

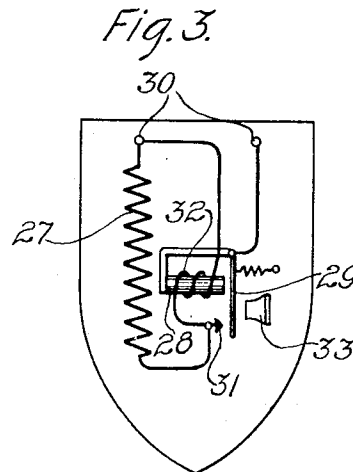
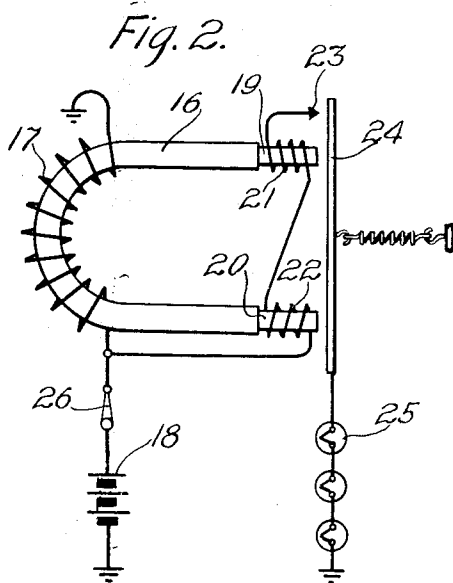
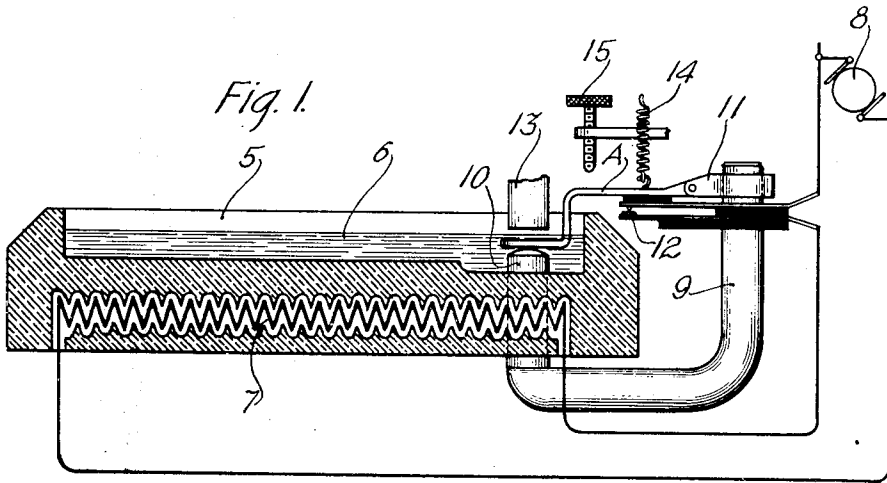
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MAGNETIC TEMPERATURE REGULATOR

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UNITED STATES PATENT OFFICE.

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MAGNETIC TEMPERATURE REGULATOR.

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This invention relates to magnetic temperature regulators and more particularly to devices of the above character which respond to changes in temperature for controlling an electrical circuit and which control the temperature and vice versa.

The principal object of the invention is to provide a magnetically controlled temperature responsive device operative due to variations in temperatures for controlling an electrical circuit.

In accordance with one embodiment, the invention contemplates a magnetic control means operative responsive to temperature changes in which a metal of the nickel-iron series is utilized as a part of the magnetic circuit and which nickel-iron metal is affected by temperature variations to cause operative response of the magnetic control means for controlling or regulating electrical circuits or other apparatus such as that which produces the temperature.

The various features of the invention will be pointed out more particularly in the specification and appended claims.

For a better understanding of the invention reference is to be had to the accompanying drawing, in which

Fig. 1 shows the invention applied for regulating the temperature of a metal bath;

Fig. 2 shows the invention applied to a flasher circuit, and

Fig. 3 shows the invention applied as a safety device to an electrical flat iron to prevent the overheating of the iron.

Referring now more in detail to the arrangement shown in Fig. 1, a suitable receptacle 5 is provided for holding a metal bath 6 such as tin or solder and which receptacle and bath are heated by a suitable resistor or heating element 7 shown as operated from a source of electrical current 8.

In the arrangement shown in Fig. 1 the temperature of the bath is maintained within upper and lower limits by a magnetic control means which is responsive to the temperature changes of the bath, this control means including a suitable magnet 9 which may be a permanent magnet in case the temperatures to which it is subjected are sufficiently low so that its permanence will not be deleteriously affected thereby, having a soft iron pole piece 10 which extends up into the bath so as to conduct the magnetic lines

of force from the magnet 9 to the armature 55 A. This armature is magnetically connected to the magnet 9 through the yoke 11, being pivotally attached thereto so that it will close and open the contacts 12 to close and open the circuit to the resistor when the armature 60 A is attracted and released. A portion of the armature A extends into the bath 6 so that it will be heated thereby.

This armature A is made of a metal of the nickel-iron series and of a composition of 65 these two metals which will lose its ferro-magnetism or normal permeability when it reaches a predetermined critical temperature, but will regain ferro-magnetism or normal permeability when cooled to another predetermined critical temperature. Thus so long as the armature A is below its critical temperature the magnetism from the magnet 9 will hold it attracted to the pole piece 10, but upon reaching the critical point it 75 is released or retracted and moves against the back-stop 13 which may be of suitable metal to speed the cooling of the armature. This back-stop may be of copper, or it may consist of a wet wick or other means so that 80 the armature will quickly cool until it regains its normal permeability and be drawn into the bath by the magnet before the bath has had time to cool more than the predetermined amount.

The armature A is retracted by a spring 14 and its retraction may be limited by a back-stop screw 15. Of course, if desired the armature may be made of a balanced structure or lifted out of the bath in any 90 of the well known ways.

The portion of the armature A which is affected by the heat of the bath should be of small mass and designed so as to be heated quickly by the bath and also quickly 95 cooled, thereby securing a sensitive control of the temperature.

For a control device such as in Fig. 1 a nickel-iron element is employed, preferably composed of 45% nickel and 55% iron and 100 adjusted so that operations within a close range are obtained. That is, assuming the bath 6 is at a temperature below the critical temperature at which the armature A loses its normal permeability, at this time the 105 current is on the heating element 7. Therefore the temperature of the bath and the immersed armature A continues to increase,

and when the temperature of the armature A reaches that at which it loses its normal permeability the armature is released and opens the heating circuit. The armature now begins to cool, also the bath, and when the temperature of the armature drops, say for the purpose of illustration somewhere between 40 and 50 degrees F., its other critical point is reached where it regains its normal permeability and it is immediately attracted by the magnet to close the heating circuit. In the meantime the bath may have cooled only four or five degrees, depending upon relative mass and heat dissipating conditions of the bath and armature. It will thus be seen that the armature may be attracted and released to close and open the heating circuit and maintain the bath as closely as may be desired at a certain maximum temperature. That is, there is a reflex action in which when the current is on, the temperature of the bath and armature is increased until the upper critical temperature of the armature is reached and the circuit interrupted, and then the temperature of the armature decreases until the armature, outside the bath, is cooled to its lower critical temperature to again close the heating circuit, this action continuing so long as current is connected to the device.

It will be evident that due to the rapid cooling of the armature outside of the bath, the armature is redrawn into the bath before sufficient time has elapsed for the bath to cool appreciably. In other words, the armature repeatedly tests the bath to determine its temperature. Whenever in making such tests the temperature of the bath is found to be slightly less than the temperature at which it is desired to maintain it, the heating element is connected with the source of current for raising the temperature of the bath to that desired. Thus the temperature of the bath is controlled within very much closer limits than those existing between the two critical temperatures mentioned of the particular alloy employed in the armature.

In Fig. 2 the invention is applied to a flasher circuit, that is, a circuit adapted for flashing a series of lamps, although of course the device may be used for the many other purposes for which such flashers are employed. In this modification the heating element is applied directly as a winding on nickel-iron elements and in which is provided a magnet 16, preferably an electromagnet having a winding 17 in circuit with a source of current 18. The core ends of the magnet 16 have polar extensions 19—20 which compose the nickel-iron portion of the magnetic circuit for controlling the armature therein. On these nickel-iron polar extensions 19—20 heating windings 21—22 are applied which may be wound either to

enhance or decrease the magnetic effect of the winding 17, or the windings 21—22 may be non-inductive and used only for heating the extensions 19—20. The circuit through these windings 21—22 extends to a contact 23 adapted to be engaged by the armature 24 which is connected in circuit with the device to be operated, in the present instance a series of lamps 25. However the armature, any other portion or all portions of the magnetic circuit may be made of nickel-iron, the heating windings being applied to the nickel-iron portion or portions.

In the operation of the device of Fig. 2, when the switch 26 is closed a circuit is established through the winding 17 to establish a magnetic circuit including core 16, pole extensions 19—20 and armature 24, and assuming that the nickel-iron pole extensions 21—22 are at this time at a temperature at which the nickel-iron possesses its normal permeability, armature 24 is attracted to close the circuit through the heating windings 21—22 and the lamps 25. The flow of current through the windings 21—22 therefore heats the pole extensions 19—20 until they reach a temperature where the nickel-iron loses its normal permeability. Armature 24 is therefore released to open the circuit of the heating windings and also of the lamps 25. The pole extensions 19—20 now begin to cool and when the temperature has dropped to a point where the nickel-iron regains its normal permeability the armature is again attracted to close the circuit for the heating windings and also for the lamps 25 until the pole pieces are heated sufficiently to effect retraction of the armature again. Thus this reflex action continues so long as current is supplied to the device. Although the heating windings are shown connected in circuit with the lamps 25, it will be apparent that other arrangements may be used such as having the heating windings and lamp connected in separate paths, so that each will have its own circuit. It is to be understood that these heating windings 21—22 may be arranged according to the operation desired, and likewise the mass and heat dissipating features and the nickel-iron percentages of the pole extensions 19—20 may be widely varied depending upon the operation desired, and so as to secure fast or slow operations.

In Fig. 3 is shown another modification of my invention, in which the nickel-iron element is used as a portion of a magnetic circuit acting as a safety device for an electric flat iron so as to prevent overheating of the iron when not being used. In this device the usual heating element 27 is employed for heating the flat iron and in the safety device a magnetic circuit is employed including a nickel-iron element affected by the heating of the iron to release an arma-

ture to open the circuit of the heating element.

In the arrangement shown an electromagnet is employed having a core 28 and armature 29 connected to the power terminal 30 and adapted to close a circuit through contact 31 so as to connect the iron heating element 27 in circuit and also the magnet winding 32. The armature circuit is initially closed by pressing a button 33 which moves the armature to the core to close the contact 31, thereby energizing the magnet to hold the armature and thereby maintain the circuit through the heating element 27 closed. The temperature of the iron then increases and the nickel-iron element of the magnetic circuit becomes heated from the heat of the iron. The parts are preferably so arranged that so long as the iron is being used, enough heat is dissipated to keep the nickel-iron element below its upper critical temperature, that is, at a temperature where it retains its magnetic conductive quality. But should the iron be left standing without use and with the current on, the iron will heat cumulatively so as to increase the temperature of the nickel-iron element in the magnetic circuit to its upper critical temperature where it loses its normal permeability. The armature is thereupon released to open the circuit, remaining open until the button 33 is again actuated. It will be noted that the armature will not remain in its attracted position if the button is actuated while the temperature of the iron is excessive.

In the magnetic circuit of Fig. 3, the armature A is shown made of the nickel-iron alloy, although it will be apparent that the nickel-iron may be placed in any part of the magnetic circuit. It would almost equally well interrupt the magnetic flux to release the armature, when its temperature becomes that at which the nickel-iron loses its normal permeability, if it constituted the core or the pole piece, or any reasonably large portion of the magnetic circuit.

What is claimed is:

1. In a control device, a magnetic control means operatively responsive to temperature changes in which a metal of the nickel-iron series is utilized as a part of the magnetic circuit, the magnetic permeability of the nickel-iron part responsive to temperature variations to cause operative response of the magnetic control means.

2. In a control device, a magnetic circuit, including a magnet and cooperating armature, and in which a metal of the nickel-iron series is used as a part of the magnetic circuit, the magnetic permeability of the nickel-iron part responsive to temperature changes to cause operation of the armature.

3. In a control device, a magnetic circuit including a magnet and cooperating arma-

ture and in which a metal of the nickel-iron series is used as a part of the magnetic circuit, the magnetic permeability of the nickel-iron part responsive to temperature changes to cause operation of the armature, and an electric circuit controlled by the armature for causing such temperature changes to effect said operation of the armature.

4. In a control device, a magnetic circuit including a magnet and cooperating armature and in which a metal of the nickel-iron series is used as a part of the magnetic circuit, the magnetic permeability of the nickel-iron part responsive to temperature changes to cause operation of the armature, and an electric circuit including a heating element controlled by the armature for causing such temperature changes to effect said operation of the armature.

5. In a control device, a magnetic circuit including a magnet and cooperating armature and in which a metal of the nickel-iron series is used as a part of the magnetic circuit, the magnetic permeability of the nickel-iron part responsive to temperature changes to effect attraction and release of the armature, said armature being attracted to said magnet, and a heating element included in a circuit closed by the attracted armature for raising the temperature of the nickel-iron to effect a release of the armature.

6. In a control device, a magnetic circuit, including a magnet and cooperating armature, in which a metal of the nickel-iron series is used as a part of the magnetic circuit, the magnetic permeability of the nickel-iron part responsive to temperature changes to vary the magnetic circuit to effect attraction and release of the armature.

7. In a control device, a circuit in which a metal element of the nickel-iron series is included as a part of the magnetic circuit, a circuit control device actuated by a change in temperature of the nickel-iron element, and a circuit controlled by said device for effecting a temperature change of the nickel-iron element.

8. In a control device, a magnetic circuit in which a metal element of the nickel-iron series is included as a part, an armature in said magnetic circuit operatively responsive to a change in temperature of the nickel-iron element, and a circuit controlled by said armature for effecting a temperature change of the nickel-iron element.

9. In a temperature control device, a magnetic control means including an armature and in which a metal of the nickel-iron series is utilized as a part of the magnetic structure and is responsive to temperature variations to attract and to release the armature, an electric circuit controlled by the armature having a reflex action for controlling the circuit by raising the temperature of the nickel-

- iron part to affect the magnetic structure so as to release the attracted armature to interrupt the electric circuit thereby lowering the temperature of the nickel-iron part to
- 5 cause attraction of the armature to again close the circuit to raise the temperature, such reflex operations automatically continuing while current is supplied to the electric circuit.
- 10 10. In a magnetic temperature regulator, a magnetic circuit including a magnet and cooperating armature in which a part of the magnetic circuit is responsive to temperature changes of substantially separated lower and
- 15 upper temperature limits to cause said part to possess and lose its normal magnetic permeability to cause attraction and release of the magnet and armature, a heated mass from which said metal part is heated, and
- 20 means for maintaining the temperature of said heated mass within a substantially closer range than that between said lower and upper temperature limits.
11. In a temperature regulator for a heated mass, a temperature producing means for heating the mass, a magnetic circuit including a magnet and a cooperating armature and in which a part of the magnetic circuit is responsive to temperature changes of substantially separated lower and upper temperature limits to cause said part to possess
- and lose its normal magnetic permeability to attract the armature into a position wherein it is subjected to the heat of the mass, said armature releasing when attaining its said
- 35 upper limit of temperature to render the temperature producing means ineffective to heat the mass, and means for transferring the released armature into a cooler region wherein it regains its normal magnetic
- 40 permeability before the mass has cooled a corresponding amount, thereby becoming re-attracted to render the temperature producing means effective for heating the mass.
12. In a temperature regulator for a heated mass, a circuit closer controlling the application of heat to the mass, an armature of magnetic material which loses its normal magnetic permeability at a desired temperature, said armature controlling said circuit
- 50 closer, a magnet for attracting said armature into a position relative to the heated mass wherein a portion of said armature is heated to the desired temperature, and a restoring means for thereupon transferring
- 55 the armature into another position to cool the armature whereby it regains its normal magnetic permeability.
- In witness whereof, I hereunto subscribe my name this 18th day of December, A. D.,
- 60 1925.

ARTHUR HERMAN ADAMS.