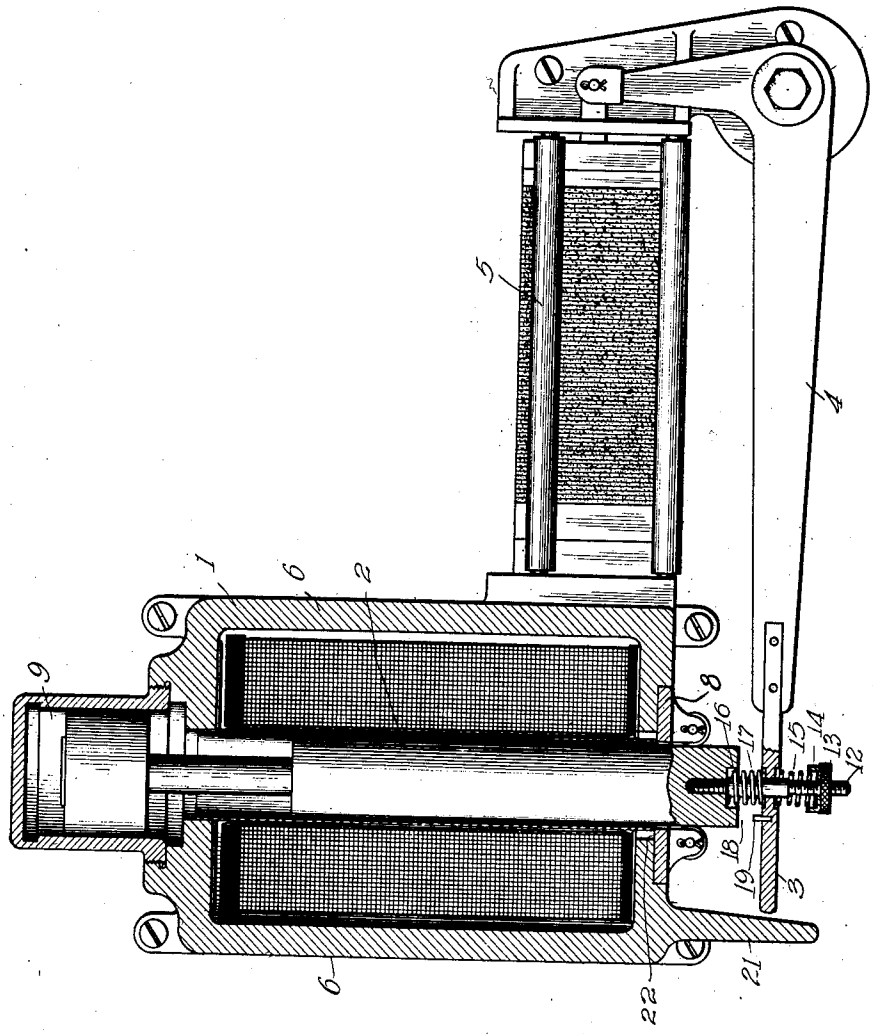
W. A. TURBAYNE.

ELECTRIC REGULATOR.

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1,259,172. Patented Mar. 12, 1918.



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UNITED STATES PATENT OFFICE.

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ELECTRIC REGULATOR.

1,259,172. Specification of Letters Patent. Patented Mar. 12, 1918.

Application filed February 11, 1915. Serial No. 7,587.

To all whom it may concern:

Be it known that I, WILLIAM A. TURBAYNE, a citizen of the United States, residing at Niagara Falls, in the county of Niagara and State of New York, have invented new and useful Improvements in Electric Regulators, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

This invention relates to regulators.

It is particularly applicable to regulators in which electromagnetic means is used to control a regulating arm, which in turn governs means for maintaining a constant voltage or current in a system wherein the electrical conditions are subject to wide variations.

Regulators which are adapted to control widely varying voltages or current must have a correspondingly wide range of operation. At the same time, the regulators should be sensitive to small changes in voltage or current so as to hold the values of either almost absolutely constant. Regulators which have heretofore been devised to operate over a wide range of current or voltage values are not sufficiently responsive to minute changes in electrical conditions to give the close regulation desired. The wide range of movement of the parts requires the use of a relatively long pull solenoid, and the inertia and friction of the parts, together with the damping action of the dash-pot, or other necessary retarding means, makes the regulator unresponsive to small changes in voltage or current. Of course, magnifying relays or similar devices may be used to secure a closer regulation, but the use of such devices increases the amount of apparatus required and makes the system more or less complicated.

One of the objects of the present invention is to provide a regulator which will operate over a wide range of current or voltage values and, at the same time, keep the voltage or current constant within small limits, without necessitating the use of magnifying relays or similar devices.

In the embodiment of the invention shown herein, the plunger of a controlling solenoid is provided with an armature which is held separated therefrom by non-magnetic resilient means in such a manner that the armature is connected to the plunger but is adapted to have a movement relative thereto. A portion of the magnetic flux is shunted through the armature so that it is sensitively responsive to changes in the excitation of the solenoid. The armature is connected to a regulating arm, so that any movement of the armature is transmitted to the arm and any movement of the plunger is also communicated to the arm, since the armature is resiliently connected to the plunger. A dash-pot is provided for the plunger for steadying the same which, together with the inertia of the parts, causes the plunger to be relatively unresponsive to minute changes in current or voltage. On the other hand, the armature has no dash-pot and is made comparatively light, so that it responds readily to small variations in the magnetizing force of the solenoid. The movement of the plunger is therefore somewhat sluggish, but it operates over a wide range of current or voltage values and controls the regulating arm to secure a comparatively accurate regulation. At the same time, the armature responds to minute variations in voltage or current, and consequently a refinement in regulation is secured which keeps the voltage or current constant within small limits.

The accompanying drawing illustrates an embodiment of the invention.

The regulator comprises, in general, a solenoid 1, a plunger 2, an armature 3 resiliently connected to the plunger, and a regulating arm 4. The regulating arm 4 is adapted to control a suitable resistance, such as a carbon pile 5.

The solenoid 1 is of any suitable type. It is provided with a frame 6 of magnetic material, which forms the magnetic circuit therefor. The plunger 2 is adapted to be operated by the solenoid and it is suitably connected to a dash-pot 9, or other steadying means.

An armature 3 is yieldingly connected to the lower end of the plunger 2 by means of a non-magnetic bolt 12, provided with a nut 13 and a cap piece 14 for the reception of a spring 15. A recess 16 in the end of the plunger 2 receives a second spring 17. Similar shallow recesses in the armature 3 receive the other ends of the springs 15 and

17. The armature is thus held away from the plunger in a balanced position with the air-gap 18 between the parts. This construction makes the armature very sensitive to the magnetic attraction of the plunger 2 across the air-gap 18. The springs 15 and 17 are made of non-magnetic material so as not to affect the reluctance of the air-gap between the plunger and the armature. A non-magnetic pin 19 is provided for preventing the armature from sealing with the plunger when subjected to a very sudden attraction due to unusually abrupt increases in the magnetizing force of the solenoid. The armature 3 is connected to a regulating arm 4 which is adapted to control a suitable resistance such as a carbon pile 5. It will be noted that the movement of the armature relative to the plunger, as well as the movement of the plunger itself, is communicated to the regulating arm.

The frame 6 is provided with a magnetic extension 21, which coöperates with the end of the armature 3 to provide a magnetic circuit from the frame through the armature to the plunger 2.

The opening in the bottom of the frame 6, through which the plunger passes, is made considerably larger than the plunger in order to provide an air-gap 22 which will increase the reluctance of the magnetic circuit at this point, and thus shunt a portion of the flux through the extension 21 and the armature 3 to the plunger 2. The plate 8 is made of non-magnetic material so as not to decrease the reluctance of the air-gap 22. The air-gaps in the magnetic circuit including the armature, and in the circuit from the solenoid frame to the plunger, are proportioned so that the flux passing through the armature makes the same sensitively responsive to small changes in the magnetizing force of the solenoid.

The armature 3 accordingly moves the arm 4 to and fro through small arcs to compensate for variations in voltage or current which are not sufficient to overcome the inertia of the plunger 2 and the dash-pot connected therewith, or for changes in voltage or current which take place too quickly for the plunger to satisfactorily follow them, particularly in view of the damping action of the dash-pot.

The operation of the regulator is as follows: When the solenoid is energized the plunger 2 moves upwardly, carrying with it the armature 3 and regulating arm 4, until a normal position is reached corresponding to the current or voltage it is desired to maintain. After this position has been reached any subsequent small variations in voltage or current which are not sufficient to move the plunger cause the armature 3 to respond and move the arm 4 to secure a minute regulation. If, however, the voltage or current varies over a wide range, the plunger 2 responds and moves the arm to compensate for the variation.

It will thus be seen that a means is provided which is adapted to regulate for minute changes in voltage or current and additional means is provided which will automatically readjust the point at which the first means operates when the voltage or current varies over a wide range. In other words, a means is provided which will give a comparatively accurate regulation over a wide range of current or voltage variations, and a second means is associated therewith analagous to a vernier attachment on a measuring instrument, whereby a minute regulation is secured for every position of the first means. A sensitive and minute regulation is thus secured over a wide range of current or voltage variations without the use of magnifying relays or other auxiliary devices.

It should be understood that the embodiment of the invention shown is for purposes of illustration only and that other structures may be devised which come within the purview of the invention and which are included in the spirit and scope of the appended claims.

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

1. An electric regulator having a solenoid, a plunger therefor, an armature connected to the plunger and movable relative thereto, and a regulating arm connected to the armature.

2. An electric regulator having an arm adapted to control a regulating means, a magnet having an armature connected to said arm to move the same in response to small variations in the solenoid excitation, and a second armature connected to the first armature to move the same in response to wide variations in the excitation of the solenoid.

3. An electric regulator having an arm adapted to control a regulating means, a solenoid having a plunger connected to said arm through an armature whereby the plunger moves the arm for wide variations in the solenoid excitation, said armature being movable independently of the plunger whereby the arm is moved in response to small changes in the excitation of the solenoid.

4. An electric regulator comprising a solenoid, a plunger movable thereby, an armature, means connecting the armature with the plunger adapted to hold the armature in a balanced position out of magnetic contact with the plunger, means for causing a portion of the magnetic flux to pass through the armature to the plunger, and a regulating arm connected to the armature whereby the armature moves the arm for

small variations in the solenoid excitation and the plunger moves the arm for wide variations in the solenoid excitation.

5. An electric regulator comprising a solenoid, a plunger therefor, an armature yieldingly connected to the plunger and held out of magnetic contact therewith, means for shunting a portion of the flux through the armature, and regulating means connected to the armature.

6. An electric regulator comprising a solenoid, a plunger therefor, an armature connected to the plunger and movable relative thereto, means for yieldingly holding the armature out of magnetic contact with the plunger, and a regulating arm connected to the armature.

7. An electric regulator comprising, in combination, a solenoid, a plunger, an armature yieldingly connected to the plunger, means for preventing the armature sealing with the plunger, and a regulating arm connected to the armature.

8. An electric regulator comprising a solenoid, a magnetic circuit therefor including a plunger, a second magnetic circuit including an armature connected to the plunger but movable relative thereto, and a regulating arm controlled by the armature.

9. An electric regulator comprising a solenoid, a plunger, a frame of magnetic material for said solenoid, an armature yieldingly connected to said plunger, a depending projection on said frame arranged in close proximity to said armature, and regulating means connected to said armature.

10. An electric regulator comprising a solenoid, a plunger therefor, a frame of magnetic material for said solenoid, an armature, non-magnetic springs connecting said armature to said plunger, and regulating means connected to said armature.

11. An electric regulator comprising a solenoid, a plunger, a frame of magnetic material for said solenoid, and an armature yieldingly connected to said plunger and adapted to control a regulating arm.

12. An electric regulator comprising, in combination, a solenoid, a large magnetic mass, a small magnetic mass, a yielding connection between the two masses, and regulating means connected to the smaller of said masses.

13. An electric regulator comprising, in combination, a solenoid, a large magnetic mass movable thereby, damping means for said mass, a smaller undamped magnetic mass movable by said solenoid and yieldingly connected to said large magnetic mass, and regulating means connected to said smaller mass.

14. An electric regulator including a carbon pile resistance, a regulating arm therefor, an armature adapted to control the arm, electro-magnetic means for controlling the armature, and a plunger resiliently connected to the armature and under the control of the electro-magnetic means.

15. An electric regulator including a carbon pile resistance, a regulating arm therefor, an armature connected to the regulating arm, a plunger connected to the armature, said armature being movable relative to the plunger and provided with means for holding it out of magnetic contact with the plunger, and electro-magnetic means controlling the plunger and armature.

16. An electric regulator including a carbon pile resistance, a regulating arm therefor, an armature connected to said regulating arm, a plunger connected to said armature, spring means for holding said armature in balanced position out of magnetic contact with the plunger but adapted to allow relative movement of the plunger and armature, and a solenoid for controlling the plunger and armature whereby a minute regulation is secured for a wide range of voltage or current variations.

17. An electric regulator including a regulating medium and operating means therefor, said means including an electro-magnetic winding, a magnetic member requiring a relatively great change in energization of said winding or a long continued change to effect variations in said regulating medium, and a second magnetic member responsive to minute or sudden changes in energization of said winding to effect a variation in said medium.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

WILLIAM A. TURBAYNE.

Witnesses:
L. C. SCHANTZ,
R. H. VAN NEST.