starter according to claim 1 wherein axial movement of the armature is at all times opposed by a spring which tends to maintain the clutch member thereon out of engagement with the engine clutch member.

3. Starter according to claim 1 wherein axial movement of the armature to effect engagement of the starter clutch member with the engine clutch member is opposed by a spring-urged detent which permits such movement when the motor is energised and resumes its opposition to movement only when the armature has been subjected to an opposite axial movement by thrust exerted between the starter and engine clutch members.

4. In an electrically operated engine starter of the jaw clutch type, a starting motor having a field, armature and shaft, a jaw clutch axially movable with said shaft, reduction gearing between said shaft and clutch for normal cranking, and a direct connection from said shaft to said clutch including an overrunning device for maintaining the clutch teeth in rotational engagement during the cranking, said armature being biased to an out of line position with its field, whereby upon excitation of said motor an initial endwise thrust of said jaw clutch to effect engagement with the engine is effected by the resultant axial movement of said armature.

5. In an engine starter, an electric motor having a field and an armature normally axially displaced, a hollow shaft for said armature, an inner shaft within said hollow shaft and axially displaceable with said armature, an engine engaging jaw on said inner shaft, a slip friction drive connection between said two shafts whereby, upon starting, said jaw is both advanced and quickly rotated into engagement with the complementary jaw on the engine, and reduction gearing and an overrunning clutch connection between said hollow shaft and said first mentioned jaw to supply the requisite cranking torque to the engine.

6. In an electrically operated engine starter of the jaw clutch type, a starting motor having a field, armature and shaft, a jaw clutch axially movable with said shaft, reduction gearing between said shaft and clutch for normal cranking, a direct connection from said shaft to said clutch including an overrunning device for maintaining the clutch teeth in rotational engagement during the cranking, and a spring urged detent for normally maintaining said armature out of line position with its field, whereby, upon starting the motor, an initial endwise thrust of the jaw clutch to effect engagement with the engine is effected, said detent resuming its opposition to such movement only when the armature has been returned to its normal position by other means.

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