F. E. RICKETTS.

ELECTRIC REGULATOR.

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1,146,956. Patented July 20, 1915.

Fig. 1.

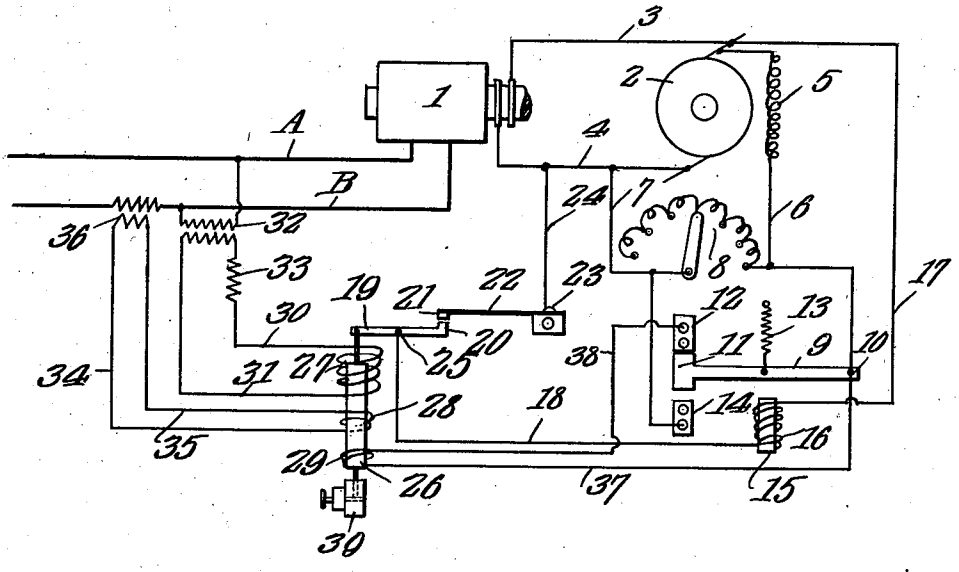
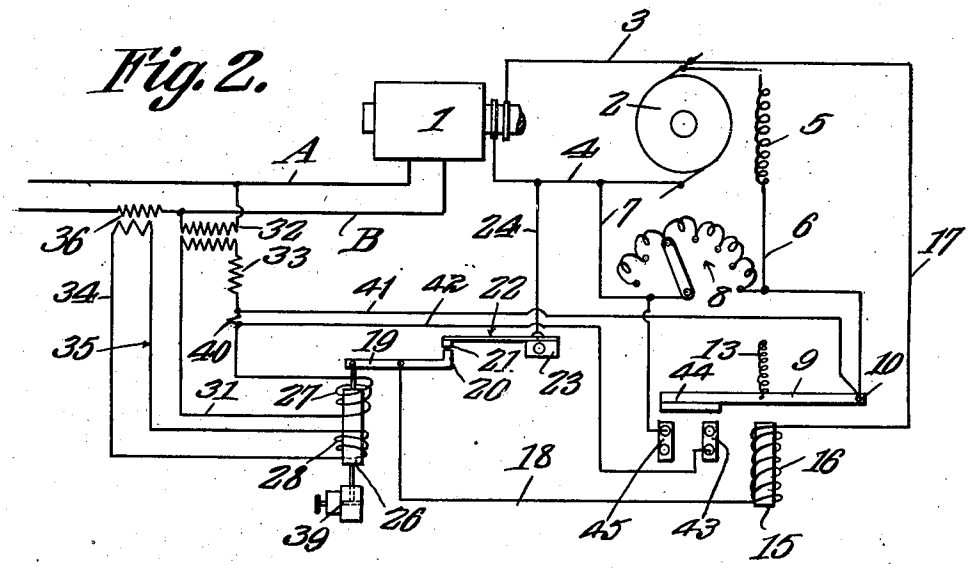


Fig. 2.



WITNESSES

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ELECTRIC REGULATOR.

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To all whom it may concern:

Be it known that I, FORREST E. RICKETTS, a citizen of the United States, residing in the city of Baltimore and State of Maryland, have invented a new and useful Improvement in Electric Regulators, of which the following is a specification.

My invention relates to the regulation of electric generators and is particularly adapted to the control of the potential delivered to the line from large alternating current generators, the field coils of which are separately excited.

The object of the present invention is to provide a regulator adapted to vary the current in the field circuit of a generator to compensate for changes in the armature circuit.

In accordance with the invention means are provided for controlling the field current of the exciter in accordance with the requirements of the armature circuit of the generator.

In the preferred embodiment of the invention an automatic switch is placed in parallel with the field resistance of the exciter, and a movable contact responsive to changes in the armature circuit of the generator is provided for operating the switch. As the armature circuit of the generator does not instantly respond to the movement of the contact so as to prevent the contact from moving beyond the normal position, means are provided for making the contact directly responsive to its own movement which prevents the contact from moving beyond normal first in one direction and then in the other.

The invention will be best understood from a consideration of the following description taken in connection with the accompanying drawing forming a part of the specification, in which drawing,

Figure 1 is a diagram of a portion of an electric generating system with the controlling means of the present invention incorporated. Fig. 2 is a similar view showing a somewhat different arrangement of the controlling means of the present invention.

Referring first to Fig. 1 there is shown a generator —1— which is assumed to be driven by power supplied from any convenient source and furthermore is assumed to have a rotating field and a stationary armature. The field current is furnished, in the system illustrated in Fig. 1, by means of an exciter —2, the armature of which is connected to the field coils of the generator through mains 3 and 4. Exciter 2 has a field coil 5 one terminal of which is connected to main 3 while the other terminal is connected by means of conductors 6 and 7 through an adjustable resistance —8 to main 4. A movable iron switch lever —9 is pivoted at 10 and carries a contact —11 which is brought into engagement with a contact —12 by a spring —13 and into engagement with a contact —14 when a magnet —15 overpowers the spring. The lever 9 is electrically connected to conductor 6 and contact 14 is connected to conductor 7, so that when contact 11 engages contact 14 the resistance 8 is short circuited. The magnet 15 has a winding —16 one terminal of which is connected to conductor 3 by conductor 17 while the other terminal is connected through conductor 18 to a switch lever —19. The lever 19 carries a contact —20 adapted for engaging a contact —21, mounted on a spring —22, supported at 23 and connected through a conductor —24 to conductor 4, so that when contacts 20 and 21 are in engagement the coil 16 is energized from mains 3 and 4 so as to bring contact 11 into engagement with contact 14 to short circuit the resistance 8. The switch lever 19 is pivoted at 25 and at the end remote from the contact 20 is attached to a magnet —26, the weight of which tends to close contacts 20 and 21. About the magnet 26 there are wound three coils, —27, 28 and 29. Coil 27 is connected through conductors 30 and 31 to the secondary coil of a voltage transformer —32 the primary coil of which is connected across mains A and B which form a part of the armature circuit of the generator 1. Intermediate the conductor 30 there is a resistance —33 the object of which is to hold the current in the circuit of coil 27 substantially in phase with the voltage of the transformer 32. The function of the coil 27 is to lift the magnet 26 against gravity to open contacts 20 and 21. The coil 28 is connected through conductors 34 and 35 to the secondary coil of a current transformer —36, the primary coil of which is in series with conductor B. The function of coil 28 is to oppose the action of coil 27 so that the voltage required on mains A and B to separate contacts 20 and

21 will increase as the current in conductor B increases. One terminal of coil 29 is connected through a conductor —37 to the lever 9 while the other terminal is connected through a conductor —38 to contact 12. The function of coil 29 is to form a short circuit about the magnet 26 when contacts 11 and 12 are together to thereby oppose the magnetism of coil 27 and allow contact 20 to move toward contact 21. But when contact 20 touches contact 21 magnet 15 attracts lever 9 to separate contacts 11 and 12 which opens the circuit of coil 29 so that the opposition of coil 29 to coil 27 ceases and contact 20 moves away from contact 21. To prevent the contact 20 from moving too quickly a dash pot 39 is attached to the magnet 26. When the voltage of the armature circuit of the generator decreases, the voltage of the secondary of transformer 32 will decrease and therefore the current in coil 27 will decrease allowing contact 20 to engage contact 21. This will allow coil 16 to become energized, which will cause magnet 15 to attract lever 9 and move contact 11 from contact 12 to contact 14 which will short circuit resistance 8 to increase the voltage of exciter 2 and at the same time open the circuit of coil 29, so that by the time the increased exciter voltage affects the generator to increase the voltage of mains A and B, coil 29 will no longer oppose coil 27, and therefore magnet 26 will immediately respond to the increased voltage of mains A and B to open contacts 20 and 21. But as soon as contacts 20 and 21 separate the circuit of coil 16 will be opened and the spring 13 will pull contact 11 from contact 14 to contact 12, opening the short circuit around resistance 8 to decrease the voltage of the exciter and as the coil 29 is short circuited by contact 11 engaging contact 12, coil 29 will again oppose coil 27 so that by the time the voltage of mains A and B responds to the decrease in the exciter voltage a smaller decrease in voltage will be required to separate contact 20 and 21 than if coil 29 had remained open circuited. It will be seen from this that if coil 29 is properly proportioned to coil 27 the contact 20 will be operated almost entirely by the action of coil 29 on magnet 26 which will result in the voltage on mains A and B remaining substantially constant. As the load on main B increases, however, coil 28 will oppose more and more coil 27, resulting in the voltage on A and B being increased as the load on mains A and B increases.

The system shown in Fig. 2 is substantially the same as that shown in Fig. 1, except that the coil 29 is omitted while a similar effect to that produced by coil 29 on coil 27 in Fig. 1 is obtained by inserting in conductor 30 a resistance —40 and connecting conductors 41 and 42 one on either side of resistance 40. Further, the contact 43 is arranged so that it is in contact with contact 44 when magnet 15 is energized. When the regulator as shown in Fig. 2 is in operation a decrease in voltage on mains A and B will cause the current in coil 27 to decrease and allow magnet 26 to drop and close contacts 20 and 21 which will allow current to flow through the circuit of the coil 16 and magnetize core 15 to attract lever 9 and bring contact 44 into engagement with contacts 43 and 45. This will short circuit the resistance 8 which will cause the exciter voltage to increase, but as contact 44 also is in contact with contact 43, the resistance 40 will be short circuited, which will increase the current in coil 27 so that by the time the voltage of mains A and B respond to the increased exciter voltage the magnet 26 will already be moving in the direction to open contacts 20 and 21. When contacts 20 and 21 separate the circuit of coil 16 will be interrupted which will cause magnet 15 to release lever 9 when contact 44 will move away from contacts 43 and 45 relieving the short circuit around resistance 8 to allow the exciter voltage to decrease, but at the same time the short circuit around resistance 40 will be broken which will decrease the current in coil 27 by cutting resistance 40 in its circuit so that by the time the voltage of mains A and B responds to the decrease in the exciter voltage, the magnet 26 will already be moving in the direction to separate contacts 20 and 21, thereby preventing any lag in the movement of contact 20 to respond to changes in the voltage of mains A and B.

The coil 28 opposes the operation of the coil 27 to compensate for changes of load on mains A and B as described with reference to Fig. 1.

The regulator herein described operates without attention to control the electric condition of the circuit to which it is connected, and is extremely effective in preventing the exciter voltage from varying beyond the value necessary to maintain in the armature circuit of the generator the electric condition for which the regulator is adjusted.

It will be understood that I have illustrated my invention diagrammatically, and in practice other modifications than those shown will be possible while still retaining the salient points of the invention.

What is claimed is:—

1. An electrical regulator comprising an actuating magnet, main and auxiliary windings therefor, the auxiliary winding being disconnected from a source of energy, and means for opening and closing a short circuit including the auxiliary winding.

2. An electrical regulator comprising an actuating magnet, main and auxiliary windings therefor arranged to act in opposition, the auxiliary winding being disconnected

from a source of energy, and means for opening and closing a short circuit including the auxiliary winding.

3. An electrical regulator comprising cooperating contact members, an actuating magnet therefor, main and auxiliary windings for the magnet, the auxiliary winding being disconnected from a source of energy, and means controlled by the contact members and in turn opening and closing a short circuit including the auxiliary winding.

4. An electrical regulator comprising cooperating contact members, an actuating magnet therefor, a main and an opposing auxiliary winding for the magnet, the auxiliary winding being disconnected from a source of energy, and means controlled by the contact members and in turn opening and closing a short circuit including the auxiliary winding.

5. In an electrical regulator, the combination with a regulating resistance, coöperating contact members, an actuating magnet for the contact members, and main and auxiliary windings for the magnet, of a relay controlled by the contact members and comprising an intermediate and two outer contact members, the regulating resistance being short circuited when the intermediate contact member engages one of the outer contact members, and the auxiliary winding being short circuited when it engages the other outer contact member.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

FORREST E. RICKETTS.

Witnesses:

JOHN T. FARDY,

STEPHEN D. BROADBENT.