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EUROPEAN PATENT APPLICATION

21 Application number: 90303752.1

51 Int. Cl.⁵: H01H 50/08, H01H 9/16

22 Date of filing: 09.04.90

30 Priority: 14.04.89 JP 96084/89
30.08.89 JP 101622/89 U

43 Date of publication of application:
17.10.90 Bulletin 90/42

54 Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI NL SE

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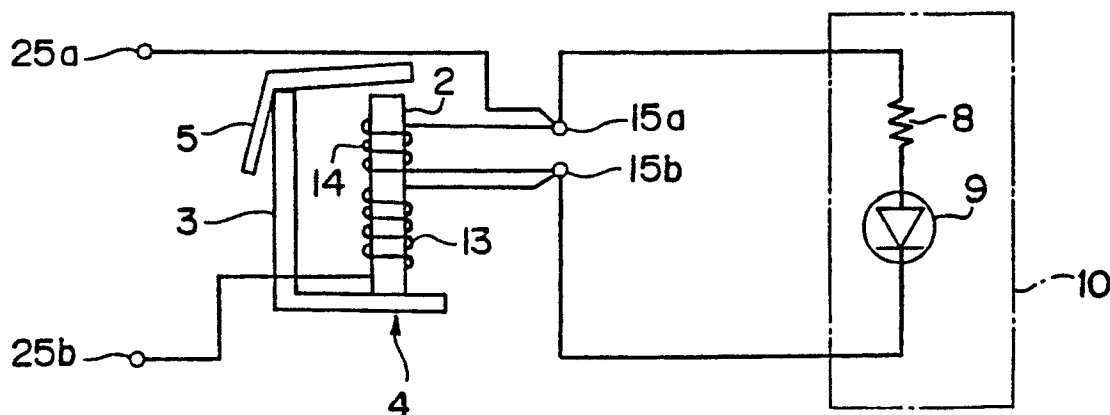
54 Operation display apparatus for electromagnetic relay.

57 An operation display apparatus for an electromagnetic relay, wherein the division voltage corresponding to the impedance ratio between the primary coil and the secondary coil is applied upon the operation display circuit so as to effect the display operation, and when the primary coil is disconnect-

ed, the operation display circuit does not operate, because the current does not flow even into the secondary coil, and the brightness of the light emitting element of the operation display circuit changes, because the voltage to be applied upon the operation display circuit changes.

Fig. 1

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OPERATION DISPLAY APPARATUS FOR ELECTROMAGNETIC RELAY

The present invention generally relates to an operation display apparatus for an electromagnetic relay which is adapted to apply a direct current voltage upon an operation coil.

Generally, the electromagnetic relay is composed, as shown in Fig. 8, of an electromagnet 4 having a L-shaped yoke 3 secured onto one end of an iron core 2 with a primary coil 1 for excitation use being wound around it, a L-shaped movable iron piece which is supported by the tip end of the yoke 3, and is provided for its free oscillating operation in accordance with the excitation and the non-excitation of the electromagnet 4, and a contact mechanism not shown to be driven by the movable iron piece 5.

This type of electromagnetic relay has an operation display apparatus disposed, where a secondary coil 6 for the operation display use, separately from the primary coil 1, is wound around the iron core 2 of the electromagnet 4, an operation display circuit 10 composed of a current limit resistor 8 and a light emitting diode 9 is connected, in parallel to the secondary coil 6, with the coil terminals 7a, 7b of the secondary coil 6.

Since the voltage is caused on the secondary coil side through the induction by the change in the magnetic field to be caused in the iron core 2 when the alternating current voltage is applied upon the primary coil 1 to effect the operation, the light emitting diode 9 of the operation display circuit 10 is lit by the voltage on the side of the secondary coil 6 so as to effect the operation display.

But if an operation display apparatus which is similar in construction to the electromagnetic relay for alternating current use in the electromagnetic relay which applies the direct current voltage upon the operation coil, the magnetic field which is caused in the iron core by the energization into the primary coil becomes constant and the electromotive voltage is not caused in the secondary coil, so that the current does not flow into the operation display circuit and the operation display is not effected.

Conventionally, the operation display apparatus for the electromagnetic relay for direct current use has the operation display circuit 10 connected, in parallel to the exciting coil 11, with the coil terminals 12a, 12b of the exciting coil 11 as shown in Fig. 9.

But in the operation display apparatus for the electromagnetic relay for the direct current use like this, the current flows into the operation display circuit 10 even if the operation is not effected due to the disconnection in the exciting coil 11 so as to light the light emitting diode 9, because the opera-

tion display circuit 10 and the exciting coil 11 are in parallel to each other, with a problem that the correct operation display is not effected.

Also, since the exciting voltages into the coil terminals 12a, 12b are applied as they are upon the operation display circuit 10, an operation display circuit 10 which is different in the resistance value has to be provided for each of the electromagnetic relays different in the rated value of the exciting voltage, thus resulting in the lower productivity, with a problem that the light emitting diode 9 goes wrong upon the application of the high voltages such as surge voltage and so on upon the operation display circuit 10, or the like.

Accordingly, the present invention has been developed with a view to substantially eliminating the above discussed drawbacks inherent in the prior art operation display apparatus for the electromagnetic relay, and for its essential object to provide an improved operation display apparatus for the electromagnetic relay taking advantage of the merits of the prior art operation display apparatus.

Another important object of the present invention is to provide an improved operation display apparatus for the electromagnetic relay of the type referred to above, which is capable of reliable operation display, is better in productivity, and further, is less wrong in operation.

In accomplishing these and other objects, according to one preferred embodiment of the present invention, the exciting coils are divided between the primary coil and the secondary coils for winding around the iron core so as to effect the series connection of the primary coil and the secondary coil, and also, the operation display circuit having the light emitting element is connected in parallel to the secondary coil.

Also, the present invention has the secondary coil of the invention in accordance with the claim 1 wound on the inner side from the primary coil.

In accordance with the construction of the above described invention, the division voltage corresponding to the impedance ratio between the primary coil and the secondary coil is applied upon the operation display circuit so as to effect the display operation.

When the primary coil is disconnected, the operation display circuit does not operate, because the current does not flow even into the secondary coil. Also, when the secondary coil is disconnected, the brightness of the light emitting element of the operation display circuit changes, because the voltage to be applied upon the operation display circuit changes.

Also, according to the construction of the present invention, since the secondary coil is wound on the inner side where the deterioration is likely to be effected with the temperature being highest, the secondary coil is first deteriorated into the disconnection because of the years of use so as to change the brightness of the light emitting element of the operation display circuit.

Furthermore, the present invention provides the electric connection construction of the coil terminal, in which large initial stress is not caused, and the break away of the welded portion, the crack of the spool, and the broken rupture of the coil trunk terminal are not caused. Therefore, in the electric connection construction of the coil terminal, wherein the outgoing wire of the coil wound around the drum of the spool is bound on the basic portion of the coil trunk terminal projected from the flange portion of the spool so as to effect the electric connection, and also, the free end portion of the coil trunk terminal is integrated through the welding with the coil terminal to be projected from the top face of the base with the spool being placed on it, the free end portion of the coil trunk terminal is made long into a bent shape, and also, the tip end portion thereof is integrated through the welding with the coil terminal.

These and other objects and features of the present invention will become apparent from the following description taken in conjunction with the preferred embodiment thereof with reference to the accompanying drawings, in which;

Fig. 1 is a circuit diagram of the operation display apparatus in accordance with the present invention;

Fig. 2 is a perspective view of an electromagnetic relay provided with an operation display apparatus in accordance with the present invention;

Fig. 3 through Fig. 5 show one embodiment of the electric connection construction of a coil terminal in accordance with the present invention;

Fig. 3 is a perspective view showing the connection condition;

Fig. 4 is an enlarged perspective view of the essential portions thereof;

Fig. 5 is an enlarged side view of the essential portions thereof;

Fig. 6 is a perspective view of the completed coil apparatus;

Fig. 7 is an illustrating view showing a method of assembling the coil apparatus;

Fig. 8 is a circuit diagram of the operation display apparatus of the conventional electromagnetic relay for alternating current use; and

Fig. 9 is a circuit diagram of the operation display apparatus for the conventional electromagnetic relay for the alternating current use.

Before the description of the present invention proceeds, it is to be noted that like parts are designated by like reference numerals throughout the accompanying drawings.

Referring now to the drawings, there is shown in Fig. 1, a circuit diagram for the operation display apparatus in accordance with the present invention according to one preferred embodiment of the present invention, wherein the exciting coils are divided between the primary coil 13 and the secondary coil 14 so as to be wound around the iron core 2, both the ends of the secondary coil 14 are connected with trunk portions 15a, 15b to effect the series connection of the primary coil 13 and the secondary coil 14 through the trunk portion 15b, and also, the operation display circuit 10 is connected in parallel to the trunk portions 15a, 15b.

Fig. 2 shows an electromagnetic relay provided with an operation display apparatus composed of the circuit construction.

The electromagnet 4 is secured so that the iron core 2 (not shown) may become parallel to the base 16 by the pressure insertion of the yoke 3 into the base 16. An operation display circuit retaining block 17 with a current limiting resistor 8 and an light emitting diode 9 being retained thereon is mounted on the top face of the yoke 3 by the hook 18.

The movable iron piece 5 is supported for its free oscillating operation in engagement with the tip end of the yoke 3, and also, is urged in a direction being separated from the pole face of the iron core 2 (not shown) by the coil spring 19. A pair of movable contact pieces 20, 20 having the movable contact are mounted on the movable iron piece 5. The movable contact pieces 20, 20 are connected by wire harnesses 22, 22 with the movable contact terminals 21, 21 secured onto the base 16. The movable contact of the movable contact pieces 20 and 20 is adapted to be located between the normal open contact of the stationary terminals 23, 23 on the normally open side secured onto the base 16 and the normally closed contact of the stationary terminals 24, 24 on the normally closed side.

The primary coil 13 or the secondary coil 14 is wound around the iron core 2 (not shown) so that the secondary coil 14 may become inside. The outgoing wire 13a of one end of the primary coil 13 is connected with the trunk portion 15b of tip end of the lead piece 9a of the light emitting diode 9, and the outgoing line 13b of the other end is connected with the coil terminal 25b secured to the base 16. Also, the outgoing line not shown at one end of the secondary coil 14 is connected with the trunk portion 15a (not shown) of the tip end of the lead piece 8a of the current limiting resistor 8, and the outgoing wire 14b of the other end is con-

nected with the trunk portion 15b. Furthermore, the trunk portion 15a (not shown) of the tip end of the lead piece 8a is connected with the coil terminal 25a (not shown).

When the direct current voltage is applied upon between the coil terminals 25a, 25b to excite the primary coil 13 and the secondary coil 14 in the electromagnetic relay, the movable iron piece 5 is adsorbed on the iron core to drive the movable contact pieces 20, 20, so that the normally closed contact is opened, and the normally open contact is closed.

At the same time with it, the division voltage corresponding to the impedance ratio between the primary coil 13 and the secondary coil 14 is applied upon the operation display circuit 10 through the trunk portions 15a, 15b. Thus, it is confirmed that the light emitting diode 9 emits the light, and the electromagnetic relay is in the operating condition.

Suppose the primary coil 13 has been connected, and the current does not flow even into the secondary coil 14, needless to say the primary coil 13, so that the electromagnetic relay does not operate, and the light emitting diode 9 does not emit its light, either. Therefore, the operation display in conformity with to the operation of the electromagnetic relay is effected.

Also, assume that the secondary coil 14 has been disconnected, and the brightness of the light emitting diode 9 changes, because the voltage to be applied upon the operation display circuit 10 changes. Therefore, it can be detected that the secondary coil 14 has been gone wrong.

In the present embodiment, since the secondary coil 14 is wound on the inner side closer to the iron core 2 than to the primary coil 13, the temperature is higher so that the deterioration is likely to be effected. Therefore, first, the secondary coil 14 is deteriorated because of the years' use and the impedance of the secondary coil 14 is lowered, so that the division voltage ratio is lowered to reduce the voltage into the operation display circuit 10 so as to decrease the brightness of the light emitting diode 9. Therefore, the deterioration condition of the coil, namely, the service life thereof may be predicted, so that the trouble due to the burning or the like of the coil may be prevented, thus resulting in safety.

Even if the electromagnetic relay is different in the rated value of the exciting voltage, the division voltage of the secondary coil 14, namely, the voltage into the operation display circuit 10 may be made constant by the adjustment of the number of the turns or the like of the secondary coil 14. Therefore, if the operation display circuit 10 is kept manufactured as one type of component as shown in the operation display circuit retaining block 17 as

shown in Fig. 2, it may be engaged with even in any electromagnetic relay different in the exciting voltage, so that the number of the components may be reduced, and the productivity may be improved. Therefore, if the division voltage of the secondary coil 14 is lowered, unless the conventional operation display apparatus, the voltage to be applied upon the operation display circuit 10 may be lowered. Thus, the high voltage such as surge voltage or the like to be applied upon between the coil terminals 25a, 25b is not applied upon the light emitting diode 9, thus resulting in no possibility of troubles. Also, if it is a coil which effects the high tension operation, the consumption power of the current limiting resistor 8 may be made smaller.

As is clear from the foregoing description, according to the arrangement of the present invention, the reliable operation display corresponding to the operation of the electromagnetic relay is effected, because the light emitting element does not emit its light if the coil is disconnected.

Also, the self-examination may be effected about the abnormality such as disconnection of the secondary coil or the like through the changes in the brightness of the light emitting element.

The coping operation may be effected, without change in the operation display circuit, by the change or the like in the number of turns of the secondary coil with respect to the electromagnetic relay of the different excitation voltage specification. Thus, the components for the operation display circuit use may be standardized so as to improve the productivity.

Further, since the voltage to be applied upon the operation display circuit may be reduced by the reduction of the division voltage of the secondary coil, with effects that the troubles are reduced in number, and the consumption power may be reduced.

Especially, according to the present invention, the service life may be predicted by the brilliance change of the light emitting element, with an effect that the troubles caused by the coil burning or the like may be prevented, thus resulting in safety.

The electric connection construction of the coil terminal will be described hereinafter in one embodiment with reference to Fig. 3 through Fig. 7.

As shown in Fig. 3 through Fig. 7, a coil 14 is wound around the drum portion 2 of a spool 30 with flange portions 31, 32 being provided at both the ends thereof. The outgoing wires 14a, 14a thereof are respectively bound on the basic portions 35a, 35a of a pair of coil trunk terminals 35, 35 projected from the flange portion 3 so as to effect the electric connection therebetween. The free end portions 35b, 35b of the coil trunk terminals 35, 35 bent from the basic portion 35a are

integrated respectively through the welding with the top end face of the coil terminal 41 (the coil terminal on the interior side is not shown) to be projected from the top face of the base 40 to effect the electric connection between them. The free end portion 35b of the coil trunk terminal 35 is flexed downwardly by the height size H of the projection portion 36, and is integrated through the welding with the top end face of the coil terminal 41.

In the present embodiment, the free end portion 35b of the coil trunk terminal 35 to be projected from the collar portion 32 of the spool 30 is longer than in the conventional embodiment, and is bent.

Namely, the free end portion 35b of the coil trunk terminal 35 has an approximately C-shaped plane, with the projection for welding use 36 being provided on the under face of the tip end portion 35c thereof.

Therefore, if the projection for welding use 36 is welded with the top end face of the coil terminal 41, and is electrically connected therebetween with the tip end portion 35c being flexed by the height size H of the projection portion 36, the spring constant of the free end portion 35b is smaller, and the spring force of the free end portion 35b to be caused when the welding integration has been effected becomes smaller than in the conventional example, because the substantial distance from the basic portion 35a of the coil trunk terminal 35 to the tip end portion 35c is longer than in the conventional example. Furthermore, as the straight line distance from the welding tip end portion 35c to the basic portion 35a is almost similar to the conventional example, the bending moment to be caused when the welding integration has been effected is smaller than in the conventional example, coupled with the smaller spring force of the free end portion 35b as described hereinabove.

Accordingly, since the initial stress to be caused in the free end portion 35b of the coil trunk terminal 35 is smaller than in the conventional example, if the projection portion 36 of the tip end portion 35c is integrated through the welding with the upper end portion of the coil terminal 41, the breaking away of the welding portion, the crack in the flange portion 32 of the spool 30, and the bending rupture of the coil trunk terminal 35 are not caused. Although in the above described embodiment, a case has been described where the free end portion of the coil trunk terminal has an approximately C-shaped plane in the above described embodiment, the shape is not always restricted to the above description, it will do if only the substantial length of the free end portion is long, the shape is not especially restricted to it. Also, the basic portion of the coil trunk terminal is not always required to be bent.

As is clear from the foregoing description, according to the arrangement of the present invention, since the member length from the basic portion of the coil trunk terminal to the tip end portion thereof is substantially long, the flexibility per unit length is relatively smaller and the spring force to be caused when the welding integrating operation has been effected becomes smaller if the flexibility of the tip end portion is constant. Furthermore, as the free end portion is flexed, the straight line distance from the basic portion to the operation point where the external force is loaded does not become long. The bending moment to be caused in a case where the welding integrating operation has been effected is smaller than in the conventional example, coupled with the smaller spring force of the free end portion as described hereinabove.

Therefore, since the initial stress to be caused in the free end portion of the coil trunk terminal is smaller than in the conventional example even if the welding integration is effected with the upper end portion of the coil terminal with the tip end portion of the free end portion being bent by the constant size, the welding portion is hard to break away, with an effect that the flange portion of the spool and the coil trunk terminal are not broken.

Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be noted here that various changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention, they should be construed as included therein.

Claims

(1) An operation display apparatus for an electromagnetic relay comprising a coil including a primary coil and a secondary coil to be wound around an iron core so as to effect the series connection of the primary coil and the secondary coil; and

an operation display circuit having a light emitting element, said circuit being connected in parallel to the secondary coil.

(2) An operation display apparatus for an electromagnetic relay described in accordance with the claim 1, wherein the secondary coil is wound on the inner side from the primary coil.

(3) An electric connection construction of a coil terminal wherein an electric connecting is effected with the basic portion of the coil trunk terminal projected from the flange portion of the spool with the outgoing wire wound around the drum portion of the spool being flexed, and also, the free end

portion of the coil trunk terminal is integrated through the welding with the coil terminal to be projected from the top face of the base with the spool being placed on it, wherein the free end portion of the coil trunk terminal is made longer and is bent in shape, and also, the tip end portion thereof is integrated through the welding with the coil terminal.

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Fig. 1

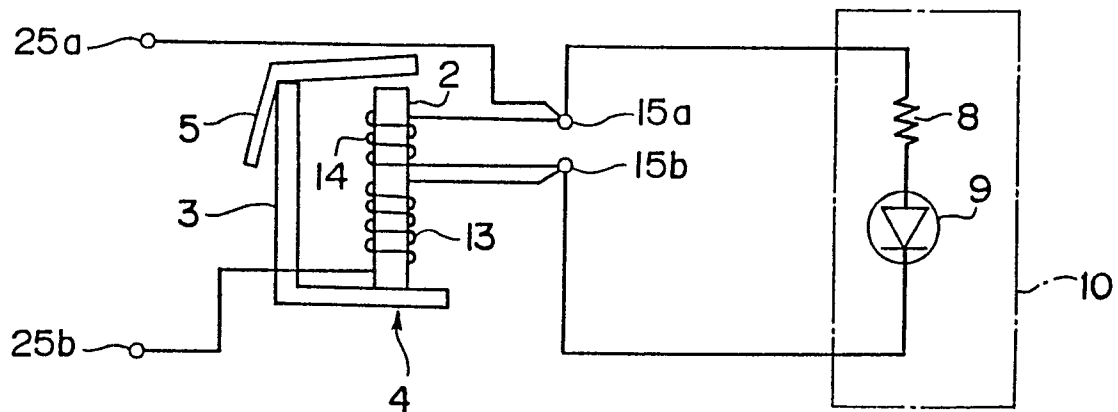


Fig. 2

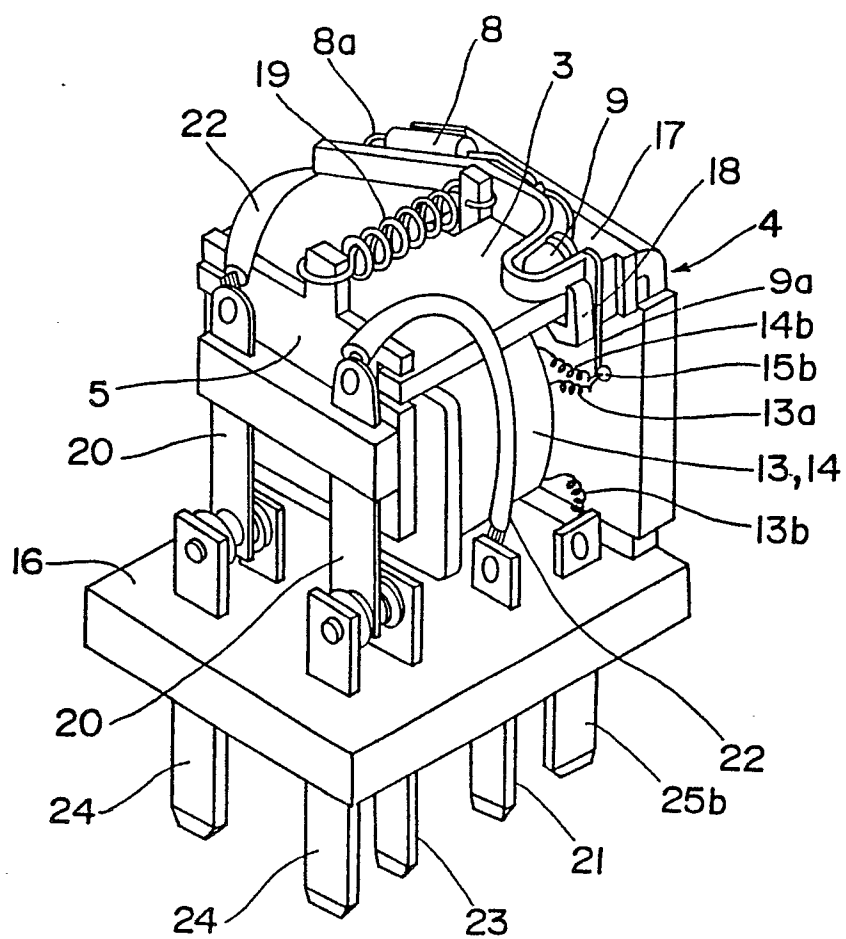


Fig. 3

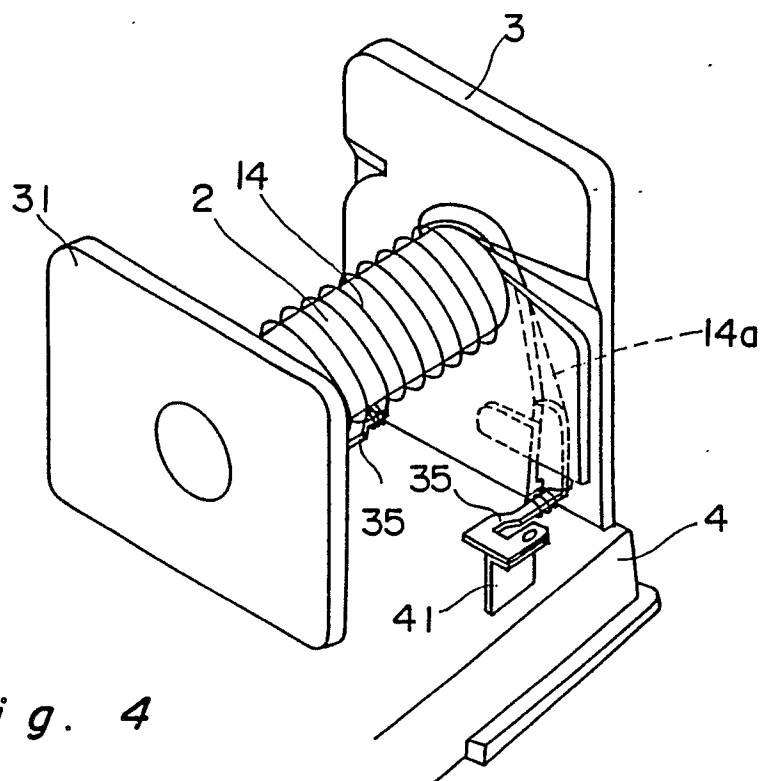


Fig. 4

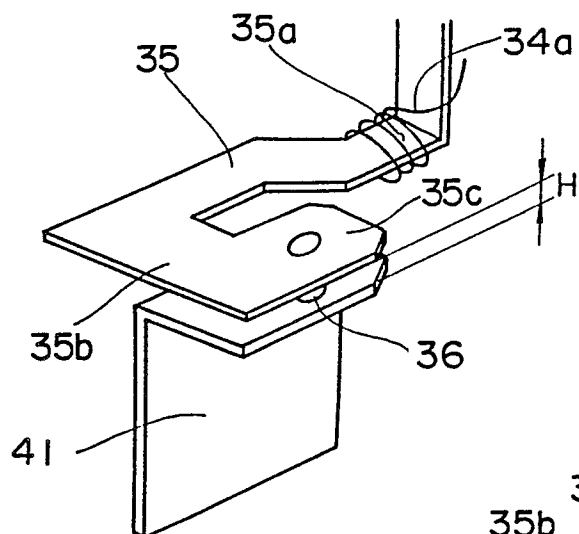


Fig. 5

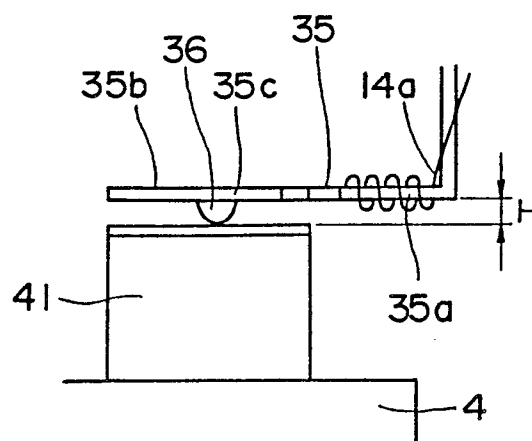


Fig. 6

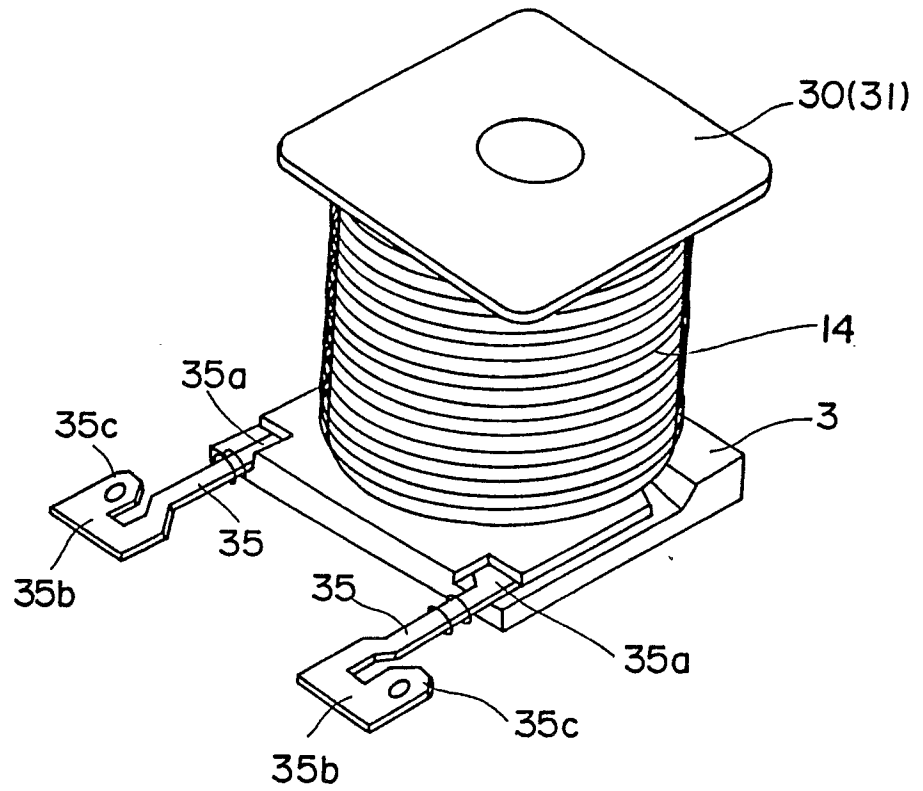


Fig. 7

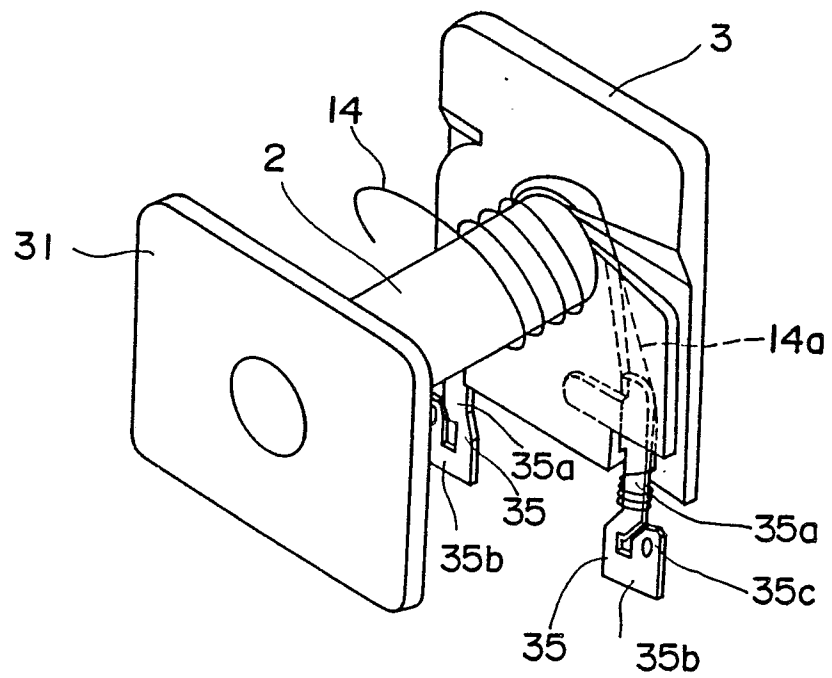


Fig. 8
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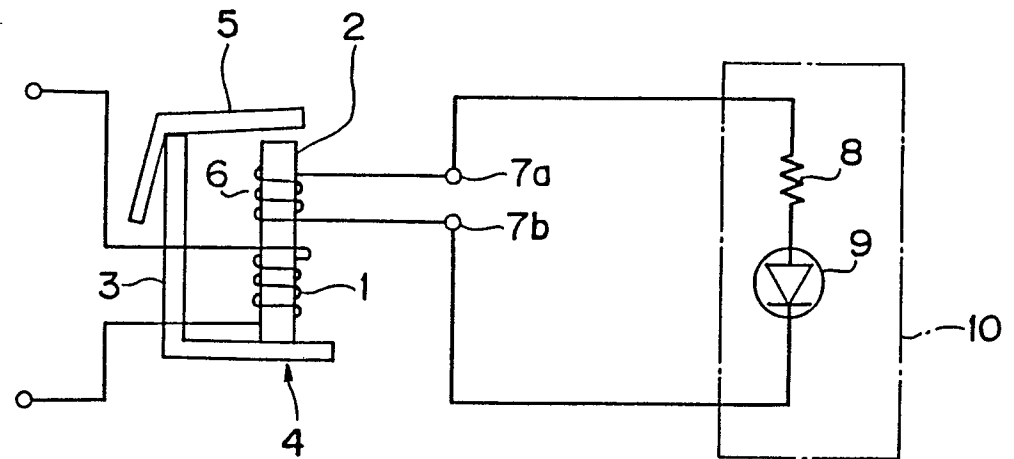


Fig. 9
PRIOR ART

