No. 729,199. PATENTED MAY 26, 1903.

H. S. MEYER.

INDUCTION MOTOR.

APPLICATION FILED JAN. 11, 1901.

NO MODEL.

Fig. 1.

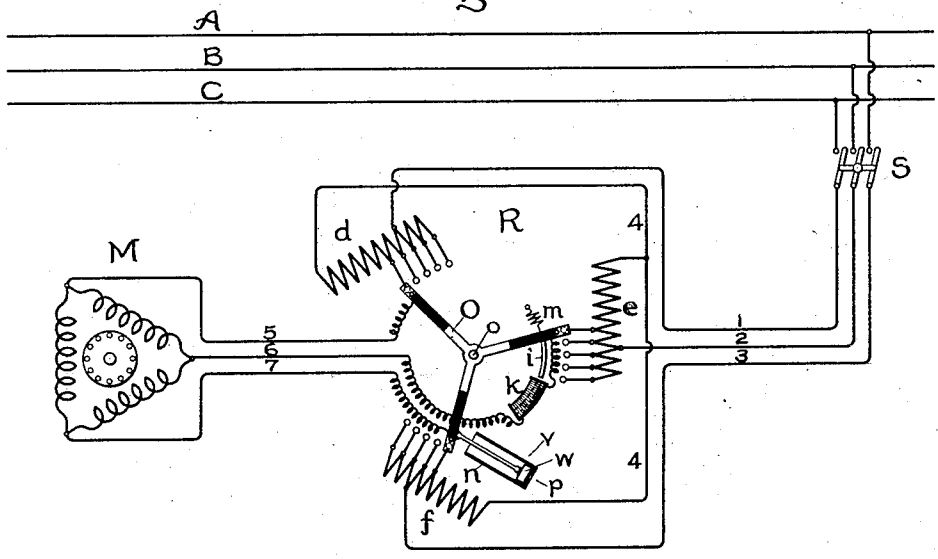
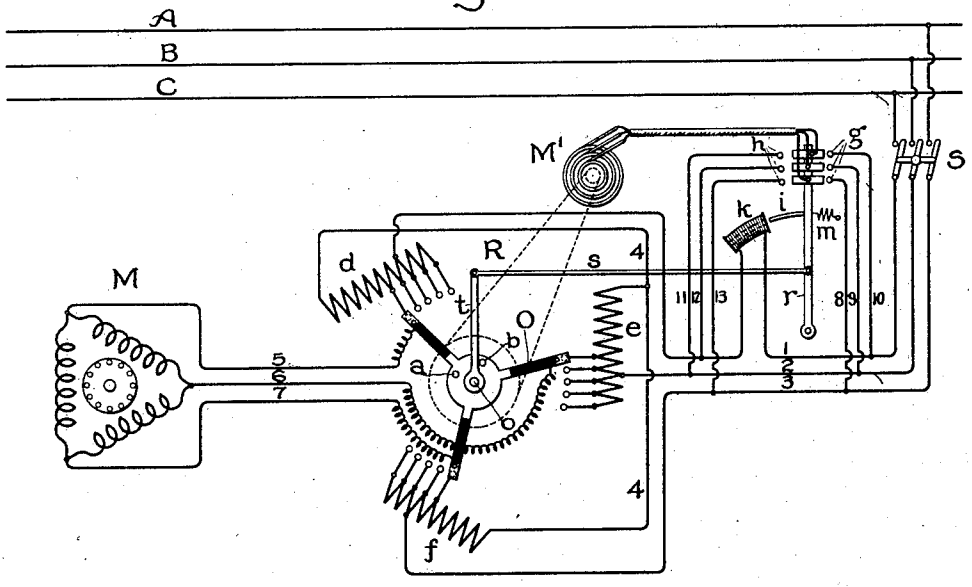


Fig. 2.



Witnesses:

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No. 729,199. Patented May 26, 1903.

UNITED STATES PATENT OFFICE.

HANS S. MEYER, OF RUGBY, ENGLAND, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

INDUCTION-MOTOR.

SPECIFICATION forming part of Letters Patent No. 729,199, dated May 26, 1903.

Application filed January 11, 1901. Serial No. 42,829. (No model.)

To all whom it may concern:

Be it known that I, HANS S. MEYER, a subject of the Emperor of Germany, residing at Rugby, England, have invented certain new and useful Improvements in Induction-Motors, of which the following is a specification.

My invention relates to alternating-current motors of the induction type, and has for its object to reduce to a minimum the wattless current required by such motors.

In many installations where induction-motors are employed it is required that the motors shall have a large starting-torque. If, however, the motors are constructed to give a high torque at starting, they will take a large magnetizing-current, and will therefore load the mains with an unnecessarily large wattless current when running under normal load as well as when running light.

It is the purpose of my invention to do away with excessive magnetizing-current without reducing the starting-torque and the overload capacity of the motor, and since the starting-torque, as well as the output of an induction-motor, is proportional to the second power of the potential at the motor-terminals, while the magnetizing-current is directly proportional to the potential, I am enabled to accomplish the desired result by providing the motor with a regulating device which operates automatically to adjust the potential at the motor-terminals in such a manner as to cause it to increase with an increase of the load on the motor and to decrease with a decrease of the load.

My invention will be understood by reference to the following specification when taken in connection with the accompanying drawings, while its scope will be pointed out in the appended claims.

In the drawings, Figure 1 represents diagrammatically one arrangement of a regulating device by means of which my invention may be carried out, and Fig. 2 illustrates a modified arrangement.

In Fig. 1, M indicates a three-phase induction-motor, and A, B, and C the mains of a three-phase supply system. S is a switch interposed between the supply-mains and the conductors through which current is supplied to the motor. R is the regulating device, by means of which the potential at the motor-terminals is regulated in accordance with the load on the motor. This regulating device is a transformer, and, as shown, it comprises three compensator-windings *d*, *e*, and *f*, connected at one end to the common conductor 4 and having their other terminals connected, through the conductors 1, 2, and 3, to the lower terminals of the switch S. Each of the compensator-windings is provided with a plurality of terminals arranged in the arc of a circle, so that they may be engaged by contacts carried by the arms of a contact-lever O, pivoted at *o*. The contacts carried by the arms of the said lever are suitably connected to the conductors 5, 6, and 7, leading to the terminals of the motor M. The contact-lever is normally maintained in the position shown in the drawings by means of a spring *m* and is moved from this position in accordance with the load on the motor-circuit by means of a solenoid *k*, included in circuit with one of the conductors leading to the motor, the core *i* of the solenoid being attached to one of the arms of the contact-lever. In order to prevent the contact-lever from being moved to unduly increase the potential at the motor-terminals at the moment of starting due to the momentary rush of current in the motor-circuits, a dash-pot *n* is provided, having its piston *w* connected to one of the arms of the contact-lever. The cylinder of the dash-pot is provided with two openings, one, *p*, at the bottom and another larger opening, *v*, at the side and just above the piston when it is in its lowest position. If the motor is started without load, then, since the rush of current will exist only momentarily, the solenoid *k* will be unable to change the position of the contact-lever sufficiently to move the piston of the dash-pot beyond the opening *v* before the motor has reached a sufficient speed to reduce the current to substantially its normal no-load value; but by the time that the motor has reached its full speed the piston of the dash-pot will have been raised above the opening *v* and thereafter the dash-pot will offer no appreciable resistance to the movement of the contact-lever. When, therefore, a load is thrown onto the motor after it has been started in

operation or whenever the load on the motor is increased, the contact-lever will be immediately moved under the influence of the solenoid to increase the potential to an amount sufficient to supply the motor with the magnetizing-current requisite for that load. By properly adjusting the device the magnetizing-current may be caused to have the smallest possible value consistent with the load on the motor. If it is attempted to start the motor under a load so great that it is unable to start at the low potential which is initially supplied to the motor-circuits, a large current will continue to flow in the motor-circuits, and therefore through the solenoid *k*, until the piston in the dash-pot is drawn above the opening *v*, when the voltage will be immediately adjusted to the amount necessary to start the motor. The nearer the speed of the motor approaches to synchronism the less will be the value of the current taken from the mains, and as the current in the mains falls off the spring *m* will overcome the pull of the solenoid *k* upon its core *i*, and thereby the potential at the motor-terminals and at the same time the magnetizing-current taken by the motor will be reduced.

The arrangement shown may be modified in various ways. For example, the solenoid *k* may be connected in any one of the circuits 5 6 7, or it may be connected in one of the circuits 1 2 3 between the source and the compensators, or instead of being included directly in circuit with one of the mains it may be placed in shunt to a portion of the same. Also in place of the transformer any other suitable regulating device may be used.

In Fig. 2 I have shown a modified arrangement for preventing a too rapid operation of the potential-controlling device. In the arrangement shown in this figure the contact-lever is operated by a separate motor M′, the connection between the motor-shaft and the lever being indicated by dotted lines as a belt connection, although evidently the connection may be made in any desired manner. The motor M′ is connected to the supply-circuit through three contacts mounted on a switch-arm *r* and arranged to engage with one or the other of two sets of contacts *g* and *h*, reversely connected to the supply-mains. The switch-lever *r* is normally drawn toward the set of contacts *g* by the spring *m*; but whenever current is flowing in the motor-circuit the solenoid *k*, connected in circuit with the conductor 1, will be energized to draw in its core *i* and to move the contacts on the switch-lever *r* toward the set of contacts *h*, connected to the conductors 11, 12, and 13. With the parts in the position shown in the drawings as soon as the switch S is closed current will flow through the conductors 1, 2, and 3 to the compensator-windings and thence by way of conductors 5, 6, and 7 to the motor-windings. If the current required by the motor is more than normal, the solenoid *k* will actuate the switch-lever *r* and will bring the contacts carried thereby into engagement with the set of contacts *h*, supplying current to the motor M′ in such a direction as to cause it to move the contacts on the lever O to increase the potential at the motor-terminals. When the current falls to its normal value, the switch-lever *r* will be maintained in the mid-position, (shown in the drawings,) and when the current falls below normal the lever is drawn by the spring *m* into such a position that the contacts carried thereby are caused to engage the set of contacts *g*. Current is then supplied to the motor M′ in a reverse direction, and the contact-lever O is moved in a direction to reduce the motor-potential. In order that the circuit of the motor M′ may be opened whenever the contact-lever O has been moved to either of its extreme positions, a lost-motion device of any suitable mechanical construction is interposed between the contact-lever O and the switch-lever *r*. In the drawings I have indicated this device as comprising an arm *t*, loosely mounted on the same pivot with the contact-lever and connected by a rod *s* with the lever *r*. The contact-lever is also provided with two lugs *a* and *b*, one of which is brought into engagement with the arm *t* in each of the extreme positions of the said lever. By means of this device the lever *r* is forced into its mid-position whenever the contact-lever is in either of its extreme positions. The spring *m* is so proportioned with respect to the pull of the solenoid *k* that current is supplied to the motor M′ through the set of contacts *g* as long as the current supplied to the motor M remains below normal. When the normal current-flow is reached, the lever *r* is drawn into its midposition and when the current rises above normal the circuit to the motor M′ is closed through the set of contacts *h*. This arrangement operates as follows: Whenever the main motor M is cut out of circuit, the contact-arm will always stand on the point of the lowest potential and the contacts on the switch-arm *r* will be drawn toward the contacts *g*, connected to the conductors 8, 9, and 10. As soon as the main switch S is closed the contacts of the switch-lever *r* will be drawn into engagement with contacts *h*, which constitute the terminals of the conductors 11, 12, and 13, and the motor M′ will be supplied with current in such a direction as to move the contact-lever right-handedly to increase the potential on the motor-terminals. As soon as the contact-lever has reached the point of highest potential the circuit is automatically broken at the switch-lever *r* by means of the lost-motion device and the motor M′ is stopped. If now the main motor M continues to increase in speed, the current will decrease in the mains (at normal load below the normal value, since the potential at the motor-terminals is above normal) and the spring *m* will move the switch-lever *r* into such a position as to sup-

ply current to the motor M′ in the opposite direction and the contact-lever will be moved in left-handed rotation until the current in the motor-circuits has been increased to the normal value, when the contact-lever will be brought to its mid-position, thereby opening the circuit of the motor M′. Whenever the load varies, the strength of the current changes in the solenoid *k*, and therefore the switch-lever *r* is constantly vibrating back and forth, so as to close the circuit of the motor M′ first in one direction and then in the other, and thereby whenever the load varies from normal the potential at the motor-terminals is immediately increased or decreased, as the case may be.

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

1. In combination, an induction-motor, and automatic means constructed and arranged to vary the potential at the motor-terminals in such a manner as to cause it to increase with an increase of the load on the motor and to decrease with a decrease of the said load.

2. In combination, an induction-motor, a source of variable potential therefor, and automatic means for varying the potential of said source in such a manner as to cause it to increase with an increase of the load on the motor and to decrease with a decrease of the said load.

3. In combination, an induction-motor, a source of variable potential therefor, means for varying the potential of the source in accordance with the load on the motor, and a retarding device for preventing a sudden increase of potential due to the rush of current at starting.

4. In combination, an induction-motor, a source of variable potential therefor, means for varying the potential of the source in accordance with the load on the motor, and a retarding device constructed and arranged to prevent a sudden increase of potential due to the rush of current at starting but permitting a quick change of potential upon change of load.

5. In combination, an induction-motor, a source of current-supply therefor provided with a plurality of terminals of varying potentials, contacts connected to the motor-circuits and arranged to engage said terminals, means tending to maintain said contacts in the position of lowest potential, a motive device controlled in its operation by current flowing in the motor-circuits for actuating said contacts, and a retarding device comprising a dash-pot provided with an auxiliary opening arranged to permit a free movement of the contacts under the influence of the motive device after the motor has been started in operation.

In witness whereof I have hereunto set my hand this 24th day of December, 1900.

HANS S. MEYER.

Witnesses:

LEONORE RASCH,

BENJAMIN B. HULL.