

May 12, 1942.

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2,282,933

VOLTAGE REGULATOR AND THE LIKE

Filed Aug. 23, 1940

2 Sheets-Sheet 1

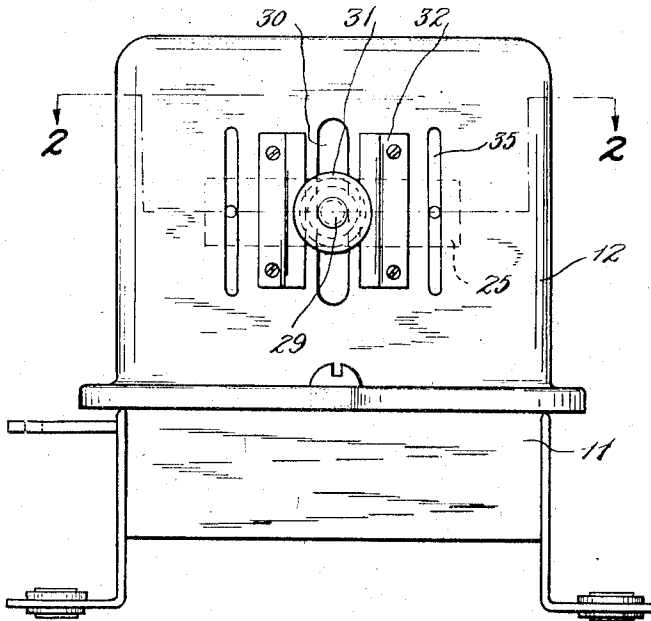


FIG. 1

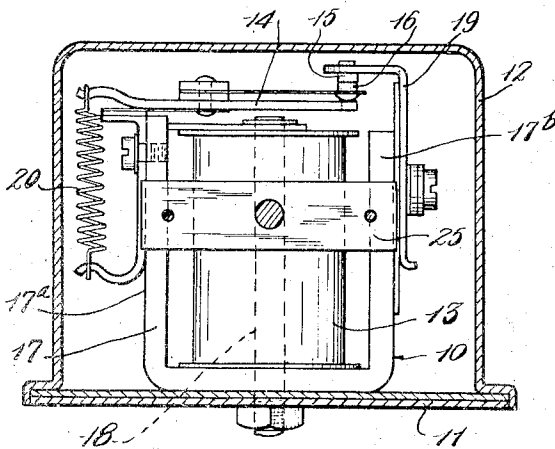


FIG. 3

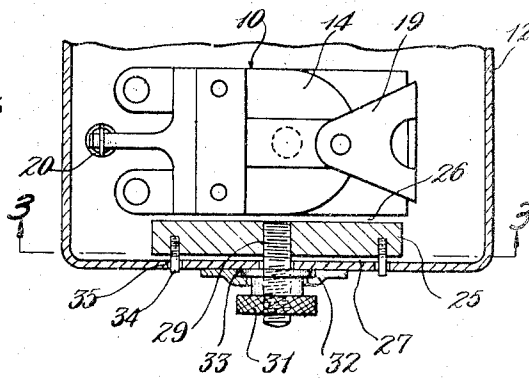


FIG. 2

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2 Sheets-Sheet 2

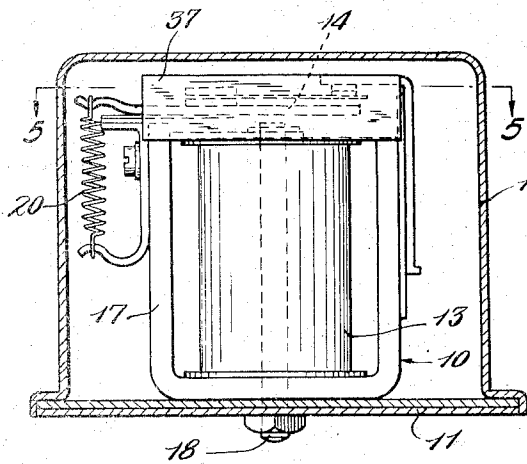


FIG. 4

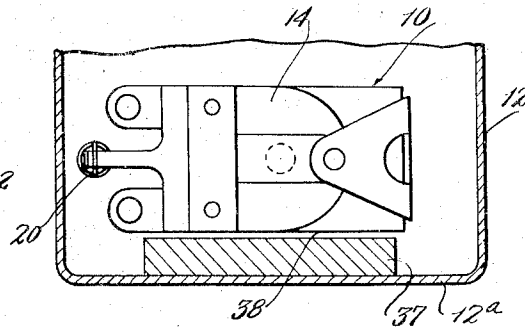


FIG. 5

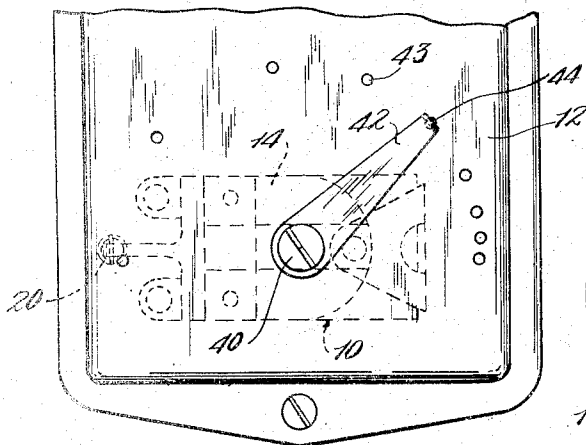


FIG. 6

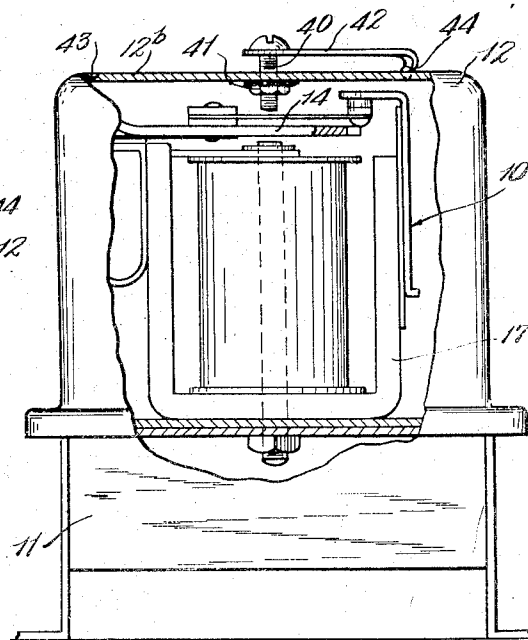


FIG. 7

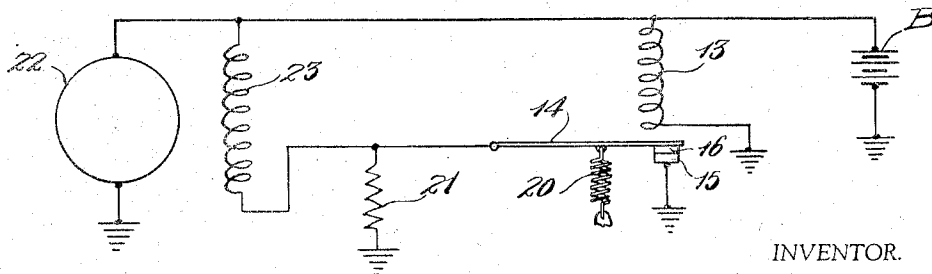


FIG. 8

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2,282,933

VOLTAGE REGULATOR AND THE LIKE

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Application August 23, 1940, Serial No. 353,880

4 Claims. (Cl. 175—336)

This invention relates to voltage regulators and other electromagnetic relays, and more particularly to an improved construction by which the operating characteristics of such devices can be adjusted with greater accuracy and facility than has heretofore been possible.

Voltage regulators and other electromagnetic devices applied to automotive electrical systems or other apparatus are usually enclosed by a housing formed of magnetic material such as steel or iron and during the operation of these devices more or less of the flux traverses the housing. In the case of voltage regulators it is desirable to be able to adjust or vary the operating characteristics to thereby vary the voltage of the generator to suit the charging requirements of the battery for a wide variety of driving conditions. One way of making this adjustment is to vary the tension of the spring acting on the armature of the regulator, as by bending the spring-supporting arm, but this requires the removal of the cover or housing to gain access to the spring and the replacement of the housing for checking the adjustment inasmuch as the housing forms a part of the magnetic circuit. Repeated bending of the spring-supporting arm may result in early failure thereof, and moreover, in order to be able to adjust a regulator by such variation in the spring tension, it is necessary that the device be manufactured with such care and accuracy that its initial operating characteristics are very close to the desired or ultimate characteristics. As will be explained in detail hereinafter, my invention eliminates the need for altering the tension of the armature spring or opening the housing and provides a simpler and more satisfactory way of adjusting a voltage regulator or the like by controlling the magnetic flux.

It is, therefore, an object of my invention to provide novel means for controlling or varying the magnetic circuit of a voltage regulator or like device whereby the voltage setting or operating characteristics can be adjusted more readily and more accurately than heretofore.

Another object of my invention is to provide an improved construction for voltage regulators and like devices by which adjustment of the voltage setting or operating characteristics can be quickly and easily made with the housing or cover surrounding the regulator or relay as in the ordinary service condition in which the device is intended to be used.

My invention also aims to provide an improved construction for voltage regulators and the like,

wherein a simple and efficient adjusting means embodied in the device has an effectiveness such that it is only necessary to have a rough or approximate commercial or initial setting during the manufacture of the devices.

A further object of my invention is to provide an improved construction for voltage regulators and other relays of the type having a housing formed of magnetic material, in which a body of magnetic material is located in the housing at a point relative to the relay to so control or regulate the flow of flux as to produce a desired voltage setting or operating characteristic.

Still another object of my invention is to provide an improved regulator or relay construction of the character just mentioned in which means is accessible externally of the housing for shifting the body of magnetic material relative to a portion of the regulator or relay to produce the desired adjustment.

Other objects and advantages of my invention will be apparent from the following description when taken in conjunction with the accompanying sheets of drawings in which,

Fig. 1 is an end elevation showing a voltage regulator or like device enclosed in a housing and provided with means for adjusting the operating characteristics of the device while the housing is closed.

Fig. 2 is a partial sectional plan view taken through the device as indicated by line 2—2 of Fig. 1.

Fig. 3 is a transverse sectional view taken through the device as indicated by line 3—3 of Fig. 2.

Fig. 4 is a similar transverse sectional view showing a modified form of my invention.

Fig. 5 is a partial sectional plan view taken through this modified device as indicated by the line 5—5 of Fig. 4.

Fig. 6 is a partial plan view showing a voltage regulator or the like enclosed in a housing provided with another form of adjusting means.

Fig. 7 is an end view of the device showing the same with portions thereof broken away, and

Fig. 8 is a wiring diagram showing a typical circuit in which my improved regulator or relay may be used.

As just indicated above, the drawings illustrate different embodiments of my invention to which further reference will now be made for the purpose of describing the construction and operation thereof in greater detail. However, before proceeding with such more detailed description, it should be understood that the in-

vention is not limited to the particular constructions and arrangements hereinafter described but may be embodied in numerous other devices of this character.

In Figs. 1, 2 and 3 of the drawings I show an electromagnetic relay 10 mounted on a base 11 and enclosed by a housing or cover 12 formed of magnetic material, that is, a material capable of readily conducting magnetic flux such as steel or iron. The relay shown in this instance may be a voltage regulator of the type frequently used in the starting and lighting systems of motor vehicles and may comprise a magnet or coil 13 adapted to be energized to move an armature 14 to thereby cause opening and closing of a pair of contacts 15 and 16. This regulator may be provided with a U-shaped frame 17 having a core 18 between its arms 17a and 17b on which the magnet coil 13 is mounted or wound. The armature 14 may be mounted on the arm 17a of the frame 17 so as to extend across the upper end of the core 18 and into adjacent relation with the opposite arm 17b. The contact 15 may be a stationary contact supported by the bracket 19 and the movable contact 16 may be carried by the armature 14 and urged toward engagement with the stationary contact by means of a tension spring 20.

When the relay 10 is a voltage regulator, as illustrated in this instance, the armature 14 may operate with a rapid vibratory action or a switch action and the contacts 15 and 16 may be used to intermittently short-circuit a field resistance 21 as shown in the wiring diagram of Fig. 8. The typical circuit here illustrated shows the magnet 13 of the regulator connected across the terminals of a generator 22 being used to charge a storage battery B and shows the contacts 15 and 16 located in the circuit of the shunt field winding 23. As will be seen from this diagram, the movement of the armature 14 will cause opening and closing of the contacts 15 and 16 and upon each opening of the contacts the resistance 21 will be inserted in the field circuit and upon each closing of the contacts will be short-circuited out of the field circuit.

For adjusting the operating characteristics of the regulator or relay 10 to control the voltage of the generator 22, or for other reasons, I provide a body 25 of magnetic material which is located in the housing 12 and the position of which relative to the relay varies or determines the percentage of the flux to pass through the armature 14. In the embodiment shown in Figs. 1 to 3 inclusive, the body 25 forms a magnetic shunt across the arms of the frame 17. To this end the body 25 may be in the form of an elongated flat member or bar formed of iron or other magnetic material and of a length to extend across the space or gap between the arms of the frame. The effectiveness of the magnetic shunt formed by the body 25 will depend upon its proximity to the arms of the frame 17 and also upon its proximity to the upper ends of these arms, that is, its proximity to the armature 14. In this instance I show the body 25 located somewhat below the ends of the arms of the frame and with air-gaps 26 and 27 separating the body from the frame member and from the housing or cover 12. It will be understood, of course, that the thickness of the body 25 and other dimensions may be varied to increase, decrease, or substantially eliminate these air-gaps. In serving as a magnetic shunt, the body 25 provides a more direct path for the flux than the armature 14 and thus

reduces the amount of flux passing through the latter, and hence the presence or absence of the shunt or a variation in the reluctance thereof will alter the operating characteristics of the device.

To thus vary the effectiveness of the magnetic shunt I provide adjusting means whereby the position of the body 25 relative to the frame 17 and to the armature 14 can be varied while the housing or cover 12 is in its closed position. For this purpose I may provide the body 25 with a stud 29 which projects through a slot 30 of the housing and carries an adjusting nut 31. Guide strips 32 mounted on the housing at opposite sides of the slot 30 provide a guideway along which the nut 31 can be slid for shifting the position of the body 25 toward or from the armature 14. The nut 31 preferably has a flange or collar 33 engaging in the guideway formed by the strips 32 so that rotation of the nut will screw the stud inwardly or outwardly of the housing, depending upon the direction of rotation, and thereby move the body 25 toward or away from the arms of the frame 17. The body 25 may be held against rotation in the housing 12 by one or more pins 34 carried thereby and projecting through a slot or slots 35 of the housing.

With the adjusting means just described, it will be seen that the body 25 can be shifted upwardly or downwardly relative to the armature 14 and can also be moved toward or away from the arms of the member 17 and its effectiveness as a magnetic shunt can thereby be varied within a wide range. It will also be seen that this adjustment of the body 25 can be accomplished while the housing 12 is closed and the regulator or relay is functioning in the service or use to which it is intended to be put. Since the adjustment as just described can be made while the housing 12 is closed, the magnetic effects of the housing will be automatically taken into consideration and the adjustment can be more quickly and accurately made than if it were necessary to remove and replace the housing. When the device embodying the magnetic shunt is a voltage regulator, the movement of the body 25 in a direction to increase its effectiveness as a magnetic shunt increases the operating voltage of the regulator and movement in a direction to decrease its effectiveness as a shunt decreases the operating voltage.

In the embodiment of the invention illustrated in Figs. 4 and 5, I show a similar body 37 of iron or other magnetic material located in the housing 12 and mounted on the end wall 12a thereof so as to lie adjacent or substantially opposite the armature 14 of the regulator or relay 10. When the body 37 is located in this position, I find that it decreases the reluctance of that part of the magnetic circuit which extends through the cover or housing 12 and also directs this stream of stray flux so that it will pass through the armature thereby causing an increase in the total amount of flux which passes through the armature. This position for the body 37 also decreases the reluctance of that part of the normal magnetic circuit consisting of the armature and the U-like frame 17 because it decreases the air gaps between the armature and the arms of the frame. The decreased reluctance in these two magnetic circuits thus causes an increased amount of flux to pass through the armature and the armature will be much more responsive to changes in the energization of the coil or winding 13 than if the magnetic body 37 were not em-

ployed. The use of the body 37 in the position illustrated in Figs. 4 and 5 thus serves to decrease the voltage setting at which the device will operate as a voltage regulator because the armature will be attracted toward the frame member 17 at a lower voltage value. In the device of Figs. 1 to 3 the body 25 is located relatively remote from the armature 14 and forms a shunt or auxiliary flux path and thus decreases the amount of flux left to pass through the armature. On the other hand, in the device of Figs. 4 and 5 the body 37 is very close to the armature and directs or influences the flux to pass through the latter. The body 37 thus increases the flux through the armature instead of acting as a shunt and reducing it as in the case of the body 25.

The body 37 can be permanently mounted on the end wall of the housing 12 in substantially the position shown in Figs. 4 and 5 by any suitable fastening means, or, if desired, can be adjustably mounted thereon by the same mounting and adjusting means as is illustrated in Figs. 1 to 3 inclusive. It will also be understood that the operating characteristics of the regulator or relay can be varied more or less by substituting for the body 37 other similar bodies of different sizes or proportions. The effectiveness of the body 37 will also depend upon the width of the air-gap 38 and this can be made of any desired width by varying the thickness or position of the body.

In Figs. 6 and 7 I show still another way of controlling the flow or distribution of the flux to thereby adjust or regulate the operating characteristics of the voltage regulator or relay 10. In this form of the invention I show the housing 12 having a body of magnetic material mounted on the top wall 12b thereof preferably in the form of a screw 40 which extends into the housing to a point adjacent the armature 14 of the regulator or relay 10 contained in the housing. For suitably mounting the screw 40 on the housing 12 I may provide the latter with a threaded opening in which the screw is engaged or may mount a nut 41 or the like on the wall of the housing to accommodate this screw. The body of magnetic material constituting the screw 40 may be arranged in any desired position or location relative to the armature and as here shown may extend adjacent the armature 14 from a point thereabove so as to reduce the reluctance between the housing and the armature and hence increase or redistribute the flux through the armature. The inner end of the screw 40 need not touch the armature and preferably is at all times spaced therefrom. In this modification the housing and screw form portions of a second magnetic path for flux produced by the relay and since the screw is located above the armature this additional flux is made to pass through the latter. When the screw is adjusted inwardly the air gap is decreased and consequently the flux through the armature is increased.

The operating characteristics of the regulator or relay shown in Figs. 6 and 7 can be accurately adjusted while the device is in use by moving the screw inwardly or outwardly relatively to the armature 14 to vary the air space therebetween. To facilitate this adjustment of the screw 40 while the housing 12 is closed, I may provide an arm or lever 42 by which the screw can be conveniently rotated. Any suitable means may be provided for holding the screw in a desired position of adjustment, such as by providing the

housing 12 with indentations 43 into which a knob or detent portion 44 of the lever 42 may engage.

The body of magnetic material used in the above described embodiments of my invention for adjusting the operating characteristics of the voltage regulator or relay may be formed of iron or other suitable magnetic material, but, as a further feature of my invention, I may make this body of nickel-iron alloy so that a temperature compensation can also be obtained. When the body is formed of nickel-iron alloy, it will have greater reluctance when the operating temperature of the regulator or relay increases, and this, in the devices of Figs. 4 and 6, will correspondingly decrease the pull or attraction on the armature 14.

In disclosing my invention I have pointed out advantages gained in embodying my improvement in voltage regulators and like devices during the manufacture thereof but it should be understood that my invention also contemplates the application of my improvement to voltage regulators and like devices which are already in use. This may be accomplished by manufacturing and selling housings or covers having my flux control means thereon.

From the foregoing description and the accompanying drawings it will now be readily understood that I have provided an improved construction for voltage regulators and other electromagnetic relays by which the flow or distribution of the magnetic flux can be controlled or varied so as to produce a desired operating characteristic in the device. It will be seen furthermore, that my improved construction permits the adjustment of a voltage regulator or the like to be accomplished while the housing or cover is in a closed condition and hence more accurately and with greater facility than has heretofore been permissible.

While I have illustrated and described my invention in a more or less detailed manner, it will be understood, of course, that I do not wish to be limited to the particular constructions and arrangements of parts herein disclosed but regard my invention as including such changes and modifications as do not constitute a departure from the spirit of the invention and the scope of the appended claims.

Having thus described my invention, I claim:

1. An electromagnetic device of the character described comprising a relay having a U-like frame and a core with a surrounding coil thereon between the arms of the frame and a movable armature extending across said arms and core, a removable housing of magnetic material enclosing the relay, a body of magnetic material mounted on a wall of the housing and arranged thereon relative to said frame and armature to form a portion of an auxiliary magnetic circuit which extends through the housing when the housing surrounds the relay, and means for shifting said body toward or away from said armature to vary the effectiveness of the auxiliary magnetic circuit.

2. In a voltage regulator, a base, a relay mounted on said base and having a U-like frame with a vibratory armature extending across the arms of the frame and a core with a surrounding coil between such arms, a removable cover formed of magnetic material and cooperating with said base to enclose the relay, a body of magnetic material disposed in said cover to extend as a magnetic shunt across the arms of said frame

when said cover is applied to said base, the wall of said cover having a slot therein and said body having a threaded stem projecting through said slot, and a nut slidably anchored on said cover and engaging said threaded stem, said stem and nut providing a means for shifting said body toward or away from said arms to vary the airgap therebetween and also providing a means for shifting said body along said arms relative to said armature and thereafter locking said body in its adjusted position.

3. In an electromagnetic device of the character described, a relay having a core with a winding thereon and a movable armature, a housing enclosing the relay and made of magnetic material so as to form a portion of an auxiliary magnetic circuit, said relay being disposed in the housing with its core connected to one wall thereof and with its armature adjacent to but spaced from the opposite wall, and means formed of magnetic material and extending from said opposite wall to a point adjacent said armature to complete the auxiliary magnetic circuit through the housing, said means having a screw

adjustment accessible from the outside of the housing for varying the air gap between the same and said armature.

4. In an electromagnetic device of the character described, a relay having a frame including a core portion, a winding on the core portion and a movable armature extending across an end of said core portion, a housing enclosing the relay and made of magnetic material so as to form a portion of an auxiliary magnetic circuit, said relay being disposed in the housing with its frame connected to one wall thereof and with its armature adjacent to but spaced from the opposite wall, a screw formed of magnetic material and extending through said opposite wall substantially coaxially with said core portion to a point adjacent said armature to complete the auxiliary magnetic circuit through the housing, said screw having its head accessible from the outside of the housing for purposes of adjustment of the air gap between the stem of the screw and the armature.

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