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ELECTROMAGNETIC DEVICE

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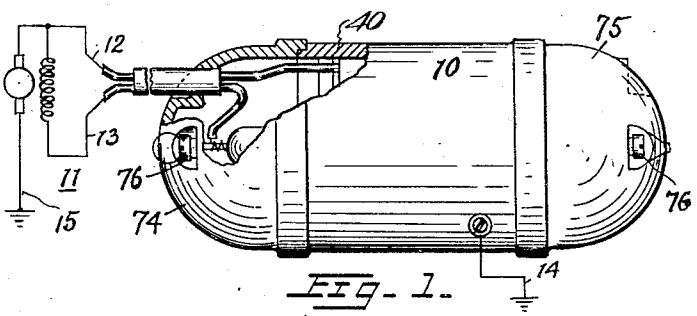


Fig. 1.

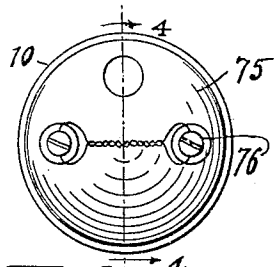


Fig. 2.

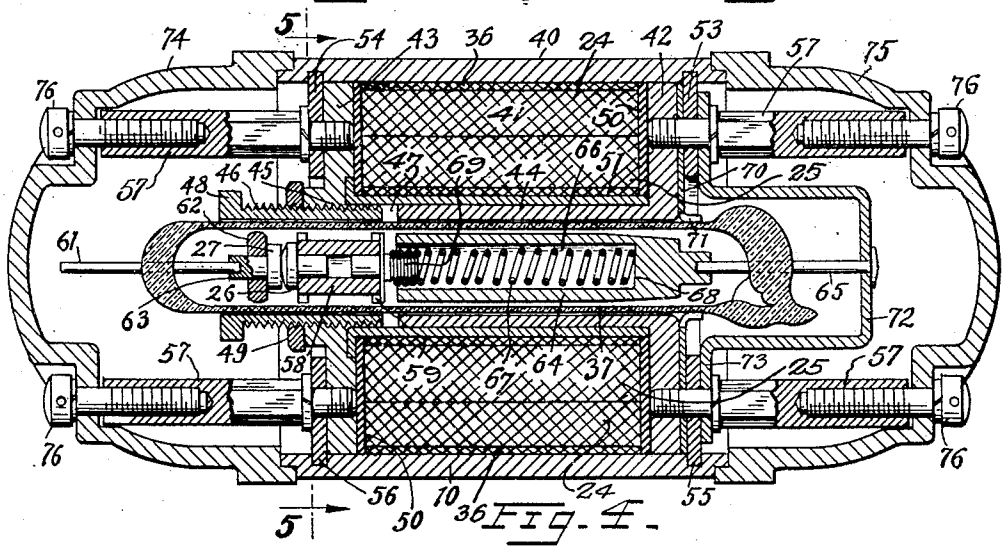


Fig. 4.

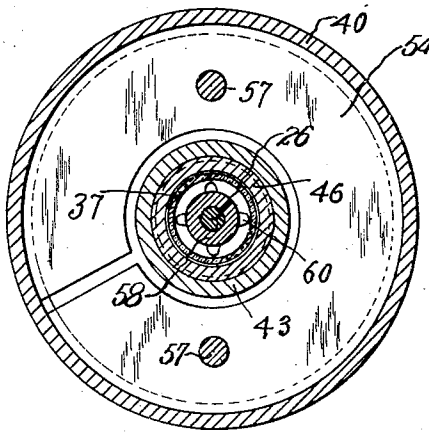


Fig. 5.

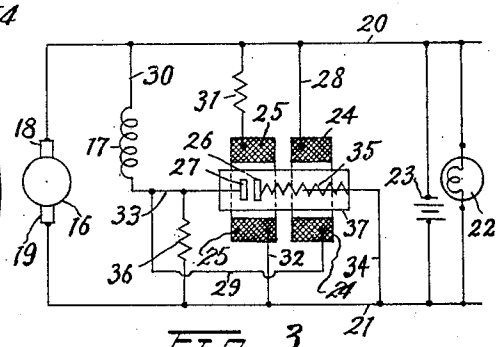


Fig. 3.

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UNITED STATES PATENT OFFICE

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ELECTROMAGNETIC DEVICE

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Application June 10, 1932, Serial No. 616,464

6 Claims. (Cl. 200—90)

This invention relates generally to electromagnetic control devices and, more particularly, to an improved voltage regulator of the vibratory contact type which may be applied to vehicle generating systems and to various other uses.

An object of the invention is to provide an improved voltage regulator which is of very practical and compact construction and which is efficient and reliable in operation.

Another object of the invention is to provide a regulating device, of the type referred to, wherein the cooperating contact elements are enclosed in an envelope, and wherein a plurality of magnet core sections are associated with the envelope and are relatively adjustable for varying the action of the contact elements.

A further object of this invention is to provide a compact and improved form of regulating device, of the type referred to, wherein the magnet windings are disposed around an envelope containing the cooperative contact elements, and wherein the frame of the magnet includes an outer casing member which is disposed around the winding, and a pair of core sections connected with the casing member and extending into the winding and around the envelope.

Other objects and advantages of the invention will be apparent from the following description, when taken in conjunction with the accompanying sheet of drawing, wherein

Fig. 1 is an elevational view, partly diagrammatic, showing our improved regulating device applied to an electrical machine;

Fig. 2 is an end view of the regulating device;

Fig. 3 is a wiring diagram showing our regulating device embodied in a generating system;

Fig. 4 is a longitudinal sectional elevation taken substantially on line 4—4 of Fig. 2; and

Fig. 5 is a transverse sectional view taken on line 5—5 of Fig. 4.

Detailed reference will now be made to the accompanying drawing, wherein we have illustrated the regulating device of our invention as applied to a generator of the type commonly provided on motor vehicles for auxiliary purposes. The invention is not to be regarded, however, as necessarily limited to this particular use nor to the specific arrangements illustrated in the drawing.

Our regulating device as herein disclosed, represents an improvement over the regulating device disclosed in our earlier application Serial No. 577,836, filed November 28, 1931, which became Patent No. 1,001,579 on May 14, 1935.

As will appear hereinafter, our improved regulator is of very compact construction, being preferably in the form of the self-contained unit 10 which, as shown in Fig. 1, may be connected to an electrical machine such as the shunt generator 11. Such connection may be made through insulated conductors 12 and 13, and through the ground conductors 14 and 15.

Before proceeding with a detailed description of the specific construction of our self-contained regulating unit, we shall describe briefly the electrical circuits of the regulator when applied to a generating system, such as the vehicle lighting and battery charging system diagrammatically illustrated in Fig. 3. In this instance, I have shown a generator 16 having a shunt field winding 17 and main brushes 18 and 19, which brushes are connected, respectively, with the load conductors 20 and 21. These load conductors may be arranged to supply current for operating one or more lamps 22, as well as current for charging the storage battery 23 and for various other purposes.

The circuits of our regulating device include a pair of magnet windings 24 and 25 which are arranged in additive magnetic relation and produce a desired vibratory movement of the contact 26 relative to the contact 27 for varying the excitation of the shunt field 17. The winding 24 is an operating winding which is in series with the cooperating contacts and produces a rapid vibration of the contact 26. The winding 25 is a shunt winding, which responds to changes in the operating condition of the generator and exercises a regulating effect upon the vibratory movement of the contact 26. One terminal of the winding 24 is connected to the load conductor 20 by the conductor 28 and the other terminal of this winding is connected to one end of the shunt field winding by means of the conductor 29, the opposite end of the field winding being connected to the load conductor 20 through the conductor 30. One terminal of the shunt winding 25 is connected to the load conductor 20 through a resistance 31, of suitable value, and the other terminal of the shunt winding is connected to the load conductor 21 by the conductor 32.

The stationary contact 27 is connected to one end of the field winding 17 by a conductor 33, and the movable contact 26 is connected to the load conductor 21 through the conductor 34, and through the spring 35 which normally moves the contact 26 toward engagement with the contact 27. A regulating resistance 36, of appropriate value, is arranged in parallel relation with the

contacts 26 and 27, with one of its ends connected to the conductor 33 and its other end connected to the load conductor 21. The cooperating contacts 26 and 27, and the spring 35, are enclosed in an airtight envelope 37 which is disposed within the magnet windings 24 and 25. From the circuit arrangement just disclosed, it will be seen that during the operation of the generator, the windings 24 and 25 will be energized, the winding 24 serving to cause rapid vibration of the contact 26 for intermittently short circuiting the resistance 36 out of the circuit of the field winding 17. The shunt winding 25 responds directly to changes in the operating condition of the generator, such as changes in speed, and exercises a regulating effect upon the rate of vibration of the contact 26. The cooperation of the contacts under the magnetic influence of the windings 24 and 25, causes the voltage output of the generator to be maintained at a substantially constant value.

In accordance with our invention, the various parts of our regulating device are arranged to constitute a self-contained unit of very practical and compact form. As shown in Fig. 4 of the drawing, this unit is provided with an intermediate casing section 40, which is of magnetic material, and which constitutes a part of the frame of the electromagnet 41 of the regulator. This casing section may be of any suitable shape but is preferably of sleevelike or cylindrical form. Adjacent the ends of the intermediate section 40, I provide the transversely extending members 42 and 43, which are constructed of magnetic material, and which also constitute parts of the magnet frame. The frame member 42 is provided centrally thereof with a tubular core section 44 which extends toward the frame member 43 in substantially coaxial relation with the casing section 40. The frame member 43 is provided centrally thereof with a threaded opening 45, and with a tubular core section 46 which extends through this opening toward the core section 44 and in substantial axial alignment with the latter. The core section 46 is provided with external threads for cooperation with threads of the opening 45 so that this section can be adjustably moved relative to the core section 44, to thereby vary the width of an air gap 47 between the adjacent inner ends of these sections. Rotation of the core section 46, for purposes of adjustment, may be facilitated by providing this member with a squared or hexagon head portion 48. This section may be retained in desired positions of adjustment by suitable means, such as the lock nut 49.

The magnet windings 24 and 25 of our regulating device are disposed between the frame members 42 and 43 and around the core sections 44 and 46. These windings may be suitably insulated from the frame members 42 and 43, as by means of the insulating disks 50, and from the core sections by the insulating barrel 51. The resistance elements 31 and 36 may be incorporated in the device in any suitable form, but to further simplify the regulator, we prefer to construct these elements in the form of resistance windings which are arranged around the core sections 44 and 46 and between the frame members 42 and 43 or, in other words, are included in the same space that is provided for the magnet windings 24 and 25.

With the magnet windings 24 and 25 and the resistance elements 31 and 36 disposed around the core sections 44 and 46, as just described, the magnet assembly is inserted into the casing section 40 to occupy the position shown in Fig. 4. The magnet assembly may be retained in the casing section by any suitable means, but we prefer to employ the retaining rings 53 and 54 for this purpose. The retaining ring 53 is disposed outwardly of the frame member 42 with its outer annular edge 55 engaging in a groove provided in the inner surface of the section 40. Likewise, the retaining ring 54 is disposed outwardly of the frame member 43 with its outer annular edge 56 engaging in another annular groove provided in the inner surface of the section 40. These retaining rings are clamped to the respective frame members by means of studs 57 having threaded portions which extend through the retaining rings and are screwed into the frame members.

The cooperating movable and stationary contacts 26 and 27, and the spring 35 for normally urging the movable contact toward the stationary contact, constitute a make and break device, and are all enclosed in an elongated airtight envelope 37 which is disposed within the axially aligned core sections 44 and 46. The movable contact 26 is carried by a block or body 58 of magnetic material which is slidably disposed within the envelope. Frictional resistance between this body and the inner surface of the envelope may be reduced by providing the body with bearing portions 59 at the ends thereof, each comprising an annular series of lugs or protuberances 60. The stationary contact 27 is mounted upon the inner end of a terminal 61 which extends through and is sealed in the end wall of the envelope. To maintain the stationary contact in a central position within the envelope for proper cooperation with the movable contact 26, and to prevent the wall of the envelope from collapsing and interfering with movement of the body 58 when the end of the envelope is sealed around the terminal 61, we prefer to employ a disk-like body 62 of non-magnetic material, which is disposed around the stem portion 63 of the stationary contact, and which is only slightly smaller in diameter than the inner diameter of the envelope.

As shown in Fig. 4 of the drawing, the movable body or armature 58 which carries the contact 26 is disposed between the stationary contact 27 and one end of an elongated body of magnetic material 64. This elongated body or core member is disposed in the envelope in substantially coextensive relation with the core section 44 and is electrically connected to a terminal 65 which extends through and is sealed in an end wall of the envelope. A recess 66 is provided in the elongated body 64 in which a coil spring 67 is disposed for normally urging the movable contact 26 toward engagement with the stationary contact 27. One end of this spring engages the bottom wall 68 of the spring recesses, and its other end may be connected to the movable body 58 by providing this body with a threaded extension 69 upon which some of the convolutions of the coil spring are screwed.

The envelope itself may be of any suitable substance but is preferably of glass or like material, which can be conveniently worked into tubular shape, as shown in Fig. 4, and which can be easily evacuated and rendered airtight by fusing the material to close the communicating passage through which the air is exhausted. The device may be operated with a vacuum existing in the envelope or, if desired, a suitable inert gas may

be introduced into the envelope and confined therein. Rattling or vibration of the envelope within the core sections 44 and 46 may be prevented by providing a disk member 70, of fibre or other suitable material, which is clamped between the frame member 42 and the retaining ring 53, and which is provided with an angularly disposed retaining flange or serrated portion 71 for snugly and resiliently gripping the envelope. Additionally, if desired, a layer of paper or other suitable material may be disposed between the envelope and the core sections 44 and 46.

The envelope is preferably made long enough to project laterally outwardly beyond the frame member 42 and the outer end of the core section 46, as shown in Fig. 4, so as to facilitate connection of the terminals 61 and 65 with appropriate electrical conductors. The terminal 61 may be connected to an electrical machine to be regulated, as by means of the conductor 33 shown in Fig. 3, or by the conductor 13 shown in Fig. 1. The terminal 65 may be connected to the machine to be regulated preferably by being grounded to the casing of the regulating unit. To this end, we provide a conductor in the form of the metallic strap 72, shown in Fig. 4, which is soldered or otherwise connected to the outer end of the terminal 65, and which is grounded to the frame of the electromagnet by having laterally extending flange portions 73 clamped against the retaining ring 53 by the studs 57.

To complete the casing of the regulating unit and to provide a suitable protecting enclosure for the projecting ends of the envelope and its terminals 61 and 65, we provide the cover members 74 and 75, which are removably clamped against the ends of the casing section 40 by means of the screws 76 threaded into the outer ends of the studs 57.

From the arrangement of the various parts, as herein disclosed, it will be seen that in their assembled relation the casing section 40, the members 42 and 43, and the core sections 44 and 46 constitute a frame for the electromagnet, which frame provides a path of low reluctance for passage of magnetic flux. The positioning of the envelope within the core sections 44 and 46, brings the members 64 and 58 into such position relative to these core sections that the flux produced by the windings is efficiently utilized in actuating the member 58. By adjusting the core section 46 relative to the core section 44, the length of the air gap 47 may be varied to thereby change the effect of the magnetic flux on the member 58. Such variation in the air gap provides a positive and convenient means for accurately adjusting the device, without need of altering the position of the envelope, to compensate for variations in the manufacture of the parts contained in the envelope, as well as to suit different circuit requirements or conditions under which the device is operated.

It should now be readily understood from the foregoing description and the accompanying sheet of drawing, that we have provided a very compact and practical construction for a regulating device of the vibratory type, wherein all of the magnetizing windings and resistance elements are enclosed within a casing formed by the frame members of the electromagnet. It will also be seen that in our novel construction the cooperating contacts are disposed within an air-tight envelope which is arranged within aligned hollow core sections of the electromagnet, and that these core sections are relatively adjustable for regulation of the rate of vibration of the movable contact. Such adjustment can be easily and conveniently accomplished at the initial assembly of the regulating unit, or from time to time during the use of the device as might be desirable to compensate for seasonal requirements of vehicle generating systems. By simply removing the cover member 74, access may be had to the squared portion 48 of the core section 46 for making the adjustment referred to, or if conditions should require replacement of the make and break device of the regulator unit, both cover members may be detached and the envelope removed and replaced by a new envelope assembly. It will also be seen that since our improved regulator is in the form of a compact self-contained unit, it can be easily installed by mounting upon an available support, such as upon a portion of the electrical machine to which the regulating device is to be applied. During use of our regulating device, the enclosing envelope protects the contacts against moisture, dirt, and against destructive sparking and, likewise, the intermediate casing section and the cover members protect the electromagnet and the envelope against damage from shocks or blows.

While we have illustrated and described the device of our invention in a detailed manner, it should be understood, however, that we do not intend to be limited to the precise details of construction and arrangement of parts illustrated and described, but regard our invention as including such changes and modifications as do not involve a departure from the spirit of the invention and the scope of the appended claims.

Having thus described our invention, we claim:

1. An electromagnetic device of the character described comprising a hollow frame element, a pair of spaced frame elements extending transversely of said hollow frame element, a magnet winding disposed in said hollow element between said spaced elements, aligned core sections extending into said winding from said spaced elements, means for relatively adjusting said sections, an envelope disposed in said sections, and a make and break device in said envelope responsive to magnetization produced by said winding.

2. A voltage regulator comprising a casing, a magnet winding in said casing, a tubular member extending into said winding, an envelope disposed in said tubular member, a stationary core element in said envelope, a second core element in said envelope movable relative to said stationary core element under the magnetizing action of said winding, a stationary contact element in said envelope, and a contact element actuated by movement of said second core element for cooperation with said stationary contact element.

3. An electromagnetic device of the character described comprising a magnet winding, spaced hollow core sections extending into said winding from opposite ends thereof, an envelope disposed in said core sections and spanning the spaced inner ends thereof, a core element in said envelope substantially coextensive with one of said hollow sections, a second core element movable in said envelope relative to the first mentioned core element, a stationary contact in said envelope, and a contact cooperating with said stationary contact and actuated by the movable core element.

4. An electromagnetic device of the character described comprising a magnet winding, hollow core sections extending into said winding with

their inner ends in spaced relation, adjusting means for varying the spacing of said inner ends, an envelope disposed in said core sections and spanning the spaced inner ends thereof, a core element in said envelope substantially coextensive with one of said hollow sections, a second core element movable in said envelope relative to the first mentioned core element, a stationary contact in said envelope, and a contact cooperating with said stationary contact and actuated by the movable core element.

5. An electromagnetic device of the character described comprising a hollow frame having spaced end walls, a magnet winding disposed in said frame between said end walls, hollow core sections extending into said winding from said end walls with their inner ends in spaced relation, adjusting means for varying the spacing of said inner ends, an envelope disposed in said core sections and spanning the spaced inner ends thereof, a core element in said envelope substantially coextensive with one of said hollow sections, a second core element movable in said envelope relative to the first mentioned core element, a stationary contact in said envelope, and a contact cooperating with said stationary contact and actuated by the movable core element.

6. An electromagnetic device of the character described comprising a magnet winding, spaced hollow core sections extending into said winding from opposite ends thereof, an envelope disposed in said core sections and spanning the spaced inner ends thereof, a stationary core element in said envelope substantially coextensive with one of said hollow sections, a member in the envelope adapted for vibratory movement relative to said core element, and cooperating contacts in said envelope adapted to be rapidly opened and closed by the vibratory movement of said member.

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