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ELECTROMAGNETIC RELAYS

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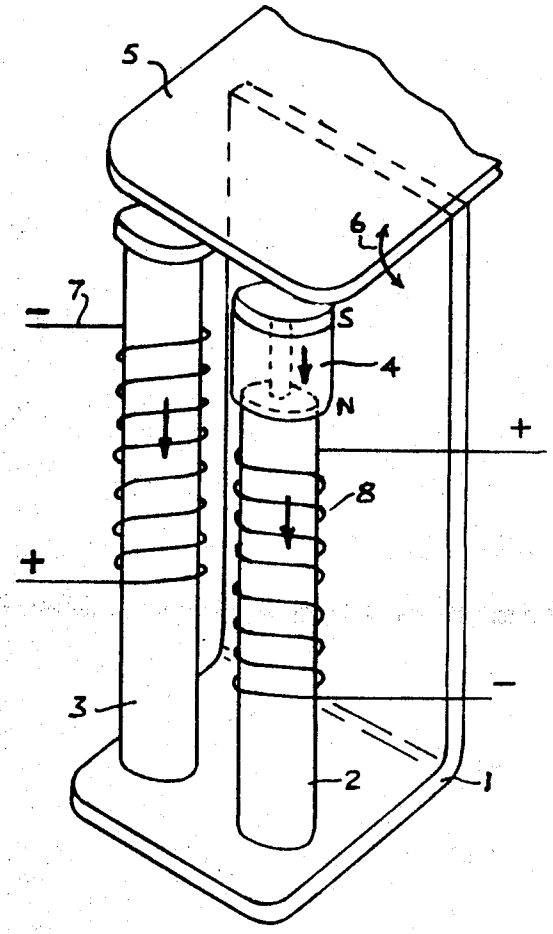

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ELECTROMAGNETIC RELAYS

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ABSTRACT OF THE DISCLOSURE

An electro-magnetically operated relay is provided which is magnetically held and which has two stable armature positions. The relay includes a magnetic circuit including the armature and a yoke member and having two parallel branches, one including a first magnetizable core and the other including a second magnetizable core and a permanent magnet. A pick-up coil is wound around the first branch and a separately energizable release coil is wound around the second branch.

This invention relates to electromagnetic relays and relates more particularly to relays which are provided with a magnetic stick facility.

Certain stick relays have been proposed having a magnetic stick facility which holds them operated following electrical energization of a pick-up coil and release from the "stick" condition being achieved by energization of a release coil. However such relays may have the problem that spurious pulses of electrical energy in the pick-up coil may cause release.

Accordingly to the present invention there is provided an electro-magnetically operated and magnetically held, two- position stable relay comprising a magnetic circuit including a magnetizable yoke and a relay armature and having first and second parallel branches, a first magnetizable core included in the first branch, a second magnetizable core included in the second branch, a permanent magnet included in the second branch, a relay pick-up coil wound about the first branch, and a separately energizable release coil wound about the second branch. The relay armature is biassed into a first stable position wherein an air gap is formed between the armature and the first and second cores and is movable to a second stable position wherein a substantially reduced air gap exists between the armature and the first and second branches, responsive to the energization of the pick-up coil.

In order that the invention may be more clearly understood and readily carried into effect, the same will be further described by way of example with reference to the accompanying drawing which illustrates in diagrammatical form the relevant flux paths of a relay embodying the present invention.

The relay to be described is constructed on a magnetisable L-shaped yoke indicated by the reference 1 and the yoke carries a pair of magnetisable cores 2 and 3 the axes of these cores being substantially parallel to the upright portion of the yoke 1. The core 2 supports a a small permanent magnet represented by reference 4 mounted in this example, on the upper end thereof such that the overall length of the core 2 and the magnet 4 is slightly greater in length than the length of the core 3. Supported over the upper ends of the cores 2 and 3 there is provided a relay armature represented by the reference 5 and only shown in part in the drawing. The armature 5 is pivotably moveable as indicated by the arrows 6 and is spring biassed in an outward direction away from the

cores by spring means not shown in the drawing. The core 3 has wound about it on a suitably adapted bobbin (not shown) a relay energising winding 7 and the core 2 has wound about it also on a suitably arranged bobbin which is not shown, a winding 8. The polarities with which the windings are intended to be energised and the directions of the resulting magnetic fluxes are indicated in the drawing.

For reasons to be understood hereafter, the relay winding 7 may be referred to as the pick-up or first winding and the winding 8 may be referred to as the release or second winding of the relay.

In operation of the relay arrangement shown in the drawing, it may first be assumed that the winding 7 is not energised and that the armature 5 of the relay is retained in its outward position thereby providing a substantial air gap between it and the free ends of the cores 2 and 3, this being achieved by the spring means mentioned above. On energisation of the winding 7 with the polarity shown, the core 3 becomes magnetised with a polarity of magnetisation at the upper end and at the lower end. The armature 5 is thereby attracted by virtue of the flux path which is provided via the core 3, across the air gap between 5 and 3, the armature 5 and the yoke 1. The spring holding the armature outwards is thereby overcome and the armature moves inwards against the free end of the core 2 and leaves a small air gap between the armature and core 3. On closure of the gap between the core 2 and the armature 5, a substantial magnetic flux due to the magnet 4 is established in a parallel flux path including the core 2 as indicated by the arrow, the yoke 1 and the armature 5. This flux is sufficient to retain the armature 5 in its innermost or operated position regardless of subsequent de-energisation of the winding 7. The relay thereby has a "stick" facility.

Considering now what occurs under the "stick" conditions of the relay, and consider the effect of a spurious forward polarity pulse appearing from the circuit to which the relay is connected, in the energising winding 7. The spurious pulse causes a momentary magnetisation of the core 3 and it will be seen that in the flux path which now is present through the core 3, the base of the L-shaped yoke 1 the core 2 and the armature 5 there is provided a flux hold as shown an core 2 which assists the flux produced by the magnet 4 on the assumption that the magnet 4 is arranged with the polarity shown. Such forward polarity pulses therefore do not tend to allow the armature 5 to move from its second or innermost condition back to its first condition.

Consider now the effect of a reverse polarity pulse appearing on energising winding 7. The flux generated in core 3 is as represented by the arrow on the core and will find a path across the air gap to armature 5 and yoke 1, thus by passing the alternative path offered by core 2, and not affecting the stick feature described above.

In order to achieve the movement of the armature 5, from the second position to the outermost first position, it is necessary to apply a release energisation to the winding 8 with the polarity shown to overcome the magnetic flux due to the magnet 4 which normally retains the armature 5 in its second position. Again, it will be appreciated that an incorrect polarity pulse applied to the winding 8 will have the effect of assisting the magnet 4 and therefore the relay remains in its operative condition.

It will be appreciated that in order to achieve correct operation of a relay in accordance with the present invention, appropriate selection of the relative reluctances of the magnetic circuits with the armature in its first and second positions must be made. The magnetic circuits to be considered are the parallel circuits including the cores 2 and 3 and the yoke 1 together with the armature 5

and also the combined magnetic circuit which is present via each of the cores **2** and **3**, the base of the yoke and the armature **5**.

Having thus described my invention, what I claim is:

1. An electro-magnetically operated and magnetically held, two-position-stable relay comprising a magnetic circuit including a magnetizable yoke and a relay armature and having first and second parallel branches, a first magnetizable core included in said first branch, a second magnetizable core included in said second branch, a permanent magnet included in said second branch, a relay pick-up coil wound about said first branch, and a separately energizable release coil wound about said second branch, said relay armature being biassed into a first, stable position wherein an air gap is formed between said armature and said first and second branches and being movable to a second stable position wherein a substantially reduced air gap exists between said armature and said first and second branches responsive to the energization of said pick-up coil.

2. A relay as claimed in claim **1** wherein said magnet is mounted substantially co-extensively with the second core.

3. A relay as claimed in claim **2** wherein the magnet is mounted on said second core at the end thereof adjacent to said armature.

References Cited

UNITED STATES PATENTS

2,535,977	12/1950	Willing et al.	335—234
2,749,454	6/1956	Little et al.	335—230 XR
2,876,397	3/1959	Wasson	335—230

FOREIGN PATENTS

983,303	2/1965	Great Britain.

GEORGE HARRIS, Primary Examiner

U.S. Cl. X.R.

335—234