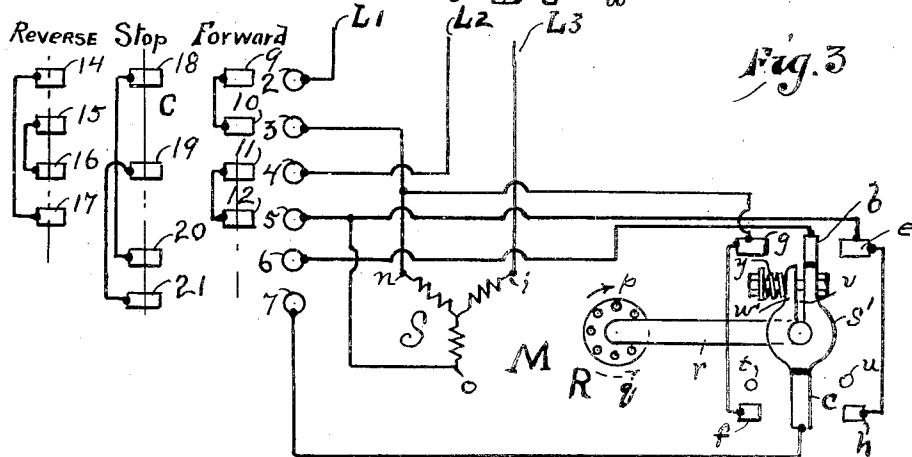
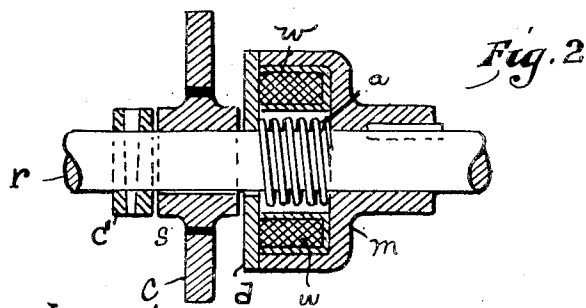
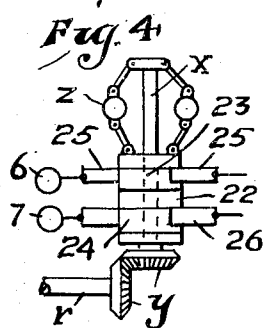
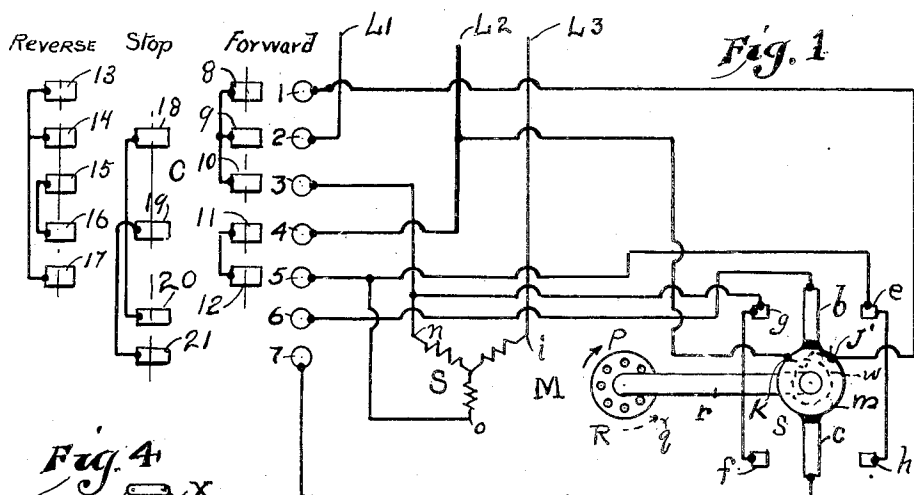


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STOPPING APPARATUS FOR ALTERNATING CURRENT MOTORS.
APPLICATION FILED JULY 12, 1919.

1,364,847.

Patented Jan. 4, 1921.



WITNESS.

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STOPPING APPARATUS FOR ALTERNATING-CURRENT MOTORS.

1,364,847.

Specification of Letters Patent.

Patented Jan. 4, 1921.

Application filed July 12, 1919. Serial No. 310,369.

To all whom it may concern:

Be it known that I, HARRY F. STRATTON, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented new and useful Improvements in Stopping Apparatus for Alternating-Current Motors, of which the following is a specification.

This invention relates to apparatus for stopping motors, particularly of the alternating current type.

The principal object of this invention is to secure the quick stopping of alternating-current or induction motors with the same facility as is now possible with direct current motors provided with a controller designed for reversal and quick stop by dynamic braking. Other objects appear hereinafter.

On the accompanying drawings, Figure 1 is a diagrammatic view illustrative of one of the many ways for carrying out my invention; Fig. 2, a section of a detail involving a magnet and clutch, shown on Fig. 1; and Fig. 3, a diagrammatic view of a second form of my invention in which the said magnet is not employed. Fig. 4 is a view showing a portion of my invention modified.

Referring first to Figs. 1 and 2, C represents a controller having the contact fingers 1 to 7 arranged to be engaged by the contact strips shown at their left. The motor M has the stator windings S and the rotor R. The rotor shaft *r* carries the double-armed contact device loose thereon and seated between the collar *c'* pinned to the shaft and the magnet *m* having its casing or frame keyed to the shaft. The casing contains the magnet-winding *w* concentric with the shaft and inclosing the coiled spring *a* which has one end seated on the bottom of the casing and the other end bearing on the disk *d* loose on the shaft and arranged and adapted to engage the hub of the contact device *r* when the expansion of the spring is allowed and causes the said device to rotate with the shaft. The device *s* has two insulated contact arms *b* and *c*, arranged to engage simultaneously the contacts *e*, *f*, or the contacts *g*, *h*.

The supply lines *L*¹, *L*², *L*³ are connected

respectively with the contact-finger 2, the contact-finger 4, and the stator terminal *i*. The contact-finger 1 is connected to the terminal *j* of the winding of the magnet *m*, the other terminal *k* of the magnet being connected to the supply line *L*². The contact-finger 3 is connected to the stator terminal *n*; the contact-finger 5 to the stator terminal *o*, and to the contacts *e* and *h*; the contact-finger 6, to the contact arm *b*; and the contact-finger 7, to the contact arm *c*. The contacts *e* and *h* are connected together, and the contacts *f* and *g* are also connected together.

When the "forward" contact strips 8 to 12 are moved by the controller C into contact with the contact-fingers 1 to 5, the rotor R will rotate in the forward direction which will be assumed to be indicated by the arrow *p*. The line *L*¹ is connected through the contact-fingers 2 and 3, and the contact-strips 9 and 10 to the stator terminal *n*; the line *L*² is connected through the contact-fingers 4 and 5, and the contact-strips 11 and 12 to the stator terminal *o* and to the contact *e*; and the line *L*³ is connected directly to the stator terminal *i*. The lines *L*¹ and *L*² are connected through the contact fingers 1 and 2, and the contact strips 8 and 9 to the terminals of the magnet *m*, which causes the magnet to pull the disk *d* toward the casing, thereby compressing the spring *a* and allowing the contact-devices to be loose on the shaft *r*. It can do no harm, however, if the device is carried over so as to bring the arms *b* and *c* against the contacts *e* and *f*, as the arms are open circuited on the fingers 6 and 7.

If the "reverse" contact strips 13 to 17 are brought into engagement with the fingers 1 to 5, the direction of rotation of the rotor will be reversed as indicated by the arrow *q*, the former connections of the lines *L*¹ and *L*² with the rotor terminals *n* and *o* being now reversed. The magnet winding *a* is energized by current flowing between the lines *L*¹ and *L*² by way of the fingers 1 and 2, and the strips 13 and 14. No harm can come, if the arms *b* and *c* engage the contacts *g* and *h*, as the fingers 6 and 7 are still unenergized.

If the "stop" contact strips are brought

from the "forward" position into engagement with the fingers 2, 4, 6, and 7, the magnet circuit is opened at the finger 1, and the spring *a* pushes the disk *d* into contact with the hub of the device *s* and causes the latter to be clamped to the shaft *r* through friction with the collar *c'* and the disk *d*. The device *s* is rotated with the drifting shaft, its arms *b* and *c* soon engaging the contacts *e* and *f*, if they have not already done so. Current from the line L^1 passes through the finger 2, the strips 18 and 20, the finger 6, the arm *b*, and the contact *e* to the rotor terminal *o*; and current from the line L^2 passes through the finger 4, the strips 19 and 21, the finger 7, the arm *c*, and the contacts *f* and *g* to the rotor terminal *n*. The lines L^1 and L^2 being now connected in the reverse order to the rotor terminals *n* and *o* from what they were when the controller was in the "forward" position, the torque exerted by the rotor is now reversed, tending to stop it. The result is that the rotor is quickly brought to rest and even rotates in the reverse direction a slight fraction of a revolution until the connections are broken between the arms *b* and *c*, and the contacts *e* and *f*. The rotor necessarily actually comes to a standstill before it is reversed, and obviously, it has attained only a very slow speed in the reverse direction when its circuit is interrupted. The result is that all the torque tending to rotate the rotor is removed when the rotor is revolving at very low velocity, and consequently, the rotor comes to rest almost immediately. In actual operation this result cannot be distinguished by the eye from that of bringing the rotating element to standstill without any reverse of rotation.

One of the principal advantages of thus stopping the motor lies in the difficulty of disconnecting the motor current by means of any relay action responsive to motor current, inasmuch as the variation of motor current is very small as the direction of rotation reverses.

If the controller has been brought from the "reverse" position to the "stop" position, the shaft *r* would have carried the arms *b* and *c* against the contacts *g* and *h*, whereupon the line L^1 would be connected to the rotor terminal *n*, and the line L^2 to the rotor terminal *o*, thereby causing the motor to run in the "forward" direction and the motor circuit to be at once opened at the contacts *g* and *h*, and the motor to be quickly stopped.

In Fig. 3, the parts are the same as in Fig. 1 except that the magnet has been omitted together with the finger 1 and the strips 8 and 13. The contact device *s'* is clamped to the shaft *r* in any convenient manner so as to cause it to rotate with the shaft and still allow it to stand still when

it engages the stop *t* or the stop *u*. When the device is against the stop *t*, its insulated contact arms *b* and *c* engage the contacts *e* and *f*; and when it is against the stop *u*, these arms engage the contacts *g* and *h*.

The device *s'* has a slot *v*, providing the arm *w'* opposite the arm *b*. The bolt *x* extends through the arms *b* and *w'*, and has thereon the spring *y* seated between the arm *w'* and the nut *z* on the bolt to draw the arms *b* and *w* toward each other and cause the device *s'* to yieldingly grip the shaft *r*.

The operation of the apparatus of Fig. 3 is the same as that of Fig. 1, the device *s'* gripping the shaft yieldingly all of the time instead of at the time only when the motor is to be stopped.

In Fig. 4, I have shown a centrifugal governor for opening the motor circuit when the current becomes low. It may open the circuit to serve as a safety device in case the device *s* of Fig. 1 or *s'* of Fig. 3, or an equivalent device fails to operate, or it may open the circuit slightly before the motor starts to reverse. On Fig. 4, I show the rotor shaft *r* driving the governor shaft *w* by means of the bevel gears *y*. The governor balls *z* connected to the cylinder 22 rotatable with and slidable on the shaft *w* carry the two contact rings 23 and 24. The brushes 25 are inserted in the wire leading from the contact-finger 6 and bear on the contact-ring 23, and the brushes 26 are inserted in the wire leading from the contact-finger 7 and bearing on the contact-ring 24. As the speed of the motor becomes zero or quite low, the governor balls fall so low as to cause the brushes 25 and 26 to open the motor circuit.

I have shown the motor connected to a three-phase alternating-current circuit without the interposition of a transformer or resistance. If an induction motor is thrown across the line, the starting current is about five times full load current. If the connections are changed to reverse the motor when running at full speed, the reversing current is only about 10% more than the current taken when starting from rest. This permits reversing small induction motors without the use of a transformer or a resistance, when it is satisfactory to start such a motor by initially applying full line voltage.

It is to be understood that, although I have given a theory of operation of my device, I do not limit myself to the same, as the principle of this invention may be worked out in apparatus and operations differing from those set forth herein.

I claim:

The combination of a reversing motor, forward and reverse circuits therefor, a selective switch operated by the motor to close a set of contacts in the reverse circuit when

the motor is operating in the forward direction and to close another set of contacts in the forward circuit when the motor is operating in the reverse direction, a master
5 switch having contacts for operating the motor in the forward direction, contacts for operating the motor in the reverse direc-

tion, and contacts in the stop position which last mentioned contacts are in series with the closed contacts of the said selective 10 switch.

Signed at Cleveland, Ohio, this 27th day of June, 1919.

HARRY F. STRATTON.