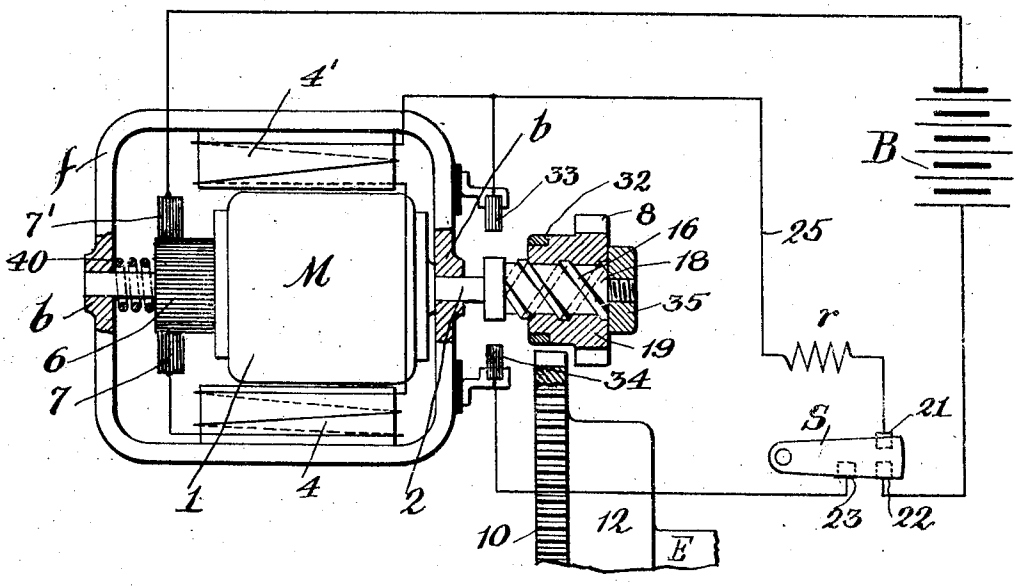
J. R. MILLWARD.

ELECTRIC STARTER FOR INTERNAL COMBUSTION ENGINES.

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1,341,659. Patented June 1, 1920.



WITNESSES

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ELECTRIC STARTER FOR INTERNAL-COMBUSTION ENGINES.

1,341,659. Specification of Letters Patent. Patented June 1, 1920.

Original application filed November 19, 1913, Serial No. 801,850. Divided and this application filed December 24, 1917. Serial No. 208,561.

To all whom it may concern:

Be it known that I, JOHN ROSCOE MILLWARD, a citizen of the United States, residing at 36 North 6th street, county of Essex, city of Newark, State of New Jersey, U. S. A., have invented certain new and useful Improvements in Electric Starters for Internal-Combustion Engines, of which the following is a full, clear, and exact description.

This invention relates to electrical starting devices for internal combustion engines and controlling means therefor and has particular reference to the coupling means whereby the motor employed is thrown automatically into and out of engagement with the engine to be started.

My improved device is especially adapted for starting automobile engines and an important feature thereof consists in an arrangement whereby the aforesaid means for engaging the motor with the engine controls the current passing through the motor whereby the full working current and the engagement of the connector is made dependent on the proper engagement of the connector and the driving of the engine by the motor. The operation is such that the full working current will not pass through the motor until the gears are in proper mesh and upon the starting of the engine the motor circuit will be opened and the connector disengaged. The latter function is arranged to be effected instantly on the acceleration of the engine by its own power thus to effect the disengagement of the motor before the engine can exert a driving force thereon. My improved arrangement is thus positive in its operation to engage and disengage the motor and, moreover, when disengaged is entirely free of any connection with moving parts.

The foregoing and other features of my invention are shown in the accompanying drawings wherein are shown desirable embodiments of my invention and in which the reference characters of this description are applied to like parts in the various figures.

The drawing shows diagrammatically a preferred embodiment of my invention.

In the figure M indicates the starting motor consisting of an armature 1 carried on a shaft 2 and having the field poles 4—4′, commutator 6 and the commutator brushes 7—7′. A suitable frame *f* is indicated for the purpose of supporting the pole-pieces 4—4′ and to provide suitable bearings *b*—*b* for the armature shaft 2. The armature shaft is shown elongated at one end to have rotatively secured thereon a shiftable connector element to effect its engagement with the engine to be started, here shown as a driving pinion 8 adapted to engage the gear teeth 10 of the engine fly wheel 12. The engine is indicated at E and may be the usual internal combustion motor of the automobile type.

The pinion 8 is rotatably secured to the armature shaft 2 and laterally shifted thereon by a spiral spline or thread 16 formed on an operating collar 18 secured on the shaft 2 and threaded to the interior of the hub 19 of the connector pinion 8. The motor shown is series wound, and the operating circuit is closed therethrough from a storage battery B by a suitable switch arm S. The switch arm is moved to bridge the contacts 21 and 22 initially to close the circuit through the connection 25 having therein a resistance *r*.

Upon the inner end of the pinion hub, and suitably insulated therefrom is an annular switch member in the form of a copper ring 32 which is adapted, when the pinion is in full engagement with the gear 12, to engage the brushes 33, 34 and close the circuit therethrough to receive the full working current from the battery to turn the engine. The brushes are shown supported by and insulated from the motor frame *f* and connected in series with the motor through the rings 32 to a contact 23 likewise engaged by the switch arm S.

It is to be noted that the armature *m* is normally maintained in an axially de-centered position, that is, it is journaled so as to normally be displaced from its field under the influence of a coil spring 40, the bearings and commutator being sufficiently elongated to permit of this movement and position of the armature. Upon establishing the initial circuit through the resistance *r* by operating the switch S, the armature will be shifted into its field against the pressure of the spring 40 thereby carrying with it the operating collar 18 and the pinion 8, the latter being brought in partial or retarding engagement with the fly-

wheel gear 12. Thereafter, on rotation of the armature, the pinion positively will be shifted into full engagement with the gear 12. When the engine begins to run under its own power, it will automatically throw out the pinion 8, and the driving circuit will be completely broken owing to the shifting of the rings 32; the coil spring 40 will then displace the armature to complete the disengaging of the pinion.

It is to be noted that when the switch S is in the position shown in the drawings, it bridges contacts 21, 22 and 23. Current flows from battery through contact 22, switch S, contact 21, resistance r, field coil 4, brushes 7, commutator 6, brush 71 back to battery. When the annular switch member 32 comes into contact with the brushes 33, 34, the resistance r is short-circuited, so that the full power of the motor and battery is applied to start the engine.

This application is a division of my United States application, Serial No. 801,850, filed November 19, 1913.

What I claim is:

1. In combination with an engine, a toothed member connected therewith; a starting motor; a battery; means for connecting said battery with said motor; a helix driven by said motor; a pinion movably mounted on and rotatable with said helix; said starting motor including means for bringing said pinion in engagement with said toothed member to cause a relative movement between said pinion and said helix, and engagement of said pinion with said toothed member.

2. In combination with an engine, a starting device therefor comprising a motor; a battery; circuit connections between said battery and said motor; a normally de-centered armature for said motor; a helix connected with said armature; a pinion movably mounted on said helix; a toothed wheel connected with the engine; and means for connecting said motor with said battery so that said motor may cause engagement of said pinion with said toothed member to start the engine.

3. In combination with an engine, a starting device therefor comprising a motor; a battery; a helix connected with the motor; a pinion movably mounted on the helix; a toothed wheel connected with the engine; and said starting motor including means for imparting bodily movement to the helix and pinion and causing relative movement between the pinion and the helix prior to the enmeshment of said pinion with said toothed wheel.

4. In a starting mechanism, the combination with a pair of coacting gear wheels, and a screw-threaded shaft for supporting one of said gear wheels, of means for simultaneously rotating said shaft and shifting it longitudinally.

5. In a starting mechanism, the combination with a pair of coacting gear wheels, and a screw-threaded shaft for supporting one of said gear wheels, of electro-responsive means for simultaneously rotating said shaft and shifting it longitudinally.

6. In a starting mechanism, the combination with a pair of coacting gear wheels, and a screw-threaded shaft for supporting one of said gear wheels, of a motor for simultaneously rotating said shaft and shifting it longitudinally.

7. In a starting mechanism, the combination with a pair of coacting gear wheels, of means for shifting one of said gear wheels into and out of mesh with the other, said means comprising a screw-threaded shaft and means for shifting the shaft longitudinally and rotating it relatively to said pinion.

8. In a starting mechanism, the combination with a pair of coacting gear wheels, of means for shifting one of said gear wheels into and out of mesh with the other, said means comprising a screw-threaded shaft and electro-responsive means for shifting the shaft longitudinally and rotating it relatively to said pinion.

9. In a starting mechanism, the combination with a pair of coacting gear wheels, of means for shifting one of said gear wheels into and out of mesh with the other, said means comprising a screw-threaded shaft, and a motor for shifting the shaft longitudinally and rotating it relatively to said pinion.

10. In a starting mechanism, the combination with a pair of coacting gear wheels, of means for shifting one of said gear wheels into and out of mesh with the other, said means comprising a screw-threaded shaft and a motor having a normally displaced armature for shifting the shaft longitudinally and rotating it relatively to said pinion.

11. In a starting mechanism, the combination with a pair of coacting gear wheels, of means for controlling their relative positions, said means comprising an electric motor having a longitudinally shiftable armature, and an armature shaft having a portion inclined relatively to its axis for coacting with one of said gear wheels.

In testimony whereof I affix my signature.

JOHN ROSCOE MILLWARD.