Feb. 2, 1971 SHIZUKA HORII ET AL 3,560,901

ELECTROMAGNETIC RELAY

Filed March 12, 1969 2 Sheets-Sheet 1

FIG. 1.

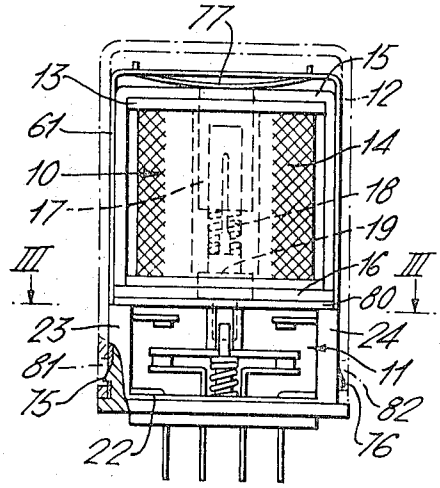

FIG. 2.

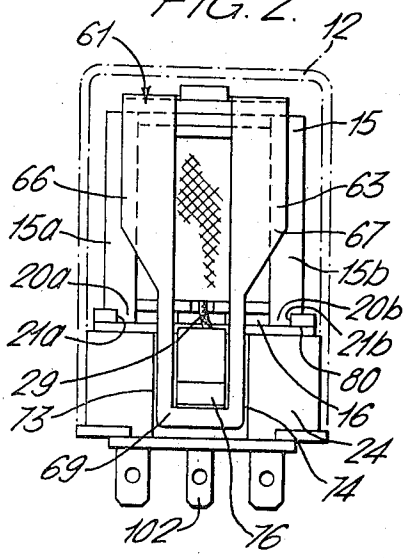

FIG. 3.

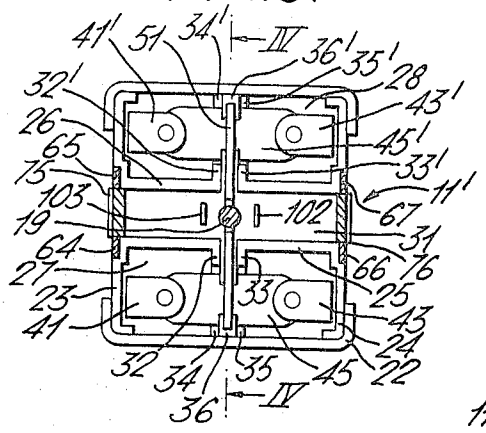

FIG. 4.

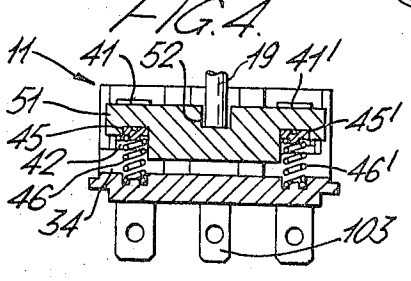

FIG. 5.

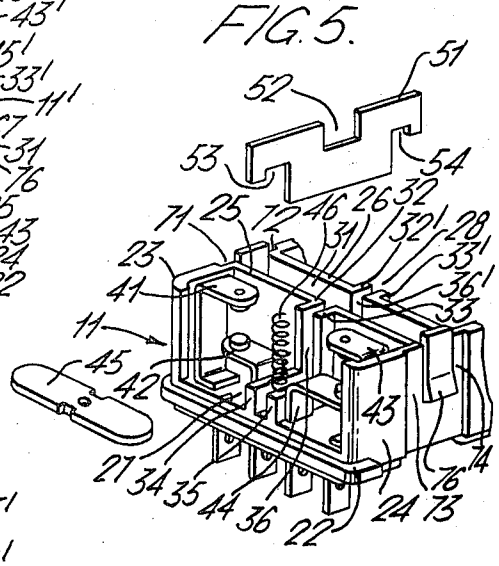

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FIG. 6.

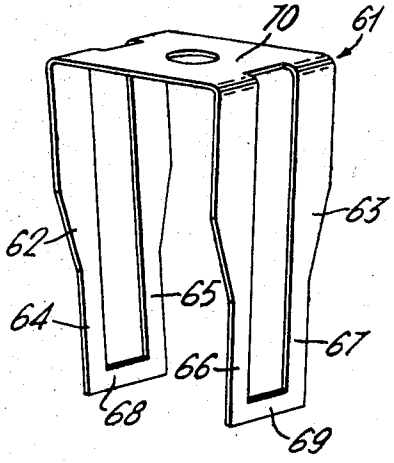


FIG. 7.

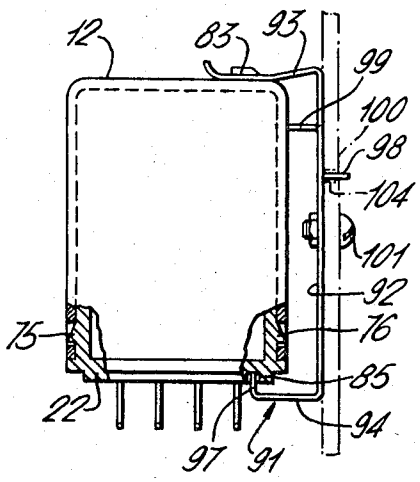


FIG. 8.

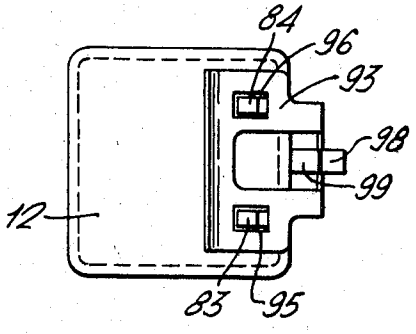


FIG. 9.

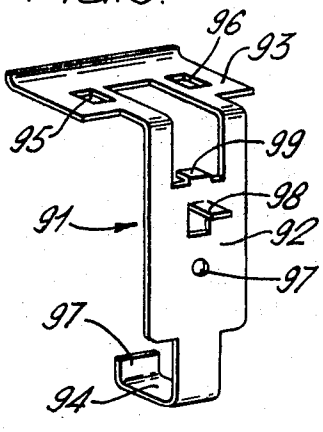
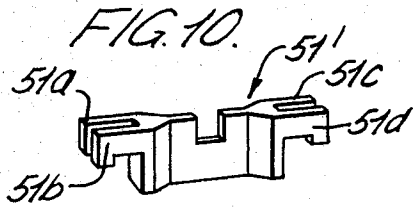


FIG. 10.



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ELECTROMAGNETIC RELAY

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Int. Cl. H01h 45/00
U.S. Cl. 335—132 9 Claims

ABSTRACT OF THE DISCLOSURE

An electromagnetic relay assembly of the plunger type consisting of separate electromagnet and switch structures, with a snap-on type binding member mounted on the electromagnet structure and gripping the switch structure to hold the two together in a simplified manner so that the electromagnet plunger bears accurately on the movable actuator of the switch assembly. Both the electromagnet and the switch portions of the unit are of conveniently simple construction for ease of assembly, eliminating the need for fastening elements such as screws and the like. The entire assembly is fitted within a housing, and a separate mounting element is provided for securing the relay to a wall structure.

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to an electromagnetic relay of the plunger type, that is, the relay in which the plunger of the electromagnet controls the opening and closing of the switch contacts.

This type of electromagnetic relay generally comprises two portions, that is, an electromagnet structure and a switch mechanism, and these two portions must be mechanically combined in such a manner that the plunger of the electromagnet structure may properly control the opening or closing of the contacts of the switch mechanism. In other words, the movement of the plunger must be exactly transferred to the movable contact member of the switch. If screws or the like are employed to assemble the two portions of the relay, the manual work involved is troublesome and time-consuming. Various devices have been proposed to solve the problems, but to the best knowledge of the present inventors they are all more or less complicated in construction.

Accordingly, it is one object of the invention to provide a new and improved electromagnetic relay of the plunger type which is easy in assemblage or decomposition of the component parts.

Another object of the invention is to provide such an electromagnetic relay as aforesaid in which the movement of the plunger of the electromagnet structure can be transferred to the movable contact members of the switch mechanism with such stability and exactness as to assure reliable operation of the switch.

Still another object of the invention is to provide such an electromagnetic relay as aforesaid which can be easily mounted onto or dismount from a suitable supporting member such as a panel of a control board.

The invention will best be understood from the following description of a preferred embodiment thereof with reference to the accompanying drawings, wherein:

FIG. 1 is a front elevation, partly broken away, of the relay of the invention;

FIG. 2 is a side elevation of FIG. 1;

FIG. 3 is a sectional view taken on the line III—III of FIG. 1;

FIG. 4 is a sectional view taken on the line IV—IV of FIG. 3;

FIG. 5 is an exploded perspective view of the switch mechanism of the relay as shown in FIGS. 1–4;

FIG. 6 is a perspective view of a binding member for combining the electromagnet structure and the switch mechanism of the relay;

FIG. 7 is a front elevation, partly broken away, of the relay as it is mounted on a panel;

FIG. 8 is a top plan view of FIG. 7;

FIG. 9 is a perspective view of the member for mounting the relay onto the panel;

FIG. 10 is a perspective view of a modified form of the the movable switch contact member actuating member shown in FIG. 5.

Referring now in detail to the drawings, the electromagnetic relay of the invention comprises an electromagnet structure and a switch mechanism generally designated at **10** and **11**, respectively, and enclosed in a box-like casing **12** of transparent plastic material in assembled relation.

The electromagnet structure **10** comprises a spool **13**, an electromagnetic coil **14** wound thereon, a generally U-shaped yoke **15** formed of magnetic material, an end plate **16** of magnetic material to reduce the loss of the magnetic flux, a stationary iron core **17** extending axially of the coil **14** and adapted to be pulled toward the core **17** against the resiliency of a compression spring **18** upon energization of the coil **14**. The yoke **15** has two pairs of legs **15***a* and **15***b*, one pair at each side. The lower ends of each pair of legs are provided with downwardly projecting tongues **20***a* and **20***b*, respectively, whose length is equal to the thicknes of the end plate **16**. Notches **21***a* and **21***b* are formed in each of the opposite ends of the plate **16** to receive therein the tongues **20***a* and **20***b* of the yoke legs **15***a* and **15***b* to securely connect the yoke **15** and the plate **16**. The spool **13** with the coil **14** wound thereon is first combined with the yoke **15** with the fixed iron core **17** being inserted into the axial bore of the spool, and the end plate **16** is then connected to the yoke **15** in the manner mentioned just above to securely assemble the parts. The electromagnet structure of the relay is thus assembled as a unit independent of the switch mechanism except for the plunger **19** and the spring **18** to be described later.

The switch mechanism of the relay comprises a base plate **22** provided at opposite ends with a pair of upright side walls **23** and **24**, and a pair of spaced partition walls **25** and **26** extending between the side walls **23** and **24** transversely thereof to divide the space above the base plate **22** into three chambers **27**, **28** and **31**. The chamber **27** is defined by one side portion of each of the side walls **23** and **24** and the partition wall **25**; the chamber **28** by the other side portion of each of the side walls **23** and **24** and the partition wall **26**; and the chamber **31**, by the middle portions of the side walls **23** and **24** and the two partition walls **25** and **26**. The chambers **27** and **28** enclose a set of switch contact members, while through the chamber **31** there pass a pair of lead lines, one of which is shown at **29** in FIG. 2, connecting the coil **14** to a pair of terminals **102** and **103**.

The partition wall **25** comprises two portions each of which extends from the side wall **23**, **24** perpendicularly thereof and bends inwardly of the contact chamber **27** to form a wall portion **32**, **33** extending a small distance in parallel with the side walls **23** and **24** and terminating in a short wall portion **34**, **35**, with a small gap or groove **36** interposed between the wall portions **32**, **34** and **33**, **35**. Similarly, the other partition wall **26** comprises two portions each of which extends from the side wall **23**, **24** perpendicularly thereof and bends inwardly of the chamber

28 to form a wall portion 32', 33' extending a small distance in parallel with the side walls 23 and 24 and terminating in a short wall portion 34', 35', with a small gap 36' intervening between the wall portions 32', 34', and 33', 35'. The gaps 36 and 36' extend in alignment with each other and parallel with the side walls 23 and 24.

A switch contact mechanism is enclosed in each of the chambers 27 and 28. In the chamber 27, there are provided two pairs of fixed or stationary contact members 41, 42, 43, 44. As best shown in FIG. 5, the contact member 41 stands upright alongside the inner surface of the side wall 23, and a little below the upper edge of the wall 23 the member 41 is bent inwardly of the chamber 27 and horizontally extends a suitable distance to provide an upper contact on the under surface thereof. The lower end of the contact member 41 projects downwardly through the base plate 22 to provide a terminal outside the chamber 27 for connection in a circuit. The contact member 42 stands upright alongside the inner surface of the short wall 34 as high as the upper edge thereof, where it is bent toward the member 41 to extend horizontally to provide a lower stationary contact on the upper surface thereof just below the upper stationary contact. The lower end of the member 42 projects downwardly through the base plate 22 to serve as a terminal outside the chamber 27. In a similar manner, the contact members 43 and 44 are so bent and shaped as to provide a pair of upper and lower stationary contacts arranged symmetrically with the above-mentioned pair of stationary contacts across the wall portions 34 and 35. As will be seen later, the upper contacts serve as a normally open contact and the lower contacts, as a normally closed contact to be opened upon energization of the coil 14.

A movable contact member 45 has its one end interposed between the upper and lower stationary contacts provided by the contact members 41 and 42 and its opposite end interposed between the upper and lower stationary contacts provided by the contact members 43 and 44. A coil spring 46 has its lower end disposed in the groove 36 and its upper end bearing up the under surface of the middle portion of the movable contact member 45 to bias the latter toward the upper stationary contact.

The switch mechanism enclosed in the other contact chamber 28 is of the same construction as that in the chamber 27 just described above. Therefore, the corresponding component parts of the mechanism in the chamber 28 are designated by the same reference numerals with a (') added thereto as those designating the parts of the switch mechanism in the chamber 27.

The movable contact members 45 and 45' in the two chambers 27 and 28 are simultaneously moved by a common actuator 51. The actuator is made of a suitable insulating material and loosely inserted in the aligned grooves 36 and 36' so as to be vertically slidable therein. The actuator 51 is formed in the middle portion of its upper edge with a notch 52 for receiving therein the lower end of the plunger 19, and at the opposite sides of its under edge with a pair of notches 53 and 54 for engagement with the middle portions of the movable contact members 45 and 45', respectively. Normally, the plunger 19 projects downward due to the resiliency of the spring 18, so that the actuator 51 presses the movable contact members 45 and 45' onto the lower stationary contacts against the force of the springs 46 and 46', respectively. When the coil 14 is energized to pull the plunger 19 upward against the resiliency of the spring 18, the springs 46 and 46' move the movable contact members 45 and 45' from the lower stationary contacts into contact with the upper stationary contacts.

To assemble the electromagnet structure 10 and the switch structure 11, a binding member 61 as show in FIG. 6 may advantageously be used. The binder 61 is U-shaped and comprises a pair of side wall elements 62 and 63 spaced apart and connected by a top wall element 62 is longitudinally and centrally slotted to form a pair of vertical legs 64 and 65 connected at their respective lower ends by a horizontal connecting element 68. Similarly, the other side wall element 63 comprises a pair of vertical legs 66 and 67 and a horizontal connecting element 69. On the other hand, the side walls 23 and 24 of the base plate 22 of the switch structure are provided on their respective lateral surfaces with a pair of parallel vertical grooves 71, 72 and 73, 74 connected at their lower ends by a horizontal groove, with a central lug 75, 76 projecting a little from the lateral surface of each side wall 23, 24.

The electromagnet structure 10 is placed on the switch structure 11 with an insulating plate 80 interposed therebetween in such a manner that the plunger 19 is urged by the spring 18 to push down the actuator 51 thereby to press the movable contact members 45 and 45' onto their respective lower stationary contacts. The two structures 10 and 11 thus assembled are then fitted in between the side wall elements 62 and 63 of the binder 61, with a leaf spring 77 interposed between the under surface of the top wall 70 of the binder 61 and the upper surface of the electromagnet structure 10 as far as the lower ends of the legs of each side wall element 62, 63 are fitted into the corresponding grooves of each side wall 23, 24 of the switch structure 11, respectively, with the connecting portion 68, 69 being fitted into the horizontal groove to engage the projecting lug 75, 76 as best shown in FIG. 2. Under this condition, the resiliency of the leaf spring 77 tending to urge the electromagnet structure and the binding member 61 in opposite directions helps ensure the engagement of the horizontal connecting portions 68 and 69 of the side walls 61 and 62 of the binder 61 with the projecting lugs 75 and 76 of the side walls 23 and 24 of the switch structure, thereby preventing casual separation of the two assembled structures 10 and 11.

The relay thus assembled may be enclosed in a casing 12. Near the bottom edges of the opposite side walls of the casing 12 there are provided a pair of apertures 81 and 82 into which the laterally projecting lugs 75 and 76 on the side walls 23 and 24 of the switch structure engage, respectively, thereby preventing the relay body from slipping out of the casing 12.

To mount the relay onto a panel or the like, a socket may be provided beforehand in the panel so that the terminal ends of the switch contact members may be fitted into the corresponding bores in the front face of the socket. FIGS. 7–9 show a mounting member 91 which can be used for the same purpose. To use the member 91 the casing 12 must be provided on the upper surface of its top wall with a pair of projections 83 and 84 and the base plate 22 of the switch structure 11 must be provided with a groove 85 (FIGS. 7 and 8). The mounting member 91 comprises a base wall 92 and a pair of upper and lower support wall elements 93 and 94 extending from the opposite ends of the base wall 92 substantially perpendicularly thereto. The upper support wall 93 is formed with a pair of apertures 95 and 96 for the projections 83 and 84 of the casing 12 to engage in and the lower support wall 94, with a bent edge 97 to engage in the groove 85 of the base plate 22. The mounting member 91 may be secured to the panel 100 by means of a screw 101 passing through a hole 97 formed in the wall 92 of the mounting member 91. A support tongue 99 is lanced out from the wall 92 to extend in the same direction as the upper and lower support walls 93 and 94 so that when the relay is mounted on the member 91, the outer edge of the tongue 99 abuts against the side wall of the casing 12, thereby preventing the relay from being moved toward the panel 100. Another tongue 98 is lanced out from the wall 92 of tfhe mounting member 91 in the opposite direction to that of the tongue 99, so that it may be inserted into a corresponding hole 102 formed in the panel 100, thereby preventing the rotational movement of the mounting member 91 about the screw 101.

To mount the relay onto the panel by means of the

mounting member **91**, the member **91** is first secured to the panel, and then the bent edge **97** of the lower support wall **94** of the member **91** is inserted into the groove **85** of the base plate **22** of the switch structure **11** and the relay is pushed in between the support walls **93** and **94** as far as the projecting lugs **83** and **84** on the top wall of the casing **12** engage in the apertures **95** and **96** formed in the upper wall **93** of the mounting member **91**. To dismount the relay from the mounting member **91**, the relay may simply be pulled to disengage the projections **83** and **84** from the apertures **95** and **96** and then the bent edge **97** from the groove **85**.

FIG. 10 shows a modified actuator **51'** which can be used in place of the actuator **51** of FIG. 5. The actuator **51'** has one side portion bifurcated to provide a pair of fingers **51***a* and **51***b*, and the other side portion similarly bifurcated to provide a pair of fingers **51***c* and **51***d*. Each pair of fingers bear on the movable contact **45**, **45'** at two places or points thereon, so that even when the actuator is more or less displaced relative to the movable contact member, the actuator can press evenly on the movable contact member, thereby assuring even contact pressure of the movable contact against the stationary contacts.

The invention has various advantages such as follows: The electromagnet structure **10** and the switch mechanism **11** are independent of each other, and no screws or the like are required to assemble them, so that the manual work involved in assembling them is quite simple and easy. In the switch mechanism, since the movable contact member actuator **51** or **51'** is slidable up and down in the guide grooves **36**, **36'**, no positional fluctuations of the actuator occurs during its sliding movement, so that the movable contact members also move properly, thereby providing a good contact pressure on the stationary contacts. The two movable contact members **45** and **45'** are supported by the separate coil springs **46** and **46'**, respectively, so that it is possible to regulate the contact pressure of each movable contact independently of that of the other. As the two contact chambers **27** and **28** are separated by the insulating partition walls **25** and **26**, there will be no possibility of the contacts short-circuiting in the two contact chambers **27** and **28**.

What we claim is:

1. An electromagnetic relay comprising: an electromagnet structure comprising an electromagnetic coil wound on a spool, means for providing a path for the magnetic flux produced by said coil upon energization thereof, a stationary core disposed in said coil, a plunger adapted to be attracted toward said stationary core upon energization of said coil, and spring means normally urging said plunger downwardly away from said core; a switch structure independent of said electromagnet structure and comprising a base plate, partition wall means dividing the space above said base plate into at least two contact chambers, guide groove means extending transversely of said partition wall means, a plurality of stationary contact members disposed in each said chamber, a movable contact adapted to be brought into and out of contact with said stationary contacts in each said chamber, a spring for biasing each said movable contact member upward, and an actuator slidable in said guide groove

means and engageable with said movable contact member to press the same down against the resiliency of said spring; and a binding member mounted on said electromagnet structure and gripping said switch structure to hold the same in assembled relation so that said plunger bears on said actuator to normally urge said actuator downward.

2. The relay of claim **1**, wherein said flux path providing means comprises a generally U-shaped yoke enclosing said coil therein and an end plate having notched ends and closing the open end of said yoke, with the ends of the opposite legs of said yoke being fitted into the notches formed in the opposite ends of said end plate.

3. The relay of claim **1**, wherein said actuator acts on said movable contact members in both said chambers simultaneously.

4. The relay of claim **3**, wherein said actuator has each of its opposite end portions bifurcated to provide a pair of fingers bearing on said movable contact member in each said chamber.

5. The relay of claim **1**, wherein said stationary contact members in each said chamber are disposed one pair at each of the opposite ends of said movable contact member, one of each said pair of stationary contact members being disposed above the other, with said movable contact member being interposed therebetween.

6. The relay of claim **1**, wherein each said spring is disposed beneath the middle portion of each said movable contact member.

7. The relay of claim **1**, wherein said binding member comprises a generally U-shaped frame having a pair of side leg portions and enclosing said assembled electromagnet and switch structures, said switch structure having a projection formed on each of the opposite lateral side walls thereof for gripping the ends of said side leg portions, respectively.

8. The relay of claim **1**, further including a transparent box-like casing having a bottom opening and enclosing said assembled electromagnet and switch structures therein, said casing engaging at its lower end with said end plate of said switch structure to hold said assembled structures therein.

9. The relay of claim **8**, in combination with a mounting member comprising a base wall and a pair of support walls extending from the opposite ends of said base wall generally perpendicularly thereto, so that one of said support walls engages the top wall of said casing while the other engages said base plate of said switch structure.

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HAROLD BROOME, Primary Examiner

U.S. Cl. X.R.

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