

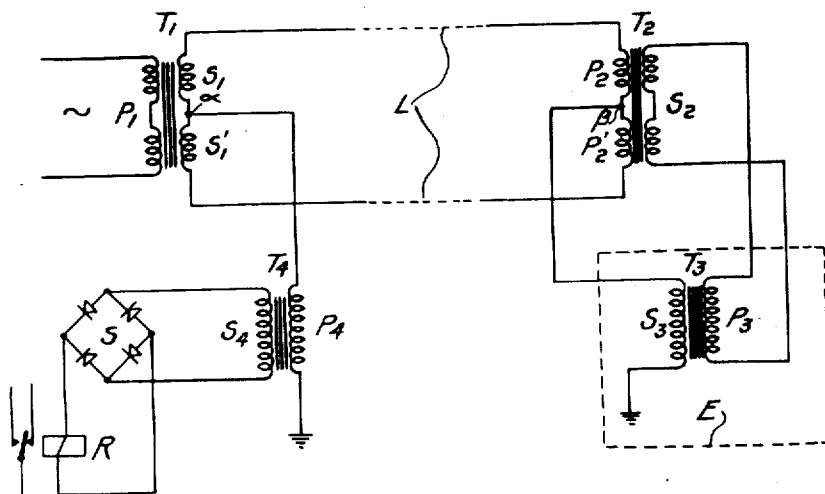
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THERMALLY RESPONSIVE ELECTRICAL RELAY SYSTEM

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THERMALLY RESPONSIVE ELECTRICAL
RELAY SYSTEM

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This invention relates to an arrangement for the protection of electrical apparatus and equipment against undue heating which is liable to cause damage or risk of fire. Likewise, it relates to a device for the remote indication and measurement of predetermined degrees of heating of the apparatus or equipment.

It is well known in the art that a magnetic material loses its magnetism at a predetermined temperature, which brings about a sharp increase in its reluctance. This predetermined temperature, known as the Curie point, is ordinarily rather high for magnetic materials commonly employed in electrical circuits and apparatus. However, certain materials are known which show the peculiarity of losing their magnetism at a comparatively low temperature.

For example, there is known the method of making alloys containing iron, nickel and manganese, of which the Curie points are spread out over a continuous range extending from -40° to $+700^{\circ}$ C., approximately. The change of magnetism for each alloy having a definite composition takes place in a comparatively abrupt fashion at a sharply marked temperature.

Broadly speaking, the instant invention discloses means for utilizing the sharp change of reluctance brought about in a magnetic circuit by its reaching the Curie point, in the special cases where there is used a magnetic material having a relative low Curie point, for example 250° C., with the purpose of measuring the degree of heat or of protecting or giving warning in the case of electrical apparatus and equipment.

This invention also discloses further methods of using such magnetic materials having a relatively low Curie point, to build up, entirely or in part, the magnetic circuits of the pieces of apparatus of an electrical circuit, not only of the static type including transformers, choke coils, and so forth.

The passage through the Curie point under certain conditions of usage of the magnetic material incorporated in such pieces of apparatus in the circuit, will consequently bring about an alteration of the electrical conditions in the circuit embodying these pieces of apparatus by the change of inductance in the case of static device. This invention consequently discloses means for using such circuit elements in a way to assure the indication or measurement at a distance of predetermined degrees of heat.

It is equally clear that this invention does not demand the utilization of magnetic material hav-

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ing a somewhat low Curie point, for every part of the electro-magnetic devices, but such material can be employed in one portion only of the magnetic circuit, chosen so that the loss of ferromagnetic properties of the material in this particular part, will bring about in the principal magnetic circuit of the electro-magnet such a degree of increase of reluctance, that it will be sufficient to accomplish the desired opening-up action.

According to an example of an embodiment of the principles of this invention, an indicating circuit or an alarm circuit which is supposed to operate when the temperature attains a certain predetermined value at some particular spot or in an enclosed space, is provided with one or more devices of which the magnetic circuit is formed, wholly or in part, of a material having a relatively low Curie point, corresponding to the above-mentioned predetermined degree of temperature, the arrangement of the indicating or alarm circuit being such that the sharp change of reluctance due to the characteristics of the material, brings about a change of electrical conditions such that it actuates the arrangement controlling the indication or the alarm and responsive to this change of conditions.

One practical example of such application utilizing a static circuit device, is herein described and reference is now made to the drawing hereunto attached.

In the drawings, the circuit here shown is arranged so as to give an alarm when the temperature reaches a predetermined value θ in an enclosed space situated at some distance from the supervisory point. A transmission line having two conductors L, fed with alternating current from a transformer T1, the primary of which is excited by such current, serves to interconnect the spot where the indication is to be given with the location E, which is to be supervised. In this enclosure, there is arranged a transformer T3, of which the magnetic circuit is made to include a material having a Curie point equal to θ . At the other end of the transmission line L there is provided a second transformer T2. The respective magnetic circuits of transformers T1 and T2 are constructed of ordinary sheet iron. Another transformer T—4, likewise constructed with ordinary sheet iron, has a secondary winding S4, the output of which is rectified by the bridge rectifier S. The output of this rectifier serves to actuate a relay R and the contacts of relay R may be con-

nected to any suitable indicating or alarm apparatus.

The primary P4 of transformer T4 is connected between the ground and the mid-point α of the secondary winding S1—S'1 of transformer T1. Transformer T2 likewise has its primary split into two portions P2 and P'2 and the mid-tap between these portions is connected to ground through winding S3 of transformer T3. There is, in this fashion, provided a transmission path between transformers T3 and T4 respectively, over the transmission line L, in such fashion that the alternating current energy passing in the opposite direction over transmission line L will not affect the temperature indicating current proceeding from transformer T3 to transformer T4.

The alternating current derived from transformer T1 and passing over transmission line L to transformer T2, sets up in the secondary winding S2 of the latter transformer an electro-motive force which is fed to the primary winding P3 of transformer T3, as indicated in the drawing.

The operation of this apparatus under normal conditions of temperature is as follows: The alternating current derived from transformer T1 passes over line L to transformer T2. The alternating current from the secondary of transformer T2 excites the primary of transformer T3. Under normal temperature conditions, the magnetic circuit of transformer T3 functions in the usual fashion, so that an electro-motive force is induced in the secondary winding S3 of this transformer. This last-mentioned electro-motive force is the one utilized for purposes of remote indication and passes over the transmission line L without being affected by the alternating current already existing upon this line, as previously described. Therefore it can be seen that windings S3 and P4 are effectively connected in series with one another, the ground serving as a return circuit between these two windings. The electro-motive force induced in S3 will, then, excite transformer T4, thus causing the actuation of relay R, via rectifier S. Relay R is so arranged that when it is excited, the armature will rest upon a contact which is not connected to the indicating or alarm apparatus.

The operation of this apparatus under the condition that the temperature at the locale E becomes elevated, is as follows:

When transformer T3 is subjected to an elevation of temperature, reaching the value θ , the magnetic circuit of this transformer loses its ferro-magnetic properties and therefore no electro-motive force will be produced by the secondary winding S3. Therefore the indicating current passing over transmission line L will cease, winding P4 of transformer T4 will cease to receive any current as a result of the balanced or neutralized connection of the coils S3 and P4 to the midpoints of the secondary of T1 and the primary of T2 in neutralized potential relation. Consequently relay R will become de-excited and the armature will fall off against its back contact. This back contact may be connected to any convenient indicating or alarm device.

A heat detecting device of the nature just described is possessed of specific qualities which render it useful for numerous applications, especially those in which the speed of response of the element which is sensitive to an elevation of temperature, is not a particularly important factor.

While this invention has just been described as embodied in a particular device, it is to be understood that it is in nowise limited, but that

devices having a magnetic circuit made up of material having a relatively low Curie point, as indicated, are capable of numerous other applications, without transcending the bounds of this invention.

It is likewise to be noted that the term heating, as used in the preceding description, can indicate either a positive or a negative heating. That is to say, that it is possible to utilize either the increase of resistance of a magnetic circuit having a relatively low Curie point, when the temperature increases, or to utilize the decrease of reluctance of the circuit when the temperature decreases after having been greater than that which corresponds to the Curie point of the particular magnetic material employed. In the case of the device shown in the drawing, it will be evident that a shifting of the indicating or alarm device from the back contact of relay R to the front contact of its relay, together with a choice of material for the magnetic circuit of transformer T3, having a suitable θ point, would allow an indication or alarm to be given when the temperature at the locale E decreases, rather than increases.

What is claimed is:

1. Remote temperature signalling system including, at the indicating point, a source of A. C. energy, a first transformer fed from said source and having a mid-tapped secondary, a second transformer having a primary bridged from the mid-tap of said secondary to the ground, a rectifier and D. C. relay fed from the secondary of said second transformer, said system also including at the remote point thereof, a third transformer having a mid-tapped primary and a secondary, and a fourth transformer having the secondary thereof bridged from the mid-tap of said primary to the ground and having the primary connected across the secondary of said third transformer, said system also including a two-wire transmission line feeding A. C. energy from the entire secondary of said first transformer to the entire primary of said third transformer, said fourth transformer being exposed to the temperature to be signalled and having a magnetic circuit of a material chosen with a predetermined Curie point, whereby temperatures relative to said Curie point will determine the excitation of the secondary thereof and whereby said secondary, when excited, will transmit signals over said transmission line to said second transformer and thereby will actuate said relay.

2. A remote temperature signalling system including, at the indicating point a source of A. C. energy, a first transformer fed from said source and having a mid-tapped secondary, a second transformer having a primary bridged from the mid-tap of said secondary through a ground, a two-wire transmission line connecting the secondary of said first transformer with the primary of a third transformer at a control point, said third transformer having a secondary included in a control circuit and having in series therewith a primary of a temperature responsive control transformer, said control transformer being exposed to the temperature to be signalled and having a magnetic circuit of a material chosen with a predetermined Curie point whereby temperature relative to said Curie point will determine the excitation of a secondary thereof, the secondary of the control transformer being connected by a mid-tap to the primary of the third transformer and to ground to have a neutral relation to the transmission line circuit and to

permit transmission of signals from the control transformer secondary over the transmission line to said second transformer, and said second transformer having a secondary connected to actuate a controlled relay at the indicating point whereby the latter is responsive to temperature change of the control transformer.

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