(No Model.) 2 Sheets—Sheet 1.

T. VON ZWEIGBERGK.

CONTROLLER.

No. 592,104. Patented Oct. 19, 1897.

Fig. 1.

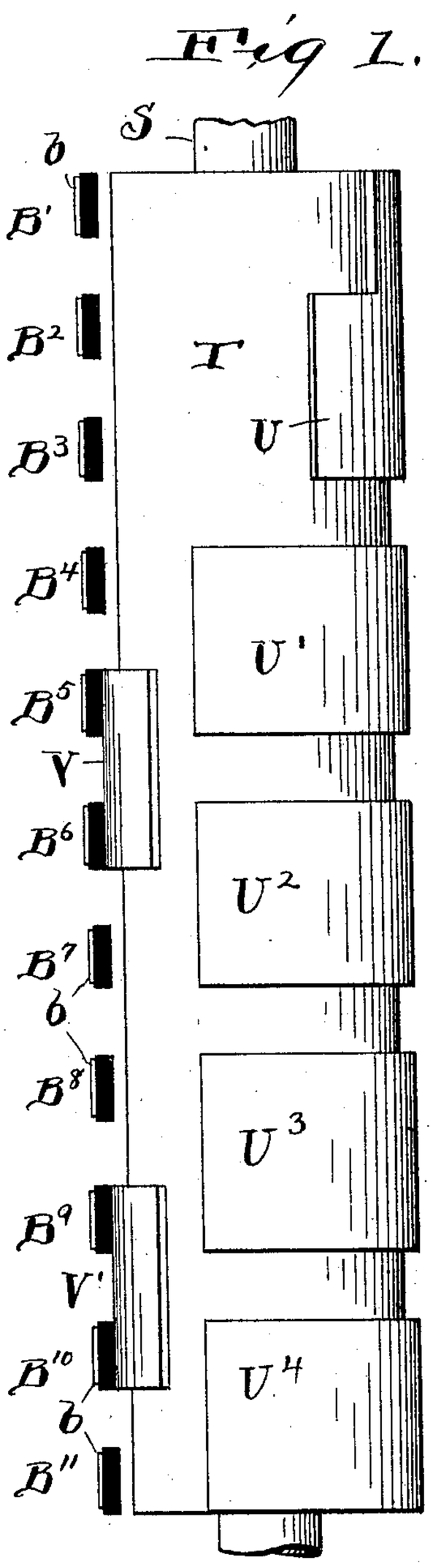


Fig. 2.

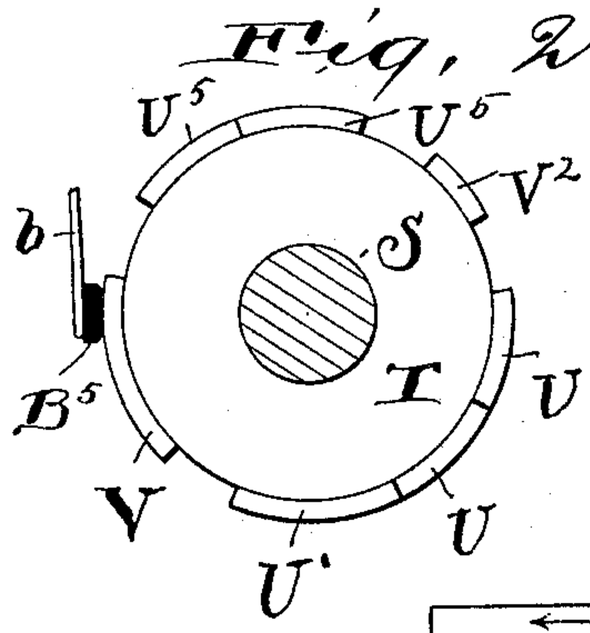
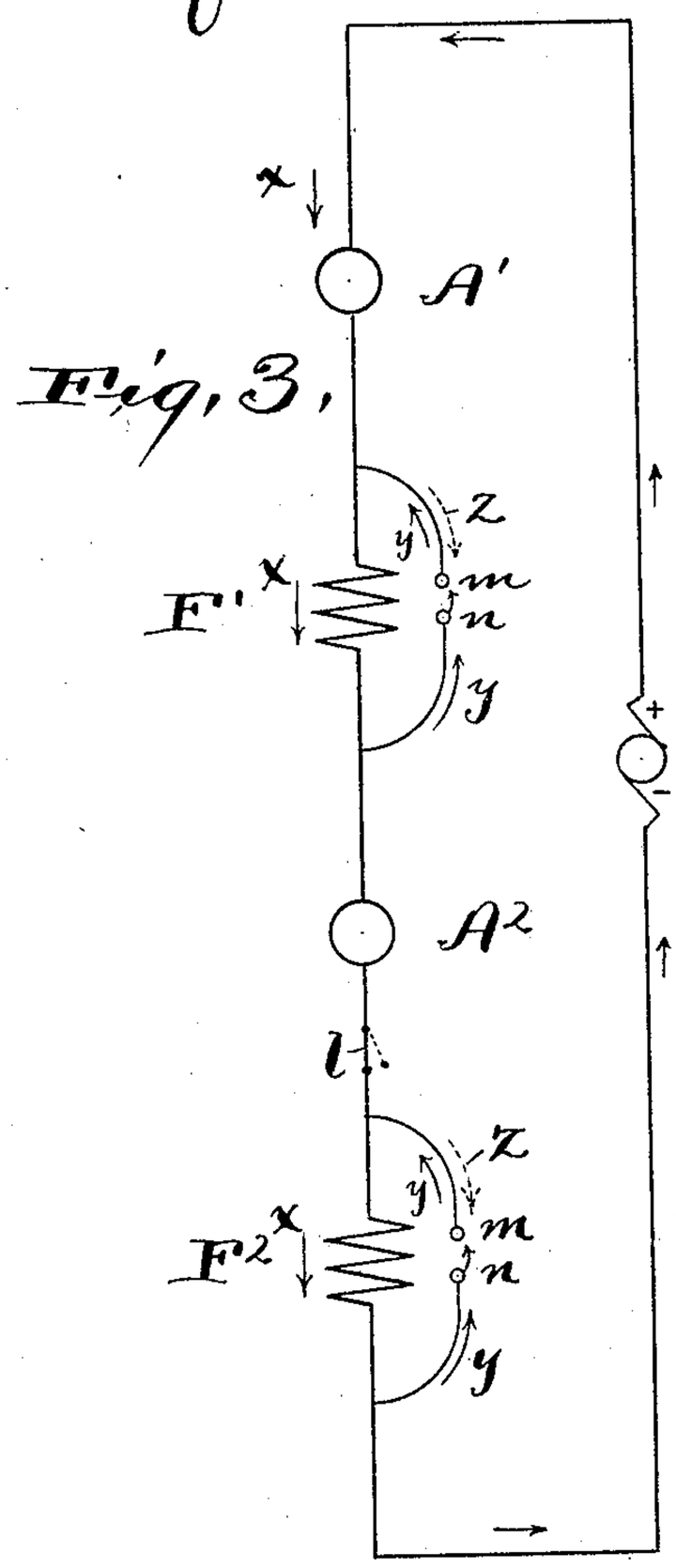


Fig. 3.



Witnesses.
E. B. Gilchrist
H. M. Hutchison.

Inventor:
Thorsten von Zweigbergk,
By his attorneys,
Thurston & Bates.

(No Model.) 2 Sheets—Sheet 2.

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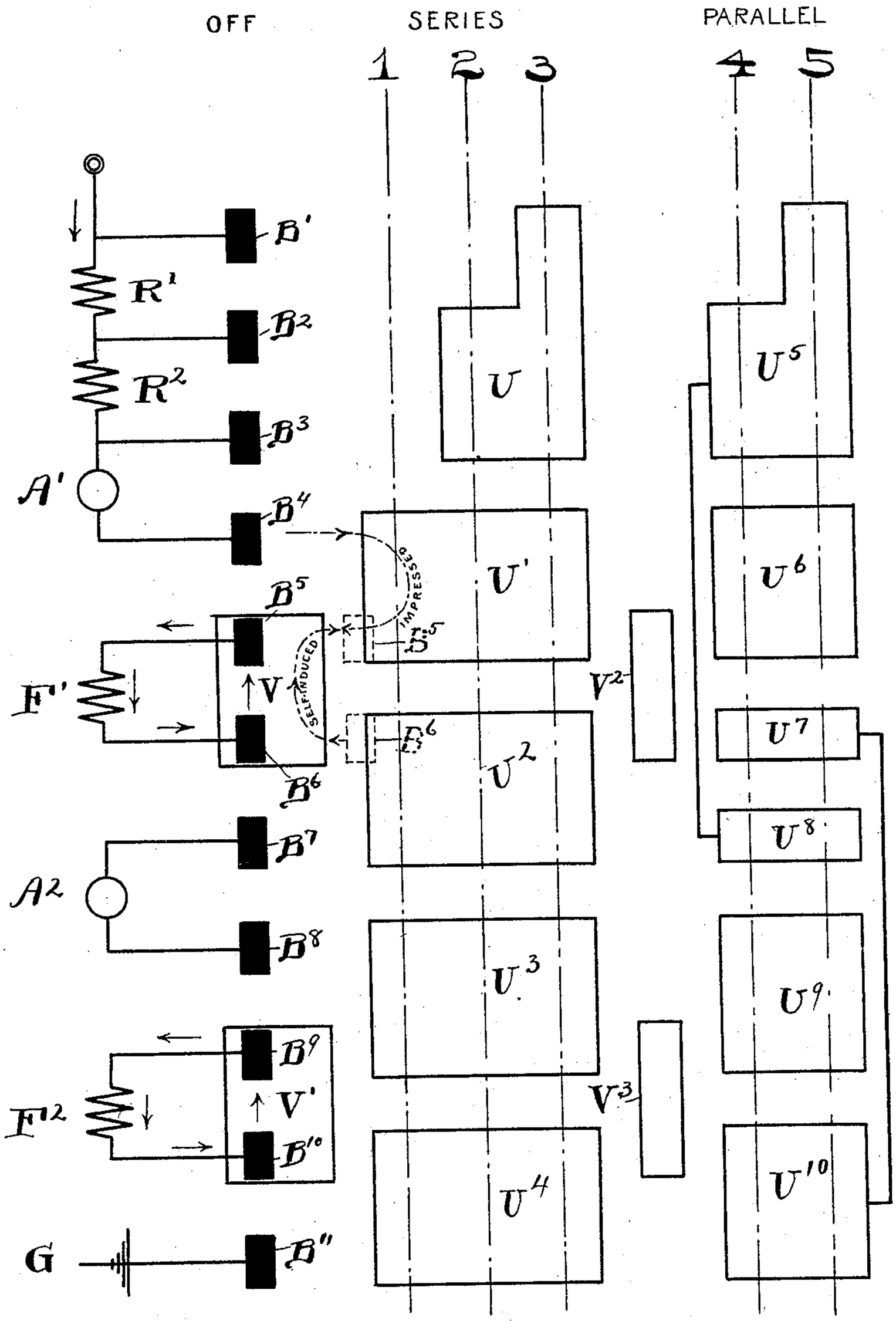

Fig. 4.

Witnesses
E. B. Gilchrist
H. M. Hutchison

Inventor
Thorsten von Zweigbergk,
By his Attorneys,
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UNITED STATES PATENT OFFICE.

THORSTEN VON ZWEIGBERGK, OF CLEVELAND, OHIO, ASSIGNOR TO THE WALKER COMPANY, OF SAME PLACE.

CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 592,104, dated October 19, 1897.

Application filed April 3, 1897. Serial No. 630,602. (No model.)

To all whom it may concern:

Be it known that I, THORSTEN VON ZWEIGBERGK, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Controllers; 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.

The object of my invention is to provide means for preventing dangerous self-induction in the fields of electric motors when the circuit through those fields is suddenly broken. The self-induction in the fields caused by a sudden stopping of the current through them may become so great in fields having large numbers of turns that the insulation is burned through and the motor rendered inoperative. I have discovered that by short-circuiting the fields just after the circuit through them is broken at the controller, the self-induced current is allowed to die down gradually through the circuit thus provided, and hence becomes harmless.

My invention consists broadly of means for establishing an electrical connection between a conductor leading to a coil through which an electric current may flow and a conductor leading from that coil just after a circuit by which an electric current has been flowing through the coil is broken. I prefer to establish this connection by a construction which is also my invention, and which consists in providing a controller with one or more special short-circuiting contact-plates, as the circumstances may require, which are so placed that they are adapted to electrically connect contact-fingers forming terminals of a field-coil just after those contact-fingers have left the contact-plates forming the terminals of their line-circuit.

In the drawings, which clearly illustrate my invention, Figure 1 is an elevation of a controller with the case, bearings, and operating-handle removed; and Fig. 2 is a plan view of the same with the upper four contact-fingers omitted. Fig. 3 is a diagram illustrating the manner in which the impressed electromotive force is neutralized by the self-induced current under certain circumstances, as will be hereinafter explained. Fig. 4 is a development of the controller-cylinder, showing diagrammatically the contact-fingers and their respective circuits.

Referring to the parts by letters, S represents the shaft of a controller. An insulating-sleeve T surrounds this shaft, and carries on its cylindrical surface contact-plates U U′ U^2, &c., which are adapted to be brought by partial rotations of the shaft into various contacts with a series of contact-fingers. These contact-fingers are indicated by the reference-letters B′ to B^{11}, inclusive. They are held in a row parallel with the shaft, and in suitable position to bear against the contact-plates toward which they are spring-pressed, (either by the resilience of their bars *b*, which support the contact-fingers proper, or by other springs.) The contact-plates U U′, &c., are so disposed that in different positions of the controller-cylinder different contact-fingers are connected together. The position which the contact-fingers occupy with reference to the contact-plates, in the drawings, is the "off" position of the controller.

Fig. 4 indicates by the broken lines marked 1, 2, 3, 4, and 5 different running positions. The controller shown is of the series-parallel type, governing two motors. R′ and R^2 represent resistances; A′ and F′, the armature and field, respectively, of one motor; A^2 and F^2, the armature and field of the other motor, and G the ground or return wire. When the contact fingers and plates are in the relative position indicated by broken line 1, both resistances and the two motors are in series. In position 2 resistance R^2 is cut out and the resistance R′ and both motors are in series. In position 3 both resistances are out and the two motors alone are in series. In position 4 the current flows through the resistance R′ and then through both motors in parallel, and in position 5 through both motors in parallel without either resistance. This much description of the general operation of the controller is deemed desirable for the better understanding of my invention, though there is no novelty in the construction so far explained, and that construction is only chosen

as illustrative. When the controller moves from the first parallel position 4 to the last series position 3, or vice versa, or from the first series position 1 to the off position, the circuit through the field-coils is broken as the contact-fingers B^5 and B^6, and B^9 and B^{10}, leave the plates U^6 and U^7, and U^9 and U^{10}, or U′ and U^2, and U^3 and U^4. This sudden stopping of the current causes a self-induced current to be set up in the field-coils. The more sudden the break, the higher the intensity of the induced current. Hence it sometimes happens that when the controller is suddenly withdrawn from position 4 or 1, (or 3 in the opposite direction,) such an intense current is self-induced in the fields as to burn out the insulation. To prevent this, I provide the metallic plates V V′ V^2 V^3 in substantially the position shown, the forward edge of the plates V and V′ being distant from their corresponding contact-plates U′, U^2, U^3, and U^4 a little more than the width of the contacting face of the fingers B^5 B^6, &c., and the plates V^2 and V^3 having their edges a similar distance from said plates U′ U^2, &c., and also from the plates U^6, U^7, U^9, and U^{10}. If now the field contact-fingers are withdrawn from their plates U′ and U^2—for example, when a current is flowing through the field—the field is short-circuited by the plate V, and hence a continuous path is provided for the self-induced current, and it, therefore, circulates around the field and plate V, as indicated by the arrows, and gradually dies down without producing harmful effect. The plate V′ performs the same office for the other motor, and the plates V^2 and V^3 each for their corresponding motors, when the controller is moved from position 3 to 4 or vice versa. If the controller is returned quickly from an off position (either the one shown as off or that intermediate of positions 3 and 4) to a running position, it might appear at first sight that an arc caused by the self-induced current between the plate V and the contact-fingers B^5 and B^6, for instance, might form a circuit for the impressed electromotive force at the instant the fingers touch the plates U′ and U^2, thereby short-circuiting the field when the fingers are in operative position and grounding the motor. The position of the fingers referred to is indicated in dotted lines in Fig. 4; but such result will not take place, because the impressed current will be in the opposite direction to the self-induced current in the plate V, and will, therefore, neutralize it and destroy its spark. This neutralization is illustrated in Fig. 3. The current is represented as flowing through the armatures and fields of the motors in the direction indicated by the arrows x. If the current is now broken at some point, as 1, a self-induced current tends to flow around the field in the same direction, and if there is no complete circuit for it it will try to make one for itself by burning out the insulation. If a closed circuit is provided by connecting the points m and n (contact-fingers, for example,) then the self-induced current flows as indicated by the arrows x and y, and gradually dies down, and is hence harmless. If now m and n are slightly separated and the circuit reëstablished at 1, while the self-induced current still continues, a spark will be formed from n to m. The impressed electromotive force, flowing in the direction of the dotted arrow z, tends to arc over from m to n. This incipient arc, however, is neutralized by the arc which the self-induced current has caused, and itself destroys that arc. Hence the two arcs—the one already formed and the other trying to form—destroy each other. It is important that the distance between the short-circuiting contact-plate and the line contact-plates be just a little greater than the width of the contacting face of the contact-fingers.

If the distance is much greater than that width, the self-induced current will have produced harmful effect before the short-circuiting plate comes into action, while if the separating distance is equal to or less than that distance the fingers will connect the line-plates with the short-circuiting plate and thus ground the motor.

Having described my invention, I claim—

1. The combination, with a series-wound electric motor and a controller adapted to entirely open the circuit through the field of the motor, of means for short-circuiting said field just after but not until after said controller has so opened said circuit, substantially as described.

2. The combination with an electric motor and a controller adapted to entirely open the circuit through the field of said motor, of means for short-circuiting said field while leaving the armature-circuit open just after but not until after said controller has so opened said circuit, substantially as described.

3. In a controller, in combination, contact-fingers B^5 and B^6 and contact-plates U′ and U^2 and V disposed substantially as shown, whereby the inside distance between the plates U′ and U^2 is less than the outside distance between the fingers B^5 and B^6 and the distance between the plate V and the plates U′ and U^2 is just a little greater than the width of the said contact-fingers, substantially as described.

4. In a controller, a pair of contact-plates electrically separated from each other, a pair of contact-fingers adapted to contact one with one of said plates and the other with the other of said plates, an electric conductor distant from each of said plates a distance just a little greater than the width of the contacting face of said contact-fingers, said contact-fingers being both adapted to contact with said conductor and thereby become electrically connected, substantially as described.

5. In a controller, in combination, a pair of contact-fingers forming the terminals of a field-coil, a pair of contact-plates adapted to

connect said fingers with a source of electric energy, whereby an electric current may flow through the coil, means for breaking the contact between said fingers and plates and means for connecting said fingers together just after but not until after said contact is broken, substantially as described.

6. In a controller, in combination, a pair of contact-fingers forming the terminals of a field-coil, a pair of contact-plates adapted to connect said fingers with a source of electric energy, whereby an electric current may flow through the coil, and a contact-plate adapted to connect said contact-fingers directly together and thereby short-circuit the said field-coil, the distance between said last-mentioned plate and said first-mentioned pair of plates being a little more than the width of the contacting face of said contact-fingers, substantially as described.

7. In a controller, in combination, contact-fingers forming terminals of the fields and armatures of a pair of motors, two series of contact-plates adapted to engage said fingers, one series operating to connect the motors in series and the other in parallel, and short-circuiting plates adapted to short-circuit the fields of the motors and located substantially midway between the proximate edges of said two series of first-mentioned plates, substantially as described.

8. In a controller for an electric motor, a pair of contact-fingers forming terminals of a field-coil, contact-plates adapted to contact with said fingers when the controller is in running positions and thereby establish the line-circuit through said coil, and a contact-plate adapted to connect together said pair of contact-fingers when the controller is in the off position, substantially as described and for the purpose specified.

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

THORSTEN VON ZWEIGBERGK.

Witnesses:
JOHN J. BEVER,
ALBERT H. BATES.