W. A. TURBAYNE.

AUTOMATIC REGULATOR.

APPLICATION FILED APR. 18, 1913.

1,131,176. Patented Mar. 9, 1915.

Fig. 1.

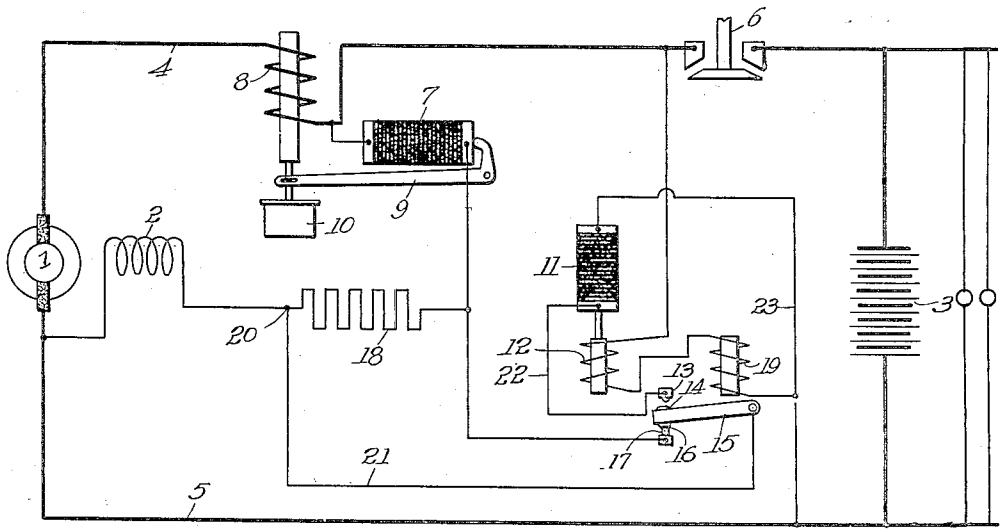


Fig. 2.

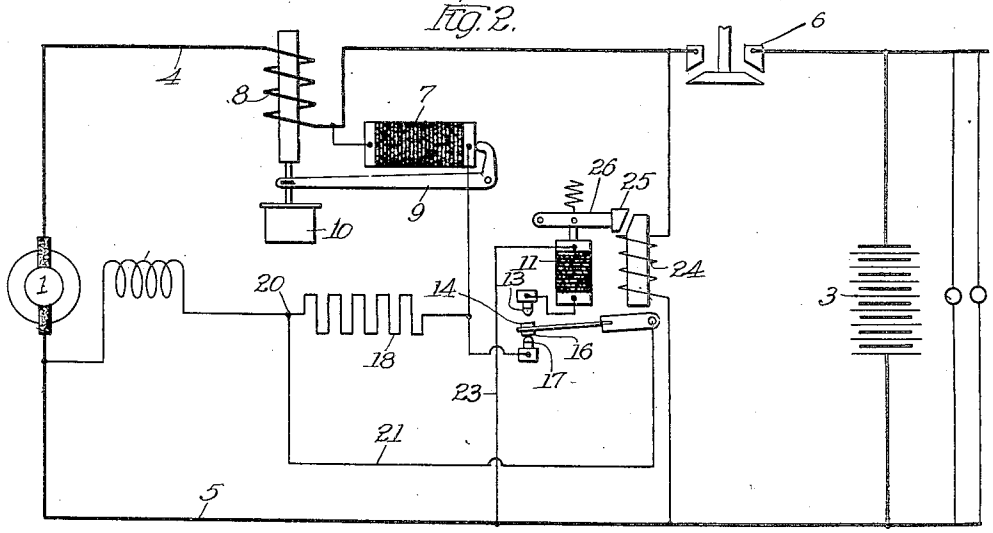


Fig. 3.

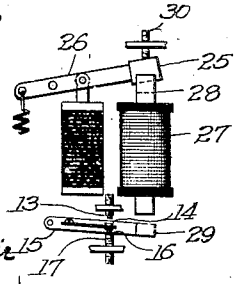
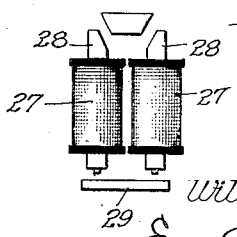


Fig. 4.



Witnesses

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UNITED STATES PATENT OFFICE.

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AUTOMATIC REGULATOR.

1,131,176. Specification of Letters Patent. Patented Mar. 9, 1915.

Application filed April 18, 1913. Serial No. 762,053.

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 Automatic 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 an improvement in automatic regulators.

In my co-pending application, Serial No. 722,276, filed September 25, 1912, there is described an automatic regulator for use in car lighting or other systems in which the generator speed fluctuates within very wide limits. In this system a current regulator is provided for maintaining constant current from the generator until the voltage of the system reaches the fully charged voltage of the battery. At this predetermined voltage an auxiliary regulator, preferably in the form of a compressible rheostat, is connected in shunt to the generator field, the value of the resistance of this rheostat being controlled by a coil responding to the voltage of the system.

The present invention relates to a similar system in which additional advantages are obtained by certain modified arrangements.

An object of this invention is to provide for the connection and disconnection of the auxiliary regulator in circuit by means which will accurately respond under all conditions of service to the predetermined voltages.

Another object is to provide controlling means for the auxiliary regulator which are stable in operation and not easily thrown out of adjustment.

Another object is to provide a regulator for car lighting systems in which a single regulator will automatically come into action at the fully charged battery voltage and will thereafter automatically maintain a voltage on the system below the cutting-in voltage of the regulator.

Another object of the invention is to provide an improved combined relay switch and compressible rheostat which will accurately respond to predetermined circuit conditions.

Two embodiments of the invention are illustrated in the accompanying drawings, in which:

Figure 1 diagrammatically represents the improved regulating circuits for a car lighting generator. Fig. 2 represents diagrammatically a modified arrangement of regulating circuits. Figs. 3 and 4 are detailed views of the combined switch and compressible rheostat.

Fig. 1 illustrates a variable speed generator of any preferred type provided with an armature 1 and shunt field 2. A storage battery 3 is connected across the generator main leads 4 and 5. Suitable lamp circuits may be connected across leads 4 and 5 in parallel with the battery. An automatic switch 6 of any well known type may be connected in one of the generator leads to control the connection and disconnection of the generator and storage battery and lamps.

A compressible rheostat 7 is connected in series with the shunt field 2 and is controlled by a coil 8 in series with the generator. Coil 8 operates the rheostat 7 by means of a bell crank lever 9 normally held in such a position as to reduce to a minimum the resistance of the rheostat. A dashpot 10 may be employed to steady the action of the bell crank lever. A second compressible rheostat 11 is adapted under predetermined conditions to be connected in shunt to the generator field. This rheostat is under the control of a voltage coil 12 connected across the generator leads. When the voltage of the system is below the fully charged voltage of the battery, the circuit, including the rheostat 11, is broken at the contact 13. A movable contact 14 carried by lever 15 is adapted to engage contact 13 to complete the circuit for the auxiliary compressible rheostat. An additional contact 16 also carried by the lever 15 is adapted to coöperate with a fixed contact 17 to control a normally closed short circuit around a fixed resistance 18 in circuit with the field.

When the lever 15 is in its lower position rheostat 11 is open circuited and the resistance 18 is short circuited, and when the lever 15 is raised the rheostat 11 is connected in shunt to the field and the short circuit around resistance 18 is opened to connect the resistance in series with the field. A coil 19 connected across the generator leads controls the position of the lever.

The regulating system, as illustrated in Fig. 1, operates substantially as follows: With the generator at rest, the automatic switch 6 will be open and the battery 3 will supply the lamp load. The energization of the coil 19 will be insufficient to raise the lever 15 so that rheostat 11 is open circuited and resistance 18 is short circuited. Coil 8 will be substantially deënergized so that the resistance of rheostat 7 will be reduced to a minimum. As the generator starts to operate its field will rapidly build up until the voltage of the generator reaches substantially the voltage of the battery when the automatic switch 6 will close. Upon further increase in speed, coil 8 will be energized sufficiently to increase the resistance of rheostat 7 and will tend to maintain constant current to charge the battery and supply the lamps throughout speed changes in the generator and regardless of the rising C. E. M. F. of the battery. When a voltage is reached which represents substantially the fully charged condition of the battery, coil 19 will become sufficiently energized to raise the lever 15, open the short circuit around resistance 18 at contacts 16 and 17 and connect the rheostat 11 in shunt to the field by means of contacts 13 and 14. This places the resistance 18 in series with the field and at the same time provides a circuit in parallel with the field from the point 20 in the field circuit, through conductor 21, lever 15, contacts 13 and 14, conductor 22, compressible rheostat 11 and conductor 23 to generator lead 5. The resistance thus inserted in the field circuit and the effect of the parallel circuit described are sufficient to reduce the charging current substantially to zero so that the battery 3 will float across the line and at the same time the rheostat 7 will be permitted to return to its minimum resistance value. From this point the generator is regulated for constant potential by means of the coil 12 which decreases the resistance of rheostat 11 and thus diverts more current from the field with every tendency to increase the generator voltage. Under these conditions the battery is merely floating across the line and constant potential will be maintained regardless of whether the battery circuit is opened or not, and even with the battery circuit accidentally opened a stable voltage will be held throughout the entire range of speed of the generator. A regulator of this type is particularly adapted for high generator speeds at which the field magnets are operating at a low flux density, under which conditions the machine would respond to very slight changes in voltage across its field. An inductive circuit, such as the field winding, when connected in series with a non-inductive resistance, such as the rheostat 7, especially where such resistance is high when compared with the inductive resistance, is very sensitive to variations in impressed voltage. This feature together with the unstable condition of the magnetic circuit, would make close regulation difficult at widely varying speeds if regulation were attempted solely through varying the resistance in series with the field. By the provisions of the auxiliary rheostat 11, however, the field winding is shunted by a non-inductive resistance which prevents rapid changes in the magnetic flux in the generator, as any tendency to a rapid change is immediately met by the development of an E. M. F. in the field winding which sets up a current through the local circuit comprising rheostat 11 which tends to retard initial flux changes. The higher the generator speed, the less the value of this resistance, and, consequently, the apparatus becomes even more stable at the higher speeds than at the lower.

Fig. 2 illustrates a system in which a novel form of combined relay switch and regulator is employed, whereby a single coil 24 performs the functions of coils 12 and 19 in Fig. 1. Coil 24 is connected across the generator leads and controls the lever 15 and contacts carried by the lever in a manner similar to coil 19 on Fig. 1. A movable armature 25 carried by pivoted lever 26, within the radius of influence of coil 24, controls the compression of rheostat 11. The circuit connections and principles of operation of the system illustrated in Fig. 2 are substantially the same as the system illustrated in Fig. 1.

Figs. 3 and 4 illustrate the construction and operation of the combined relay switch and regulator. The coil 24 is provided with two windings 27 arranged on the vertical poles 28 of a magnet in the ordinary horseshoe form. The lever 15, in addition to the contacts 14 and 16, carries the armature 29. The upper armature 25 on lever 26 is wedge shaped and coöperates with the beveled ends of the magnet poles 28. This construction provides for a long range of action and an increasing attraction as the lever moves downward. The increasing attraction is designed to compensate for the increase in counter-pressure exerted by the compressible rheostat. The upper air-gap between the armature 25 and magnet poles is made so great that the lever 26 will not be moved by energization of the windings so long as the lower air-gap is open. By thus causing the upper armature to remain fixed, the reluctance of the magnetic circuit is maintained constant so that the lower armature may be accurately adjusted to close at a definite voltage which represents the fully charged voltage of the battery. As soon as the lower armature is attracted the reluctance of the magnetic circuit will be so

greatly reduced that the upper armature 25 will immediately come under the influence of the windings and will be caused to exert a varying pressure on the compressible rheostat, causing it to accomplish its regulating functions.

The device may be readily set to respond to different voltages by varying the normal position of the armatures by means of the adjustable stop 30 for the upper armature and the adjustable contacts for the lower armature.

The rheostats employed are preferably of the type in which a plurality of disks of carbon or similar material are connected in the circuit, the resistance of the rheostat being determined by the amount of pressure exerted on the disks. By providing separate contacts independent of the rheostats for controlling the rheostat circuits, quick breaking metallic contacts may be used. Repeated operation of such contacts will not cause a burning of the contact surfaces with the resultant variations in contact resistance and effective air-gap. Consequently, the adjustment of the system will not be interfered with by continued use.

The advantages of employing the improved relay and regulator in connection with car lighting systems may be illustrated by considering a representative set of conditions obtaining in such a system. Assuming a 30 volt system employing 16 lead battery cells, a fully charged condition of the battery will be reached when the voltage of the system has been raised to approximately 42 volts, but the voltage at which such a battery will just float across the line is approximately 35 volts. With the improved construction of regulator, therefore, it is possible to set the lower armature to respond at 42 volts which, as already explained, would be insufficient to operate the rheostat as long as the lower air-gap is open. As soon as the lower armature is raised and the lower air-gap eliminated, the upper armature will be within the radius of influence and may be set to hold substantially 35 volts on the system. Thus, with this unitary device, it is possible to employ a single normally energized coil which will prevent operation of the voltage regulator until the fully charged voltage of the battery is reached, after which point the regulator will automatically operate to hold the proper voltage on the system to float the battery across the line.

It is to be understood that the embodiments of the invention herein described are merely for the purposes of illustration as it is apparent that many modifications in circuit connections and details of construction may be made without sacrificing the advantages of the invention as set forth in the following claims.

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

1. Means for regulating a generator comprising a current operated resistance in series with the field thereof, a voltage operated resistance in a circuit in shunt to the field, and voltage operated means for controlling the circuit of said voltage operated resistance.

2. In a regulating system, a variable speed generator, means tending to cause the generator to produce constant current, and means tending to cause the generator to operate at a constant potential, said last named means comprising a resistance in shunt to the generator field, means for decreasing said resistance as the generator voltage tends to rise, and means operated by a predetermined voltage rise in the system for connecting said last named resistance in circuit.

3. In a regulating system, a variable speed generator, a shunt circuit around the field thereof, and a single means operating to close said shunt circuit when the voltage of the system reaches a predetermined value and thereafter responding to a predetermined lower voltage to vary the resistance of said shunt circuit.

4. In a regulating system, a variable speed generator, means tending to cause the generator to produce constant current, a shunt circuit around the generator field, and a single means to close said shunt circuit at a predetermined voltage of the system and thereafter operating responsive to a predetermined lower voltage to vary the resistance of said shunt circuit.

5. In a regulating system, a variable voltage source, means tending to regulate the voltage of said source to cause the same to produce a constant current, and an auxiliary regulating means operating upon a predetermined voltage condition to predominate in regulating said source and to maintain constant potential therefrom, said constant potential being less than the predetermined voltage at which said auxiliary regulator begins to operate.

6. In combination with a variable speed generator provided with a shunt field, a circuit in parallel with said field but normally open, and a single operating coil for closing said circuit at a predetermined voltage and thereafter varying the resistance thereof to maintain the voltage of said generator at a predetermined voltage lower than said first mentioned voltage.

7. In combination, a shunt wound generator, a variable resistance in series with the field thereof, a current coil for varying said resistance, a storage battery supplied by said generator, an auxiliary regulator comprising a normally open circuited resistance in parallel with said field, and a voltage coil designed to close the circuit for said last named resistance when the voltage

of the system reaches the fully charged voltage of the battery, said voltage coil thereafter operating in response to a predetermined lower voltage to maintain said generator voltage constant.

8. In a regulating system, a variable speed generator provided with a shunt field, a compressible rheostat in series with said field, a series coil for controlling said rheostat, a second compressible rheostat adapted to be connected in shunt to said field, and a coil connected across the system for connecting said second rheostat in circuit on predetermined voltage conditions in the system, and thereafter operating at a predetermined lower voltage to vary the resistance of said rheostat.

9. In a regulating system, a variable speed generator provided with a shunt field, a storage battery charged thereby, a compressible rheostat in series with said field, a series coil for controlling said rheostat, a second compressible rheostat, normally open circuited, adapted to be connected in shunt to said field, and a coil connected across the system adapted to close the circuit for said second compressible rheostat when the voltage of the system reaches the fully charged voltage of the battery, said coil thereafter operating at a predetermined lower voltage representing the battery floating voltage to vary the compression on said second compressible rheostat to hold said generator voltage constant.

10. In combination, a variable voltage source, a storage battery charged thereby, and means for regulating the voltage of said source, said means comprising a normally open circuited variable resistance, and a single operating coil therefor, said coil operating, when the fully charged voltage of the battery is reached, to close the circuit for said resistance, and said coil thereafter operating in response to a predetermined lower voltage to cause said resistance to maintain said lower voltage from said source.

11. In combination, a variable speed generator provided with a shunt field, a variable resistance in series with said field, a coil in series with said generator for varying said resistance, a normally short circuited fixed resistance in series with said field, a second variable resistance adapted to be connected in shunt to said field, a voltage responsive coil varying said second resistance, and a voltage responsive means including quick breaking metallic contacts for opening the short circuit around said fixed resistance and connecting said second variable resistance in circuit.

12. In combination, a variable speed generator provided with a shunt field, a variable resistance in series with said field, a coil in series with said generator for varying said resistance, a normally short circuited fixed resistance in series with said field, a second variable resistance adapted to be connected in shunt to said field, and a single voltage responsive means operating at a predetermined voltage to open said short circuit around said fixed resistance and to close the normally open circuit for said variable resistance, and thereafter operating at a predetermined lower voltage to vary said resistance in shunt to the field.

13. Regulating means comprising a compressible rheostat adapted to be connected in the circuit to be regulated, contacts controlling said circuit, a lever for varying the compression of said rheostat, and a single operating coil operating responsive to a predetermined voltage to close said contacts, and thereafter operating responsive to varying voltages including a predetermined lower voltage to vary the position of said lever.

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

WILLIAM A. TURBAYNE.

Witnesses:
C. H. WILMER,
E. MACVITTEL.