J. R. MILLWARD.

ELECTRIC STARTER FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED DEC. 24, 1917.

1,341,660. Patented June 1, 1920.

Fig. 1,

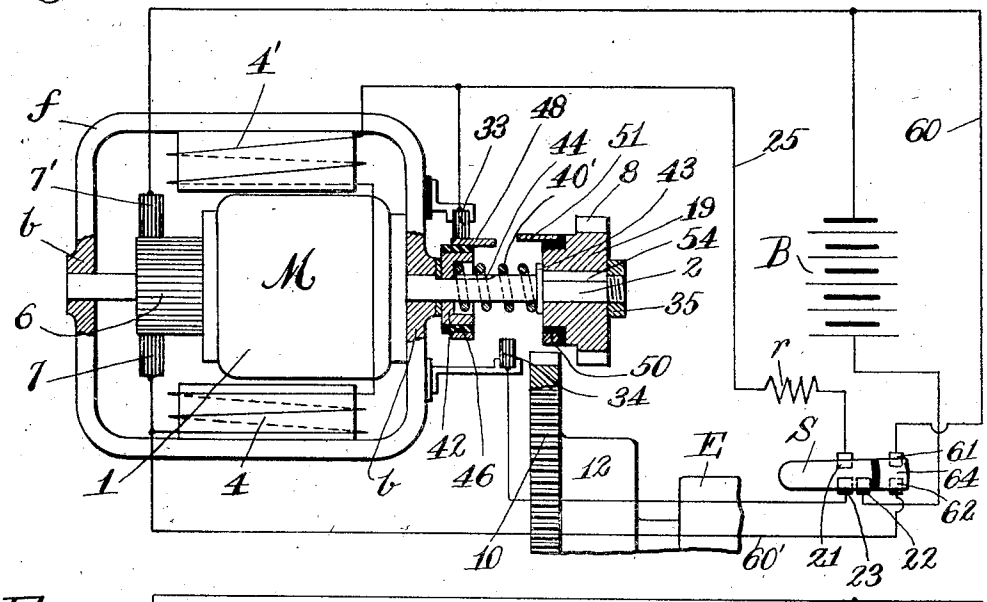


Fig. 2

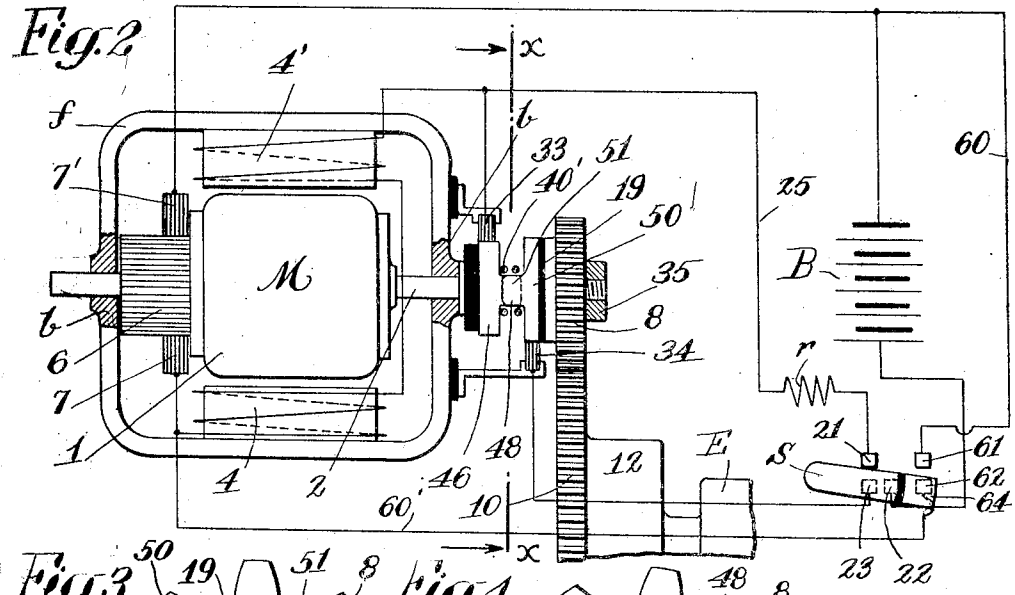


Fig. 3,

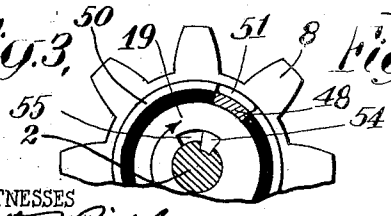
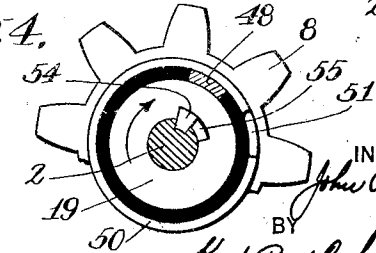


Fig. 4.



WITNESSES

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ELECTRIC STARTER FOR INTERNAL-COMBUSTION ENGINES.

1,341,660. 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. 208,502.

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, 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 particularly adapted for starting automobile engines, and contemplates a starting motor which has a normally decentered sliding armature, which armature carries a connector member or toothed pinion which is movable with the armature into engagement with a toothed member connected with the engine. In order to control the circuits in accordance with the position of the connector member, I provide a switch-controlling device consisting of coacting contact members having sliding or wiping contact with one another, one of said contact members being actuated by the armature movement, and I prefer to so arrange that when the main switch, which may be a manually operated switch actuated by the driver, is closed, this will cause the current from the battery to flow to the motor through the intermediary of a resistance, thereby preventing too great a current flowing initially, and as soon as the armature has moved into its centered position and brought the pinion carried by it into engagement with the toothed member connected with the engine, the aforesaid switch controlling device is closed and permits the full current to flow from the battery to the motor to cause the motor to act with full power to crank the engine. A further feature of the invention consists in means whereby, immediately the engine is running under its own power, it causes the disconnection of the battery from the motor prior to the disengagement of the pinion from the toothed member driven by the engine.

In order that the invention may be more completely understood, reference will now be made to the accompanying diagrammatic drawing in which:

Figure 1 shows a preferred embodiment of my invention, with the parts of the starting device in disengaged position.

Fig. 2 is a view of the same arrangement when the connector is in engaged position and the current on full.

Figs. 3 and 4 are cross-sectional views on the line X—X of Fig. 2, illustrating the positions of the contact when the motor drives the engine and when the engine drives the motor respectively.

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.

Referring more particularly to Figs. 1 and 2, the armature is arranged to be displaced under the action of a retractile spring 40′ confined between a collar 42, held against the frame *f* thereby, and a collar 43 on the armature shaft 2. The collar 42 is rotatively connected to the armature shaft by a key fitted to a suitably elongated keyslot 44 in the shaft. Upon the collar, insulated therefrom, is supported a copper contact ring 46 having a laterally extended contact projection or lip 48. Said ring 46 is arranged constantly to be engaged by the brush 33. On the hub 19 of the pinion S, keyed on the end of the shaft, is a similar copper contact ring 50 having a contact lip 51 projecting in a plane and toward the lip 48 to be in overlying engagement therewith when the pinion is in driving engagement as shown in Figs. 5 and 6.

As shown in Figs. 3 and 4 the pinion 8 is keyed on the armature shaft 2 by a key 54 on the shaft fitted to an enlarged key slot 55 in the pinion hub 19. By this ar-

rangement it will be seen that a partial rotative movement of the pinion with reference to the shaft 2 is permitted. While the armature shaft is exerting a driving pressure on the gear 10, through the pinion, the key 54 will assume a position engaging at the forward end of the key slot 55, as shown in Fig. 3, and the contact lips 48 and 51 are arranged then to be in radial alinement to complete the work circuit through their respective rings 46 and 50 and brushes. However, on the acceleration of the gear 12, by starting of the engine, it will turn the pinion 8 with relation to the shaft 2 to the position shown in Fig. 4, moving the contact 51 circumferentially with relation to contact 48 whereby they are separated to break the circuit. The engagement of the key will then be at the rear of the slot 55.

Upon the motor circuit being so broken the spring 40′ will force the pinion 8 out of engagement, likewise moving the motor armature into the initial displaced position. When the motor is again energized by moving the switch S around to the starting position, of Fig. 4 the contacts 48 and 51 will again be brought into radial alinement so that they will make engagement when the pinion is moved into operative engagement.

To promote the introduction of the gears I have indicated an arrangement whereby the magnet initially will receive the full current to exert its maximum energy in shifting the pinion while less than the maximum current is passed through the motor armature to reduce the rotative effort. This consists in a connection 60—60′ from the battery connected to the field coils as shown to short circuit the armature. The connection 60—60′ is arranged to be broken at contacts 61—62 and the switch arm S carries an auxiliary arm 64 to close the circuit through the connection 60—60′ in the first position of arm S. The magnetic pull is thus strengthened to insure of shifting the pinion in the first position of the switch arm while the armature receives a reduced energizing current to reduce the rotative effort. On advancing the switch to the second position indicated in Fig. 5, the circuits through connections 25 and 60—60′ are broken and with the pinion in proper engagement the armature will receive the full working current from the battery.

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 starting motor therefor including a normally decentered sliding armature; a connector member connected with said armature and movable with said armature into engagement with the engine; and circuit closing means for said motor including brush and coacting contact members, one of said members mechanically connected with the armature.

2. In combination with an engine; a starting motor therefor including a normally decentered sliding armature; a connector member connected with said armature and movable therewith into engagement with the engine; a battery; circuit connections between said battery and motor; a main switch for closing one of said circuits to initiate the connection of the motor with the engine; and circuit closing means for closing another connection to apply the full power of the motor to start the engine, including brush and coacting annular contact members, one of said members carried by and movable with the armature.

3. In combination with an engine; a starting motor therefor; a pinion carried by said motor and adapted for angular movement relative to said motor; a toothed member connected with the engine; means for bringing said pinion into mesh with said toothed member; a switch controlled by said pinion; and means for causing the actuation of said switch by the engine when the engine runs under its own power and prior to the disengagement of said pinion from the toothed member.

4. In combination with an engine; a starting motor therefor; a battery; circuit connections between said battery and said motor including a switch; a pinion connected with said motor; a toothed member carried by the engine; means for bringing said pinion into engagement with said toothed member; and means for actuating said switch under power of the engine after the engine has started running and prior to the disengagement of said pinion from said toothed member.

5. In combination with an engine; a starting motor therefor; a battery; a gear carried by the engine; a pinion; means connecting the pinion and motor and adapted to permit a certain movement of the pinion independent of the motor when the gear begins to drive the pinion; means for bringing the pinion into engagement with the gear; and circuit connections between the battery and motor including a switch having means actuated by said pinion during said independent movement thereof for opening said switch after the engine has started running and prior to the disengagement of said pinion from said gear.

6. In combination with an engine; a starting motor therefor; a battery; normally disconnected driving connections for connecting the motor and engine; means for connecting together said driving connections; circuit connections between the motor and battery including a switch having provisions actuated to complete the circuit when the motor and engine are connected, said

driving connections having means for effecting the disconnection of said switch provisions after the engine has started running and prior to the disengagement of said pinion from said gear.

7. In combination with an engine; a starting motor therefor, a battery; normally disconnected mechanical connecting devices between the engine and motor; normally disconnected electrical connecting devices between the motor and battery; means for rendering said mechanical and electrical connecting devices operative; said mechanical devices and electrical devices having cooperating provisions for effecting the disconnection of said electrical devices after the engine has started running and prior to the disengagement of said mechanical connecting devices.

8. In combination with an engine; a starting motor therefor having a normally decentered armature, normally disconnected mechanical connecting devices between the engine and motor; normally disconnected electrical connecting devices between the motor and battery; means for causing the motor magnets to be energized to center the motor armature whereby to render operative said mechanical and electrical devices; said mechanical devices and electrical devices, having coöperating provisions for effecting the disconnection of the electrical devices after the engine has started running and prior to the disengagement of said mechanical connecting devices.

9. In combination with an engine; a starting motor therefor having a normally decentered armature; a gear carried by the engine; a pinion carried by the armature shaft; connections between said pinion and said shaft providing a certain angular movement of said pinion relative to said shaft; a battery; a circuit between the battery and motor including a switch contact carried by said pinion and a switch contact having a splined connection with said shaft; manually controlled means for effecting the centering of the armature and the initial rotation of the armature whereby to cause said pinion to engage said gear and said switch contacts to come into engagement; said switch contacts being arranged so as to be in engagement when the motor is driving the engine, but to be moved out of engagement by virtue of the said driving connection between the pinion and shaft as soon as the engine drives the motor.

10. In combination with an engine; a starting motor therefor having a normally decentered armature; a gear carried by the engine; a pinion carried by the armature shaft; connections between the said pinion and shaft including a key mounted in the shaft and a key-slot provided in the pinion, said key-slot being wider than the key whereby to provide a certain angular movement of said pinion relative to said shaft; a battery; a circuit between the battery and motor including a switch contact carried by said pinion and a switch contact having a splined connection with said shaft; manually controlled means for effecting the centering of the armature and the initial rotation of the armature whereby to cause said pinion to engage said gear and said switch contacts to come into engagement; said switch contacts being arranged so as to be in engagement when the motor is driving the engine, but to be moved out of engagement by virtue of the said driving connection between the pinion and shaft as soon as the engine drives the motor.

In testimony whereof I affix my signature.

JOHN ROSCOE MILLWARD.