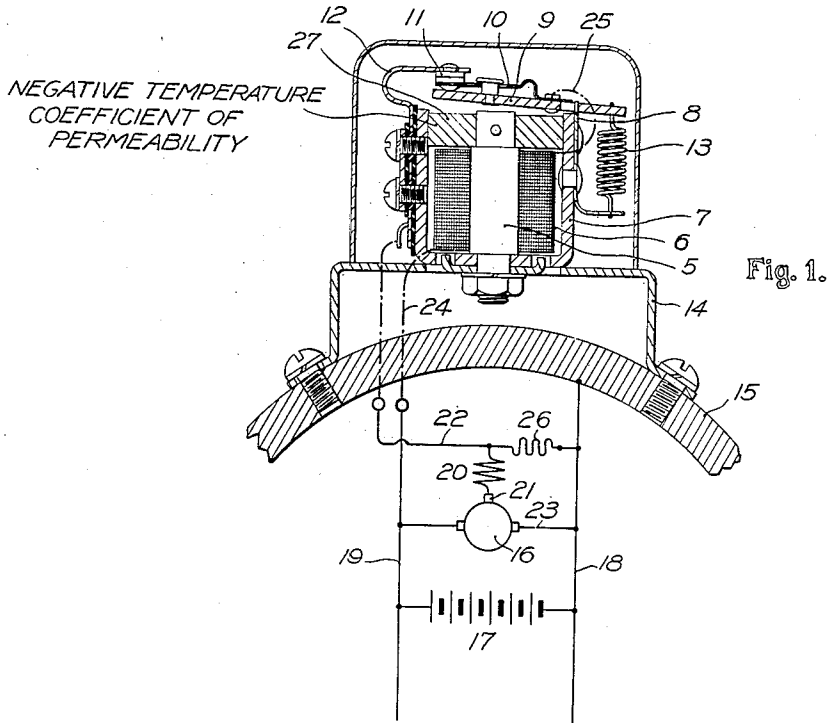
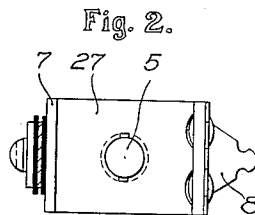


T. L. LEE.
ELECTROMAGNETIC INSTRUMENT,
APPLICATION FILED NOV. 5, 1920.

1,398,463.

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ELECTROMAGNETIC INSTRUMENT.

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To all whom it may concern:

Be it known that I, THOMAS L. LEE, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Electromagnetic Instruments; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which appertains, to make and use the same.

This invention relates to an electromagnetic instrument or relay which must respond accurately to a current of a definite strength of voltage. Such an instrument is frequently used to control the voltage or output of a dynamo-electric machine, and the object of the invention is to produce an instrument of this kind of which the operation shall be substantially unaffected by changes in temperature, and which shall be simple in construction and reliable in operation.

In charging storage-batteries from a generator operating for indefinite periods, as in the case of the electrical systems used on automobiles, it has been proposed to use an electromagnetic controller subjected to the electromotive force of the battery and adjusted to operate when this voltage reaches a predetermined point indicative of a fully charged condition in the battery. The controller acts to reduce the voltage or output of the generator under these circumstances, usually by throwing resistance into the circuit of the field-winding.

In an arrangement such as that just described the controller must be sensitive to slight differences in voltage, since there is little difference between the E. M. F. of a fully charged battery and that of a battery only partially charged. On the other hand, the changes in temperature to which a controller of the kind is subjected produce such considerable changes in the resistance of the winding of the controller as to prevent its operating with the necessary precision. It has accordingly been proposed to compensate for temperature changes by the use of various devices, such as thermostatic springs, external resistances, etc.

In the present invention the same result is accomplished by means of a magnetic shunt which acts automatically to divert, from the armature of the instrument, more

or less of the flux of the electromagnet, in such a manner as to compensate for the effect of temperature on the magnet-winding. For this purpose use is made of the peculiarity of certain alloys that their magnetic permeability diminishes with increase in temperature, within the normal range of atmospheric temperatures. The alloy which is preferred for this purpose is that commonly known as "Monel metal," though other alloys may be known which have the necessary characteristics.

Other features of the invention, and the details of construction by which the Monel metal is or may be embodied in the controller, are set forth hereinafter, in connection with the description of the illustrated embodiment of the invention.

In the accompanying drawings Figure 1 is a side-elevation, in vertical section, of an instrument embodying the present invention, together with a diagrammatic representation of other parts of the electric system in which the instrument is used. Fig. 2 is a plan-view, with the armature and the contact-members removed.

The invention is illustrated as embodied in an electromagnetic voltage-controller, comprising a central magnetic core 5, energized by a solenoid 6. The lower end of the core is attached to the middle portion of a U-shaped magnetic yoke 7, and one arm of this yoke is provided with a hinge-plate 8, on which an iron armature 9 is pivoted. The armature is provided with a flat contact-spring 10, carrying a contact-member which coöperates with a stationary contact-member 11. The latter is supported by a plate 12, which is secured to the yoke 7 by screws, but is insulated from the yoke. The movement of the armature is controlled by a spring 13, which is attached to one end of the hinge-plate 8 and may be adjusted by bending the plate.

The controller is shown as mounted on a base-member 14, which in turn is fixed to the field-frame 15 of the electric generator of which the voltage and output are controlled by the instrument.

The armature of the generator is indicated conventionally at 16, and the storage-battery 17 is shown as connected with the generator, to be charged thereby, through main circuit wires 18 and 19. The generator is shown as of the three brush type, having

a shunt field-winding 20 of which one terminal is connected with the third or auxiliary brush 21. The field is energized by current which flows normally from the brush 21, through the winding to a wire 22. This wire is connected with the contact supporting plate 12, as shown by a broken line Fig. 1, and the current thus flows from the fixed contact to the stationary contact, and thence through the armature and the frame of the controller, which are in electrical contact, and from frame of the controller the current passes through the base 14 and the field-frame 15 to the main wire 18, which is grounded on the field-frame. From the wire 18 the current returns, through a wire 23, to one of the main brushes of the machine. So long, therefore, as the armature of the controller remains in the closed-circuit position shown in Fig. 1, the field-winding 20 is energized by current flowing, under the difference of potential between the third brush and the main brush, through a circuit of low resistance.

The solenoid 6 is constantly energized by current flowing under the difference of potential between the terminals of the battery, which is also the effective electromotive force of the generator. For this purpose one terminal of the solenoid is connected, through a wire 24, with the main wire 19, while the other terminal is connected, through a wire 25, with the armature 9, and thence through the frame and the base of the controller and through the field-frame 15, to the main wire 18. At a voltage which may be determined by the adjustment of the tension of the spring 13, the armature will be drawn down by the electro-magnet, thus separating the contacts of the controller and opening the circuit, previously described, through which the field-winding 22 is energized. When this occurs the current through the field-winding can pass only through an alternative path, including a resistance-device 26, which connects the wire 22 directly with the main wire 18, and in this way the controller acts to throw increased resistance into the field-circuit and thus partly deenergize the field-magnet of the generator and reduce the voltage and the output of the generator. In the illustrated instrument, by the use of the contact-carrying spring 10 and a suitable disposition of the parts with respect to air-gap, the instrument may be so adjusted that having once thrown the resistance 26 into the field-circuit, the armature 9 will remain depressed notwithstanding the resultant diminution in the voltage generated, until a substantial further reduction in the voltage across the main wires has occurred either through depletion of the storage-battery or through reduction in the speed of operation of the generator, so that the operation of

the instrument may be periodic rather than vibratory.

The controller, as so far described, is not novel in its construction and mode of operation, and the present invention resides in the combination, with the parts described, of novel means for compensating for the effect of changing temperature upon solenoid 6. To this end a block 27 of suitable material is mounted upon the upper end of core 5, and extends into engagement or proximity with the two arms of the yoke 7. The block 27 may be composed of any metal or alloy having a substantial degree of magnetic permeability and a negative temperature coefficient such that the permeability decreases to a substantial degree upon a rise in temperature within the ordinary atmospheric range. Such materials are known, and the applicant prefers to use the alloy known as Monel metal for this purpose, since the variations in permeability of this material, within the required range of temperatures, follow a substantially straight-line law and thus can be made to compensate almost exactly for the temperature coefficient of resistance of the copper wire which is most conveniently used in the solenoid of the controller.

The compensating block 27 is shown as of considerable thickness, since the permeability of Monel metal and other suitable alloys is small in comparison with that of iron. It will be understood, therefore, that while the compensating member constitutes to a certain extent a magnetic shunt between the core and the yoke, thus short-circuiting lines of force which would otherwise be effective on the armature 9, the major part of the flux is still effective on the latter. As the temperature of the controller rises, owing either to the resistance of the solenoid 6 or to external causes, the temperature of the compensating member 27 rises to the same degree, and thus as the flow of current through the solenoid under a given electro-motive force diminishes, the permeability of the member 27 likewise diminishes, so that a smaller part of the magnetic flux is diverted from the armature. In this way the flux effective upon the armature for any given electro-motive force effective upon the solenoid may be kept substantially constant, regardless of changes in temperature, so that the instrument will continue to open the field-circuit of the generator at substantially the same voltage under all conditions of temperature. In this way an instrument is provided which is capable of operating with the precision necessary for controlling the flow of charging current to a storage-battery automatically, in accordance with changes in the electro-motive force of the battery.

While the invention has been described

particularly as applied to an instrument used to control a generator, other possible uses and various modifications in form and structure will readily suggest themselves, and accordingly the invention is not limited to the embodiment thereof hereinbefore described, and illustrated in the accompanying drawings, but it may be embodied in various other forms within the scope of the following claims.

The invention claimed is:

1. An electromagnetic instrument comprising: an electro-magnet; an armature cooperating with the magnet; contacts controlled by the armature; a spring controlling the armature and adjustable to yield to a definite magnetic force; and a magnetic shunt arranged in parallel with the armature and diverting a part of the magnetic flux from the armature, said shunt consisting of a material having a negative temperature coefficient of magnetic permeability such as to compensate substantially for the temperature coefficient of resistance of the magnet-winding.

2. An electromagnetic instrument com-

prising: a straight magnet-core; a U-shape yoke attached to one end of the core at the middle of the yoke and with its arms embracing the core; a winding on the core between the arms of the yoke; a body of compensating-material mounted between the ends of the yoke and the free end of the core and providing a shunt path for a part of the magnetic flux, said material having a strong negative temperature coefficient of magnetic permeability; an armature extending across the free end of the magnet-core and pivoted on one end of the yoke; and a contact-device mounted on the other end of the yoke.

3. An electromagnetic instrument comprising: an electro-magnet with a winding having a positive temperature coefficient of resistance; an armature controlled by the magnet; and a magnetic shunt so associated with the magnet as to divert a part of the flux thereof from the armature, said shunt consisting of material having a negative temperature coefficient of magnetic permeability.

THOMAS L. LEE.