No. 772,465. PATENTED OCT. 18, 1904.

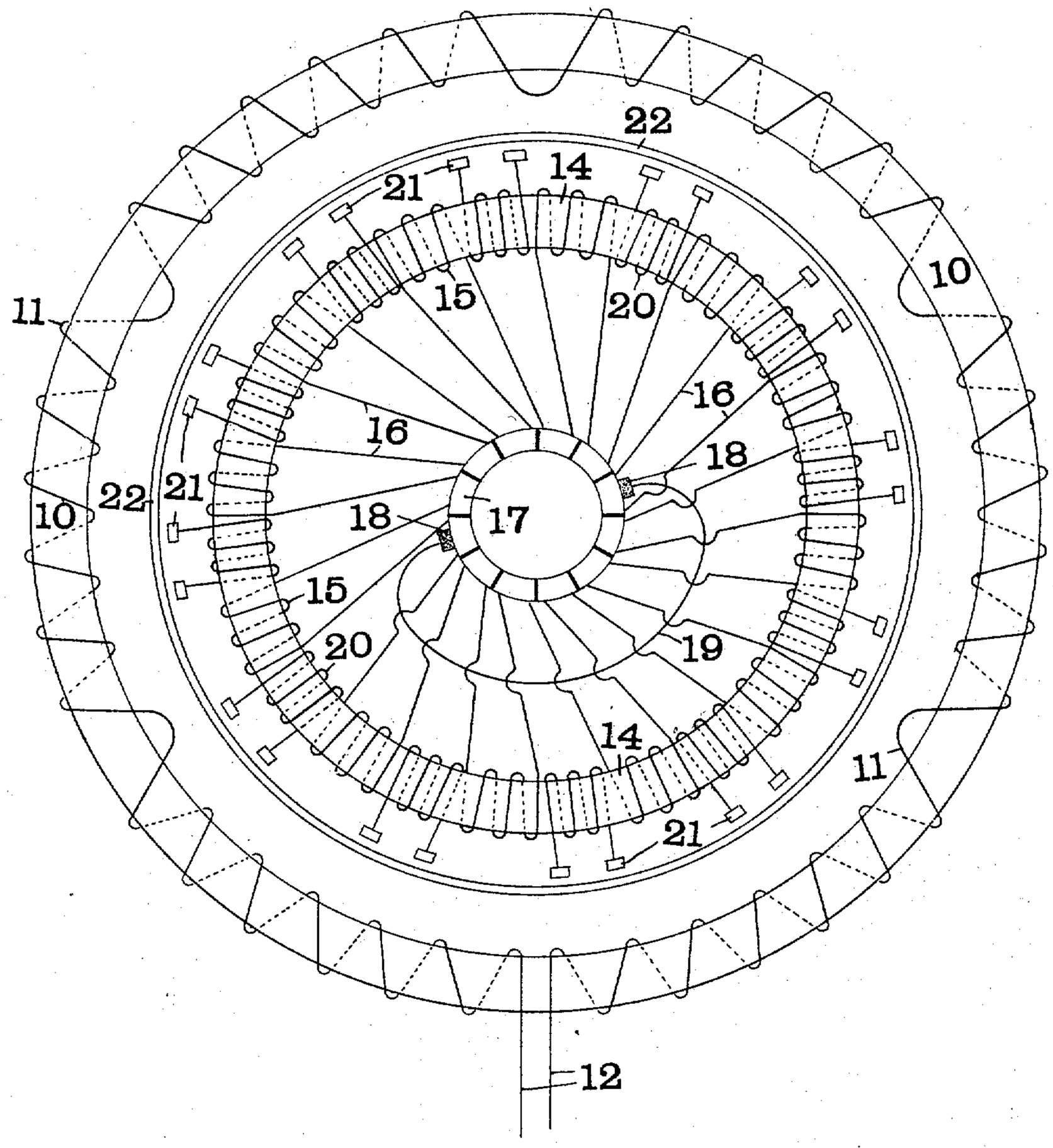
W. A. LAYMAN.

ALTERNATING CURRENT MOTOR.

APPLICATION FILED MAR. 9, 1903.

NO MODEL. 4 SHEETS—SHEET 1.

Fig. 1.



Witnesses

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NO MODEL. 4 SHEETS—SHEET 2.

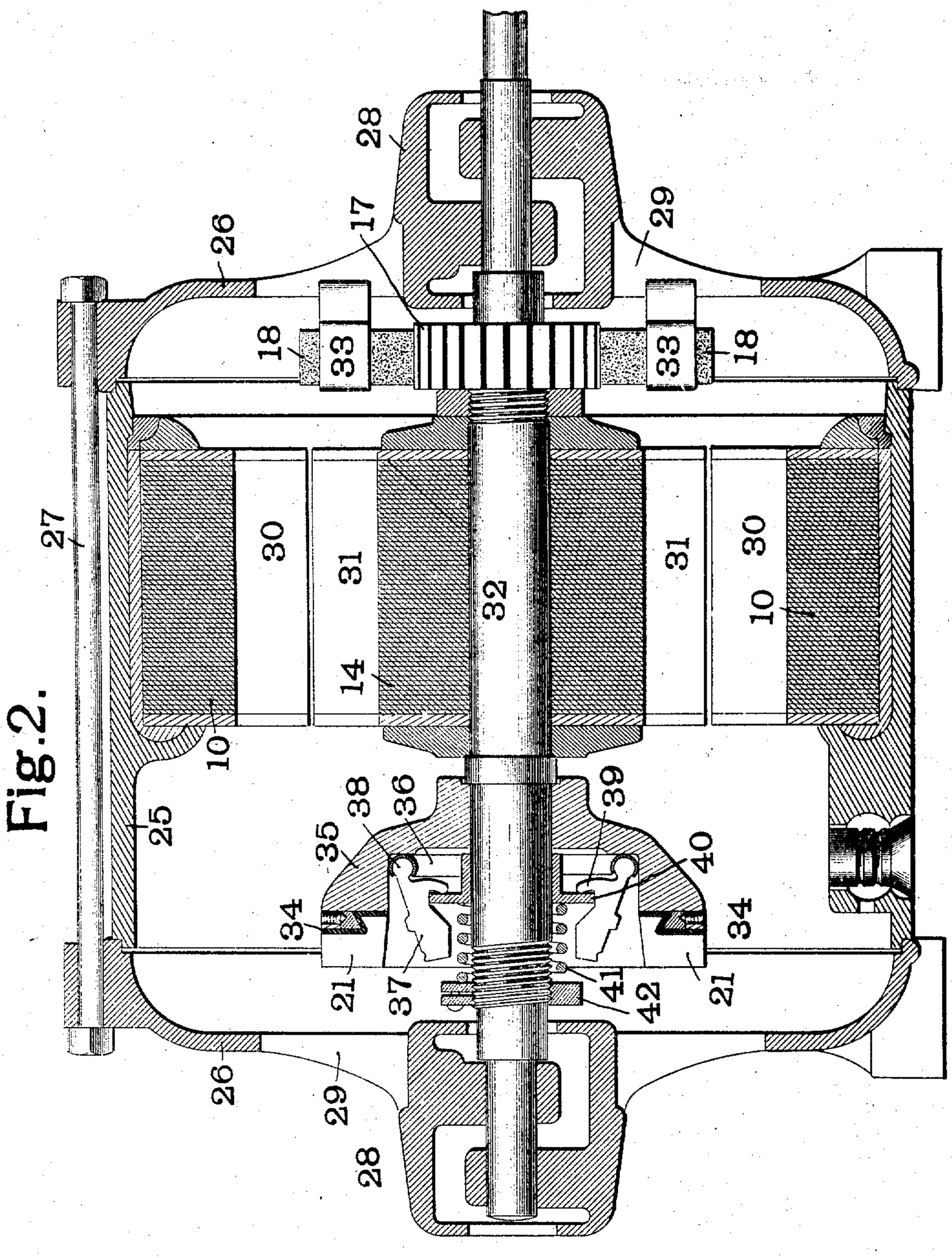

Fig. 2.

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NO MODEL. 4 SHEETS—SHEET 3.

Fig.3.

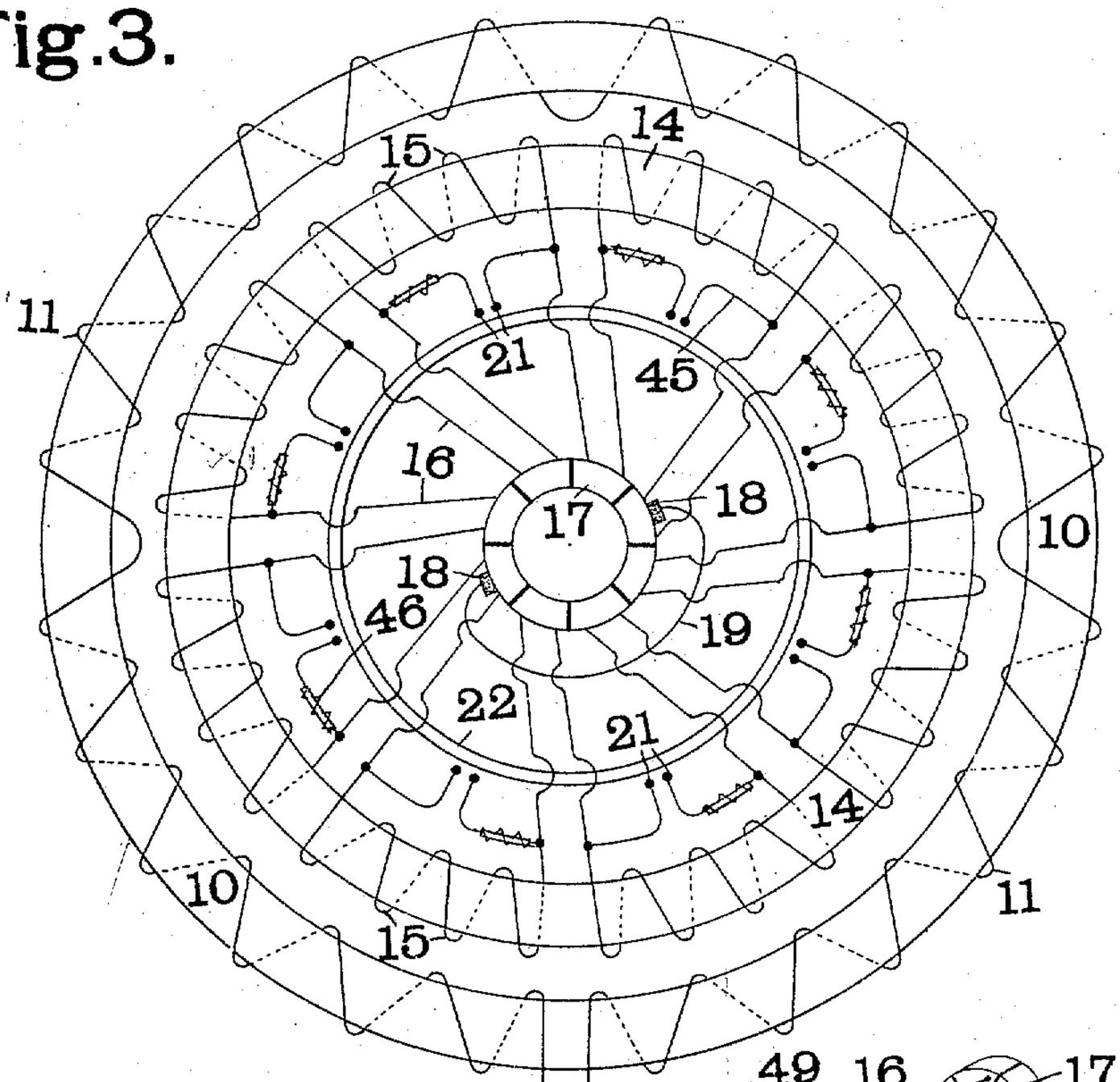
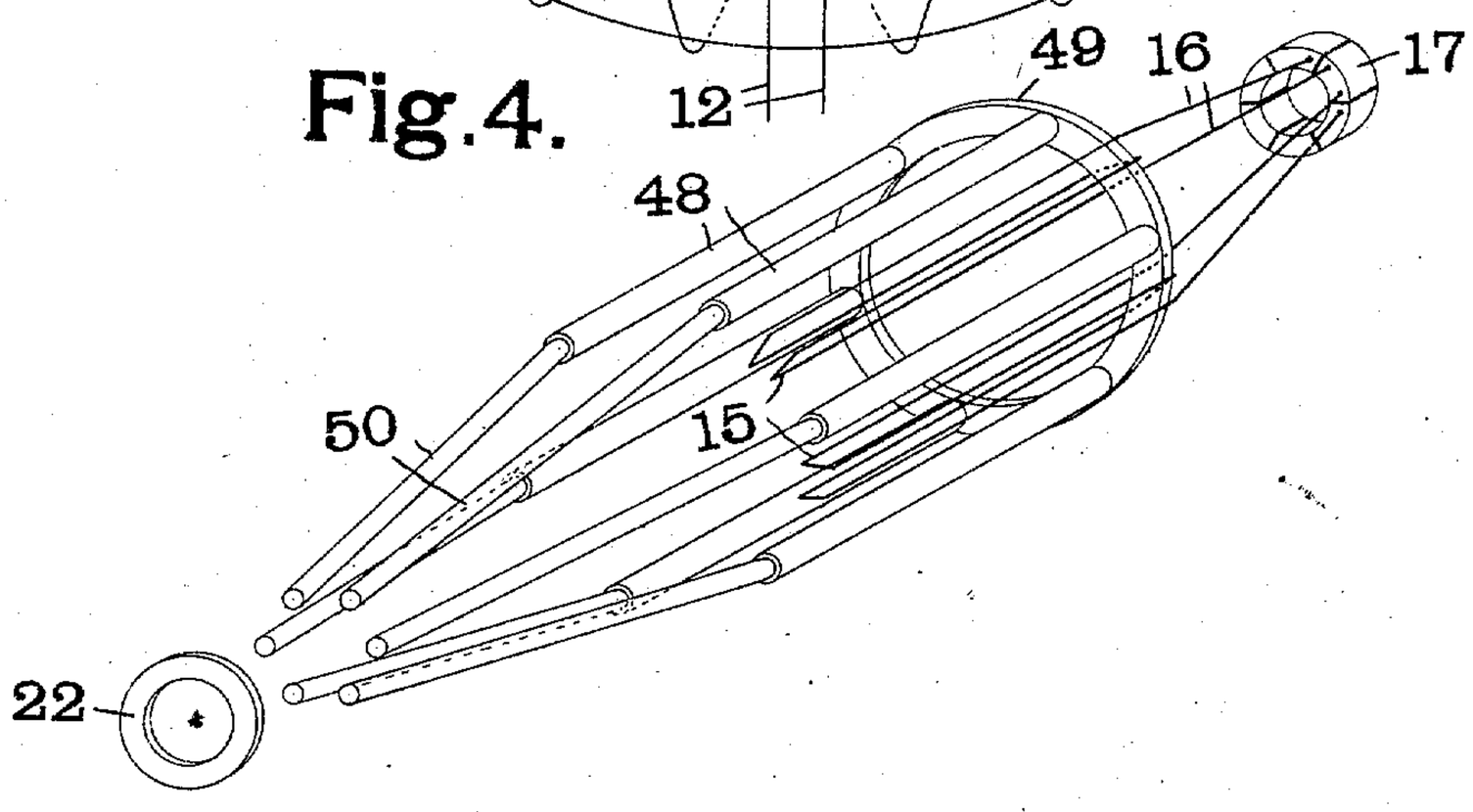


Fig.4.



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NO MODEL. 4 SHEETS—SHEET 4.

Fig.5.

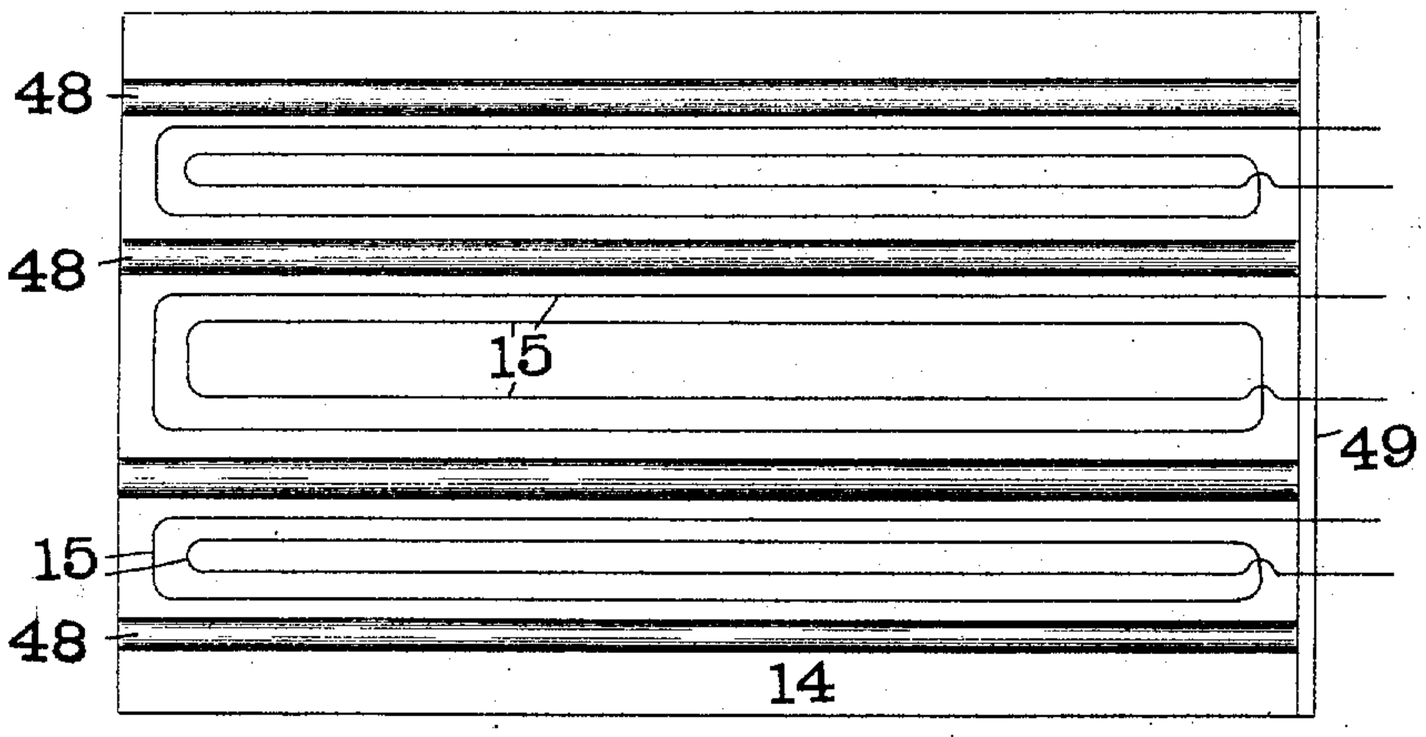


Fig.6.

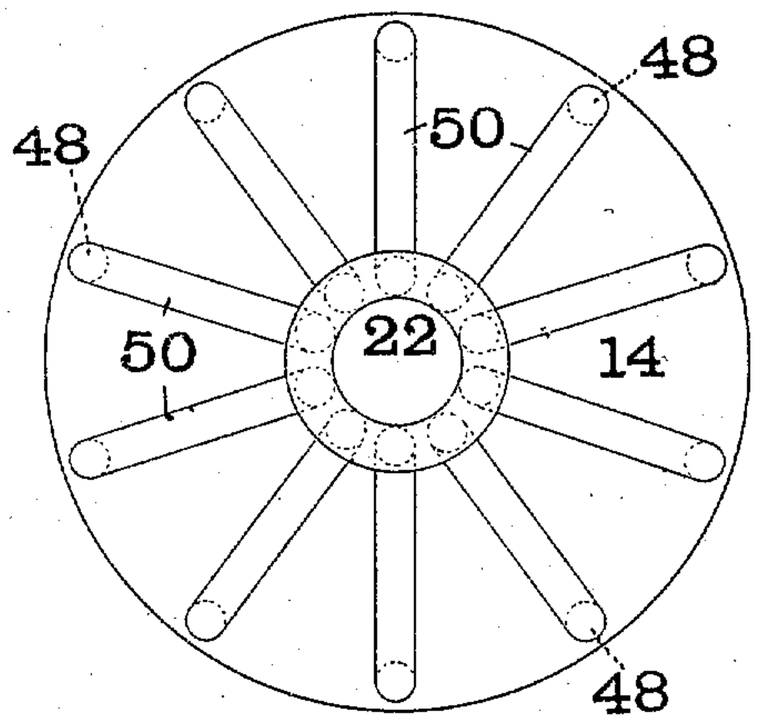
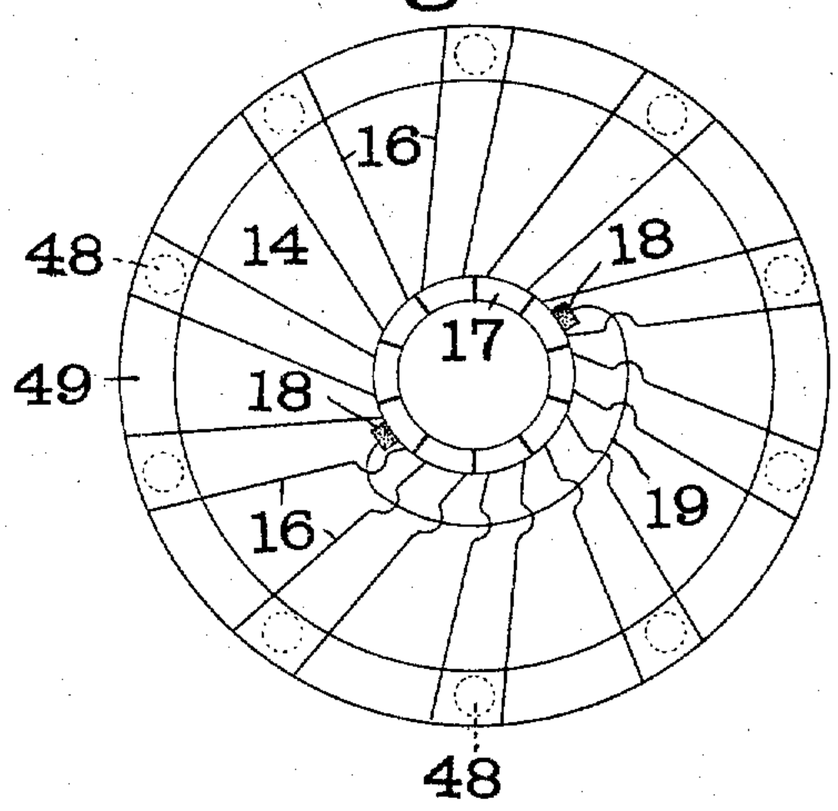


Fig.7.



Witnesses

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No. 772,465. Patented October 18, 1904.

UNITED STATES PATENT OFFICE.

WALDO A. LAYMAN, OF ST. LOUIS, MISSOURI.

ALTERNATING-CURRENT MOTOR.

SPECIFICATION forming part of Letters Patent No. 772,465, dated October 18, 1904.

Application filed March 9, 1903. Serial No. 146,858. (No model.)

To all whom it may concern:

Be it known that I, WALDO A. LAYMAN, a citizen of the United States, residing at the city of St. Louis, in the State of Missouri, have invented a certain new and useful Alternating-Current Motor, of which the following is such a full, clear, and exact description as will enable any one skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification.

My invention relates more particularly to alternating-current motors of the commutator type in which the circuits of one of the members of the motor, preferably the rotary member, are reorganized after the motor has started.

The invention has for its object to provide a motor which will have a sufficient initial torque to start under load and in which the different circuits are so proportioned and arranged that the current consumed will be of a high power factor.

In some alternating-current motors the armature-circuits have been in part composed of a plurality of permanently short-circuited conductors and in part of a commuted winding, this arrangement being maintained both at starting and when the armature has reached normal running speed. It has been found that such an arrangement in which a portion of the current flowing in the armature-windings is permanently short-circuited at starting seriously affects the capacity of the motor to start under load. By means of my invention, however, all the well-known advantages of these short-circuited conductors after the motor has started are preserved, and at the same time they are rendered inoperative at starting, thus avoiding the disadvantages of diminished initial or starting torque above referred to.

My invention is applicable not only to motors in which the circuits of one or both members are composed of windings of insulated wire, but also to motors in which the circuits of said members or one of them are composed of other forms of conductors, such as in the well-known "squirrel-cage" type of motors. It is also to be noted that each of the circuits of motors embodying my invention may be composed of a separate conductor or that two or more of such circuits may have a portion of their paths through a common conductor without departing from my invention.

In the forms of my invention shown and described hereinafter the peculiar arrangement of circuits forming part thereof is placed upon the rotary or induced member of the motor, or, as it is sometimes called, the "armature;" but it will be understood that such a disposition of the circuits is not a necessary portion of my invention and may be widely varied without departing from its principle.

In the drawings, in which like marks of reference refer to similar parts in the different figures, Figure 1 is a diagram of the field and armature windings of a form of my motor, showing also the connections of the armature-windings with the commutator and a short-circuiting device. Fig. 2 is a vertical central section through a motor embodying specific forms of commutator and short-circuiting mechanism adapted to carry out my invention. Fig. 3 is a diagram of the field and armature of a motor in which the two different kinds of circuits forming part of my invention have a portion of their paths through a common conductor. Fig. 4 is a cabinet projection of a form of my invention adapted for use with a squirrel-cage armature of the drum or Siemens's type. Fig. 5 is a side elevation of a drum-armature embodying substantially the form of my invention shown in Fig. 4; and Figs. 6 and 7 are end views of the armature of Fig. 5, showing, respectively, the short-circuiting device and the commutator therefor.

Referring first to Fig. 1, 10 indicates a body of magnetic metal, preferably laminated, which carries the field-winding 11 of the motor. The field-winding 11 is supplied with single-phase alternating current from any suitable source by means of the wires 12. This field-winding may be of any usual and suitable kind. 14 indicates the armature-core. This core is here shown in the form of a Gramme ring. It may, however, be of any of

the usual types. The armature-windings are of two kinds. One of the sets of windings, 15, has its terminals connected, by means of wires 16, with the insulated segments of a commutator-ring 17, as indicated in the diagram. Upon this commutator 17 bear brushes 18. This portion of the armature-winding is placed on locally-closed circuit by means of the conductor 19, connecting the brushes 18. The other portion of the armature-winding is composed of a number of coils 20. Each of these coils has its terminals connected with contact-plates 21, which are insulated from each other at starting, as indicated in the diagram. 22 is a ring of conducting material adapted to make contact simultaneously with all of the contact-plates 21 to close the circuit through each of the separate armature-coils 20, thus placing each of the coils 20 on individual short circuit. This individual short-circuiting of the armature-coils 20 may be accomplished by any suitable mechanism without departing from my invention. I prefer, however, to accomplish it automatically when the armature after starting under load has reached normal running speed by means of the combined centrifugal governor and short-circuiting device now to be described.

Referring to Fig. 2, the motor-casing consists of three parts—a middle portion 25 and end pieces 26, suitably bolted together at 27. The end pieces 26 are provided with boxes 28, and ventilating-openings are formed in said end pieces by cutting the same away around said boxes, as indicated in the drawings at 29. These portions of the motor are of well-known construction and are not more particularly described herein for the reason that they relate only remotely to the invention herein claimed. The stationary or field portion 10 of the motor is provided with polar projections 30, and the armature 14 is also provided with similar projections 31. The field 10 is secured to the inner side of the middle part 25 of the motor-casing. The armature 14 is mounted upon a shaft 32, journaled in the boxes 28. The brushes 18, which bear upon the commutator 17, as described in connection with Fig. 1, are carried by means of arms 33, fastened to one of the end portions 26 of the motor-casing. I find that in practice the metal of the motor-casing may be made to perform the function of the conductor 19 (shown in Fig. 1)—that is, to connect the brushes 18 and place the commuted portion of the armature-winding on locally-closed circuit. Rigidly mounted upon the end of the shaft 32 and within the casing of the motor is the cup-shaped portion 35, which carries the insulated contact-plates 21. But two of these contact-plates are shown in the drawing of Fig. 2. They are, however, distributed in the form of a ring around the cup-shaped portion 35 and suitably insulated from each other. A ring of insulation 34 serves to insulate these contact-plates 21 from the cup-shaped portion 35. The contact-plates 21 are connected with the terminals of the armature-coils 20, as described above in connection with Fig. 1. 36 indicates a grooved ring of conducting metal situated within the cup-shaped portion 35. Short-circuiting plates 37 are secured pivotally in this grooved ring by means of the lugs 38. These plates 37 are also provided with arms 39, by means of which they are when the motor is starting held in the position shown in Fig. 1 by means of the collar 40, sleeved upon the shaft 32. But two of these plates 37 are shown in Fig. 2. It is evident, however, that the ring 36 may be provided with a large number of them to form substantially a continuous conducting-ring within the cup-shaped portion 35. The collar 40 is when the motor is starting held in the position shown in Fig. 2 by means of the helical spring 41, which abuts at one end against said collar and at the other against an adjustable abutment 42, screwed upon the shaft 32. It will be evident that the ring 36 and the short-circuiting plates 37 correspond in function to the short-circuiting ring 22, described above in connection with Fig. 1, the purpose of which is to place the armature-coils 20, which are on open circuit and inoperative at starting, upon short circuit after the motor has started and when it has reached normal running speed. When the armature 10 has started and has reached substantially normal running speed, the centrifugal force which it generates will cause the short-circuiting plates 37, disposed within the cup-shaped portion 35 in the form of a ring, to spread outward and come in contact with the contact-plates 21 and electrically connect these contact-plates 21 with one another. When the speed of the armature decreases, these short-circuiting plates 37 will be forced back by means of the spring 41 to the position shown in Fig. 2 out of contact with the plates 21. It will be seen, therefore, that a portion of the armature-circuits represented by the windings 20 is open and inoperative at starting and is automatically short-circuited and rendered operative after the motor has started and when it has reached normal running speed. It will also be seen that the remaining portion of the armature-circuits—viz., that portion connected with the commutator 17—is operative both at starting and after normal running speed has been attained.

Referring now to Fig. 3, I have there shown a form of my invention in which separate windings, such as shown at 20 in Fig. 1 for the short-circuited current, are dispensed with and in which the short-circuited and commuted currents have a portion of their paths in common. Here 14 again indicates the armature-

core, 15 the commuted armature-windings, and 16 the wires connecting the terminals of these windings with the segments of the commutator 17. Connected to each of the wires 16 is a wire 45, and one of each pair of the wires 45 has connected in it an inductive resistance 46 to control the current flowing therein, as hereinafter described. These wires 45 lead to the insulated contacts 21, which are adapted to be connected by means of the short-circuiting ring 22, as described in connection with Figs. 1 and 2. It will be seen that when the short-circuiting ring is connected with the contacts 21 the current flowing in the windings 15 will be divided, a portion of it flowing through the commutator 17, brushes 18, and conductor 19 and a portion of it being short-circuited through the resistance 46, wires 45, contacts 21, and short-circuiting ring 22. It is evident that by properly varying the resistance 46 any desired amount of the current flowing in the windings 15 may be made to pass through said resistance.

Referring now to Figs. 4, 5, 6, and 7, which show diagrammatically a squirrel-cage-motor armature embodying my invention, 14 again indicates the armature-core; 15, the commuted winding; 16, the wires connecting the winding 15 with the commutator 17; 18, the commutator-brushes, and 19 the conductor for placing the commuted winding on locally-closed circuit. In this embodiment of my invention the commuted winding 15 is wound upon the face of the drum-armature in the usual way and is connected, by means of the wires 16, with the segments of the commutator 17, as described in connection with Fig. 1. The short circuits of the armature instead of being composed of individual windings of insulated wire, as described in connection with Fig. 1, are composed of a number of conductors 48, laid in grooves in the iron of the armature-core. At one end of the drum-armature these conductors 48 are permanently connected by means of the conducting-ring 49, and at the other end of the armature-core they are brought, by means of extensions 50, within reach of the short-circuiting ring 22. This will be best understood from Figs. 4 and 6.

It will be evident that in the modifications of my invention described in connection with Figs. 3, 4, 5, 6, and 7 a portion of the armature-circuits is open and inoperative at starting and may be short-circuited and rendered operative after the motor has started and when it has reached normal running speed. This short-circuiting is accomplished by movement of the short-circuiting ring 22, as described in connection with Fig. 1, and may evidently be accomplished automatically by means of the mechanism shown in Fig. 2 and described in connection therewith. It will also be seen that the remaining portion of the armature-circuits—viz., that portion connected with the commutator 17—is operative both at starting and after normal running speed has been attained.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In an alternating-current motor, a member having a circuit commuted at starting, said circuit being locally closed and operative both at starting and at speed, a second circuit for said member inoperative at starting, and means for rendering said second circuit operative after said motor has started.

2. In an alternating-current motor, a member having a circuit locally closed, commuted and operative both at starting and at speed, a second circuit for said member inoperative at starting, and means for rendering said second circuit operative after said motor has started.

3. In an alternating-current motor, a member having a circuit commuted and locally closed at starting, a second circuit for said member inoperative at starting, and means independent of the commutator for rendering said second circuit operative after said motor has started.

4. In an alternating-current motor, a member having a circuit commuted at starting, said circuit being locally closed and operative both at starting and at speed, a second circuit for said member inoperative at starting, and means independent of the commutator for rendering said second circuit operative after said motor has started.

5. In an alternating-current motor, a member having a circuit commuted at starting, said circuit being locally closed and operative both at starting and at speed, a second circuit for said member open at starting, and means for closing said second circuit after said motor has started.

6. In an alternating-current motor, a member having a circuit commuted at starting, said circuit being locally closed and operative both at starting and at speed, a second circuit for said member inoperative at starting, and automatic means for rendering said second circuit operative after said motor has started.

7. In an electric motor, a member having a circuit operative at starting and at speed, a second circuit inoperative at starting, and means for rendering said second circuit operative after said motor has started, said circuits having a portion of their paths in a common conductor.

8. In an electric motor, a member having a circuit effective at starting and at speed, a second circuit open at starting, and means for closing said second circuit after said motor has started, said circuits having a portion of their paths in a common conductor.

9. In an electric motor, a member having a locally-closed circuit operative at starting, a second circuit for said member inoperative at

starting, and means independent of the commutator for rendering said second circuit operative after said motor has started, said circuits having a portion of their paths in a common conductor.

10. In an electric motor, a rotary member having a circuit operative at starting, a second circuit for said member inoperative at starting, and automatic means independent of the commutator and controlled by the rotation of said member for rendering said second circuit operative when said rotary member attains a predetermined speed, said circuits having a portion of their paths in a common conductor.

11. In an electric motor, a member having a circuit operative at starting and at speed, a second circuit for said member inoperative at starting, means for governing the flow of current in one of said circuits, and means for rendering said second circuit operative after said motor has started, said circuits having a portion of their paths in a common conductor.

12. In an electric motor, a member having a circuit operative at starting and at speed, a second circuit for said member inoperative at starting, a resistance in one of said circuits, and means for rendering said second circuit operative after said motor has started, said circuits having a portion of their paths in a common conductor.

13. In an electric motor, a member having a circuit operative at starting and at speed, a second circuit inoperative at starting, a resistance in said second circuit, and means for rendering said second circuit operative after said motor has started, said circuits having a portion of their paths in a common conductor.

14. In an electric motor, a member having an inductive circuit operative at starting and at speed, a second circuit for said member inoperative at starting, means for controlling the flow of current in one of said circuits, and means for rendering said second circuit operative after said motor has started.

15. In an electric motor, a member having an inductive circuit operative at starting and at speed, a second circuit for said member inoperative at starting, a resistance in one of said circuits, and means for rendering said second circuit operative after said motor has started.

16. In an electric motor, a member having an inductive circuit operative at starting and at speed, a second circuit for said member inoperative at starting, a resistance in said second circuit, and means for rendering said second circuit operative after said motor has started.

In testimony whereof I have hereunto set my hand and affixed my seal in the presence of the two subscribing witnesses.

W. A. LAYMAN. [L. S.]

Witnesses:
JAMES H. BRYSON,
L. B. BEACH.