No. 696,055. Patented Mar. 25, 1902.

S. L. G. KNOX.

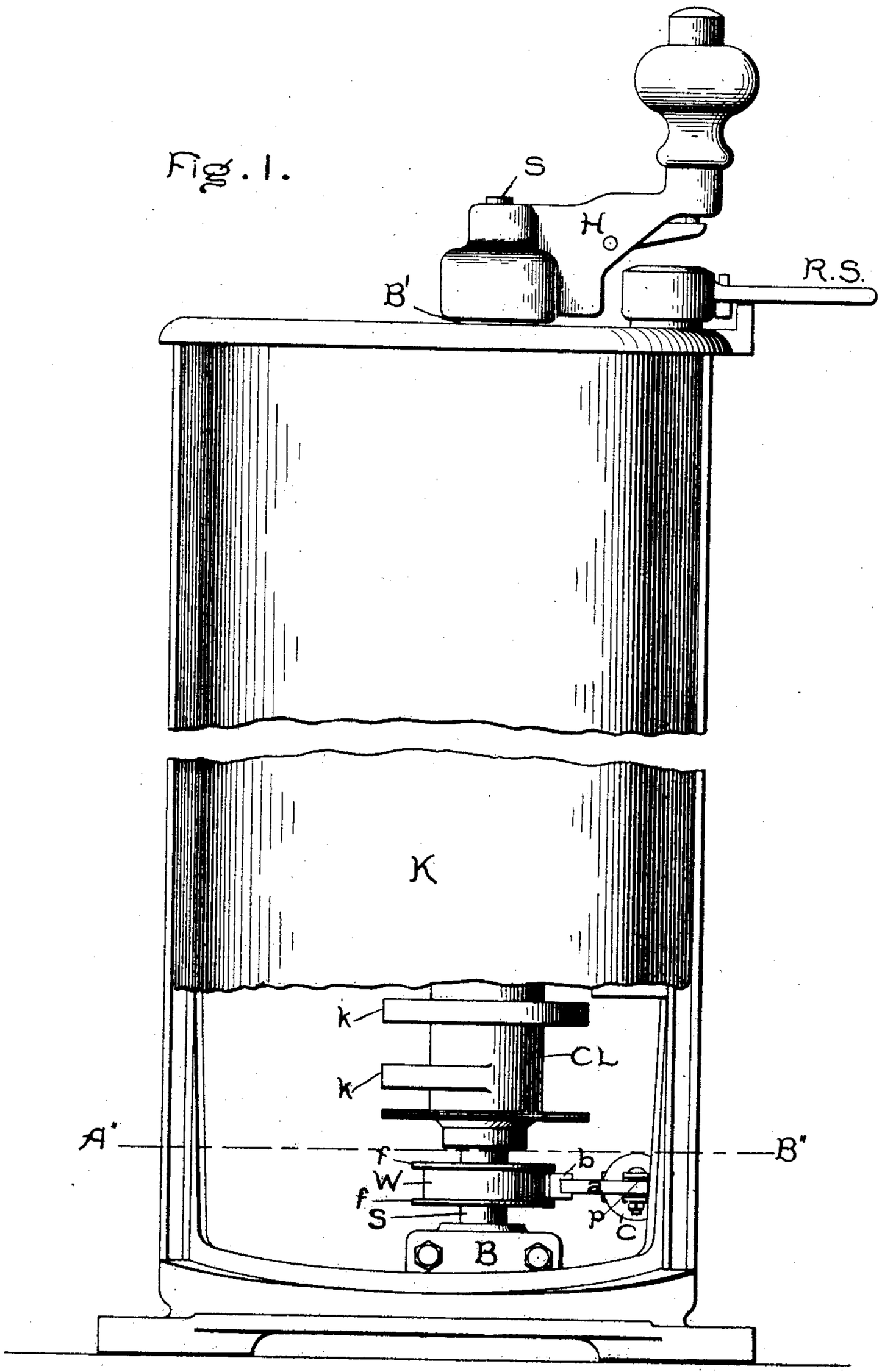
CURRENT LIMITING DEVICE.

(Application filed July 31, 1901.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1.



Witnesses:
Benjamin B. Hull,
Hobel A. Emerson.

Inventor:
Samuel L. G. Knox,
by Allen G. Dodge
Att'y.

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(No Model.) 2 Sheets—Sheet 2.

Fig. 2.

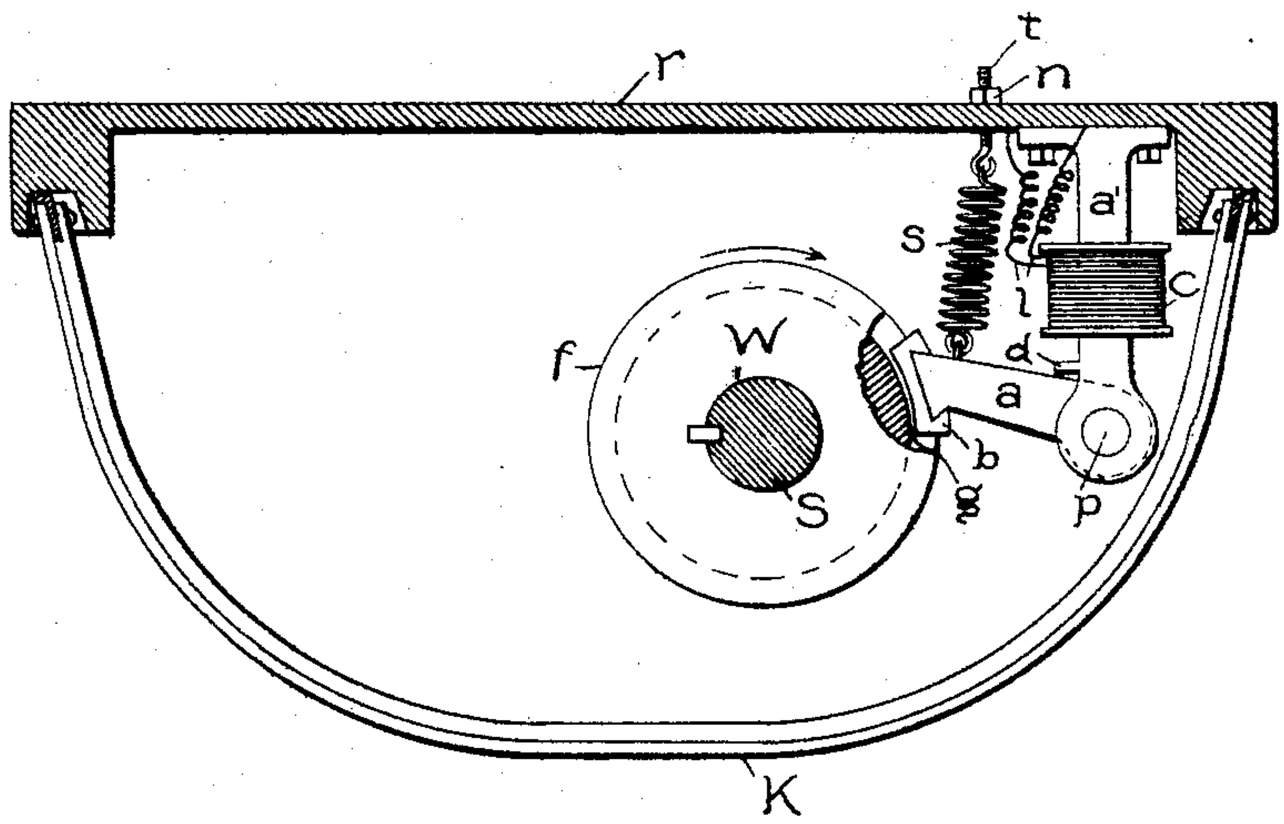
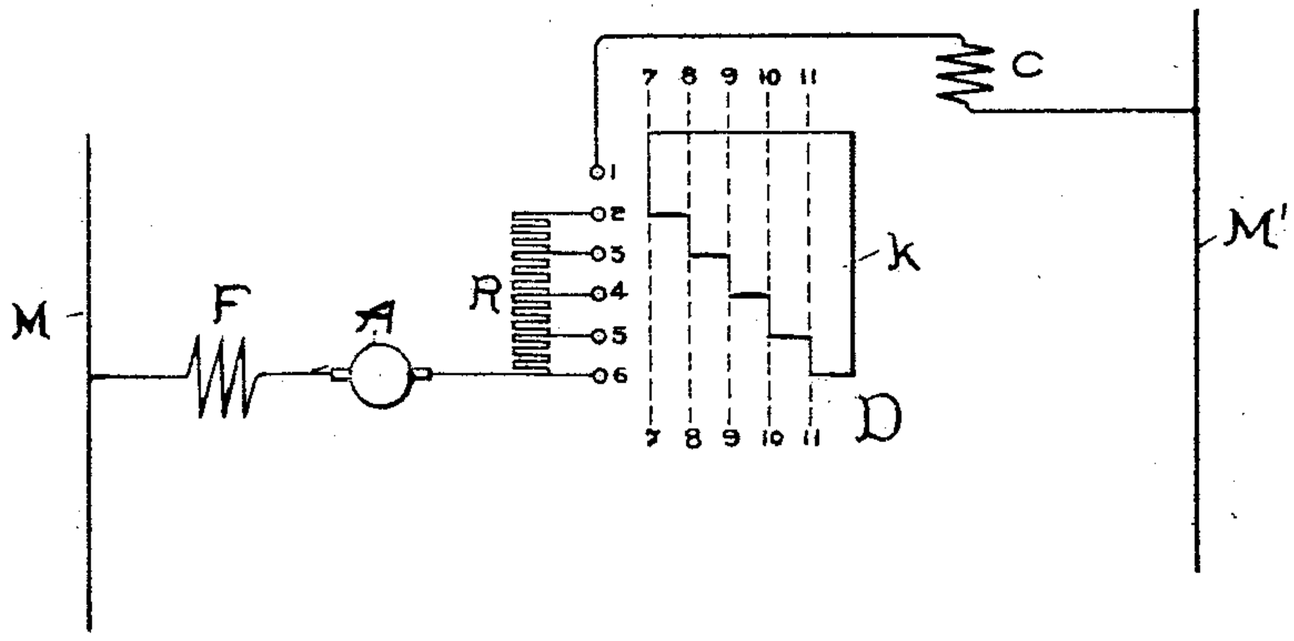


Fig. 3.



Witnesses:
Benjamin B. Hull,
Mabel N. Emerson.

Inventor:
Samuel L.G. Knox,
by Albert G. Davis
Att'y.

UNITED STATES PATENT OFFICE.

SAMUEL L. G. KNOX, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

CURRENT-LIMITING DEVICE.

SPECIFICATION forming part of Letters Patent No. 696,055, dated March 25, 1902.

Application filed July 31, 1901. Serial No. 70,358. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL L. G. KNOX, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Current-Limiting Devices, (Case No. 1,929,) of which the following is a specification.

This invention relates to the operation of electric-motor controllers, and has for its object the provision of improved means for preventing such controllers from being turned on too rapidly.

I propose to furnish a member composed of a pivoted arm and a shoe adapted to engage with an engaging surface provided for the purpose upon the movable portion of the controller, an adjustable spring for normally holding the shoe away from the engaging surface, and a coil connected in the circuit which is to govern the operation of the device. If desired, the adjustment of the spring may be assisted or dispensed with by providing well-known means for adjusting the proportion of current in the coil to that in the circuit to which it is connected. The shoe is so mounted that when it is in contact with the engaging surface any effort to move the movable part in one direction will wedge the surface and shoe together, thus effectually preventing movement in that direction; but effort to move it in the opposite direction will reverse the wedging action and the device will not obstruct its motion. The shoe will come in contact with the engaging surface whenever the current in the coil rises to such value that the tension of the spring is overcome by the magnetism induced through the shoe and engaging surface. When the current subsides, the spring will again become dominant and remove the shoe and surface from contact.

Having given an outline of my invention, I will now describe it in detail as applied to a hand-operated controller of the usual cylindrical type, which I consider one of its best applications.

Referring to the drawings, Figure 1 is a front elevation of the controller with a portion of the cover at the bottom removed that my invention may be seen. Fig. 2 is a section of the controller at A'' B'', Fig. 1, showing a plan view of my invention. Fig. 3 is a diagram of connections.

Referring to Fig. 1, CL is the cylinder or movable portion, carrying contacts *k* and rigidly connected to shaft S. The stationary contacts are not shown, as they would complicate the drawings without aiding in the illustration of my invention. They are, however, shown diagrammatically in Fig. 3. W is a wheel keyed to shaft S and furnishes an engaging surface upon its circumference for shoe *b*. Flanges *f* serve as guides for shoe *b*. H is a handle for imparting a rotary motion to shaft S, to which it is rigidly connected. Shaft S is supported by bearings B at the bottom and B' in the top of the controller-case. RS is a handle for actuating a reversing-cylinder. This cylinder is concealed beneath the controller-cover K and is not necessary to a full and clear description of my invention.

Referring to Fig. 2, arm *a'* is screwed to back of controller *r* and supports coil C, through which circuit is made by leads *l*. Arm *a* is pivoted to arm *a'* at *p* and at its other extremity carries the shoe *b*. (Flange of wheel W is broken away to show shoe.) Spring *s* tends to hold shoe *b* away from wheel W, and its tension can be adjusted by screw *t* and nut *n*. For best results in this construction screw *t* should be made of brass or other non-magnetizable material. Stop *d* is to prevent spring *s* from drawing shoe *b* too far away from wheel W.

Referring to Fig. 3, A is the armature of the motor; F, the field. D is the controller, shown diagrammatically, having the movable contacts appearing as developed on a plane surface and the stationary contacts 1 2 to 6 as small circles, according to the usual practice in diagrams of such structures. R is the usual starting-resistance. C is the coil for energizing the magnetic circuit through shoe *b*, and M and M' the conductors of the supply-circuit.

The controller being in the "off" position, as shown, and it being desired to start the motor, the handle H, Fig. 1, is turned to the right or in the direction of the arrow, Fig. 2, so that (referring to Fig. 3) the lines 7 7 8 8 to 11 11

successively occupy positions in the order named over the stationary contacts. When line 7 7 is over the stationary contacts, a circuit can be traced from conductor M′ through coil C, stationary contacts 1 and 2, resistance R, armature of motor A, field of motor F to conductor M. Further movement of the controller operates to cut out resistance R in a well-known manner until, in the last position, when line 11 11 is over the stationary contacts, the resistance is all cut out and the motor is in series with coil C between conductors M and M′. The resistance of coil C will ordinarily be so low as to have no appreciable effect on the operation of the motor. As the controller is turned on the current passing through the coil C energizes a magnetic circuit, which may be traced as follows, (see Figs. 2 and 1:) through arms a' and a, shoe b, air-gap g, wheel W, shaft S, bearings B and B′, and controller-back r. The back r of the controller, the shaft s, and bearings B and B′ are usually constructed of iron, and this is the best material for my purpose. The wheel W and arms a and a' should also be constructed of iron or other magnetizable material; but the shoe b should be made of brass or other non-magnetizable material for reasons as will appear later. With the exception of air-gap g and shoe b we now have a circuit composed entirely of magnetizable material, which insures efficient utilization of the magneto-motive force developed by coil C and also directs the induction in the proper course—*i. e.*, across air-gap g. The energizing of this circuit by current in coil C tends to bring the shoe b in contact with the periphery of the wheel W, but ordinarily this is prevented by spring s. If, however, the current reaches or exceeds a certain value, the tension of the spring is overcome and the shoe comes in contact with the wheel. The tendency then is for the shoe to adhere to the circumference of the wheel, so that any further effort to turn on the controller will but operate to wedge the wheel W, shoe b, and arm a between shaft S and pivot p, and the greater the effort put forth the tighter will the parts mentioned be wedged together, thus effectually preventing movement of the controller in this direction. If, however, it is desired to move the controller in the opposite direction or turn it off, it is evident that the wedging action will be reversed, and there will consequently be no opposition to such motion. After the device described has operated to prevet further movement of the controller in a certain direction it will remain in that condition until the current in coil C (and that in the motor) has fallen to a certain value, when the spring s will overcome the magnetic attraction between arm a and wheel W. The shoe b will then be removed from contact with wheel W and the controller free to be turned farther on. It is a matter of general knowledge in the art that if a magnetic circuit composed entirely of magnetizable material is energized by means of a current flowing in a coil which is interlinked with it that the material will retain magnetism after the current has ceased, so that mechanically separate parts of the material composing the circuit will adhere strongly together. This effect can be eliminated to a large extent if a portion of the circuit be composed of non-magnetizable material. I have therefore specified that the shoe b should be of brass or other non-magnetizable material, so that it may be promptly removed from contact with wheel W when the current falls.

I desire it to be understood that my invention is not limited to the particular construction which I have illustrated in this application. For example, while in the construction which I have shown the magnetic circuit of the coil which actuates the shoe is directed through the shoe and the engaging surface it is evident that this is not a necessary feature of my invention. In the appended claims I aim to cover all modifications which embody the essence of my invention.

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

1. The combination in a current-controller of an engaging surface upon a movable member thereof, a shoe adapted to engage with said engaging surface and a coil, the whole so arranged and constructed that the magnetic circuit of the coil is directed through said shoe and said engaging surface and the said shoe so mounted that when it is in contact with the said engaging surface, effort to move the movable body in one direction will wedge them together but effort in the opposite direction will reverse such wedging action.

2. The combination in a current-controller of an engaging surface upon a movable member thereof, a pivoted arm, a shoe carried by said arm and adapted to engage with said engaging surface, a spring normally holding said shoe away from said engaging surface, means for preventing the spring from drawing said shoe too far away from said surface, a coil, and means for adjusting the operation of the device to respond to certain currents in said coil, the whole so arranged and constructed that the magnetic circuit of the coil is directed through said shoe and said engaging surface and said shoe so mounted that when it is in contact with said engaging surface effort to move the movable body in one direction will wedge them together but effort in the opposite direction will reverse such wedging action.

3. The combination of a current-controller, an engaging surface on a movable portion thereof, a pivoted arm, a shoe carried by said arm and adapted to engage with said engaging surface, a spring normally holding said shoe away from said engaging surface, means for preventing the spring from drawing said shoe too far away from said surface, a coil and means for adjusting the operation of the device to respond to any given

current in the coil, the whole so arranged and constructed that the magnetic circuit of the coil is directed through said shoe and said engaging surface and said shoe so mounted that when it is in contact with said engaging surface, effort to move the movable portion in one direction will wedge them together but effort in the opposite direction will reverse such wedging action.

4. The combination of a cylindrical current-controller, a wheel mounted on the cylinder-shaft, a pivoted arm, a shoe carried by said arm and adapted to engage with the periphery of said wheel, an adjustable spring normally holding said shoe away from said wheel, a stop for preventing the spring from drawing said shoe too far away from said wheel and a coil connected in the circuit controlled by the controller, the whole so arranged and constructed that the magnetic circuit of the coil is directed through said shoe and said wheel, and said shoe so mounted that when it is in contact with said wheel, effort to turn on controller will wedge them together but effort to turn it off will reverse such wedging action.

5. The combination in a current-controller of an engaging surface upon a movable member thereof, a shoe adapted to engage with said engaging surface and an electrically-actuated device tending to bring said shoe in contact with said engaging surface, the said shoe being so mounted that when it is in contact with said engaging surface, effort to move the movable body in one direction will wedge them together, but effort in the opposite direction will reverse such wedging action.

In witness whereof I have hereunto set my hand this 30th day of July, 1901.

SAMUEL L. G. KNOX.

Witnesses:

BENJAMIN B. HULL,

MARGARET E. WOOLLEY.