PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

An improvement of an Electromagnetic Relay

We, TATEISI ELECTRONICS CO., duly organized under the laws of Japan, locating at 10, Tsuchido-Cho, Hanazono, Ukyo-Ku, Kyoto City, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an improvement of a device for switching electric circuits, and more particularly to an improvement of an electromagnetic relay which effects switching of an electric circuit by electromagnetic force.

Control circuits for machine tools and similar instruments are extremely complex and a large number of controlling contacts are required which are subject to repeated switching. Electromagnetic relays are employed for this purpose. The contacts in electromagnetic relays, however, wear out easily through repeated switching, and if left unreplaced, reliable switching can no longer be performed. Accordingly, electromagnetic relays used for switching complex controlling circuits must be provided with contact units which are replaceable readily and simply. In addition since electromagnetic relays may be installed together with other instruments, on a panel and the like there is a limit to the space available, so that they must also be compact in size.

Furthermore, it is desirable that the electromagnetic relays should not only have greater circuit breaking capacity than that of conventional relays, but also they should be free from deformation by arcing.

Electromagnetic relays, moreover, must meet the following requirements:— protection of the contacts against dust to ensure a longer service life; resistance against shock and vibration so as to avoid erroneous operation and a minimum of parts to facilitate assembly and to lower the cost of production.

An object of the invention is to provide an electromagnetic relay having a movable contact member and a stationary contact member which are both replaceable without disturbing the other assembly, to make either of said contact members separately replaceable, and which can readily be constructed in such a manner that the aforementioned desiderata are achieved.

Another object of the present invention is to provide an electromagnetic relay having a group of contact members and greater circuit breaking capacity than conventional relays of comparable size.

According to the invention there is provided an electromagnetic relay comprising a case made of insulating material divided by a shoulder into an upper space and a lower space, an electromagnet unit in said lower space comprising a stationary core and an armature, an electromagnetic coil and a coil frame therefor, cavities in said upper space separated by partition walls extending from the shoulder, a movable contact member support in each of said cavities which is movable along said partition walls in reciprocating motion, a movable contact member which is disposed, in an element receiving section formed in each of said contact member supports, lower stationary contact members mounted, respectively on seats separated by each partition wall on the shoulder, a spring respectively mounted on each of the movable contact member supports and which presses each movable contact member support against an armature cap mounted on the armature of the electromagnet unit, and a return spring provided in said electromagnet unit so as to press said movable contact supports and armature against the bias of said springs which press said supports against said armature cap.

The invention also provides an electromagnetic relay wherein the spring which presses each movable contact member support against the armature cap is held by spring receiving members each of which is formed with a pair of flanges and wherein upper stationary contacts are provided corresponding to the

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Price 25p

movable contact members and mounted in a readily removable manner on connecting members connecting each partition wall above said shoulder, each upper stationary contact member engaging a flange of said receiving member so as to prevent each receiving member from leaving said cavity.

Embodiments of the invention will now be described by way of example, with reference to the accompanying drawing, in which.

Fig. 1 is a view in cross section of an electromagnetic relay in accordance with the invention, as viewed along the line A-B-O-C in Fig. 3;

Fig. 2 is a view of the same in partial cross section along the line C-O-D in Fig. 3;

Fig. 3 is a plan view of the electromagnetic relay shown in Fig. 1;

Fig. 4 shows in cross section an electromagnetic relay as viewed along the line A-B-O-C in Fig. 6;

Fig. 5 is a view of the same in partial cross-section as viewed along the line C-O-D in Fig. 6;

Fig. 6 is a plan view of the electromagnetic relay shown in Fig. 4;

Fig. 7 is a perspective exploded view of a contact assembly of an electromagnetic relay;

Fig. 8 is a perspective exploded view of a contact unit of an electromagnetic relay;

Fig. 9 is a perspective view of an arc shielding member used in an electromagnetic relay;

Fig. 10 is a partly sectional exploded perspective view of an arc shielding member having a permanent magnet;

Fig. 11 is a partly sectional perspective view of an arc shielding member, shown in Fig. 10, as installed in a case;

Fig. 12 is a perspective view of a dust-proof cover;

Fig. 13 is a perspective exploded view showing an electromagnetic unit of an electromagnetic relay.

Referring to Figs. 1 to 3, a case 1 made of insulating material is divided by a shoulder 2 into an upper space 3 and a lower space 4. The upper space 3 provides five cavities 7 which are formed between a pair of side walls 5 by four partition walls 6 extending upwardly from the shoulder 2. To connect each of said partition walls 6 a pair of connecting members 8 are provided. In the middle portion of each cavity 7, there is a section 9 for receiving a movable contact member support. At the shoulder 2 at the bottom of each said section 9, a hole 10 is provided for receiving a downwardly projecting rod of the contact member support. The shoulder 2 is formed with L-shaped portions 12 and for receiving lower stationary contact members, two groups of seats 13. In the lower space 4 an electromagnet unit is disposed. Said shoulder 2 provides a recessed section 14 which accomodates an armature.

Referring to Fig. 7, a spring receiving member 15 made of insulating material consists of a spring receiving section 16, a pair of flanges 17 and a hole 18 for receiving the guiding rod 21 of a movable contact member support 19. The movable contact member support 19 comprises an element receiving section 20, said guiding rod 21 and a downwardly projecting rod 22. Inside said element receiving section 20 are provided an upper movable contact member 23, a lower movable contact member 24, and between them a spring 27 and insulating members 25 and 26 interposed respectively between each contact member and each end of spring 27. A movable contact member support 19 is mounted in each of the sections 9 for receiving a movable contact member. This is assembled by inserting a downwardly projecting rod 22 into a receiving hole 10 in the shoulder 2, setting a spring 28 around a guiding rod 21, placing the guiding rod 21 and the spring 28 within said section 16 of a spring receiving member 15, mounting said receiving member 15 in said section 9, and inserting said rod 21 into the hole 18. Said support 19 is movable along said partition walls 6 in vertically reciprocating motion.

On each of connecting members 8, "U"-shaped upper stationary contact members 29 are removably mounted symmetrically to each other, and the upper edge of each upper stationary contact member 29 is fitted over each of the flanges 17 from above so that the upper edge of each stationary contact member 29 may, against the resiliency of the spring 28, prevent said receiving member 15 from removing upward from said section 9.

As explained above, the arrangement is made in such a manner that the contact surface of each upper movable contact member 23 of said support 19 can be brought into contact with the contact surface of each upper stationary contact member 29. Each lower stationary contact member 30 corresponds to the shape of each L-shaped portion 12 and is mounted on a respective seat 13 on the shoulder 2 which is separated by each partition wall 6. This assembly should be made so that the contact surface of said contact member 30 may correspond to the contact surface of the lower movable contact member 24 of said support 19.

Referring to Figs. 4 to 6, a further embodiment of electromagnetic relay of the invention is described as follows:

The construction of electromagnetic relay shown therein is identical with that shown in Figs. 1 to 3 except for the following construction.

The upper stationary contact member 29, upper movable contact member 23 and spring receiving member 15 are omitted. Furthermore, a movable contact member support 19, as shown in Fig. 8, provides only one movable contact member 58. A holding member 56 (Fig. 10) keeps the movable contact member

support 19 in place. It is removably mounted by means of screws, upon the upper surfaces of the connecting members 8. Each guiding rod 21 is inserted into a respective hole 57 in said member 56. Said member 56, of course, covers the upper opening end of said each cavity 7.

Referring, now to Figs. 1, 8 and 13, the numeral 31 indicates an E-shaped stationary core, and the numeral 32, an E-shaped armature upon which a core cap 33 is mounted. The armature 32 is mounted in the above mentioned recessed section 14. The core cap 33 is provided with recessed portions 34 into which downwardly projecting rods 22 of said supports 19 are respectively inserted. The numeral 35 indicates an electromagnetic coil. Upon the energization of said electromagnetic coil 35 the armature 32 is attracted toward the stationary core 31, thereby each of the movable contact members supports 19 is depressed by the resiliency of each spring 28, permitting the lower movable contact member 24 to contact the lower stationary contact member 30. Within the central hole 39 of the coil frame 38 where the central legs 36 and 37 of the core 31 and armature 32 are located, a return spring 40 is arranged so as to encircle said legs 36 and 37. The spring 40 keeps said support 19 and the armature 32 biased against the resiliency of said springs 28. Along the inner edge of the central hole 39 of the coil frame 38 a pair of flanges 41 are formed, and the arrangement is made to allow the lower end of the return spring 40 to come in engagement with the flange 41, and the upper end thereof to engage the armature 32. The electromagnet unit comprising both cores 31 and 32 is entirely enclosed within the lower space 4 of case 1 after insertion through the floor 42.

As already described the movable contact member supports 19 carrying the movable contact members therein are urged towards the movable armature 32 of the electromagnetic unit by the springs 28. Upon energization of the electromagnetic coil 35 the supports 19 are pushed downwards by the springs 28, unlike conventional relays which usually have a pin connecting the supports to the armature and are thus pulled down by the armature. This present construction avoids damage to the supports 19 and incomplete or unwanted contact due to deformation of the supports 19 is substantially eliminated and the life of the relay prolonged.

Furthermore movable contact member supports of the same shape are mounted respectively in the each section 9 of cavity 7 in the upper space 3 and the electromagnetic unit is positioned in the lower space 4, while said supports and said electromagnetic unit are connected only in the pressure transmitting relation. The lower stationary contact members 30 are also fixed on each of the seats 13 on the L-shaped portion 12 of the case 1. In consequence, by a simple removal of the upper stationary contact member 29 mounted on the connecting member 8, and the receiving member 15, the maintenance, inspection and replacement of the movable contact member support 19 and movable contact member are readily effected without dismantling the entire body of the electromagnetic relay. Accordingly, when any of the movable contact members is found defective, only the support holding the defective movable contact member need be removed for the replacement of said member held therein, without disturbing the other supports which have effectively operating movable contact members.

Further as the movable contact members and the supports thereof are replaceable from above the electromagnetic relay, the replacement is extremely readily effected even when a number of relays are mounted on control panels and the like. And the relays can easily be manufactured in the same exterior shape as conventional relays.

As already mentioned since the return spring 40 is provided between the core 31 and armature 32, around the central legs 36 and 37, only one spring is necessary and a spring receiving member usually provided on the core side of conventional relays is not required. In this respect, the relay is simplified and made compact. The force of the return spring exerted on the flanges 41 formed about the central hole 39 of the coil frame 38 pushes said frame 38 against the stationary core 31 so as to keep it resiliently positioned.

Furthermore, since only one return spring 40 is provided it can exert a uniform contact pressure over each of the movable contact members thus greatly reducing the wear on the contacts.

Referring, now to Figs. 1, 3 and 12 respectively on the side of each of the side walls 5 and partition walls 6 a protrusion 43 is formed integral therewith. Over the open sides of individual cavities 7 separated by each partition wall 6 dust-proof covers 44 are mounted. Said dust-proof covers 44, each made of resilient material such as polycarbonate resin or the like, are fitted into the open side of the cavities 7.

Each cover 44 comprises plate pieces 47, and every two plate pieces adjacent to each other are connected by a protruding connection 48. A slit 45 is formed at one end of each piece and also a specific portion standing on different levels 46 thereat. The cover 44 may be placed on the case 1 by keeping one end thereof touching the upper surface of a stationary contact member 64, pressing the edges of each plate piece 47 at the other end with slit 45 to narrow the width thereof, and then inserting each piece 47 between protrusions 43 which are respectively formed on partition walls 6 and side walls 5.

The dust-proof cover 44 thus inserted is brought back to shape by the resiliency thereof and the removal of the cover from said case is prevented. Once the cover 44 is mounted in case 1, as shown in Fig. 1, the insertion of protruding connections into recessed portions 65 respectively provided on partition walls 6 preclude the upward movement of the cover 44 or the downward removal thereof if the electromagnetic relay should be installed inverted. Although the dust-proof cover consists of several plate pieces a different cover comprising a single plate piece may be used instead. The two dust-proof covers 44 are provided along the sides of the case 1. Instead of the protrusions 43 formed on side walls 5 and partition walls 6 apertures or recessed portions may be provided therein, and protrusions may be provided on the corresponding sections of dust-proof covers 44.

The protrusions 43 formed on each side of partition walls, displaced from the terminal screws 49 of each of the stationary contact members, hold in engagement the dust-proof covers 44 of resilient material, so that in applying or removing the dust-proof covers it is not necessary to loosen or remove each terminal screw 49. The cover need only be pressed into the case 1 for mounting, and removal thereof is readily effected by pulling it out. The dust-proof covers 44 which protect the contact assembly in the case against dust, water droplets and other contaminants, contribute much to marked reduction of trouble in the electromagnetic relay thus extending its life.

Referring to Figs. 9 to 11, two sections 11 and 11 for receiving arc shielding members are provided on the both sides of each cavity 7 in said case 1 interposed between said sections, and in each of said sections 11 arc shielding members 50 are provided. Each partition wall 6 forming the side of each sections 11 has a recessed portion 51 for receiving a leg of the arc shielding member 50. The U-shaped arc shielding member 50 is made of ferro-magnetic material and has a pair of legs 52 and a crosspiece 53 connecting said legs together. Each leg is located in one of said recessed portions 51. The legs 52 are mounted so as to be disposed on both sides of the movable contact member 58 and the stationary contact member 64. An arc shielding member having a construction different from the one described above consists, as seen in Figs. 10 and 11, of legs 55 of ferro-magnetic material connected by a permanent magnet crosspiece 54.

Because each pair of legs 55 is inserted in each pair of recessed portions 51 and is connected by permanent magnet cross-piece 54, the magnetic flux of the permanent magnet 54 carried close to the contact by the pair of legs 55 can effectively extinguish any arc which is generated upon switching. The permanent magnet connection 54 and pair of legs 55 can be inserted in each section 11 from above the case 1, in the same direction as the movable contact member supports 19 and the permanent magnet 54 and a pair of legs of magnetic material 55 are arranged so as to be held in said section by the holding member 56 (Fig. 10). In the same way said movable contact member support 19 is also held in place by holding member 56, therefore, it is not necessary to employ an additional member for holding the connection 54, and as a result, assembly can be effected extremely simply and easily. Said holding member 56, made of insulating material, is provided with holes 57 for receiving the guiding rods.

As compared with a compact electromagnetic relay of conventional type having no arc extinction unit, a difference lies in that the relay described has recessed portions in the side of the partition walls, a device to utilize the space which is left unused in conventional relays. Thus, the formation of the recessed portions obviates need for making a bigger case to accommodate the arc extinction unit and an electromagnetic relay with larger circuit breaking capacity in the same dimension of case can now be provided.

The positioning of the permanent magnet and magnetic bodies also ensures an extremely easy and simple assembly procedure. Furthermore, instead of a direct arrangement of a permanent magnet close to the contact, the permanent magnet connection is so constructed as to conduct the magnetic flux near the contact and extinguish the arc, whereby degeneration of the permanent magnet by the arc is avoided.

The numeral 59 refers to a terminal indicating plate shown in Fig. 3, and the numeral 60 to a transparent cover over said plate, which is disposed between a pair of side walls 5, 5 with both ends thereof inserted into the narrow space formed between each side wall 5 and the spring receiving member 15 adjacent to said wall. The numeral 61 indicates a terminal screw of each stationary contacting member. Holes 62 for ventilation are formed in the front and rear walls of the lower space 4. Numeral 63 indicates a terminal of the electromagnetic coil 35.

WHAT WE CLAIM IS:—

1. An electromagnetic relay comprising a case made of insulating material divided by a shoulder into an upper space and a lower space, an electromagnet unit in said lower space comprising a stationary core and an armature, an electromagnetic coil and a coil frame therefor, cavities in said upper space separated by partition walls extending from the shoulder, a movable contact member support in each of said cavities which is movable along said partition walls in reciprocating mo-

The dust-proof cover 44 thus inserted is brought back to shape by the resiliency thereof and the removal of the cover from said case is prevented. Once the cover 44 is mounted in case 1, as shown in Fig. 1, the insertion of protruding connections into recessed portions 65 respectively provided on partition walls 6 preclude the upward movement of the cover 44 or the downward removal thereof if the electromagnetic relay should be installed inverted. Although the dust-proof cover consists of several plate pieces a different cover comprising a single plate piece may be used instead. The two dust-proof covers 44 are provided along the sides of the case 1. Instead of the protrusions 43 formed on side walls 5 and partition walls 6 apertures or recessed portions may be provided therein, and protrusions may be provided on the corresponding sections of dust-proof covers 44.

The protrusions 43 formed on each side of partition walls, displaced from the terminal screws 49 of each of the stationary contact members, hold in engagement the dust-proof covers 44 of resilient material, so that in applying or removing the dust-proof covers it is not necessary to loosen or remove each terminal screw 49. The cover need only be pressed into the case 1 for mounting, and removal thereof is readily effected by pulling it out. The dust-proof covers 44 which protect the contact assembly in the case against dust, water droplets and other contaminants, contribute much to marked reduction of trouble in the electromagnetic relay thus extending its life.

Referring to Figs. 9 to 11, two sections 11 and 11 for receiving arc shielding members are provided on the both sides of each cavity 7 in said case 1 interposed between said sections, and in each of said sections 11 arc shielding members 50 are provided. Each partition wall 6 forming the side of each sections 11 has a recessed portion 51 for receiving a leg of the arc shielding member 50. The U-shaped arc shielding member 50 is made of ferro-magnetic material and has a pair of legs 52 and a crosspiece 53 connecting said legs together. Each leg is located in one of said recessed portions 51. The legs 52 are mounted so as to be disposed on both sides of the movable contact member 58 and the stationary contact member 64. An arc shielding member having a construction different from the one described above consists, as seen in Figs. 10 and 11, of legs 55 of ferro-magnetic material connected by a permanent magnet crosspiece 54.

Because each pair of legs 55 is inserted in each pair of recessed portions 51 and is connected by permanent magnet cross-piece 54, the magnetic flux of the permanent magnet 54 carried close to the contact by the pair of legs 55 can effectively extinguish any arc which is generated upon switching. The permanent magnet connection 54 and pair of legs 55 can be inserted in each section 11 from above the case 1, in the same direction as the movable contact member supports 19 and the permanent magnet 54 and a pair of legs of magnetic material 55 are arranged so as to be held in said section by the holding member 56 (Fig. 10). In the same way said movable contact member support 19 is also held in place by holding member 56, therefore, it is not necessary to employ an additional member for holding the connection 54, and as a result, assembly can be effected extremely simply and easily. Said holding member 56, made of insulating material, is provided with holes 57 for receiving the guiding rods.

As compared with a compact electromagnetic relay of conventional type having no arc extinction unit, a difference lies in that the relay described has recessed portions in the side of the partition walls, a device to utilize the space which is left unused in conventional relays. Thus, the formation of the recessed portions obviates need for making a bigger case to accommodate the arc extinction unit and an electromagnetic relay with larger circuit breaking capacity in the same dimension of case can now be provided.

The positioning of the permanent magnet and magnetic bodies also ensures an extremely easy and simple assembly procedure. Furthermore, instead of a direct arrangement of a permanent magnet close to the contact, the permanent magnet connection is so constructed as to conduct the magnetic flux near the contact and extinguish the arc, whereby degeneration of the permanent magnet by the arc is avoided.

The numeral 59 refers to a terminal indicating plate shown in Fig. 3, and the numeral 60 to a transparent cover over said plate, which is disposed between a pair of side walls 5, 5 with both ends thereof inserted into the narrow space formed between each side wall 5 and the spring receiving member 15 adjacent to said wall. The numeral 61 indicates a terminal screw of each stationary contacting member. Holes 62 for ventilation are formed in the front and rear walls of the lower space 4. Numeral 63 indicates a terminal of the electromagnetic coil 35.

WHAT WE CLAIM IS:—

1. An electromagnetic relay comprising a case made of insulating material divided by a shoulder into an upper space and a lower space, an electromagnet unit in said lower space comprising a stationary core and an armature, an electromagnetic coil and a coil frame therefor, cavities in said upper space separated by partition walls extending from the shoulder, a movable contact member support in each of said cavities which is movable along said partition walls in reciprocating mo-

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tion, a movable contact member which is disposed in an element receiving section formed in each of said contact member supports, lower stationary contact members mounted, respectively, on seats separated by each partition wall on the shoulder, a spring respectively mounted on each of the movable contact member supports and which presses each movable contact member support against an armature cap mounted on the armature of the electromagnet unit, and a return spring provided in said electromagnet unit so as to press said movable contacts supports and armature against the bias of said springs which press said supports against said armature cap.

2. An electromagnetic relay as claimed in claim 1 wherein said spring which presses each movable contact member support against the armature cap is held by spring receiving members each of which is formed with a pair of flanges, and wherein are provided upper stationary contact members corresponding to the movable contact members and mounted in a readily removable manner on connecting members connecting each partition wall above said shoulder, each upper stationary contact member engaging a flange of said receiving member so as to prevent each receiving member from leaving said cavity.

3. An electromagnetic relay as claimed in claim 1 or 2 wherein said springs are held by a holding member to keep the movable contact member supports in place, said holding member being disposed so as to cover an upper open end of each cavity and removably mounted on each of the connecting members connecting the partition walls above said shoulder.

4. An electromagnetic relay as claimed in claim 1, 2 or 3 wherein a central leg of said stationary core is located in a central hole of the coil frame of said electromagnet coil, flanges being provided on the outer and inner edges of said electromagnetic coil frame so as to surround a central leg of the armature and the central leg of the stationary core.

5. An electromagnetic relay as claimed in claim 3 wherein inverted U-shaped shielding members of ferro-magnetic material, comprising a pair of legs and a cross-piece are located in recessed portions one recessed portion being formed in each partition wall, one leg of each shielding member being inserted into each recessed portion, respectively, so as to span said movable contact member in each cavity and the stationary contact member mounted on said shoulder, each end of said legs engaging with said shoulder, and said cross-piece being pressed by said holding member.

6. An electromagnetic relay as claimed in claim 5, wherein the pair of legs is made of ferro-magnetic material and the cross-piece of the "U" shape is a permanent magnet connecting said legs at one end.

7. An electromagnetic relay as claimed in any preceding claim wherein a pair of dust proof covers made of resilient material which cover the open sides of said cavities and which are provided with connections each of which connects plates pieces of each cover adjacent to each other, a slit being formed at the upper end of each of said plate pieces, a protrusion respectively formed on the upper side of each of said partition walls so as to keep both edges of each plate piece of said cover held in place thereof.

8. An electromagnetic relay substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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