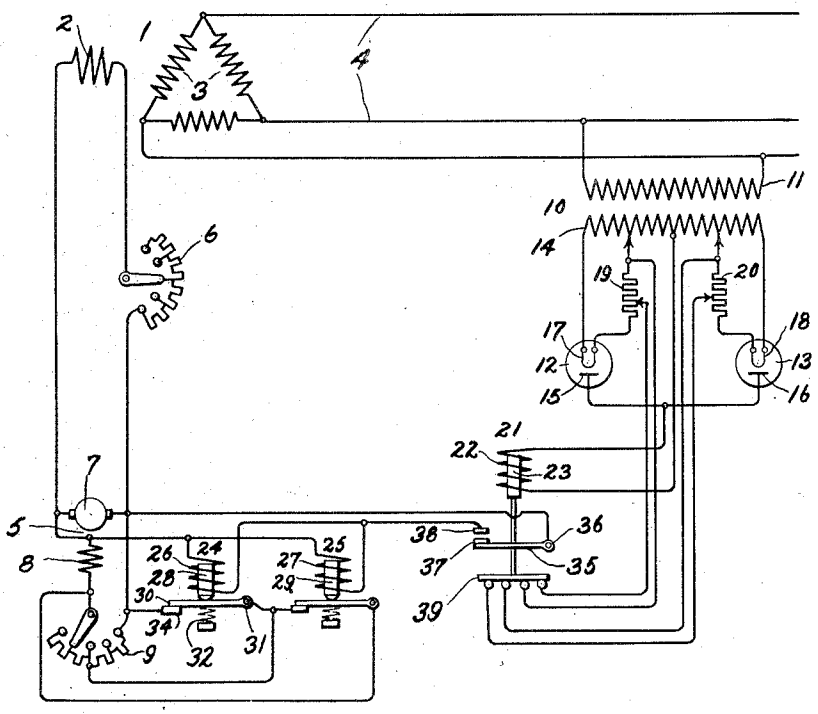
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L. W. THOMPSON

REGULATING SYSTEM

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Inventor:
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UNITED STATES PATENT OFFICE.

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REGULATING SYSTEM.

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My invention relates to regulating systems, and has for its object the provision of an improved regulator which comprises an anti-hunting device of rugged and simple construction.

It is customary to provide a regulator with anti-hunting means designed to eliminate periodic pulsations or changes in an electrical condition of the circuit to be controlled. In the past these anti-hunting means have comprised a relay or a relay coil arranged to anticipate and obviate the production of a condition apt to produce periodic pulsations in voltage and current of the circuit to be regulated. In accordance with my invention, the use of such a relay or relay coil is rendered unnecessary and the construction of the regulator as a whole is greatly simplified.

My invention will be better understood on reference to the following description when considered in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Referring to the drawing, the single figure thereof is a diagrammatic showing of a regulating system wherein my invention has been embodied.

The drawing shows an alternating current machine 1, comprising a field winding 2 and an armature winding 3 operatively associated with the polyphase line 4. The field winding 2 is arranged to be supplied with current from an exciter 5 through an adjustable resistor 6. The exciter 5 comprises an armature winding 7 and a field winding 8 adapted to be connected in series with a field resistor 9 between the exciter armature terminals. The effective resistance of the exciter field circuit is regulated in accordance with the voltage of the polyphase line 4. This result is accomplished through a transformer 10 having its primary winding 11 connected to the polyphase line 4 and its secondary winding associated with one or more space discharge devices of the thermionic type or electron discharge tubes through which a plurality of relays are operated to control the effective field resistance of the exciter.

I have shown two electron discharge tubes 12 and 13 associated with the secondary 14 of the transformer 10. It will be apparent, however, that two tubes are required only where it is desired to rectify both sides of the alternating current wave and thus to avoid inoperativeness of the regulating apparatus, due to failure of one of the tubes. The tubes 12 and 13 are provided with plates 15 and 16 respectively and with filaments 17 and 18, each adapted to be supplied with heating current from a different section of the secondary winding 14. A resistor 19 is connected in series with the filament 17 and a like resistor 20 is connected in series with the filament 18.

Current from the tubes 12 and 13 is supplied to a relay 21 comprising a coil 22 and an armature 23. The relay 21 is provided to control operation of the relays 24 and 25 which are arranged to short-circuit different portions of the exciter field rheostat 9. The relays 24 and 25 are provided with operating coils 26 and 27 arranged to operate the armatures 28 and 29 respectively. When the coil 26 is not energized, the armature 28 rests upon the member 30 which is pivoted at the point 31 and is held against the pressure of a spring 32 to cause engagement of the relay contact 34. When the coil 26 is energized, the armature 28 is raised and the contact 34 is disengaged by the spring 32. The operation of the relay 25 is similar to that of the relay 24 and will be readily understood without further explanation. If desired, the relays 24 and 25 may be designed to have different degrees of sensitivity so that they operate in succession to short circuit different portions of the rheostat 9.

The armature 23 of the relay 21 is operatively associated with a member 35 pivoted at the point 36 and provided at its left hand end with a contact 37 arranged to cooperate with a contact 38 for controlling the connection of the relay coils 26 and 27 to the

armature terminals of the exciter 5. The member 35 is also provided with a back contact 39 for controlling the resistance connected in series with filaments of the tubes 12 and 13 to prevent hunting in a manner hereinafter explained.

The operation of my invention will now be readily understood. If the voltage of the line 4 is slightly below normal, the relays 21, 24 and 25 will be in the positions indicated and all of the resistor 9 will be excluded from the field circuit of the exciter 5. Under these conditions, the excitation of the machine 1 is a maximum and the voltage of the line 4 will tend to rise. If this voltage exceeds its normal value, sufficient current to raise the armature 23 and close the contacts 37 and 38 is supplied through the tubes 12 and 13 to the coil 22. When this occurs, the coils of the relays 24 and 25 are energized and the more sensitive of these relays, relay 24 for example, is opened to increase the resistance of the exciter field circuit. This increase in resistance produces a decrease in the excitation and voltage of the machine 1 and may be sufficient to restore normal voltage on the line 4. In this case, the relay 21 opens before opening of the less sensitive relay 25. If the relay 21 does not open, however, the opening of the relay 24 is followed by operation of the relay 25 and the exciter field circuit resistance is raised to its maximum value. The effective resistance of the exciter field circuit is determined by the vibratory action of the relays 21, 24 and 25. These relays are designed to respond to slight variations from the normal voltage of the line 4 and by the rapidity of their vibration determine the proportion of time during which the exciter field resistor is short circuited. In this manner, variations in the voltage of the line 4 are maintained within narrow limits.

The relay 21 functions both to control energization of the relays 24 and 25 and to actuate anti-hunting means comprising filament resistors 19 and 20 and back contact 39 through which these resistors are altogether or partially short-circuited when the relay 21 is in its illustrated open position. Upon closure of the relay 21, the resistance of the filament circuit is increased. This reduces the current supplied through the tubes to the operating coil 22 and accelerates the opening of the relay 21, thereby anticipating abnormal pulsations in the voltage of the line and preventing hunting.

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

1. An electric circuit regulator comprising a relay for causing a change to be produced in an electrical condition of a circuit to be regulated, an electron discharge device connected to respond to variations in the electrical condition of said circuit for controlling the actuation of said relay, and means operable in response to actuation of said relay for controlling said device to prevent hunting.

2. A regulator for an electric circuit comprising a relay for causing a change to be produced in an electrical condition of said circuit, a hot cathode tube operably associated with said circuit for controlling the actuation of said relay in accordance with variations in the electrical condition of said circuit, and means operable in response to actuation of said relay for changing the temperature of the cathode of said tube for preventing hunting.

3. An electric circuit regulator comprising a relay for causing a change to be produced in an electrical condition of said circuit, a vacuum tube including a filament operably associated with said circuit for controlling the actuation of said relay, and a back contact arranged to cooperate with said relay and said tube for increasing the filament circuit resistance of said tube in response to actuation of said relay.

4. The combination of an electric circuit, a dynamo electric machine operably associated with said circuit and an exciter for supplying the field excitation of said machine, means for regulating said circuit, said means comprising a relay for regulating the field current of said exciter, electron discharge means operably associated with said circuit for controlling the actuation of said relay, and means operable in response to actuation of said relay for controlling said electron discharge means to prevent hunting.

5. A regulating system of the type wherein a vibratory relay is arranged to control a condition to be regulated, an electron discharge device connected to vary the energization of said relay in accordance with variations in said condition, and means controlled by said relay for controlling the amount of electron discharge to vary the energization of said relay to prevent hunting.

6. A regulating system of the type wherein a relay is arranged to control a condition to be regulated, a space discharge device of the thermionic type for controlling the energization of said relay in accordance with variations in said condition, and means operable in response to actuation of said relay for controlling the thermionic current of said device to prevent hunting.

7. A regulating system wherein means are provided for regulating an electrical condition of a circuit, comprising a relay for controlling the energization of said means, a hot cathode device arranged to have its plate voltage and cathode temperature controlled in accordance with said condition, and means controlled by said relay to vary the effect of said condition on said temperature.

8. A regulating system wherein means are provided for regulating an electrical condition of a circuit, comprising a relay for controlling the energization of said means, a hot cathode device for controlling the actuation of said relay, means including a transformer connected to said circuit to control the plate voltage and cathode temperature of said device in accordance with said condition, and means controlled by said relay to vary the effect of said condition on said temperature.

In witness whereof, I have hereunto set my hand this 19th day of April 1924.

LOUIS W. THOMPSON.