No. 740,963. PATENTED OCT. 6, 1903.

R. B. WILLIAMSON.

INDUCTION MOTOR.

APPLICATION FILED MAR. 16, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

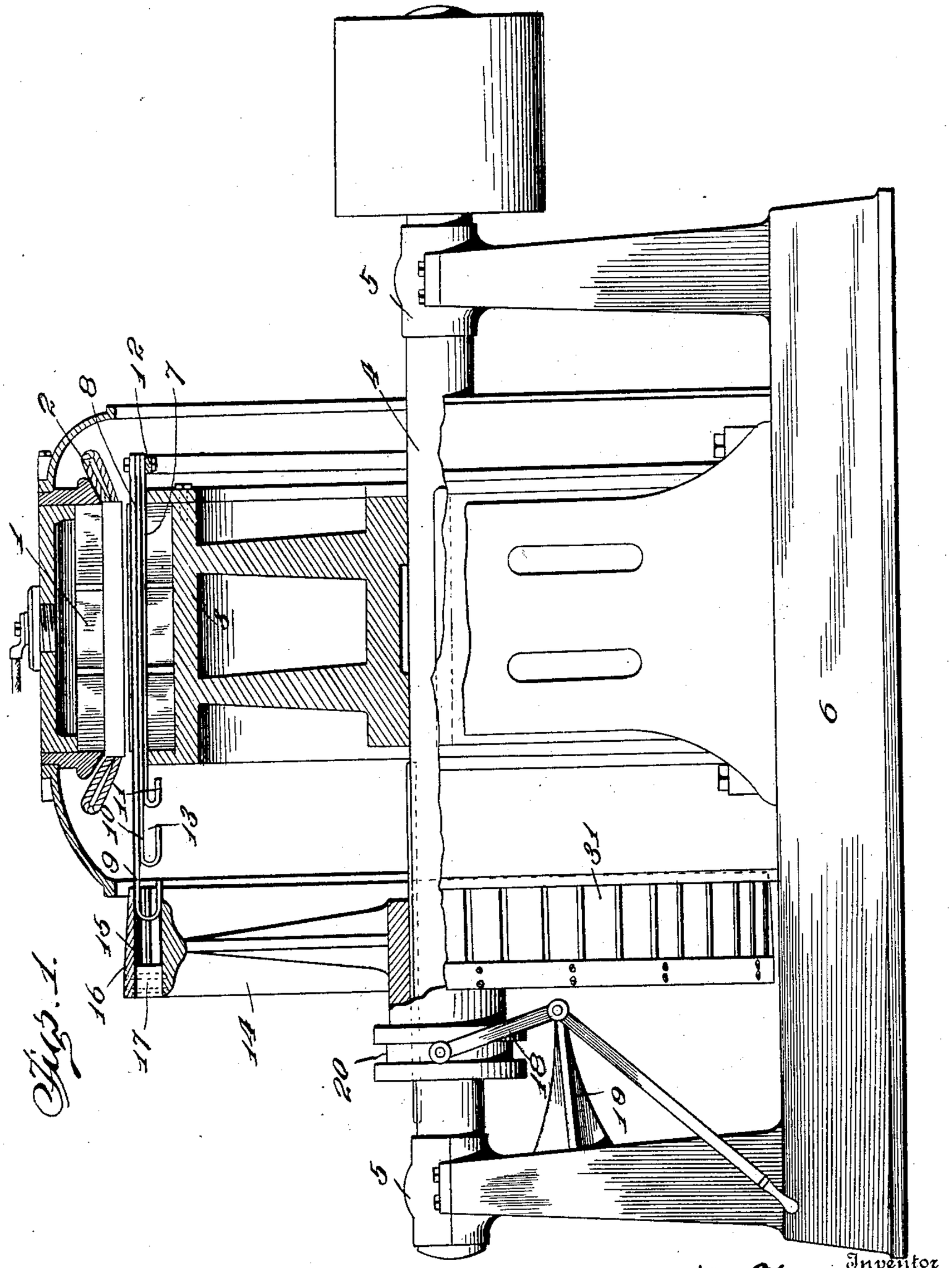

Fig. 1.

Inventor
Robert B. Williamson

Witnesses
L. Lunsford Handy
W. T. Jones.

By Mason, Fenwick & Lawrence
Attorneys

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 2.

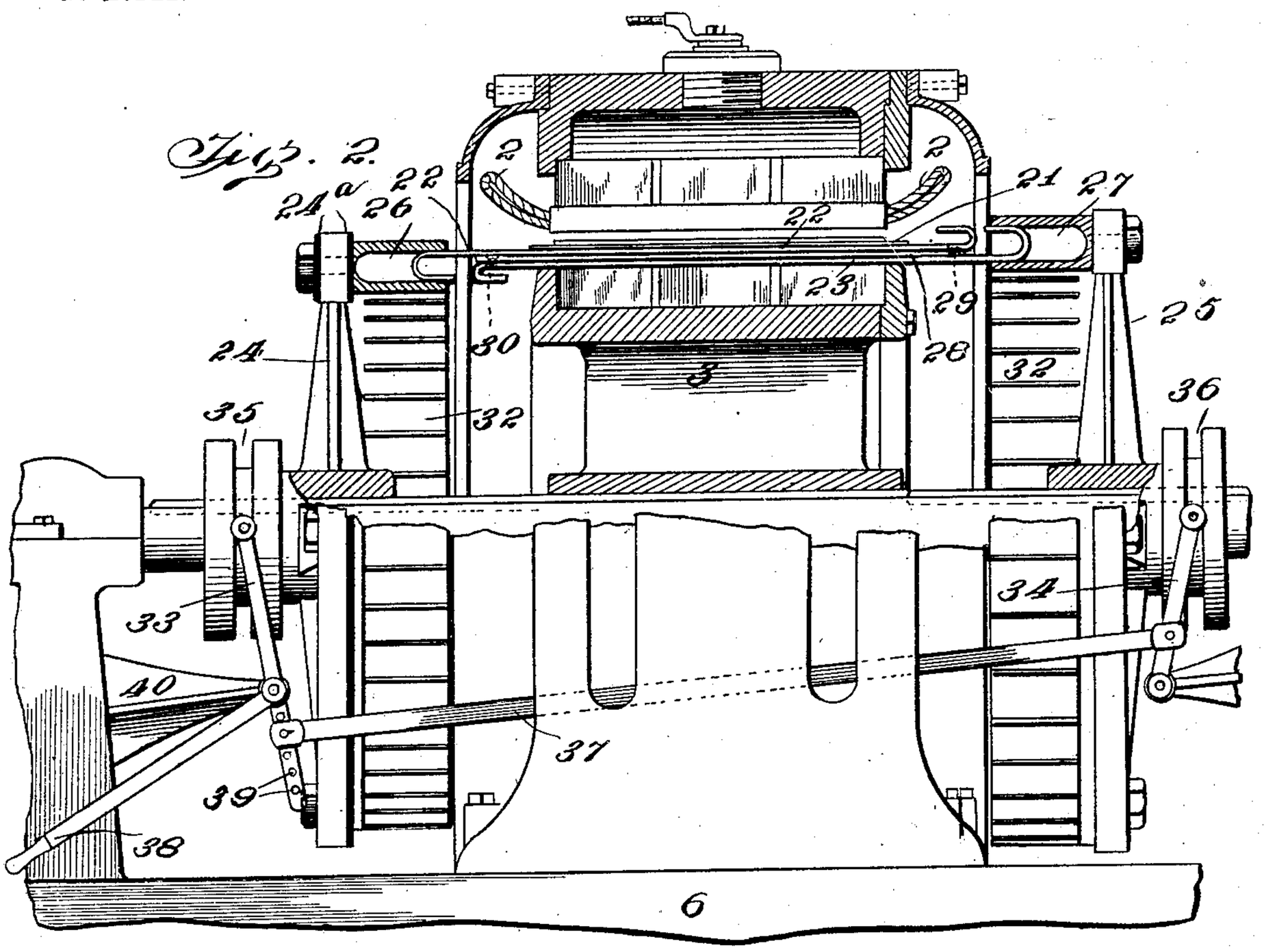


Fig. 5.

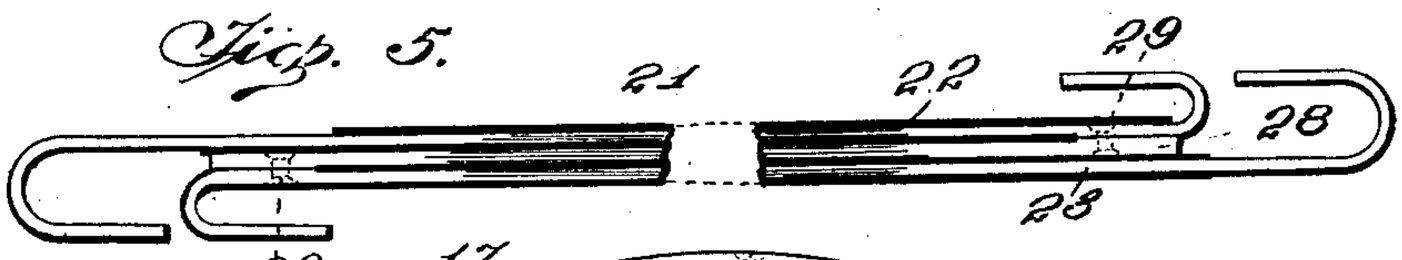


Fig. 3.

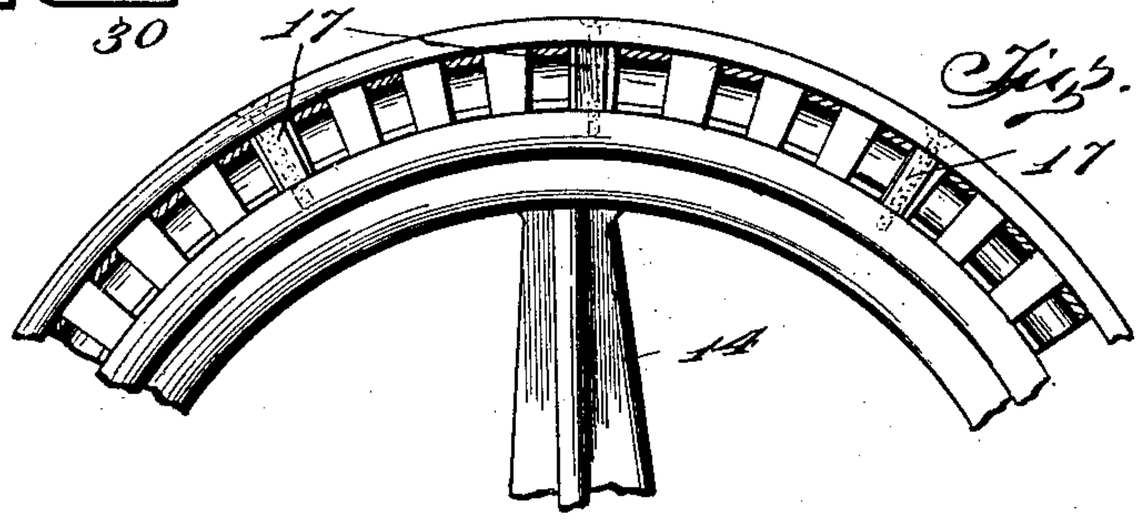
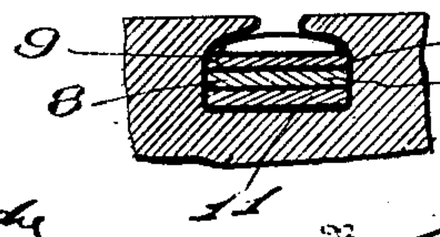


Fig. 4.



Witnesses

L. Ensford Handy

W. T. Jones.

Inventor

Robert B. Williamson,

By Mason, Fenwick & Lawrence.

Attorneys

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UNITED STATES PATENT OFFICE.

ROBERT B. WILLIAMSON, OF SCRANTON, PENNSYLVANIA.

INDUCTION-MOTOR.

SPECIFICATION forming part of Letters Patent No. 740,963, dated October 6, 1903.

Application filed March 16, 1903. Serial No. 148,101. (No model.)

To all whom it may concern:

Be it known that I, ROBERT B. WILLIAMSON, a citizen of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented certain new and useful Improvements in Induction-Motors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in electric motors, and especially to that class of electric motors known as "induction-motors," in which the armature is supplied with an induced current resulting from the current passed through the field-coils of the motor.

In the present invention the motor is so constructed that the conductors carried by the armature will be increased in resistance at the starting of the motor to avoid the development of an enormous current in the armature at first and a corresponding weakening of the magnetic field of the motor, so that very little starting effort is produced. As the motor gains movement the resistance of the armature-conductors is then decreased, so that the normal conditions for the running of the motor prevail.

The invention consists in an induction-motor armature provided with conductors made up of several pieces and means for bringing one or more pieces into action in accordance with the movement of the motor.

It also consists in an induction-motor having an armature of the squirrel-cage type, which is provided with laminated conductors carried by the said armature, and means for causing the induced currents to pass through the members of said laminated conductors, either singly or in parallel or through all of them in series.

It also consists in certain other novel constructions, combinations, and arrangements of parts, as will be hereinafter fully described and claimed.

In the accompanying drawings, Figure 1 represents a side elevation of my improved induction-motor, the parts of the same being shown in vertical section. Fig. 2 is a view similar to Fig. 1 and showing two rings for varying the resistance of the armature-conductors. Fig. 3 is a fragmentary view in elevation of a portion of one of said resistance-varying rings. Fig. 4 is an enlarged detail cross-sectional view through one of the armature-conductors, showing the insulation between the laminæ thereof; and Fig. 5 is an enlarged longitudinal view of the armature-conductors.

I have illustrated in the accompanying drawings one practical mechanism embodying the present invention, in which I have shown a motor provided with a field-core 1, mounted in a suitable casing and upon a suitable standard in any usual and well-known manner. The field-core is such as is adapted for use in induction-motors, preferably those provided with armatures of the squirrel-cage type. The core is provided with the usual field-coils 2 and surrounds an armature 3, carried by a shaft 4. The shaft 4 is mounted in suitable bearings 5, carried by the base 6 of the machine. The armature is preferably keyed to the shaft 4, so as to turn the same when it is rotated. The said armature is formed with transverse recesses 7 upon its periphery, which receive the armature-conductors 8. In the present instance the conductors are made of a series of plates or bars or strips, as 9, 10, and 11, each one being shorter than its neighbor. Thus, for instance, the strip 9 may be made quite long, while the strip 10 is a little shorter and the strip 11 still shorter. These strips are permitted to project in these different lengths from one side of the armature, while from the other side of the armature the ends of the strips are made to come opposite each other and are secured to a common short circuit-ring 12, which connects the ends of all of the laminated conductors around the armature. The laminæ of each conductor are insulated from each other by suitable material except at their ends, which are connected with the ring 12. The ends of the laminæ at the opposite side of the armature from the ring 12 are preferably folded back, as shown at 13, so that a conductor which engages them, as hereinafter described, will be subjected to somewhat of a spring-pressure from the said folded end portions. The ends of each of the laminæ of one conductor are so folded that they will all enter the aperture or recess formed in such conductor, which is of the

same width throughout. For properly connecting the laminæ at their folded ends a contact member 14 is provided, which is splined to the shaft 4, so as to be capable of longitudinal movement thereon, but be forced to rotate with the same when it is turned. The conductor 14 thus has the same movement as the armature 3 and the laminated conductors carried thereby. The contact member 14 is preferably made circular and is formed with an annular recess 15 near its periphery for receiving the ends of the laminæ 9, 10, and 11. The recess 15 may be obtained in a simple manner by providing an outer ring 16 for the circular contact 14 and placing spacing-blocks 17 between the said ring and the said contact at suitable intervals. The ring and the blocks may be secured together by bolts, screws, or the like and also to the periphery of the contact 14. The space 15 is made sufficiently narrow to engage the bent spring ends of the laminæ with a good contact, the said ends tending to spread always against the walls of the recess 15. The circular contact 14 is moved back and forth upon the shaft 4 in any suitable manner for engaging one or more of the laminæ. I have shown a simple means for accomplishing this purpose in the drawings, in which a lever 18 is pivoted upon a suitable fulcrum-standard 19, the end of said lever being bifurcated and engaging a groove 20 on the hub of the contact 14. In this manner the contact member 14 can be moved toward or away from the armature 3 without interfering with its rotation with said armature. From the above description it will be evident that in starting the motor if the contact 14 is brought into engagement with the longest lamina 9 the resistance to the current induced in the armature will be considerable. As the motor gains headway the contact 14 may be moved in, so as to engage also the curved ends of the lamina 10, thus placing the lamina 10 in parallel with the lamina 9, and thereby reducing the effective resistance of each armature-conductor. The resistance of the armature-conductors can be still further decreased by continued inward movement of the contact 14, so as to bring the same into engagement with the inner lamina 11, thus permitting the current to travel through all the plates of each conductor in parallel. It will also be apparent that a greater number of laminæ may be employed in each conductor than those shown in Fig. 1 for still further varying the resistance of such conductor at various stages of the starting operation without departing in the least from the spirit of the present invention. It is sometimes desirable to arrange the strips of the conductors so that they may be connected in series. I have shown a structure in Fig. 2 of the drawings in which such an operation of the parts is provided for. In this structure the field and the armature are as before, but the conductors of the armature are formed with strips which project in both directions from the armature. As shown in Fig. 2, the conductors 21 may be formed of strips, as 22 and 23, one of which projects farther to one side of the armature than the other, while the other extends farthest from the other side of the armature. In this instance also two circular contacts 24 and 25 are employed, one at each side of the armature. One at least of these contacts should be insulated from its support or spider, as indicated at 24ª. These contacts are splined to the shaft of the armature in the same manner as the contact member 14 and are provided with inwardly-opening peripheral grooves 26 and 27 to receive the ends of the laminæ 22 and 23. The laminæ 22 and 23 are spaced apart by a strip 28, which is connected at one end, as at 29, with the outer lamina 22, but is insulated for the remainder of its length therefrom. At its other end the central plate or lamina 28 is electrically connected with the inner lamina 23, as at 30, but is insulated therefrom for the remainder of its length. It will thus be seen that when the contact members 24 and 25 are drawn inwardly, so as to engage the ends of the laminæ 22 and 23, the circuit will first be completed in series from the strip 22 through the strip 28 to the strip 23, and thus to the contact members. As soon as the contact members are drawn inwardly far enough to engage the inner ends of the laminæ 22 and 23 the current may pass in parallel through the same from one contact member to the other. If desired, the members may be so constructed that when the contact member 24 is moved inwardly to engage the end of the strip 23 the contact member 25 will not be moved quite far enough to engage the end of the laminæ 22, thus a further step may be provided for this structure in starting the motor.

The flanges or walls of the recesses 15, 26, and 27 are provided with slits at suitable intervals to permit the metal forming such walls to have a more yielding action in receiving the ends of the laminæ than would be the case if the walls were made integral throughout. As shown in Fig. 1, for instance, the outer ring 16 is preferably provided with a number of slits or recesses let in from its inner edge, so as to form a series of spreading fingers 31 for engaging the ends of the laminæ of the conductors. As shown in Fig. 2, both the inner and outer walls of the recesses 26 and 27 may be slitted or recessed in this manner to form a series of spreading fingers 32 for engaging the ends of the laminæ 22 and 23. In this manner a spreading contact is insured between the conductors of the armature and the contact-piece, and while the pressure exerted by the walls of the said recess may be made ample to insure a good contact at the end of every conductor, yet the contact will not be such but that the members may be easily moved with respect to each other for engaging or disengaging them. When employing two contact members, as shown in Fig. 2, they are

preferably made to move simultaneously, and for this purpose bifurcated levers 33 and 34 are used for engaging the grooves 35 and 36 of the hubs of said members. These levers 33 and 34 may be connected by a link 37, so as to operate simultaneously. The lever 33 is provided with a handle portion 38, by which it may be operated. A portion of the lever 33 is provided with a series of apertures 39, so that the end of the link 37 engaging the said lever may be adjusted to different points from the fulcrum 40 of said lever. In this manner the correspondence of the movement of the member 25 to the movement of the member 24 may be varied. From the above description it will be evident that my improved mechanism is admirably adapted for the controlling and varying of the resistance offered by the conductors of the armature of an induction-motor to the induced current affecting said armature, and it will also be apparent that the mechanical arrangement of the parts may be varied to a considerable degree without departing from the spirit of the invention.

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

1. In an induction-motor the combination with a suitable field, of an armature revolving therein provided with laminated conductors, and means for engaging some or all of the laminæ of said conductors for varying the resistance of the conductors in starting the motor, substantially as described.

2. In an induction-motor, the combination with a suitable field, of an armature revolubly mounted within the same, a series of conductors arranged upon the periphery of the armature, each conductor being formed of a plurality of strips or plates, and means for engaging one or more of the said plates to increase or diminish the resistance offered by the conductors, substantially as described.

3. In an induction-motor the combination with a suitable field, of an armature revolubly mounted within the same, conductors carried by the armature made up of a series of strips forming the conductors, the ends of some of the strips projecting a greater distance from the plane of the adjacent edge of the armature than the ends of other strips and a movable contact member for engaging some of the strips first and then others as it is moved nearer the armature to vary the resistance of the armature.

4. In an induction-motor, the combination with a field and armature, of a series of conductors carried by the armature, each conductor being made up of a number of strips of different lengths, means for connecting all the strips by a common conductor at one point, and means for engaging the uneven ends of the strips successively for gradually reducing the resistance of the conductors when the motor is being started, substantially as described.

5. In an induction-motor, the combination with a suitable field and armature, of conductors carried by the periphery of the armature and formed of a series of strips of different lengths so that the ends of the strips extend beyond each other successively, the said ends being lapped or folded upon themselves, and a movable contact member for engaging the ends of the said strips successively for varying the resistance of the conductors, substantially as described.

6. In an induction-motor, the combination with a field and armature, of conductors carried by the armature and formed of a series of strips insulated from each other for the greater portion of their length but held together to form laminated conductors, the ends of the strips of each conductor being successively longer than its adjacent one, and means for engaging the ends of said conductors successively for varying the resistance of the conductors, substantially as described.

7. In an induction-motor, the combination with a field, of an armature of the squirrel-cage type comprising an armature proper and conductors carried upon its periphery, the said conductors being made up of a number of strips each having its ends projecting beyond the armature to a greater or less extent than its adjacent strips, and a movable contact-piece for engaging the ends of the strips successively, substantially as described.

8. In an induction-motor, the combination with a field and an armature, of a series of laminated conductors arranged in grooves on the periphery of the armature, a common connecting-ring joining all the conductors, the ends of the strips projecting at one side of the armature at different lengths therefrom, the said ends being bent or folded upon themselves to form starting yielding contacts, and a movable contact member engaging the said spring-contacts successively for varying the resistance of the conductors in starting the motor, substantially as described.

9. In an induction-motor, the combination with a field and armature, of a series of conductors carried by the armature formed of strips, means for connecting the strips so that the current may pass through them either in series or in parallel, and contact means for engaging the conductors for varying the resistance thereof, substantially as described.

10. In an induction-motor, the combination with a field and armature, of a series of conductors carried by the armature having their ends projecting from the sides of the armature at different lengths the said conductors being connected so that the current may pass through them either in series or in parallel, and contact members engaging the ends of the said strips on each side of the armature for gradually diminishing the resistance of the conductors as the motor is started, substantially as described.

11. In an induction-motor, the combination with a field and armature, of a series of con-

ductors carried thereby and formed with their ends made successively longer, a contact member for engaging said conductors provided with an annular groove opposite the ends of the conductors, and means for moving the contact toward or away from the armature for engaging some or all of the strips of the conductors and varying their resistance, substantially as described.

12. In an induction-motor, the combination with a field and an armature, of a series of laminated conductors carried by the armature, the laminæ thereof projecting successively to greater lengths beyond the side of the armature, a contact member splined to the shaft of the armature so as to be movable longitudinally thereon and provided with an annular groove near its periphery for receiving the ends of the laminated conductors, the walls of said groove being cut or slitted for forming spreading contact-fingers to engage the armature-conductors, substantially as described.

13. In an induction-motor, the combination with a field and an armature, of a series of conductors formed of strips of different lengths applied together to produce a laminated conductor, insulating material inserted between the laminæ, a circular contact-piece movably mounted on the shaft of the armature, and carrying a ring on its periphery, spacing-blocks interposed between the ring and the periphery of the contact-piece for forming an annular groove opposite the ends of the laminated conductors, and means for moving the contact toward or away from said conductors, substantially as described.

14. An induction-motor, comprising a field-magnet and an armature having grooves formed in its periphery, a series of laminated conductors arranged in the grooves and projecting beyond the armature at different distances at the sides thereof, contact-pieces splined to the shaft of the armature on each side of the armature and provided with annular grooves for receiving the ends of the conductors, the walls of said grooves being slitted to form spreading fingers for contacting with the ends of the conductors, and means for moving the said contact-piece toward or away from the armature for varying the resistance of the conductors, substantially as described.

In testimony whereof I hereunto affix my signature in presence of two witnesses.

ROBERT B. WILLIAMSON.

Witnesses:
W. W. BAYLOR,
NELLIE V. MULLEN.