

C. ROBINSON.
INDUCTION MOTOR.
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936,360.

Patented Oct. 12, 1909.

Fig. 2.

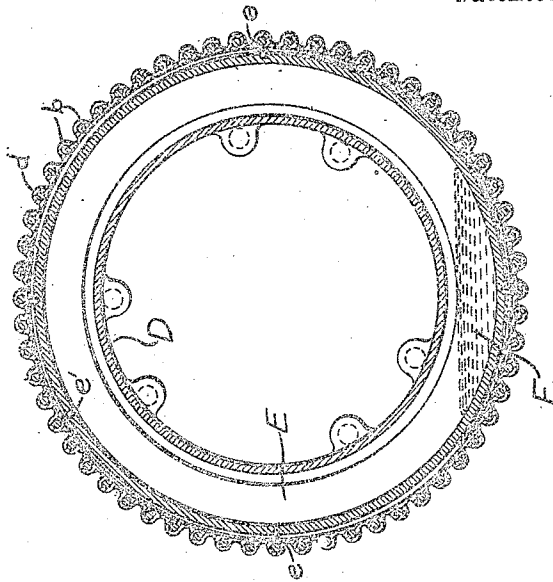
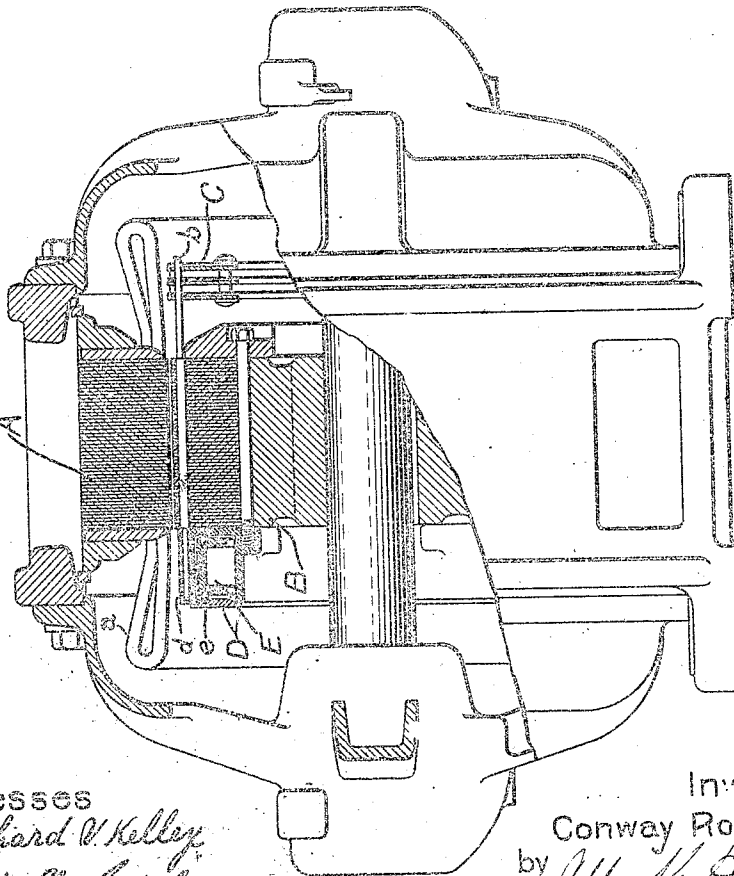


Fig. 1.



Witnesses
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UNITED STATES PATENT OFFICE.

CONWAY ROBINSON, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

INDUCTION-MOTOR.

936,360.

Specification of Letters Patent.

Patented Oct. 12, 1909.

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To all whom it may concern:

Be it known that I, CONWAY ROBINSON, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Induction-Motors, of which the following is a specification.

My invention relates to induction motors, and its object is to provide a novel and inexpensive automatic starting device.

As is well known in the art, an induction motor that is to start under load should have a resistance included in the rotor circuit, if it is desired to prevent it from drawing a heavy starting current, and this resistance should be short-circuited when the motor is up to speed. This short-circuiting of the resistance may be done by hand or automatically, and for this purpose centrifugally actuated switches have been sometimes employed heretofore, the rotor conductors being short-circuited through a resistance at starting and the switch being arranged to cut out the resistance automatically when the motor is up to speed. In order that these switches may be used, it has been customary heretofore to form the rotor winding out of coils so that the rotor conductors may be connected directly in series and only a small number of terminals brought out for short-circuiting. This coil construction is more expensive than what is known as the squirrel-cage construction, which is employed in motors which start without resistance in circuit, and in which the rotor winding is composed simply of bars all connected together at opposite ends through short-circuiting end-rings. This simple construction has presented difficulties heretofore when it has been desired to have a resistance in the rotor circuit at starting, since a switch adapted to short-circuit individually a large number of bars is necessarily complicated. By my invention it is possible, without a complicated starting switch, to employ a squirrel-cage construction and yet to obtain the advantages of a coil-wound rotor with respect to starting with a resistance in the rotor circuit.

My invention consists in providing the motor with a rotary casing containing a conducting fluid, such as mercury, adapted to be distributed around the periphery of the casing by centrifugal force as the motor speeds up, and so arranging the casing and

connections of the rotor conductors that this distribution of the mercury provides a low-resistance short-circuit for all the conductors individually, as in a squirrel-cage winding, when the motor is up to speed. I further provide means for retarding the peripheral distribution of the mercury so as to obtain the proper time element in operation.

More specifically stated, my invention consists in providing the motor with a casing carried by the rotor and forming a high resistance short-circuit for the rotor conductors and a conducting fluid in the casing adapted to form a low-resistance short-circuit for the conductors when distributed around the inner periphery of the casing by centrifugal force.

My invention comprises a number of other features which will best be understood by reference to the accompanying drawings, in which—

Figure 1 shows a side elevation, partly in cross-section, of a rotor provided with an automatic starting device in accordance with my invention; and Fig. 2 shows an end elevation in cross-section, of the starting device.

In the drawings A represents the stator of the motor, which carries the usual primary winding *a*. B represents the rotor structure which carries the rotor conductor *b*, which consists of bars supported in the usual manner in slots in the laminations at the periphery of the rotor structure. The bars are all directly connected to each other at one end by short-circuiting rings C. At the other end of the rotor the rotor bars are short-circuited by a member D, which is bolted to the rotor structure, and which serves as one of the clamping rings for holding the rotor laminations in place, and which is in the form of an annular casing. The rotor conductors *b* extend through the peripheral wall *d* of the casing D close to its inner side. This wall, or, if it is not insulated from the rest of the casing, the entire casing, is made of high resistance metal, such, for instance, as manganese copper, and forms a high resistance short-circuit for the rotor conductors at starting. Within the casing D is supported an annular trough E, which is carried on pins *e* close to the peripheral wall of the casing D. This trough is provided with a restricted opening *e'* in its periphery, as shown in Fig. 2. F, in Fig. 2, represents a con-

ducting fluid, such as mercury, which is carried within the casing. The walls of the trough E are arranged to extend inward a distance substantially equal to the maximum depth of the mercury in the casing when the casing is at rest, as shown in Fig. 2, so that when the casing is at rest nearly all the mercury is contained in the trough; only a small portion being outside of the trough and in contact with the peripheral wall d.

As the motor starts, the fluid F is distributed by centrifugal force around the annular trough E. At starting, the rotor conductors b are short-circuited only by the high resistance casing, the small amount of mercury outside of the trough short-circuiting only a few conductors, and not materially affecting the operation. After the mercury is distributed around the trough E by centrifugal force, it begins to pass outward through the restricted opening c', and to distribute itself around the inner periphery of the casing. In this way, an additional short-circuit of low resistance is produced for the rotor conductors through a low-resistance formed by the mercury itself, and also by the trough E, which is made of low-resistance material, and which is placed in electrical connection with all the conductors b by the mercury filling the space between the trough and the peripheral wall d. The time which elapses between the starting of the motor and a complete short-circuiting of all the rotor conductors by the mercury is determined by the size of the restricted opening c', and consequently may readily be made whatever is desired. The conductors b are placed close enough to the inner side of the wall d so that the resistance is little greater than if the mercury were in direct contact with these conductors, and this construction renders it unnecessary to make a fluid-tight joint between each conductor and the casing, as would be necessary if the conductors extended into the chamber within the casing so as to come into direct contact with the mercury.

If the casing is built up of separate parts, for convenience in assembling, a fluid-tight joint between the parts may be obtained by finishing the contact surfaces and, before securing them together, covering them with a mixture of litharge and glycerin. The construction of the end-ring may, of course, be varied as desired.

With a motor as thus constructed the advantages of a coil-wound rotor are obtained, as regards the amount of starting-current taken, with the cheapness and simplicity of construction of a squirrel-cage. Furthermore, since the starting device is entirely automatic, the motor may be installed in an inaccessible position and started by merely closing a switch in the primary circuit located wherever is most convenient. Fur-

thermore, the device, in addition to being automatic in its action at starting, also automatically resets itself for starting again when the current is cut off, since, as the rotor slows down, the mercury will collect at the lower portion of the casing.

What I claim as new, and desire to secure by Letters Patent of the United States, is,—

1. In an induction motor, a rotor having a squirrel cage winding, a closed casing carried at one end of the rotor engaging the ends of all the conductors of said winding and serving as a high resistance end ring for said winding, and a conducting fluid in said casing adapted when distributed around the inner periphery of said casing to furnish an additional low resistance short-circuit for said conductors and to act electrically as a low resistance end ring therefor.

2. In an induction motor, a starting switch comprising a rotary casing, a conducting fluid therein, connections whereby the rotor conductors are short-circuited by the distribution of the fluid around the inner periphery of said casing by centrifugal force, and means for retarding the distribution of the fluid.

3. In an induction motor, a starting switch comprising a casing carried by the rotor and forming a high resistance short-circuit for the rotor conductors, and a conducting fluid in said casing adapted to form a low-resistance short-circuit for said conductors when distributed around the inner periphery of said casing by centrifugal force.

4. In an induction motor, a starting switch comprising a casing carried by the rotor and forming a high-resistance short-circuit for the rotor conductors, a conducting fluid in said casing adapted to form a low-resistance short-circuit for said conductors when distributed around the inner periphery of said casing by centrifugal force, and means for retarding the distribution of said fluid.

5. In an induction motor, a starting switch comprising a casing carried by the rotor and forming a high-resistance short-circuit for the rotor conductors, said conductors extending into the peripheral wall of said casing close to its inner side, and a conducting fluid in said casing adapted to be distributed around the inner periphery of said casing by centrifugal force and thereby to form a low-resistance short-circuit for the rotor conductors.

6. In an induction motor, a starting switch comprising a casing carried by the rotor and forming a high-resistance short-circuit for the rotor conductors, said conductors extending into the peripheral wall of said casing close to its inner side, a conducting fluid in said casing adapted to be distributed around the inner periphery of said casing by centrifugal force and thereby to form a low-

resistance short-circuit for the rotor conductors, and means for retarding the distribution of said fluid.

7. In an induction motor, a starting switch comprising a casing carried by the rotor and forming a high-resistance short-circuit for the rotor conductors, a conducting fluid in said casing adapted to be distributed around the inner periphery of said casing by centrifugal force and thereby to form a low-resistance short-circuit for the rotor conductors, and an annular trough carried within said casing and having a restricted opening in its periphery.
8. In an induction motor, a starting switch comprising a casing carried by the rotor and forming a high-resistance short-circuit for the rotor conductors, a conducting fluid in said casing adapted to be distributed around the inner periphery of said casing by centrifugal force and thereby to form a low-resistance short-circuit for the rotor conductors, and an annular trough of low-pressure material carried within and close to the inner periphery of said casing and having a restricted opening in its periphery.
9. In an induction motor, a starting switch comprising a casing carried by the rotor and forming a high-resistance short-circuit for the rotor conductors, a conducting fluid in said casing adapted to be distributed around the inner periphery of said casing by centrifugal force and thereby to form a low-resistance short-circuit for the rotor conductors, and an annular trough carried within said casing, its sides extending inward a distance substantially equal to the maximum depth of said fluid in said casing when said casing is stationary, said trough having a restricted opening in its periphery.
10. In an induction motor, a starting switch comprising a casing carried by the rotor and forming a high-resistance short-circuit for the rotor conductors, said conductors extending into the peripheral wall of said casing close to its inner side, a conducting fluid in said casing adapted to be distributed around the inner periphery of said casing by centrifugal force and thereby to form a low-resistance short-circuit for the rotor conductors, and an annular trough carried within said casing and having a restricted opening in its periphery.
11. In an induction motor, a starting switch comprising a casing carried by the rotor and forming a high-resistance short-circuit for the rotor conductors, said conductors extending into the peripheral wall of said casing close to its inner side, a conducting fluid in said casing adapted to be distributed around the inner periphery of said casing by centrifugal force and thereby

to form a low-resistance short-circuit for the rotor conductors, and an annular trough for low-resistance material carried within and close to the inner periphery of said casing and having a restricted opening in its periphery.

12. In an induction motor, a laminated rotor body, an end-ring for clamping the laminations in place in the form of an annular casing, conductors carried by the rotor connected at one end to said ring, said ring being adapted to form a high-resistance short-circuit for said conductors, and a conducting fluid within said end-ring adapted to be distributed around its inner periphery by centrifugal force and thereby to form a low-resistance short-circuit for said conductors.

13. In an induction motor, a laminated rotor body, an end-ring for clamping the laminations in place in the form of an annular casing, conductors carried by the rotor connected at one end to said ring, said ring being adapted to form a high-resistance short-circuit for said conductors, a conducting fluid within said end-ring adapted to be distributed around its inner periphery by centrifugal force and thereby to form a low-resistance short-circuit for said conductors, and means for retarding the distribution of said fluid.

14. In an induction motor, a laminated rotor body, an end-ring for clamping the laminations in place in the form of an annular casing, conductors carried by the rotor and extending into the peripheral wall of said casing, said wall being adapted to form a high-resistance short-circuit for said conductors, and a conducting fluid within said casing adapted to be distributed around its inner periphery by centrifugal force and thereby to form a low-resistance short-circuit for said conductors.

15. In an induction motor, a laminated rotor body, an end-ring for clamping the laminations in place in the form of an annular casing, conductors carried by the rotor and extending into the peripheral wall of said casing, said wall being adapted to form a high-resistance short-circuit for said conductors, a conducting fluid within said casing adapted to be distributed around its inner periphery by centrifugal force and thereby to form a low-resistance short-circuit for said conductors, and means for retarding the distribution of said fluid.

In witness whereof, I have hereunto set my hand this 13th day of February, 1906.

CONWAY ROBINSON.

Witnesses:

BENJAMIN B. HUI-
HELEN ORFORD.