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MAGNETIC RELAY

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Fig. 1.

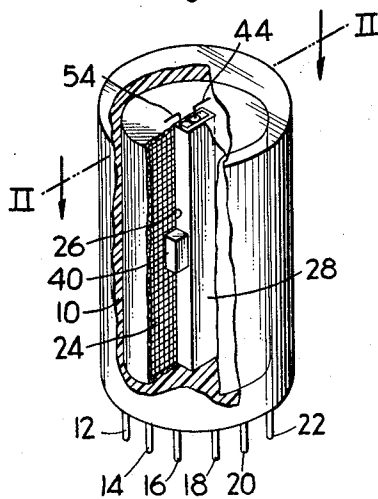
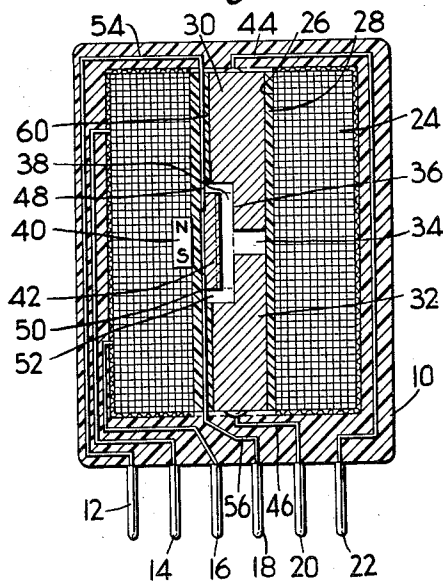


Fig. 2.



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MAGNETIC RELAY

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4 Claims. (Cl. 200—87)

This invention relates to electromagnetic relays and more particularly to the core, armature, and contactor construction thereof.

The present invention provides a relay having contact members forming part of the core structure which is mounted within the exciting coil. A gap between the core contact members is adapted to be alternately opened and closed by a short armature piece which is also contained within the core space and which is attracted to the contacts to close the gap in both the magnetic and electric circuits defined by the core contact members when the coil is energized. A small permanent magnet is so mounted as to attract the armature to its normal position clear of the normally open core contacts, and conductors of a normally closed circuit may be provided to be bridged by the armature in that position. Thus, the invention provides a relay wherein the core members themselves become electric contacts and in which all of the working parts are completely enclosed within a core chamber so that a very compact structure is provided which lends itself to being hermetically sealed by a plastic covering or the like surrounding the surface of the coil and the ends of its core chamber.

Accordingly, one object of the invention is to provide an improved electromagnetic relay wherein all of the working parts are compactly disposed entirely within the exciting coil.

Another object of the invention is to provide an improved relay wherein the magnetic core elements serve also as electric contact parts.

Another object of the invention is to provide an improved relay having a minimum of mechanical parts and in which the control forces are highly localized at the optimum areas for rapid and reliable relay operation.

Still another object of the invention is to provide improved relay having minimum contact bounce and inherent provision whereby the contacts may be immersed in inert gas or oil.

Other objects of the invention will be apparent from the specification and from the drawing, in which:

Fig. 1 is a partially broken away perspective view of an improved relay of the invention; and

Fig. 2 is a longitudinal section taken along line II—II of Fig. 1, on an enlarged scale.

Referring more specifically to the drawing, a preferred embodiment of the invention is shown in Fig. 1 as comprising an outer case 10 which mounts connector pins 12, 14, 16, 18, 20, 22 and encloses a relay exciting coil 24 having a core chamber 26 extending along the magnetic axis thereof. As is shown more clearly in Fig. 2 the core chamber 26 is provided with a tube of insulating material 28 throughout its length along the magnetic axis of the coil, and a pair of normally open contact members 30—32 are mounted within the insulating tube 28 to form a magnetic core for the coil 24 having a non-magnetic and electrically insulating gap 34 between the contact members. In the preferred embodiment of the

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invention the contact members are provided with a stepped portion 36 at their adjacent ends so that an enlarged part 38 of the gap 34 is provided within the tube 28 at one side thereof.

A small permanent magnet 40 is provided at the side of the core chamber 26 adjacent to the enlarged portion 38 on the outside wall surface of the insulating tube 28, and a small armature of magnetic material is freely contained in the enlarged armature chamber portion 38 between the magnet 40 and the contact members 30—32. As is shown in Fig. 2, the armature 42 is so dimensioned relative to the length of the armature chamber 38 that it is confined to overlapping relation with the gap 34 so that it will provide electrical contact between the contact members whenever it is in position against them, as will be explained more fully hereinafter. The contact members 30—32 are preferably made from magnetic material such as soft iron and may be copper plated if desired so that they are effective as elements in both the magnetic and normally open electric circuits. To provide electrical connection to the contact members 30—32 a pair of leads 44—46 are welded or otherwise electrically fixed to their opposite ends and are connected to corresponding contact pins 20—22.

A pair of normally closed contacts 48—50 may be provided to underlie the armature 42 when the latter is in its normal position against the insulating tube 28. These normally closed contacts may be conveniently mounted in the wall of the insulating tube 28 so as to be insulated from the contact members 30—32, and in such case a portion of the insulating tube 28 is cut away as shown at 52 to provide access by the armature 42 to the normally closed contacts. The normally closed contacts 48—50 are provided with leads 54—56 which connect to corresponding connector pins 12, 18, and the leads of the exciting coil 24 are brought to connector pins 14, 16. In practice the relay may be built up by placing the contact members 30—32, in spaced aligned relation as shown; then placing the armature 42 in the armature chamber 38; and completing the core tube assembly by forming the insulating tube 28 thereabout with the normally closed contacts mounted in the tube wall and overlying the armature. Alternately the contacts 48—50 may be plated on the inside of the tube 28 since their only function is to conduct electricity and they are not required to have any substantial mechanical strength. In either case insulation 60 is provided between the pairs of contacts 30—32 and 48—50, either as part of the tube wall or as separate elements.

The permanent magnet 40 is then placed on the outside of the insulating tube and the coil 24 is wound thereabout. The leads are then formed about the coil in compact relation thereto with the connector pins 12—22 arranged for insertion in a customary socket (not shown), and the whole is then coated with plastic or the like to provide the case 10 which encloses the parts hermetically with only the connector pins exposed, and provides mounting rigidity for the pins.

In operation, the permanent magnet 40 normally attracts the armature 42 away from the contact members 30—32 and into contacting relation with the normally closed contacts 48—50 so as to close the circuit of pins 12, 18 and to open the circuit of pins 20, 22. When a current is passed through the coil 24 to magnetize the core contact members 30—32 sufficiently, the attraction of the permanent magnet 40 will be overcome and the armature 42 will move out of contact relation with the contacts 48—50 and into electrically and magnetically bridging relation with the contact members 30—32. Thus, the normally closed circuit of pins 12, 18 will be opened and the normally open circuit of pins 20—22 will be closed. When the coil 24 is de-energized the per-

manent magnet 40 will regain control of the armature 42 so as to return the circuit elements to their original condition.

It is a particular feature of the invention that the armature contacts directly on the magnetic core pieces 30—32 and that the control circuit passes directly through the core members and the armature without use of spring contacts or the like. Thus, the construction of the invention is inexpensive to manufacture and provides an unusually reliable action with a minimum of contact bounce because maximum magnetic force is applied as the contacts close. There are no springs, sliding armature guides, flexing conductors or the like, and so the device has a long life and requires no adjustments or maintenance. Inasmuch as the single working part is wholly contained within the core of the coil, the relay of the invention lends itself to potting or other hermetically sealing techniques, and the armature chamber 38 may be filled with inert gas or oil if desired to dissipate heat and to quench the arcs. Also, since the armature 40 is permitted a degree of play in the armature chamber, the points of contact between the armature and the contacts 30—32, 48—50 continually change so as to provide a long contact life.

As shown in the drawing, the polar ends of the permanent magnet 40 and the adjacent ends of the contact members 30—32 are in close relationship to the armature. Thus, it will be appreciated that the control forces are highly localized at the armature 42 to bring about rapid and reliable operation of the relay with a minimum input power. Because the control forces are magnetic, the armature moves with a snap action in both directions, and the intervening wall of the tube 28 between the magnet 40 and the armature 42 serves to equalize this action. Therefore the action of the armature is resistant to external vibration and is unaffected by the positional attitude of the relay unit.

Thus, it will be appreciated that the invention provides a very compact and simple arrangement having only one moving part which has a reliable make and break snap action which is operative in all positions and is highly resistant to vibration forces. While only one form of the invention has been illustrated and described in detail, it will be appreciated that it may be otherwise embodied within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. An electromagnetic relay comprising a core tube means of insulating material, a pair of contact members of magnetic material mounted in said tube means in consecutive relation longitudinally thereof with a gap between said members, said members each having stepped portion at their adjacent ends forming an armature chamber in said gap at one side thereof, a pair of electric conductors of non-magnetic material extending from opposite ends of said tube means on the inside thereof to said armature chamber, an armature of magnetic material freely contained in said armature chamber in overlapping relation between said conductors and the adjacent ends of said stepped portions, insulating material separating said conductors from said contact members, a permanent magnet fixed to the outside of said tube means adjacent to said armature chamber adapted to attract said armature to a normal position in contacting relation with said conductors and clear of said contact members, an exciting coil wound about said tube means and the attached permanent magnet, said coil being adapted to magnetize said contact members to attract said armature from said normal position, electric leads from said coil and said conductors and said contact members to exterior terminals, and a hermetically sealed case enclosing said leads and said coil and the ends of said core tube means.

2. An electromagnetic relay having a core structure

comprising a core tube of insulating material, a pair of contact members of magnetic material mounted in said tube in consecutive relation longitudinally thereof with a gap between said members, said members each having stepped portions at their adjacent ends forming an armature chamber in said gap at one side thereof, a pair of electric conductors of non-magnetic material extending into said armature chamber, an armature of magnetic material freely contained in said armature chamber and dimensioned relative thereto to be freely shiftable therein while being retained therein in overlapping relation with the adjacent ends of said stepped portions, said core structure comprising means electrically separating said conductors from said contact members, a permanent magnet mounted at the outside of said tube adjacent to said armature chamber for attracting said armature to a normal position out of bridging engagement with said stepped portions and in bridging engagement with said conductors, an exciting coil wound about said tube and the permanent magnet, electric leads from said coil and said conductors and said contact members to exterior terminals, and a hermetically sealed case enclosing said leads and said coil and the ends of said core tube.

3. An electromagnetic relay having a core structure comprising a core tube of insulating material, a pair of contact members of magnetic material mounted in said tube in consecutive relation longitudinally thereof with a gap between said members, said members each having stepped portions at their adjacent ends forming an armature chamber in said gap at one side thereof, a pair of electric conductors of non-magnetic material extending into said armature chamber, an armature of magnetic material freely contained in said armature chamber and dimensioned relative thereto to be retained thereby in overlapping relation with said conductors and also with the adjacent ends of said stepped portions and to be displaceable between a normal position engaging and bridging said conductors and an energized position engaging and bridging said stepped portions, said core structure comprising means electrically separating said conductors from said contact members, a permanent magnet mounted at the outside of said tube adjacent to said armature chamber adapted to attract said armature to said normal position, and an exciting coil wound about said tube and the permanent magnet for magnetizing said contact members to attract said armature to said energized position.

4. An electromagnetic relay comprising magnetic core means, exciting coil means wound about said core means for setting up magnetic flux therein, said core means comprising a pair of contact members comprising magnetic material and arranged consecutively in the path of said flux, said contact members being relatively spaced to provide a non-magnetic and electrically insulating gap in said path, a permanent magnet and means fixing said magnet in spaced relation to said contact members opposite said gap to one side of said flux path, an armature freely disposed between said magnet and said contact members, said armature being dimensioned to overlap said contact members for bridging said gap, said armature being normally attracted and held away from bridging engagement with said contact members by said magnet but being displaceable away from said magnet to such bridging relation by and upon a predetermined energization of said coil means.

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