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(54) Electromagnetic relay

(57) A slender electromagnetic relay having superior isolation and a small surface area is disclosed. The electromagnetic relay includes a contact mechanism and an electromagnetic block which are sandwiched between two base portions, the two base portions being separated along an axis of the width. A recess is provided in the center of one of the base portions between the contact mechanism and the electromagnetic block. From the opposite surface of the other base portion rises a wall. This wall engages in the recess when the two base portions are assembled to form the electromagnetic relay.

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Description

Field Of the Invention

The invention generally relates to electromagnetic relays. More specifically, it relates to a slender electromagnetic relay with a high degree of isolation yet occupies a small surface area.

Background Of The Invention

An example of an electromagnetic relay which insures a high degree of isolation is that disclosed in Japanese Patent Publication (Kokai) 4-123049.

In this relay, an electromagnetic block is inserted in an axial direction through an opening in a sleevelike base. The base is formed of molded resin, and one of its ends is closed. Contact mechanism is placed at the other end of the base.

This type of electromagnetic relay requires that the base be sleeve-shaped so that it can encase a coil in the block. This, however, tends to increase the thickness of the relay. If one wishes to design a slender electromagnetic relay which occupies a small surface area, for example, one that is less than 5 mm wide, the space in which the coil is wound must be made smaller, with the result that the appropriate length of coil cannot be wound and the desired pull cannot be achieved. In addition, production of a sleeve-shaped base for such a relay requires that a side core be used as the mold. This drives up the coat of producing a sleeve-shaped base.

An example of a slender electromagnetic relay is that disclosed in Japanese Patent Publication (Kokai) 1-302631.

Japanese 1-302631 discloses a core and an armature both consisting of flat plates. It further teaches stacking a fixed leaf spring and a movable leaf spring on top of the armature, and enclosing the leaf springs within the core.

In the electromagnetic relay of Japanese 1-302631, however, there is no partition between the coil and the two leaf springs to provide isolation. This is because the distance between the coil and the springs is short and, therefore, it is impossible to achieve the desired isolation characteristics.

Summary Of The Invention

The object of the invention is to provide a slender electromagnetic relay with a small surface area and which offers a high degree of isolation.

To achieve the objective, the electromagnetic relay relating to the invention is designed as follows.

In an electromagnetic relay in which a card is moved back and forth by a movable member which itself rotates with the magnetization and demagnetization of an electromagnetic block, and in which the movement of the card drives a contact mechanism, the electromagnetic block and the contact mechanism are sandwiched between two base portions, the first of which is segmented into two parts along its width. A groove is provided for the purpose of isolation on one of the opposing surfaces of the two base portions, and a tongue which engages with the groove is provided on the other opposing surface.

The front of the groove should be shaped like the letter "L" or the letter "T".

The movable and fixed contact elements which constitute the contact mechanism should be sandwiched between the two base portions, and a second groove should be provided on one of the opposing surfaces of the two base portions between the bottoms of the movable and fixed contact members. A second tongue for engaging in this groove should be provided on the other opposing surface.

The front of the second tongue should also be shaped like the letter "L" or the letter "T".

The base of the relay should be formed from the two base portions, one of which should engage elastically with the other.

Brief Description Of The Drawings

Figure 1 is an exploded perspective drawing of an electromagnetic relay which is an ideal embodiment of this invention.

Figure 2 is an exploded perspective drawing which illustrates how the block of the relay shown in Figure 1 is assembled.

Figure 3 is an exploded front view which illustrates how the block of the relay shown in Figure 1 is assembled.

Figure 4 is a front view of the block after the assembly process shown in Figure 3 is completed.

Figure 5 is an exploded perspective drawing which illustrates from a different angle how the block of the relay shown in Figure 1 is assembled.

Figure 6(a) is a perspective drawing of the movable member of the relay in Figure 1 with the hinged spring attached to it; and Figure 6(b) is a perspective drawing of the movable member of the relay in Figure 1 by itself.

Figure 7(a) is a perspective drawing of the hinged spring shown in Figure 1; and Figure 7(b) is a perspective drawing of a modified version of the same hinge.

Figure 8 is a perspective drawing which illustrates how the second base portion of the relay pictured in Figure 1 is assembled.

Figure 9 is an exploded front view which illustrates how the two base portions pictured in Figure 1 engage with each other.

Figure 10 is an exploded front view from another angle, which illustrates how the second base portion pictured in Figure 1 is assembled.

Figure 11 is an exploded perspective view which illustrates how the card in the relay shown in Figure 1 is assembled.

Figure 12 is a front view of the electromagnetic relay shown in Figure 1 once the card has been attached.

Figure 13(a) is an exploded view from underneath the relay of Figure 1 when it is partly assembled; Figure 13(b) shows the relay of Figure 1 once assembly is completed; and Figure 13(c) is a view of the underside of the relay of Figure 1 once the case has been mounted.

Detailed Description Of The Invention

We shall next discuss several ideal embodiments of this invention with reference to appended Figures 1 through 13.

As is shown in Figure 1, the electromagnetic relay of this embodiment consists of base 10, comprising two base portions 20 and 60 which can engage or disengage with each other along the axis of the width; contact mechanism 30; electromagnetic block 40; movable member 50; card 70; and case 80.

In the center of front surface 21 of the base portion 20 is structure 22, which serves to isolate two halves of the base portion 20. On either side of this structure are lateral walls 23 and 24.

In the center of the structure 22 is recess 22a, which separates contact mechanism 30 from electromagnetic block 40. There is a depression 22b on one of the outer surfaces of the structure 22; on the other outer surface there is an L-shaped boss 22c. On top of the structure 22 is a boss 22d which serves to maintain the base in the proper position.

On the outer surface of the lateral wall 23 is a small projection 25a (see Figure 2), which serves to lock the two base portions together, and a small groove 26a, into which one of the contact elements fits. At the base of the interior surface of the lateral wall 23 are a recess 23a to enhance isolation and a small groove 26b, into which the other contact element fits. Between the structure 22 and lateral wall 24 is a depression 27 to accommodate the movable member. At the bottom of depression 27 is a shallow groove 27a. In the wall consisting of front surface 21 which encloses depression 27 is a hole 21a (see Figure 2) for the purpose of keeping the base in the proper position. A slit 28 at the bottom end of the lateral wall 24 goes along the axis of the width; the opposite base portion will be pressed into this slit. On the upper surface of slit 28 is a groove 28a which guides the position of the opposite base portion. See Figure 3.

Contact mechanism 30 comprises fixed contact element 31 and movable contact element 35. See Figure 2. Fixed contact element 31 is formed by bending a thin plate of conductive material. Fixed contact 32 is on its upper end and terminal 33 is attached to its lower end. Like the fixed element 31, movable contact element 35 is formed from a thin plate of conductive material. On its upper end is a mounting hole 36. Below hole 36 is movable contact 37. Terminal 38 is attached to the element below contact 37.

When the fixed contact element 31 and movable contact element 35 are pressed into grooves 26b and 26a, respectively, in the base portion 20, fixed contact 32 and movable contact 37 face each other so that contact can be made and broken.

The lower portion of fixed contact 32 on contact element 31 comes in contact with the upper edge 23b of the lateral wall 23. If the fixed contact 32 and movable contact 37 should fuse together, then when the relay resets, movable contact element 35 will be held in position by the upper edge 23b so that the contacts can be freed by force.

Electromagnetic block 40 has a coil 43 which is wound around spool 42. The spool 42 is inserted into an L-shaped core 41. The ends of the wire which are drawn out of the coil 43 are tied and soldered to posts 44a and 45a on coil terminals 44 and 45, respectively. The terminals are pressed into flange 42a on the spool 42. On the horizontal extremity 41a of the core 41 are two projections 41b. An L-shaped yoke 46 is caulked to the upper end of core 41 which projects beyond flange 42 on the spool 42. On the lower end of the vertical portion of yoke 46 are two projections, 46a (see Figure 2) and 46b, which extend along the width of the yoke 46.

When horizontal extremity 41a of the core 41 is inserted along the axis of its width into slit 28 in the base portion 20, its projection 41b is guided by groove 28a in the slit 28. The horizontal extremity 41a is anchored in place when it comes up against the top of slit 28. See Figure 4. Extremity 41a of core 41 now projects into depression 27. Projection 46a on yoke 46 is forced into hole 21a in the base portion 20. See Figure 2. Thus, the electromagnetic block 40 is supported at two points on the base portion 20. This prevents it from rattling and allows it to be assembled with a high degree of precision. Projections 46a and 46b on the yoke 46 may be caulked if necessary.

Referring to Figures 6(a) and 6(b), movable member 50 is made of a magnetic material whose lengthwise cross section has the form of a pole. On one end of its main unit 51 is a narrow neck 52 with a T-shaped top. Neck 52 is pressed sideward so as to form an overhang which projects beyond the edge of unit 51 by a distance of 52a. Neck 52 has approximately the same thickness as main unit 51. Thus if the member is heated to eliminate residual stress, neck 52 will not be warped by abrupt cooling and the precision of member 50 will not suffer. The fact that neck 52 is not excessively thin protects it from being deformed or damaged during transport or when the component is being supplied by a part feeder. This enhances the precision with which the relay can be assembled. Enhanced precision results in unvarying operating characteristics and a longer interval between needed adjustments, both of which boost productivity.

The base of the neck 52 has a tapered undersurface 53. This eliminates the need to bend neck 52 at a right angle along the axis of its width and, as such, makes

the component easier to produce.

Hinged spring 55 is caulked to the movable member 50. As can be seen in Figure 7 (a), this spring has two caulking holes 58 on the upper end of fixed element 57, which is shaped like an archway. Elastic element 56 is formed by stamping out a portion of fixed element 57. The lower portion of element 57 is bent at a right angle. The elastic element 56 is bent at an obtuse angle.

Projections 54 on the movable member 50 engages in caulking holes 58 in hinged spring 55. When the projections 54 are caulked in place, movable member 50 is supported by hinged spring 55 in such a way as to be held slightly away from it.

The hinged spring 55 is not limited to the shape discussed above, however. It could also have caulking holes 58 in a fixed element 57 which is cut out of the elastic element and bent at a right angle. See Figure 7 (b). The arch-shaped elastic element 56 would then be bent at an obtuse angle.

No matter which of the above designs is chosen, the spring material is cut out to form the elastic and fixed elements. This keeps material loss to a minimum.

Movable member 50 is inserted into depression 27 in the base portion 20. When the hinged spring 55 is held in position by groove 27a, the lower end of movable member 50 is in contact with the surface of extremity 41a of core 41. See Figure 8. The horizontal end of hinged spring 55 is stopped when it comes up against extremity 41a of core 41. The upper end of elastic element 56 is stopped when it engages with projection 22c. In this way, the position of movable member 50 is controlled both above and below.

Referring to Figure 10, there is shown a base portion 60, which is formed from molded resin, and consists of front wall 61. This wall 61 is identical in shape to front wall 21 of the base portion 20. In the part of the base portion 60 which corresponds to recess 22a in the base portion 20, there is a projecting wall 62. On the left and right sides of the front wall project arms 63 and 64, which engage elastically with projections 25a and 25b. The wall 62 has an L-shaped front. This prevents dielectric breakdown between the engaged surfaces of base portions 20 and 60, and it increases the isolation distance.

Between the arm 63 and wall 62 are T-shaped projecting wall 65 and boss 66, which correspond to the recess 23a and depression 22b, respectively.

Between wall 62 and the arm 64 is projection 67, which juts out from wall surface 61. Along with projection 22c on the structure 22, this projection 67 serves to stop elastic element 56 of hinged spring 55. See Figure 12. In the part of front wall 61 which corresponds to hole 21a in the front wall 21 is positioning hole 61a. See Figure 10.

When base portion 60 is attached to base portion 20, then wall 62, boss 66 and wall 65 are inserted into recess 22a, depression 22b and recess 23a, respectively. See Figure 8. Arms 63 and 64 engage with projections 25a and 25b on base portion 20. Projection 46b on yoke 46 is pressed into positioning hole 61a in base portion 60. The front surface of projection 67 on base portion 60 combines with projection 22c on base portion 20 to form a backward C-shaped structure. This structure encloses the upper end of elastic element 56 of hinged spring 55 so that it cannot go any further.

With this design, contact mechanism 30 is segregated from electromagnetic block 40 and movable member 50 by L-shaped wall 62 on base portion 60, and a long isolation distance is maintained.

Furthermore, the base of fixed contact element 31 is segregated from the base of movable contact element 35 by T-shaped wall 65, which further increases the isolation distance and improves the isolation characteristics.

The width of the bottom surface of base 10, which is formed by attaching base portion 20 to base portion 60, is identical to that of flange 42a on electromagnetic block 40. See Figure 13 (c). The lower surface of base 10 and the outer walls of flange 42a on block 40 form the lower surface of the electromagnetic relay and fully occupy case 80, which shall be discussed presently. Lower surface portion 11, which consists of the bottoms of base portions 20 and 60 and the outer walls of flange 42a on electromagnetic block 40, has an entirely level surface. This makes it easier to apply the sealant.

Referring now to Figure 11, there is shown a card 70 which is a flat component of molded resin with two holes, 71 and 72, on its ends. A boss 73 on its lower surface serves to position the card correctly. From one edge of hole 71, a tooth 74 projects toward the center of the card to anchor the card to the relay. Half of the other hole, hole 72, is narrowed to form a stop.

The upper end of movable contact element 35 engages in hole 71 of card 70. See Figure 12. Tooth 74 engages in hole 36. When narrow neck 52 of movable member 50 engages in hole 72, the member is locked into the narrow portion of the hole. Boss 73 on card 70 comes up against boss 22d on base portion 20 to control the position of the card.

At this stage various tests are performed to determine whether the relay has certain operating characteristics. If it does not meet specifications, then movable contact element 35 is adjusted.

Referring back to Figure 1, case 80 is made of resin molded in the shape of a box. It encloses base 10, which is formed by attaching base portions 20 and 60, and electromagnetic block 40.

As can be seen in Figure 13 (c), base portions 20 and 60 and electromagnetic block 40 engage with case 80. A sealant (not shown) is then applied to lower surface portion 11. When it hardens, the relay is sealed. Any interior gases are removed via hole 81 on the upper surface of case 80. The relay is then heat-sealed, and the assembly process is completed.

We shall next discuss the operation of an electromagnetic relay internally configured as described above.

When no voltage is applied to coil 43 in electromagnetic block 40 so that the coil is not magnetized, the spring force of movable contact element 35 is transferred through card 70 to draw movable member 50 to the left in the view shown in Figure 12. In this state, movable contact 37 is separated from fixed contact 32. Boss 73 on card 70 is up against boss 22d on base portion 20. This insures the correct positioning of movable contact element 35.

When voltage is applied to coil 43 in the electromagnetic block 40, magnetic flux is generated, and movable member 50 is drawn toward the end of the vertical extremity of yoke 46. In opposition to the spring force of movable contact element 35, movable member 50 rotates on the fulcrum of 41a, the horizontal extremity of core 41. Through card 70, movable contact element 35 is also made to rotate. As a result, movable contact 37 is pulled against fixed contact 32 and movable member 50 is pulled against the vertical extremity of yoke 46, closing the magnetic circuit.

When the voltage being applied to coil 43 in electromagnetic block 40 is cut off, the flux vanishes. Through card 70, the spring force of movable contact element 35 draws movable member 50 back so that it rotates in the opposite direction from its previous rotation. As a result, movable contact 37 separates from fixed contact 32, and boss 73 on card 70 again abuts boss 22d on base portion 20 to return the relay to its original state.

In the embodiment we have been discussing, base portion 20 has two recesses in its central region to enhance isolation, 22a and 23a, and we have discussed walls 62 and 65 in the central region of base 60. The design of the isolation devices, however, is not limited to this case only. The same walls could just as well be provided on the opposite base portion.

The invention disclosed above has the following features. As should be clear from the above explanation, the electromagnetic relay related to the invention has a wall which engages in a groove between the contact mechanism and the electromagnetic block. This segregates and electrically isolates the two halves of the relay. This design allows realization of an electromagnetic relay whose isolation characteristics are superior to those of previous relays and which is easier to produce.

Because the two halves of the base are detachable along the axis of their width, the internal components may be positioned in one of the base portions before the other portion is attached to it. This design allows us to achieve a slender electromagnetic relay with a small surface area, and which is nevertheless easily assembled and which contributes to high productivity.

Because the base is divided into two separable portions, the base portions are easier to form. Unlike its predecessors, this relay does not require a complicated side core be used as the mold, so its production cost is lower.

With the invention disclosed in Claim 2, not only is the contact mechanism isolated from the electromagnetic block, but the floor segment of one of the base portions is also partitioned to enhance isolation. This further increases the isolation distance and effectively prevents dielectric breakdown between the engaged surfaces of the base portions.

With the invention disclosed in Claim 3, the isolation distance between the base of the movable contact element and that of the fixed contact element is increased by the presence of a wall which engages in a groove. This further improves the isolation characteristics.

With the invention disclosed in Claim 4, not only the bases of the movable and fixed contact elements are partitioned off, but the floor segment of one of the base portions is also partitioned off. Just as with the above-mentioned improvements, this increases the isolation distance and further improves the isolation characteristics.

With the invention disclosed in Claim 5, the two base portions can be separated or attached along the axis of the width. This makes it easier to attach the base portions to each other and allows us to achieve a relay which enhances productivity.

With the invention disclosed in Claim 6, the hinged spring can be made more efficiently.

While the invention has been described in detail with reference to a preferred embodiment, it should be apparent to those skilled in the art that many modifications and variations are possible without departure from the scope and spirit of this invention as defined in the appended claims.

Claims

1. An electromagnetic relay in which a card is moved back and forth by a movable member which itself moves with magnetization and demagnetization of an electromagnetic block, and a movement of said card drives a contact mechanism of said electromagnetic relay, comprising:

   a first base and a second base which sandwich said electromagnetic block and said contact mechanism;
   a first groove provided on an inner wall of said first base which is located between said contact mechanism from said electromagnetic block for isolation; and
   a tongue provided on an inner wall of said second base which engages with said first groove.

2. An electromagnetic relay according to claim 1, wherein said first groove is shaped like a letter "L" or a letter "T".

3. An electromagnetic relay according to claim 1, further comprising a second groove on said inner wall

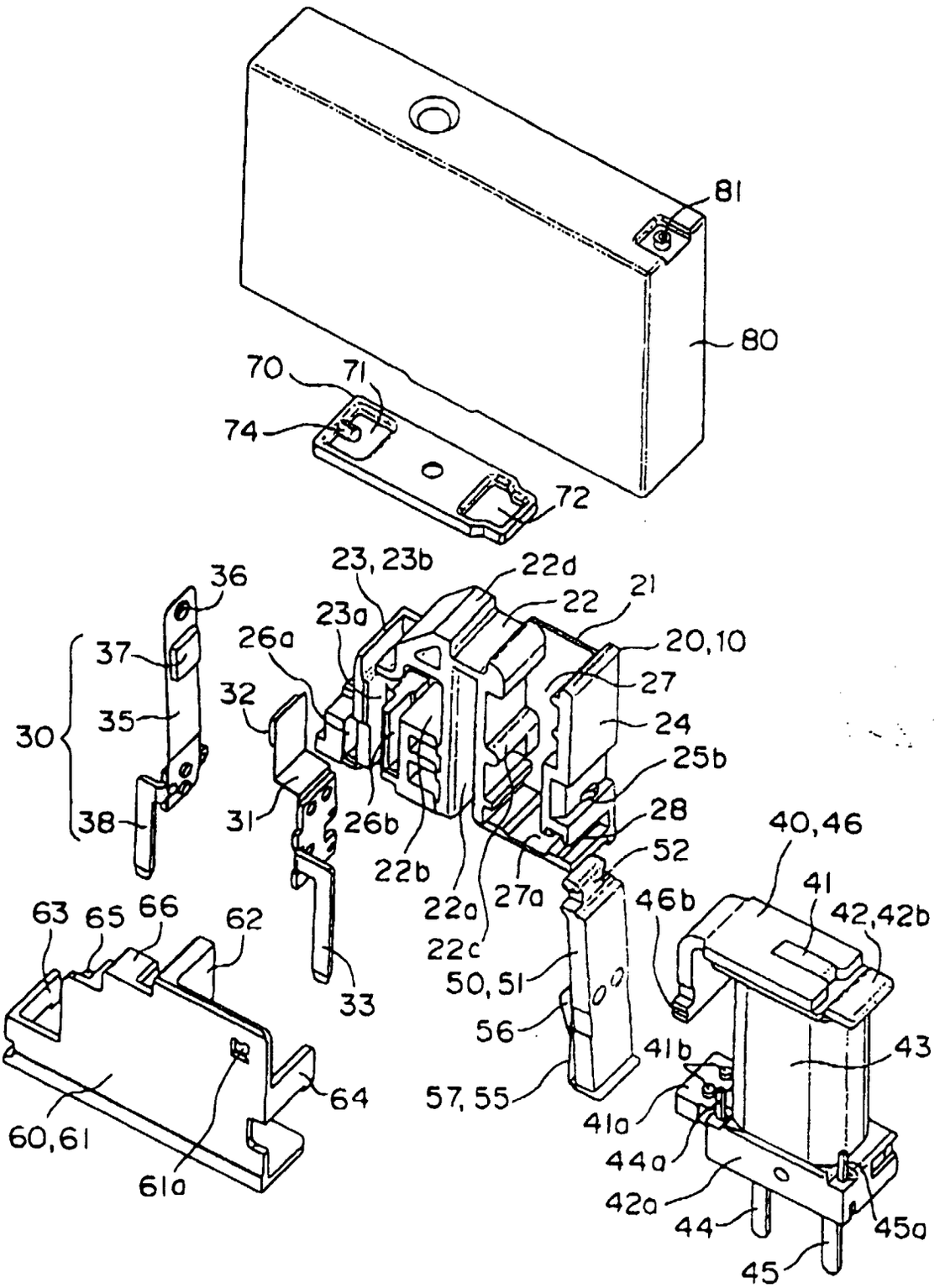
of one of said first base or said second base which is located between a base portion of a movable contact element and a fixed contact element with which said contact mechanism is formed, and a second tongue on said inner wall of the other opposing one of said first base or said second base for engaging with said second groove.

4. An electromagnetic relay according to claim 3, wherein said second groove is shaped like a letter "L" or a letter "T".

5. An electromagnetic relay according to claim 1, wherein said first and second bases elastically engage with each other.

6. An electromagnetic relay according to claim 1, further comprising a movable member having a hinged spring which comprises an elastic element formed by stamping out a portion of said hinged spring.

FIGURE 1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22c
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FIGURE 2

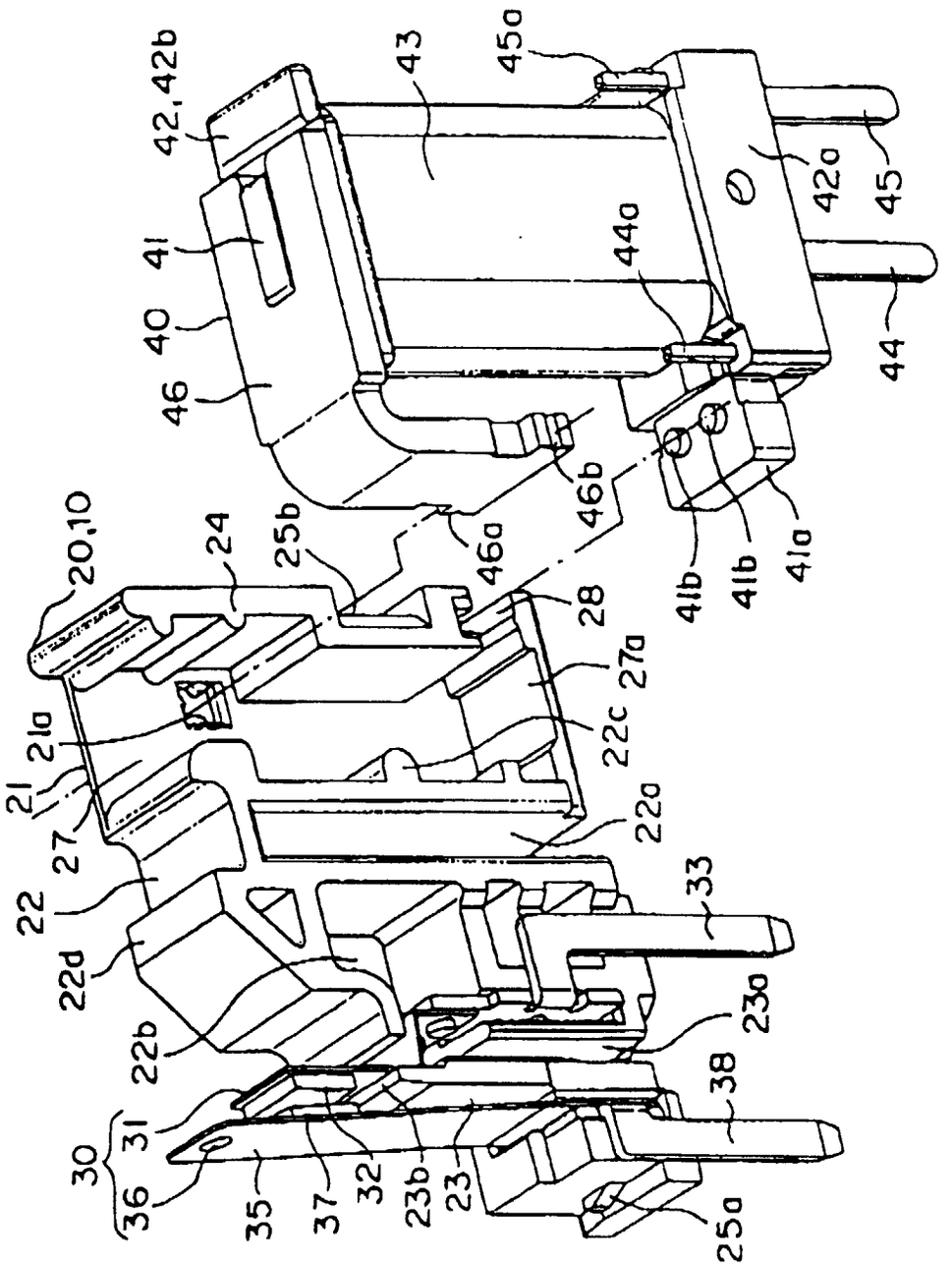
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FIGURE 3

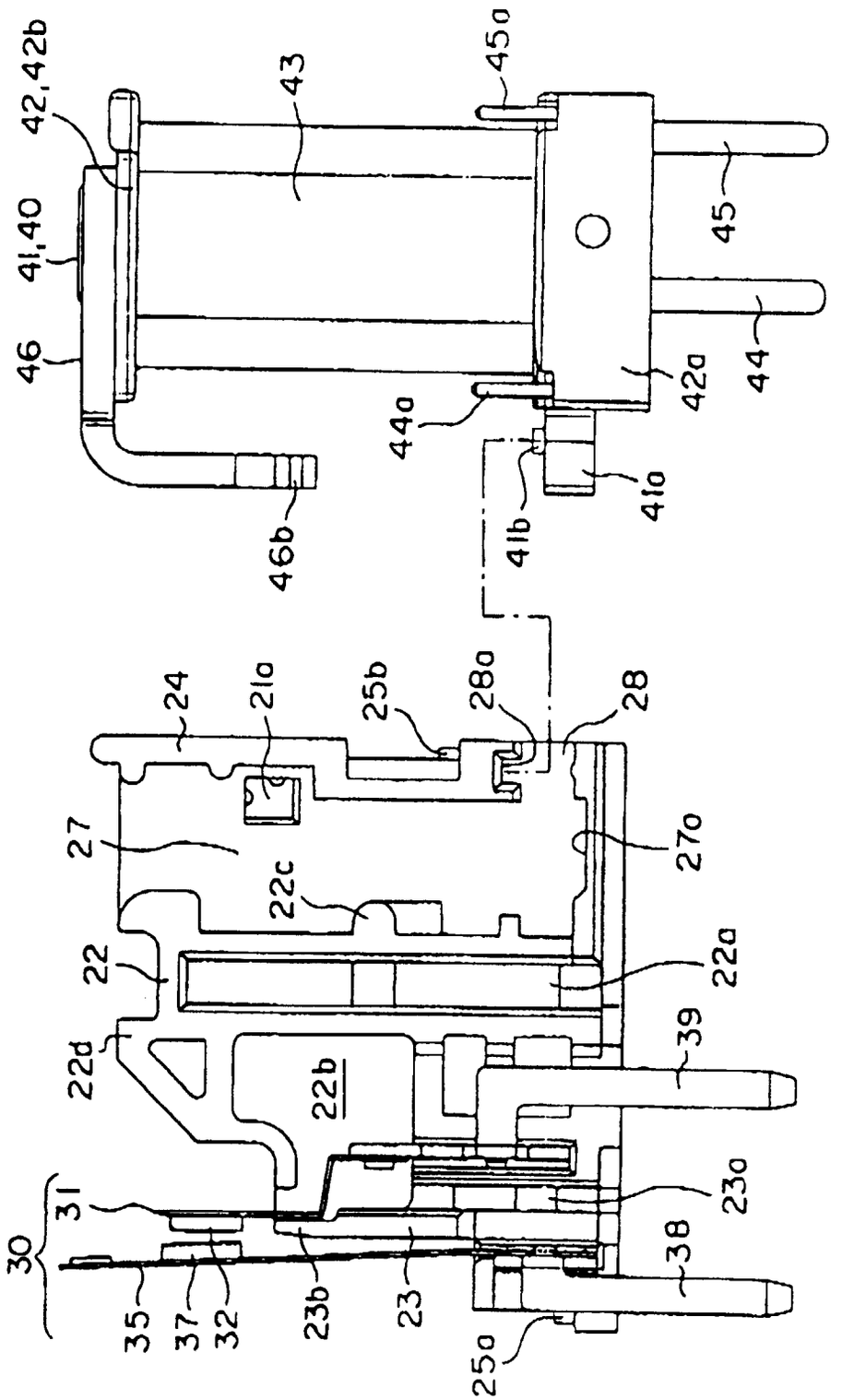
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FIGURE 4

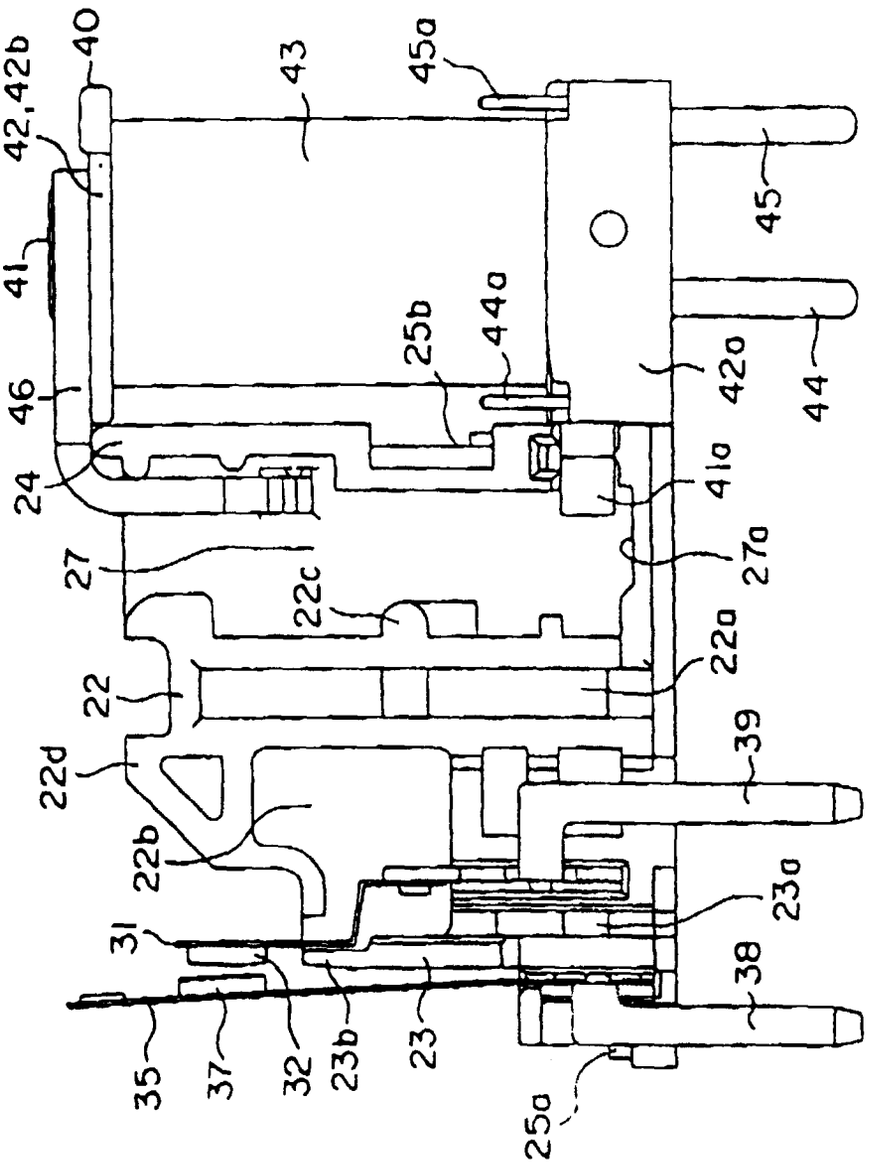
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FIGURE 5

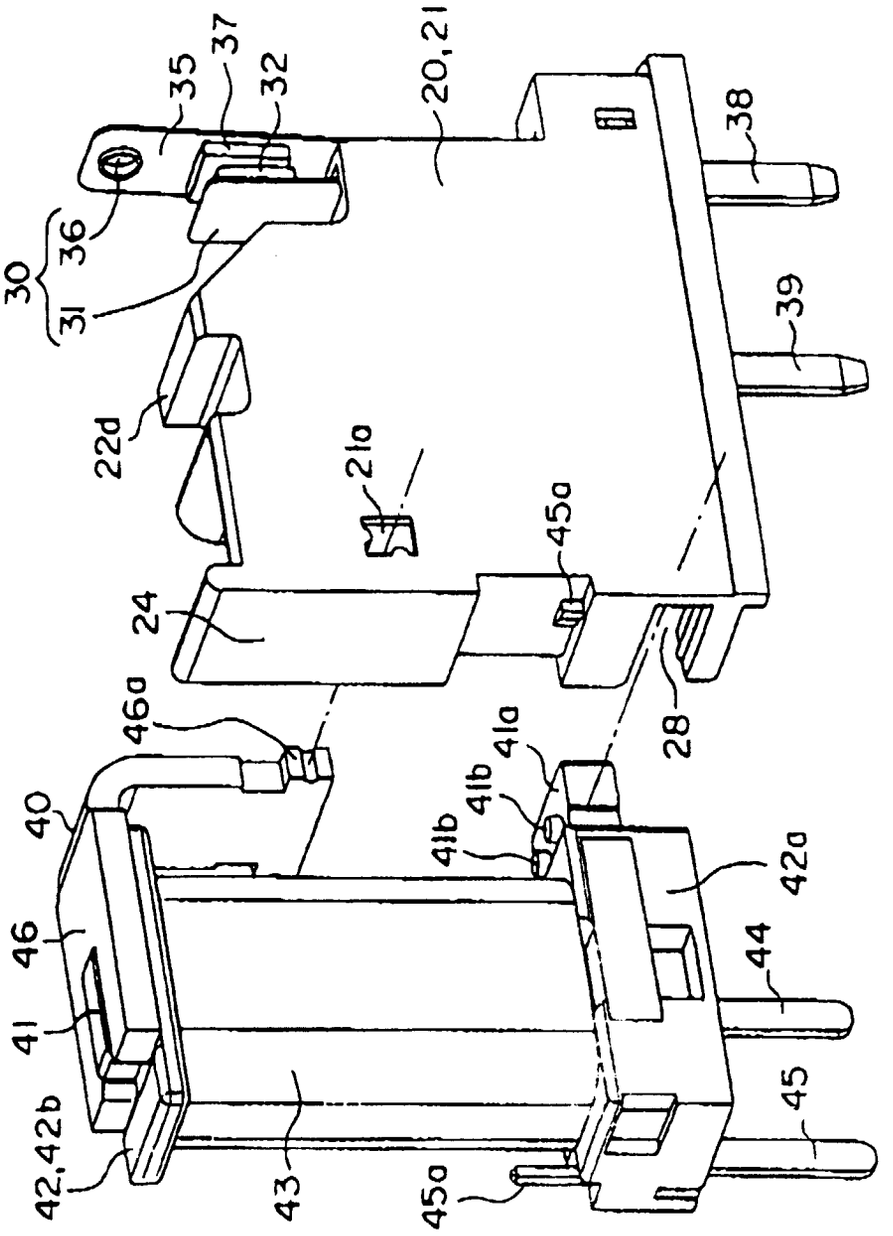
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FIGURE 6(A)

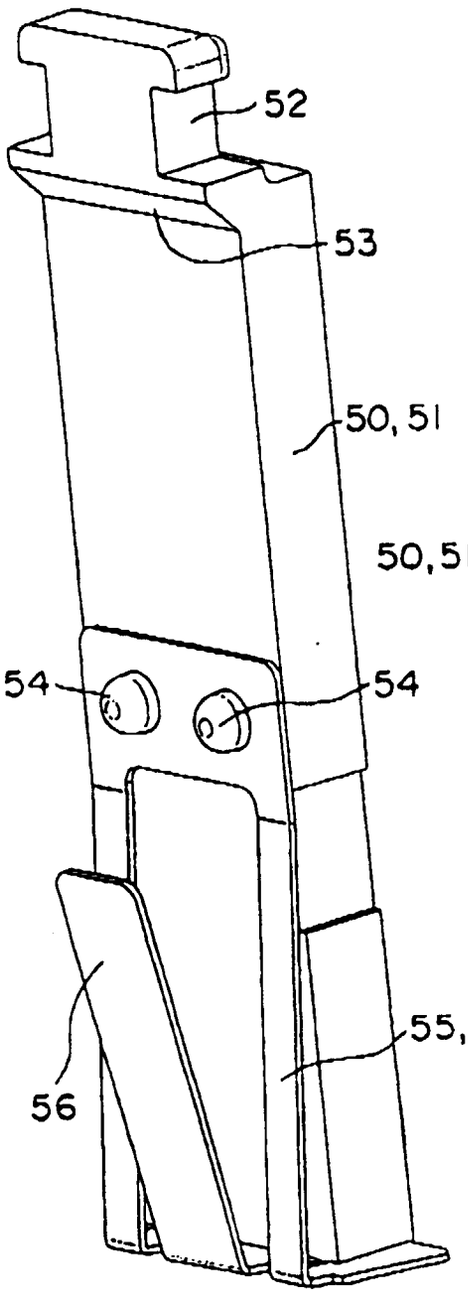

FIGURE 6(B)

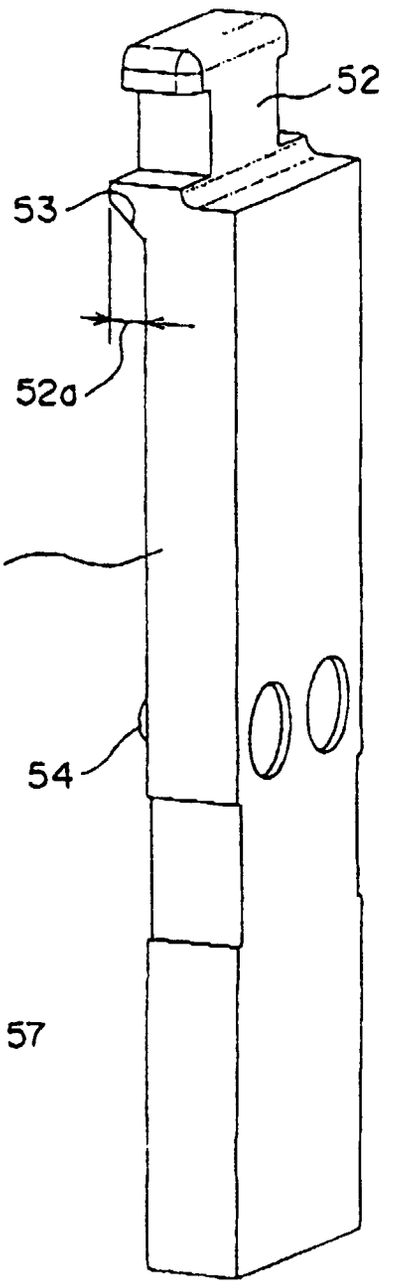

FIGURE 7(A)

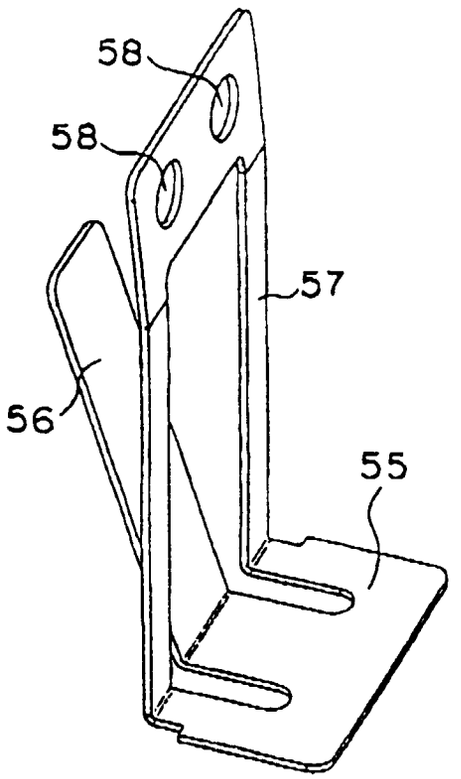

FIGURE 7(B)

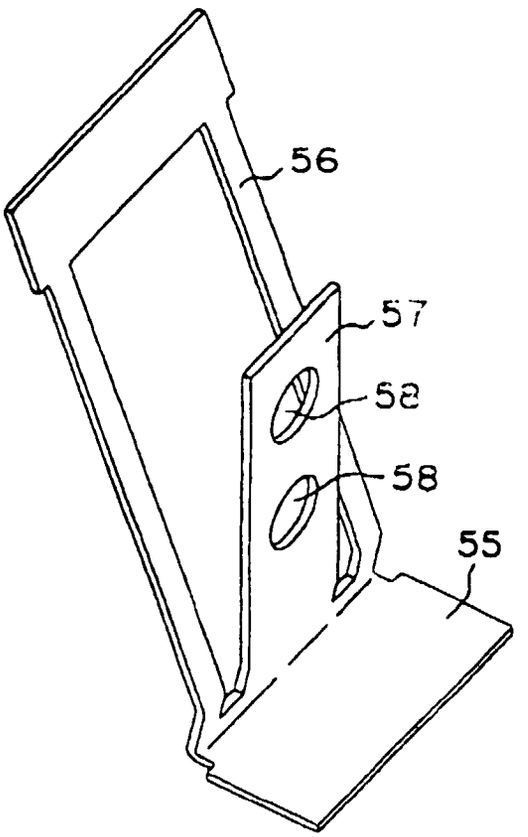

FIGURE 8

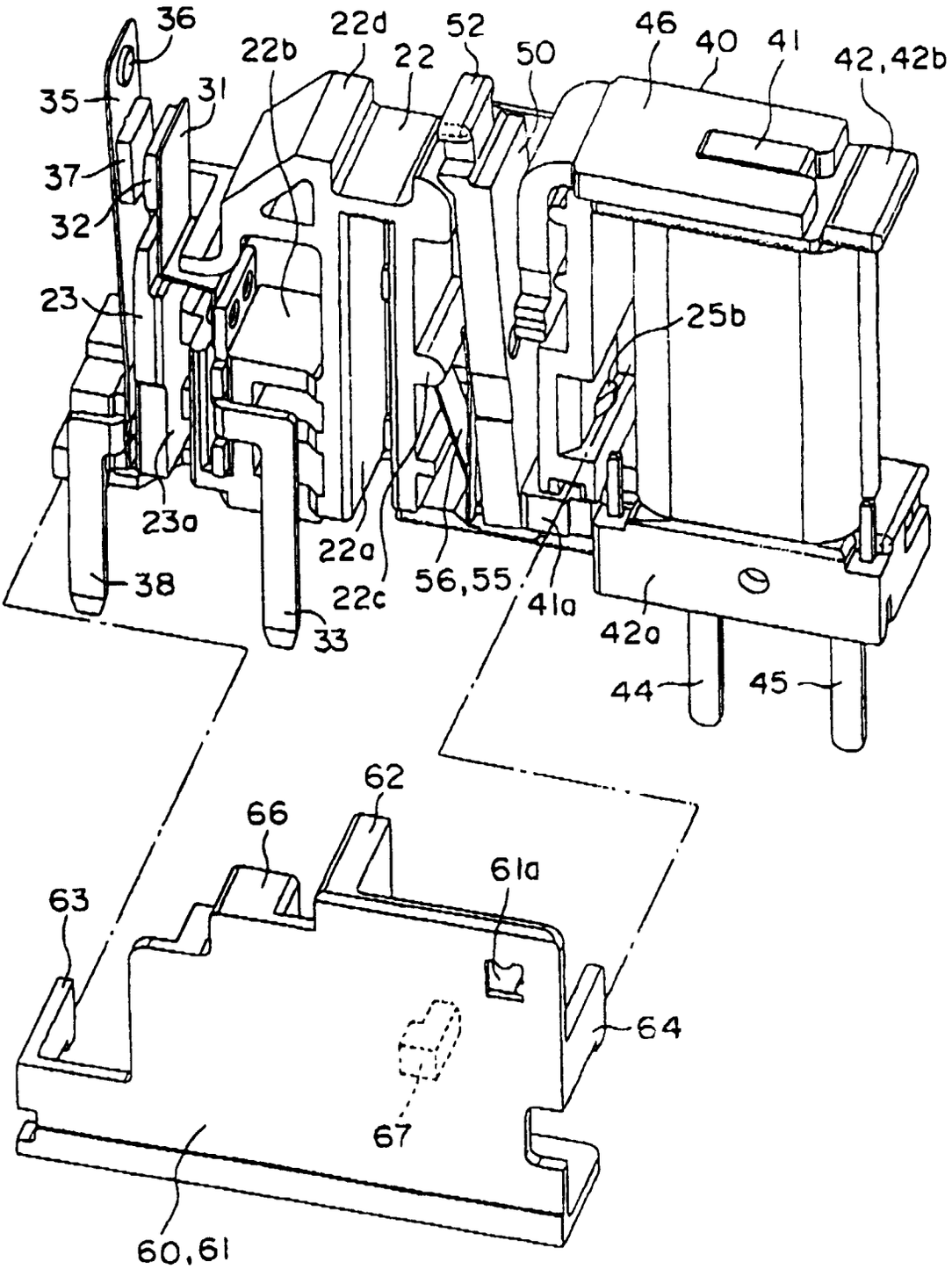
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FIGURE 9

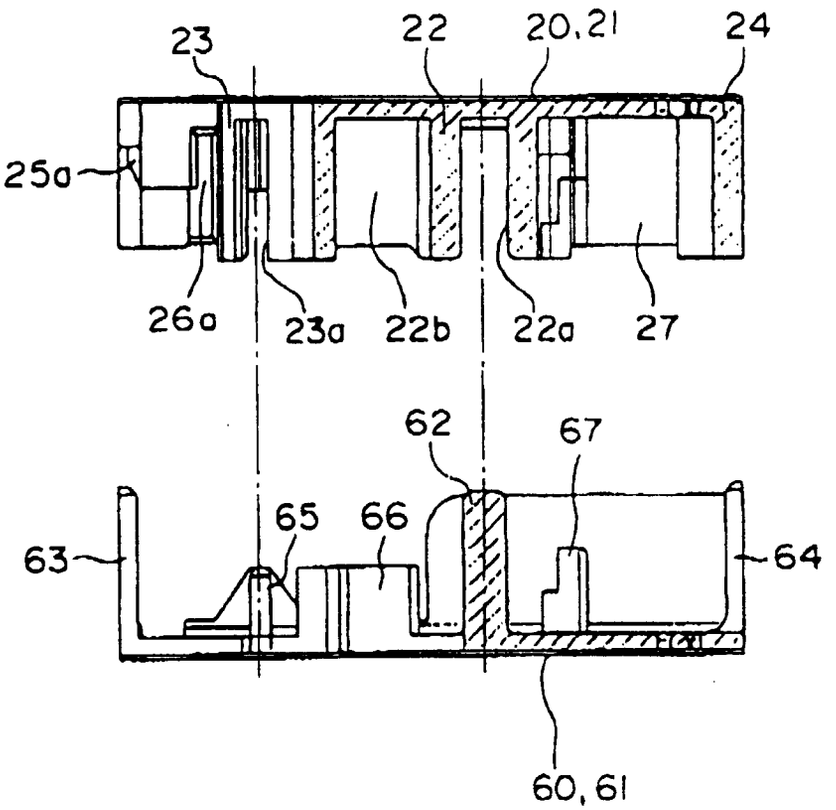

FIGURE 10

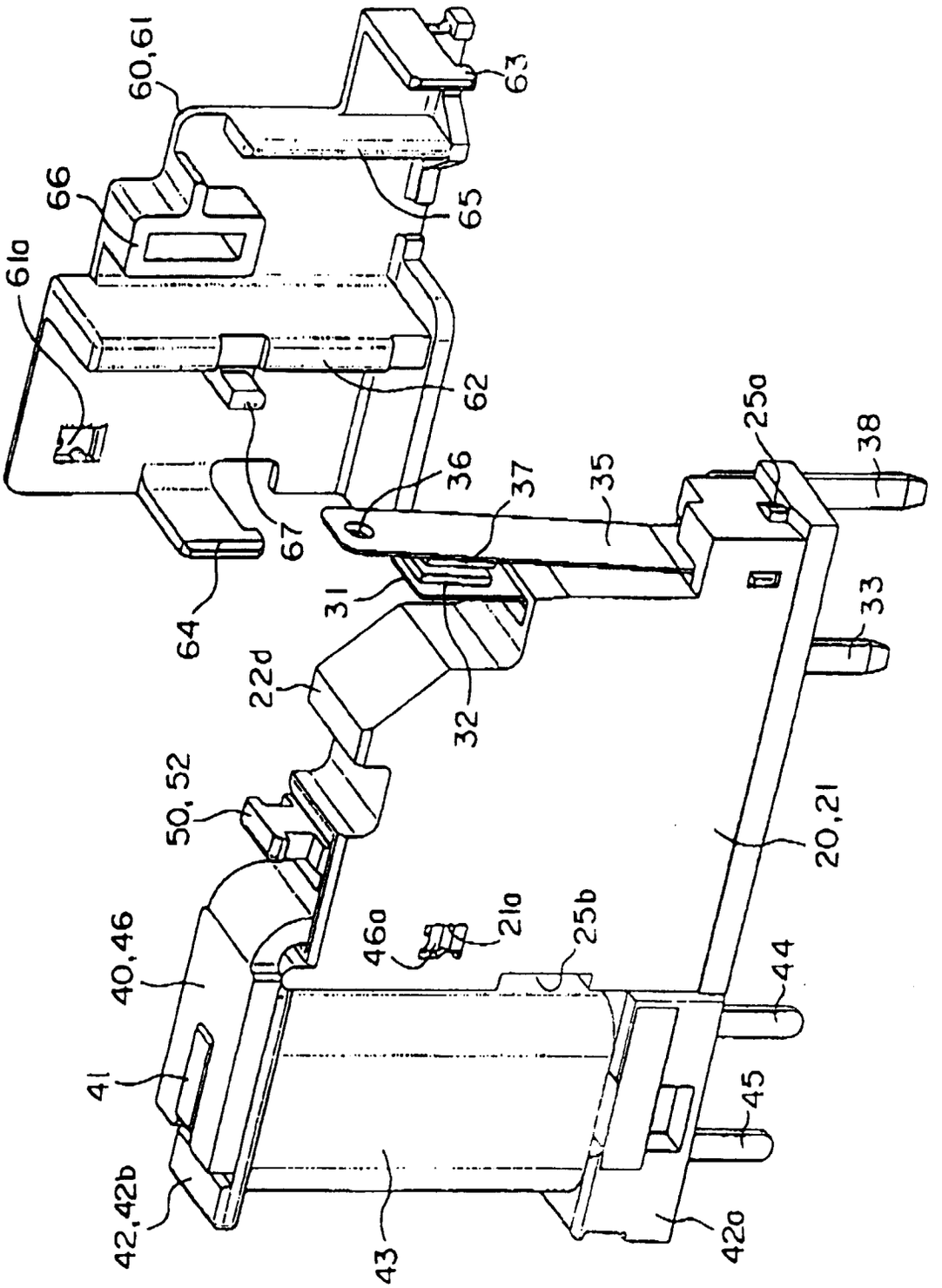
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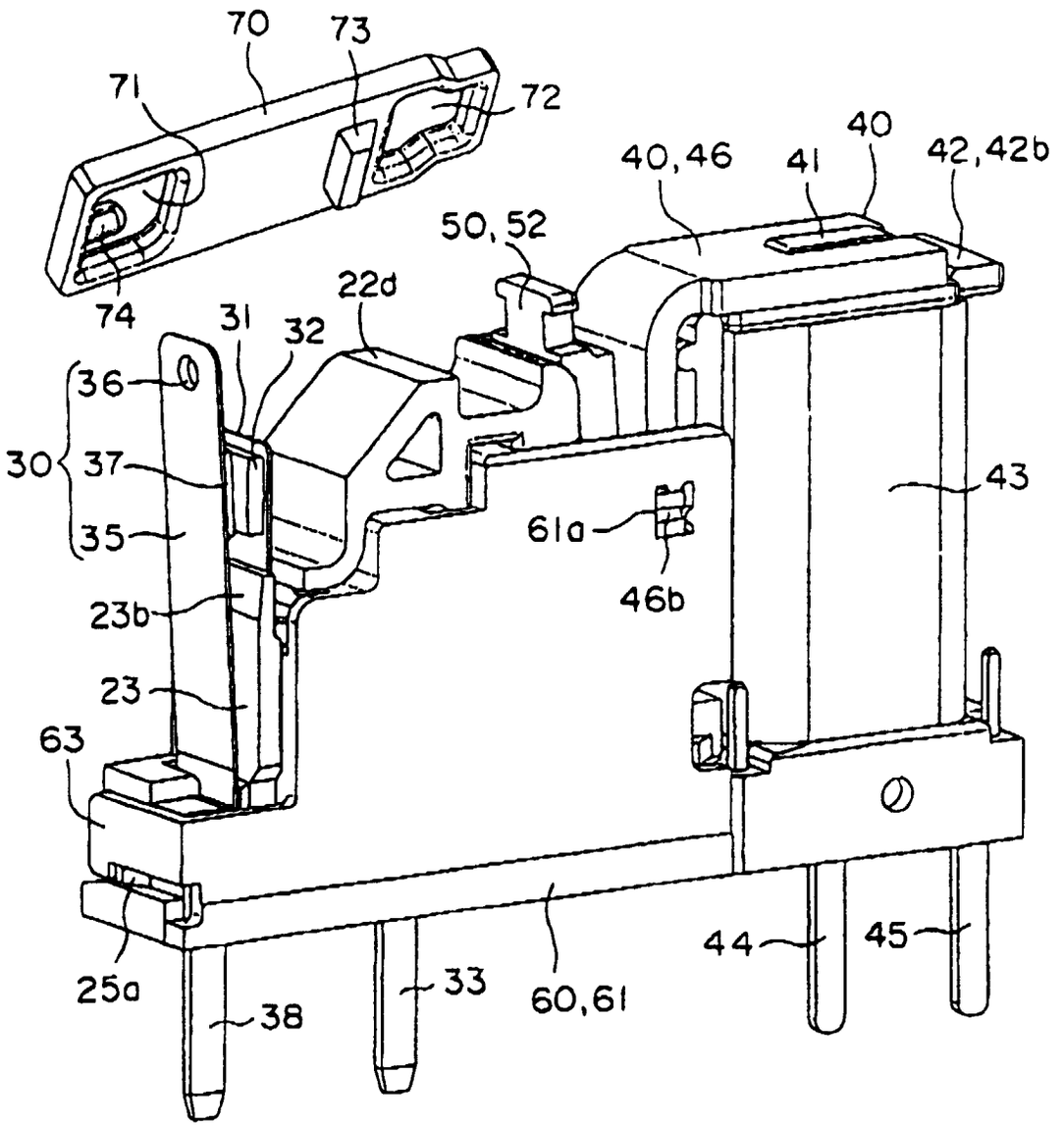
FIGURE 11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33
60,61
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45

FIGURE 12

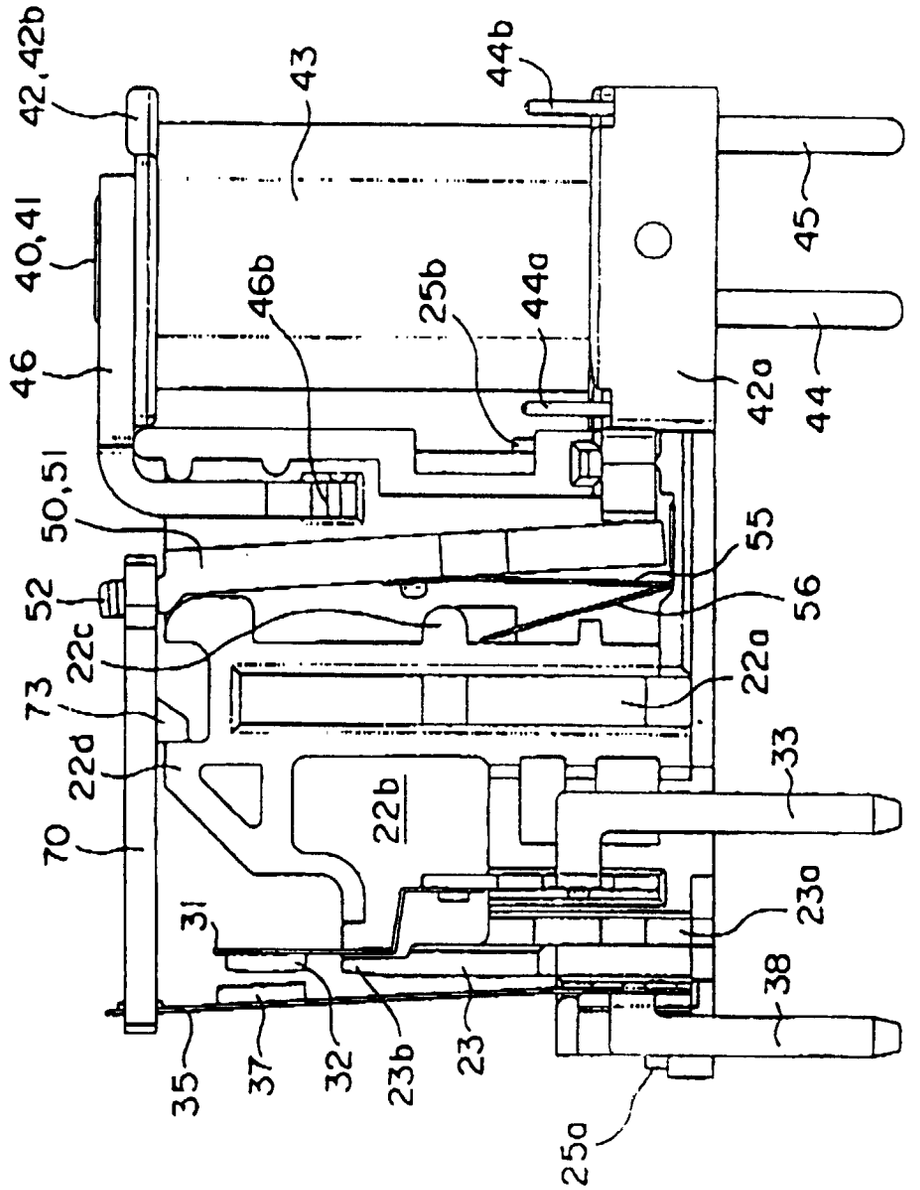

42,42b
43
44b
45
40,41
46b
25b
44a
46
42a
44
50,51
55
52
56
22c
22a
73
22d
33
22b
70
23a
31
38
35
37
32
23b
23
25a

FIGURE 13(A)

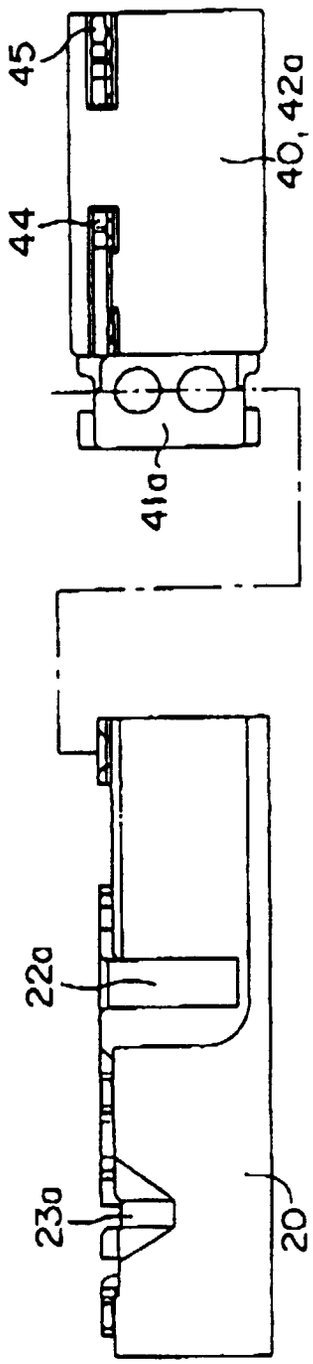


FIGURE 13(B)

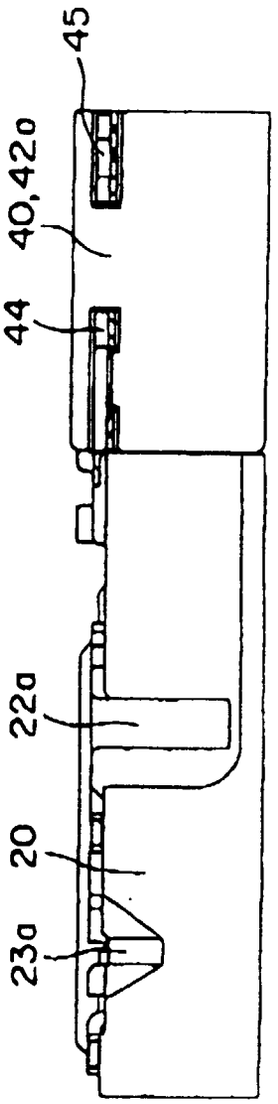
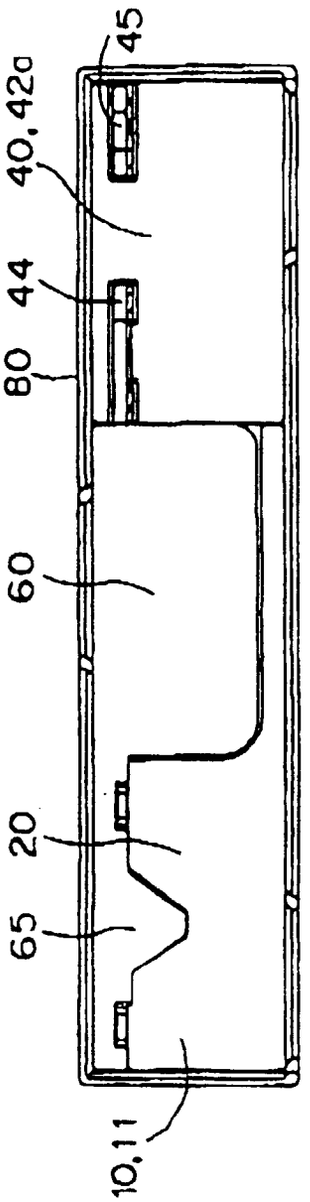


FIGURE 13(C)



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 10 0320

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US 4 316 164 A (ESSLER RICHARD) * column 2, line 46 - line 68; figure 1 * ---	1	H01H50/02
A	EP 0 727 800 A (MATSUSHITA ELECTRIC WORKS LTD) * abstract; figure 1 * ---	1	
D,A	DE 38 35 105 A (FUJI ELECTRIC CO LTD) * claim 1; figure 1 * -----	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	20 April 1998	Mausser, T

CATEGORY OF CITED DOCUMENTS

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L : document cited for other reasons

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