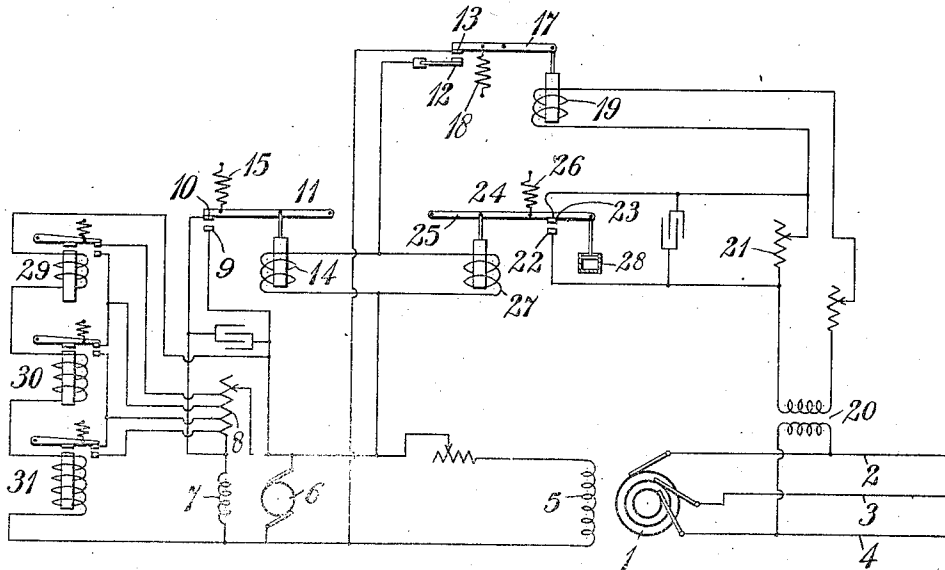


A. A. TIRRILL.
ELECTRICAL REGULATOR.
APPLICATION FILED OCT. 5, 1911.

1,252,060.

Patented Jan. 1, 1918.



WITNESSES:

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ELECTRICAL REGULATOR.

1,252,060.

Specification of Letters Patent.

Patented Jan. 1, 1918.

Application filed October 5, 1911. Serial No. 653,012.

To all whom it may concern:

Be it known that I, ALLEN A. TIRILL, 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 Electrical Regulators, of which the following is a specification.

My invention relates to electrical regulators, and it has for its object to provide a simple and effective regulator of the kind in which the regulation is effected by adjustment of the field excitation of a dynamo-electric machine.

The single figure of the accompanying drawing diagrammatically illustrates a system embodying my invention.

A system in connection with which the present invention may be conveniently employed comprises an alternating current generator having an armature 1, that is connected to a suitable distributing circuit 2—3—4, and a field magnet winding 5, that is supplied from the armature 6 of an exciter. The exciter is provided with a field magnet winding 7 that is preferably shunt excited, though if desired, it may receive exciting current from any other suitable source. In series with the field winding 7 is a resistor 8, the terminals of which are connected to contact members 9 and 10 respectively, of a relay 11, which constitutes a part of the regulator.

The regulator comprises also another pair of contact members 12 and 13 that control the circuit of an actuating winding 14 for the movable contact terminal 10 of the relay 11, the said winding serving, when energized, to draw the contact terminal 10 downwardly into engagement with the terminal 9, against the tension of a spring 15. The contact terminal 12 is preferably resiliently mounted, and the terminal 13 is carried upon one end of a lever 17 and is normally held in engagement with the terminal 12 by means of a spring 18 acting in opposition to a winding 19 that serves, when sufficiently energized, to raise the contact 13 out of engagement with the terminal 12 and that receives energy, through a transformer 20, that is proportional to the voltage of the distributing circuit 2—3—4. In series with the winding 19 is a resistor 21 that is adapted to be shunted by a pair of cooperating contact terminals 22 and 23 which constitute parts of a relay 24. The movable con-

tact terminal 23 of the relay is carried by a lever 25 and is adapted to be drawn into engagement with the terminal 22, against the tension of a spring 26, by means of an actuating winding 27 that is connected in parallel with the winding 14 of the relay 11 and the circuit of which is controlled by the contact terminals 12 and 13 in the same manner as the circuit of the winding 14 is controlled. The windings 14 and 27 receive energy from the exciter, though, if desired, they may be connected to any other suitable source of current. The movements of the contact terminal 23 of the relay 24 are preferably somewhat retarded by means of a dash pot 28, so that the contact terminals 22 and 23 will engage and disengage a slight period of time after the engaging and disengaging of the contact terminals 9 and 10.

Means are also provided for automatically adjusting the value or effective length of the resistor 8, in accordance with the value of the exciter voltage, the said means comprising a plurality of relay switches 29, 30 and 31 that are adapted to close at different values of the exciter voltage and to thereby successively shunt portions of the said resistor, intermediate points of which are suitably connected to the contact members of the switches. In order to provide for successive closure of the switches, their actuating windings are here shown as connected in series between the terminals of the exciter, though other suitable means may be employed to secure this result. By the provision of these means the fluctuations of the voltage during the operation of the regulator are lessened, since, at the higher field excitations, where such fluctuations are otherwise most noticeable, the amount of exciter field resistance that is periodically shunted is lessened.

In operation the regulator tends, through the relay contact terminals 9 and 10, to vary the field excitation of the exciter so as to compensate for variation in the voltage of the distributing circuit. To this end the contact terminal 13 is moved into and out of engagement with the terminal 12, by means of the winding 19 and the spring 18, in accordance with the variations of the voltage of the distributing circuit 2—3—4, thereby establishing and interrupting the circuits of the relay actuating windings 14 and 27. Upon energization of the windings 14 and 27, the relay contact

terminals 10 and 23 are drawn into engagement, respectively, with the terminals 9 and 22, the engagement of the terminals 22 and 23 being somewhat delayed by the dash pot 5 28. Upon engagement of the contact terminals 9 and 10, the resistor 8 in the exciter field circuit is shunted and the exciter field strength and voltage are thereby increased. The increase of the exciter voltage is fol- 10 lowed by an increase of the generator field strength and voltage, with the result that the winding 19 is more strongly energized, and the contact terminal 13 is thereby moved out of engagement with the terminal 12.

15 On account of the inductances of the respective field circuits of the exciter and the generator, the change of the voltage of the distributing circuit, resulting from the shunting of the resistor 8 in the exciter field 20 circuit, is delayed materially after the said shunting operation has occurred. In order that the generator voltage may not be unduly changed, followed by a fluctuation or "hunting" thereof, the relay 24 is provided 25 for the purpose of shunting the resistor 21 in the circuit of the winding 19 a short time subsequent to the shunting of the resistor 8 in the exciter field circuit, and to open the shunt to the resistor 21 subsequent to 30 the opening of the shunt to the resistor 8. Upon establishing a shunt to the resistor 21, more current is permitted to flow through the winding 19, with the result that it will be sufficiently energized to effect separation 35 of the terminals 12 and 13 prior to the time that such separation would occur if brought about solely by an increase of the voltage of the circuit 2—3—4. The various corresponding contact terminals of the regulator are 40 moved into and out of engagement in such

manner that the excitation of the exciter is governed so as to maintain the voltage of the distributing circuit 2—3—4 substantially uniform or at a required value, and also so as to restore the same promptly to a 45 condition of equilibrium after it has been changed, as, for instance, by a sudden fluctuation of load.

Since the present regulator operates to effect the desired regulation by adjustment 50 of the field excitation of the generator, it is evident that it may be employed for regulating in accordance with variations of any other electrical condition of a generator or circuit than the voltage by simple and obvi- 55 ous changes of the connections of the winding 19, or by the substitution therefor of other suitable means for varying the position of the terminal member 17, all within the spirit of the present invention. 60

I claim as my invention:

The combination with an electrical circuit, and a dynamo-electric machine associated therewith, of a regulator for the dynamo-electric machine comprising coöperating 65 contact members, an actuating winding therefor energized from said circuit, and relay devices controlled by the contact members for governing the field excitation of the dynamo-electric machine and the degree of 70 energization of the said winding, the latter relay device being retarded in its operation.

In testimony whereof, I have hereunto subscribed my name this 3rd day of October, 1911.

ALLEN A. TIRRELL.

Witnesses:

OTTO S. SCHAIRER,
B. B. HINES,