C. E. WILSON.

STARTING MECHANISM FOR AUTOMOBILES.

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1,246,691. Patented Nov. 13, 1917.

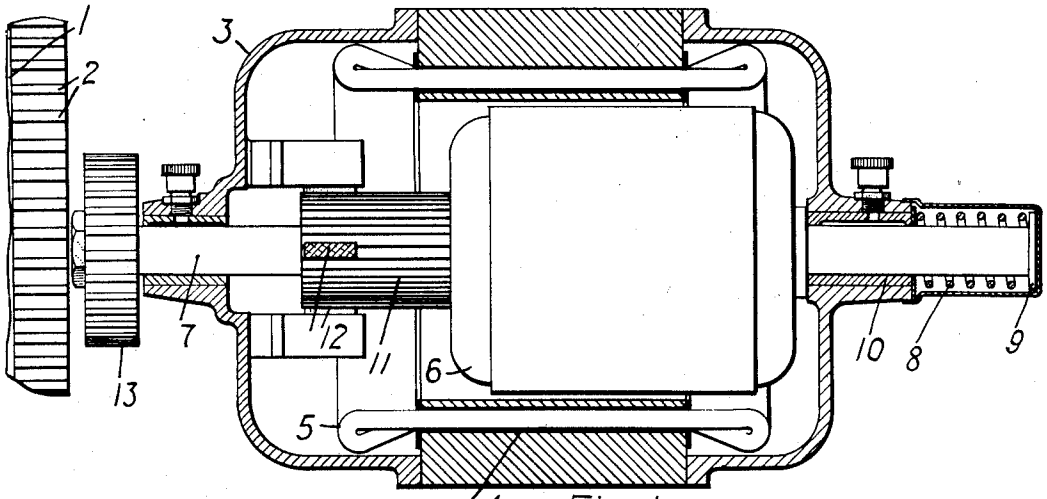


Fig. 1.

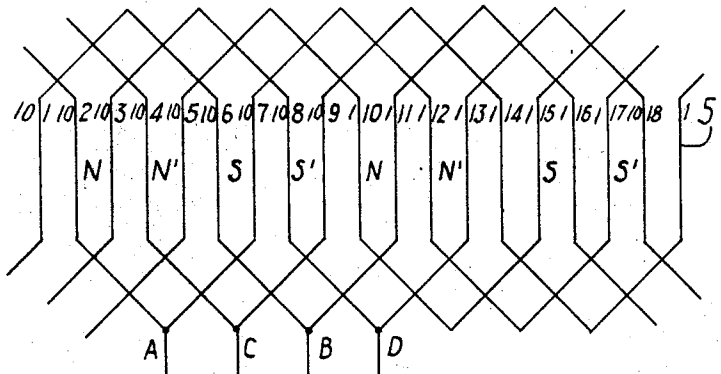
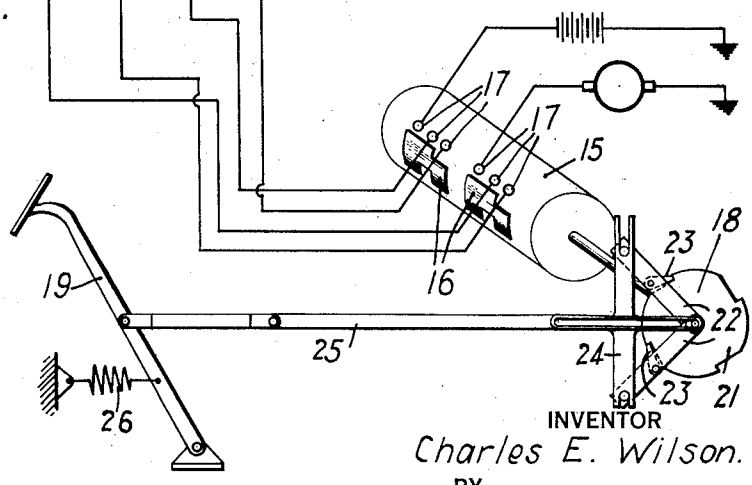


Fig. 2.



WITNESSES:

P. J. Ridge

J. R. Langley

INVENTOR

Charles E. Wilson.

BY

Wesley G. Carr

ATTORNEY

UNITED STATES PATENT OFFICE.

CHARLES E. WILSON, OF WILKINSBURG, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

STARTING MECHANISM FOR AUTOMOBILES.

1,246,691. Specification of Letters Patent. Patented Nov. 13, 1917.

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To all whom it may concern:

Be it known that I, CHARLES E. WILSON, a citizen of the United States, and a resident of Wilkinsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Starting Mechanism for Automobiles, of which the following is a specification.

My invention relates to starting mechanisms for automobiles, and particularly to such mechanisms as embody dynamo-electric machines having reciprocating armatures for actuating pinions into and out of operative connection with the shafts of internal combustion engines.

My invention has for its object to provide a simple arrangement, whereby the armature of a dynamo-electric machine may be reciprocated longitudinally with a strong force, while little or no torque is effective to rotate the armature.

It has been proposed, heretofore, to provide electric starting motors with displaced armatures, but they possess certain disadvantages, in that it is necessary to employ auxiliary switching mechanisms either for temporarily short circuiting the armature or for inserting resistance in circuit with it. Such an arrangement is necessary because, in the displaced position of the armature, the torque is sufficiently high to rotate the armature at a comparatively high rate of speed before the gear wheels are completely meshed.

It is also difficult to effect the meshing of the gear wheels when there is considerable lateral pressure between the coacting teeth. When no torque is effective to rotate the armature during its longitudinal movement, the gear wheels may be readily meshed because there is little or no lateral pressure between their respective teeth to retard their relative slidable movements.

I provide an electric motor having a distributed series field-magnet winding that is provided with two pairs of terminals by means of which current may be supplied at different points. When current is supplied through one pair of terminals, the field-magnet poles produced by the winding are displaced approximately 90 electrical degrees and occupy positions corresponding substantially to the positions of the poles produced in the armature core by the armature winding.

Since the magnetic field is shifted to such position that it substantially coincides with the magnetic field of the armature winding, there is little or no tendency for the armature to rotate. The longitudinal pull is sufficient, however, to shift the armature and thereby establish driving connections between the motor and the engine shaft. By changing the connections, the normal magnetic field is produced by the series field winding, and full torque is effective to rotate the armature to crank the engine.

The details of my invention will be described in connection with the accompanying drawing, in which Figure 1 is a view, partially in section and partially in elevation, of an engine fly wheel, with my invention applied thereto. Fig. 2 is a diagrammatic view of circuits and apparatus embodying my invention.

A fly wheel 1, only a portion of which is shown, is provided with gear teeth 2. An electric motor 3 has a field-magnet core structure 4 and a distributed series field winding 5. The motor armature 6 and the armature shaft 7 are arranged for longitudinal movement relatively to the motor frame.

A spring 8, which is interposed between a collar member 9 on the armature shaft and one of the motor bearings 10, tends to maintain the armature in a displaced position relatively to the core structure, as illustrated. The commutator cylinder 11 is of such length that it is always in engagement with coacting brushes 12 that are secured to the motor frame. The armature shaft 7 is provided with a pinion 13 which coacts with the gear teeth 2 in the engine fly wheel.

Referring particularly to Fig. 2, the field magnet core structure may be provided with any suitable number of slots as, for example, eighteen which are numbered from 101 to 118. The number taken is smaller than that preferably employed in practice, but is chosen in order to simplify the illustration and explanation of my invention. The series field-magnet winding 5 is shown as a closed wave winding but any other suitable type of winding may be substituted therefor. The winding is arranged to produce four field-magnet poles, the normal positions of which are indicated at N, S, N and S, and the displaced positions of which are indicated at N′, S′, N′ and S′. The pitch or throw of the windings is five slots which is

slightly greater than the pole pitch. The series winding 5 is provided with a pair of terminals or connections A and B for use during normal operation of the motor and a second pair of terminals C and D for temporary operation, while the motor is being operatively connected to the engine.

The connections of the field-magnet winding 5 are controlled by a switching mechanism 15 that is provided with contact segments 16, only two of which are shown, which coact with contact fingers 17. The position of the controller 15 is controlled by a unidirectional ratchet mechanism 18 that is actuated by a starting pedal lever 19.

The ratchet mechanism 18 comprises a notched disk 21, a pair of pivotally mounted levers 22 which carry pawls 23 for coacting with the disk 21 and a slotted bar 24 that is connected to the pedal lever 19 by a link 25. A spring 26 normally retains the pedal lever and the ratchet mechanism in their respective illustrated positions.

It may be assumed that the various parts are in their respective illustrated positions, with the pinion 13 out of engagement with the gear teeth 2 and the controller 15 in its inoperative or "off" position. To start the motor, the pedal lever 19 is actuated forwardly against the tension of the spring 26 to cause a corresponding forward movement of the link 25, the bar 24 and the lever 22. The pawl 23, that is carried by the upper of the levers 22 and is in engagement with one of the notches of the disk, actuates the latter in a clockwise direction.

The initial engagement of the contact segments 16 with respective pairs of the corresponding contact fingers 17 establishes a circuit which extends from the ungrounded side of the battery through contact fingers 17 and contact segment 16, terminal B, the field magnet winding 5, terminal A, contact fingers 17, contact segment 16 and motor armature 6 to ground, and thence back to the battery. The field-magnet winding 5 will then be energized to produce four poles, the position of which is indicated at N′, S′, N′, S′.

Since the magnetic field thus produced is approximately 90 electrical degrees from the normal magnetic field, little or no torque is effective to rotate the armature. However, a slight rotation of the armature facilitates the meshing of the pinion 13 and the gear teeth 2, and this result is accomplished in the present invention by arranging the pitch of the field magnet winding slightly greater than the pole pitch. This arrangement insures that a slight torque will be effective when the connections are arranged to establish the circuit above described.

Because of the low resistance of the circuit, a heavy current traverses the motor windings, and the poles produced in the field magnet structure exert a strong magnetic force to shift the armature 6 to its central position and thereby effect the meshing of the pinion 12 with the gear teeth 2. Further movement of the controller 15, because of the actuation of the pedal lever 19, serves to connect the terminals C and D in circuit and then to effect the separation of the contact segments 16 and the contact fingers 17 that are connected to the terminals A and B.

When the pedal lever 19 has reached the limit of its forward movement, the controller 15 will have been rotated through an angle of substantially forty-five degrees. The contact fingers 17 then engage the lower extremities of the contact segments 16 and the motor circuit is arranged as above described, except that the field magnet winding 5 is connected through the terminals C and D instead of the terminals A and B. The magnetic poles thus produced are in their normal positions, as indicated at N, S, N and S. Normal torque is now effective to rotate the armature, and the fly wheel 2 is rotated to crank the engine.

When the engine starts under its own power, the pedal lever 19 is released by the operator and the spring 26 actuates the lever 19 and its connected mechanism to the left to return them to their respective illustrated positions. The lower lever 22, which has moved relatively to the disk 21 a sufficient distance to engage the succeeding notch, then rotates the disk 18 and the controller 15 in a clockwise direction to effect the disengagement of the contact fingers 17 and the contact segments 16 and thereby open the motor circuit. The armature 6 will then be returned to its displaced position by the spring 7, which has been under compression. The unidirectional ratchet mechanism insures that the circuit cannot be completed through the connections A B to again shift the armature. This action would occur if the switch were actuated to its "off" position in a counter clockwise direction.

If the operator fails to open the motor circuit immediately after the engine starts, the motor will be driven at a rapidly increasing speed. The counter electromotive force of the motor is thereby increased to reduce the current traversing its windings to such a value that the longitudinal pulls exerted by the field magnet poles is less than the force of the spring 8, whereupon the armature is shifted to its displaced position and the pinion 13 is disengaged from the gear teeth 2. It is obvious, therefore, that no damage may be caused by a failure to open the switch at the proper time.

It will be understood that the number of field-magnet poles shown and described is illustrative only, and that a motor having any convenient number of poles may be em-

ployed. It is obvious, also, that the arrangement of the field magnet winding is shown by way of example only, and that any other suitable arrangement may be substituted therefor. Other changes may be made within the scope of the appended claims without departing from the spirit of my invention.

I claim as my invention:

1. In a starting mechanism, the combination with a dynamo-electric machine having a field-magnet winding and a longitudinally shiftable armature, of means for causing an angular displacement of the magnetic field produced by said winding while the armature is being shifted to its central position and for causing the normal magnetic field to be established for rotating said armature.

2. In a starting mechanism, the combination with a dynamo-electric machine having a field-magnet winding and a longitudinally shiftable armature, of means for successively causing an angular displacement of the magnetic field produced by said winding while the armature is being shifted to its central position and for causing the normal magnetic field to be established for rotating said armature.

3. In a starting mechanism, the combination with a dynamo-electric machine having a field-magnet winding and a longitudinally shiftable armature, of means for controlling the connections of said field-magnet winding to cause an angular displacement of the magnetic field while the armature is shifted to its operative position and to establish the normal magnetic field for rotating said armature.

4. In a starting mechanism, the combination with a dynamo-electric machine having a field-magnet winding and a longitudinally shiftable armature, of means for controlling the connections of said field magnet winding whereby the magnetic field is angularly displaced by substantially 90 electrical degrees for shifting the armature longitudinally and the magnetic field is in its normal position for rotating said armature.

5. In a starting mechanism, the combination with a dynamo-electric machine having a distributed field-magnet winding and a longitudinally shiftable armature, of means for causing an angular displacement of the magnetic field produced by said winding while the armature is being shifted to its central position and for causing the normal magnetic field to be established for rotating said armature.

6. In a starting mechanism, the combination with a dynamo-electric machine having a distributed field-magnet winding and a longitudinally shiftable armature, of a unidirectional switching device for controlling the connections of said field-magnet winding to cause an angular displacement of the magnetic field while the armature is shifted to its operative position and to establish the normal magnetic field for rotating said armature.

7. In a starting mechanism, the combination with a dynamo-electric machine having a distributed field-magnet winding and a longitudinally shiftable armature, of means for causing an angular displacement of the magnetic field produced by said winding while the armature is being shifted to its central position.

8. In a starting mechanism, the combination with a dynamo-electric machine having a longitudinally shiftable armature and a distributed field-magnet winding, of means for producing an angular displacement of the respective magnetic fields produced by the armature winding and the field-magnet winding of said dynamo-electric machine while the armature is being shifted to its central position.

9. In a starting mechanism, the combination with a dynamo-electric machine having a field-magnet winding and a longitudinally shiftable armature, of means for causing an angular displacement of the magnetic field produced by said winding while the armature is being shifted to its central position.

In testimony whereof, I have hereunto subscribed my name this 23rd day of March, 1915.

CHARLES E. WILSON.