

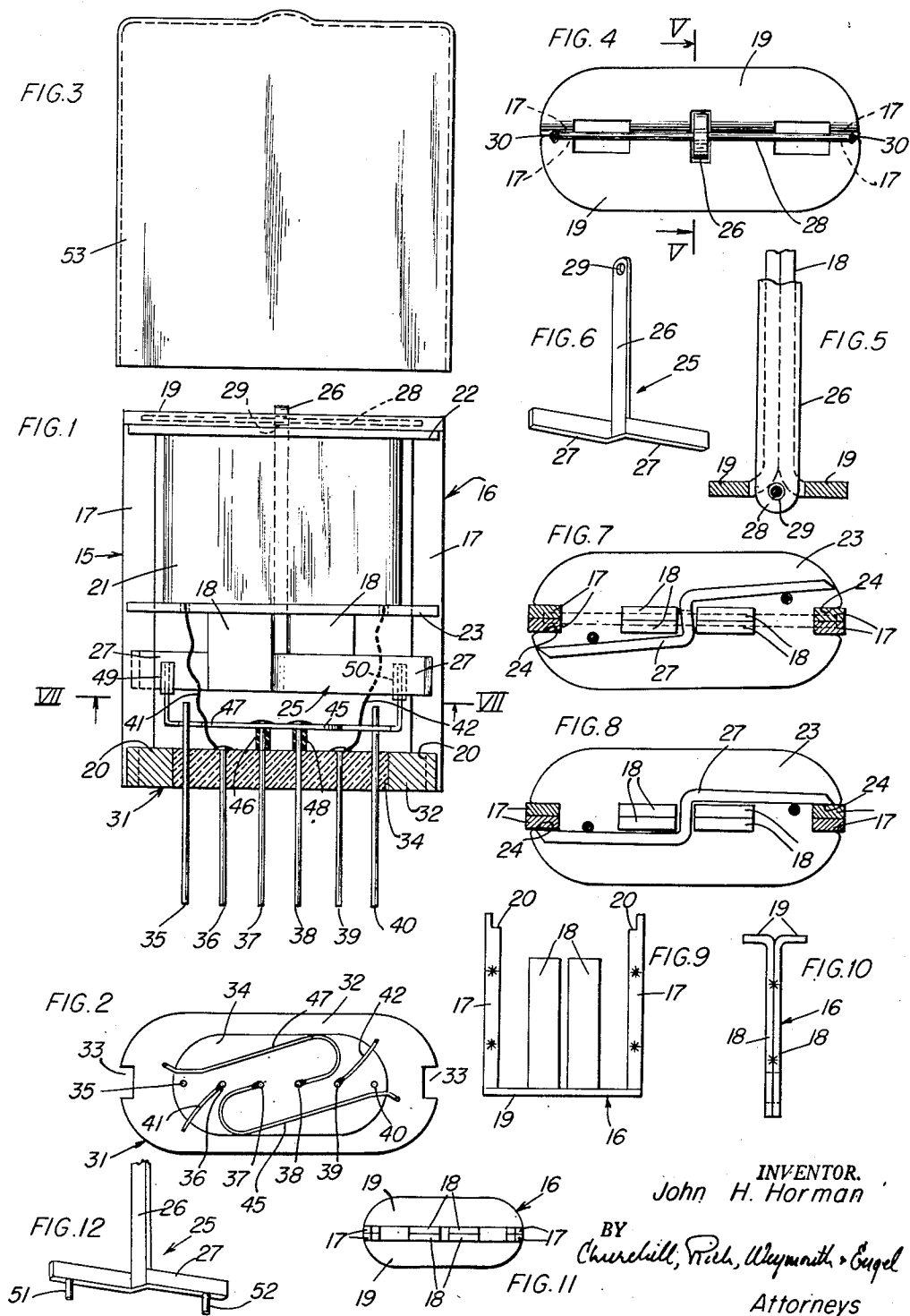
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ELECTROMAGNETIC SWITCH

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ELECTROMAGNETIC SWITCH

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5 Claims. (Cl. 200—87)

This invention relates to switches or relays, and more particularly an electromagnetically operated switch of small size and low internal capacity.

Certain types of electrical equipment having low current, low voltage circuits require electromagnetically actuated switches of exceedingly small size and light weight, having moving parts of small inertia, and with low internal capacity.

The general object of the invention is to provide a switch meeting the foregoing requirements, the parts of which are simple, inexpensive and capable of assembly and interconnection with a minimum of labor and time.

According to the invention the frame of the switch is stamped from magnetic sheet metal and provides pole pieces for the electromagnetic coil which actuates the switch. The frame also provides a magnetic flux path externally of the coil. Furthermore, an equally simple armature is stamped and formed from magnetic sheet metal and is loosely held centrally of the magnet actuating coil between the pole pieces therein by means which require no exacting effort to apply. The leads for the magnet coil and the contacts and circuit connections of the switch are carried by a separate header which is then easily fixed to the frame in position for coaction with the armature. A suitable cover is finally fitted over the entire assembly to enclose and protect it, but to leave accessible the external circuit connections. The structure is one which may be hermetically sealed if desired.

The several parts of the switch are simple and inexpensive; and no painstaking interfittng or interconnection is required either in the final assembly or in any subassembly. An inexpensive, light-weight and effective miniature remote-control switch is thus provided. Moreover, the armature is light in weight and moves but slightly in operating the switch, thus minimizing inertia.

The present preferred embodiment of the invention is illustrated in the accompanying drawings, in which

Fig. 1 is an elevation of an assembled switch constructed and arranged according to the invention, the cover being removed and parts of the switch being shown in mid-section;

Fig. 2 is a plan view of the header carrying the circuit connections, which is shown in section in Fig. 1 as the lowermost sub-assembly;

Fig. 3 is an elevation of the switch cover;

Fig. 4 illustrates the switch as viewed from above in Fig. 1;

Fig. 5 is a section taken on the line V—V of Fig. 4;

Fig. 6 is a perspective view of the armature shown on a reduced scale;

Fig. 7 is a cross-section taken on the line VII—VII of Fig. 1, in the direction of the arrows, the armature being shown in the position assumed when it is not attracted by the electromagnet;

Fig. 8 is a cross-section like Fig. 7, the armature being shown as attracted to the pole pieces of the electromagnet;

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Fig. 9 is a front elevation of the frame of the switch, shown on a reduced scale;

Fig. 10 is an end elevation of the switch frame shown in Fig. 9, showing its composite construction;

Fig. 11 is a view of the switch frame as seen from above in Fig. 9; and

Fig. 12 is a broken perspective view of a modified form of armature.

In the drawings there is shown a switch, generally indicated as 15, the parts of which are mounted on a novel frame 16 which provides pole pieces for the electromagnetic coil which operates the switch. It is preferred to flatten the switch as far as is possible in order that it may be conveniently disposed, and such a switch is here illustrated.

The frame 16 (Figs. 9–11) is composed of two identical pieces stamped out of magnetic sheet metal and spot-welded or otherwise connected together. Each identical piece is unitary and is formed to provide end tongues 17, 17 and separated intermediate tongues 18, 18, all lying in a common plane at right angles to a unitary flange 19. The end tongues 17, 17 are longer than the intermediate tongues 18, 18 and, with the unitary flange 19, constitute the frame of the switch. The outer ends of the end tongues 17 are shouldered as at 20, for a purpose which will later appear. Accordingly the frame 16 is simple in construction and inexpensive.

An electromagnetic coil 21 operates the switch 15 and is positioned in the frame by being thrust against the flanges 19, 19 of the frame 16 over the intermediate tongues 18, 18 which project outwardly of the coil. See Figs. 1, 7 and 8. The coil 21 is of a size to be positioned between the end tongues 17, 17 of the frame; and the end flanges 22 and 23 of the spool upon which the coil is wound are notched, as at 24, 24 to permit sliding over the end tongues with sufficient friction to hold the coil in place in the frame. It may be permanently secured with a suitable cement. The coil 21 may thus be assembled on and interconnected with its pole pieces with ease.

As will be obvious, energization of the electromagnetic coil 21 produces a magnetic flux which follows the path provided by the frame 16, through the intermediate tongues 18, 18, the flanges 19, the respective end tongues 17, 17, and across the gaps between the end tongues and the nearest intermediate tongues. The invention comprehends a specially-formed armature, pivoted in a special manner in the frame 16, and so related to the electromagnetic coil as to bridge both magnetic gaps when the coil is energized, and thereby to actuate the switch.

In the illustrated embodiment of the invention, an armature 25 is formed from magnetic sheet metal, having a stem 26 of a width slightly greater than the thickness of the frame 16 and a T-shaped head 27 the arms of which are oppositely turned substantially at right angles to the plane of the stem. See Fig. 6. The stem 26 is substantially longer than the axial length of the electromagnetic coil 21, and each arm of the T-shaped head 27 is of sufficient length to extend from the axis of the coil at least partly across one of the end tongues 17 of the frame. A simple and inexpensive armature is thus provided.

The armature 25 is very easily positioned and connected with the assembled electromagnetic coil 21 and frame 16. For this purpose, the stem 26 is inserted axially through the coil between the intermediate tongues 18, 18, and a rod 28, which may be a short piece of wire, is passed through a hole 29 in the end of the stem. See Figs. 1, 4 and 5. The rod is then connected to the

frame, as by soldering or welding at 30, 30 along the external depression where the two flanges 19, 19 are brought together in forming the frame. Axial movement of the stem in the coil is thus prevented. The diameter of the hole 29, however, is appreciably larger than that of the rod 23, thereby permitting slight rotation of the armature. So positioned, one arm of the T-shaped head 27 lies on one side of the plane of the frame and the other arm lies on its opposite side.

With the coil 21 and the armature 25 assembled upon the frame 16 as described, energization of the coil causes each arm of the armature head to bridge the magnetic gap between the end of the adjacent intermediate tongue 18 and the end tongue 17 nearest it, in accordance with well-known principles of magnetism. See Fig. 8. Rotation of the armature into and out of such bridging position is employed to operate the switch, in a manner presently to be described. As may be seen from Figs. 1, 7 and 8, there is a split magnetic flux path through the two symmetrical sides of the frame, each side comprising one pair of core elements 18 and one pair of end tongues 17 with two air gaps between the end tongues and the outer ends of the armature crosshead 27 which, in effect, are in parallel which gives increased flux density and lower reluctance and a better utilization of space. The armature stem 26 also carries flux and the inner ends of the arms of the armature head, adjacent the stem, are at all times substantially in contact with the core elements and lie flat across them when the gaps are closed as shown in Fig. 8, which gaps in actual practice are only a few thousandths of an inch, Figs. 7 and 8 being substantially three times actual size in the original drawings. Thus the outer ends of the armature cross-head are of the same polarity and the switch actuating force is very strong relative to the current flowing in the coil. Furthermore, the two flux paths being equal, the effect is to tend to make the stem of the armature float in the space between the core elements.

The last unit to be fixed upon the frame 16 is a header 31 which carries the contacts and circuit connections of the switch. The header 31 comprises an elongated block 32 of substantially the size and shape of the end flanges 22 and 23 of coil 21, but of greater thickness. Notches 33, 33 in the ends of the header permit it to be positioned with a frictional fit between the ends of the end tongues 17 and 17 where it rests on the shoulders 20, 20.

A central opening extends symmetrically through the block 32, which may be of metal, and this opening is filled by a body of insulating material 34, such as a glass composition having a thickness substantially equal to that of the block. The leads and circuit connections of the switch 15 project through and are fixed in the insulating material 34, and will now be described.

In the embodiment illustrated, six parallel, co-planar, equally spaced conductor rods 35, 36, 37, 38, 39 and 40 project through the block 32 and are firmly fixed in the body of insulating material 34 along its major axis and at right angles to its opposite faces. The spacing of the rods, and their length beyond what becomes the outer face of the header when in place in the switch, are such that the rods may be inserted into a conventional miniature tube socket. The conductor rods 36 and 39 next to the outer rods 35 and 40, respectively, are connected to the leads 41 and 42 of the electromagnetic coil 21 and constitute the control connections of the switch.

The illustrated switch 15 is designed to open and close two circuits simultaneously. Each circuit includes one of the inner rods between the control connections of the switch and that outer rod which is farthest from it. Thus, one of the circuits which the switch is designed to open and close includes the conductor rods 35 and 38, and the other such circuit includes the rods 37 and 40.

Contact within the switch to close the circuit through the conductor rods included in each circuit is very simply made. A fish-hook shaped resilient conductor 45 is fixed

at the inner end of the inner conductor rod 37 at the short end of the hook-shaped bend therein, extending from the rod 37 in a plane at right angles thereto and parallel to the adjacent face of the block 32. The resilient conductor 45 is soldered to the inner end of the conductor rod 37. The end of the former may be flattened and pierced, the pierced end of the resilient conductor being placed over the inner end of the conductor rod and secured against a spacing bushing 46 surrounding the end of the conductor rod 37.

The resilient conductor 45 extends from the rod 37 generally toward the line of the adjacent switch control rod 36, and then curves to extend close to the outer rod 40, which projects beyond the block 32 past the plane in which the resilient conductor lies. The end of the conductor 45 is bent sharply away from the block 32 beyond the outer rod 40 to lie against the adjacent leg of the armature head 27 and press it resiliently away from contact with the adjacent parts of the switch frame 16. See Figs. 1, 2 and 7. Because of the light weight of the armature 25 and its loose pivoting, little force is necessary to hold it as described when the coil 21 is not energized. Obviously, however, the armature 25 may easily be turned to overcome the resilient pressure upon it and to move the resilient conductor 45 into contact with the outer conductor rod 40.

Identical mechanism is employed in connection with the circuit through the conductor rods 38 and 35. A conductor 47 is fixed at its short end to the inner end of the rod 38 and secured against a bushing 48. The conductor 47 is bent as previously described so that it extends close to the outer rod 35, and its end is bent sharply away from the block 32 beyond the outer rod 35 to lie against the other leg of the armature head 27 and press it resiliently away from contact with adjacent parts of the frame 16.

From the foregoing, operation of the switch will be obvious. Normally the switch 15 is held in open circuit condition by the resilient conductors 45 and 47, which are out of contact with the conductor rods 40 and 35, respectively. The resilient conductors also hold the armature resiliently out of position bridging the two magnetic gaps provided by the magnetic frame of the switch. To close the circuits including the conductor rods 38 and 35 and the conductor rods 37 and 40, current to energize the coil 21 is supplied to the control circuit connections 36 and 39. This energizes the coil which gives the two intermediate tongues 18, 18 like magnetic polarity and the end tongues 17 and 17 magnetic polarity which is opposite to that of the intermediate tongues. The armature is therefore impelled to close the magnetic gaps between the ends of the intermediate tongues and their adjacent end tongues. In so doing the armature moves the resilient conductors 45 and 47 into contact with the outer conductor rods 40 and 35.

To prevent short circuit through the armature, sleeves or coatings of insulating material 49 and 50 are applied to the upstanding ends of the resilient conductors 47 and 45, respectively, to prevent direct contact with the armature head 27.

Referring to Fig. 12, it may be preferred not to turn the ends of the resilient conductors away from the block 32 for contact with the armature, but to provide pins 51 and 52 on the armature head for contacting the unturned resilient conductors. Such pins would either be of dielectric material or covered therewith.

With all of its parts assembled upon the frame 16 as described, the switch 15 is completed by slipping over it, in frictional engagement therewith, a cover 53 such as that illustrated in Fig. 3. The cover 53 encloses and protects the switch and may be hermetically sealed to the header 31.

The form and modification of the invention here described and illustrated are presented merely as examples of how the invention may be applied. Other forms, em-

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bodiments and applications of the invention will, of course, suggest themselves to those familiar with the electrical art.

What is claimed is:

1. In a relay, a supporting frame, core and armature assembly comprising, a pair of identical sheet metal members each having a pair of spaced apart core elements and a pair of end tongues parallel thereto and a flange, said members being arranged back to back with the flanges extending in opposite directions, a T-shaped armature comprising a stem and a head, said stem having an aperture adjacent its end and being positioned between said core elements with said aperture adjacent the junction of said flanges therewith, and a retaining member extending through said aperture and secured to said flanges, said armature stem being smaller than the space between the core elements so as to be capable of limited rotation between said core elements.

2. A miniature relay comprising, a substantially flat supporting frame and core member composed of a pair of identical sheet-metal units each having a pair of spaced-apart core elements and a pair of end tongues parallel thereto and an integral flange, said members being joined back to back with the flanges extending in opposite directions, an armature comprising a cross-head and a central supporting stem, said stem being positioned in the space between said core elements, means for rotatably supporting said stem in said space permitting free rotation thereof within the limits of movement of the armature, said cross-head including a pair of offset arms adapted to bridge the gaps between said core members and said end tongues and positioned on opposite sides of said frame, and a magnet coil surrounding said core elements.

3. A miniature relay comprising, a substantially flat supporting frame and core member composed of sheet-metal and having a pair of spaced-apart parallel core elements and a pair of end tongues parallel thereto and spaced therefrom on either side thereof, an armature comprising a cross-head and a stem, said stem being positioned in the space between said core elements, means anchoring said stem against longitudinal movement while permitting free rotation thereof within the limits of movement of the armature, said cross-head being adapted to bridge the gaps between said core members and said end tongues and having its ends positioned on opposite sides of said frame, a magnet coil surrounding said core elements, said tongues extending beyond the ends of said core elements, and a header assembly supported on the ends of said tongues and carrying switching means adapted to be actuated by movement of said armature.

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4. A miniature relay comprising, a substantially flat supporting frame and core member composed of a pair of identical sheet-metal units each having a pair of spaced-apart core elements and a pair of end tongues parallel thereto and spaced therefrom and an integral flange, said members being joined back to back with the flanges extending in opposite directions, and an armature comprising a stem and a cross-head having offset ends, said stem being positioned in the space between said core elements, means anchoring said stem against longitudinal movement while permitting free rotation thereof within the limits of movement of the armature, said cross-head ends being adapted to bridge the gaps between said core members and said end tongues and being positioned on opposite sides of said frame, a coil surrounding said core elements, and a bobbin for said coil having end members adapted to engage said end tongues and said flanges to position the coil relative to said frame.

5. A miniature relay comprising, a substantially flat supporting frame and core member composed of a pair of identical sheet-metal units each having a pair of spaced-apart core elements and a pair of end tongues parallel thereto and spaced therefrom and an integral flange, said members being joined back to back with the flanges extending in opposite directions, and a T-shaped armature comprising a cross-head having offset ends and a supporting stem, said stem being positioned in the space between said core elements, means anchoring said stem against longitudinal movement while permitting free rotation thereof within the limits of movement of the armature, said cross-head ends being adapted to bridge the gaps between said core members and said end tongues and being positioned on opposite sides of said frame, a coil surrounding said core elements, a bobbin for said coil having end members adapted to engage said end tongues, said tongues extending beyond the ends of said core elements, and a header assembly supported on the ends of said tongues and carrying switching means for actuation by movement of said armature.

References Cited in the file of this patent

UNITED STATES PATENTS

1,706,937	Parham	Mar. 26, 1929
1,763,003	Mead	June 10, 1930
2,445,401	Langer	July 20, 1948

FOREIGN PATENTS

11,707	Great Britain	1885
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