J. H. HUNT.

REGULATOR.

APPLICATION FILED DEC. 31, 1917.

1,372,073. Patented Mar. 22, 1921.

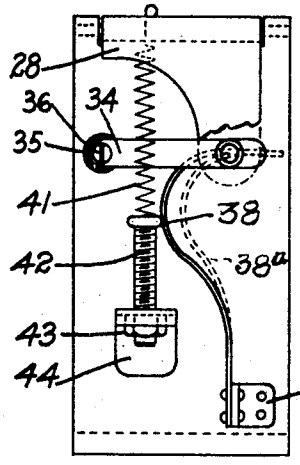


Fig. 2.

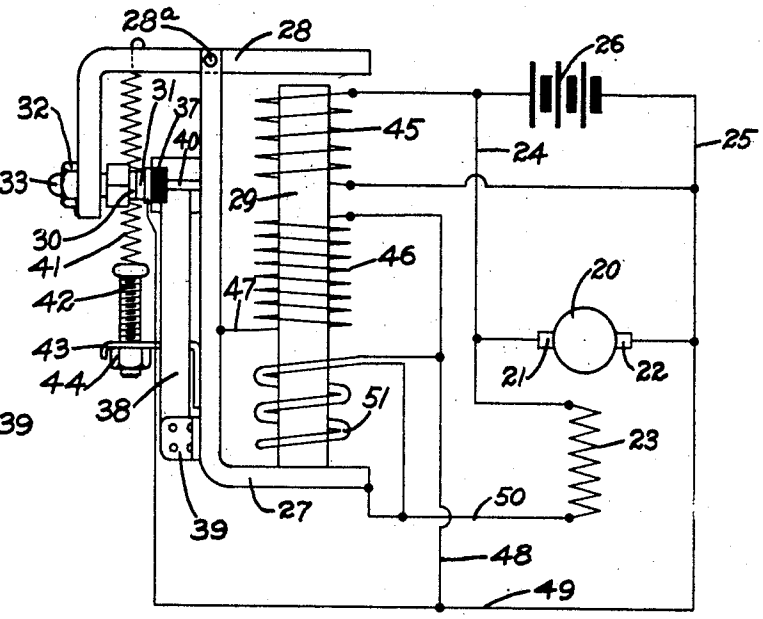


Fig. 1.

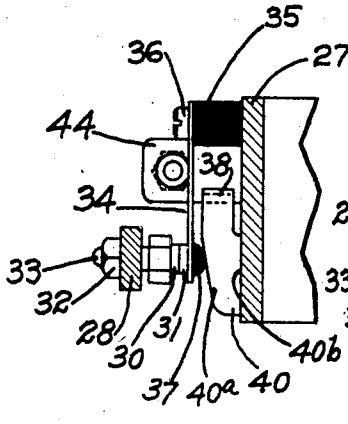


Fig. 3.

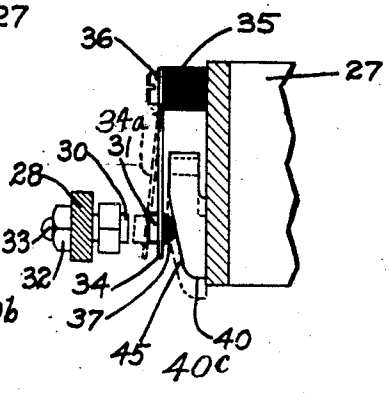


Fig. 4.

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REGULATOR.

1,372,073. Specification of Letters Patent. Patented Mar. 22, 1921.

Application filed December 31, 1917. Serial No. 209,619.

To all whom it may concern:

Be it known that I, JOHN H. HUNT, a citizen of the United States of America, residing at Dayton, county of Montgomery, and State of Ohio, have invented certain new and useful Improvements in Regulators, of which the following is a full, clear, and exact description.

This invention relates to improvements in electrical regulators, and more particularly to regulators of the type which are automatically varied in their operation in accordance with changes in temperature.

One of the objects of the present invention is to provide an electric regulator which may be of either the current or voltage type, wherein the operation of the regulator is automatically controlled in accordance with temperature changes.

More specifically it is an object of this invention to provide thermostatic control for regulators of the interrupter type, comprising an electromagnet and an armature, by causing the relation of these elements to change with changes in temperature, whereby, for example, in case of a voltage regulator, the voltage in a system will be maintained at a higher value in colder weather than in warmer weather, or vice versa, as desired.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

Figure 1 shows a side elevation of a voltage regulator embodying the thermostatic control which forms the subject matter of this invention, and a wiring diagram showing the connections between the voltage regulator and a circuit leading from the generator to a storage battery to be charged.

Fig. 2 is an end view of the regulator shown in Fig. 1.

Fig. 3 is a sectional view with the contacts in closed position.

Fig. 4 is a view similar to Fig. 3, but with the contacts in open position.

Referring to the drawings, 20 designates the commutator of a shunt wound generator, and 21 and 22 are the brushes. 23 denotes the shunt field winding, and 24 and 25 are the main leads from the generator to a storage battery 26.

The present invention is shown in the present instance as combined with a regulator of the voltage type. This regulator includes a frame 27, upon which the magnet core 29 is mounted. This frame also supports the armature 28, which is pivoted at 28^a, in such a position that one end of the armature 28 lies in alinement, but is normally spaced from the magnet core 29. On the opposite end of said armature, a contact 30 is adjustably mounted, by means of the nut and bolt 32 and 33 respectively, said bolt 33 having threaded connection with the armature for purposes of adjustment, while the nut 32 functions to lock said bolt in properly adjusted position.

A contact 31, normally coöperating with contact 30 to close a circuit which will be described later on, is mounted upon a flexible arm 34 of light construction, which in turn is mounted upon a post 35 of insulating material, by means of a screw 36. The post 35 is secured to the frame 27 in any preferred manner.

On the front end of the arm 34, but on the side opposite the contact 31, is mounted the block 37 of insulating material. A strip of thermostatic material 38, consisting of two dissimilar metals having different coefficients of expansion, is fixed at its lower end by a bracket secured to the regulator frame 27. The shape of the thermostat 38 is such that the upper free end will have movement across the back of the regulator frame 27 and transverse to the movement of the armature 28. The free end 40 of the thermostat 38 has a surface 40^a, which is oblique to the surface to the back of the frame 27, and an edge surface 40^b, which is in contact with the back of frame 27. The oblique surface 40^a is, by reason of the flexibility of the arm 34, at all times in engagement with the block 37. A spring 41 is connected at one end to the armature and at the other end to a clip 43, mounted on the back of frame 27, by means of adjusting bolt 42 and nut 44. Spring 41 tends to separate the magnet and armature, and cause the contacts 30 and 31 to be retained in touching relation.

The strip 38 is so constructed that upon an increase of temperature, the same will move from the full line position shown in Figs. 2 and 4, to the dotted line position 38^a. It is evident that when the contacts 30 and 31 are separated by the attraction of the magnet upon the armature, the movement of

the end 40, of the thermostat, from full to dotted line position 40c will cause the movement of arm 34 and contact 31 from the full line position to the dotted line position 34a shown in Fig. 4.

When the contacts come together again, it is evident that the gap between the magnet and armature will be less as the temperature increases. Thus it will be seen that the oblique surface of the thermostat provides an adjustable stop limiting the movement of contact 31, and consequently contact 30, when the magnet attraction between the magnet and armature is insufficient to overcome the tension of the spring 41.

Since the construction of the thermostat is such that its controlling movements are transverse to the movement by the spring, the force causing the movements of the thermostat, which is of course very small, is not counteracted by the force of the spring. The thermostat has only to overcome the spring arm 34 which has been made as light in construction as possible.

By virtue of this construction, the movement of the thermostat and the consequent movement of the contact 31, when the contacts 30 and 31 are separated, will readily respond to changes in temperature.

The main magnet winding 45 comprises comparatively few turns of wire, which for purposes of illustration, is shown in Fig. 1 as connected across the main leads 24 and 25. A resistance winding, designated by numeral 46, includes comparatively many turns of fine wire, one end of which is grounded on the frame 27, and the other connected by means of the wire 48 with wire 49. This wire forms a part of the shunt field circuit, and terminates in contact 31, as shown in Fig. 1. The shunt circuit is completed across the contacts 31 and 30, through the armature 28, the frame 27, and conductor 50 to the shunt field winding 23. 51 denotes a non-inductive resistance connected in parallel with the circuit across the contacts 30 and 31.

The operation of the regulator, including the present invention as shown in the drawings, is as follows:

When the voltage across the leads 24 and 25 exceeds a predetermined voltage, that is, for instance, when the voltage across the leads 24 and 25 exceeds the proper voltage for the charging of the battery 26, the magnet 29 will be energized through the effect of the energy passing through the coil 45 and will attract the armature 28 to such a position as will open the contacts 30 and 31.

By opening contacts 30 and 31, the current passing through the shunt field winding 23, will necessarily have to pass through the resistance winding 46, and this, of course, will tend to cut down the strength of the generator field. This weakening of the generator field will effect a consequent reduction in the voltage across the leads 24 and 25, with the result that the magnetic effect on the armature 28 will be so reduced that the spring 41 will tend to return the armature to its normal position, thereby closing the contacts 30 and 31.

The above operation is intermittently effected throughout the operation of the generator, and by this vibratory operation of the regulator, the voltage across the generator brushes will be regulated.

The arrangement of the winding 46 and also the effect of the non-inductive winding 51, on the operation of the regulator, has been clearly described, claimed and illustrated in the co-pending application of C. F. Kettering, Serial No. 41,886, filed July 26, 1915, and therefore further description is not deemed necessary in the present application.

In the use of storage batteries, it is well known that the internal resistances thereof vary in accordance with temperature changes, that is, the voltage of the charging current must be much higher in cold weather, to overcome the internal resistances of the battery, than in warm weather.

In order to compensate for this condition, and to provide for automatically controlling the generator so that the storage battery may be properly charged with substantially the same effectiveness in cold weather as in warm weather, the thermostatic strip 38 is so constructed and arranged as to change the relative position of the armature 28 to the core 29 of the magnet. That is, in cold weather, the thermostatic strip will automatically move in such a direction as to throw the armature 28 away from the magnet core 29, thus increasing the gap between the core of the magnet and the armature. It will readily be understood that under this condition, greater electrical energy will have to pass through the coil 45 to increase the energization of the core 29, so as to attract the armature 28, thereby breaking the main shunt field circuit and cutting resistance into the field circuit to reduce the voltage across the generator brushes.

The operation of the thermostatic strip relative to the armature during hot weather, or during weather wherein the temperature is above a predetermined normal point, will be exactly the opposite. That is, the effect of the thermostatic strip on the armature will be to lessen the gap between the armature and the magnet core, and thereby require a less amount of electrical energy to pass through the coil 45 to effect the attraction of the armature. Therefore, it is apparent that there has been provided a thermostat which will so control the operation of a voltage regulator that the voltage across the leads to the storage battery will be held

at a higher value in cold weather than in warm weather, and that this value will decrease with a corresponding increase in temperature.

While the form of regulator herein shown and described constitutes one form of the application of the present invention, it is to be understood that other applications of the present invention to other regulators might be adopted, all coming within the scope of the claims which follow.

What I claim is as follows:

1. The combination with an electro-magnet and an armature mounted for movement, the one relatively to the other, and means normally holding these elements apart; of thermostatic means independent of the armature and unaffected by said holding means adapted to render it more or less difficult for the magnet, when energized, to overcome said means.

2. The combination with an electro-magnet and an armature mounted for movement, the one relatively to the other, and means normally holding these elements apart; of thermostatic means independent of the armature and unaffected by said holding means for changing the gap between these elements.

3. The combination with an electro-magnet, an armature mounted to move relatively to the magnet, and a spring normally holding the armature away from the magnet; of a thermostat independent of the armature and unaffected by said spring for changing the gap between the armature and magnet.

4. The combination with an electro-magnet and an armature mounted for movement, the one relatively to the other, and a spring normally holding these elements apart; of a thermostat independent of the armature and unaffected by said spring serving as a stop to limit the movement of the movable member and to change the gap between the armature and magnet.

5. The combination with an electro-magnet, an armature mounted to move relative to the magnet, and a spring normally holding the armature away from the magnet; of a thermostat independent of the armature and unaffected by said spring serving as a stop to limit the movement of the armature and to change the gap between the armature and magnet.

6. The combination with an electro-magnet element and an armature element mounted for movement relatively thereto, and a spring normally holding these elements apart; of a thermostat, a portion of which acts as a stop to limit the movement of said armature, said portion being capable of movement transverse to the normal line of movement of the armature element to change the gap between the said elements.

7. The combination with an electro-magnet, an armature mounted to move relatively to the magnet, and a spring normally holding the armature away from the magnet; of a thermostat serving as a stop to limit the movement of the armature and to change the gap between the armature and magnet; and coöperating contacts adapted to be placed in an electric circuit, one contact being mounted on the armature and the second contact being positioned between the first contact and the thermostat.

8. The combination with an electro-magnet, an armature mounted to move relatively to the magnet, and a spring normally holding the armature away from the magnet; of a thermostat, a portion of which acts as a stop to limit the movement of the armature, said portion having motion transverse to the line of motion of part of the armature to change the gap between the armature and magnet; and coöperating contacts adapted to be placed in an electric circuit, one contact being mounted on the armature and the second contact being positioned between the first contact and the thermostat.

9. The combination with an electro-magnet element and an armature element mounted for movement, the one relatively to the other, and a spring normally holding these elements apart; of coöperating contacts adapted to be placed in electric circuit, one of which is mounted in the line of motion of the first contact on a movable support; and a thermostat having a surface which moves with temperature changes transversely to the line of motion of the contacts, said surface being oblique to said line of motion and coöperating with the support for the second contact.

10. The combination with an electro-magnet, an armature mounted for movement relatively to the magnet, and a spring normally holding these elements apart; of cooperating contacts adapted to be placed in an electric circuit, one of which is mounted on the armature, and the other mounted in the line of motion of the first contact on a movable support; and a thermostat having a surface which moves with temperature changes transversely to the line of motion of the contacts, said surface being oblique to said line of motion, and coöperating with support for the second contact.

11. The combination with an electromagnet and an armature mounted for vibratory movement with respect to the magnet; of thermostatic means independent of said armature for varying the range of movement of said armature.

In testimony whereof I affix my signature.

JOHN H. HUNT.

Witnesses:

J. W. McDONALD.

WARREN SCHMIDING.