United States Patent [19]

Morimoto et al.

[11] **3,747,035**

[45] **July 17, 1973**

[54] **ELECTROMAGNETIC RELAY**

[75] Inventors: **Ikuhisa Morimoto; Hiroaki Fujimoto,** both of Tsu-shi, Mie-ken; **Kiyoshi Yamada,** Hirakata-shi, Osaka; **Kowashi Hisano,** Tsu-shi, Mie-ken, all of Japan

[73] Assignee: **Matsushita Electric Works, Ltd.,** Osaka, Japan

[22] Filed: **Apr. 7, 1972**

[21] Appl. No.: **241,970**

[30] **Foreign Application Priority Data**

April 21, 1971 Japan..... 46/25799

[52] **U.S. Cl.**..... **335/106,** 335/202, 335/234

[51] **Int. Cl.**..... **H01h 51/06**

[58] **Field of Search**..... 335/106, 132, 202, 335/203, 234, 127, 128

[56] **References Cited**

UNITED STATES PATENTS

3,209,095	9/1965	Obszarny	335/203
3,626,339	12/1971	Lisnay	335/202
3,569,890	3/1971	Baratelli	335/234

Primary Examiner—Harold Broome
Attorney—Wolfe, Hubbard, Leydig, Voit & Osann, Ltd.

[57] **ABSTRACT**

An electromagnetic relay having main and auxiliary contacts which are arranged in two blocks. Main contact block includes an electromagnet device and an armature pivotably engaged to an end of yoke and having an insulator base fixed to one side of the armature and a movable contact spring secured to said insulator base. Auxiliary contact block comprises an insulator plate, an auxiliary movable contact spring fixed at an end to said insulator plate, at least an auxiliary movable contact fixed to the other free end of said auxiliary movable contact spring, and at least an auxiliary fixed contact fixed to said insulator plate so as to oppose said auxiliary movable contact. The two blocks are fitted in a covering means adapted to hold them in positions, in which said auxiliary movable contact spring of the auxiliary contact block is driven through said insulator base of the armature of the main contact block upon attraction of the armature. The electromagnet of the main contact block has an auxiliary iron core provided in contact with a central axial iron core and disposed in a space in a frame of bobbin, and a permanent magnet provided in contact with said auxiliary iron core. The electromagnet is in contact with the yoke on the side of said permanent magnet.

1 Claim, 6 Drawing Figures

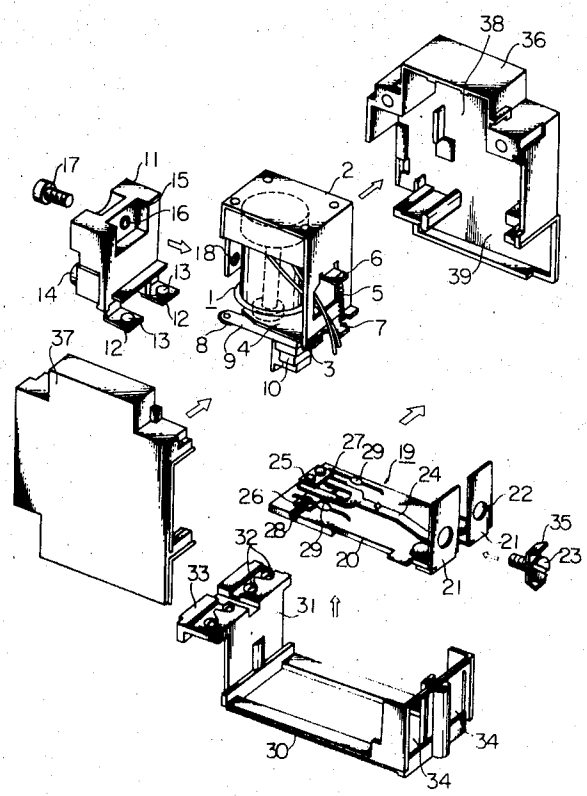


Fig. 1

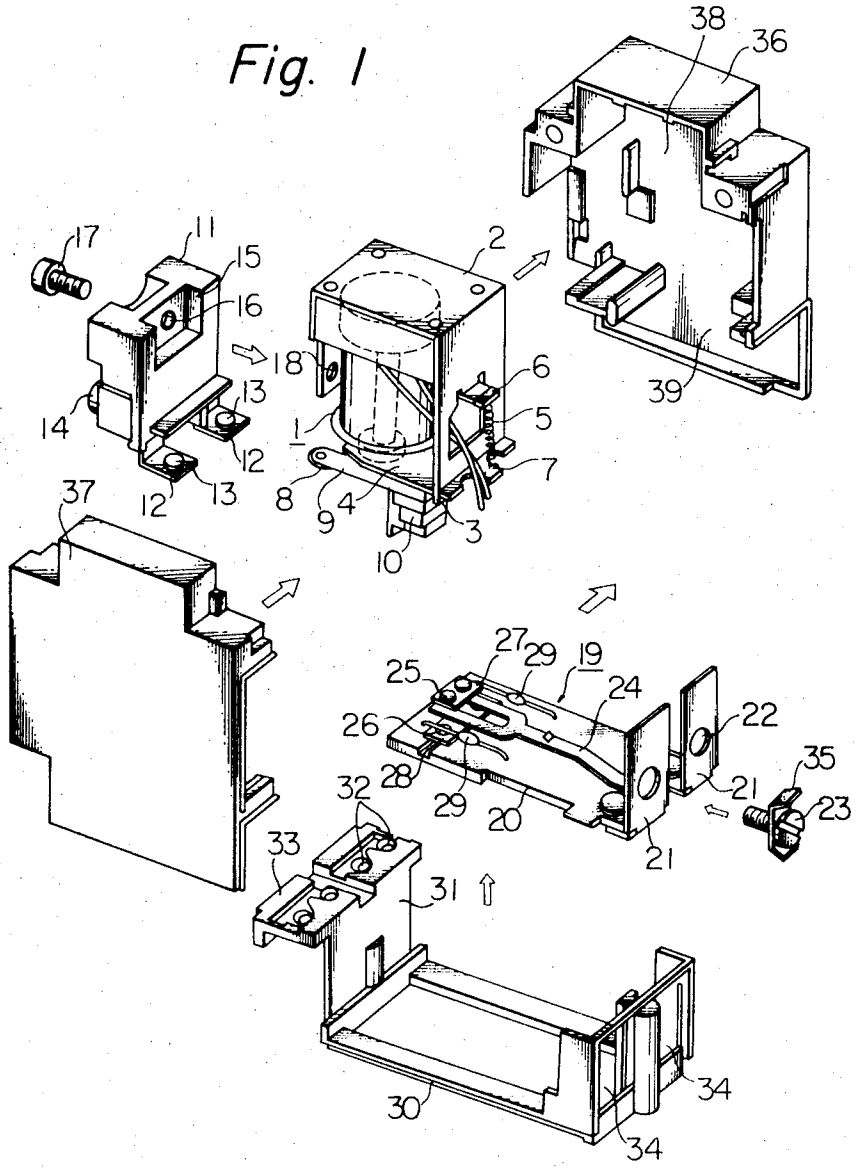

38
36
17
11
15
16
2
18
6
5
7
13
14
1
12
12
13
8
9
4
3
10
39
37
27
29
19
25
24
22
26
28
29
20
21
21
35
23
32
33
31
30
34
34

Fig. 2

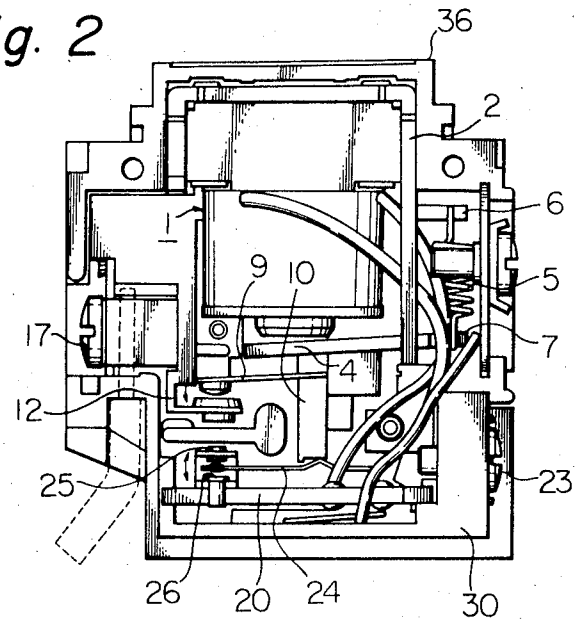


Fig. 3

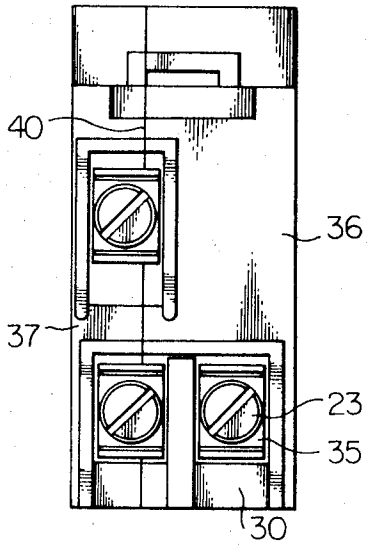


Fig. 4

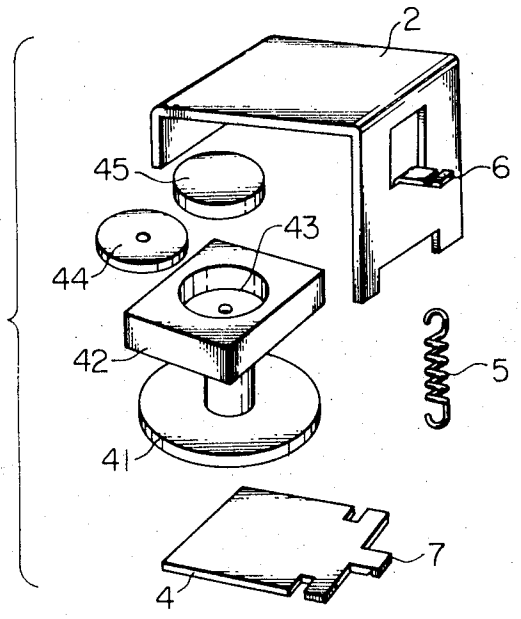


Fig. 5A

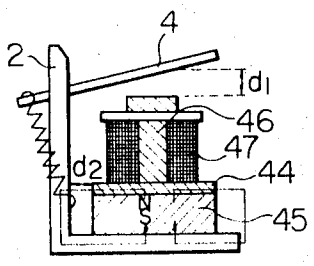
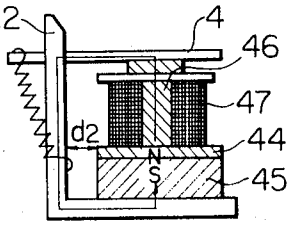


Fig. 5B



ELECTROMAGNETIC RELAY

This invention relates to electromagnetic relays and, more particularly, to an electromagnetic relay having auxiliary contacts.

In conventional electromagnetic relays having main switching contacts and auxiliary contacts, as these contacts are arranged horizontally in the same plane, the structure has been difficult of access to the respective contacts in one direction in order to adjust them.

On the other hand, in polar relays using a permanent magnet, a magnetic flux of the permanent magnet is present even in a nonexcited state. Even in latching relays of the type having also a permanent magnet so that the magnetic circuit will be open in the OFF-position but closed in the ON-position, a magnetic flux by the permanent magnet is present. Therefore, in the relays of such type, an attraction is always present in the gap between the fixed iron core and armature and, therefore, there is a defect that, if said gap is made smaller than a certain limit, due to such motivation as a shock or vibration, the relay will be reversed or the contact pressure on the OFF-side will become unstable. On the other hand, in electromagnetic relays of any coil-type, the coil must be properly designed in order to reduce the power consumption but, the smaller the above mentioned gap, the larger the freedom of the coil design. However, in practice the gap has been taken to be large enough for the stability of the quality.

The present invention has been suggested to eliminate the above mentioned defects.

A principal object of the present invention is, therefore, to provide an improved electromagnetic relay having main contacts and auxiliary contacts and of small type.

Another object of the present invention is to provide an electromagnetic relay which is easy to adjust and assemble.

A further object of the present invention is to provide an electromagnetic relay wherein the electromagnetic device is easy to design.

The present invention shall now be explained in detail with reference to a preferred embodiment as shown in attached drawings, in which:

FIG. 1 is a perspective view of an embodiment of the electromagnetic relay according to the present invention as disassembled.

FIG. 2 is an elevation of the same with the cover removed in assembling it.

FIG. 3 is a side view of the same.

FIG. 4 is a perspective view as disassembled of an electromagnetic device utilized in the embodiment.

FIGS. 5A and 5B are explanatory views of the operation of the same.

While the present invention shall be explained with reference to the particular embodiment as shown in the drawings, the intention is not to limit the invention thereto but rather to include all modifications and alterative and equivalent arrangements covered in the scope of the apended claims.

Referring to FIG. 1, 1 is an electromagnet formed by fitting a bobbin around a iron core, winding a coil on this bobbin and molding the entirety except both end surfaces with a synthetic resin. The detailed structure of this electromagnet shall be described later. 2 is a substantially L-shaped yoke having an armature 4 pivotably engaged to extensions 3 provided at both side

edges of one side bent edge, so that the armature body will oppose an end of the iron core of the electromagnet. 5 is a coil spring engaged at an end to a projection 6 provided on said bent of the yoke 2 to which the armature is engaged and at the other end to an extended end 7 of the armature 4.

8 is a main movable contact provided at the tip of a contactor arm 9 fixed at the base part to an insulator base 10 fixed to the armature so that, when the armature rotates, the contact 8 will also move. The electromagnet 1 is assembled in the L-shaped yoke 2 by being pushed in from any open side of the yoke.

11 is a terminal base supporting main fixed contacts, made of a synthetic resin and having L-shaped fixed contactor arms 12 integrally provided at the lower part of the base 11 and fixed contacts 13 provided on said fixed contactor arms 12.

14 is a terminal screw for the respective main fixed contacts. 15 is a recess in which on side wall of the yoke 2 is fitted. 16 is a through hole made in the recess. A screw 17 is inserted into said hole 16 and is screwed into a threaded hole 18 provided in said side wall of the yoke 2 to fix the terminal base 11 to the yoke so that the main contact block will be thus completed.

19 is an auxiliary contact part having auxiliary movable contacts and fixed contacts, wherein L-shaped terminal plates 21 are fixed to one end part of an insulator plate 20. 22 is a threaded hole provided in the respective terminal plates. 23 is a screw to be screwed into each of said threaded holes. 24 is an auxiliary movable contactor arm, riveted at one end to the insulator plate 20 adjacent the terminal plates 21 and disposed at the other end between upper and lower auxiliary fixed contacts 25 and 26. 27 and 28 are fixed contact plates supporting respectively said contacts 25 and 26 and fixed to the insulator plate 20. 29 is a diode secured to the insulating plate.

30 is a supporting frame made of a synthetic resin, formed to be substantially in U-shape, provided in the top part of one side wall 31 with supporting sections 33 having holes 32 for inserting conductive wires and provided in the other side wall with apertures 34. The above mentioned auxiliary contact part 19 is inserted into the bottom of the U-shaped supporting frame 30 and the screw 23 having a washer 35 is screwed into the threaded hole 22 of the terminal plate 21 to receive and fix the auxiliary contact part 19 in the supporting frame 30 so that the auxiliary contact block will be thus completed.

36 and 37 are cover members made of a synthetic resin and provided with inside spaces 38 and 39. The assembly of the electromagnet 1, yoke 2 and terminal base 11, that is, the main contact block is fitted in the space section 38, the other assembly of the auxiliary contact part 19 and supporting frame 30 is fitted in the space section 39, respectively of the cover member 36. Then the other cover member 37 is fitted to the member 36 to complete the whole assembly. In such case, the lower end of the insulator base 10 provided on the armature 4 is caused to abut, for example, a projection made on the suxiliary movable contactor arm 24.

FIG. 2 shows an elevation of the whole assembly with one cover member 37 removed. FIG. 3 shows one side view thereof, wherein 40 is an abutting line of the cover members 36 and 37.

FIG. 4 shows in a perspective view the electromagnet device of the embodiment in FIG. 1 with the respective

components disassembled. In the device, an iron core (not illustrated) is inserted in the center of a bobbin **41** and an auxiliary iron core **44** of a disk shape is inserted in a circular space **43** in the center of an upper bobbin frame part **42** and is fixed to the iron core (not illustrated). **45** is a permanent magnet kept in contact with the auxiliary iron core **44** and contained in the space **43.** A coil (not illustrated) is wound on the bobbin **41.** These components thus assembled are integrally held as molded in the entirety.

The operation of the electromagnet device used in the electromagnetic relay according to the present invention shall be explained in the following.

FIG. **5A** shows the state in which the armature **4** is not attracted. If distances between the armature **4** and the head part of the iron core **46** and between the auxiliary iron core **44** and the inside wall of the yoke **2** are represented by d_1 and d_2, respectively, when the armature is not attracted, the relation between these distances will be $d_1 > d_2$. Therefore, the magnetic flux from the permanent magnet **45** will flow mostly from the permanent magnet through the auxiliary iron core to the yoke and back to the permanent magnet, and substantially no magnetic flux will flow to the distance d_1. The distance d_1 is so little influenced by the permanent magnet that the armature **4** can be attracted by only flowing a slight electric current through the coil **47.**

However, when the armature is attracted (See FIG. **5B**), the magnetic flux from the permanent magnet will flow from the permanent magnet through the auxiliary iron core and the iron core to the armature and then to the yoke, and back to the permanent magnet. Therefore, the armature will be strongly attracted by both of the magnetic flux due to the electric current flowing through the coil and the magnetic flux by the permanent magnet.

Now, the operation of the electromagnetic relay of the present invention itself shall be explained. When an electric current is caused to flow through the coil and thus the armature is attracted by the electromagnet, the main movable contact **8** will separate from the main fixed contact **13** with the movement of the armature. At the same time, the insulator base **10** fixed to the armature will also move to the iron core side and, therefore, the auxiliary contactor arm **24** will also move at the tip to the electromagnet side and the auxiliary movable contact will become ON with the auxiliary fixed contact **25** while the same will become OFF with the other auxiliary fixed contact **26.**

If an electric current is flowed to the coil in the direction of cancelling the magnetic flux being caused by the permanent magnet, the attraction of the armature will be released. When the attraction of the armature is released, the ON and OFF state of the auxiliary contact will return to the original state.

In the present invention, as described above:

a. As the main contact block having the main movable and fixed contacts and the auxiliary contact block having the auxiliary movable and fixed contacts are arranged vertically with respect to the axis of the electromagnet device, the relay can be minimized in size even though the relay includes the main contacts and auxiliary contacts.

b. As the respective contacts are divided into such two blocks as the main contact block and the auxiliary contact block, each block can be separately assembled and adjusted and, therefore, the assembling efficiency can be improved.

c. As the auxiliary iron core is interposed between the iron core and the permanent magnet in the electromagnet device, the armature can be operated by flowing only a small amount of electric current to the coil and, therefore, the design of the coil can be made easy.

What is claimed is:

1. An electromagnetic relay comprising a main contact block comprising a substantially L-shaped yoke, an armature pivotably engaged to an extended end of a bent of said yoke and having an insulator base fixed to one side thereof, a main movable contact spring secured to said insulator base of the armature, an electromagnet disposed between the other side of said armature and the other bent of said yoke, said electromagnet comprising a bobbin having a flange at one end of a cylindrical body and a frame at the other end, an iron core provided in a central axial space of said cylindrical body of the bobbin, an auxiliary iron core provided in contact with said iron core and disposed in a space in said frame of the bobbin, and a permanent magnet provided in contact with said auxiliary iron core, said electromagnet being in contact with the yoke on the side of said permanent magnet; an auxiliary contact block comprising an insulator plate, an auxiliary movable contact spring fixed at an end to said insulator plate, at least an auxiliary movable contact fixed to the other free end of said auxiliary movable contact spring, and at least an auxiliary fixed contact fixed to said insulator plate so as to oppose said auxiliary movable contact; and covering means adapted to contain therein said main and auxiliary contact blocks in positions in which said auxiliary movable contact spring of the auxiliary contact block is driven through said insulator base of the armature of the main contact block upon attraction of the armature.

* * * * *