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Suzuki

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[54] **ELECTROMAGNETIC SWITCH DEVICE**

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[51] **Int. Cl.** **H01h 9/38**

[58] **Field of Search** 335/201; 200/146

[56] **References Cited**

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[57] **ABSTRACT**

An improved electromagnetic switch device capable of remarkably reducing the arcs which would be produced at the time of opening and closing of the switch. The switch is provided with an arc-cutting contact in either one of the movable and fixed main contacts, the arc-cutting contact being retractively protruded outwardly beyond the contacting surface of the main contact in which it is provided, so that the arc-cutting contact comes into contact with the opposing main contact prior to the engagement of the main contacts, through which the switch is brought into on-operation, while the arc-cutting contact comes out of contact with the opposing main contact after disengagement of the main contacts by which the switch is brought into off-operation.

8 Claims, 3 Drawing Figures

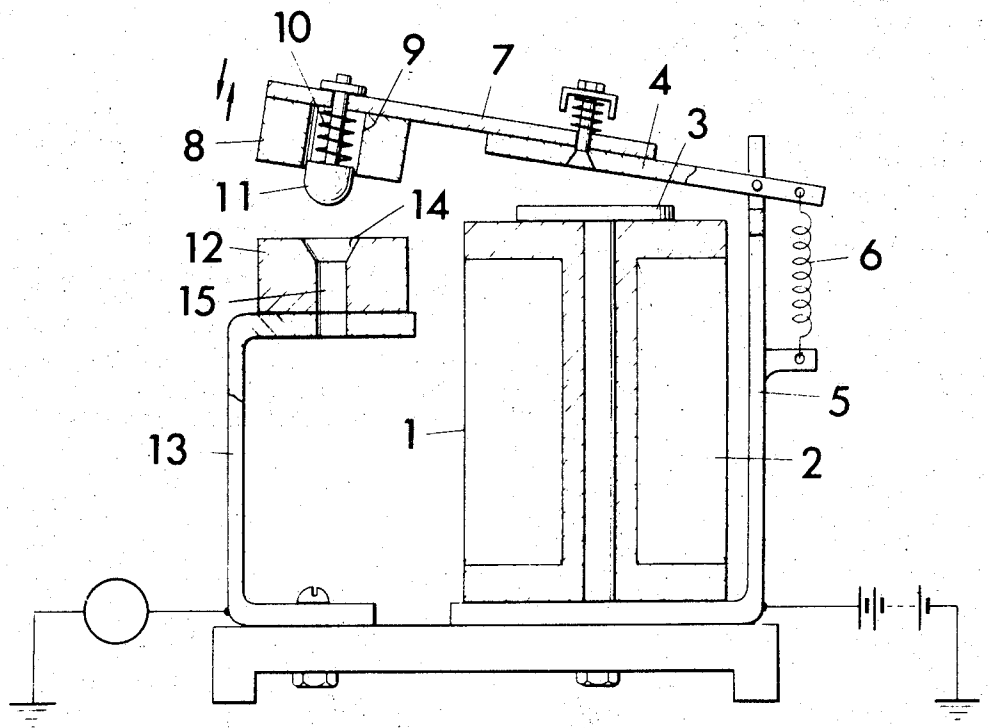


FIG. 1

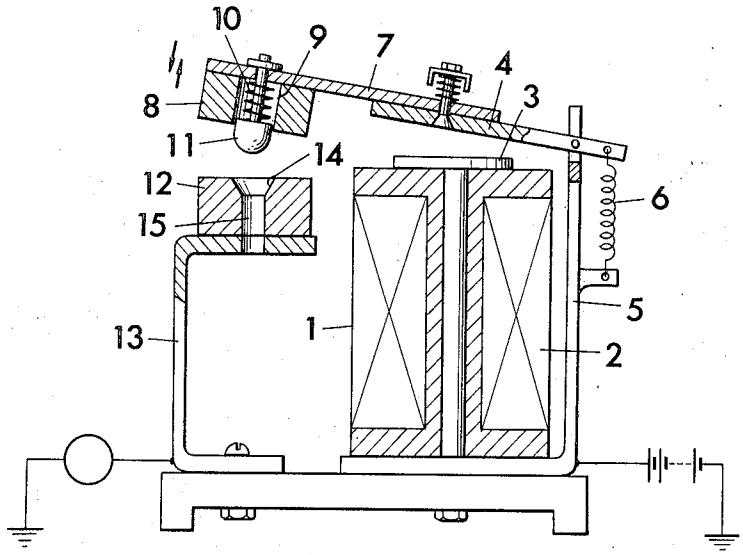


FIG. 3

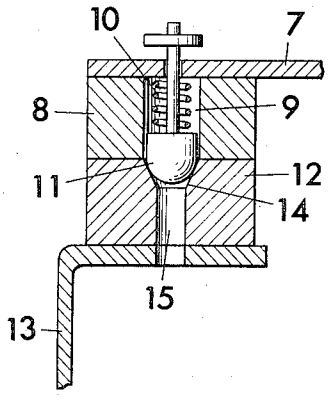
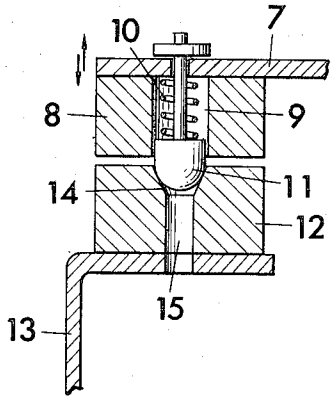


FIG. 2



ELECTROMAGNETIC SWITCH DEVICE

BACKGROUND OF THE INVENTION

This invention relates to an electromagnetic switch device, and more particularly to an improved electromagnetic switch device whereby burning losses due to arcs of the switch contacts may be remarkably reduced.

It is known in the art that the main cause of the burning losses of the switch contacts in a switch having a movable contact and a fixed contact is the arc heat generated at the time of opening and closing of the switch. The conventional switches of the type are generally provided with arc-cutting contacts connected in parallel with main contacts of the switches.

THE OBJECT OF THE INVENTION

It is a primary object of the present invention to provide an electromagnetic switch device whereby generation of arcs between the contacts is remarkably reduced.

It is another object of the present invention to provide an electromagnetic switch device having a retractile arc-cutting contact in either one of the movable and fixed main contacts for reducing generation of arcs therebetween.

It is other object of the present invention to provide an electromagnetic switch device having a retractable arc-cutting contact in either one of movable and fixed main contacts, the arc-cutting contact being normally protruded outwardly beyond the contacting surface of the main contact in which it is provided, so that the arc-cutting contact comes into contact with the oppositing main contact before the engagement of the main contacts, through which the switch is in on-operation, while the arc-cutting contact comes out of contact with the opposing main contact only after the disengagement of the main contacts by which the switch is brought into off-operation.

It is a further object of the present invention to provide an electromagnetic switch of the nature mentioned above, which switch is simple and compact in construction, easy to use and economical to manufacture.

SUMMARY OF THE INVENTION

According to the present invention, there is provided an electromagnetic switch device comprising a base plate member; an electromagnet securely mounted on said base plate member by means of a conductive bracket and including a coil winding and a fixed iron core inserted in the coil winding along the longitudinal axis thereof; a movable arm member pivotally mounted on said conductive bracket, adapted to be attracted by said iron core upon energization of the coil and provided with an extension connected to the fore end portion thereof; said movable arm member being normally biased away from the iron core by means of a spring; a movable main contact provided in the fore end portion of said extension; a fixed main contact provided on a conductive bracket securely mounted on the base for engagement with said movable main contact; a retractable arc-cutting contact provided in either one of the movable and fixed main contacts and being normally protruded outwardly beyond the contacting surface of the main contact in which it is provided by means of a spring, so that the arc-cutting contact comes into contact with the opposing main contact prior to the engagement of the main contacts, through which the switch is in on-condition, and comes out of contact with the opposing contact after disengagement of the main contacts by which said swich is brought into off-condition.

It is preferred that the arc-cutting contact mentioned above has a head of convex shape and the opposing main contact has a recess of concave configuration to snugly fit with the head of the arc-cutting contact.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will become more obvious from the following description when taken in conjunction with the accompanying drawings which show, for purposes of illustration only, a preferred embodiment in accordance with the present invention, and wherein:

FIG. 1 is a partially sectioned side elevation of the electromagnetic switch device according to the present invention;

FIG. 2 is a fragmentary vertical cross-section, on an enlarged scale, of the main and arc-cutting contacts of the present invention showing the main contacts in a slightly opened position; and

FIG. 3 is a view similar to FIG. 2, but showing the main contacts in a closed position.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the accompanying drawings wherein like reference numerals are used throughout the various figures to designate like parts, and more particularly to FIG. 1, the reference numeral 1 designates an electromagnet securely mounted on a base plate member and having a fixed iron core 3 inserted in a coil winding 2 along the longitudinal axis thereof. There is shown at 4 an arm member movably mounted on a bracket 5 of a conductive material for pivotal movement toward and away from the fixed iron core 3 of the electromagnet 1. The movable arm member 4 is normally urged away from the iron core 3 by means of a tension spring 6 which is connected at one end thereof to the rear end of the movable arm member 4 and at the other end to a flange provided on the conductive bracket 5. The movable arm member 4 is further provided with an extension strip member 7 having a movable main contact 8 at the fore end portion thereof. The movable main contact 8 has a recess or bore 9 in the central portion thereof for receiving a retractable arc-cutting contact 11 which is normally held in a projected position by means of a spring 10. There is provided a fixed main contact 12 beneath the movable main contact 8 for engagement therewith. The fixed contact 12 is securely mounted on a bracket 13 of conductive material and has a recessed or concaved contact surface 14 in the central portion thereof for engagement with the arc-cutting contact 11. A through hole 15 is formed in the fixed contact 12 and communicates with the central portion of the recessed concave contact surface 14.

With the switch device of the present invention, when the coil 2 of the electromagnet is energized and the movable arm member 4 is attracted by the iron core 3 against the tension of the spring member 6, the arc-cutting contact 11 comes into contact with the recessed concave contact surface 14 of the fixed main contact

12 as shown in FIG. 2 before the movable contact 8 engages with the fixed contact 12 as shown in FIG. 3, thus closing the switch. On the other hand, if the coil 2 is deenergized, the movable main contact 8 disengages from the fixed main contact 12 before the disengagement of the arc-cutting contact 11 from the recessed concave contact surface 14.

The arc-cutting contact 11 which is normally held in the protruded position by the spring may be alternatively provided on the side of the fixed contact 12. In such a case, the same on- and off-operation may be effected as described hereinabove. The recessed contact surface 14 may be covered with an arc-resistant metal chip.

The arc discharge is generally produced in an increased amount at the time of opening of the switch than at the time of closing of the same. According to the present invention, when the movable main contact 8 is disengaged from the fixed contact 12, the arc-cutting contact 11 is still in contact with the concave contact surface 14 allowing the current to flow therethrough. Therefore, no arc is produced at this stage. Only a small amount of arc is produced at the time when the arc-cutting contact 11 is disengaged from the fixed contact 12.

It is preferred to use silver as a material of a contact in an electromagnetic switch having opposed contacts. However, this material easily lends itself to the burning loss due to an arc discharge and therefore is usually used in the form of an alloy added with W, Cu, Cd and the like. Such alloy, however, has a disadvantage that it is oxidized by the arc and produces heat due to increased contact resistance. With the switch construction of the present invention, arc is produced in a slight amount only at the arc-cutting contact 11, so that it is possible to form only the arc-cutting contact 11 by an arc resistant metal and the others by silver to obtain improved contacts with remarkably reduced burning losses, oxidation and heat generation and with increased durability. Furthermore, according to the present invention, the arc-cutting contact may be provided either on a side of the movable contact 8 or fixed contact 12 and is normally held in a protruded position by means of a spring, so that the arc-cutting contact 11 invariably comes into contact with one of the opposed main contacts prior to the engagement thereof at a time of the on-operation of the switch and comes out of contact with the one of the opposing main contacts after disengagement thereof at a time of off-operation of the switch.

It will be understood from the foregoing that, according to the present invention, a contact of compact construction is obtained, so that the electromagnetic switch of the present invention may be easily inserted into various kinds of circuits. The present electromagnetic switch further has an advantage of durability sufficient for opening and closing operation of large amount of current.

While there has been shown and described a preferred embodiment of the present invention, it is understood that the same is not limited thereto, but is susceptible of many changes and modification within the apirit and scope thereof and it is not intended to limit to the details shown and described herein but to cover all such changes and modifications as are encompassed by the scope of the appended claims.

What is claimed is:

1. An electromagnetic switch device comprising a base plate member; an electromagnet securely mounted on said base plate member by means of a conductive bracket and including a coil winding and a fixed iron core inserted in the coil winding along the longitudinal axis thereof; a movable arm member pivotally mounted on said conductive bracket, adapted to be attracted by said iron core upon energization of the coil and provided with an extension connected to the fore end portion thereof; said movable arm member being normally biased away from the iron core by means of a spring; a movable main contact provided in the fore end portion of said extension; a fixed main contact provided on a conductive bracket securely mounted on the base for engagement with said movable main contact; a retractable arc-cutting contact provided on one of the main contacts and being normally protruded outwardly beyond the contacting surface of the one main contact in which it is provided by means of a spring, so that the arc-cutting contact comes into contact with the other main contact prior to the engagement of the main contacts, through which the switch is in on-condition, and comes out of contact with the other main contact after disengagement of the main contacts by which said switch is brought into off-condition; said one main contact having a bore formed therein and communicating with the contacting surface of said one main contact, said arc-cutting contact being slidably disposed within said bore and said spring also being disposed within said bore and resiliently urging said arc-cutting contact outwardly of said bore so that a portion thereof normally protrudes beyond said contacting surface, the protruding portion of said arc-cutting contact having a convex configuration, and said other main contact having a recess formed therein and communicating with the contacting surface of said other main contact, said recess being adapted to receive therein the protruding portion of said arc-cutting contact prior to engagement of the contacting surfaces of said main contacts.

2. An electromagnetic switch device as claimed in claim 1, wherein the arc-cutting contact has a head of convex shape while the main contact engageable with the arc-cutting contact has a recess of concave configuration.

3. An electromagnetic switch device as claimed in claim 2 wherein a surface of said recess is covered with an arc resistant metal.

4. An electromagnetic switch device as claimed in claim 2, wherein the head of the arc-cutting contact is made of an arc resistant material.

5. An electromagnetic switch device according to claim 1, wherein said other main contact has a through hole formed therein, one end of said hole communicating with the central portion of said recess so that oxidized metal particles formed as a result of arcing may pass through said hole to maintain the contacting surface of said recess clean.

6. An electromagnetic switch device, comprising base means, electromagnetic means mounted on said base means and including a core;

conductive arm means disposed adjacent said electromagnetic means, and means mounting said conductive arm means for movement relative to said electromagnetic means between a first position wherein said arm means is attracted to said core and a second position wherein said arm means is

spaced from said core, and biasing means coacting with said arm means for normally maintaining same in said second position;

a first main contact mounted on said conductive arm means for movement therewith;

a second main contact disposed opposite said first main contact, and conductive means mounting said second main contact securely on said base means, said first and second main contacts having opposed contacting surfaces which are adapted to be moved into engagement with one another;

one of said main contacts having a recess formed therein and communicating with the respective contacting surface, an arc-cutting contact slidably disposed within said recess, and spring means disposed within said recess for normally urging said arc-cutting contact so that at least a portion thereof protrudes outwardly of said recess beyond the respective contacting surface, the protruding portion of said arc-cutting contact having a substantially convex external configuration;

the other main contact having a concave recess formed therein and communicating with the respective contacting surface of said other main contact, said recess being disposed opposite the protruding portion of said arc-cutting contact so as to receive said protruding portion therein as said main contacts are relatively moved toward one another, said other main contact further having a through hole formed therein with one end of the through hole communicating with the central portion of said recess, whereby oxidized particles caused by arcing pass through said hole;

whereby movement of said main contacts toward one another causes the protruding portion of said arc-cutting contact to engage the surface defining said recess before said contacting surfaces engage one another, and whereby the protruding portion remains in engagement with the surface defining said recess after the opposed contacting surfaces have been moved out of engagement with one another.

7. A switch device according to claim **6**, wherein said first and second main contacts each comprise blocklike members, said recess and said through hole as formed in said other main contact being disposed in the central portion of said blocklike member so that said recess is disposed near the center of the respective contacting surface, and wherein the recess as formed in said one main contact is also positioned centrally thereof and communicates with the respective contacting surface substantially in the center thereof.

8. A switch device according to claim **7**, wherein said one main contact is disposed above said other main contact, and said through hole as formed in said other main contact extending substantially vertically so that the oxide particles caused by arcing freely fall through said hole.

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