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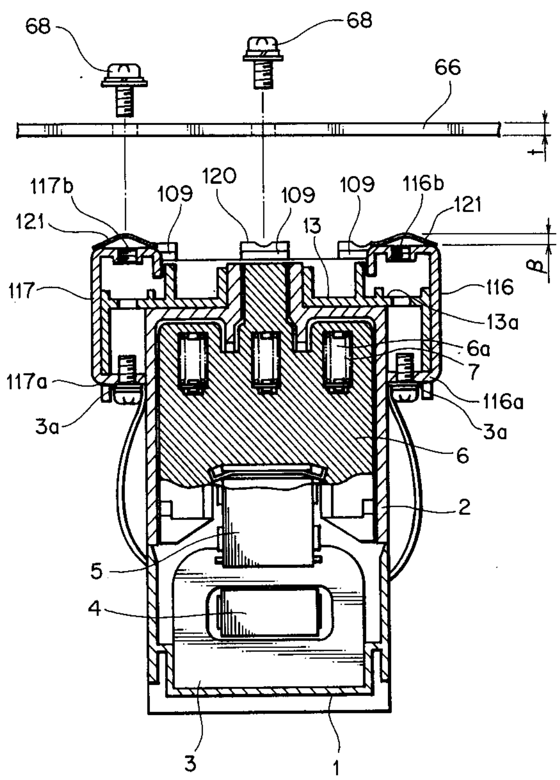
(54) Electromagnetic contactor.

(57) In an electromagnetic contactor, an electromagnet having an exciting coil, a contact apparatus driven for switching by the electromagnet, a fixed terminal board having fixed contacts of the contact apparatus at one end and having a terminal screw engaging portion at other end, and a coil terminal board having a lead wire of the exciting coil connected to one end and having a terminal screw engaging portion at other end are incorporated in a case. The fixed terminal board and the coil terminal board are arranged at the terminal screw engaging side horizontally on the upper surface of the case, and plate springs are installed on the upper surface of the fixed terminal board and the coil terminal board. Or at least one of the fixed terminal board and the coil terminal board is of floating structure so that the terminal height is moved upwards and downwards to other terminal height.

FIG. 1



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BACKGROUND OF THE INVENTION

Field of the Invention:

The present invention relates to an electromagnetic contactor which makes it possible to rationalize a wiring through connection to a printed wiring board.

Description of the Prior Art:

FIG. 10 is a sectional view showing constitution of an electromagnetic contactor in the prior art. In FIG. 10, numeral 1 designates a stand for installation, numeral 2 designates a case, and numeral 3 designates an exciting coil. A fixed iron core 4 is located opposite to a movable iron core 5 with a constant gap. A crossbar 6 constituted by insulating material is connected to the movable iron core 5, and holds a movable contact 8 ready to slide at an upper window 6a. The crossbar 6 is introduced slidingly through the case 2 in order to be able to make up-and-down motion in FIG. 10 (not shown).

A contact spring 7 is provided in order to give a contact pressure to the movable contact 8, and is constituted by compression coil spring. Movable contact tips 8a, 8b are mounted on both ends of the movable contact 8, and are located oppositely to fixed contact tips 9a, 10a with specified contact gaps.

Numerals 9, 10 designate fixed contacts respectively each bonded with the fixed contact tips 9a, 10a on the one end, and terminal screws 11 and 12 are screwed and connected on the other end. An arc cover 13 has metallic arc runners 14, 15 fixed on the inside, and extinguishes arc generated between the contact tips.

Coil terminals 16, 17 are located at both ends of the exciting coil 3. Lead wires, at the beginning and the end of winding, are connected to the coil terminals 16, 17 and terminal screws 18, 19 are screwed into and connected to the ends. Numeral 20 designates a spring for release which is located and installed to boost upwards a combination body of the crossbar 6 and the movable iron core 5 in FIG. 10.

Next, operation will be explained. When voltage is applied to the exciting coil 3, the generated magnetic flux causes attraction between the fixed iron core 4 and the movable iron core 5. According to this attraction, the combination body of the movable iron core 5 and the crossbar 6 moves downwards in FIG. 10 against the energy of the release spring 20. According to this movement, the movable contact tips 8a,8b abut on the fixed contact tips 9a, 10a. At this point, as iron core gap with the open condition of FIG. 10 is made larger than that of contact tips the crossbar 6 moves down lower than the above-mentioned abutting position of the contact tips and contact wipe can be obtained, and the contact spring 7 will be compressed and the compression force is applied to the movable iron contact 8 to generate the contact pressure. Thus the shutting operation of the contact tips will be completed.

Next, eliminating the impressed voltage of the exciting coil 3, attraction will disappear between the movable iron core 5 and the fixed iron core 4, and the combination body of the movable iron core 5 and the crossbar 6 will be moved upwards by the energy of the release spring 20 and the contact tips will open. At this time, arc generated between the contact tips is attracted and cooled to the arc runners 14, 15 and extinguished. Thus, a disconnecting operation of the contact tips will be completed.

FIG. 11 is a circuit diagram showing the application of the above-mentioned electromagnetic contactor to a semiconductor circuit device wired by a printed wire board, for example, an inverter. In FIG. 11, numeral 51 designates a diode module converting 3-phase a.c. of commercial frequency into d.c. (converter portion), numeral 52 designates a transistor module converting d.c. into 3-phase a.c. of the desired frequency, numeral 53 designates a smoothing capacitor, numeral 54 designates a source-side terminal, numeral 55 designates a load-side terminal, and numeral 56 designates a control device controlling the operation of the transistor module 52.

Also numeral 57 designates a rush current limiting resistor which is necessary only at the time of starting the inverter and is short-circuited by a short-circuit contact tip 58 when operating, because of the voltage drop of this resistor at the operation. In the inverter, the above-mentioned electromagnetic contactor in FIG. 10 is used as this short-circuit contact tip 58.

As an example of such an inverter circuit as wired and constructed by a printed board, "Semiconductor Circuit Device" is disclosed in Japanese utility model application laid-open No. 83292/1985.

FIG. 12 is a sectional view showing constitution of a semiconductor circuit device being disclosed in the above bulletin. In FIG. 12, the same reference numerals as those in FIG. 11 designate the same parts. Numeral 59 designates an inverter base supporting main circuit parts 51, 52, 53 and the like on the inside surface, numeral 60 designates a heat dissipating fin reducing the temperature rise of each of the parts 51 - 53 due to the currents of main circuits, and numeral 66 designates a main circuit wiring board (printed board) wired by wiring to connect the main circuit parts 51, 52, 53, and fixed to respective terminal 67 of the main parts 51, 52, 53 by a screw 68. Numeral 70 designates a control circuit wiring board (printed board) which carries a control device 56 and is bonded electrically and mechanically to the main circuit wiring board 66 by a connector 69. Numeral 65 designates a front cover of inverter to close the opening of the inverter base 59.

This bulletin does not disclose the details regarding the situation of application of the electromagnetic contactor, but the electromagnetic contactor is provided in such constitution that the main circuit wiring board 66 disclosed in FIG. 12 is fixed to each terminal 67 of the main circuit parts 51 - 53 by the screw 68.

FIG. 13 is a constitution illustration showing the details of application form of an electromagnetic contactor in the prior art. In FIG. 13, numeral 30 designates an electromagnetic contactor shown in FIG. 10, whose fixed contacts 9, 10 are provided with main circuit terminal boards 31, 32 extended by screw for connection to a main circuit wiring board 66 located on the upper surface of the electromagnetic contactor. Coil terminals 16, 17 are provided with coil terminal boards 33, 34 extended as well. Respective terminal boards 31 - 34 are provided with female screws 31a - 34a, and the main circuit and the exciting coil of the electromagnetic contactor 30 are connected by a screw 68 being clamped through the main circuit wiring board 66 to the female screws 31a - 34a.

The electromagnetic contactor 30 connectable to the printed board in the prior art is constructed as above described, and the main circuit wiring board 66 in FIG. 13 is in structure generally called power printed board in order to carry large current in the main circuit.

FIG. 14 is a perspective view showing constitution of a power printed board, and FIG. 15 is a sectional view taken in line X-X of FIG. 14. In these diagrams, a wiring pattern 66a is formed by normal manufacturing process (pattern manufacturing process by etching of copper clad laminated board) of a printed board. A wired conductor 66b is punched out from such good conductor as copper plate into the approximately same shape as the wiring pattern 66a. The wired conductor 66b is bonded electrically and mechanically by such means as soldering with the wiring pattern 66a, and makes it possible to carry the main circuit current which could not be carried only by the wiring pattern 66a.

Also numeral 66c designates a laminated portion of the copper-covered lamination board, which has a property of shortening its dimension caused by shrinkage due to seasoning by the heat dissipated by carriage of the main circuit current, as this portion is a laminated board generally made of thermosetting resin. That is, the thickness of board t is lessened. Lessening of the thickness of board causes the screw 68 (see FIG. 13) to work loose, and the contact resistance between the main circuit wiring board 66 and the main circuit terminal boards 31, 32 becomes higher, and further this portion is heated and has a possibility of resulting in burnout in the worst case.

The upper surfaces of the main circuit boards 31, 32 should be flush with each other, but when the difference in the terminal height due to the variance of the part manufacturing exists and their upper surfaces are not parallel to the main circuit wiring board 66, there has been the problem that there is possibility of heating and burnout due to the high contact resistance with the main circuit wiring board 66 similarly to the above case.

SUMMARY OF THE INVENTION

An object of the present invention is to solve the above-mentioned problems in the prior art and to acquire an electromagnetic contactor suitable for printed board connection, which solves the problem of the differences in terminal height due to part processing variation, and the problem of heating caused by the contact resistance increase due to the inclination of the terminal upper surface or the seasoning of the printed board, and is able to maintain the reliability of connection to the main circuit wiring board.

Another object of the present invention is, in addition to the above-mentioned object, to acquire an electromagnetic contactor suitable for printed board connection, which can be clamped and connected without applying bending force to the printed board, even in the case of the terminal height difference due to the part processing variance, terminal height difference due to intervention of surge absorber terminal, height difference due to wiring conductor of the both sides power printed board.

In an electromagnetic contactor relating to the present invention, terminal screw engaged part of a fixed terminal board and a coil terminal board is located horizontally on the upper surface of the above-mentioned case, and a plate spring is located on the upper surface of the above-mentioned fixed terminal board and the coil terminal board.

An electromagnetic contactor relating to the present invention has a floating construction that the terminal screw engaged portion of the fixed terminal board and the coil terminal board is placed horizontally on the upper surface of the casing, and at least one of the fixed terminal board and the coil terminal board can be moved upwards and downwards in the terminal height with respect to other terminal height.

In the present invention, since the plate spring is mounted on the upper surface of the fixed terminal board and the coil terminal board, even when the printed board clamped by screw generates the seasoning due to temperature rise and each terminal has terminal height difference according to part processing variation and inclination of the terminal upper surface, the reliability of contact can be maintained due to pressure of the plate spring.

Also in the present invention, as at least one of the fixed terminal board and the coil terminal board is made floating construction, terminal height difference due to the part processing variation, terminal height difference due to the intervention of surge absorber terminal and height difference due to wiring conductor of the both side power printed board are absorbed by the floating construction.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of an electromagnetic contactor being an embodiment of the invention taken on line A-A of FIG. 2 showing a top view;

FIG. 2 is a top view of an electromagnetic contactor being an embodiment of the invention;

FIG. 3 is a sectional view taken on line B-B of FIG. 2;

FIG. 4 is a perspective view showing an example of constitution of a plate spring in the embodiment of the invention;

FIG. 5 is a sectional view of an electromagnetic contractor being another embodiment of the invention taken on line A-A of FIG. 6 showing a top view;

FIG. 6 is a top view of an electromagnetic contactor being another embodiment of the invention;

FIG. 7 is a sectional view taken on line B-B of FIG. 6;

FIG. 8 is a front elevation showing a junction condition with power printed board of the electromagnetic contactor according to the embodiment of FIG. 5 - FIG. 7;

FIG. 9 is a sectional view showing an example of constitution of power printed board;

FIG. 10 is a sectional view showing constitution of an electromagnetic contactor in the prior art;

FIG. 11 is a circuit diagram of an inverter showing an example of the place where an electromagnetic contactor is employed with a power printed board;

FIG. 12 is a sectional view of a semiconductor circuit device disclosed in Japanese utility model application laid-open No. 83292/1985;

FIG. 13 is a side sectional view showing conditions when the electromagnetic contactor in FIG. 10 is installed on a power printed board;

FIG. 14 is a perspective view showing the construction of the power printed board with which an electromagnetic contactor is combined; and

FIG. 15 is a sectional view taken on line X-X of FIG. 14.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention will be described referring to the accompanying drawings as follows. FIGs. 1 - 3 are constitution drawings of an electromagnetic contactor relating to an embodiment of the present invention. FIG. 2 is a top view, FIG. 1 is a sectional view taken on line A-A of FIG. 2, and FIG. 3 is a sectional view taken on line B-B of FIG. 2, respectively. In these drawings, numeral 1 designates an installation base, numeral 2 designates a casing, and numeral 3 designates an exciting coil. A fixed iron core 4 is disposed at an opposite location with a specified gap to a movable iron core 5. A crossbar 6 composed of insulating material is linked to the above-mentioned movable iron core 5, and maintains a movable contact 8 slidably in an upper window 6a. Also the crossbar 6 is mounted slidably movable up and down in the above-mentioned casing 2 so in FIG. 1 (not shown).

A contact spring 7 is provided to apply contact pressure to the movable contact 8, and is composed of compression coil spring. Movable contact tips 8a, 8b are installed at both ends of the movable contact 8, and are oppositely located with a specified contact gap to fixed contact tips 9a, 10a.

Fixed terminal boards 109, 110 bond the fixed contact tips 9a, 10a at the lower end of U-like shape and form female screws 109a, 110b at the upper ends. The upper end surface of U-like shape is provided horizontally on the upper surface of the case 2, and a plate spring 120 is installed on the upper surface. Also the fixed terminal boards 109, 110, the movable contact 8 etc. are parallel disposed, the number of sets being equal to the number of poles of the main circuit (three poles in this embodiment). An arc cover 13 has metallic arc runners 14, 15 fixed on the inside, and extinguishes arc generated between contact tips.

Coil terminal boards 116, 117 are of U-like shape, and lead wires 3a, 3b at the beginning and the end of winding of the exciting coil 3 are connected to the lower ends 116a, 117a of U-like shape. Female screws 116b, 117b are formed at the upper end of U-like shape. The upper ends of the coil terminal boards 116, 117 of U-like shape are disposed horizontally on the upper surface of the case, and a plate spring 121 is installed on the upper surface as is the case with the fixed terminal boards 109, 110. Numeral 20 designates a release spring which is disposed to energize the combined body of the crossbar 6 and the movable iron core 5 to the left direction in FIG. 3. In FIG. 1, numeral 66 designates a main circuit wiring board.

Next, operation of the embodiment will be described. Fundamental operation as an electromagnetic contactor, that is, ON/OFF operation of the main circuit contact tips by ON/OFF operation of the exciting coil is the same as in the example of the prior art. Therefore, omitting description of the above-mentioned fundamental operation, the coupled operation with the main circuit wiring board will be described referring to FIG. 1.

Wiring assembly to the main circuit wiring board will be completed by clamping the screw 68 through the main circuit wiring board 66 to the fixed terminal boards 109, 110 of the electromagnetic contactor. Then the plate springs 120 and 121 will be assembled in the compressed condition until β equals to T where β is the original height and T is the thickness of the plate spring as shown in the figure. That is, the plate springs 120, 121 are assembled in the pressed state of the main circuit wiring board 66 by the force necessary to deform and lessen the dimension by (β - T).

Accordingly, even if the plate thickness t decreases due to the seasoning generated in the main circuit wiring board by heating caused by the current carrying through the main circuit, connection (contact) of the fixed terminal boards 109, 110 of the main circuit and the coil terminal boards 116, 117 to the main circuit wiring board 66 will be maintained normally as the pressure of the plate spring works as a contact pressure within the range in which the decrease amount of plate thickness Δt is $\Delta t < (\beta - T)$.

Also when the terminal height differences of the fixed terminal boards 109, 110 and the coil terminal boards 116, 117 of the main circuit occur due to the part manufacturing dispersion, and when the inclinations of each terminal occur, connection (contact) to the main circuit wiring board 66 will be maintained normally for the differences and inclinations, if any, will be absorbed in the spring deformation, if the amounts of differences and inclinations are less than the amount of spring deformation (β - T) of the plate springs 120, 121.

FIG. 4 is a perspective view showing an example of constitution of a plate spring. In FIG. 4, a plate spring 120 forms two convex portions 120a, 120b and is constituted to contact with the main circuit wiring board 66 at this portion and to carry current. Of course, the constitution of the plate spring in FIG. 4 applies to the plate spring 121 as well.

The effects of plate springs on the inclination of each of the above-mentioned terminals become more prominent by increasing the number of contact points between the plate springs 120, 121 in such constitution and the main circuit wiring board 66.

FIGs. 5 - 8 are constitution diagrams of an electromagnetic contactor relating to another embodiment of the present invention. FIG. 6 is a top view, FIG. 5 is a sectional view taken on line A-A of FIG. 6, FIG. 7 is a sectional view taken on line B-B of FIG. 6, and FIG. 8 is a sectional view showing the junction condition with a power printed board. The description of the same portion as the description of the above-mentioned embodiment shall be omitted, and the differences between them will be mainly described.

Upper end surfaces of U-like shape of fixed terminal boards 109, 110 are located horizontally on the upper surface of the case, and their heights (terminal heights of fixed terminal boards) are the dimension of H1 illustrated. Coil terminal boards 116, 117 are guided slidingly by an arc cover 13 in order to move upwards and downwards in FIG. 5, and further floating springs 71, 72 composed of compression coil spring are provided between the inside surfaces 116c, 117c of upper end pieces of U-like shape of the coil terminal boards 116, 117 and supports 13a, 13b of the arc cover 13. Accordingly, height H2 of the upper end surface of the coil terminal boards 116, 117 with respect to the terminal height H1 of the fixed terminal boards 109, 110 of the main circuit is in following range.

$$H2 = [H1 - \alpha] \sim [H1 + \alpha]$$

Within the above range, H2 forms movable floating constructions. Wherein α indicates a floating dimension. The terminal height $[H1 - \alpha]$ is a terminal position shown by dash-and-dot line in FIG. 5 and the up-and-down motion can be performed through this distance.

Next, operation of the embodiment will be described by an example of a junction condition with the power printed board in FIG. 8. The main wiring board 66 is double-sided board owing to the pattern crossover in FIG. 8, and terminal height differences are needed between the fixed terminal boards 109, 110 and the coil terminal boards 116, 117 in the main circuit.

FIG. 9 is a sectional view showing an example of constitution of the pattern printed board in such a case. Wiring patterns 66a, 66c and wiring conductors 66b, 66d are placed on both sides of the main circuit wiring board 66. That is, due to pattern crossing it will be a double sided printed board. In an example of FIG. 9, the wiring conductor 66b of the main circuit is located on the upper surface, and the wiring conductor 66d for the exciting coil is located on the lower surface.

Accordingly, the power printed board needs terminal height difference between the fixed terminal board of the main circuit and the coil terminal board, and height difference equal to the thickness t of the board of the wiring conductor 66d is necessary between the terminal height H1 of the fixed terminal boards 109, 110 and the terminal height H2 of the coil terminal boards 116, 117 in the main circuit. As the above floating dimension α has been set sufficiently greater than the plate thickness t, it is possible that the coil terminal boards 116, 117 are moved downwards and adapted with the above-mentioned height difference even in such case, and the assembling is performed normally without applying a bending force to the printed board even if clamped by the screw 68.

In the example as shown in FIG. 8 and FIG. 9, the main circuit wiring board 66 is a double sided printed board on which upper surface is located a wiring conductor 66b of the main circuit, and on which lower surface is located a wiring conductor 66d for an exciting coil. However, the same effects as above described will be taken as well on a double sided printed board having the wiring conductor of the main circuit placed on its lower surface and that for the exciting coil placed on its upper surface.

It is needless to say for the above-mentioned floatation structure to absorb the height difference in the case when the terminal board of a surge absorber (not shown) is intervened between the coil terminal boards 116, 117 and the main circuit wiring board 66 or the terminal board of a main circuit surge absorber (not shown) is intervened between the fixed terminal board of the main circuit and the main circuit wiring board, or height differences due to dimension dispersion of parts used in coil terminal boards and fixed terminal boards, and then to take the same effect as is described above.

In the embodiment shown in FIGs. 5 - 8, the coil terminal boards 116, 117 are of floatation structure, but the same effects as above are taken even if the fixed terminal boards 109, 110 of the main circuit are of floatation structure. Moreover the terminals of both the coil terminal boards 116, 117 and the fixed terminal boards 109, 110 of the main circuit may be of a floating structure, and in this case the absorbing effects of height differences are growing greater and the degree of freedom becomes larger.

Plate springs in the embodiment in FIGs. 1 - 4 may be used in the embodiment in FIGs. 5 - 8. In this case, the absorbing effects of height differences become greater.

In addition, although terminals of electromagnetic contactors are described in the above-mentioned embodiments, they can be applied to the terminal portion of other devices, for example, a solid state contactor, a power relay, a diode module, a transistor module, a capacitor or the like. By the above applications, the reliability of the whole apparatus using the power printed board can be increased.

According to the invention as above described, since the plate springs are installed on the upper surface of the fixed terminal board and the coil terminal board thereby the contact current carrying is performed with the main circuit wiring board (printed board), contact unstabilities due to the height differences of terminals owing to parts manufacturing dispersion, inclination, the seasoning of the main circuit wiring board (printed board), and the burnout of the main circuit wiring board due to the above-mentioned causes can be prevented. In addition, the reliable electromagnetic contactor can be provided which can be connected to the main circuit wiring board by the screw clamping as mentioned above, thereby the simplification of wiring can be attained and the apparatus as a whole can be made cheaper.

Further according to the present invention, as at least one of the fixed terminal board and the coil terminal board is constituted in order to form floating structure to be able to move upwards and downwards, terminal height differences caused by variation in dimension of the parts, terminal height differences by intervention of the surge absorber terminal, height differences by the wiring conductor of the double sided power printed board etc. can be absorbed by the floating structure, and besides the fact that the temperature rise can be depressed because of small contact resistance with the main circuit wiring, wiring assembling can be performed by the screw clamping without applying bending force to the main circuit wiring board (printed board). Therefore, the apparatus can be manufactured at low cost and its reliability is improved.

Claims

1. An electromagnetic contactor comprising:

a case;

an electromagnet apparatus having an exciting coil;

a contact apparatus driven for switching by said electromagnet apparatus;

a fixed terminal board having fixed contacts of said contact apparatus at one end and having a terminal screw engaging portion at other end;

a coil terminal board having a lead wire of said exciting coil connected to one end and having a terminal screw engaging portion at other end; and

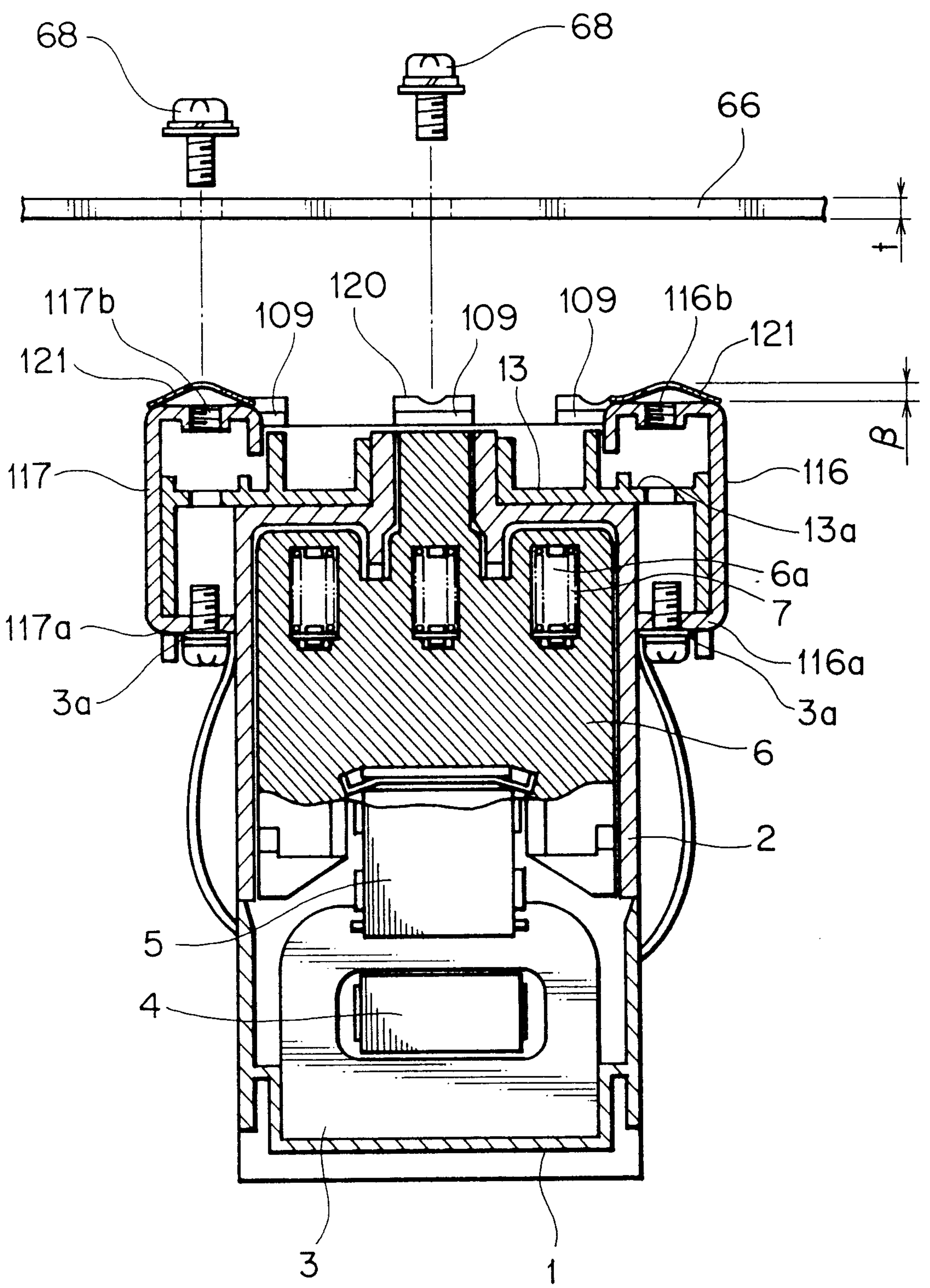
plate springs installed on upper surface of fixed terminal board and said coil terminal board; said terminal engaging portions of said fixed terminal board and coil terminal board being horizontally arranged on upper surface of the case.

2. An electromagnetic contactor as claimed in claim 1, wherein said plate spring forms substantially rectangular frame and a pair of opposite sides of the frame form convex portions.

3. An electromagnetic contactor comprising:
a case;
an electromagnet apparatus having an exciting coil;
a contact apparatus driven for switching by said electromagnet apparatus;
a fixed terminal board having fixed contacts of said contact apparatus at one end and having a terminal screw engaging portion at other end; and
a coil terminal board having a lead wire of said exciting coil connected to one end and having a terminal screw engaging portion at other end; said terminal engaging portions of the fixed terminal board and the coil terminal board being horizontally arranged on upper surface on the case, and at least one of the fixed terminal board and the coil terminal board having floating structure such that the terminal height being moved upwards and downwards with respect to other terminal height.

4. An electromagnetic contactor as claimed in claim 3, wherein plate springs are provided on said terminal engaging portions of at least one of the fixed terminal board and the coil terminal board.

FIG. 1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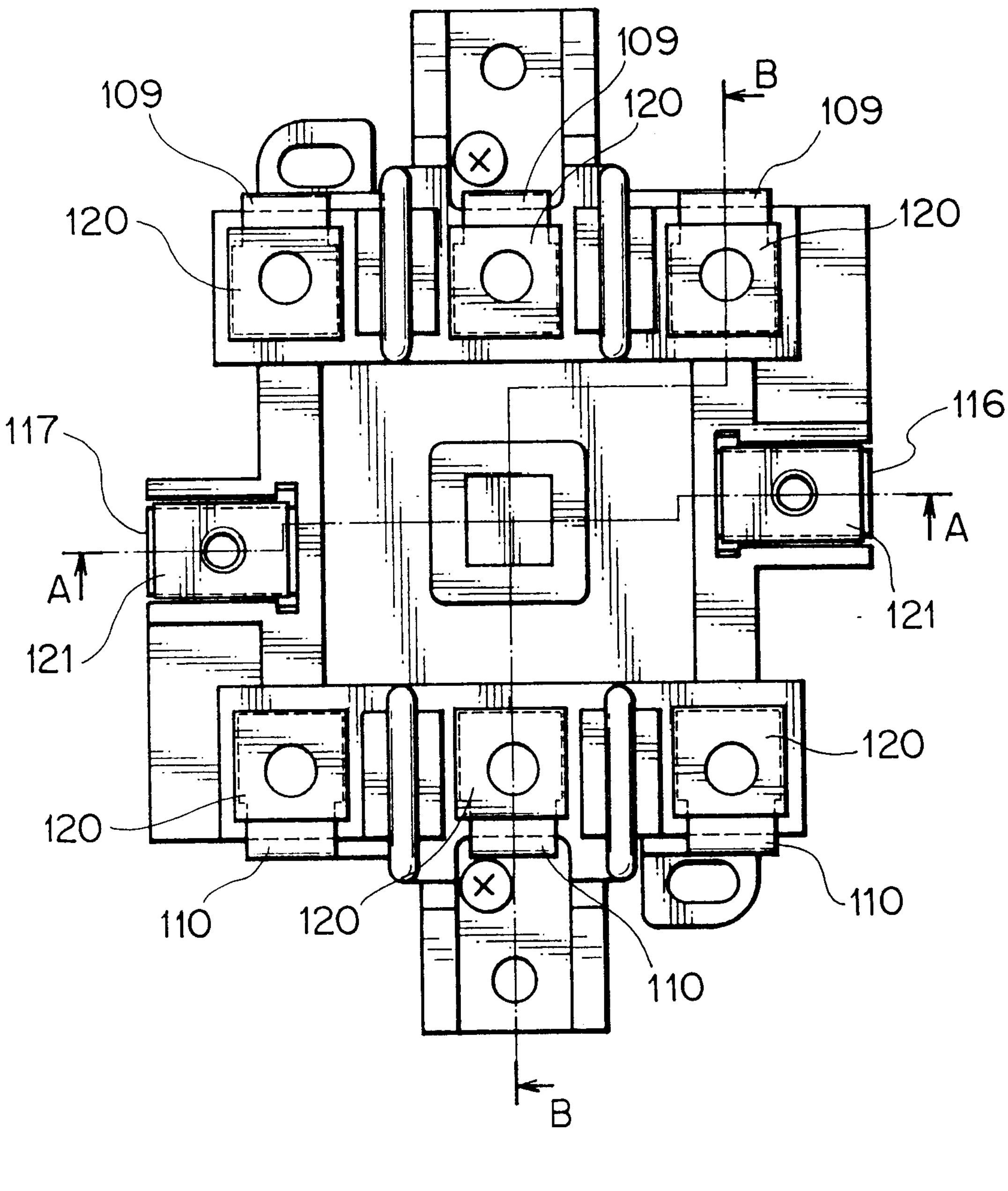
2
5
4
3
1

FIG. 2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B

F I G. 3

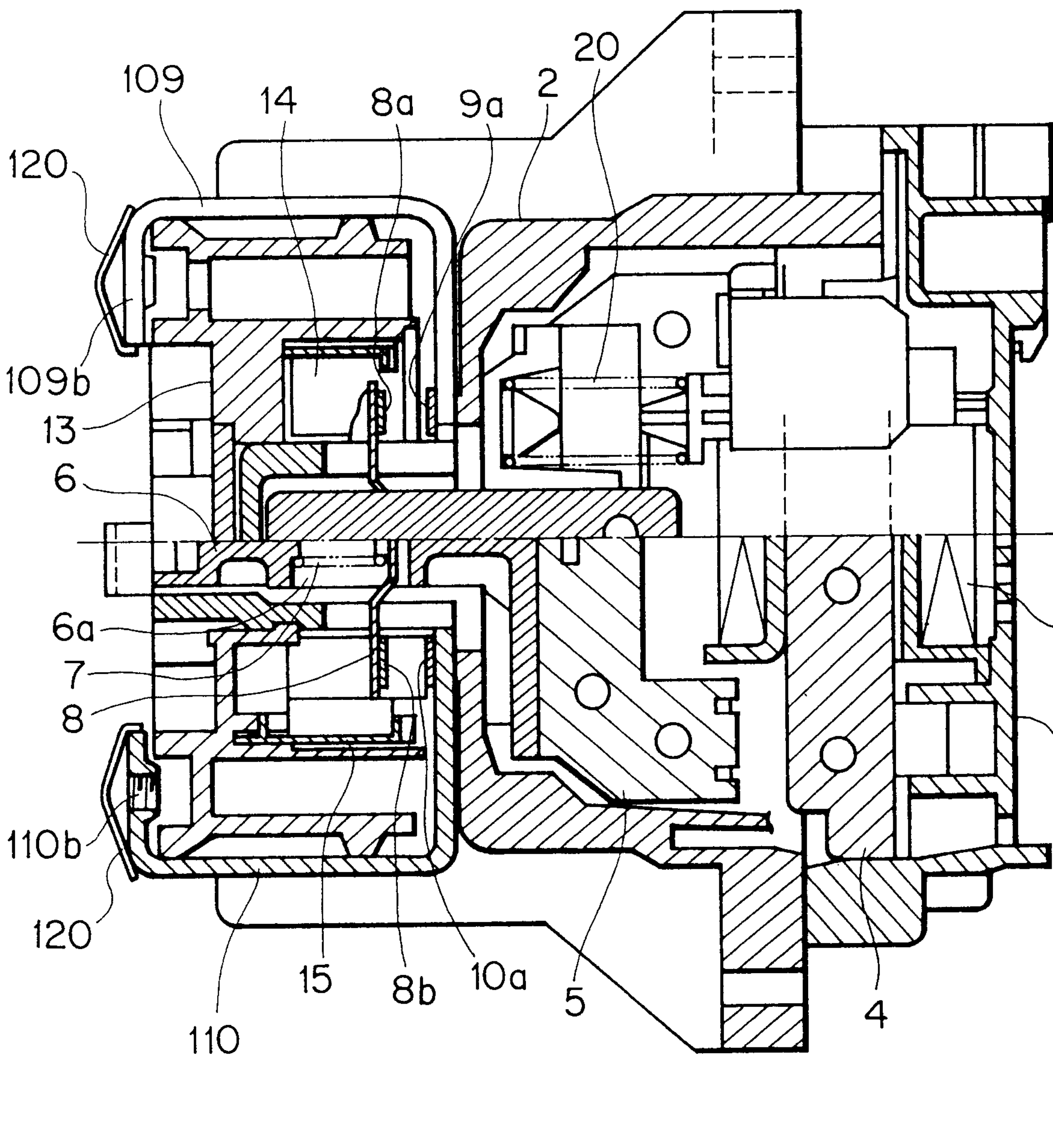
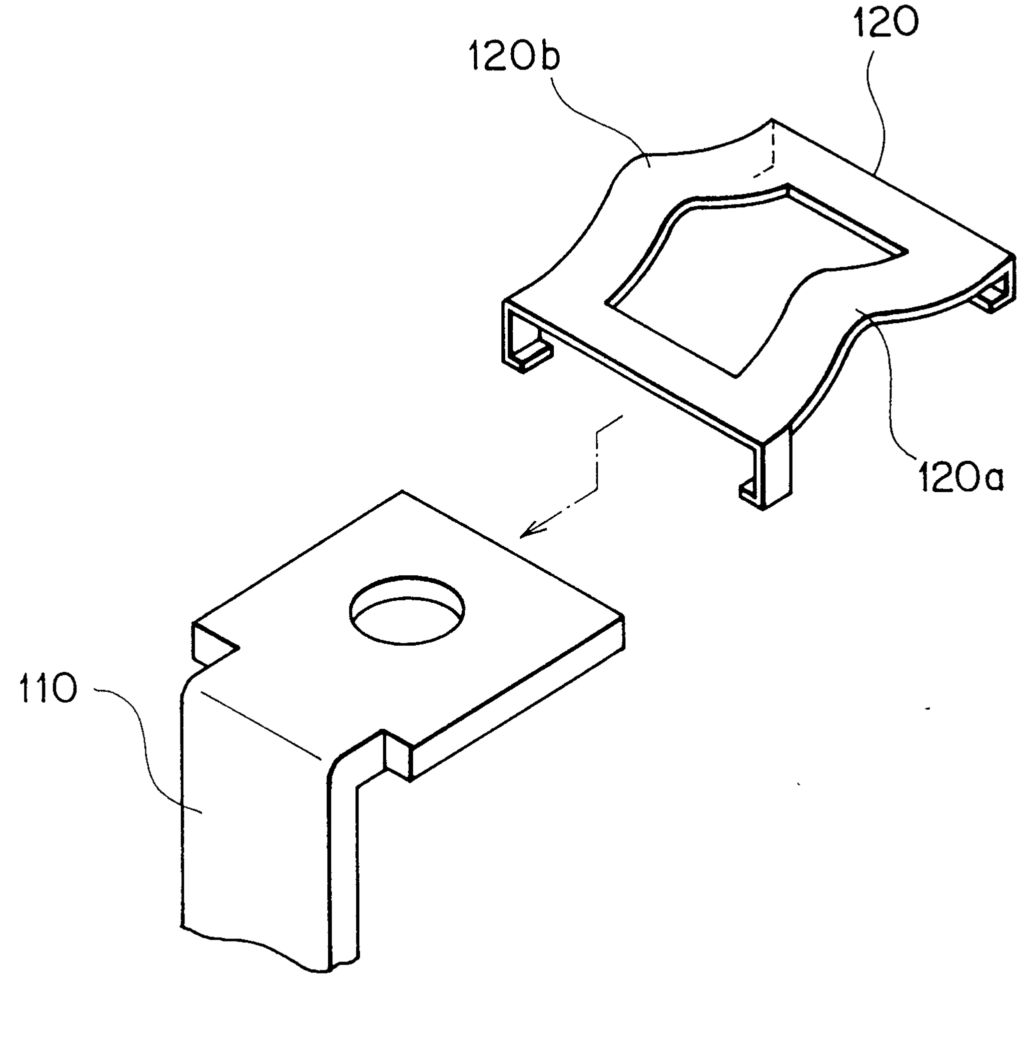
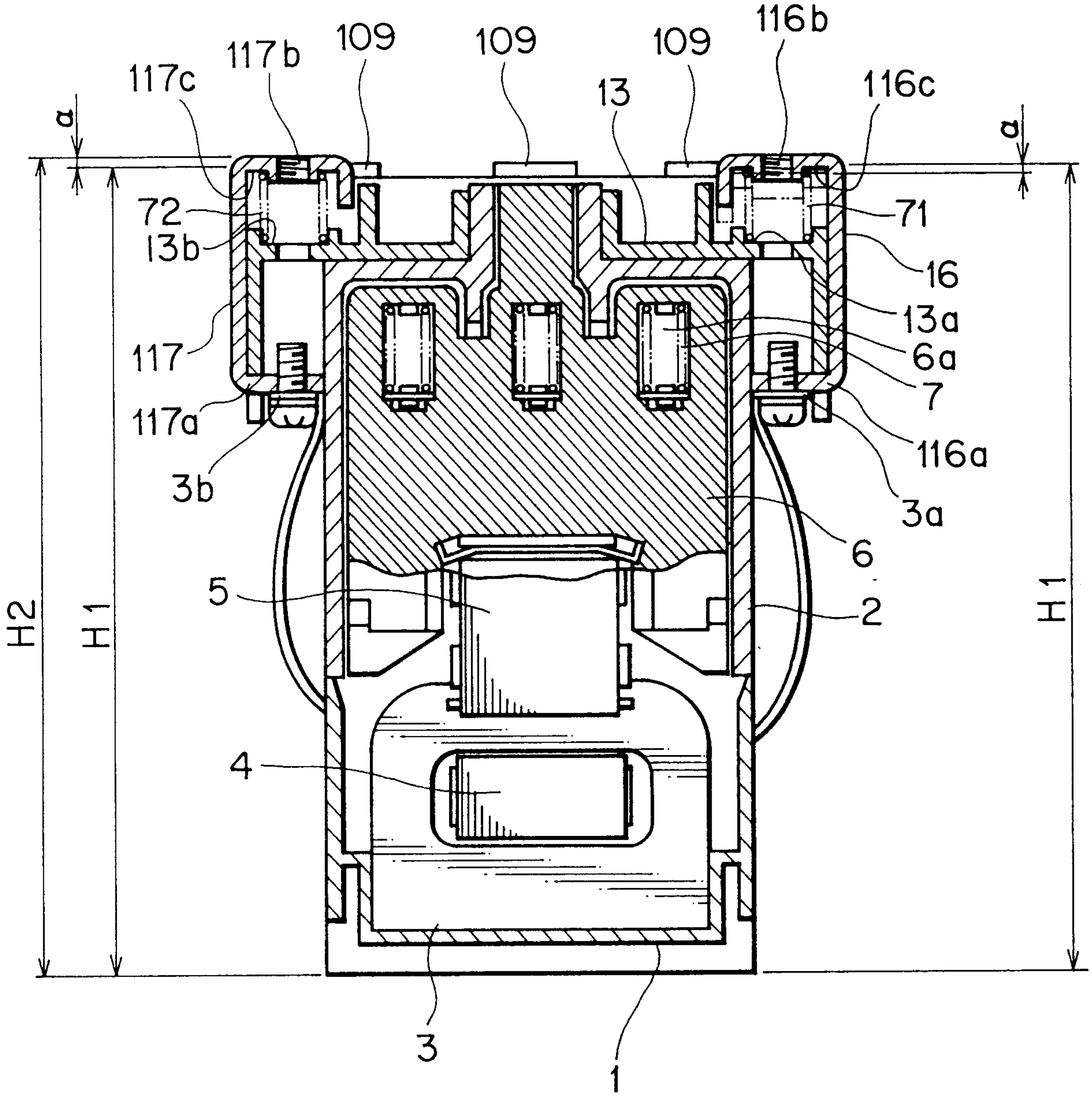


FIG. 4



F I G. 5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116a
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6
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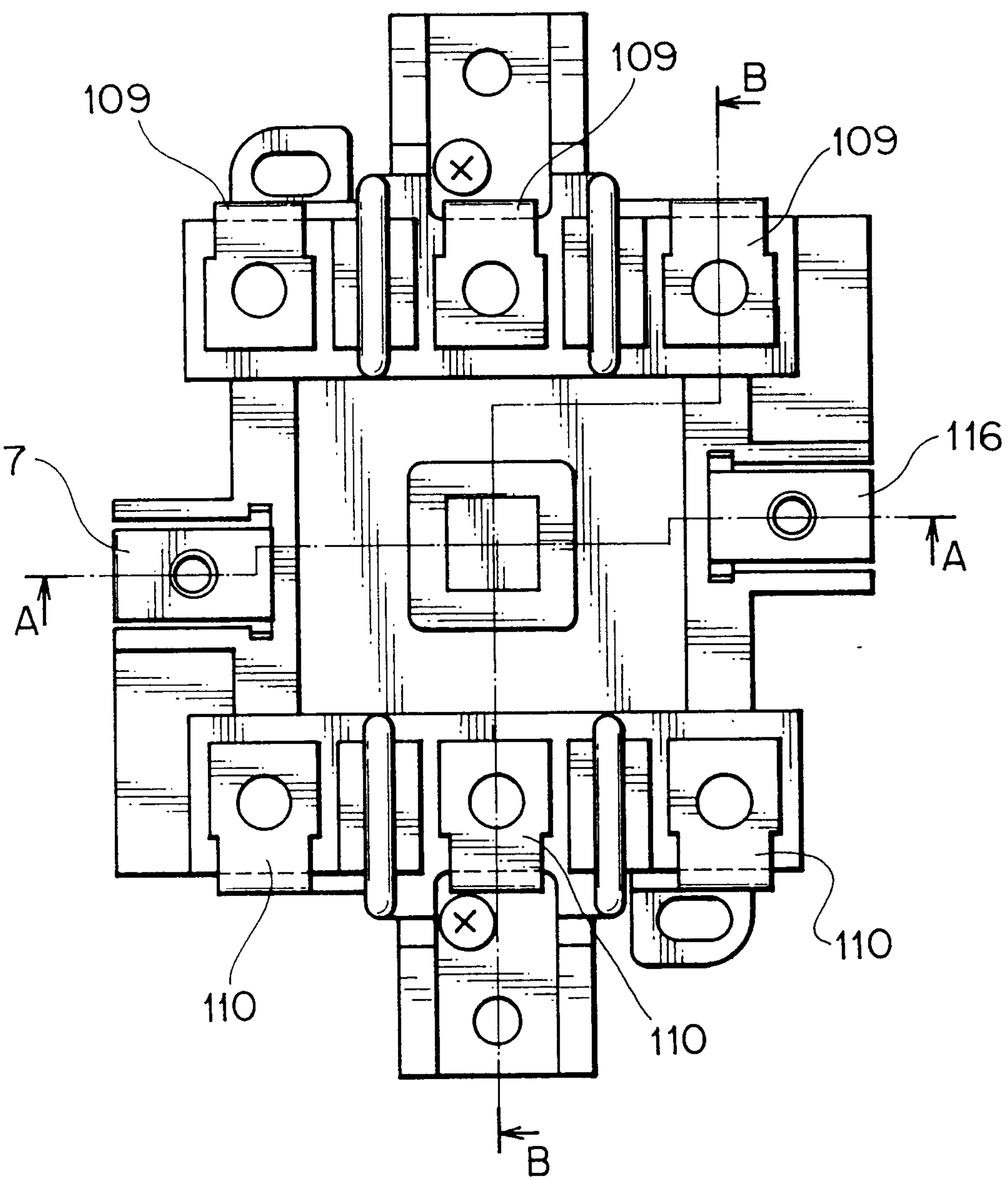
H1
H1
4
3
1

F I G. 6



F I G. 7

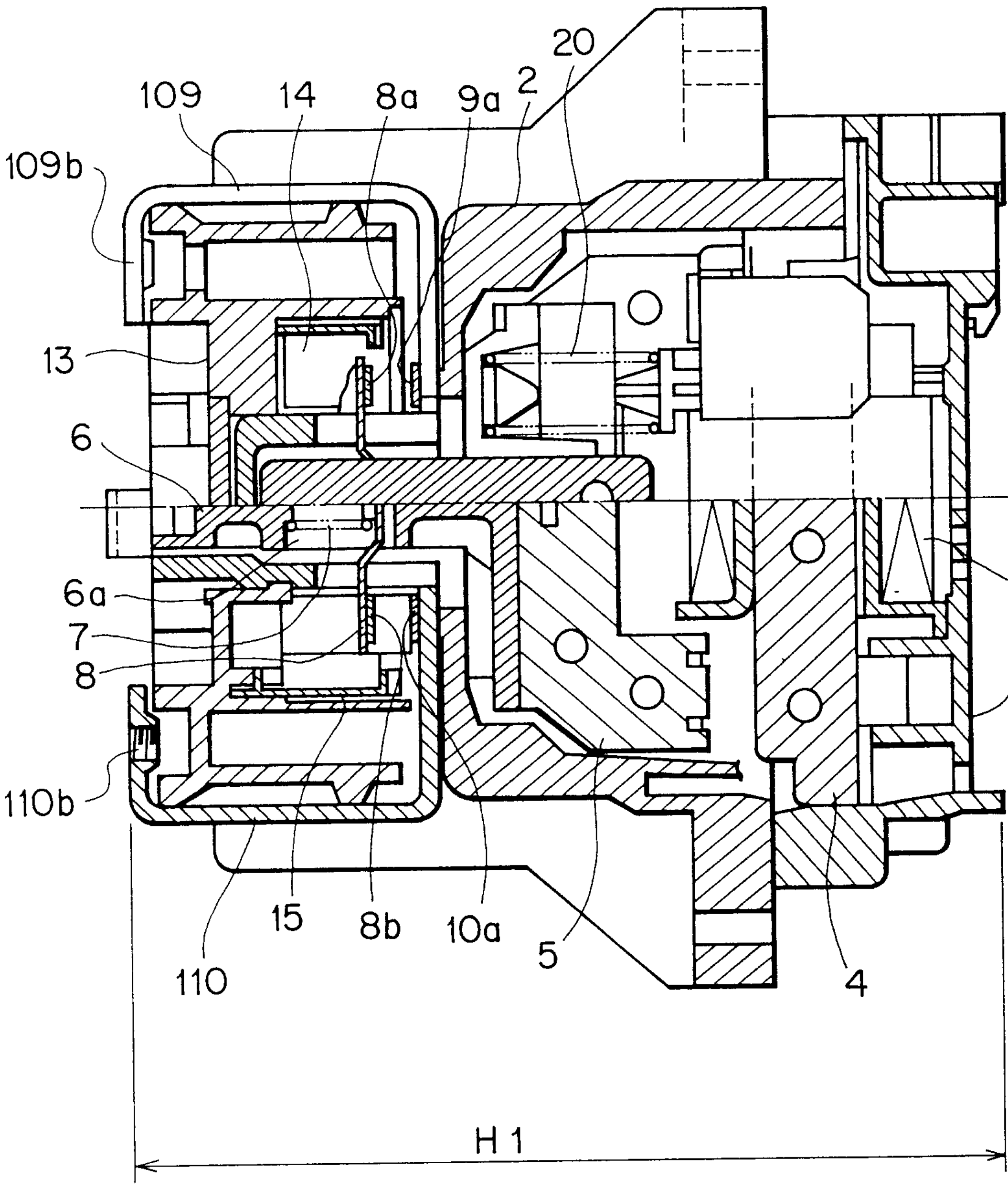


FIG. 8

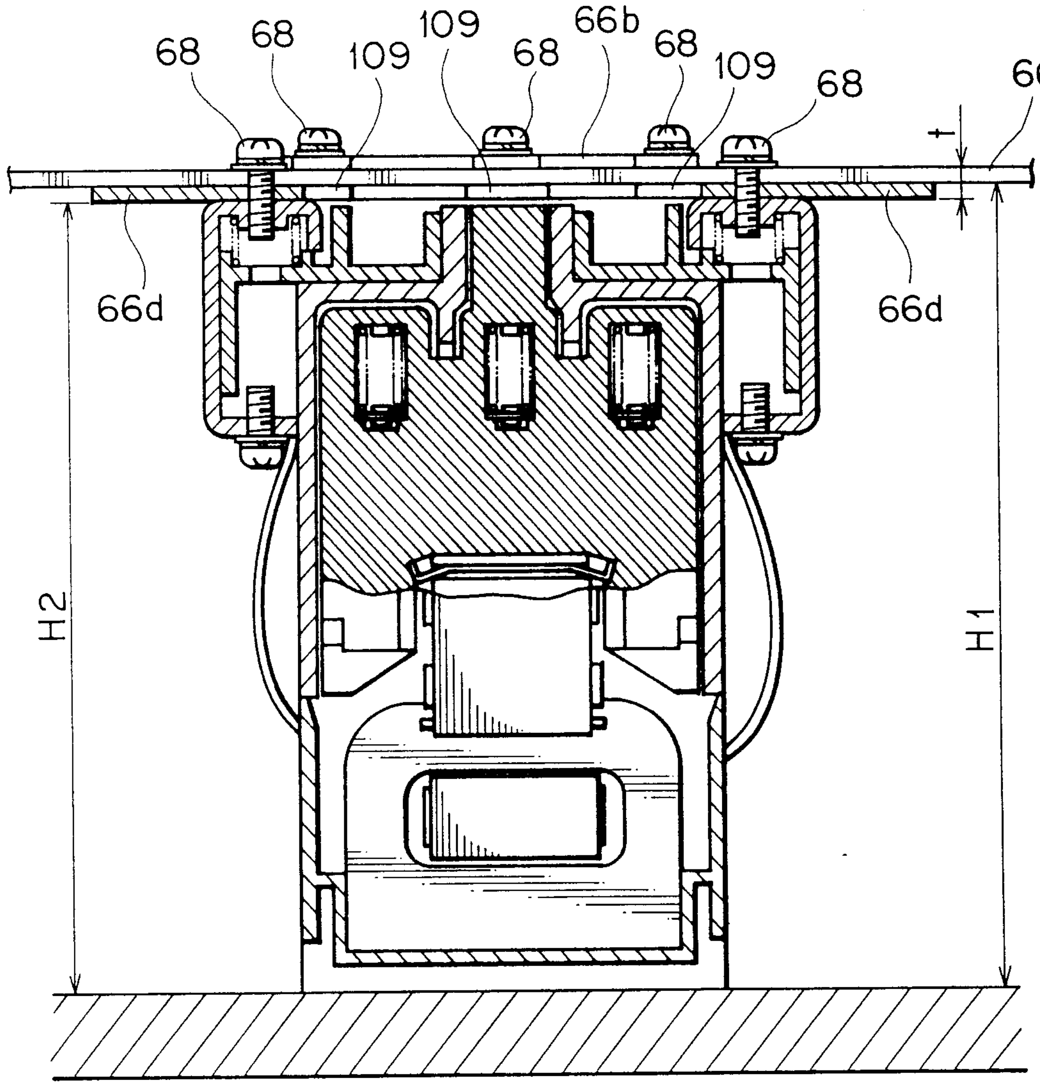
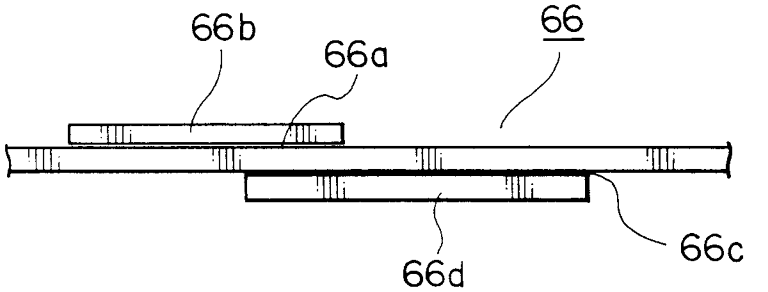


FIG. 9



F I G.10

PRIOR ART

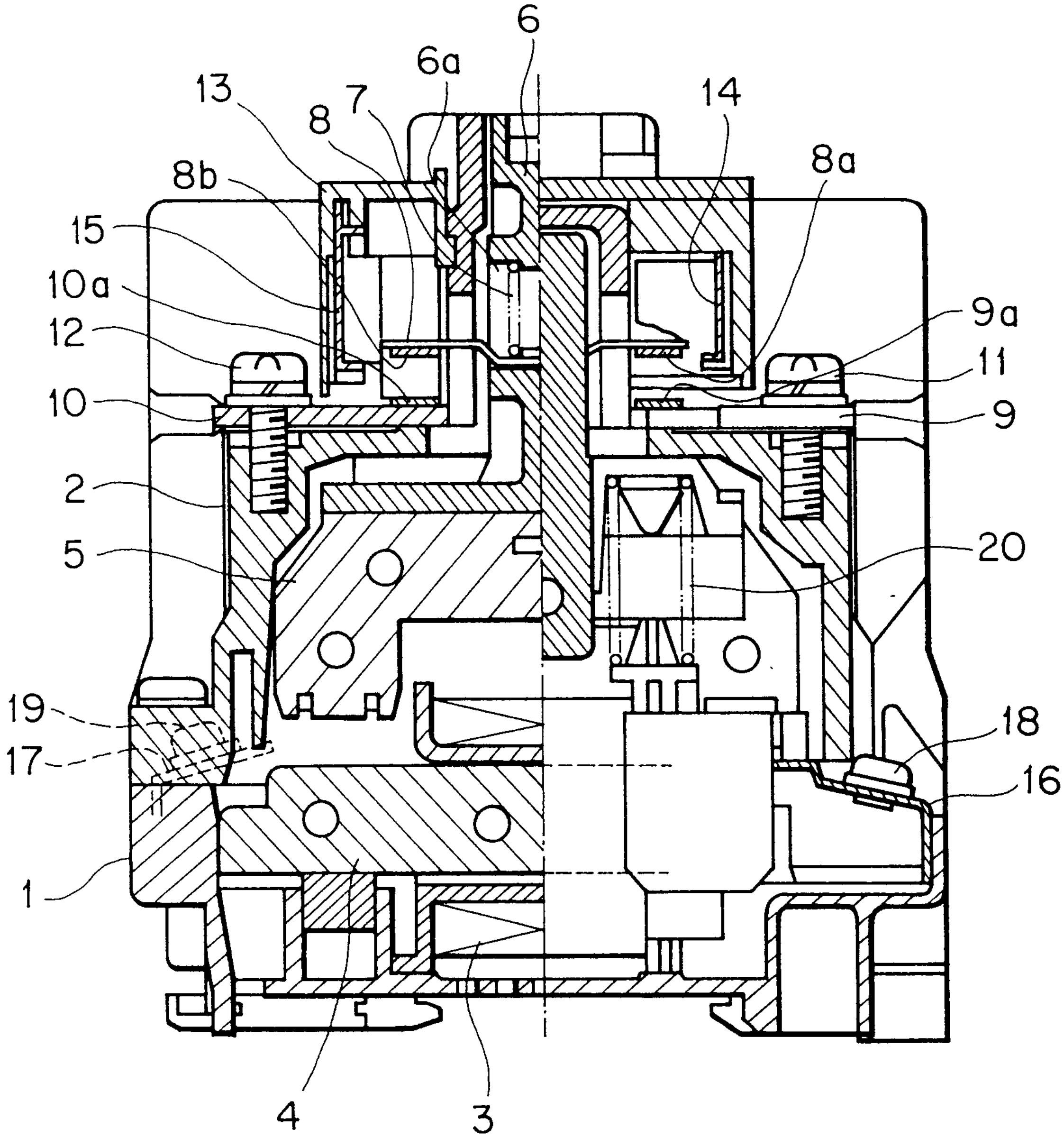


FIG. 11

PRIOR ART

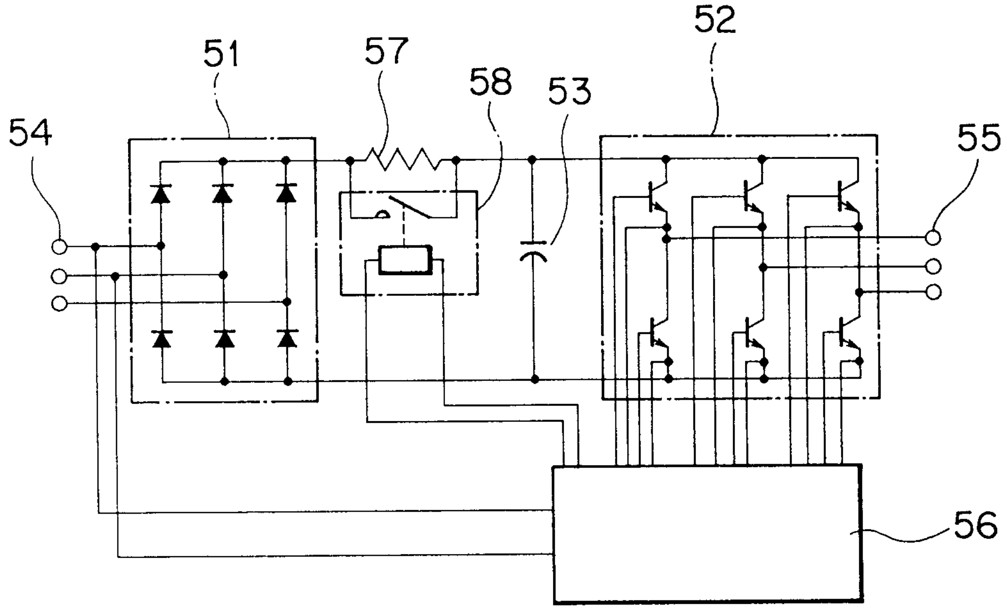


FIG. 12

PRIOR ART

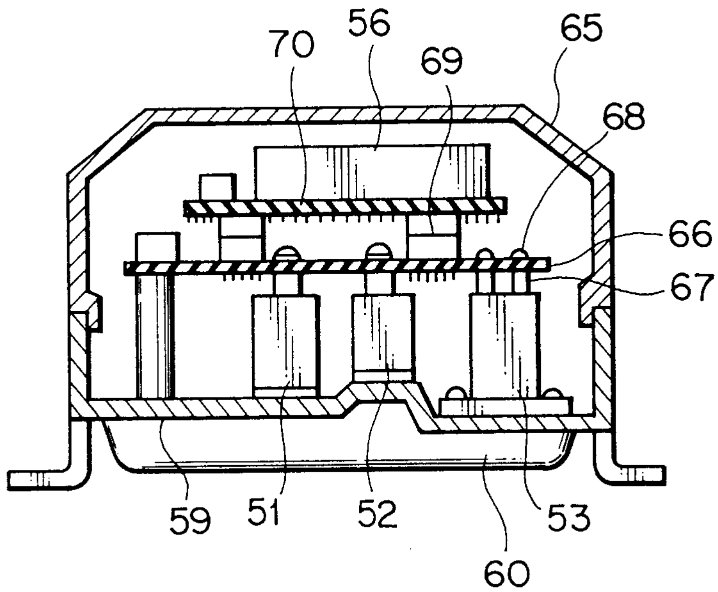
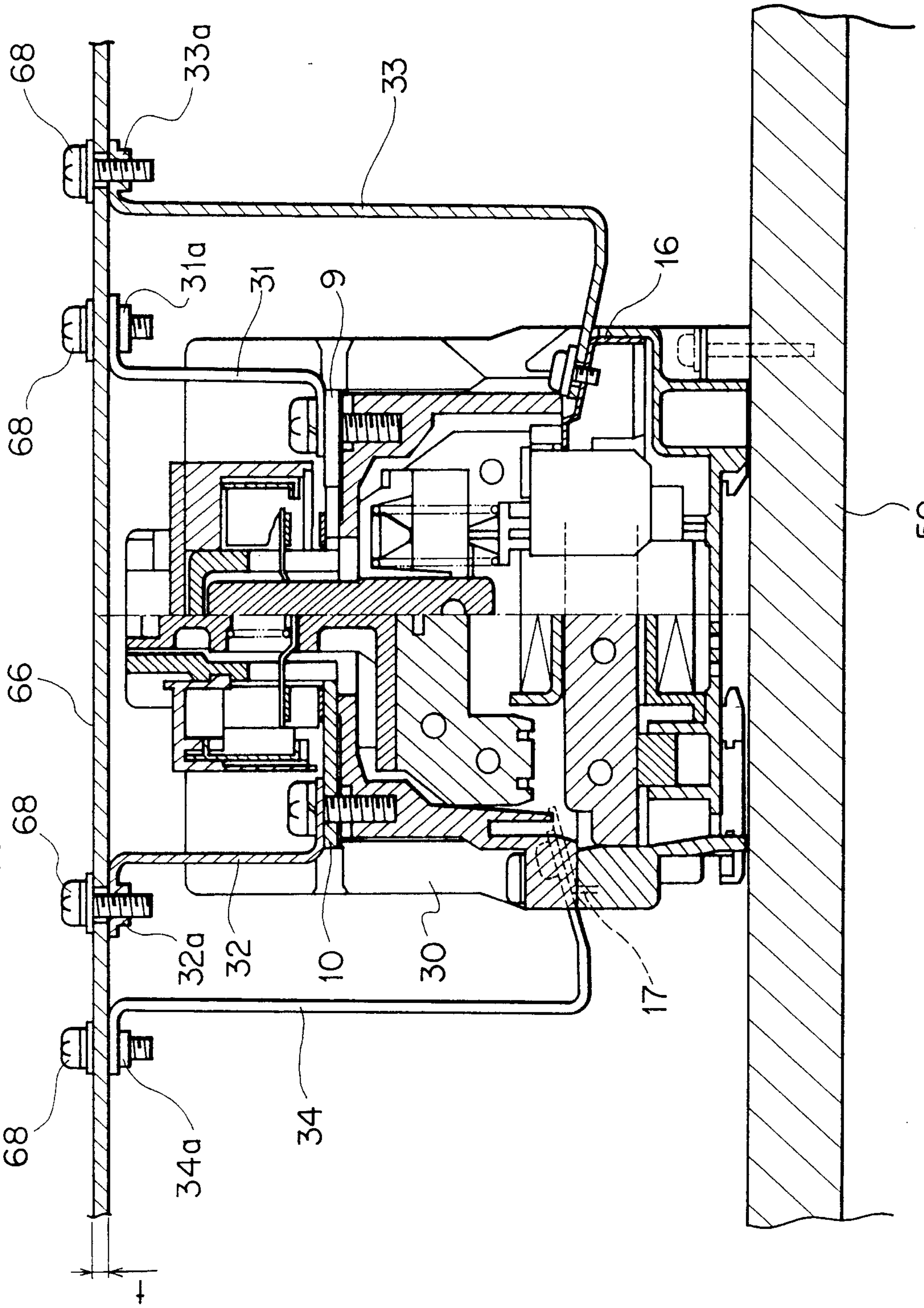


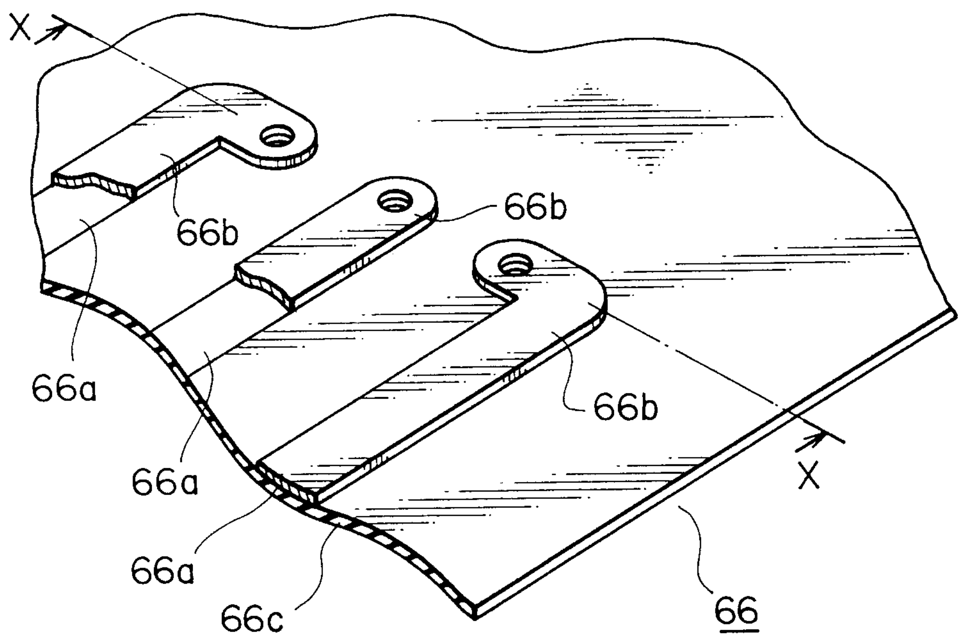
FIG. 13

PRIOR ART



F I G. 14

PRIOR ART



F I G. 15

PRIOR ART