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F. H. WINTER

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ELECTROMAGNETIC TIME ELEMENT DEVICE

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Fig. 1.

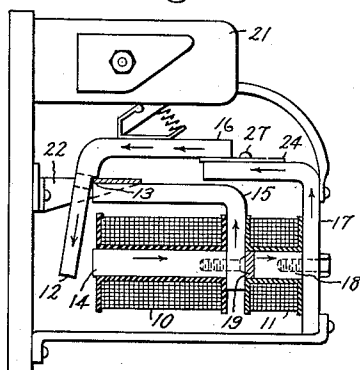
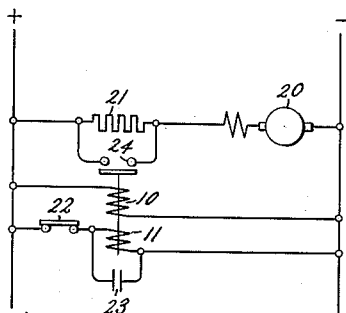


Fig. 2.



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UNITED STATES PATENT OFFICE

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ELECTROMAGNETIC TIME ELEMENT
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Application July 21, 1942, Serial No. 451,737

3 Claims. (Cl. 175-375)

My invention relates to electromagnetic time element devices, particularly to time delay switches or contactors such as used in the starting of electric motors, and has for its object simple and reliable means for compensating the contactor for the change in its magnetic force and time characteristic caused by changes in the temperature of its magnetic circuit.

My invention is especially applicable to electric relays or contactors provided with an operating coil and a restraining or lockout coil for restraining when energized the armature against the force applied by the operating coil. In such devices the operating coil is energized continuously during the operation of the motor and, consequently, its temperature, including the temperature of its magnetic iron, rises very considerably. On the other hand, the lockout coil is energized only momentarily during the starting of the motor and, consequently, does not have an opportunity to heat to any considerable extent. Thus, the pick-up force of the operating coil gradually decreases with use over an extended period of time, whereas the magnetic force of the lockout coil does not change appreciably. As a result of the decrease in the force of the operating coil, the time interval required for the operating coil to pick up its armature increases with consequent decrease in the rate of acceleration of the motor.

In carrying out my invention in one form, I provide a layer of thermomagnetic metal in the magnetic circuit of the lockout coil but adjacent the operating coil so as to be heated by the operating coil. Thus, as the temperature of the operating coil increases, the temperature of the thermomagnetic or Curie metal increases with consequent decrease in the force of the lockout coil. As a result, the time of operation of the switch remains substantially unchanged.

For a more complete understanding of my invention, reference should be had to the accompanying drawing, Fig. 1 of which is a view in section of a time delay contact such as used in the starting of electric motors embodying my invention while Fig. 2 is a simplified diagram of an electric motor starting system utilizing the contactor of Fig. 1.

Referring to the drawing, I have shown my invention in one form as applied to a time delay starting contactor of a system of the type described and claimed in Patent 2,233,169, issued on February 25, 1941 to Benjamin W. Jones.

This contactor is provided with an operating coil 10 and with a lockout coil 11. The armature

12 is pivotally mounted on a knife edged bearing support 13 and suitably biased by gravity to the unattracted position shown in Fig. 1. A magnetic core 14 extending through the coil 10 attracts the lower end of the armature when the coil 10 is energized, the magnetic circuit for the coil 10 being completed by a core member 15.

The upper portion or extension 16 on the armature overlaps the end of a core member 17 extending across the outer end of the lockout coil 11. A central core member 18 extends through the coil 11 and has its ends engaging the core member 15 and the core member 17.

In accordance with my invention, I provide a layer 19 made of a thermomagnetic material or Curie metal whose magnetic permeability decreases with an increase in temperature, such as an alloy of nickel and iron containing 32 per cent nickel and 68 per cent iron. This layer 19 is placed between the end of the core member 18 and the core member 15 so as to be in engagement with the core member 15 and therefore be heated by conduction therefrom in accordance with the temperature rise in the operating coil 10.

Referring to Fig. 2 of the drawing, in the starting of an electric motor 20 provided with a starting resistance 21, the operating coil 10 is connected across the supply mains, and also the lockout coil 11 is connected across the supply mains in series with an interlock switch 22. To provide a time delay, a suitable electric energy storage device, such as a capacitor 23, is connected in parallel with the lockout coil 11.

In operation, when the motor is at rest or starting, the switch 22 is closed and the two coils are energized, the lockout coil 11 holding the armature 12 in its unattracted position and therefore holding open the short-circuiting switch 24 operated by the armature 12. During the starting of the motor, the switch 22 is opened as by the closing of the preceding contactor or by a manually operated controller whereby the lockout coil 11 is disconnected from the supply source. The capacitor 23 then discharges through the lockout coil and maintains the energization of the lockout coil sufficiently high over a predetermined interval of time to prevent pick-up of the armature 12 and therefore prevent closure of the short-circuiting switch 24 for that appreciable interval of time. At the end of the time interval, the coil 11 has become so weakened that it is overpowered by the coil 10 and the armature picked up to close the switch 24.

Thereafter, during the running operation of the motor, the coil 10 remains energized and

consequently its temperature rises. The coil heats the core member 14 whose permeability is thereby decreased with consequent decrease in the operating force of the coil applied to the armature. The lockout coil 11, however, is not energized at this time and therefore its temperature does not rise except for the heat that is conducted to it from the coil 10. However, the layer 19 of thermomagnetic material is heated directly by the coil 10 and is responsive to the temperature of the coil 10. Thus its magnetic permeability decreases. Its thickness and change in permeability with increased temperature are such as to introduce a magnetic flux resistance in the magnetic circuit of the lockout coil of such value as to decrease the permeability of this magnetic circuit in substantial proportion to the decrease in permeability of the magnetic circuit of the coil 10. As a result, when the motor 20 is stopped after running for a time sufficient to heat the coil 10 to a high temperature and then immediately restarted, the time control in the closing of the switch 24 remains substantially unchanged.

On the other hand, without the layer of thermal magnetic material 19, the time interval of the contactor is very considerably increased, sometimes as much as 25 per cent, with consequent proportionate increase in the starting time of the motor 20.

It will be observed that the magnetic flux path for the coil 11 with the coil 10 energized is through the central core 18, the magnetic frame members 17 and 16, the armature 12 and the central core 14 back to the core 18. Also, some of the flux of the coils returns through the core member 15. The two coils ordinarily are energized in such directions that their fluxes are in the same direction through the core members 14 and 18. A substantial portion of the magnetic flux produced by the coil 10 passes through the flux path in parallel with the core member 15 afforded by the central core 18 and the magnetic frame members 17 and 16.

The layer 19 of thermomagnetic material is preferably made of a metal which has a substantial degree of permeability at normal operating temperatures but becomes substantially non-magnetic when heated to approximately 100 or 150° C. These thermal magnetic characteristics can be preselected within predetermined limits by providing a composition of the alloy which will give the particular characteristics desired.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. The combination in an electromagnetic time element device of an operating coil, a magnetic core for said coil arranged to reduce the operat-

ing force of said coil when said core is heated by energization of said operating coil, a lockout coil arranged when energized to oppose said operating coil, and a separate magnetic core member for said lockout coil including a member made of thermomagnetic material heated by said operating coil thereby to maintain a predetermined relation between the forces of said coils and a predetermined time interval in the operation of said operating coil after said lockout coil is disconnected from its supply source.

2. The combination in an electromagnetic time element device of an operating coil, an armature for said coil movable from an unattracted to an attracted position upon energization of said operating coil, a lockout coil for holding said armature in said unattracted position for a predetermined time interval after said lockout coil is disconnected from its electric supply source against the force applied by said operating coil when said operating coil is energized, a magnetic core for said lockout coil including a member made of thermomagnetic material in heat conductive relation with said operating coil for decreasing the permeability of said core in response to the temperature of said operating coil so as to maintain said time interval substantially constant.

3. The combination in an electric time element device of a pair of core members arranged in end-to-end axial alignment with respect to each other, an operating coil mounted on a first of said cores, a lockout coil mounted on the second of said cores, an armature member pivotally mounted to be moved by said first core to an attracted position upon energization of said operating coil, a first switch operated by said armature member and movable to a closed position by movement of said armature member to its attracted position, a magnetic member secured to the outer end of said second core extending to a position to be engaged by said armature when said armature is in its unattracted position so that said lockout coil when energized restrains said armature against movement by said operating coil to said attracted position, a second switch connected in circuit with said lockout coil and movable to its open position to deenergize said lockout coil thereby to provide for movement of said armature to said attracted position and closure of said first switch by said operating coil, said operating coil heating said first core so as to materially decrease the permeability of said first core and decrease the magnetic attraction of said core on said armature, and a layer of thermomagnetic material interposed between said core members so as to be heated from said first core member thereby to decrease the permeability of said second core member in substantial proportion to the decrease in permeability of said first core member and maintain substantially unchanged the time interval of operation of said armature to its attracted position after said lockout coil is deenergized.

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