HOLDING RELAY WITH OPERATING CHARACTERISTICS WHICH REMAIN CONSTANT WITH FLUCTUATIONS OF TEMPERATURE

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13 Claims

ABSTRACT OF THE DISCLOSURE

A holding relay which has operating characteristics that remain unchanged with temperature fluctuations comprising a magnetic structure which has an armature supported by springs. A principal permanent magnet is attached to the main magnetic structure of the relay and an auxiliary permanent magnet is attached to the armature. The principal and auxiliary magnets are magnetized in a direction transverse to the main magnetic field of the magnetic circuit.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates in general to holding relays and in particular to a holding relay which has an operating characteristic that does not vary with temperature.

Description of the prior art

Prior holding relays have had spring supported armatures which form a magnetic bridge controllable by an actuating coil.

In holding relays according to the prior art in which the principal magnet consists of an alnico alloy through which the energizing flux flows, difficulties have been encountered because of the danger of de-magnetization of the permanent magnet. To reset the armature from the operating to the rest position a control flux directed in the direction opposite to the flux of the permanent magnet must be applied or superimposed over the flux from the permanent magnet.

However, the danger of de-magnetization can be reduced by selecting the principal magnet from a material of high coercive force, such as generally designated as OX materials. Barium oxide or strontium oxide are examples of OX materials.

Holding relays constructed from OX materials are used over widely varying temperature ranges and the effective flux of permanent magnets constructed of such materials is considerably reduced with temperature variations. Thus, to get holding relays to operate at high temperature ranges, the current necessary for the relay to respond must be increased in order to obtain the desired manner of operation. This leads to a phenomena that holding relays which use permanent magnets of OX materials have relatively high dispersion values. Thus, at higher ambient temperatures a higher response current must be specified for reasons of safety than would be necessary at lower operating temperatures. The sensitivity of response and the specification of the response current for a relay must be carefully specified in relays of high quality.

BRIEF SUMMARY OF THE INVENTION

A holding relay with a main magnetic circuit and an armature which has a principal permanent magnet of OX material attached to the main magnet circuit and with the principal magnet magnetized in a direction transverse to the control flux in the relay and in which the armature has an auxiliary permanent magnet magnetized in a direction transverse to the control flux so that the relay may operate over widely varying temperature ranges without destroying the operability or de-magnetizing the permanent magnets.

Other objects, features and advantages of the present invention will be readily apparent from the following detailed description of certain preferred embodiments thereof taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a holding relay according to this invention; and

FIG. 2 is a sectional view taken on line X—Y from FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows the holding relay of this invention which has a main magnetic system comprising the E-shaped magnetic member M formed with a center leg M1 and end legs M2 and M3. An energizing winding W is wound about the center leg M1 to control the relay. The center leg M1 is formed with a tapered end portion M11 upon which is mounted a principal permanent magnet DM1. The surface between the portion M11 and the permanent DM1 is preferably tapered so as to form a tapered surface S and the magnet DM1 is suitably tapered to mate with the surface S as shown.

An armature A is pivotally attached to the legs M2 and M3 of the main magnetic structure M by springs F and F' which are suitably attached to the legs M2 and M3 and which have engaging portions F1 and F'1 that receive the legs A' and A'' of the armature A therein. A bracket H is attached to the main magnetic portion and extends upwardly toward the armature A. The bracket H has support arms H1 and H2 to which is mounted an auxiliary permanent magnet DM2. A flux directing panel B may be attached to the arms H1 and H2 of bracket H adjacent the upper portion relative to FIG. 1 of the auxiliary magnet DM2 to concentrate the flux in the auxiliary magnet. The principal magnet DM1 and auxiliary magnet DM2 are magnetized so that the flux from these magnets is transverse to the flux in the main magnetic core M which is produced by the control winding W. Thus, the principal magnet DM1 and auxiliary magnet DM2 would be magnetized so that the flux produced by these magnets would be transverse to the flux through the leg M1, for example.

FIG. 2 is a sectional view on line X—Y from FIG. 1 and illustrates a modification wherein the auxiliary magnet DM2 is magnetized so that its opposite ends S1 and S2 are oppositely poled. For example, at the end S1, the north pole is adjacent the bracket portion H and the south pole is adjacent the armature portion A, whereas at the end S2, the north pole is adjacent the armature portion A and the south pole is adjacent the bracket portion H. The magnets DM1 and DM2 may be made of OX material such as barium oxide or strontium oxide.

A relay constructed according to this invention may be used over a wide temperature range such as between +100° C. to —40° C. (212° F. to 40° F.). The variation in strength of the permanent magnets used in the invention caused by temperature is compensated by the structure according to this invention so that identical operating values are obtained over considerable temperature variations. It has been found desirable to utilize permanent magnets DM1 and DM2 of identical magnetic materials if the operating characteristics must be maintained constant over a wide temperature range. If
the operating characteristics need not be maintained constant over a wide temperature range magnets of different materials may be utilized according to the teachings of this invention.

The magnets DM1 and DM2 are generally attached to the armature and portion M1' by suitable glue, for example. If the attachment of the armature A to the main magnetic structure M is by springs, the springs should be chosen so that they do not bias the armature in either direction toward its rest or holding position. To facilitate ease of production, it is desirable to have the principal magnet DM1 and the portion M1' of the central leg M1 of fairly constant cross-sectional area. This allows the principal magnet DM1 to be attached to the yoke as by gluing and then the exciter coil W may be pushed over the central yoke leg M1 to complete the construction, providing the slant surface S between the principal magnet DM1 and the portion M1' obtains efficient utilization of space. The surface of magnet DM1 adjacent surface S is designated DM12 and the opposite surface of the magnet is designated DM11.

The flux-directing panel B adjacent the auxiliary magnet DM2 on the side away from the armature A substantially increases the force on the armature over a structure without the flux panel B. The panel B also isolates the auxiliary magnet DM2 from external magnetic influences.

In the simplest construction, the principal and auxiliary magnets DM1 and DM2 are magnetized similarly. However, as shown in Fig. 2, if desired, the auxiliary magnet may be magnetized with opposite poles at its two ends 31 and 32. As shown in Fig. 2, a partitioning panel T may also be mounted between the armature A and the auxiliary magnet DM2. The partitioning panel T may be supported from the bracket H, for example.

Both of the permanent magnets DM1 and DM2 are magnets with high coercive force which can be manufactured from OX materials. Such magnets will not be de-magnetized under customary counter-energizing forces. Since the permanent magnets are magnetized at right angles to the main energizing field they are not subject to being demagnetized. The auxiliary magnet DM2 holds the armature firmly in the rest position. The auxiliary magnet DM2 generates a force upon the armature which is opposite to the force of the principal magnet DM1 and it is larger than that of the principal magnet DM1. Since no energizing flux passes through the auxiliary magnet DM2, it could be made from an alnico material, if desired. However, it has been found desirable to select both permanent magnets DM1 and DM2 from materials as similar as possible.

In operation, a control signal is applied to winding W to move the armature A from rest to the closed position. The winding W, when energized, produces flux strong enough to move the armature from magnet DM1 to engagement with magnet DM2. When a second control signal is applied to winding W which counters the flux of magnet DM1, the armature will move to the rest position into engagement with magnet DM2. It is to be noted that the flux caused by winding W passes through magnet DM1.

Although minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably and properly come within the scope of my contribution to the art.

I claim as my invention:
1. A holding relay which has operating characteristics that do not change with temperature comprising (a) an actuating magnetic circuit means formed with at least two wing-shaped legs which are joined at first ends, (b) an energizing coil for passing magnetic flux through said legs, (c) an armature movably mounted on the wing-shaped legs of said actuating magnetic circuit means and spring-biased to a rest position and movable to a first position to provide a low reluctance path between the second ends of said wing-shaped legs, and (d) a permanent magnet mounted on one of said wing-shaped legs and magnetized so that its flux is transverse to the flux caused by the energizing coil.
2. A holding relay according to claim 1 comprising a second permanent magnet mounted adjacent the actuating magnetic circuit to hold the armature in the rest position.
3. A holding relay according to claim 2 wherein the second permanent magnet is magnetized so that its flux is transverse to the flux from the energizing coil.
4. A holding relay according to claim 3 wherein a holding bracket extends from the actuating magnetic circuit means and the second permanent magnet is attached thereto.
5. A holding relay according to claim 4 wherein a flux panel is mounted between the second permanent magnet and the holding bracket on the side of the second magnet which does not face the armature.
6. A holding relay according to claim 2 wherein the permanent magnets are formed of material selected from the group consisting of barium oxide and strontium.
7. A holding relay according to claim 6 wherein the permanent magnets are formed of barium oxide.
8. A holding relay according to claim 6 wherein the permanent magnets are formed of strontium oxide.
9. A holding relay according to claim 6 wherein the permanent magnets are magnetized and mounted so that their flux is parallel.
10. A holding relay according to claim 6 wherein a separation panel is mounted between the second permanent magnet and the armature.
11. A holding relay according to claim 2 wherein the second permanent magnet is magnetized so that each of its ends are formed with two magnetic poles and with the poles on each end of opposite polarity.
12. A holding relay according to claim 1 wherein the permanent magnet and the portion of the one leg to which the permanent magnet is attached have a cross-sectional area which is substantially equal to the portion of the one leg to which the permanent magnet is not attached.
13. A holding relay according to claim 12 wherein the permanent magnet and the portion of the one leg to which the permanent magnet is attached are tapered.

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