Nov. 13, 1928. 1,691,203

T. L. LEE ET AL

ELECTROMAGNETIC INSTRUMENT

Filed Aug. 27, 1923 2 Sheets-Sheet 1

Fig. 1.

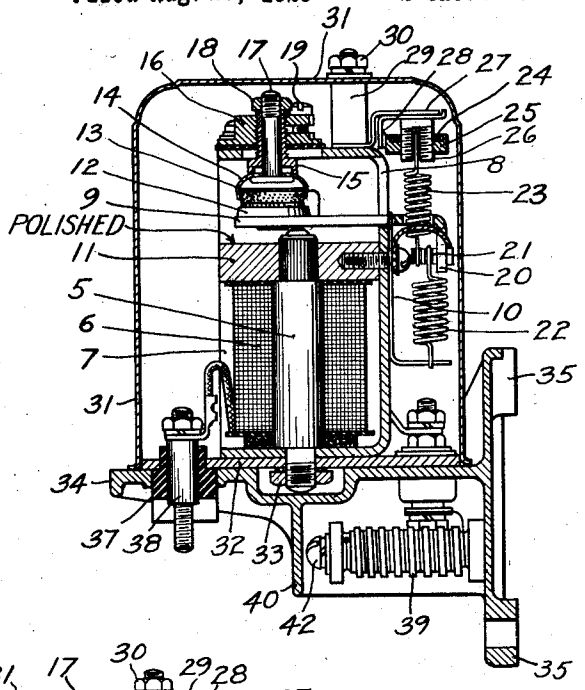
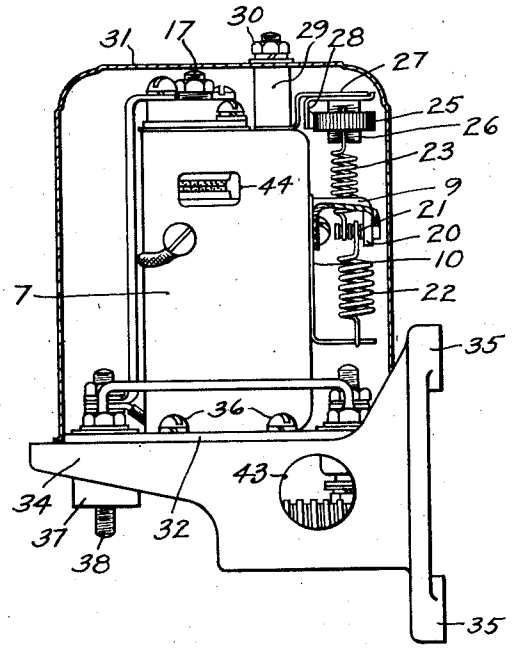


Fig. 2.



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Fig. 3.

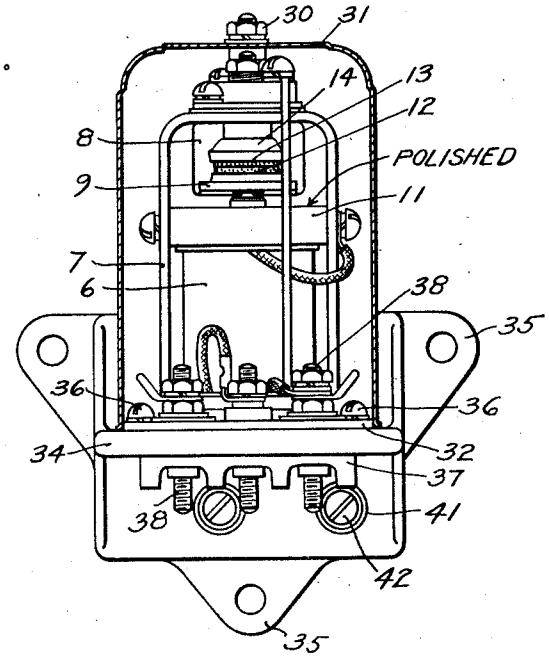
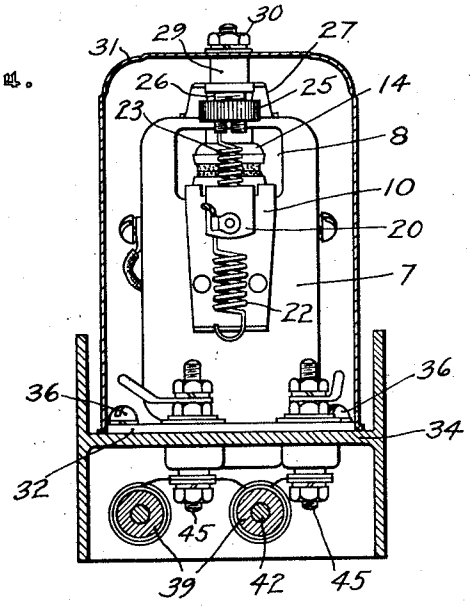


Fig. 4.



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UNITED STATES PATENT OFFICE.

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ELECTROMAGNETIC INSTRUMENT.

Application filed August 27, 1923. Serial No. 659,597.

This invention relates to electromagnetic instruments of the relay type.

One object of the invention is to produce an instrument in which an efficient magnetic circuit is combined with simple and rigid mechanical structure. Another object is to provide effectively for temperature-compensation, and particularly to so control the distribution of heat within the instrument that the action of the compensating means shall not be unduly disturbed by heat engendered at the contacts. A third object is to provide effective and convenient means for adjusting the instrument.

Other objects of the invention will be noted in connection with the following description of the illustrated embodiment, and the invention consists in the instrument illustrated and described, as it is defined in the succeeding claims.

In the accompanying drawings Fig. 1 is a side-elevation, partly in section, of an electromagnetic instrument embodying the present invention, and Fig. 2 is a side-elevation of the instrument, shown in full with the exception of the cover. Fig. 3 is a front-elevation of the instrument, with the cover in section, and Fig. 4 is a rear-elevation with the cover and bracket in section.

The invention is illustrated as embodied in a vibratory regulator such as is used to regulate the output of an electric generator. The magnetic circuit comprises an iron core 5 on which the winding or windings are mounted in the form of a solenoid 6. The core is enclosed in a box-like member 7 which is formed integrally by drawing a piece of sheet-steel to the proper shape. This member 7, which performs, among others, the function of a magnetic yoke, comprises a lower end-member, to which the lower end of the core is fixed, and side-members and a back which extend vertically so as to be parallel with the core on three sides.

The back of the yoke 7 is provided with an opening or window 8 within which an armature 9 of sheet-steel is mounted, in position to cooperate with the upper end of the core, and this armature is pivoted on a plate 10 which is fixed to the back of the yoke. The form and arrangement of this pivot-joint is not particularly described herein, as it is more fully set forth and claimed in a pending application of Thomas L. Lee, filed Feb. 25, 1922, Serial No. 539,067.

The magnetic circuit is completed by a block 11 of some alloy, such as nickel-steel, which has a negative temperature-coefficient of magnetic permeability, so that it may act as a magnetic shunt by which compensation is afforded for the effects of temperature-changes upon the windings of the regulator. This arrangement is not broadly claimed herein, as it is disclosed and claimed in Letters Patent of the United States No. 1,398,463, granted Nov. 29, 1921, to Thomas L. Lee; it will be apparent, however, that the present form of magnetic circuit lends itself particularly well to the efficient use of the compensating device, since the block 11 extends, from the upper end of the core 5 to the back and both sides of the yoke 7, and the ample area of the path thus afforded for the magnetic flux permits the use of a smaller body of compensating material than would be necessary in the case of a more restricted path. Owing to the use of a relatively small body of compensating material, heat-changes are more promptly effective upon it, while the construction is also rendered more compact and less expensive.

The nature and the arrangement of the contacts controlled by the armature 9 are not essential features of the present invention, but the instrument is shown as provided with two carbon contacts, of which the contact 12 is carried by the armature, while the contact 13 is fixed. The contact 13 is carried by a metal shell 14 which is partly spherical in form and which rests in a concave head 15 provided with a threaded stem which is screwed into a block 16. The shell 14 is perforated to receive a bolt 17 which passes centrally through the stem and is provided with a nut 18 at its upper end. By tightening the nut the head at the lower end of the bolt is caused to clamp the shell firmly to its seat, and the form of the shell is such that a preliminary angular adjustment of the shell and the contact may be made to cause the two contacts to meet squarely.

The yoke 7 is utilized not only as a part of the magnetic circuit, but also to afford a mechanical support for the fixed contact and other parts. For this purpose it is extended above the armature and provided with an

upper horizontal end-member. The block 16 rests upon, but is insulated from this member. To permit vertical adjustment of the contact 13, the block 16 is horizontally slotted from one side, as shown in Fig. 1, and provided with a clamp-screw 19. After the stem 15 has been screwed up or down to the required degree the screw 19 may be tightened, thus causing the stem to be firmly clamped in place.

A feature of the invention resides in the use of a novel arrangement of differentially acting springs for controlling the movement of the armature. At the rear end of the armature is a depending lug 20, in which a stud 21 is fixed. Two helical springs are attached to the stud, the spring 22 extending downwardly therefrom, and the spring 23 extending upwardly through a clearance hole in the armature. The spring 22 is attached to the outwardly-bent lower end of the plate 10, and it exerts a constant preponderating pull upon the armature in the direction to close the contacts.

The spring 23 is used solely for the purpose of adjustment, since its effect is opposed to that of the spring 22. Its upper end is hooked over a cross-pin 24, which is received in a vertical slot in a screw-threaded stud 26. The end of the spring is received in another slot, at a right angle to the first. The pin rests on the recessed upper surface of a nut 25 threaded on the stud. The stud is fixed to an arm 27, and a detent-spring 28 engages the knurled periphery of the nut to prevent accidental turning. When the nut is rotated by hand the pin is raised or lowered, thus adjusting the tension of the spring 23, and this adjustment is accomplished without any twisting of the spring or any interference with the action of the armature, so that the instrument may be accurately adjusted while in operation.

In order that the compensating device 11 may perform its function accurately and effectively it is necessary that its temperature be dependent upon the temperature of the windings of the instrument, and independent, so far as possible, of the evolution of heat at the contacts. Since the contacts attain a high temperature under certain working conditions, it is desirable that heat which is conducted or radiated from them be diverted from the compensator and dissipated externally. Certain features of the invention reside in simple and effective dispositions by which the foregoing object is attained. In the first place, the contact-block 16, being electrically insulated is also thereby to a great extent thermally insulated from the yoke 7, and the considerable surface of this block serves to radiate a large part of the heat and thus to dissipate it at a point remote from the compensator.

In the second place, the yoke is cut away not only by the window 8 at the back, but also by two lateral windows 44, so that the heat-conductive cross-sectional area is reduced as much as is consistent with the desirable rigidity.

In the third place, means are provided for conducting heat away from the top of the yoke, these means comprising a metal stud 29, consisting preferably of copper, threaded at its upper end and provided with a nut 30. The instrument is enclosed by a sheet-metal cover 31, consisting preferably of copper or of aluminum, and this cover is secured in place by the stud 29 and the nut 30. By the same means heat is conducted directly from the yoke to the cover, which acts effectively as a radiator to dissipate the heat in the atmosphere.

The armature 9 is unavoidably heated by the contact 12 and it radiates heat downwardly from its lower surface. We have found that an effective device to protect the compensator from this radiated heat is to impart a mirror-like polish to one or both of the opposed surfaces of the armature and the compensator respectively, whereby interchange of heat by radiation between these surfaces is substantially reduced.

The magnet of the instrument is secured to a sheet-metal base-plate 32. For this purpose the lower end of the core 5 is threaded and extended through both the base-plate and the bottom of the yoke. A nut 33 threaded on the core clamps all of these parts together.

The instrument is supported by a horizontal bracket 34, which is provided with perforated lugs 35 to receive bolts by which it may be secured to a vertical surface such as that of the dash-board of a vehicle. The base-plate is fixed to the bracket by screws 36. A block 37 of insulating material, fixed in an opening through the forward part of the bracket, supports binding-posts 38 through which the instrument may be connected with external circuits.

Where the instrument, as in the illustrated embodiment, is designed for use as a regulator it cooperates with one or more resistors, and such resistors 39 are shown as housed within a downwardly-open box or housing formed at the bottom of the bracket 34. The forward wall 40 of this housing is provided with openings 41 to afford access to screws 42 by which the resistors are fixed in place. These openings, and openings 43 in the sides of the housing, serve also to promote ventilation of the housing so that heat evolved in the resistors will be dissipated.

It should be understood that altho the instrument is illustrated as in what may be described as upright position, it will operate effectively in any other position, and that in certain of the following claims, where the terms "upper," "lower" etc. are used, these are terms of relation merely, based, for con-

venience of description, upon the illustrated position of the instrument.

The invention claimed is:

1. In an electromagnetic instrument, the combination of a magnetic yoke comprising magnetic material in the form of a box with closed ends, sides and rear but open at the front, the rear wall having an opening near the upper end; a core attached, at one end, to the lower end-wall of the yoke and extending toward the upper end-wall; an armature pivoted to the rear wall of the yoke and extending through said opening, with its inner end in cooperative relation with the upper end of the core; a spring located at the outside of the rear wall and attached to the armature; and contacts, controlled by the armature, of which one is supported upon the upper end-wall of the yoke.

2. An electromagnetic instrument, as defined in claim 1, characterized further by the fact that the cross-section of the upper part of the yoke is substantially reduced by openings formed in its side-walls.

3. In an electromagnetic instrument, the combination of a core provided with a winding; a magnetic yoke attached to the lower end of the core; an armature cooperating with the upper end of the core; a magnetic temperature-compensating shunt, comprising a body of suitable alloy, extending between the upper end of the core and an adjacent part of the yoke; contacts, controlled by the armature, of which one is fixed on the yoke; a heat-conductive cover enclosing the foregoing parts; and a heat-conductive connection from the cover to the yoke, at a point relatively near to said contact and remote from the compensating shunt, said connection serving also as means for securing the cover in place.

4. An electromagnetic instrument comprising a core; a winding thereon; an armature cooperating with the core; a contact mounted on the armature; and a magnetic temperature-compensating shunt cooperating with the core and located near the armature; said instrument being characterized by the fact that one of the opposed faces of the armature and the shunt, respectively, is polished to provide a mirror-like heat-reflective surface.

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