

Aug. 21, 1934.

R. CHILTON
ENGINE STARTER

1,970,885

Original Filed Feb. 16, 1928 2 Sheets-Sheet 1

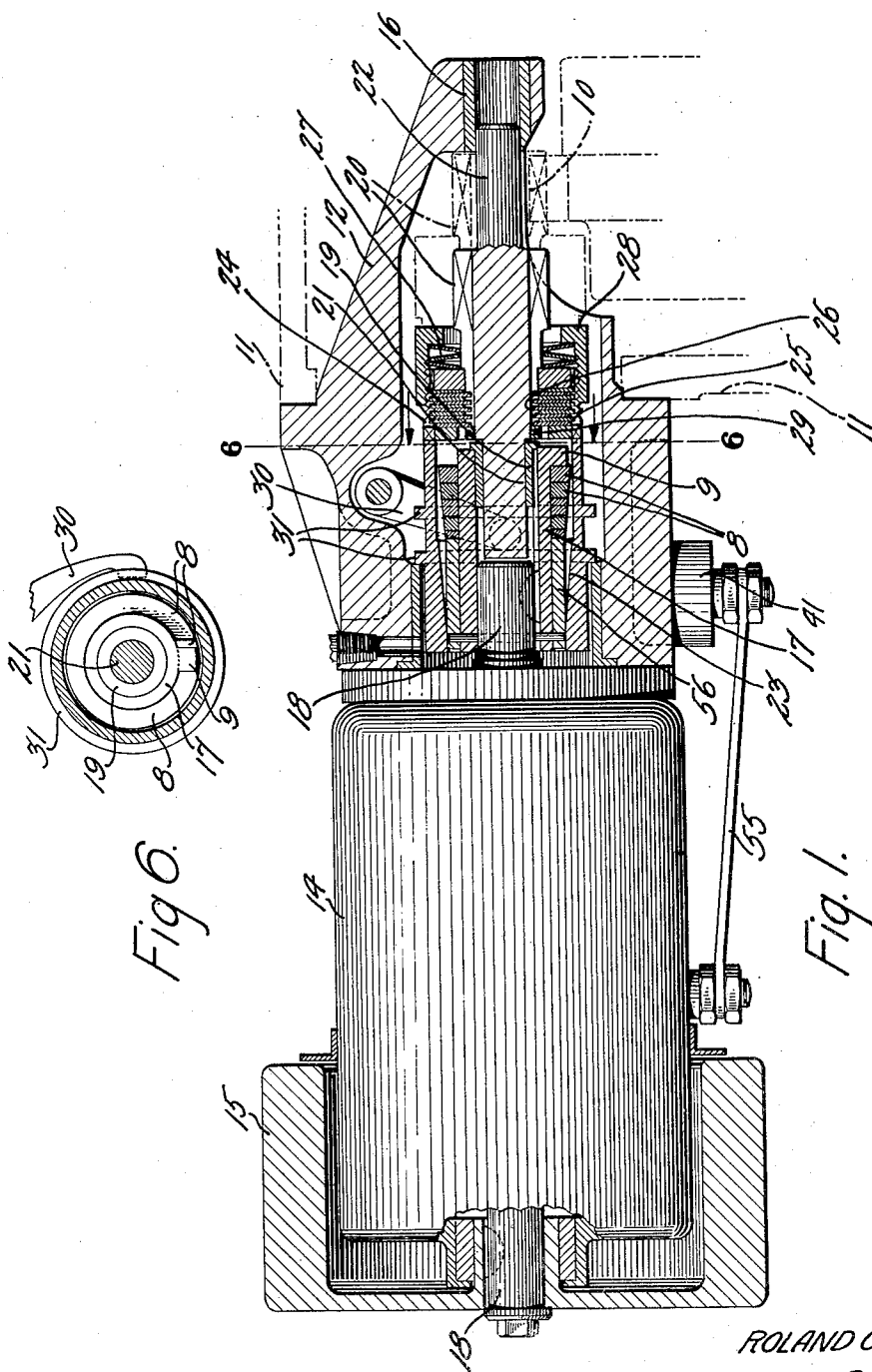


Fig. 6.

Fig. 1.

INVENTOR
ROLAND CHILTON

BY
Wm. D. Rothermeyer
ATTORNEY

Aug. 21, 1934.

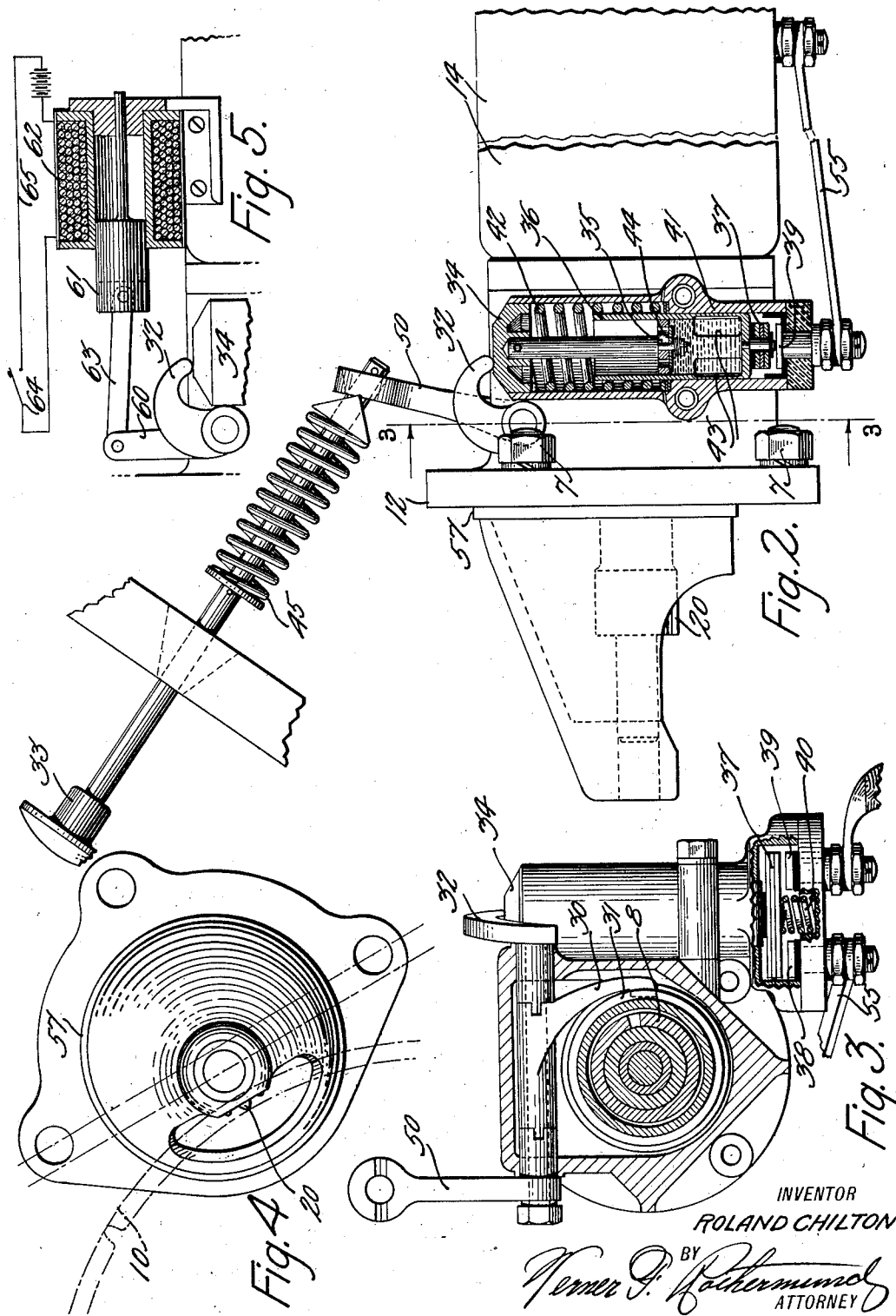
R. CHILTON

1,970,885

ENGINE STARTER

Original Filed Feb. 16, 1928

2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

1,970,885

ENGINE STARTER

Roland Chilton, Keyport, N. J., assignor, by mesne assignments, to Eclipse Machine Company, Elmira Heights, N. Y., a corporation of New York

Application February 16, 1928, Serial No. 254,876
Renewed October 31, 1933

30 Claims. (Cl. 290—38)

This invention relates to starters as for internal combustion engines and provides new and improved means whereby the connection of the starter to the engine may be effected after a pre-determined amount of kinetic energy has been stored in rotating power members whereby the stored energy may be applied to the engine at a greater rate than that at which it is built up as momentum in the rotating parts.

- 10 Objects of this invention are to provide means whereby a complete driving connection is established after a predetermined energizing period and means whereby the engine engaging member may be meshed without shock and whereby the driving connection may be completed without impact between the relatively rotating members and to incorporate means whereby the maximum starting loads generated when the momentum of the rotating means is first applied to the engine are limited to a pre-determined maximum.

Associated objects are to combine these functions in a unitary driving mechanism of simple and compact character adapted for installation on the present standard starter mountings and suited for engagement with starting gears as commonly associated with the flywheel rims of conventional engines. Another object is to provide a simple control means which will produce the desired sequence of events from a simple and conventional control motion such as a single depression of a pedal which is released when the engine starts.

Various other objects and advantages of the invention will be in part obvious from an inspection of the accompanying drawings and a careful consideration of the following particular description and claims of one form of mechanism embodying my invention.

In drawings:

- 40 Figure 1 is a longitudinal view in part section.

Figure 2 is a longitudinal view with certain control parts, including the switch, shown in section and showing a pedal control adapted for conventional automobiles.

- 45 Figure 3 is a cross section on the line 3—3 of Figure 2 as looking in the direction indicated by the arrows.

Figure 4 is an end view of Figure 2 as looking from the left hand end.

- 50 Figure 5 illustrates an alternative actuating means.

Figure 6 is a cross section taken on the line 6—6 of Figure 1 as looking in the direction indicated by the arrows.

- 55 Referring to Figure 1, 10 designates a conven-

tional flywheel ring gear and 11 a conventional mounting flange to which the starter housing 12 is secured by the usual bolts 7 shown in Figure 2. The starting motor 14 is in turn secured to this housing and is equipped with a flywheel 15 secured to the shaft 18 of the motor armature to augment its momentum. The housing 12 is provided with an outboard bearing 16, and a sleeve 17 is rigidly secured to the extended end of the armature shaft 18. This sleeve is provided with a bushing 19 and the mesh pinion 20 is provided with, preferably integral, journals 21 and 22 slidably and rotatably supported in the bushing 19 and bearing 16 respectively.

The sleeve 17 is provided with a drive lug 9 engaging one end of taper coil clutch member 8, the hand of the spiral being such that the coil will automatically expand into driving frictional engagement with the driven conical sleeve 23 as soon as forward driving contact is initiated. At its right hand end this sleeve is provided with longitudinal slots 24 engaging projections on the clutch plates 25 with which are alternated further clutch plates 26 engaged with the pinion 20 preferably through its extended teeth which, in this case, for convenience, have been somewhat reduced in height at this end.

Dished-washer springs 27 adjustably apply the driving pressure to the clutch plates through the nut 28 which is set for slippage of the clutch at the desired maximum load. A lock ring 29 at the inner end of the pinion teeth constrains the pinion, the load limiting clutch, and the cone sleeve 23 to unitary axial motion. This is imparted by means of the lever 30 engaged between the collars 31 on the sleeve. This lever 30 is secured to the levers 50 and 32 extending outside the housing, the former being actuated by the pedal 33 and the latter engaging the head 34 associated with the dash pot piston 35.

The cylinder 36 in which this piston works carries a switch bar 37 engageable with contacts 38 and 39 and is normally kept in the upward or disengaged position by a spring 40. The fixed cylinder 41 supports these parts and contains the demeshing spring 42, which normally retains the parts in the position shown. The cylinder 36 contains a suitable dampening fluid and is provided with suitable ports 43 which are over-run by the piston to permit the return of the switch cylinder 36 when desired. The piston is provided with holes covered by the spring loaded plate 44 which comprises a one-way valve, permitting the quick return of the piston when the control pedal 33, which preferably takes effect on the lever 50

through the medium of the spring 45, is released. The action of the device is as follows:

- The pedal 33 being depressed as far as it will go, loads the spring 45 to a predetermined pressure
- 5 which actuates the levers 30, 50 and 32; the rapidity of the motion imparted being controlled by the rate of leakage of the dampening fluid past the piston 35; the fit of which within the cylinder 36 is adjusted to give the desired time interval.
- 10 It will be seen that the initial movement of the piston 35 creates a downward pressure on the cylinder 36 which overcomes the switch spring 40 completing the circuit between the contacts 38 and 39 which puts the battery, not shown, into
- 15 connection with the motor through the conductor 55. This rapidly accelerates the motor armature and flywheel 15, the pinion and associated parts being free from rotative tendency, except for a slight drag due to the friction between the rotating bushing 19 and the journal 21 and also at the
- 20 bearing between the extreme left hand end of the sleeve 23 and its centering bushing 56. This friction will induce a slight creep of the pinion which is slowly moving to the right under the control of the dash pot and this creep will avoid corner mesh of the teeth permitting the pinion to continue its right hand travel towards fully meshed position until the piston 35 over-runs the ports 43, whereupon the resistance to its travel ceases,
- the spring 40 opens the switch and the drive is
- instantly completed by contacting of the taper bore in the drive sleeve 23 with the coil clutch 8 which last parts automatically lock together, shock of engagement being prevented by slippage
- between the clutch plates 25 and 26 until the torque developed thereby has brought the engine up to its relative speed with the pinion 20 which continues to drive the engine at decreasing speed until the inertia of the flywheel 15 and associated
- parts is exhausted, or until a start is attained.

When the engine starts under its own power the pinion is free to over-run the armature and flywheel 15 in virtue of the well-known one-way action of coil clutches like 8. It will be seen that

5 such over-run induces no de-meshing action, this being effected by the operator releasing the pedal when he sees that the engine has started, permitting the spring 42 to return the parts to the position shown. In this way the "hunting" due to

the de-meshing tendency of automatic shift pinions of the screw-thread type when the engine over-runs after a compression and the associated pounding of the gears is avoided.

It will be seen in this preferred showing that

5 the current is automatically cut off without special manipulation by the operator just before complete engagement is effected, so that at the instant of starting the battery is free of all starter load and, therefore, able to deliver full voltage to insure

0 effective sparks from the ignition system.

It will also be seen that by suitably adjusting the rate of flow past the dash pot piston 35, the amount of frictional drag on the pinion at the bearings 19 and 16, the strength of spring 45, and the distance traveled by the pinion before it engages; the time element of the several operations disclosed can be varied to produce the desired amount of creeping for engagement with the pinion, and to attain the desired flywheel speed, without demanding any skill or judgment

5 on the part of the operator, from whose point of view the entire device is controlled in exactly the same way as a conventional starter.

Should it be desired, in special instances, to leave these factors subject to the operator's judg-

ment, the spring 45 or the dash pot 36 may be omitted and a spring may be substituted for the dampening fluid beneath the piston 35, or the ports 43 may be eliminated should it be desired to augment the inertia power by maintaining the electrical energization through the starting period. In these cases, however, certain advantages of the preferred structure for unskilled operators would be lost.

With reference to Fig. 5, there is shown an alternative means for actuating the levers 50 and 32 in which the lever 32 is provided with a short extension 60, that is connected to the movable armature 61 of a solenoid 62 by a connecting rod 63. A manually operated switch 64 will close the circuit 65 and cause the lever 32 to downwardly press the piston 35 in the same manner as hereinbefore described.

It might be stated that the only resistance encountered by the motor in this invention is that due to the inertia of the flywheel which becomes zero as the motor approaches its maximum speed which will, therefore, be much higher than that developed in conventional starting systems where the motor always operates against the engine resistance. The initial starting speed might be unnecessarily high if a conventional pinion large enough for mounting on a screw-threaded shaft were used, and it is a feature of this disclosure that the structure is such that the pinion may be solid, permitting the use of much fewer teeth than usual and thus obtaining increased gear reduction and torque capacity. Many conventional engines have the pilot 57 which locates the starter in the housing 12 positioned for a standard pinion of eleven teeth which is the minimum practice with the standard screw-shift device. To permit the starter of this invention to interchange with present standards, the starter pilot 57 (Fig. 4) is made sufficiently

eccentric to the pinion to give the proper center distance to engage the reduced number of pinion teeth with a standard flywheel gear 10.

The pitch diameter of the pinion indicated is about one-half the standard referred to above thus giving twice the normal gear reduction without resource to the extra step-down gears necessary to obtain this result in connection with the necessarily larger screw-shift pinions in the prior art.

Variations may be resorted to within the scope of the invention and portions of the improvements may be used without the others, whilst not departing from the spirit of the invention.

Having thus described my invention, I claim:—

1. In a starter for an engine in combination, a starter part meshable with the engine, a massive rotor energizable to high speed independently of said meshable part, control means adapted to initiate said energization and to drivably engage the meshable part with the rotor and with the engine after a mechanically predetermined time of energization.

2. In a starter, the combination with a source of power, of an engine meshing part, a massive rotor, a control means adapted to apply said power to energize the rotor and further adapted to actuate said meshing part and to disconnect said power and to drivably engage the meshing part with the rotor in preset sequence.

3. In a starter, the combination with a source of power, of an engine meshing part, a massive rotor, control means adapted to apply said power to energize the rotor and further adapted to actuate said meshing part and to disconnect said

power and to drivably engage the meshing part with the rotor at preset time intervals.

4. In a starter, the combination of an engine meshing part, a massive rotor energizable to high speed independently of the engine meshing part, control means adapted to connect the rotor to a source of power for such energization, means to subsequently drivably engage the rotor with the engine and means to delay the time of such engagement without respect to the volition of the operator.

5. In a starter for an engine, the combination of a rotor, a part meshable with the engine, means to drivably connect the meshable part with the rotor after the rotor has attained a high speed, and a control means adapted to effect said mesh and engagement with a preset time interval therebetween.

6. In a starter for an engine, the combination of a power means, an engine engaging member, a manually operable control for actuating said engine engaging member and subsequently drivably engaging said member with the power means, and means associated with the control to automatically provide a preset time interval between the starting of the power means and the completion of the drive connection with the engine.

7. A starter for an engine comprising in combination, a rotor, means to connect said rotor with a source of power to energize the same, means to subsequently drivably engage the rotor with the engine, and motion retarding means adapted to automatically provide a substantial time interval between said actions.

8. In a starter, the combination of means for drivably engaging an engine after the starter has been brought to high speed, and a control means responsive to a prompt single motion by an operator to energize the starter and then to produce said connection after a preset time interval.

9. In a starter, the combination of a power member, a meshable part drivably engageable with an engine to be started and with the power member, a manually operable means to engage said meshable part; said means including a spring adapted to exert a pre-determined engaging pressure, and a dash pot means adapted to control the rate of the subsequent movement of the meshable part towards the engaged position.

10. In a starter, a rotor energizable to high speed, means to drivably engage the rotor with an engine, and control means adapted to produce a retarding action on said engaging means to permit the rotor to first attain high speed.

11. In a starter, the combination of a rotor, means to startably engage an engine after the rotor has been brought up to high speed, a control means adapted to apply a pre-set pressure to actuate the parts for such engagement, and means to restrain the rate of engagement.

12. In a starter, in combination, a rotor, means to startably engage an engine after the starter has been brought up to high speed, a control means adapted to apply a pre-set pressure to actuate the parts for such engagement and means to restrain the rate of engagement, said means comprising a dash pot.

13. In a starter, in combination, a rotor, means to startably engage an engine after the rotor has been brought up to high speed, a control means adapted to apply a pre-set pressure to actuate the parts for such engagement and means to restrain

the rate of engagement, said means comprising a dash pot adapted to actuate a switch.

14. In a starter, in combination, a rotor, means to startably engage an engine after the rotor has been brought to high speed, a control means adapted to apply a pre-set pressure to actuate the parts for such engagement, and means to restrain the rate of engagement; said means including a dash pot adapted to first close and subsequently to permit the opening of a switch.

15. In a starter, in combination, an engine engaging member, a switch, manual means adapted to enforce a relatively slow meshing movement of said engine engaging member, and means to close and open the switch during said slow meshing movement.

16. The combination with a starter having an engine engaging means manually controlled, of a power member adapted to drive said engine engaging means, a self-locking one way driving clutch between said power member and said means, and means to delay the completion of said engagement until the power member has attained high speed.

17. In a starter, the combination of a power shaft, a member movable axially of the shaft to engage an engine to be started and normally free for independent rotation of the shaft to high speed, and control means to effect a drivable engagement of said engine engaging member after a preset time interval adapted to permit the attainment of such high speed.

18. In a starter having a rotor drivable from a source of power, means to drivably engage an engine to be started after the rotor has attained high speed, a control means adapted to connect and to disconnect said source of power; and to control said engagement at predetermined time intervals responsive to a single initial movement by the operator.

19. In a starter, the combination of means for drivably engaging an engine to be started, and control means adapted to produce a delay in the engagement responsively to a prompt initial movement by an operator.

20. In a starter, the combination with an engine member, of a rotatable power member, a drive means normally disengaged from said power member and the engine member, a clutch means adapted to form a driving connection between the power member and the drive means when the drive means is shifted into engagement with the engine member, and means adapted to start the rotation of the power member and to effect an engagement of the drive means therewith after a predetermined lapse of time from the starting of the power member.

21. In a starter, the combination with an engine member, of a rotatable power member, an axially shiftable engine engaging member normally disengaged from said power member, clutch means adapted to drivably connect the engine engaging member to the power member when axially shifted, means responsive to manual actuation to rotationally start the power member said means being adapted to shift the engine engaging member to engage first the engine member and then the power member following a predetermined interval of time to the starting of the power member, and a load limiting clutch adapted to permit rotation of the power member relative to the engine engaging member whilst an overload prevails.

22. In a starter for an engine, the combination of a rotatable power member, drive means nor-

80

85

90

95

100

105

110

115

120

125

130

135

140

145

150

- mally disengaged from the power member, a clutch means adapted for the connection of the drive means to the power member, and means responsive to initial manual actuation to rotationally start the power member and to connect the drive means thereto and to the engine; said means comprising yielding connections adapted to restrain the making of said connection for a predetermined period of time following the starting of the power member.
23. In a starter for an engine, the combination of a rotatable power member, an axially shiftable engine engaging member normally disengaged from said power member, a clutch means adapted to drivably connect the engine engaging member to the power member when axially shifted, and means responsive to manual actuation to rotationally start the power member; said means being adapted to shift the engine engaging member to engage both the power member and the engine to be started following a predetermined interval of time to said starting of the power member, said clutch being also adapted to permit an overrun of the engine engaging member whilst fully engaged with the engine.
24. The combination with an engine to be started, of a rotatable power member, a drive means normally out of engagement with both the power member and the engine, clutch means adapted for the connection of the drive means to the power member, means responsive to initial manual actuation to rotationally start the power member and to connect the drive means thereto and to the engine; said means comprising a cylinder containing a displaceable fluid and adapted to restrain the making of said connection for a predetermined period following the starting of said power member.
25. In an engine starter, the combination of power means, a drive means normally disengaged from the power means and adapted for movement to operatively engage first the engine and then the power means, and means responsive to manual actuation to initiate the starting of the power means and to effect said movement of the drive means, the movement of the drive means being mechanically controlled so as to follow after a predetermined time the starting of the power means.
26. In an engine starter, a flywheel, a driving member adapted to be moved into cranking engagement with a member of the engine to be started, means for drivably connecting the flywheel and driving member, and means for actuating said flywheel and storing energy therein comprising an electric motor, a switch for said motor, a dash-pot through which the switch is operated, and means for causing the dash-pot to release the switch after a predetermined time interval.
27. In an engine starter, a flywheel, a driving member adapted to be moved into cranking engagement with a member of the engine to be started, means for drivably connecting the flywheel and driving member, and means for actuating said flywheel and storing energy therein comprising an electric motor, a movable conductor for controlling the flow of current to the motor, a spring normally maintaining the movable conductor in an open condition, a control means including a dash-pot adapted to overcome said spring up to a predetermined point in the travel of the dash-pot, and means thereat to automatically release said movable conductor to the action of said spring.
28. In a starter for internal combustion engines, the combination of an electric motor, an energizing circuit for said motor, a switch in said circuit, means for closing said switch including a motion retarding device movable with said switch to effect slow engagement of the starter with the engine to be started, said motion retarding device being operative to effect such engagement automatically after the lapse of a substantial interval measured from the closure of said switch, and means effective upon continued movement of said motion retarding device to reopen said switch.
29. In a starter, the combination of an electric motor, an operating switch therefor, means including a motion retarding device for effecting slow engagement of the starter with the engine to be started and at the same time effective to close said switch promptly, and means subsequently effective upon continued movement of said motion retarding device to reopen said switch.
30. In a starter for internal combustion engines, the combination of an electric motor, an energizing circuit for said motor, a switch in said circuit, means for closing said switch including a motion retarding device movable with said switch to effect slow engagement of the starter with the engine to be started, said engagement being subsequent to the closure of said switch, and means effective upon continued movement of said motion retarding device to reopen said switch.

ROLAND CHILTON.

55

60

65

70

75

80

85

90

95

100

105

110

115

120

125

130

135

140

145

150