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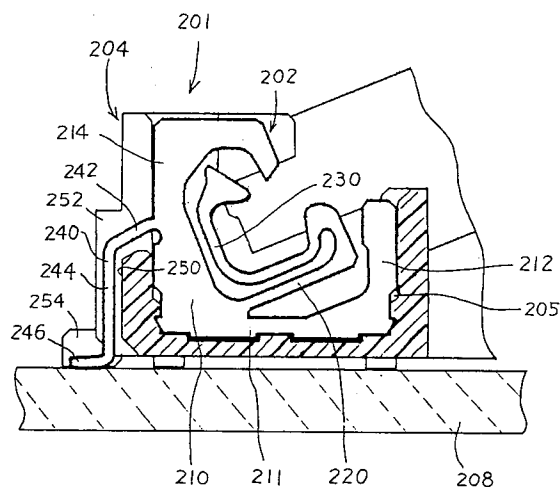
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(54) **Contact element for edge connectors.**

(57) An electrical edge connector (201, 301, 401, 501, 601) having a plurality of electrical contact members (202, 302, 402, 502, 602) secured in a dielectric housing (204, 304, 404, 504, 604) for receiving an edge of a daughter card (406), the contact members including an outer C-shaped contact member (210, 310, 410, 510, 610) and an inner C-shaped contact member (230, 330, 430, 530, 630) coupled to said outer C-shaped contact member and having opposing contacts for engagement with the daughter card, wherein said outer C-shaped contact member (210, 310, 410, 510, 610) includes side sections (212, 214, 312, 314, 412, 414, 512, 514, 612, 614) extending along inside surfaces of said housing (204, 304, 404, 504, 604) and a connecting member (240, 340, 440, 540, 640) as part of one of the side sections (212, 214, 312, 314, 412, 414, 512, 514, 612, 614) extending along an external surface of a side wall (250, 350, 450, 550, 650) of said housing for electrical connection to a conductive area of a mother board (208, 308, 408, 508, 608).

*Figure 3***EP 0 675 572 A2**

The present invention refers to electric contact elements for edge connectors which receives the edge of a daughter card on which is loaded, for example, a memory module, and is used to connect electrically the memory module to the circuits on a motherboard to which the connector is attached.

A variety of electric contact elements for edge connectors have been used thus far. However, there have been no proposals for electric contact elements for edge connectors which are versatile enough to handle the wide variations in thickness of daughter cards.

U.S. standards for the thickness of daughter cards are $1.27 \pm 0.1/-0.08$ (mm) and Japanese standards are $1.2 \pm 0.15/-0.12$ (mm). An electric contact which could handle differences in thickness of approximately 0.3 mm would be required to conform to these two sets of standards. Conventional electric contact elements, however, have not been able to handle this difference in thickness sufficiently.

An example of this type of connector is the electric contact element used for the low insertion input connector as described in U.S. Patent No. 4,737,120. In this connector, the edge of the daughter card were clamped by two electric contact surfaces which faced each other. However there was practically no leeway for one of the electric contact surfaces to deform. The contact part of the other electric contact part which made contact with the root part (which was deformed) was close by so that no significant resilient deformation was possible. When this was significantly deformed, there were problems in that the base part was subjected to plastic deformation or was damaged so that it could not handle the wide variations in thickness of the daughter card.

The electrical contact element which is used in the connector disclosed in Laid-Open Japanese Patent No. 60-230378 and in Laid-Open Japanese Patent No. 63-193473 features a support part between (a) the C-shaped contact member which accepts the edge of the daughter card and (b) the base part which supports the C-shaped contact member which is short. As a result, there is the likelihood that stress will concentrate on the support part and plastic deformation will take place. The elastic deformation of the electric contact element relies only on the C-shaped contact member so that (a) there are limitations on the amount of plastic deformation and (b) the electric contact element cannot handle the wide variations in thickness of the daughter card.

Next, Laid-Open Japanese Patent No. 63-193473 discloses an electric contact element for a connector which is soldered onto the surface of the motherboard to which the edge connector is at-

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tached (the "surface mounting type" of connector, hereafter referred to as "SMT"). In this connector, the bottom surface of the base part of the electric contact element is soldered directly to the motherboard. However, there are problems with this when there are variations in temperature. There is the possibility that temperature cracks will appear on the soldered part which is interposed between the motherboard and the base part of the electric contact part caused either by the difference in the thermal expansion coefficient of the electric element and the motherboard or due to the fact that the external force when the motherboard is mounted onto the connector is applied directly to the base part of the electric contact element thus breaking the connection.

Therefore, it is an object of the present invention to take into consideration the above-mentioned problems and provide an electric contact element for edge connectors which can handle the wide variations in thickness of the daughter card by increasing the amount of resilient deformation. It is yet another object of the present invention to provide an electric contact element for edge connectors which holds in check the occurrence of soldering cracks which occur when the SMT (surface mounting type) is used.

The electric contact element for edge connectors in the first invention is equipped with (a) a C-shaped first contact device which comprises a first part and a second part which extend upward from both ends of the base part which is fixed to the bottom part of the cavity of the housing; (b) a C-shaped second contact device which is coupled to the front end of the elastic or resilient support part which extends from the side of the above-mentioned base part of the first contact device at a sharp angle to the above-mentioned base part and (c) a connection device which protrudes onto the bottom wall of the above-mentioned housing from the above-mentioned base part of the above-mentioned first contact device and connects to the motherboard. It uses either of the above-mentioned first and second contact devices or both as a contact with the daughter card.

The electric contact element for edge connectors in the second invention is equipped with (a) a C-shaped first contact device which comprises a first and a second part which extend upward respectively from both ends of the base part which is fixed to the bottom part of the cavity of a housing; (b) a C-shaped second device which is coupled to the front end of an elastic or resilient support part which extends from the above-mentioned base part of the first contact device inside the above-mentioned first contact device; and (c) a device for connecting or a fixing to a motherboard which extends from the above-mentioned first or second

part of the above-mentioned first contact device to the outside of the above-mentioned housing. Either one of the above-mentioned first or second contact devices or both of them are used as a contact for the daughter card.

The invention shall now be described with reference to the following drawings:

FIGURE 1 is a side cross-section of the first embodiment of the invention;

FIGURE 2 is a side cross-section of the second embodiment of the invention;

FIGURE 3 is a side cross-section of another embodiment of the invention;

FIGURE 4 is a side cross-section of yet another embodiment of the invention; and

FIGURE 5 through FIGURE 7 are side cross-sections of other embodiments of the invention.

Figure 1 gives an overview of the electric contact element and the housing of the invention. Electric contact element 2 is pressed into housing 4 from the top at the position of arrow P and is forced into housing 4 and is retained on the bottom part of cavity 5 of housing 4 when convex part 2a (which is formed on the outside of both side surfaces of electric contact point 2) locks into the wall 4a of housing 4.

Electric contact element 2 is made up of (a) a C-shaped first connection device which comprises a second support column (second part) whose front end first extends upward from the first support column 12 (first part) which itself extends upward from one end of base part 11, then extends inside the electric contact element; (b) a resilient support part 20 which extends in a direct line from near the base part of the above-mentioned second support column 14 at a sharp angle to base part 11; and (c) a second contact device 30 which first extends to the front end of the above-mentioned second support column 14 from the front end of the part 20, then makes a U-turn, and then curves in a C-shape along the inside of the above-mentioned part 20 and the second support column 14.

Front end 20a of the above-mentioned part 20 faces the above-mentioned second support column 14 and forms the first contact. Front end 30a of the above-mentioned second contact device 30 faces the above-mentioned first contact 20a and extends to form the second contact. The inside 14a of front end of the above-mentioned second support column 14 faces the above-mentioned first contact 20a and forms a protrusion which serves as a reserve contact.

Daughter card 6 is inserted between the above-mentioned first contact 20a and the second contact 30a. These are connected to daughter card 6 by turning in the direction indicated by arrow Q. When the sheet of the above-mentioned daughter card 6 is thin, the surfaces of the first contact 20a and the

second contact 30a as well as the reserve contact 14a inside the front end of the above-mentioned second support column 14 are connected to the surface of the daughter card 6. The reserve contact 14a acts as an anti-overstress device which regulates the amount of deformation so that the above-mentioned second contact device 30 is not deformed excessively especially when a daughter card with a thick sheet is inserted.

Part 20 extends at a sharp angle to base part 11. The length of part 20 being long so that the amount of potential elastic deformation increases. Further, the electric contact element has a low profile and the connector can accordingly be of a low profile.

Electric contact element 2 is equipped with sliding surface 14b which is inclined toward part of the above-mentioned second support column 14 and which is opposite front end 30a of the above-mentioned second contact device 30. When this sliding surface 14b is deformed as the above-mentioned second contact device is mounted onto daughter card 6, it makes contact with the above-mentioned outside surface 30b and functions to slide front end 30a of the second contact device 30 along surface 6a of daughter card 6.

Daughter card 6 is inserted between the above-mentioned first contact 20a and the second contact 30a of electric contact element 2. The C-shaped second contact device 30 and part 20 deform elastically upon the daughter card being turned to the position indicating by 6'. The amount of deformation and the stress involved are dispersed to the above-mentioned second contact device 30 and to the rising part 20 so that (a) the amount of resilient deformation can be increased; (b) the wide variations in sheet thickness of daughter card 6 can be handled; and (c) an electric contact point can be realized which has reliable electric contact characteristics and which makes contact with both sides of daughter card 6 with great contact pressure.

The above-mentioned reserve contact 14a acts as an anti-overstress device for the above-mentioned second contact device 30. It prevents plastic deformation from extreme deformation by controlling the amount of deformation of the second contact device 30. The end 30b of the second contact device 30 makes contact with the sliding surface 14b and slides along surface 6a of daughter card 6. This makes it possible for daughter card 6 to be mounted smoothly even when there are scratches and other surface irregularities on surface 6a of daughter card 6 and prevents the above-mentioned second contact device 30 from excessive deforming and from plastic deformation.

Protrusions (not shown) are located on the inside surface 12a of the first support column 12 or

on plane 20b of the front end of rising part 20. These make contact with each other and are used as anti-overstress devices to prevent the above-mentioned rising part from deforming excessively.

Reference number 16 in Figure 1 indicates the tine part of electric element 2 which is soldered to motherboard 8. The figure also indicates tine part 17 (arrayed in zigzag fashion with tine part 16) on the electric contact element (not shown) adjacent electric contact element 2.

Figure 2 indicates a second embodiment. It indicates daughter card 106 which is clamped between first contact 120a and second contact 130a and which fits in last of all at position 106' which is parallel to the bottom surface of the housing. Since electric contact element 102 is configured exactly as element 2 except that the rising part 120 extends from the root part (near the base part) of the second support column 114 so that it is parallel to base part 111, we shall not go into detail about how it works since this is clear from the drawing.

The same reference numbers used for the contacts and other parts used with respect to element 2 correspond to the same parts in Figure 2.

Figure 3 indicates the first SMT embodiment. Electric contact element 202 is made up of (a) a C-shaped first contact device 210; (b) a rising part 220; and (c) a second contact device 230. In addition to this, it is made up of (d) an elongated part 242 which extends outside from the side part of the second support column 214 of the first contact device 210; (e) a rising part 244 which extends from the elongated part 242 downward along the wall 250 of housing 204; and (f) a soldering and junction part 246 which extends from part 244 outward so that it is almost parallel to the bottom surface of the above-mentioned housing 204; and it is equipped with connection device 240 for attachment to the motherboard.

In the above-mentioned connecting device 240, there is a comparatively long distance from the second support column 214 to the soldering and junction part 246. The space between elongated part 242 and part 244 is curved and the above-mentioned connecting device 240 has springlike characteristics. Therefore, when the daughter card is being mounted onto connector 201 (in particular, when a load is applied in the lengthwise direction of the above-mentioned connector 201), connection device 240 serves as a cushion so that the load is lightened and transferred to soldering coupling part 246. This prevents cracks from appearing in the solder which is interposed between soldering and junction part 246 and the substrate. In addition, of all the parts of electric contact element 202, only the bottom part 246 of connection device 240, which has a comparatively small surface area, makes contact with the motherboard. Little stress is

caused by the difference in the thermal expansion coefficient of the electric contact element and the motherboard even if there are temperature changes in the cooling process from soldering and fusing temperature until room temperature is reached. As a result, the danger of cracks forming in the soldering is held in check. In addition, connection device 240 is formed by blanking so that the dimensional accuracy can be upgraded more than with a connection device which is formed by bending.

Fluctuations in the position of soldering and junction part 246 can be reduced and the quality of the soldering and coupling conditions is stabilized.

The above-mentioned housing 204 is equipped with protecting wall 252 which is formed so that elongated part 242 and dropping part 244 from the above-mentioned connection device 240 are protected on both sides. the elongated part 242 and dropping part 244 are prevented from making contact with each other inadvertently and deforming when the connector 201 is being assembled or transported.

A bumper 254 is also located on both sides of housing 204 in at least the lengthwise direction and is prevented from touching the soldering coupling part 246 inadvertently when the connector 201 is being assembled or transported.

In this embodiment, no protective wall is placed on the sides of any of the soldering and coupling parts 246 and inspection of the soldering and coupling condition can be carried out easily.

The embodiment indicates the type in which the connection device extends outward from the second support column 214 of the first contact device 210. However, the connection device may be extended to the outside from the side part of the first support column 212 if necessary. In this case, if the electric contact elements are arrayed vis-a-vis each other, (a) the array pitch of soldering and junction part 246 becomes double that of the array pitch of the electric contact element, (b) the soldering and coupling pad area of motherboard 208 can be increased, (c) the reliability of the soldering and coupling can be upgraded and (d) the soldering and coupling condition can be easily inspected.

Figure 4 indicates another SMT (surface mounting type) embodiment. In this type, protrusion 360 extends downward from the bottom surface of housing 304 and locks into hole 309 which is located on motherboard 308. This is basically the same as the embodiment in Figure 3 for the surface mounting type. Therefore, we shall not give a detailed explanation of it.

Figures 4 through 7 all indicate embodiment of the mounting type in which the daughter card is clamped between the first contact and the second contact and is perpendicular.

In Figure 5, electric contact element 402 is equipped with connection device 440 which is made up of (a) elongated part 442 which curves from near the center of the side surface of the second support column 412; (b) dropping part 444 which extends downward from the front end of elongated part 442 and (c) solder junction part 446 which extends outward from dropping part 444.

Reference number 470 indicates a connection device for electric contact element (not shown) which is adjacent electric contact element 402. The advantages of arraying these two types of electric contact elements with one another have been discussed previously.

In Figure 6, electric contact element 502 is equipped with protrusion 509 which is located in housing 504 and is soldered and joined to the soldering surface of motherboard 508.

Except for soldering and junction part 546 on connection device 540, soldering and joining is carried out in the above-mentioned protrusion 580 so that the load on connection device 540 can be reduced even though a load is applied when connector 501 is used. The area of the bottom of the above-mentioned protrusion 580 is rather small compared to the area of the bottom of electric contact element 502 and so there is no danger of soldering cracks forming between protrusion 580 and motherboard 508.

Protrusion 582 is equipped with an electric contact element (not shown) which is adjacent electric contact element 502. The advantages of arraying these electric contact elements with one another have been discussed previously.

Figure 7 is an embodiment of yet another SMT type. In electric contact element 602, connection device 650 extends from the first support column 612 as in the previous example. It [electric contact element 602] is equipped with fixed device 690 which first extends outside from the side surface of the second support column 614 and then extends downward. The bottom surface 692 of the fixed 690 is soldered and joined to the soldering surface of motherboard 608. Since the fixed device 690 does not itself have any springiness, it receives most of the load applied to connector 601 and acts to reduce the load on connection device 640. The surface of the bottom 692 of fixed device 690 is comparatively small and there is little danger of soldering cracks forming. The connection device can extend from the second support column and the fixed device as well can extend from the first support column. Needless to say, this electric contact element and the above-mentioned electric contact element 602 can be arrayed with one another.

Incidentally, the protrusion and the fixed device indicated in Figure 6 and Figure 7 can be used respectively for the embodiment of the SMT in-

dicated in Figure 3 and Figure 4 and can be placed there if need be.

The bumpers indicated in Figure 3 and Figure 4 may also be placed in each of the SMT embodiments indicated in Figure 5 through Figure 7.

The first electric contact element for edge connectors in the present invention has the following characteristics. The elastic support part extends from near the base part of the first contact device at a sharp angle to the base part so that (a) the resilient support part is sufficiently long even in a low profile configuration and so that (b) the amount of potential elastic deformation can be increased. Therefore, the resilient support part is also subject to elastic deformation along with the C-shaped part of the second C-shaped contact device which makes contact with the daughter card, the amount of deformation and the stress involved are dispersed and the plastic deformation occurring is kept to a minimum. There is a large amount of potential resilient deformation so that it can handle the wide variations in sheet thickness of the daughter card inserted.

The second embodiment in the present invention has the following characteristics. It is equipped on the side part with a springy connection device. The external force applied when the connector is used is reduced by the connection device. It is effective in holding in check cracks which appear during soldering. It is easy to visually check from the outside to see whether the connection device and the motherboard are connected and it is highly reliable. Since the area on the bottom surface of the soldering and junction part of the front end of the connection part is small, the soldering cracks which cause variations in the thermal expansion coefficient between the motherboard and the soldering and junction part can be effectively held in check.

Claims

1. An electrical edge connector (201, 301, 401, 501, 601) having
 - a) a plurality of electrical contact members (202, 302, 402, 502, 602) secured in a dielectric housing (204, 304, 404, 504, 604) for receiving an edge of a daughter card (406), the contact members including an outer C-shaped contact member (210, 310, 410, 510, 610) and
 - b) an inner C-shaped contact member (230, 330, 430, 530, 630) coupled to said outer C-shaped contact member and having opposing contacts for engagement with the daughter card,

characterized in that

- c) said outer C-shaped contact member (210, 310, 410, 510, 610) includes side sections (212, 214, 312, 314, 412, 414, 512, 514, 612, 614) extending along inside surfaces of said housing (204, 304, 404, 504, 604) and a connecting member (240, 340, 440, 540, 640) as part of one of the side sections (212, 214, 312, 314, 412, 414, 512, 514, 612, 614) extending along an external surface of a side wall (250, 350, 450, 550, 650) of said housing for electrical connection to a conductive area of a mother board (208, 308, 408, 508, 608). 5 10
2. An electrical edge connector as claimed in claim 1, **characterized in that** a spring member (220, 320, 420, 520, 620) couples the inner C-shaped contact member (230, 330, 430, 530, 630) to said outer C-shaped contact member (210, 310, 410, 510, 610). 15 20
3. An electrical edge connector as claimed in claim 2, **characterized in that** one end of said spring member (220, 320, 420, 520, 620) is coupled to a junction of a side section (214, 314, 412, 512, 612) and abase section (211, 311, 411, 511, 611) of said outer C-shaped contact member (210, 310, 410, 510, 610) and the other end of the spring member is coupled to an inner end of said inner C-shaped contact member (230, 330, 430, 530, 630). 25 30
4. An electrical edge connector as claimed in claim 3, **characterized in that** said spring member (220) is at an acute angle with respect to said base section (211). 35
5. An electrical edge connector as claimed in claim 3, **characterized in that** said spring member (320) is parallel with respect to said base section (311). 40
6. An electrical edge connector as claimed in claim 3, 4 or 5, **characterized in that** said spring member (420, 520, 620) is parallel with respect to said side section (412, 512, 612). 45
7. An electrical edge connector as claimed in one of claims 1 to 6, **characterized in that** a securing section (690) extends from said side section (614) and along the external surface of another side wall of said housing (604) to a securing section on the mother board (608) for connection therewith to secure the connector thereon. 50 55

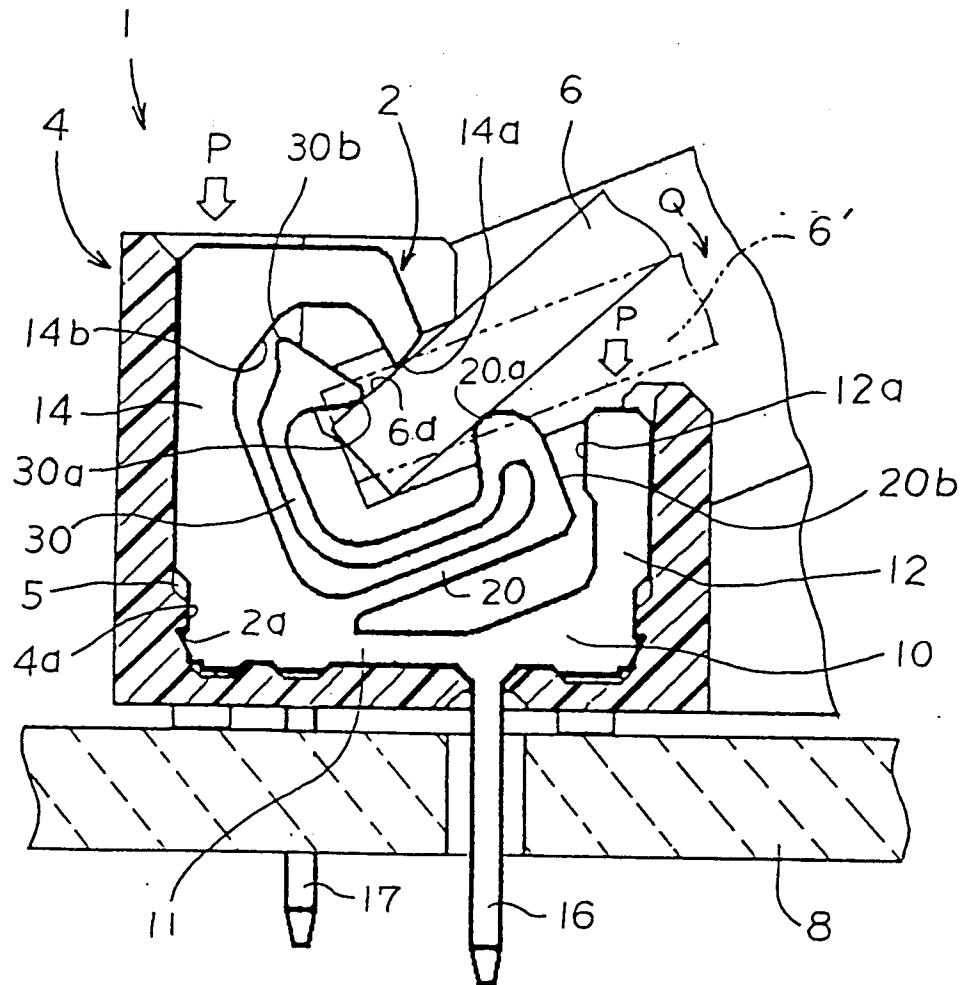


Figure 1

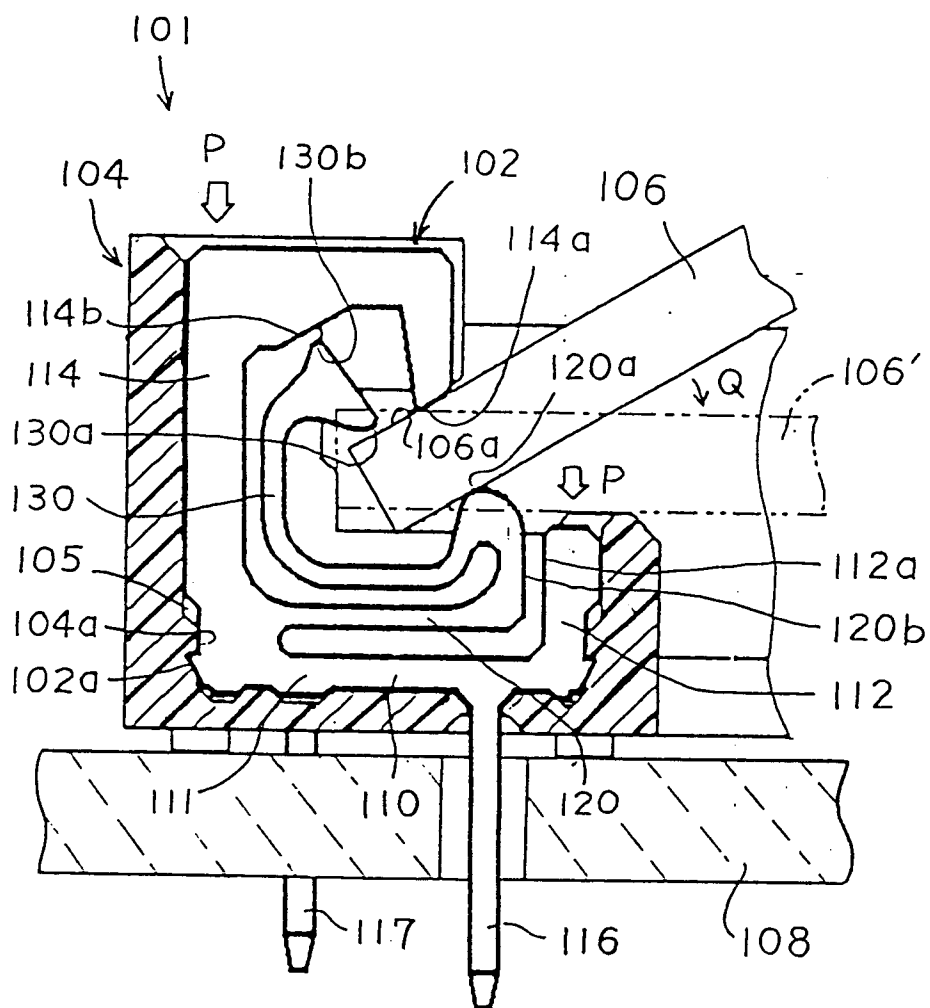


Figure 2

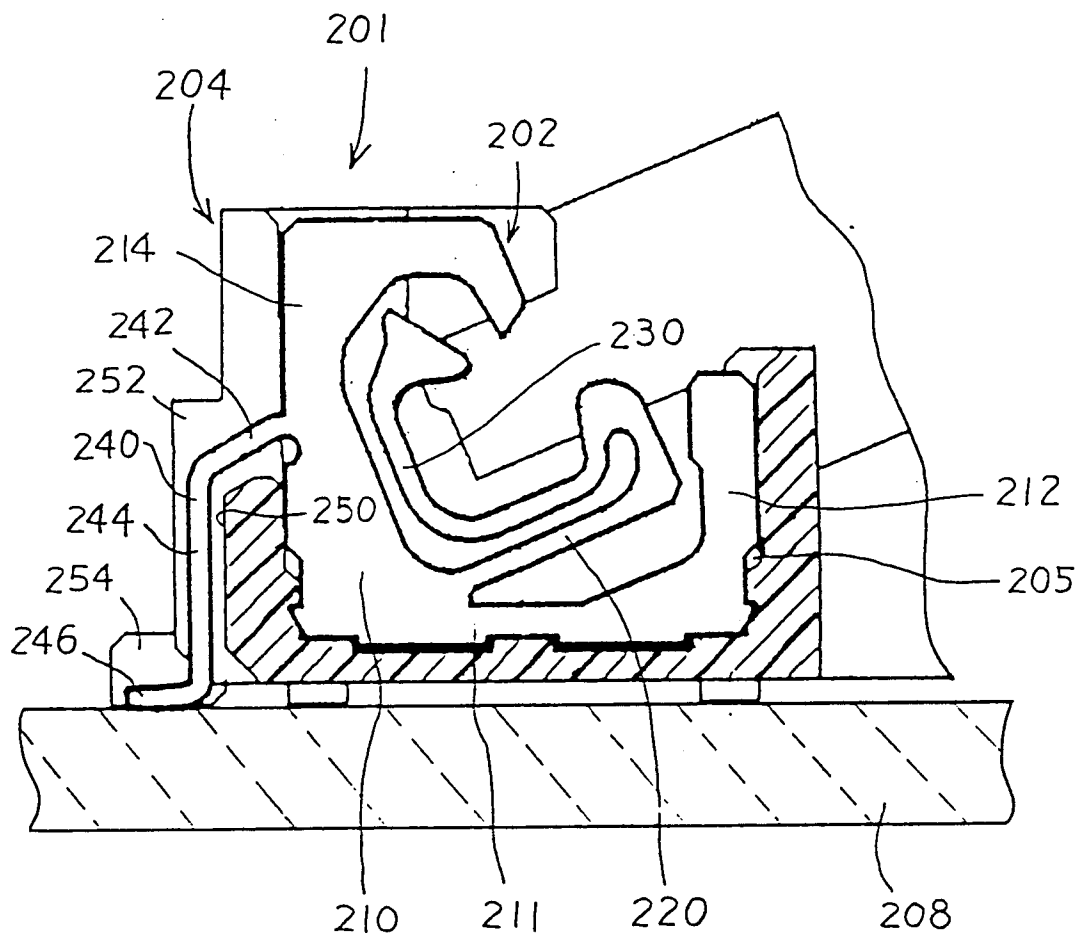


Figure 3

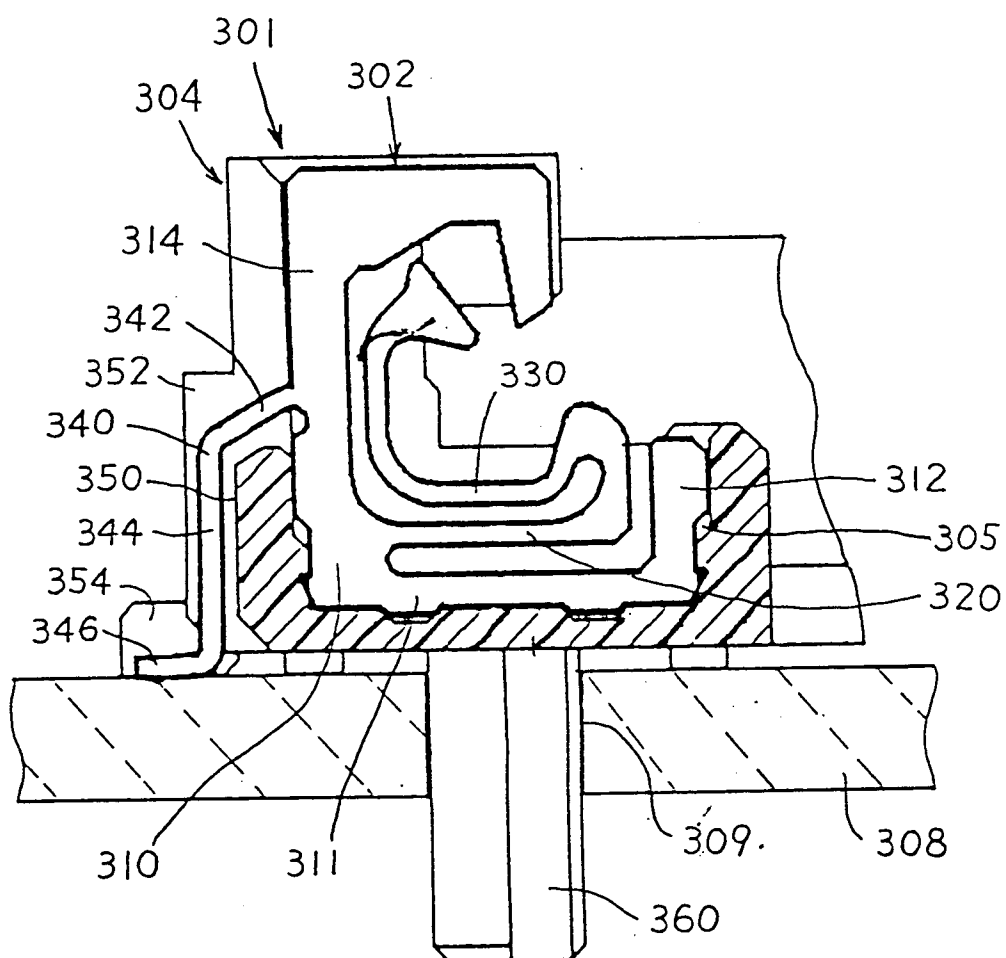


Figure 4

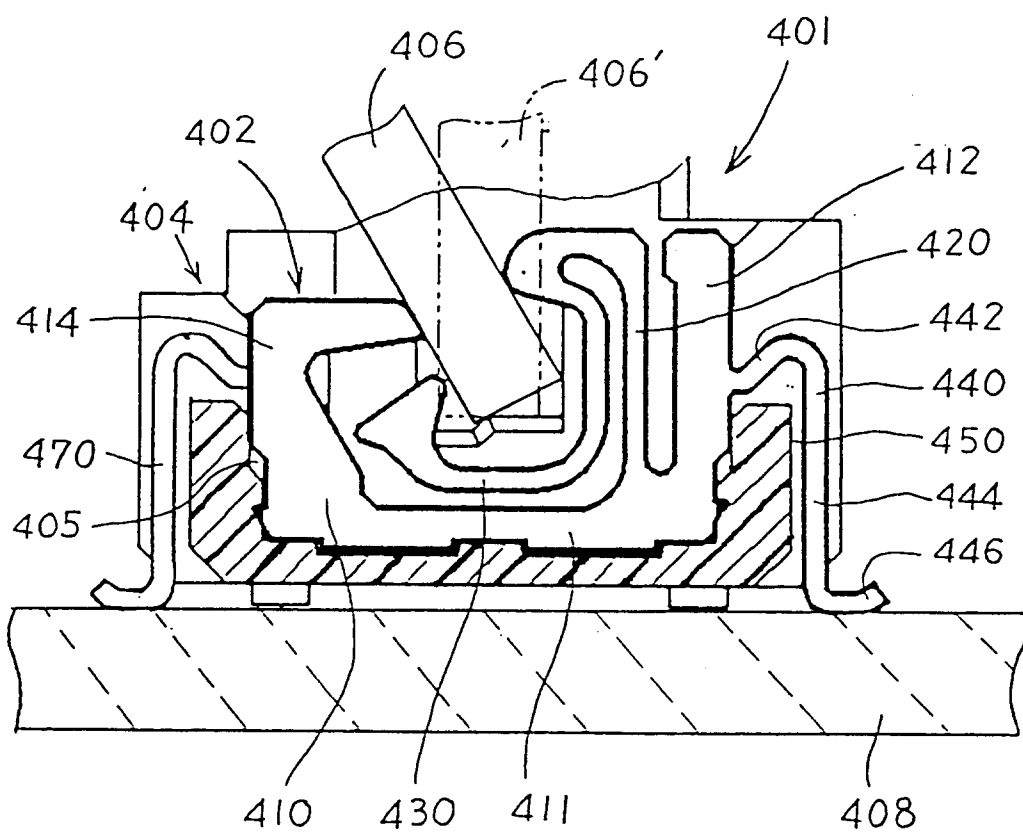


Figure 5

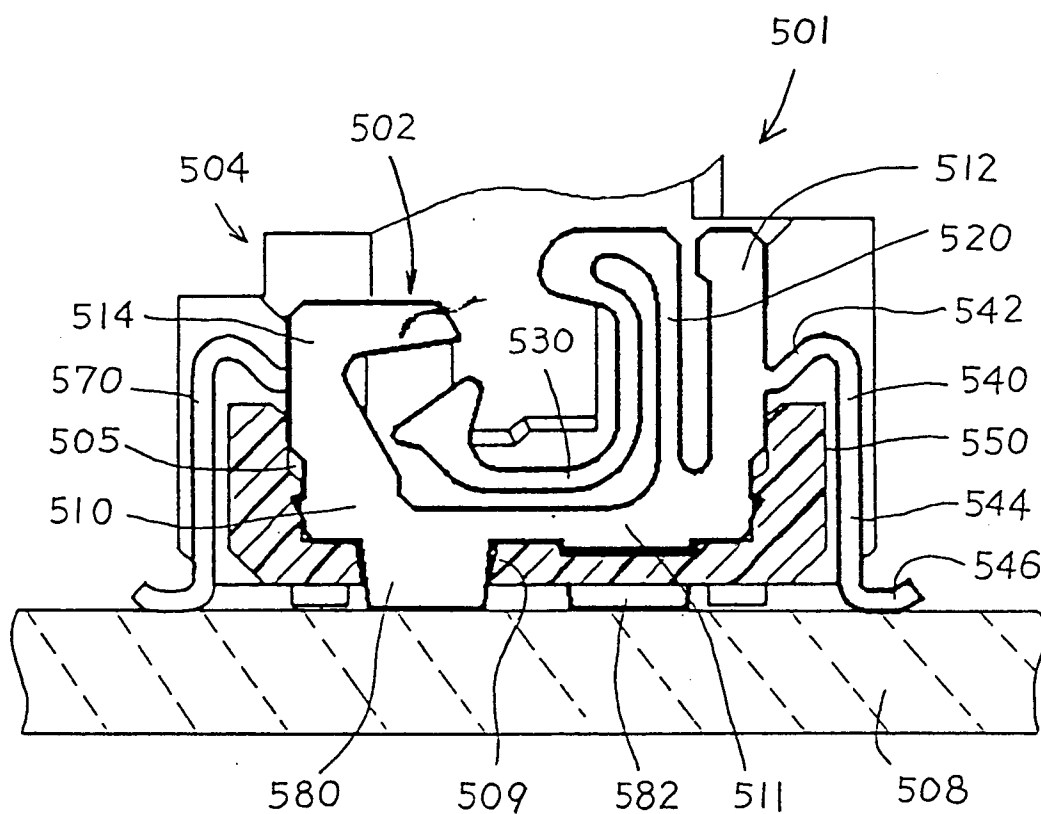


Figure 6

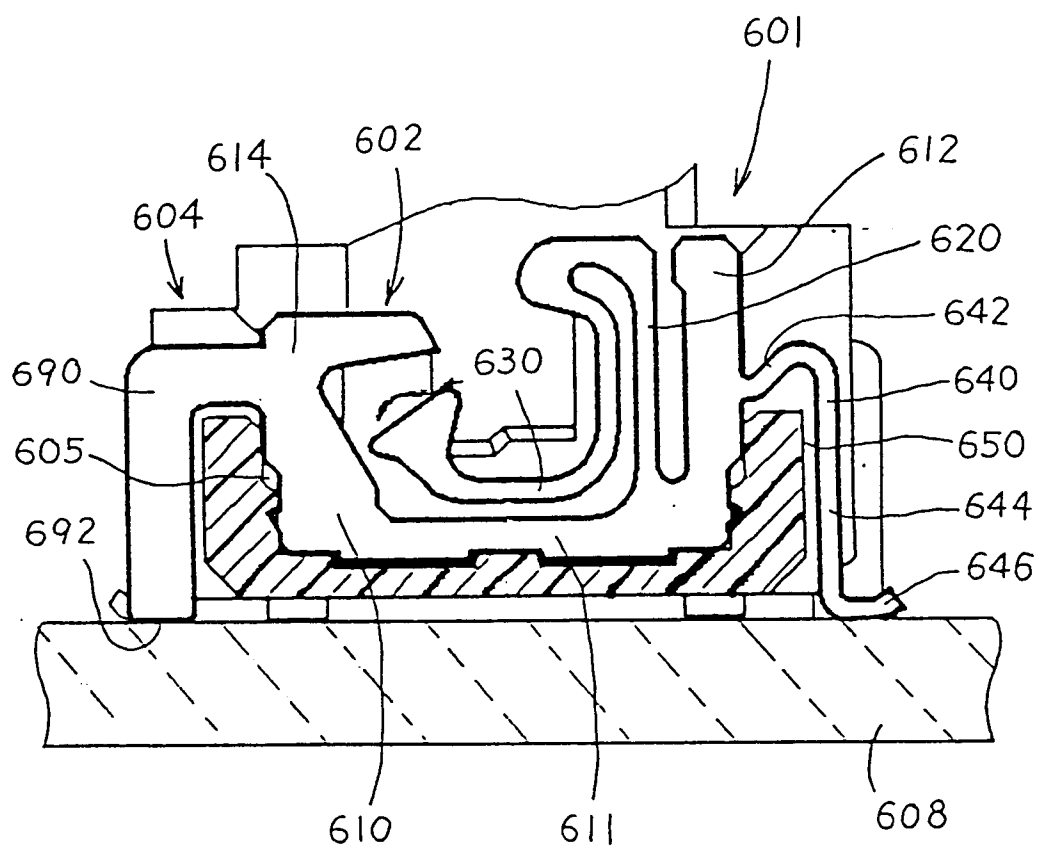


Figure 7