C. A. BODDIE.

PROTECTIVE MEANS FOR CONTACT TERMINALS.

APPLICATION FILED NOV. 9, 1918.

1,358,701. **Patented Nov. 16, 1920.**

Fig. 1.

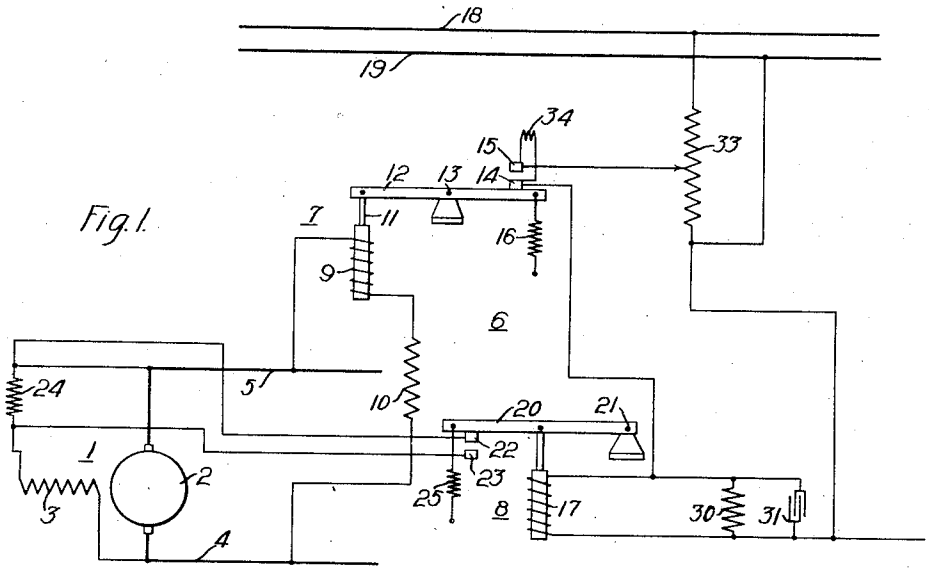


Fig. 2.

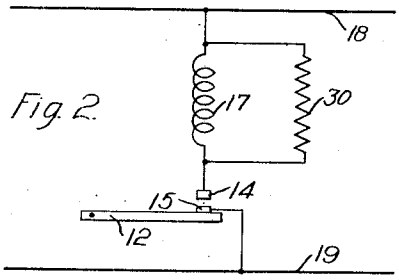


Fig. 3.

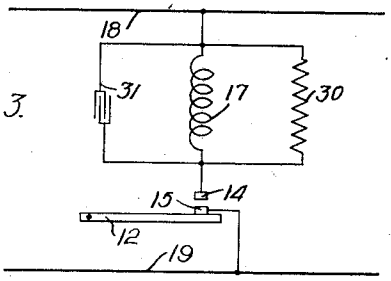


Fig. 4.

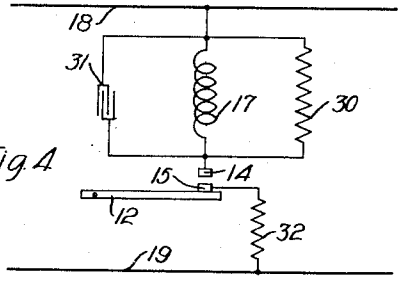
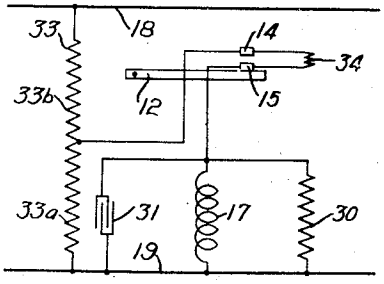


Fig. 5.



WITNESSES:

H. B. Funk.

W. B. Wells.

INVENTOR

Clarence A. Boddie.

BY

Wesley G. Carr

ATTORNEY

UNITED STATES PATENT OFFICE.

CLARENCE A. BODDIE, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

PROTECTIVE MEANS FOR CONTACT-TERMINALS.

1,358,701. Specification of Letters Patent. **Patented Nov. 16, 1920.**

Application filed November 9, 1918. Serial No. 261,925.

To all whom it may concern:

Be it known that I, CLARENCE A. BODDIE, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Protective Means for Contact-Terminals, of which the following is a specification.

My invention relates to protective means for contact terminals and particularly to protective means for the main-contact members of voltage-regulator systems.

One object of my invention is to provide a pair of contact members, with a reactor connected in circuit therewith, that shall insure the contact members against injury from the inductive discharge of any inductance device which may be connected in circuit with them.

In many electrical systems, and particularly in voltage-regulator systems, are contact members, such, for example, as the main-contact members of a regulator, that are adjusted for very delicate operation, and any freezing or sticking of the contact members will, in many cases, destroy the operativeness of the system. Thus, in voltage-regulator systems of the vibratory-contact type, the main-contact members, which are governed by a main-control electromagnet in accordance with the voltage obtaining on a supply circuit, serve to intermittently connect an auxiliary electromagnet across an auxiliary supply circuit and, consequently, the main-contact members are subjected to an inductive discharge from the winding of the auxiliary electromagnet. Inasmuch as the main-control magnet and the main-contact members, which are governed thereby, are very delicately adjusted, it requires but little freezing or sticking of the main-contact members, by reason of inductive discharges, to destroy the operativeness of the regulator. Accordingly, in case currents of relatively high value are to be controlled by the main-contact members, the contact members must be provided with protective means to insure them against sticking or freezing, by reason of the large inductive discharges.

It is proposed to connect a resistor in shunt circuit to the auxiliary-magnet winding of the regulator for dissipating any inductive discharge from the auxiliary magnet that may injure the main-contact members, but such a protective means is only of service for dissipating inductive discharges between very narrow limits. In case a condenser and a resistor are connected in parallel to the winding of the auxiliary magnet, inductive discharges of relatively large value may be dissipated without injury to the main-contact members but, upon closing of the contact members, the charging current for the condenser will, in many cases, cause a freezing together of the contact members. Moreover, a condenser connected directly across the contact members is unsatisfactory by reason of the discharge from the condenser having as detrimental an effect upon the contact members as the inductive discharge from the winding of the auxiliary electromagnet. Upon connecting a resistor and a condenser in series across the main contact members, the operation of the contact members is slightly improved. However, if the resistor is small, a freezing of the contact members is effected by reason of the discharge current from the condenser and, if the resistor is large, the effectiveness of the condenser is largely destroyed.

After considerable experimenting with various arrangements of reactors, it was discovered that, if a resistor of a suitable value was connected in series with the main-contact members and a condenser and a resistor were connected in parallel to the winding of the auxiliary electromagnet, very satisfactory operation of the contact members could be obtained for a wide range of current values. However, inasmuch as a certain amount of energy is stored in a resistor when current is passing through it, some means should be provided for effecting a discharge of the energy stored in the resistors. Accordingly, in accordance with the preferred modification of my invention, the main contact members are connected in series with the winding of the auxiliary electromagnet across a portion of a resistor, which is connected across the auxiliary supply circuit, and a resistor and a condenser are connected in parallel to the winding of the auxiliary electromagnet. Moreover, a protective resistor of a relatively high value is connected directly across the main-contact members.

In the accompanying drawing, Figure 1 is a diagrammatic view of a regulator system embodying my invention, and Figs. 2 to 5,

inclusive, illustrate various arrangements of reactors for protecting the main-contact members of a regulator.

Referring to Fig. 1 of the drawing, a generator 1, comprising an armature 2 and a field winding 3, is connected across a supply circuit, embodying conductors 4 and 5.

The voltage of the generator 1 is controlled by a regulator 6, which embodies a main-control electromagnet 7 and an auxiliary electromagnet 8. The main-control electromagnet 7 embodies a winding 9, which is connected through a resistor 10 across the supply conductors 4 and 5, and a core armature 11, which is pivotally connected to a contact arm 12.

The contact arm 12 is pivotally mounted at 13 and is provided with a main-contact member 14, which coöperates with a stationary main-contact member 15. A spring 16 is connected to the contact arm 12 for counterbalancing the weight of the core armature 11.

The auxiliary electromagnet 8 embodies a winding 17 that is connected to an auxiliary supply circuit, comprising conductors 18 and 19, by means of the main-contact members 14 and 15. The auxiliary magnet is also provided with a core armature that is pivotally connected to a contact arm 20. The contact arm 20 is pivotally mounted at 21 and is provided with a contact member 22, which is adapted to engage a stationary contact member 23. The contact members 22 and 23 are moved to closed position, upon the release of the auxiliary magnet 8, for short-circuiting a resistor 24, which is included in the field circuit of the generator 1. The action of the electromagnet 8 upon the contact arm 20 is opposed by a spring 25.

My invention chiefly involves various arrangements of reactors that are provided in the circuit of the winding 17 for protecting the main-contact members 14 and 15.

Briefly, the operation of the regulator system illustrated in Fig. 1 is as follows: In case the voltage on the supply conductors 4 and 5 is above normal value, then the main-control electromagnet 7 is operated in a manner to close the contact members 14 and 15 and, consequently, connect the auxiliary electromagnet 8 across the supply conductors 18 and 19. Upon energization of the electromagnet 8, the contact members 22 and 23 are separated to insert the resistor 24 in the circuit of the winding 3. Consequently, the voltage of the generator 1 and of the supply circuit, embodying conductors 4 and 5, is reduced. When the voltage on the supply conductors is reduced below normal value, the main-control electromagnet 7 is released to permit the separation of the main-contact members 14 and 15. Upon separation of the main-contact members 14 and 15, the circuit of the auxiliary electromagnet 8 is opened and, consequently, the contact arm 20 is operated by the spring 25 to close the contact members 22 and 23. Upon engagement of the contact members 22 and 23, the resistor 24 is short-circuited to increase the excitation of the generator 1 and, consequently, increase the voltage on the supply conductors 4 and 5.

The intermittent opening and closing of the circuit for the winding 17 of the auxiliary electromagnet 8, by the contact members 14 and 15 produces an inductive discharge from the winding 17 that is very detrimental to the operation of the contact members 14 and 15, inasmuch as, if no provision is made for dissipating the stored magnetic energy, it will cause sparking at the main-contact members.

In Fig. 2 of the drawing, a system of reactances is illustrated wherein the winding 17 of the auxiliary electromagnet 8 is shunted by a resistor 30 to protect the contact members 14 and 15 against inductive discharges from the winding 17. Such a means for protecting the main-contact members is practical only when the stored magnetic energy of the system is small.

In Fig. 3, is illustrated a system of reactors wherein the winding 17 of the auxiliary electromagnet 8 is not only shunted by a resistor 30, but also by a condenser 31. Such an arrangement of reactances is very satisfactory for dissipating the inductive discharges from the winding 17 but, upon closing of the contact members 14 and 15, the charging current for the condenser 31 is very liable to effect a freezing or a sticking of the contact members 14 and 15. The arrangement is, therefore, of no use where delicate control contacts are involved.

Referring to Fig. 4 of the drawing, a system of reactors is disclosed for protecting the main contact members that is very satisfactory over a wide range of current values. In the system illustrated in Fig. 4, a condenser 31 and a resistor 30 are connected in parallel to the winding 17, and a resistor 32 is provided in series with the contact members 14 and 15. The condenser 31 and the resistor 30 serve to prevent injury to the contact members 14 and 15 by the inductive discharges from the winding 17, and the resistor 32 serves to prevent an excessive charging current for the condenser 31 from passing through the main-contact members 14 and 15.

It is well known that more or less energy may be stored in resistors and, in order to take care of the energy which may be stored in the resistors shown in the system disclosed in Fig. 4, an improved system of reactors, such as is disclosed in Fig. 5, is provided. In the system illustrated in Fig. 5, a resistor 33, which is divided into portions 33^a and 33^b, is connected di-

rectly across the supply conductors 18 and 19, and the winding 17, which is shunted by the condenser 31 and the resistor 30, is connected in shunt to the resistor section 33^a by means of the main contact members 14 and 15. Moreover, a protective resistor 34, of a relatively high value, is connected across the contact members 14 and 15. The resistor section 33^a serves as a by-pass for freeing the contact members from any discharge from the resistor 33^b. The system of reactances shown in Fig. 5 has also been illustrated in Fig. 1 and any further description of Fig. 1, in connection with the various reactances, is deemed unnecessary.

Modifications in the system and arrangement and location of parts may be made within the scope of my invention, and such modifications are intended to be covered by the appended claims.

I claim as my invention:

1. In an electrical system, a supply circuit, a pair of contact members for bridging the supply circuit, an inductance device in series with said contact members, and means comprising a resistor and a condenser connected in parallel to said inductance device for protecting the contact members against inductive discharges.

2. In an electrical system, a supply circuit, a pair of contact members for bridging said supply circuit, an inductance device in series with said contact members, means comprising a resistor and a condenser connected in parallel to said inductance device for protecting the contact members against inductive discharges, and a resistor in series with the contact members for limiting the current flow through the condenser upon closure of the contact members.

3. In an electrical system, a supply circuit, a two-part resistor connected across the supply circuit, a pair of contact members for establishing a circuit in shunt to one portion of said resistor, an inductance device in said shunt circuit, and a condenser and a resistor connected in parallel to said inductance device for protecting the contact members against inductive discharges.

4. In an electrical system, a supply circuit, a resistor connected across the supply circuit, a pair of contact members for establishing a circuit in shunt to a portion of said resistor, an inductance device in said shunt circuit, a protective resistor of relatively high value connected across the contact members, and a condenser and a resistor connected in parallel to said inductance device for protecting the contact members against inductive discharges.

5. In an electric system, a supply circuit, a resistor and a pair of contact members connected in series across the supply circuit, an inductance device in series with said contact members, a protective resistor of relatively high value connected across the contact members, and a condenser and a resistor connected in parallel to the inductance device for protecting the contact members against inductive discharges.

6. In a regulator system, a main-control electromagnet operated in accordance with the voltage obtaining on a supply circuit, an auxiliary electromagnet, a pair of main-contact members for connecting the auxiliary magnet across an auxiliary supply circuit, and a resistor and a condenser connected in parallel to said auxiliary electromagnet for protecting the main-contact members against inductive discharges.

7. In a regulator system, a main-control electromagnet, an auxiliary electromagnet, a supply circuit, a pair of contact members governed by the main-control electromagnet for connecting the auxiliary magnet across the supply circuit, a protecting resistor of relatively high value connected across the contact members, and a condenser and a resistor connected in parallel to the auxiliary magnet for protecting the contact members against inductive discharges.

8. In a regulator system, a main-control electromagnet, an auxiliary electromagnet, a supply circuit, a resistor, a pair of contact members governed by the main-control magnet for connecting the auxiliary magnet in series with said resistor across the supply circuit, and a condenser and a resistor connected in parallel to the auxiliary magnet for protecting the contact members against inductive discharges.

9. In a regulator system, a main-control electromagnet, an auxiliary electromagnet, a supply circuit, a two-part resistor connected across the supply circuit, a pair of contact members goverened by the main-control electromagnet for connecting the auxiliary magnet in series with one portion of said resistor across the supply circuit, a protective resistor of relatively high value connected across the contact members, and a condenser and a resistor connected in parallel to said auxiliary magnet for protecting the contact members against inductive discharges.

In testimony whereof I have hereunto subscribed my name this 31st day of Oct., 1918.

CLARENCE A. BODDIE.