No. 762,671. PATENTED JUNE 14, 1904.

W. S. ANDREWS.

AUTOMATIC POTENTIAL REGULATOR.

APPLICATION FILED OCT. 1, 1902.

NO MODEL.

FIG. 1.

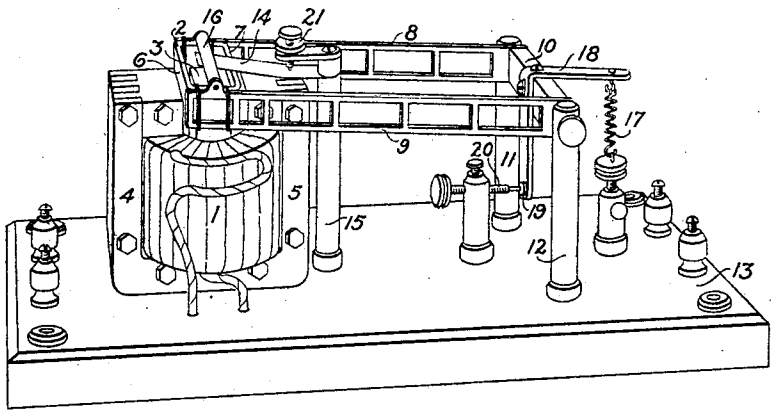
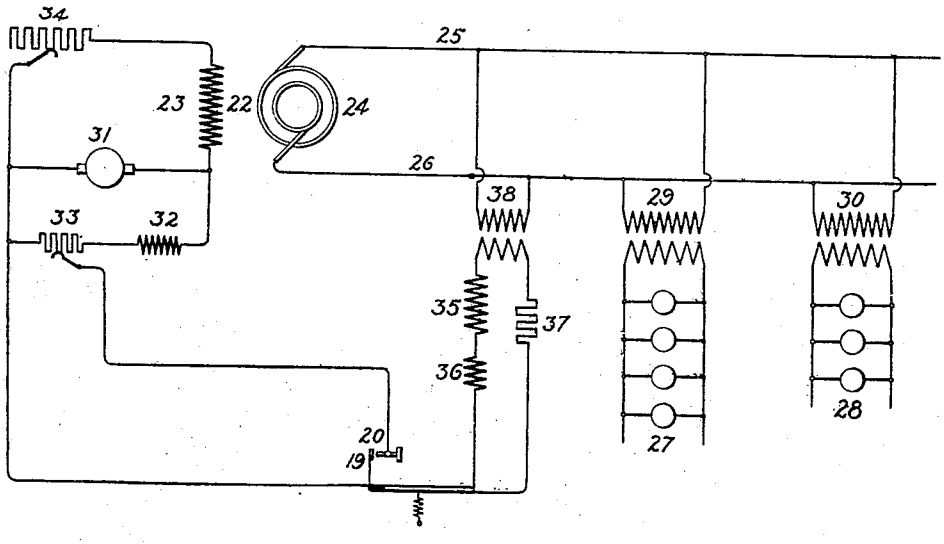


FIG. 2.



WITNESSES:

Harry A. Tilden

Helen Wilford

INVENTOR:

William S. Andrews.

by Albert G. Davis

Atty.

No. 762,671. Patented June 14, 1904.

UNITED STATES PATENT OFFICE.

WILLIAM S. ANDREWS, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

AUTOMATIC POTENTIAL-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 762,671, dated June 14, 1904.

Application filed October 1, 1902. Serial No. 125,577. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM S. ANDREWS, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Automatic Potential-Regulators, of which the following is a specification.

My present invention relates to electric regulators, and more particularly to that class of regulators employed for controlling the voltage of alternating-current generators, and comprises certain improvements pointed out with particularity in the appended claims and described in detail in the following specification, which is to be taken in connection with the accompanying drawings, in which—

Figure 1 is perspective view of a regulator embodying my invention; and Fig. 2 is a diagram of a system of electrical distribution, illustrating the connections for my regulator as used in practice.

In applying my improved regulator to the control of voltage of alternating-current generators I connect it so that it responds to the voltage of the generator and operates under the influence of variations in said voltage to rapidly vary the resistance in the field of the exciter for said generator in such a manner as to hold the voltage of the generator constant at any desired value.

In carrying my invention into practice I make use of contacts which open and close a shunt-circuit about a resistance in series with the field of the exciter, and these contacts I control by means of a species of dynamometer instrument excited by current from the mains of the generator.

In Fig. 1, 1 represents the regulating instrument in perspective, the two actuating-coils of the instrument being represented at 1 and 2. The coil 1 is fixed and operates to produce a magnetic field varying in response to variation of voltage of the alternating-current generator. In order to localize this field and render it as intense as possible, I provide the coil with a laminated magnetic core having a central member 3 extending through and surrounded by the coil and having branches 4 5 extending from the lower end of the central member and upon opposite sides of the coil 1 into proximity to the projecting portion of the central member 3 indicated. The movable coil 2 surrounds the projecting portion of the member 3, so that its opposite sides 6 7 move within the narrow spaces formed between the projecting member 3 and the adjacent inward projections of the branches or members 4 and 5 of the core.

The movable coil 2 is supported by a skeleton frame consisting of two arms 8 and 9 of open-work construction secured to a pivoted cross-bar 10. This cross-bar is pivoted between two standards 11 and 12, carried by the base 13, upon which the regulating mechanism as a whole is mounted. A leaf-spring 14, carried by a standard 15, engages at its outer end a small cross-bar 16, extending across the outer end of the skeleton frame 8 and 9 and supplies a yielding resistance to the movement of the coil 2 in the field produced by the fixed coil. This spring serves in large measure to take up or damp out the small vibrations produced by the varying pull on the movable coil due to the alternating character of the current flowing therein. Another spring 17 operates upon one arm of a bell-crank-shaped piece of metal 18, secured to the pivoted bar 10 and carrying on its other arm a contact 19, arranged in operative relation to an adjustable fixed contact 20. The helical spring 17, to which reference has just been made, serves as the chief retracting means for the pivoted member and may be adjusted so as to vary the opposition to movement of the movable coil 2 relatively to the magnetic field produced by the stationary coil 1. The leaf-spring 14 may also be controlled by the adjusting-screws 21 to produce the adjustment desired.

In Fig. 2 the alternating-current generator is represented conventionally at 22, the field-magnet winding being indicated at 23 and the

collector-rings at 24. From these collector-rings extend mains 25 and 26, by which current may be supplied to translating devices of any desired character—such, for example, as motors, electric lights, or the like. Banks of lamps 27 and 28 are, by way of example, represented as being supplied with current from the mains through step-down transformers 29 and 30, respectively.

The exciter for the alternating-current generator is provided with an armature (indicated at 31) and a shunt field-circuit having a field-winding 32 and a resistance 33 in series therewith. This exciter supplies current to the field-winding 23 of the alternator, in series with which is a regulating resistance 34.

The regulator shown in Fig. 1 is indicated in diagram in Fig. 2 by the coils 35 and 36, which indicate, respectively, the fixed and movable coils 1 and 2 of Fig. 1. These coils are in series with each other and with an adjustable current-reducing resistance 37 and are supplied with current from the secondary of a transformer 38, the primary of which is connected across the mains 25 and 26. If desired, this transformer may be omitted and the regulator connected directly across the mains 25 and 26.

The contacts 19 and 20 in Fig. 1 are represented by the corresponding numerals in Fig. 2, and these contacts, it will be noted, are connected, respectively, across the whole or a portion of the resistance 33 in series with the filed 32 of the exciter.

Any slight increase in voltage across the generator-mains causes a separation of these contacts and a consequent open-circuiting of the short circuit across the resistance 33. This sudden increase in resistance in the field-circuit of the exciter immediately decreases the exciter voltage, and this in turn decreases the voltage of the generator, thereby decreasing the force exerted between the coils of the regulator and permitting the contacts to come together again, thereby closing the short circuit across the resistance in the field of the exciter. In practice the opening and closing of these contacts goes on so rapidly that the voltage is held practically steady under all conditions of load and speed within reasonable limits.

By locating the contacts 19 and 20 at a distance from the axis of movement of the movable coil, relatively small compared with the distance between the coil itself and its axis, I am enabled to obviate the interference with the make and break at the contact-points which would otherwise be caused by the buzz or tremble due to the alternations of the current supplied. This buzz or tremble is transmitted from the movable coil 2 to the supporting arms or levers 8 and 9, but becomes weaker and weaker as it approaches the axis and is of negligible effect upon the contacts 19 and 20, which are at a relatively small distance from the axis. The density of the flux in which the coil 2 moves is such that a small variation in the alternating electromotive force causes a considerable change in the position of the movable coil 2. The movement of this latter coil, due to changes of voltage, being thus relatively large in comparison with its vibratory motion caused by the alternating field permits the contacts 19 and 20 to open and close in response to small variations in voltage, but renders them insensitive to the vibration or tremble due to the alternation of the current in the regulating-coil.

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

1. In a potential-regulator, the combination of a fixed magnetizing-coil, a movable coil in series therewith and movable within a field produced by said fixed coil, a pivoted lever carrying said movable coil, means for urging the movable coil in opposition to the force exerted between said movable coil and the field of the fixed coil, a contact movable by the pivoted lever and mounted at a distance from the axis of oscillation of said lever less than the distance from said axis to the movable coil, and a coöperating fixed contact.

2. In a potential-regulator, the combination of two coils arranged to be supplied with current from the same source and mounted so as to move relatively to each other, a laminated magnetic core for one of the coils, a pivoted support for the other coil, and a contact moved by said pivoted support and arranged so that slight relative motion between said coils produces no appreciable movement of said contact, and a fixed contact coöperating with said movable contact.

3. In a potential-regulator, the combination of a fixed magnetizing-coil, a central core therefor having extensions of magnetic material forming branch magnetic circuits and extending around the outside of the coil and into proximity to a projecting portion of the central core, a movable coil surrounding the projecting portion of the core, a skeleton support or lever for said movable coil, a spring arranged to oppose the motion of said coil in the field produced by the magnetizing-coil, a movable contact mounted at a relatively short distance from the axis of the skeleton support, and a coöperating fixed contact.

4. The combination of an alternating-current generator, an exciter therefor, a resistance in the field of said exciter, and a potential-regulator for said exciter consisting of two relatively movable electrically-connected coils supplied with current varying in response to variation of the voltage of said generator, contacts controlled by said coils, and connections between said contacts adapted when said

contacts are closed to short-circuit a chosen portion of said resistance.

5. The combination of a coil, a magnetic core having a central member passing through the coil and provided with extensions forming branch magnetic circuits extending around the outside of the coil and into proximity to a projecting portion of said central member, and a pivotally-supported coil movable over said projecting portion of the central core.

In witness whereof I have hereunto set my hand this 29th day of September, 1902.

WILLIAM S. ANDREWS.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.