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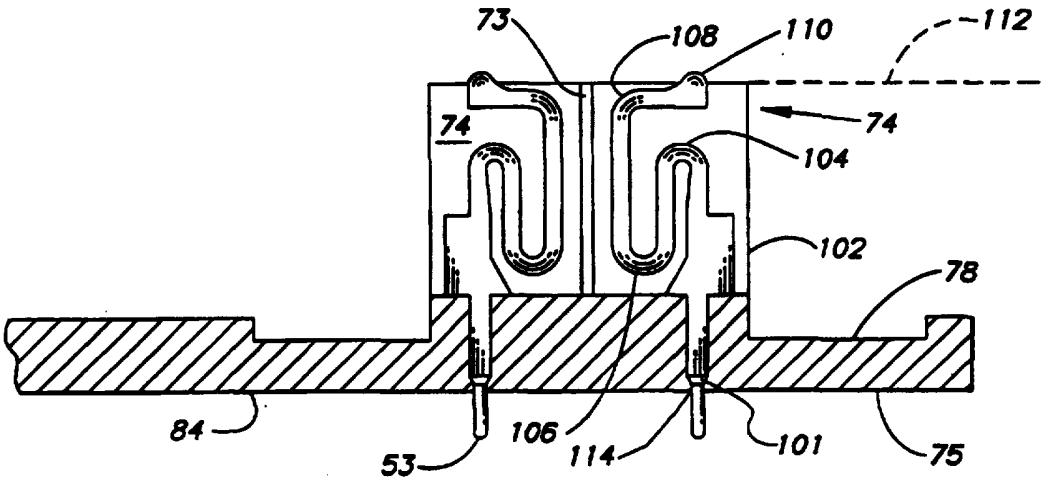

(57) Abstract

A compression arm connector (72) for connecting two circuit substrates (54) in a disk drive and a method of producing the same are provided. The compression arm connector (72) replaces the need for two vertical connectors and a base plate header traditionally used in disk drives for connecting two circuit substrates. Connector (72) is composed of curved members (104, 106, 108) provided in slots (74). Another compression arm connector (56) for connecting wires to solder pads on a circuit substrate is also provided. The contacts of this compression arm connector (56) are bent through an angle of more than 90 degrees to form a deflectable member and a solder member. Both connectors (72, 56) are capable of exhibiting large wipe and deflection capabilities. Additionally, both connectors can be used in a low-cost disk drive provided by the invention.

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LONG ARM COMPRESSION CONNECTOR WITH BUMP HEADER

Field of the Invention

The present invention relates to compression arm connectors and, more particularly, to compression arm connectors for use in disk drives.

Background of the Invention

While the compression arm connectors of the present invention will be particularly described in connection with their use in the assembly of and use in disk drives, it should be understood that the compression arm connectors described and depicted herein are not to be limited thereto, since they may likewise be used in other devices.

The demand for increasing storage capacity in personal computers (PCs) has created new challenges for disk drive manufacturers. Disk drives installed in new computers must provide more storage than ever before, while at the same time maintaining costs at a minimum. Moreover, owners of existing PCs are seeking to supplement the storage capacity of their computers by adding on additional disk drives. Therefore, it is desirable to minimize the production costs of producing high-storage disk drives.

An exploded view of part of a conventional disk drive is shown in Figure 1. A spin motor assembly 4 housing a spin motor (not shown) is mounted to the base plate 2 of the disk drive. In use a disk (not shown) is mounted to the assembly 4 so that the spin motor operates to cause the disk to rotate. While the disk is rotating, a mechanical arm (not shown) with a read/write head is positioned over the

rotating disk to read data to the disk or write data from the disk. A flexible circuit 6 is used to provide the control signals to position the mechanical arm. An integrated circuit (IC) 8 serves as a serial-to-parallel port for the drive heads. A base plate header 10 provides a plurality of pins 12a which extend upward from the base plate 2 in a plane substantially perpendicular to the base plate. The flexible circuit has a mounting surface 14 with a plurality of clearance holes 16 that permit the pins 12a from the base plate header to pass through.

A circuit substrate such as printed circuit board (PCB) 18 provides the interface for data to be read to and written from the disk. Pins 12b of the base plate header 10 are coupled to PCB 18 via vertical card connector 20. Likewise, a vertical card connector (not shown) may then be connected to pins 12a to interface a second circuit substrate to PCB 18.

The spin motor is typically driven through an interface with the circuit substrate, e.g. PCB 18. Three printed conductors 22 are shown leading from three respective pins 12a to lead wires 24 associated with the spin motor (different spin motors may provide different numbers of lead wires). Each of the lead wires 24 is soldered to one of the printed conductors. The base plate 2 is typically designed with an opening or slot 26 to expose the lead wires 24.

Adding slot 26 and the printed conductors 22 require additional assembly steps and, therefore, increase the overall cost of the disk drive. Therefore, in some disk drives the lead wires 24 are exposed through the underside of the base plate 2 where the spin motor frame is secured to the base plate. The lead wires may then be soldered directly to solder pads provided on PCB 18 to drive the spin motor. Since the lead wires are soldered directly to the PCB, the PCB and the spin motor cannot be disconnected for repair or replacement without probable damage to the PCB or the spin motor.

A conventional disk drive unit is assembled by mounting the spin motor assembly in its frame to the base plate. The base plate shown in Figure 1 has a sunken portion in which the spin motor may be placed. Alternatively, the base plate may have an aperture through which the spin motor is secured. The lead wires of the spin motor are then coupled to corresponding solder pads or printed conductors which provide the power to drive the spin motor. A base plate header is fixed to the base plate by any suitable means such as by gluing or bolting the header correctly to the base plate. A flexible circuit is attached to the base plate header by inserting the header pins into clearance holes formed within a mounting surface of the flexible circuit. A circuit substrate may then be connected to each side of the base plate header via vertical card connectors.

It should be evident that the assembly of conventional disk drives requires numerous steps in connecting many of its components. Moreover, many of these steps are manual thereby increasing the cost of production. Therefore, there is a need to eliminate some of the steps, particularly those that require manual interaction. However, in eliminating such steps care must be taken to permit repair or replacement of individual components without destroying other disk drive components.

Summary of the Invention

In response to these needs, one object of the present invention is to combine a number of connectors used in the disk drive into a single connector. Another object of the present invention is to provide a spin motor connector to connect the lead wires of the spin motor to solder pads on a circuit substrate to drive the spin motor thereby eliminating the need for soldering the lead wires to the circuit substrate and eliminating the need to add flexible conductors onto the base plate.

According to the invention, a first compression arm connector comprising an insulative housing, a conductive

multi-curved beam member capable of being received in the housing and forming a contact element of the connector, and a conductive member integrally connected to the contact element and extending from the housing is provided. The contact element preferably has a protrusion that forms a mating surface for mating with a first circuit substrate. The conductive member is preferably used to electrically interface the compression arm connector to a second circuit substrate. In one advantageous embodiment of the invention, the contact element is capable of deflecting between at least about 0.008 inches and about 0.02 inches in response to a mating force of between at least 100 g. and 300 g. In this embodiment the mating surface of the contact element is capable of being deflected against a conductive surface of the first circuit substrate so that the protrusion is movable over the conductive surface to provide a wipe of at least about 0.02 inches. In a more preferred embodiment, the conductive member provides a taper so that it creates a gas-tight seal with the housing.

The conductive member may be implemented as a pin or movable contact element. The compression arm connector preferably comprises a plurality of conductive multi-curved beam members associated with respective conductive members extending from the housing.

In a preferred embodiment, the housing comprises a base portion and a contact support section. At least a part of the base portion and a part of the contact support section preferably have a reduced thickness to minimize stress in the housing. Moreover, the contact support section preferably comprises a plurality of slots in which the contact elements are inserted. The slots may provide openings on a top side and at least a lateral side of the contact support section so that the deflection of the contact elements is not restrained by the housing.

A method of producing a compression arm connector, according to the invention comprises the steps of stamping a plurality of multi-curved contacts from a conductive plate so

that the contacts are connected together by a detachable carrier strip, molding a housing with slots from an insulative material, and inserting the plurality of multi-curved contacts into the slots of the housing so that the contacts are biased out from the top surface and capable of being deflected out from the side surface. The detachable carrier strip is detached from the plurality of contacts to form the compression arm connector. The housing is preferably molded with a thin base to reduce stress thereby substantially preventing the housing from bowing.

A second compression arm connector for connecting lead wires to a circuit substrate is also provided by the invention. This connector comprises a plurality of movable contacts bent through an angle greater than about 90° so that the contact is divided into a deflectable member and an associated solder member; and a housing for supporting the plurality of contacts such that at least a portion of each of the deflectable and solder members are exposed through the housing. The deflectable members form contact elements and each lead wire can be soldered to one of the solder members.

In one preferred embodiment, the housing has a plurality of solder windows through which the solder members are exposed and in which the lead wires can be soldered to the solder members. The housing preferably has a circular shape.

More preferably, each of the deflectable members may be provided with a protrusion for electrically contacting a conductive surface of a circuit substrate. In this embodiment, each of the plurality of contacts is capable of deflecting between about 0.014 inches and about 0.036 inches in response to a mating force of at least about 70 g. Moreover, the protrusion is movable on the conductive surface to provide at least about 0.015 inches of wipe.

In a more preferred embodiment, the housing comprises an opening from a top side of the connector to an underside of the connector through which the lead wires can be advanced from the top side through to the underside. A

multi-wire passageway adjoining the opening is connected to a plurality of single-wire passageways which preferably expose a portion of a respective solder member. In this preferred embodiment, the deflectable members and the solder members are accessible from the same side of the housing.

A method of producing a compression arm connector for use in connecting lead wires to a circuit substrate comprising the steps of stamping a plurality of contacts from a conductive plate so that the plurality of contacts are connected together by a detachable carrier strip; molding the plurality of contacts into an insulative housing; and bending each of the plurality of contacts more than about 90° is also provided by the invention.

The plurality of contacts are preferably arranged into groups of three contacts and each group preferably molded into a corresponding insulative housing. The housings are formed with solder windows exposing a portion of corresponding contacts molded into the housing. Accordingly each housing has three associated solder windows formed therein.

More preferably, a molded segment is formed in the housing such that each contact is molded into the housing directly above the molded segment. Each of the plurality of contacts may then be bent through an angle greater than of at least 90° by forcibly pressing each of the contacts against the molded segment.

The present invention also provides a disk drive comprising a compression arm connector for interfacing first and a second circuit substrates and another compression arm connector for connecting the lead wires from the spin motor to solder pads on the first circuit substrate. A method for assembling the disk drive according to the invention is also provided.

Brief Description of the Drawings

The present invention will be better understood, and its numerous objects and advantages will become apparent

by reference to the following detailed description of the invention, when taken in conjunction with the following drawings, in which:

Figure 1 shows an exploded view of part of a conventional disk drive;

Figure 2 shows an exploded view of a portion of a disk drive according to the present invention;

Figure 3 shows an exploded view of the compression arm connector shown in Figure 2;

Figure 4 shows an enlarged diagram of a single multi-curved contact according to the invention;

Figure 5 shows a cross section of a compression arm connector according to the invention;

Figure 6 shows a longitudinal cross section of a compression arm connector according to the invention;

Figure 7 shows a partial strip of contacts stamped from a plate of conductive material in accordance with the invention;

Figure 8 identifies the dimensions of a contact of a compression arm connector in accordance with the present invention;

Figure 9 shows an enlarged view of the top side of a spin motor connector according to the invention;

Figure 10 shows the underside of the spin motor assembly with a spin motor connector according to the invention connected to the spin motor;

Figure 11 shows an enlarged view of the underside of a spin motor connector according to the invention.

Figure 12 shows an enlarged view of a contact designed for use in a spin motor connector according to the invention;

Figure 13 identifies the dimensions of a contact of a spin motor connector in accordance with the present invention;

Figure 14 shows a partial strip of contacts blanked from a plate of conductive material;

Figure 15 shows a spin motor housing having three solder windows molded directly onto three contact elements grouped together along the carrier strip;

Figure 16 shows a plurality of spin motor housings molded to respective groups of contacts along a carrier strip;

Figure 17 shows a cross section of a spin motor connector housing with a contact molded therein according to the invention;

Figure 18 shows a deflectable member of a contact of the present invention after being bent downward against a segment of the housing;

Figure 19 shows a view of the underside of the spin motor connector according to a preferred embodiment of the invention;

Figure 20 shows the top side of the spin motor connector according to a preferred embodiment of the invention;

Figure 21 shows a surface mount connector utilizing a modified spin motor connector contact according to the invention;

Figure 22 shows the connector depicted in Figure 21 with a contact designed according to a further modification of the invention;

Figure 23 shows a first side of a spin motor connector according to an alternative embodiment of the invention;

Figure 24 shows a second side of the connector shown in Figure 23; and

Figure 25 shows interlocking parts of a connector housing according to an alternative embodiment of the invention.

Detailed Description of the Invention

The present invention provides two compression arm connectors for particular use in disk drives, although their use is not to be limited thereto. Figure 2 shows an exploded

view of a portion of a disk drive according to the invention. A compression arm connector 52 is used in place of the base plate header described in connection with Figure 1 to connect a data interface circuit substrate 54 located below the base plate 50. An opening 55 is preferably provided in base plate 50 so that compression arm connector 52 can be partially inserted to mate with conductors on the substrate 54. The compression arm connector 52 preferably provides conductive members 53 extending from a top surface of the connector so that a flexible circuit (not shown) may be connected to the connector in a similar manner as described above. The compression arm connector 52 thus replaces the base plate header and the two vertical connectors described in connection with Figure 1. A spin motor connector 56 is shown between the spin motor assembly 58 and the circuit substrate 54. An aperture 60 is formed in the base plate. The spin motor assembly can be disposed within aperture 60 to permit direct access to the circuit substrate below.

An exploded view of the compression arm connector 52 is shown in Figure 3. A plurality of multi-curved contacts 70 are supported in a housing 72 within respective slots 74 formed within the housing. The housing comprises a contact support member 73 referred to as a stack tower in which the slots 74 are formed, a first base plate portion 75, and a second base plate portion 84. In preferred embodiments, the slots 74 provide openings in a first surface 77 and a second surface 79 of the contact support member of the housing so that the movement of the contacts are not restrained by the housing itself. The first and second base plate portions 75, 84 are referred to in combination as the sealing base of the connector. The housing is preferably molded from an insulative material such as liquid crystal polymer.

In preferred embodiments, a trough 78 is molded into the first base plate portion 75 to advantageously thin the base plate to prevent undesirable stress causing the housing to bow. Since it is typically desirable to seal off

the inside of the disk drive from unwanted particles and other contaminants that may be harmful to the disk, a foam-like seal (not shown) may be placed into the trough 78. The contact support member may also be thinned in the slotted regions 71 to likewise minimize stress within the housing. It should be understood that the dimensions of the housing walls should be selected to maximize thickness for stability and strength and to minimize the thickness to reduce stress. Therefore, the stack tower is preferably thinned at the slotted sections 71 as shown in Figure 3. In a preferred embodiment, the thickness of the first base portion 75 is about eight to sixty thousandths of an inch and more preferably about twenty to thirty-five thousandths of an inch.

The second base plate portion 84 is primarily used for tooling purposes in the assembly of the disk drive. For instance, the second base plate portion may have tooling holes 86 formed therein so that a mechanical assembler can grasp the compression arm connector to secure it to the base plate. It should be understood that the compression arm connector 52 may be secured to the base plate 50 in numerous ways. For example, the base plate 50 preferably provides an opening 55 (Figure 2) having dimensions to permit the contact support member 73 of the connector housing 72 to pass through. Respective holes 88 may additionally be formed in the second base plate portion of the housing 84 and the base plate of the disk drive (not shown) so that they are aligned when the contact support member is inserted through the appropriate base plate aperture. A threaded screw may then be used to secure the housing to the base plate of the disk drive. In the alternative, an opening 82 may additionally be formed in the contact support member and fitted with a threaded receptacle 80 with a threaded insert 81. A corresponding opening 83 would be provided on the circuit substrate 54 so that a threaded screw (not shown) could be used to screw the connector and the circuit substrate together.

Figure 4 is an enlarged diagram of a single multi-curved contact 70. The curved portion 100 and the conductive member 53 are integrally connected to form contact 70. The curved portion serves as a contact element and the conductive member forms the base of the contact. When the contact element 100 contacts a respective solder pad on a circuit substrate, the contact element is deflected as shown by the dashed lines. The conductive member 53 may serve as a pin for mounting the flexible circuit described in connection with Figure 1. Additionally, the conductive member may be used as a through mount thereby providing an interface to connect a second circuit substrate if desired. Alternatively, the conductive member 53 can form a contact element for electrically interfacing with a solder pad on a second circuit substrate.

A contact section 102 is preferably formed on the conductive member 53. The contact section 102 is preferably designed to tightly secure the contact in a respective slot 74 of the housing 72 (see Figure 3). Additionally, the contact section 102 is preferably sloped on one side as shown in Figure 4 to permit contact deflection in the direction of the sloped side. It should be understood that the openings in the side surface 77 of the contact support member 73 (Figure 3) advantageously permit the contact to additionally deflect outward for greater overall deflection capability.

A free-standing contact element according to a preferred embodiment of the invention has three contiguous curved members 104, 106, and 108 as shown in Figure 4. A protrusion 110 is shown to extend from curved member 108. When the contact element is brought into contact or retracted from the solder pad, the protrusion is forced along the conductive surface of the solder pad. This movement across the surface of the solder pad is referred to as wipe. The curved portions 106 and 108 and protrusion 110 are deflected as the protrusion is forced along the solder pad as shown in Figure 4 by the dashed lines. Greater wipe is often desired since the movement of the contact over the surface of a

solder pad has a tendency to clean the surface of debris and break down oxides that can degrade electrical performance.

Figure 5 is a cross section of the compression arm connector depicted in Figure 3 showing the contacts 70 inserted into the housing 72. As shown in the figure, the first base plate portion 75 provides through holes 114 in which the conductive members 53 of the contact are inserted. A through hole 114 of the first base plate portion is capable of receiving the conductive member 53. Each conductive member 53 preferably includes a tapered section 101. When the conductive member 53 is inserted through the through hole 114, it creates an air-tight seal with the through hole to prevent contaminants from entering into the enclosed disk drive unit. The tapered section 101 preferably forms a Moire taper. The contacts are supported by the housing so that the protrusion 110 rests above the mating reference line 112.

Figure 6 shows a longitudinal cross section of the compression arm connector 52. The housing 72 is shown with contacts 70 supported therein. A Moire taper 101 in the conductive members 53 of the contact provides a gas-tight seal as described above.

The multi-curved contacts are preferably made of a conductive material such as beryllium copper and, more preferably, phosphorous bronze. The contacts may be formed from a plate of conductive material having a thickness substantially equal to the desired thickness of the contacts. A plurality of contact elements having the desired contact shape may be stamped out of the plate of conductive material. Figure 7 shows a partial strip of contacts formed by such a stamping process. Each of the contact elements 70 are preferably formed with a carrier attachment member 122. Each of the carrier attachment members 122 is integrally connected to a detachable carrier strip 120. The carrier attachment members 122 can be detached from the contacts along with the carrier strip 120 as is well known. It should be understood that other methods such as electronic machining and chemical etching may be used to produce the strips of contacts.

However, it is preferable to provide an attached carrier, regardless of the production method used, so that the individual contacts do not require handling and can be isolated without the assistance of expensive machinery.

The contacts 70, according to a preferred embodiment of the invention, have a contact beam length of approximately 0.41 inches, a thickness of about 0.012 inches, and a contact beam width of 0.02 inches corresponding to the dimensions, L, T, and W shown in Figure 8. In this preferred embodiment, the protrusion extends approximately 0.014 inches from member 108 of the multi-curved contact. The contacts according to the invention preferably provide more than about 100 g. of force and, more preferably, greater than about 150 g. of force against the solder pads of the circuit substrate to provide a reliable electrical interface between the circuit substrate and the compression arm connector. When interfaced with a circuit substrate with a mating force between about 100 g. and 300 g., the contacts according to this preferred embodiment, may be deflected against the solder pads between about .008 inches and .02 inches depending upon the mating force. Thus, the contacts provide a mating latitude of approximately ± .006 inches (i.e., a compliance of about .014 inches ± .006 inches). Moreover, a contact designed according to this preferred embodiment may also provide a wipe of about 0.02 inches across the surface of the solder pad. Thus, the protrusion extending from the contact element, will be forced across the surface of the solder pad approximately 0.02 inches when interfaced thereto or restricted therefrom to provide substantial cleansing of the solder pad surface.

Figure 9 shows an enlarged view of the top-side of the spin motor connector 56 shown in Figure 2. A housing 130 of the spin motor connector has a number of solder windows 132 formed therein. The solder windows 132 expose a portion of the contacts 134 supported in the housing 130. Although a spin motor may use, for example, either 2, 3, or 4 lead wires for its operation, the present invention will be described in

connection with those spin motors utilizing three-lead wire connections for exemplary purposes only. It should be understood that the principles dictating the design of the spin motor connector may be more generally applied to any application in which it is desired to connect any number of wires to appropriate interfaces on a circuit substrate. Thus, the present invention should not be construed to be limited to any particular number of solder windows or contacts.

Figure 10 shows the underside of the spin motor assembly 58 with a spin motor connector 56 connected to the spin motor (not shown). A frame 59 of the spin motor assembly 58 has an opening 61 shown in the figure in which the spin motor connector can be secured. The solder windows provide a convenient means for containing the solder and lead wires so that the housing 130 can be press-fit into the frame opening 61. Referring back to Figure 9, the housing 130 preferably has a raised portion 136 with one or more wedges 137 cut out to provide an indication of the orientation of the contacts within the housing so that the spin motor connector is press-fit into the frame opening 61 in the correct manner.

Figure 11 shows an enlarged view of the underside of a spin motor connector according to the invention. Slots 138 are formed in the housing 130 to expose a second portion of each of the contacts 134. The contacts 134 exposed by slots 138 are designed to interface with solder pads on circuit substrate 54 shown in Figure 2.

Figure 12 shows an enlarged view of a contact designed for use in the spin motor connector. The contact 134 is preferably bent through an angle greater than about 90° to define two portions; a solder member 140 and a deflectable member 142. The solder member 140 is exposed through a solder window in the housing so that a wire may be soldered to the solder member through the solder window as explained above. The deflectable member 142 is exposed through a slot 138 of the spin motor housing so that the

deflectable member is deflected as indicated by the dashed lines against a solder pad of an interfaced circuit substrate. In a preferred embodiment, a protrusion 144 is provided on the deflectable member 142. When the spin motor connector is interfaced with or retracted from the circuit substrate, the protrusion 144 is forced along the surface of a solder pad.

The contact elements 134 according to this preferred embodiment of the invention have a contact beam length of approximately 0.28 inches, a thickness of about 0.012 inches, and a contact beam width of 0.03 inches corresponding to the dimensions, L', T', and W', respectively, as shown in Figure 13. In this preferred embodiment, the contacts may provide more than about 70 g. of force and, more preferably, greater than about 120 g. of force against the solder pads of the circuit substrate to provide a reliable electrical interface between the circuit substrate and the spin motor connector. It should be understood that the compliance of the contacts can be altered by modifying the contact's dimensions.

The contacts according to this preferred embodiment can be deflected against the solder pads between about .014 inches and .036 inches under a mating force between approximately 70 g. and 150 g. Thus, the contacts provide a mating latitude of approximately ±.011 inches (i.e., a compliance of about .025 inches ± .011 inches). Moreover, a contact designed according to this preferred embodiment may also provide a wipe of at least 0.015 inches across the conductive surface of the solder pad. Specifically, the protrusion extending from the contact element will be forced about 0.015 inches across the surface of the solder pad when interfaced to or retracted from the solder pad to provide substantial cleansing of the solder pad surface.

The spin motor connector is preferably produced by first stamping a plurality of contacts from a plate of conductive material. It should be understood that other methods of producing the contacts, such as spark erosion,

chemical etches or single stamp processes, could likewise be used. Figure 14 shows a partial strip of contacts blanked from a plate of conductive material. As shown in the figure, the solder member 140 is preferably wider than the deflectable member 142 to provide a larger solder surface for soldering wires. The protrusion 144 may be formed during the stamping process or the contacts may be subjected to appropriate shaping after they are blanked. The contacts 134 are preferably connected via a detachable carrier strip 150.

The contacts may be grouped in numbers corresponding to the number of contacts to be provided by the connector. For example, Figure 15 shows a spin motor housing 130 having three solder windows 132 as described above, molded directly onto three contact elements 134 grouped together along the carrier strip 150. Such grouping provides production advantages in that a carrier having a plurality of connectors may be produced in an automated process. For example, Figure 16 shows a plurality of housings 130, each being molded to a group of three contacts attached to carrier strip 150. Typically, two halves of a housing mold may be closed together with the contacts disposed in the middle. Plastic is injected, cooled and the mold opened thereby forming a connector housing as shown in Figures 15 and 16.

A cross section of the spin motor connector housing with a contact molded therein is shown in Figure 17. The solder member 140 of the contact element is supported within the housing 130 between housing segments 152 and 154 and between housing segments 156 and 158. A solder window 132 is partially shown above the solder member 140. The deflectable member 142 may be bent downward against the housing segment 152 which serves as an anvil member molded into the housing and around to the underside of the housing so that the deflectable member is disposed within a corresponding slot 138 (partially shown in Figure 17). Figure 18 shows the deflectable member 142 after being bent downward against housing segment 152. It should be understood that the

protrusion 144 remains below the bottom surface or mating reference 160 of the housing 130 after the deflectable member is bent as described.

A more preferred embodiment of the spin motor connector eliminates the solder windows from the housing design. An enlarged view of the underside of the spin motor connector according to this embodiment of the invention is shown in Figure 19. A multi-wire passageway 164 connects to single-wire passageways 162, all of which may be formed in the housing during the molding process. The lead wires from the spin motor may be brought through an opening (not shown) provided in the housing 170 coincident with passageway 164.

Figure 20 shows the top-side of the spin motor connector according to this preferred embodiment. The lead wires may be inserted through the opening 165 into passageway 164 (Figure 19). The raised portion 176 with wedge 177 identifying the orientation of the connector as described above is also shown in connection with Figure 9. Referring back to Figure 19, each lead wire may be brought through the opening 165 and positioned within a corresponding passageway 162 (Figure 19). Each lead wire is then preferably soldered onto the solder member 140 in the passageway 162.

The deflectable members 142 and solder members are exposed on the same side of the housing in this embodiment instead of opposite sides as in the previously described embodiment. Exposing the solder and deflectable members on the same side of the housing is advantageous because the soldered lead wires may be inspected and adjusted if necessary without removing the spin motor assembly. For instance, once the spin motor connector shown in Figures 9-18 is press-fit into the frame of the spin motor assembly, it cannot be easily removed without damaging the connector or the spin motor. Therefore, if the lead wires are soldered to the solder member on the top side of the housing, the wires are inaccessible unless the connector is removed from the spin motor frame. If the connector cannot be removed from the spin motor frame, the entire spin motor assembly may

require replacement. Therefore, this preferred embodiment of the spin motor connector exposes the solder members from the underside of the housing to provide access to the wires without affecting the spin motor assembly.

Additional embodiments based on the design of the spin motor connector according to the invention are shown in Figures 21-25. It should be understood that while the connectors shown in Figures 21-25 could be used to electrically interface the spin motor to solder pads on a circuit substrate, they may be used for numerous other applications. Figure 21 shows a surface mount connector utilizing a modified spin motor connector contact. The housing 180 provides slots 190 so that the deflectable member 186 of the contact 182 is biased outward from the slot. The solder member 184 is extended and bent away from the housing 180 to serve as means for electrically interfacing and mounting the connector on the surface of a circuit substrate. The solder members 184, for example, may be soldered to respective solder pads on the circuit substrate. Thus, there is no need to provide solder windows in the embodiment shown in Figure 21. One advantage of the connector shown in Figure 21 is that it can be packaged via tape and reel for pick-and-place robotic assembly.

Figure 22 shows the connector depicted in Figure 21 with a modified contact. Specifically, the solder member 192 of the contact 194 extends from a lateral side 196 of the housing 180 and bends downward to serve as a through mount.

Figure 23 shows a first side of the spin motor connector according to another embodiment of the invention. The housing 200 has two interlocking parts 201 and 202. Interlocking parts 201 and 202 cooperate to form slots 206 in the housing. The deflectable members 203 of contacts 204 are biased outward from the slots 206. Figure 24 shows a second side of the connector shown in Figure 23. Solder windows 208 are formed in the interlocking part 202 of housing 200. Lead wires from a spin motor or other device are brought in contact with solder members 212 of contacts 204 within the

solder windows 208 as shown in Figure 24. The lead wires may then be soldered to the solder member exposed through the solder window to form an electrical interface therebetween.

Figure 25 shows one embodiment of a housing that can be used for simplifying the assembly of the connector. For example, the connector shown in Figures 23 and 24 may be assembled by inserting the contacts 204 into respective slotted openings 216 in the interlocking part 202 of the housing. Solder windows 222 are formed in the interlocking part 202. Interlocking part 202 of the housing additionally provides one or more orifice 220. The interlocking section 201 provides one or more bolts 218 extending from a lateral surface. Preferably, a one-to-one correspondence exists between each bolt 218 and each orifice 220. When the interlocking sections 201 and 202 are locked together, each orifice 220 receives a respective bolt 218 to tightly lock the interlocking sections together to form the housing shown in Figures 23 and 24.

While the invention has been described and illustrated with reference to specific embodiments, those skilled in the art will recognize that modification and variations may be made without departing from the principles of the invention as described hereinabove and set forth in the following claims.

What is Claimed:

1. A compression arm connector comprising:

an insulative housing;

a conductive multi-curved beam member capable of being received in the housing and forming a contact element of the connector, said contact element having a protrusion thereon that forms a mating surface of the contact element for mating with a first circuit substrate; and

a conductive member integrally connected to the contact element and extending from the housing for electrically interfacing the compression arm connector to a second circuit substrate; and

a compression arm connector, wherein said mating surface of said contact element is capable of being deflected against a conductive surface of said first circuit substrate so that said protrusion is movable over said conductive surface to provide a wipe of at least about 0.02 inches.

2. The compression arm connector of claim 1, wherein said contact element is capable of providing a mating force of at least about 100 g.

3. The compression arm connector of claim 1, wherein said contact element is capable of providing a mating force of at least about 150 g.

4. The compression arm connector of claim 1, wherein said contact element is capable of deflecting between at least about 0.008 inches and about 0.02 inches in response to a mating force of between at least 100 g. and 300 g.

5. The compression arm connector of claim 1, wherein said contact element is capable of being deflected approximately 0.014 inches with a mating latitude of about ± 0.006 inches.

6. The compression arm connector of claim 1, wherein said conductive member provides a taper, said conductive member being received in the housing so that said taper creates a gas-tight seal.

7. The compression arm connector of claim 1, wherein the conductive member is a pin.

8. The compression arm connector of claim 1, wherein the conductive member is a movable contact element.

9. The compression arm connector of claim 1, wherein a plurality of conductive multi-curved beam members are received in the housing and wherein each multi-curved beam member is associated with one conductive member extending from said housing.

10. The compression arm connector of claim 1, wherein said housing comprises a base portion and a contact support section, at least a part of the base portion and a part of the contact support section having a reduction in thickness.

11. The compression arm connector of claim 1, wherein said housing comprises a contact support section having a plurality of slots in which said contact elements are inserted, said slots providing openings on a top side and at least a lateral side of said support section so that the deflection of said contact elements is not restrained by said housing.

AMENDED CLAIMS

[received by the International Bureau on 24 Octobre 1995 (24.10.95); original claims 1, 4 and 6 amended; new claims 12-27 added; remaining claims unchanged (7 pages)]

1. A compression arm connector comprising:

an insulative housing;

a conductive multi-curved beam member capable of being received in the housing and forming a contact element of the connector, said contact element having a protrusion thereon that forms a mating surface of the contact element for mating with a first circuit substrate;

a conductive member integrally connected to the contact element and extending from the housing for electrically interfacing the compression arm connector to a second circuit substrate; and

wherein said mating surface of said contact element is capable of being compressed to deflect against a conductive surface of said first circuit substrate so that said protrusion is laterally movable over said conductive surface in response to the deflection to produce a wipe of at least about 0.02 inches.

2. The compression arm connector of claim 1, wherein said contact element is capable of providing a mating force of at least about 100 g.

3. The compression arm connector of claim 1, wherein said contact element is capable of providing a mating force of at least about 150 g.

4. The compression arm connector of claim 1, wherein said contact element is capable of deflecting between about 0.008 inches and about 0.02 inches in response to a mating force of between about 100 g. and about 300 g.

5. The compression arm connector of claim 1, wherein said contact element is capable of being deflected approximately 0.014 inches with a mating latitude of about ± 0.006 inches.

6. The compression arm connector of claim 1, wherein said conductive member has a taper, said conductive member being received in the housing so that said taper creates a gas-tight seal.

7. The compression arm connector of claim 1, wherein the conductive member is a pin.

8. The compression arm connector of claim 1, wherein the conductive member is a movable contact element.

9. The compression arm connector of claim 1, wherein a plurality of conductive multi-curved beam members are received in the housing and wherein each multi-curved beam member is associated with one conductive member extending from said housing.

10. The compression arm connector of claim 1, wherein said housing comprises a base portion and a contact support section, at least a part of the base portion and a part of the contact support section having a reduction in thickness.

11. The compression arm connector of claim 1, wherein said housing comprises a contact support section having a plurality of slots in which said contact elements are inserted, said slots providing openings on a top side and at least a lateral side of said support section so that the deflection of said contact elements is not restrained by said housing.

12. A compression arm connector comprising:

an insulative housing having a slot formed therein; and

an electrical contact being received in said slot and comprising:

a contact section for securing said electrical contact within said slot;

a first curved member integral with said contact section and being U-shaped;

a second curved member integral with said first curved member and being U-shaped;

a third curved member integral with said second curved member; and

a protrusion on said third curved member so that said protrusion extends from said slot beyond a surface of said housing and forms a mating surface of said electrical contact;

wherein said mating surface is deflectable against a conductive surface of a first circuit substrate so that said protrusion is laterally movable over said conductive surface.

13. The connector of claim 12, wherein said protrusion is movable over said conductive surface to provide a wipe of at least about 0.02 inches.

14. The connector of claim 12, wherein said electrical contact is capable of providing a mating force of at least about 100 g.

15. The connector of claim 12, wherein said electrical contact is capable of providing a mating force of at least about 150 g.

16. The connector of claim 12, wherein said electrical contact is capable of deflecting between about 0.008 inches and about 0.02 inches in response to a mating force of between about 100 g. and about 300 g.

17. The connector of claim 12, wherein said contact element is capable of being deflected approximately 0.014 inches with a mating latitude of about ± 0.006 inches.

18. The connector of claim 17, wherein said protrusion is movable over said conductive surface so that the connector has a wipe of at least about 0.02 inches.

19. The connector of claim 18, wherein said contact element is deflected as said protrusion wipes said conductive surface and the ratio of the wipe to deflection is greater than 1.

20. The connector of claim 12, wherein said contact section has a sloped side to permit said electrical contact to deflect in the direction of said sloped side.

21. A contact element for use in a compression arm connector comprising:

a multi-curved member comprising a first curved member having a first end and a second end and a second curved member having a first end and a second end; and

a conductive member integrally connected to said multi-curved member so that the first end of the first curved member extends linearly from one end of said conductive member and curves around approximately 180 degrees forming a first U-shape,

the second end of the first curved member integrally connected to the first end of the second curved member, the second curved member curving around approximately 180 degrees to form a second U-shape, the first and second U-shapes together forming an S-shape.

22. The contact element of claim 21, wherein said multi-curved member further comprises:

a third curved member having a first end and a second end, the second end of the second curved member being integral with the first end of the third curved member; and

a protrusion located on the third curved member and being proximate to the second end of the third curved member.

23. The contact element of claim 22, wherein said protrusion forms a mating portion of the contact element and wherein said multi-curved contact is deflected against a flat conductive surface of a mating substrate so that said protrusion is moved in a lateral direction over the flat conductive surface in response to said deflection when the compression arm connector is mated with the mating substrate.

24. The contact element of claim 23, wherein the ratio of wipe to deflection is greater than 1.

25. The contact element of claim 23, wherein said contact element has a wipe of at least about 0.02 inches.

26. The contact element of claim 25, wherein said contact element is deflected approximately 0.014 inches with a mating latitude of about ± 0.006 inches.

27. The contact element of claim 23, wherein said contact element is deflected approximately 0.014 inches with a mating latitude of about ± 0.006 inches.

STATEMENT UNDER ARTICLE 19

Replacement pages 20-26 submitted herewith contain amended claims 1, 4, and 6, and added claims 12-27. No new matter has been added. All other claims remain as originally submitted.

The amendments to claims 1, 4, and 6 are substantially identical to the amendments entered in the U.S. priority application. It is respectfully submitted that the claims as amended clearly distinguish over the references cited in the International Search Report. Entry of these amendments to claims 1, 4, and 6, and the addition of claims 12-27 are respectfully requested.

FIG. 1

PRIOR ART

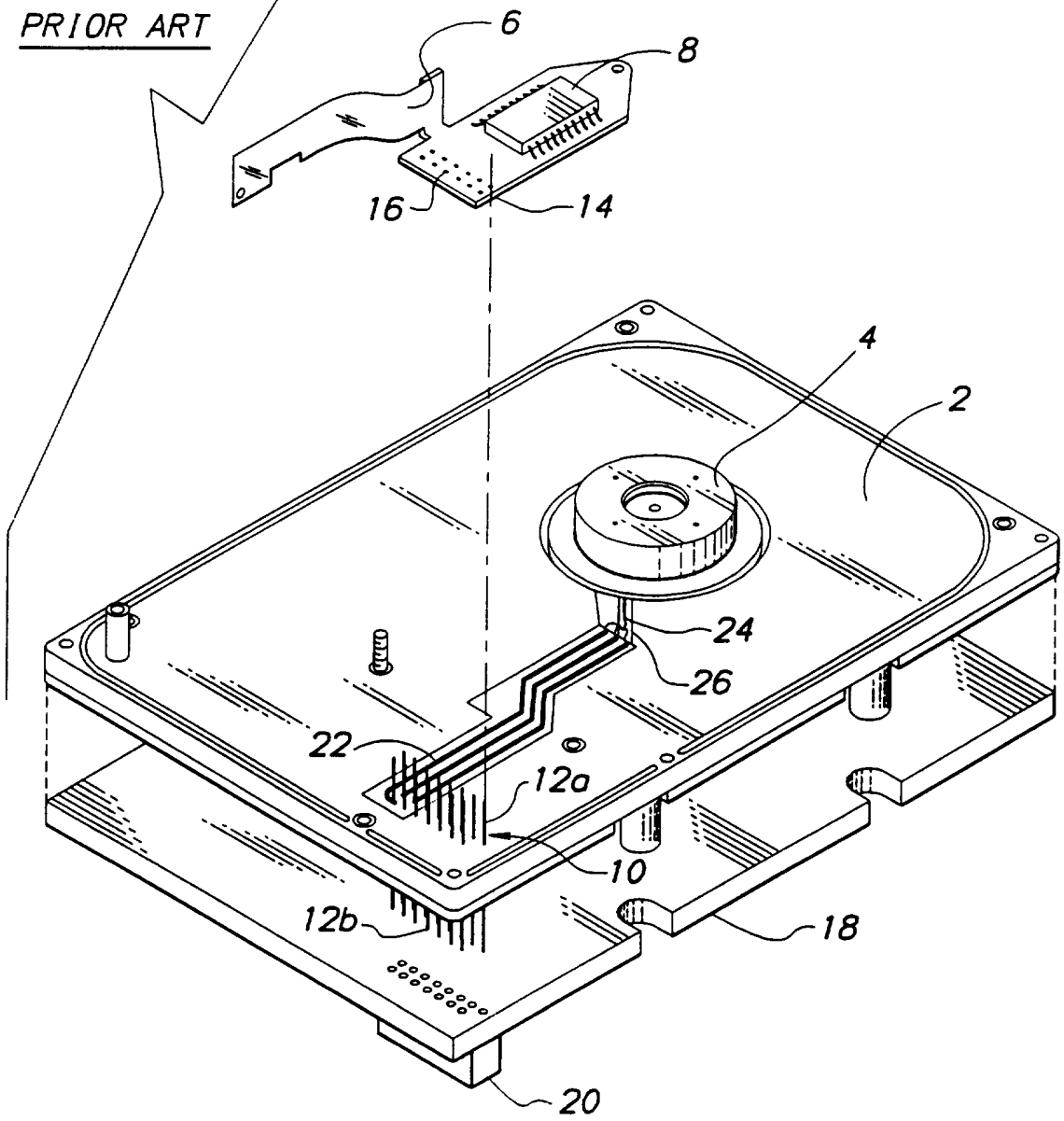


FIG. 10

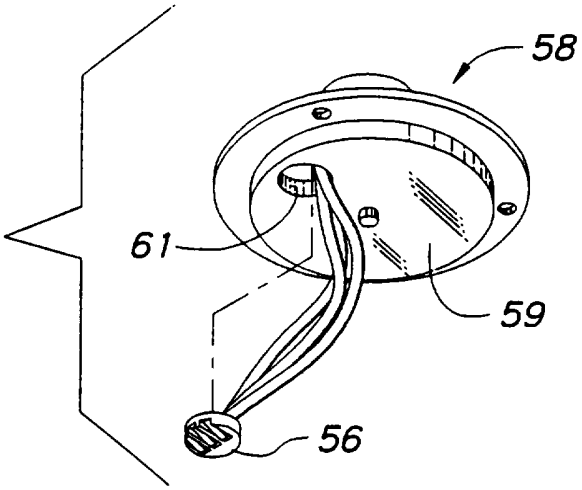


FIG. 2

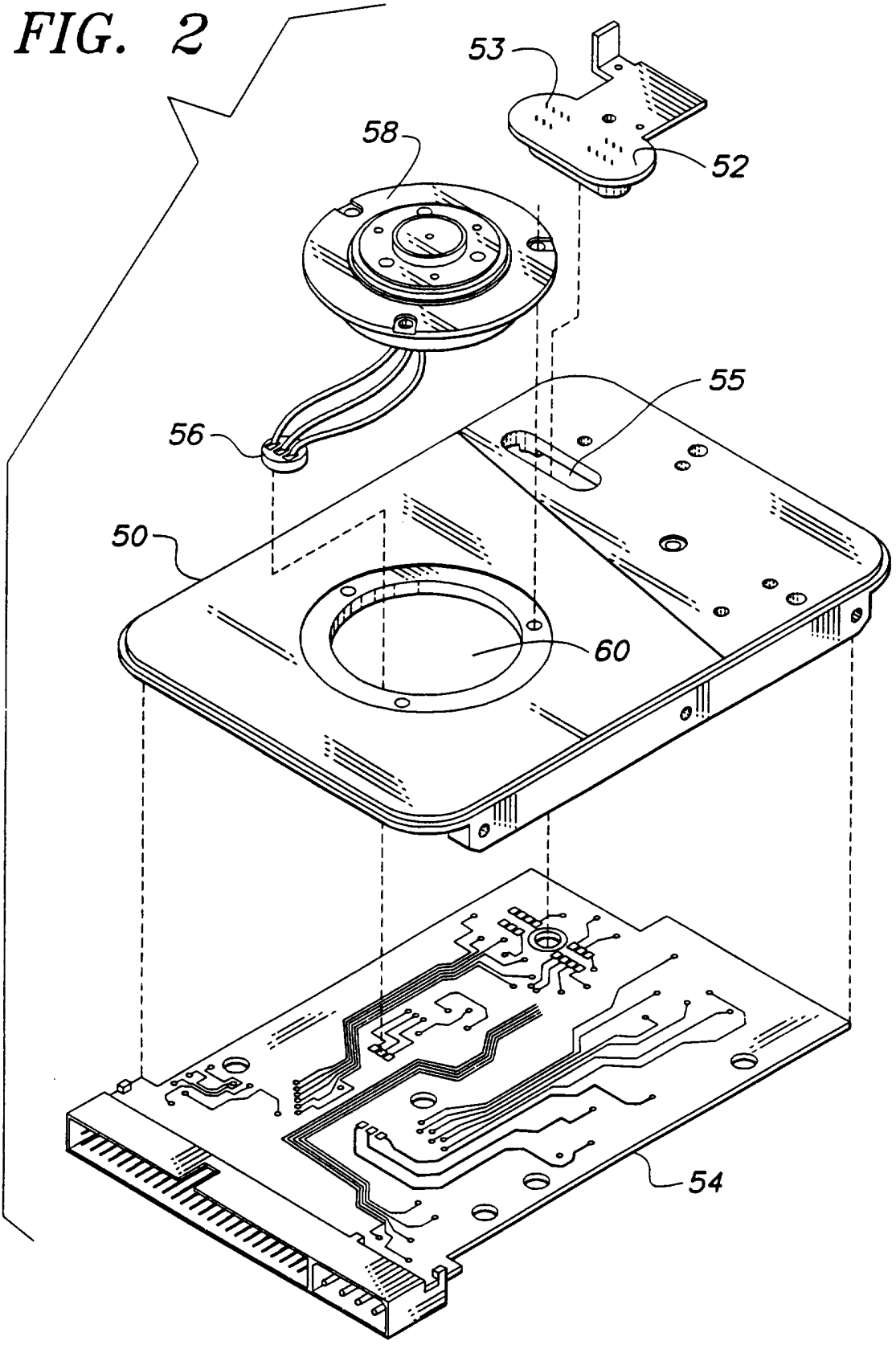
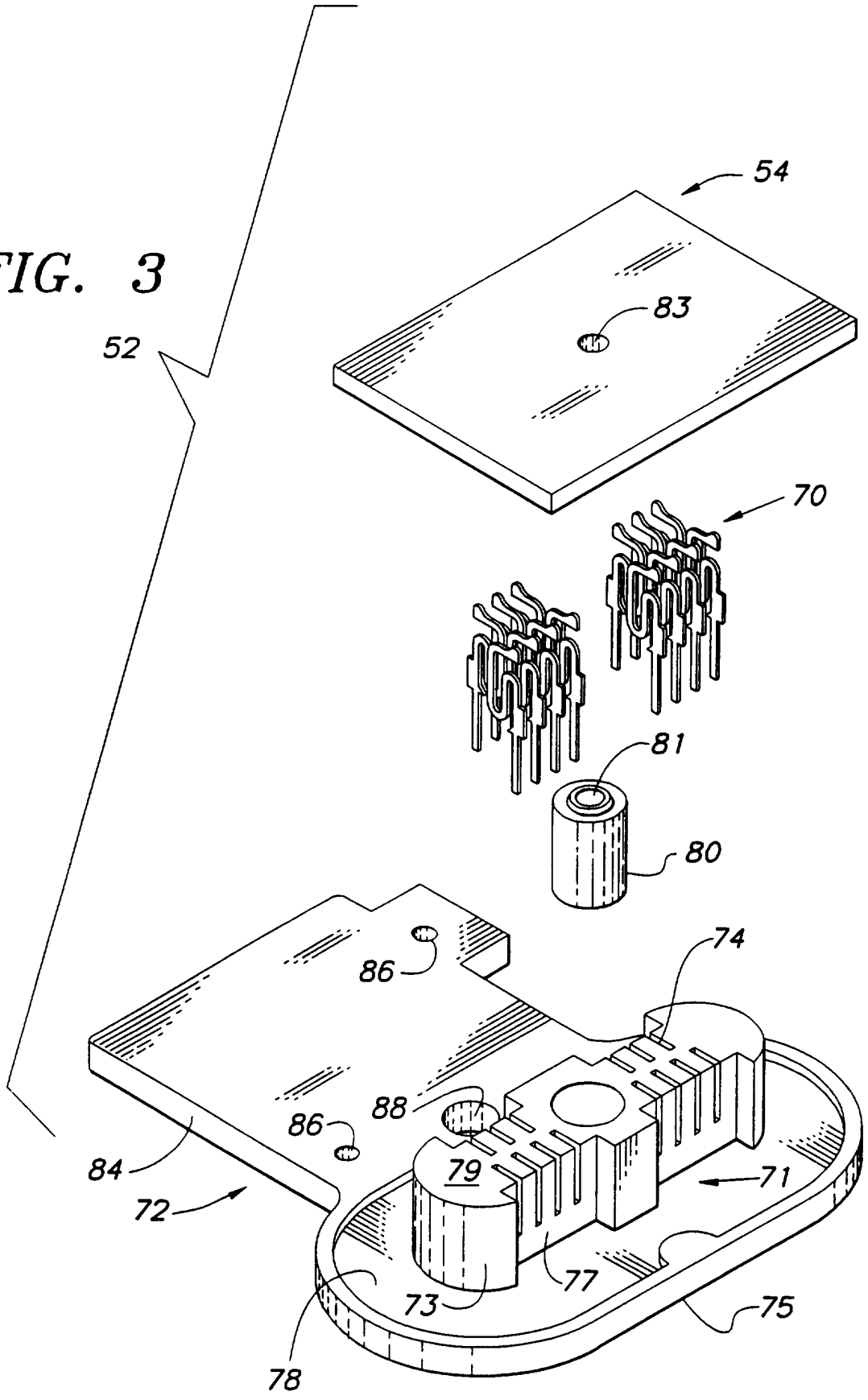


FIG. 3



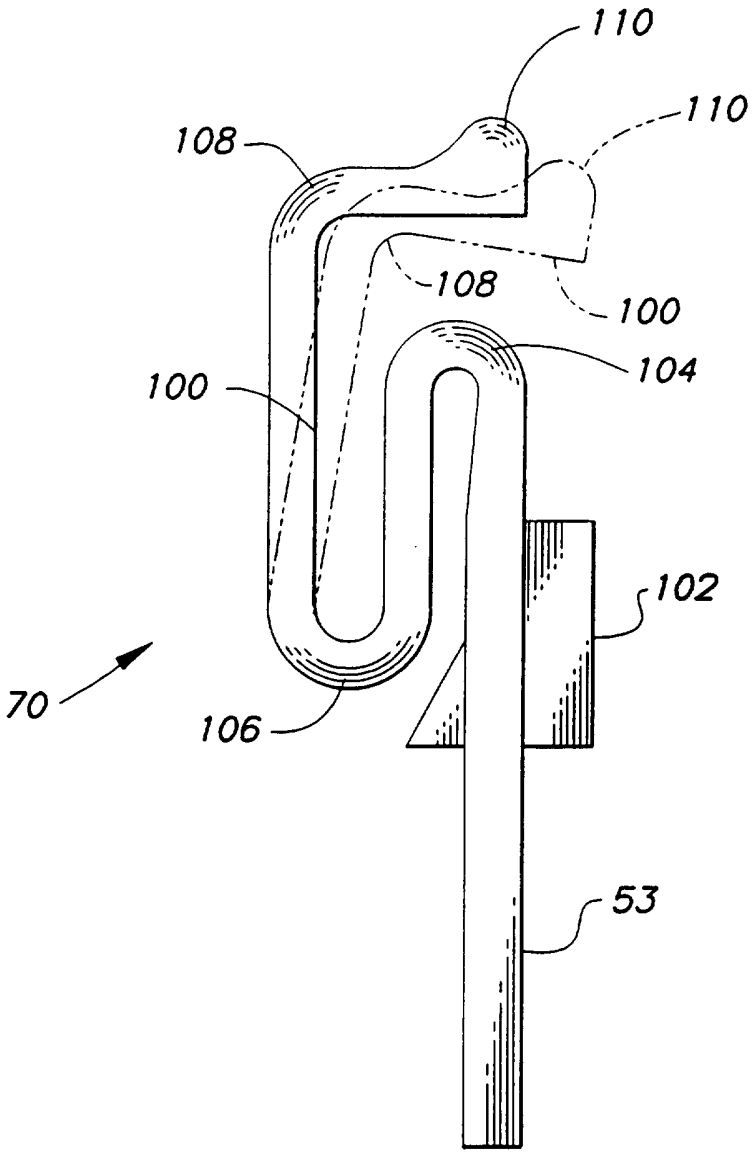


FIG. 4

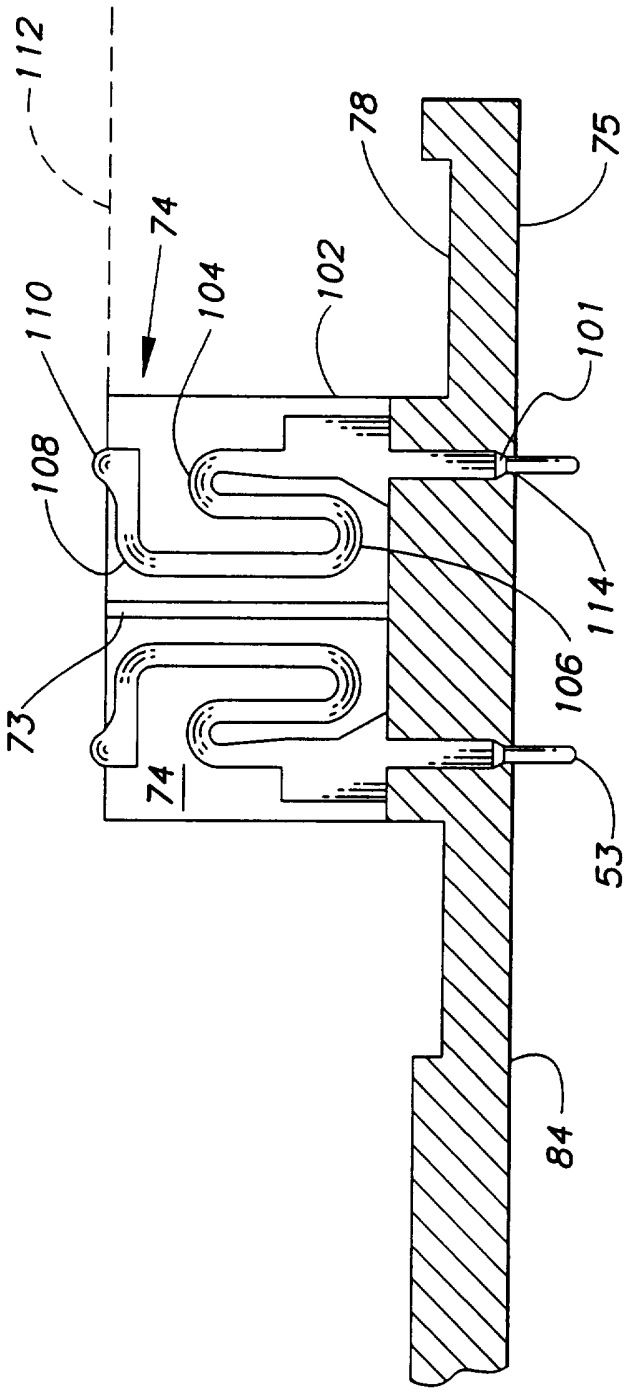


FIG. 5

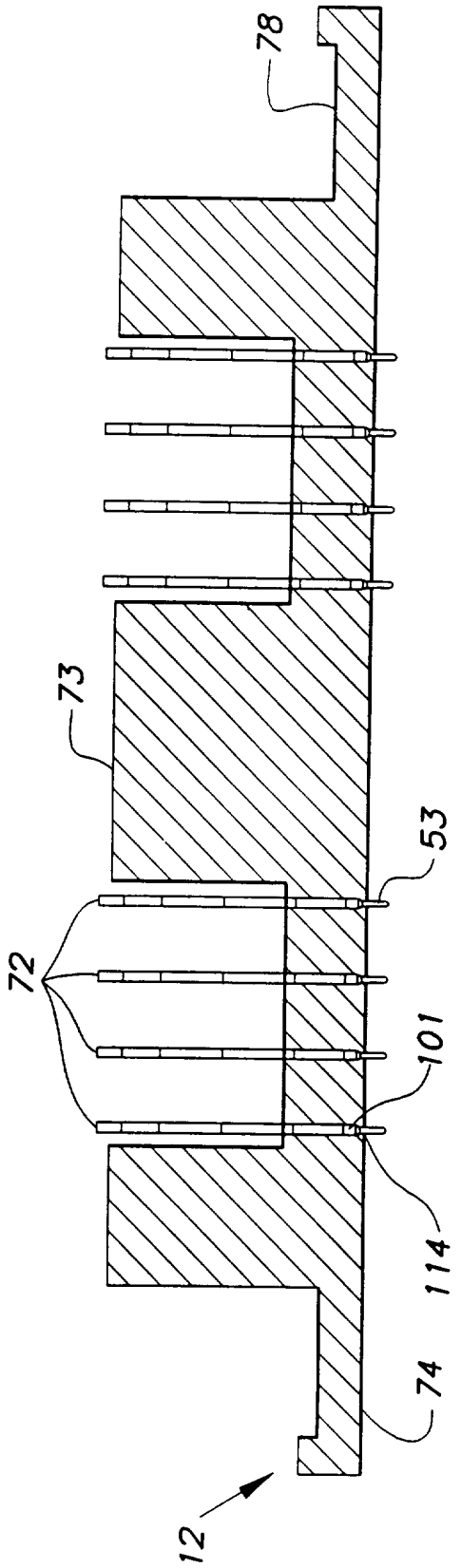


FIG. 6

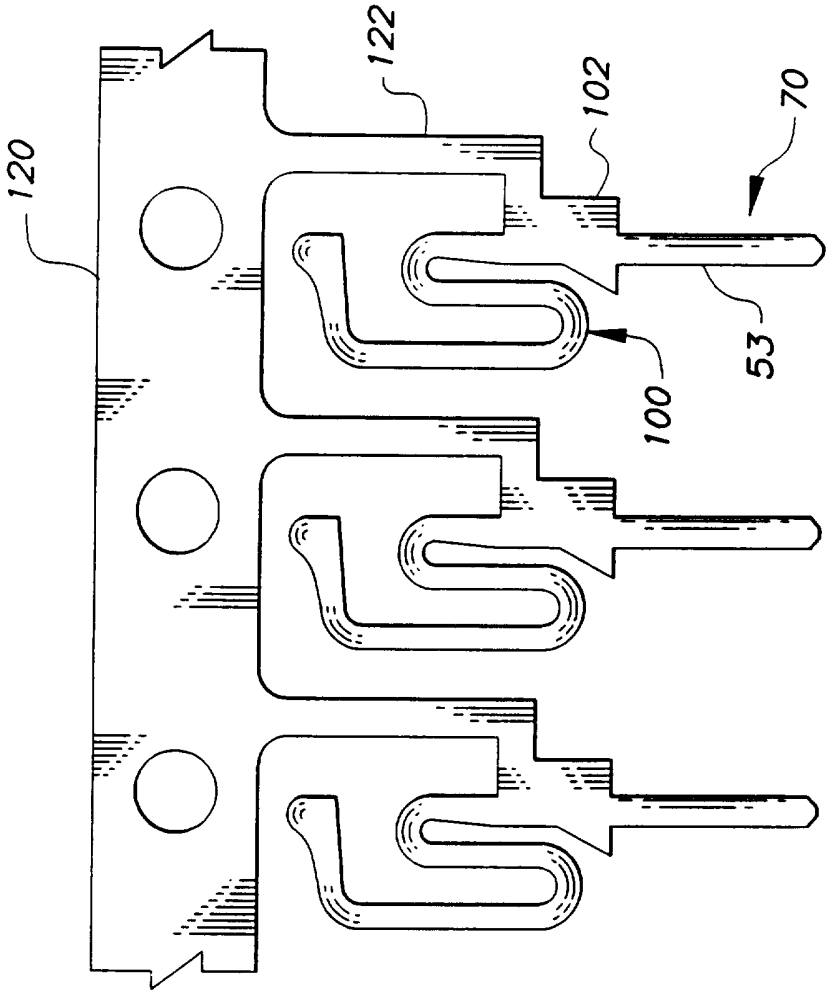


FIG. 7

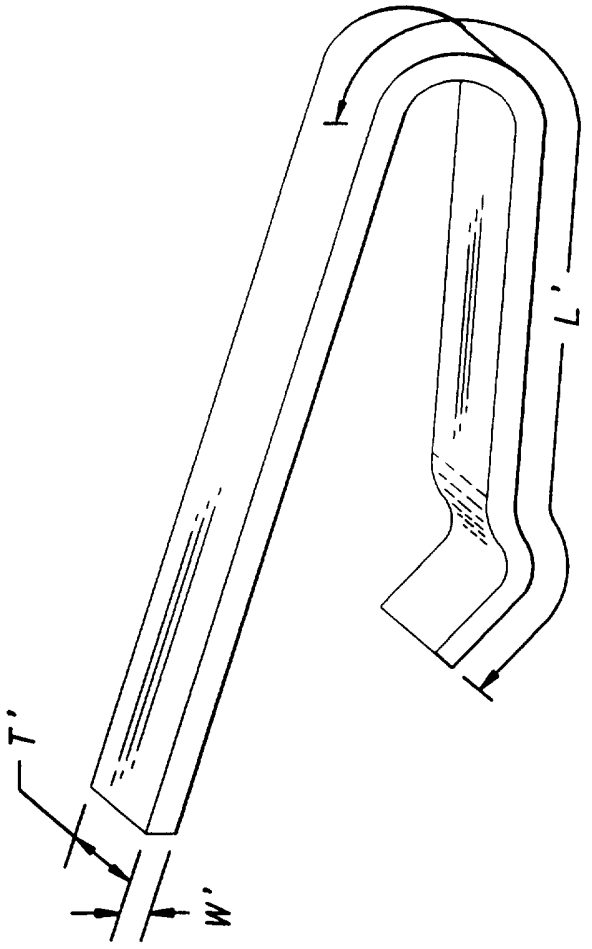


FIG. 13

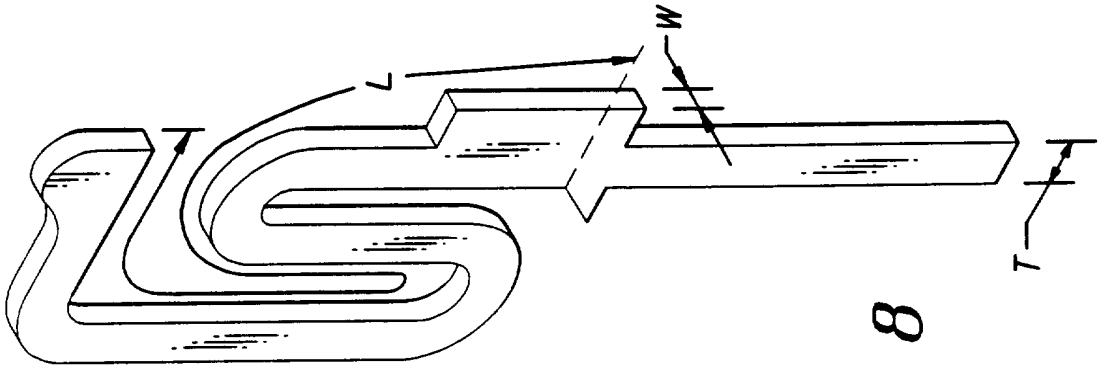


FIG. 8

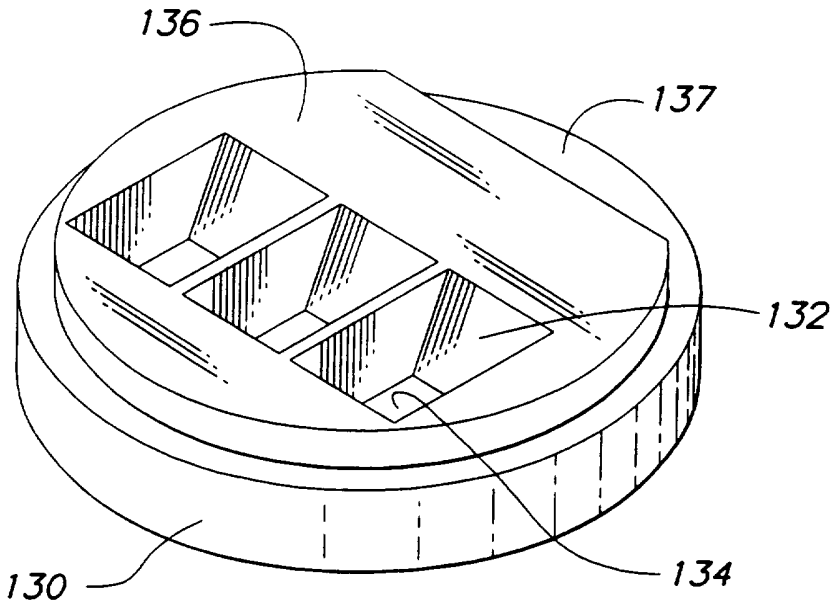


FIG. 9

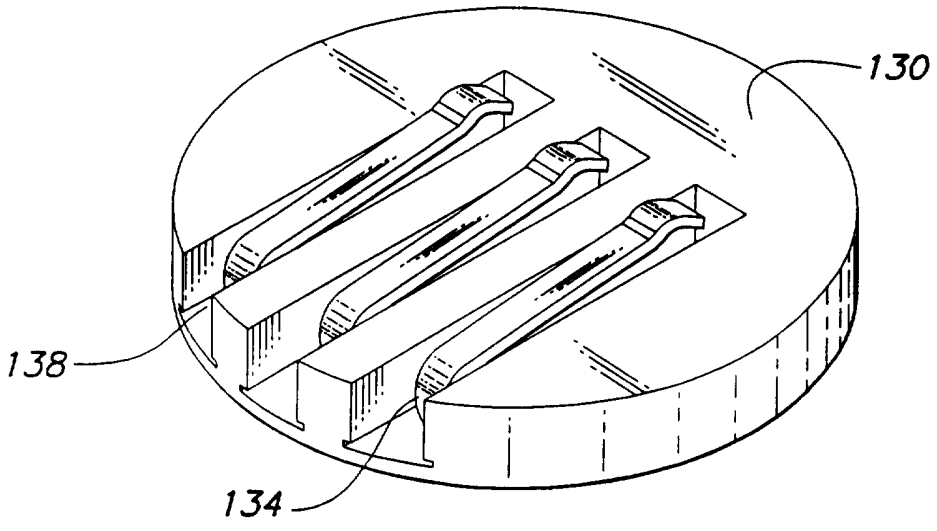


FIG. 11

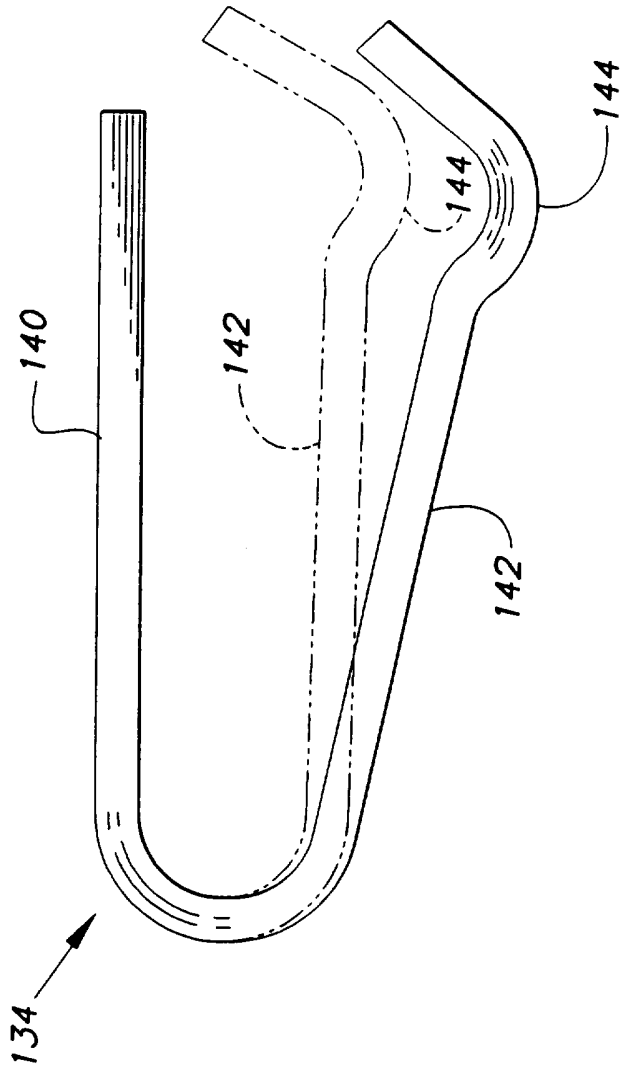


FIG. 12

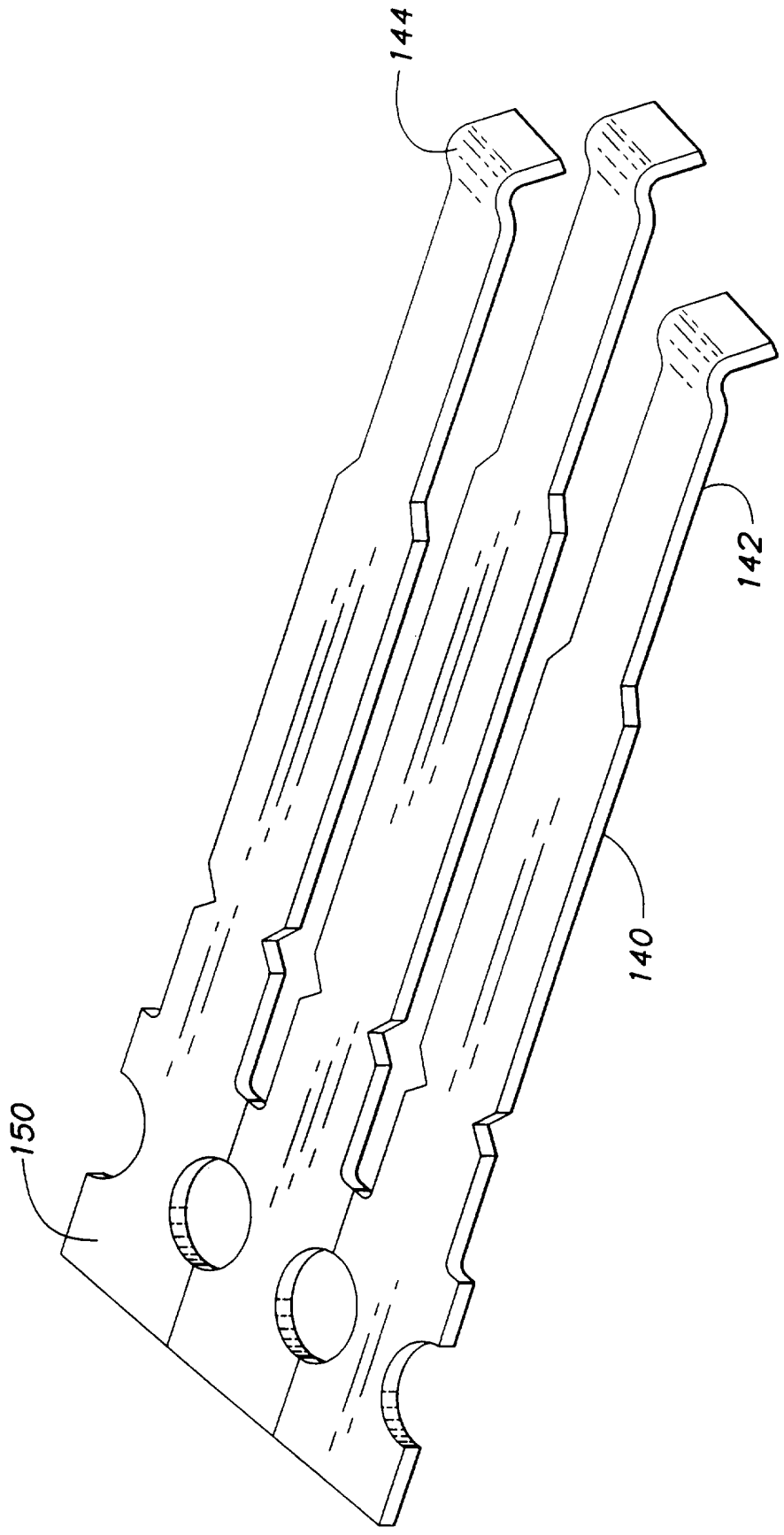


FIG. 14

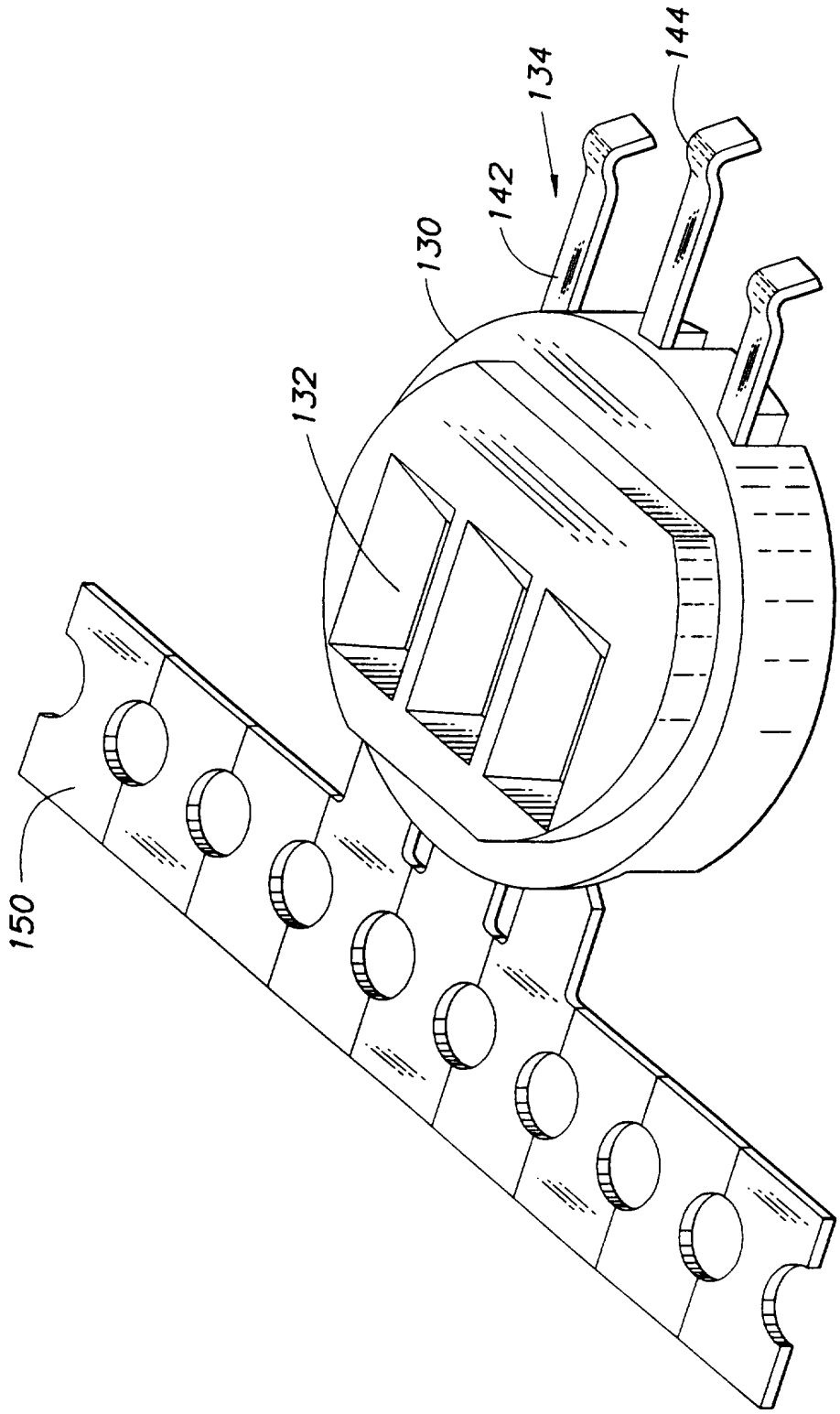


FIG. 15

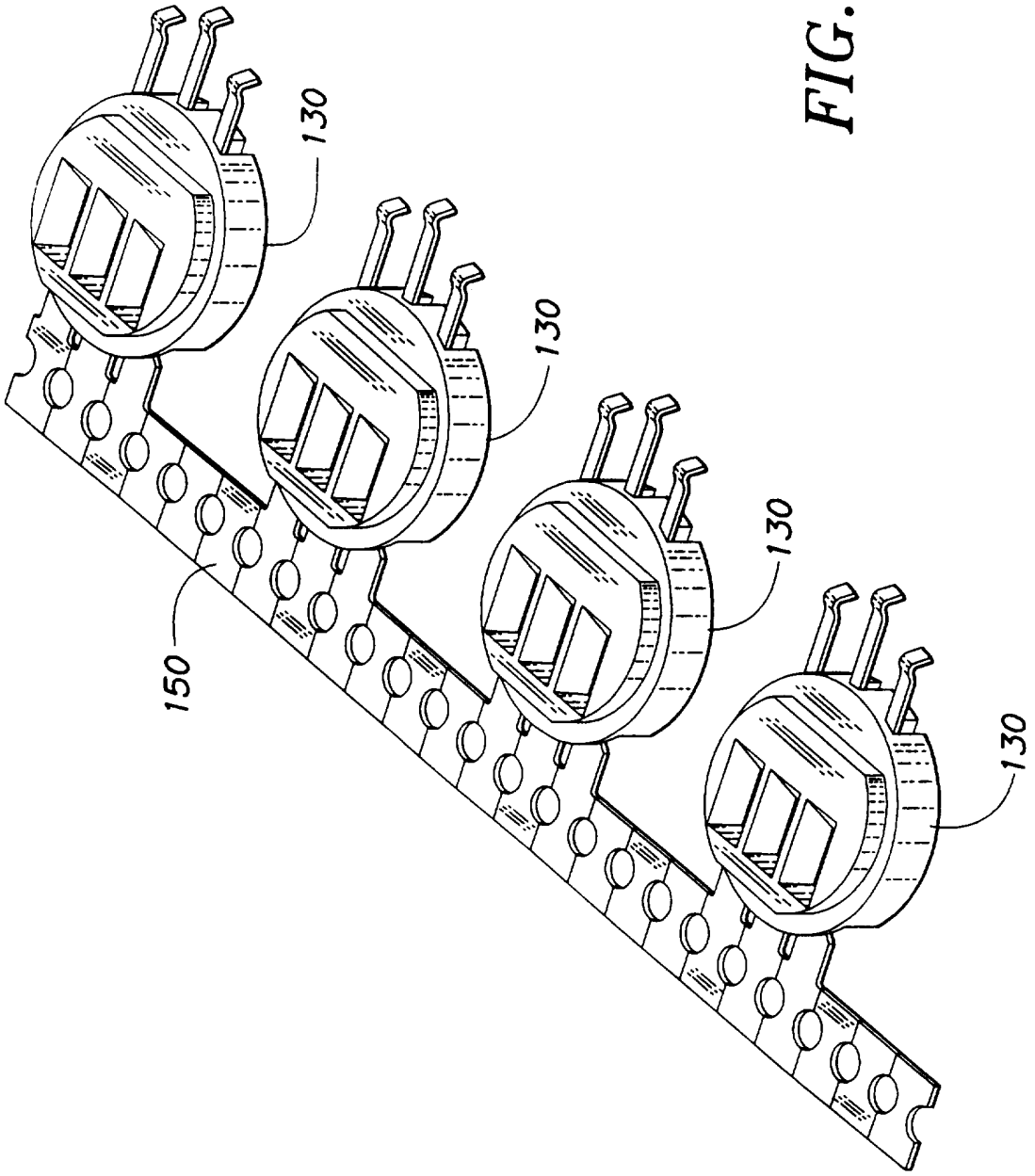


FIG. 16

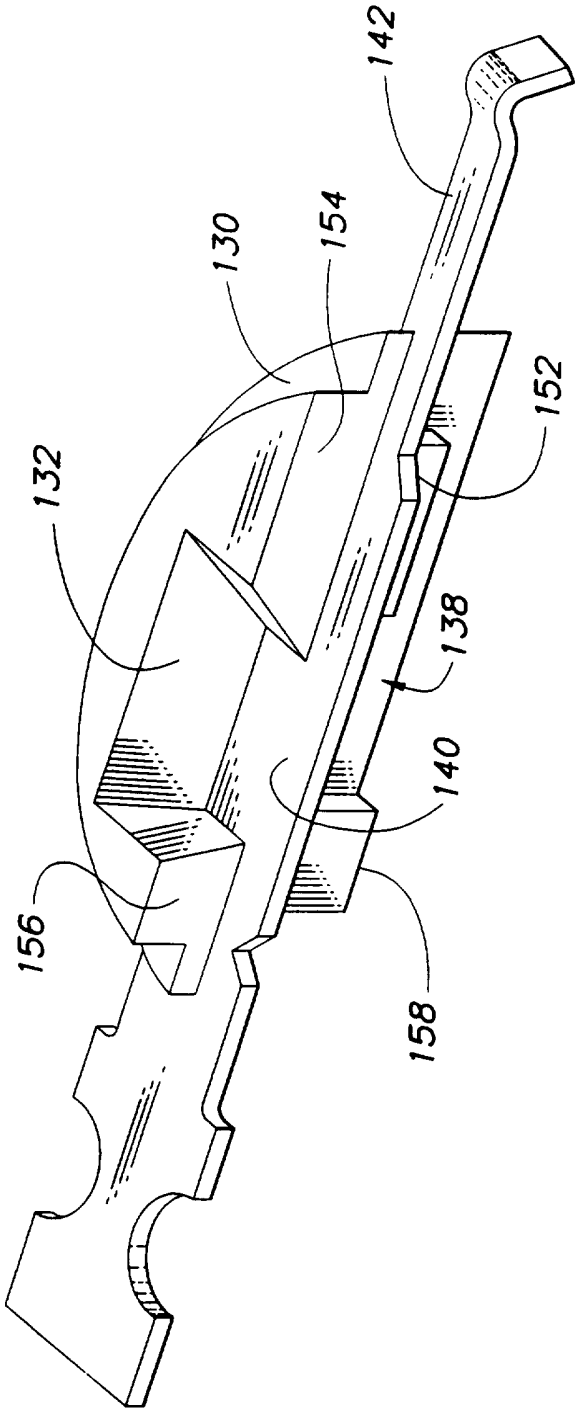


FIG. 17

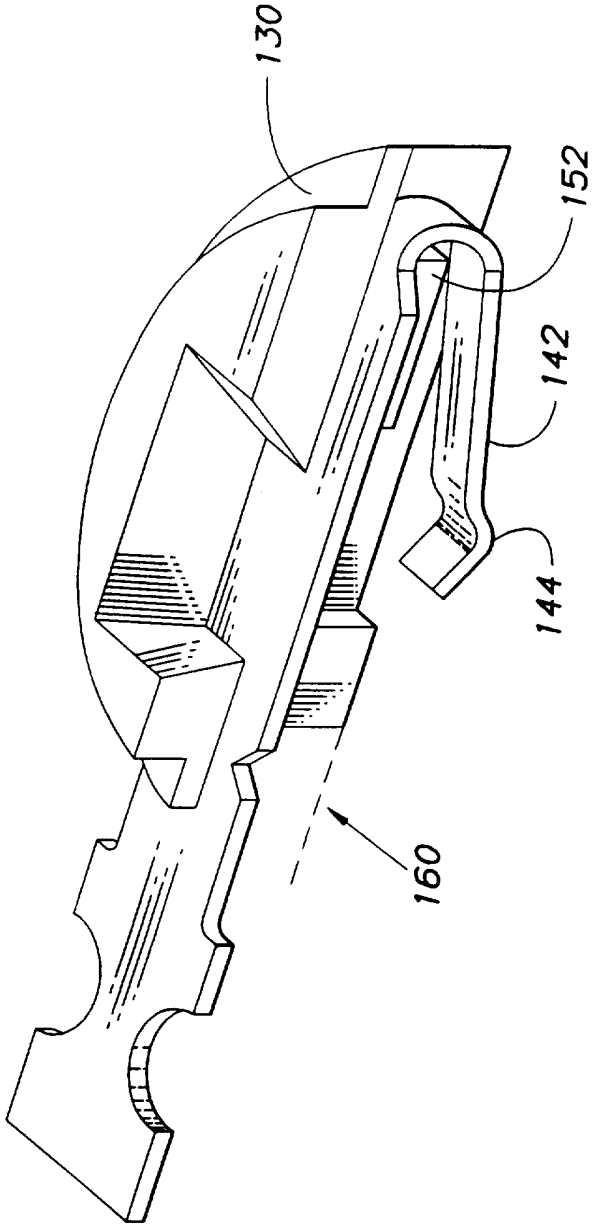


FIG. 18

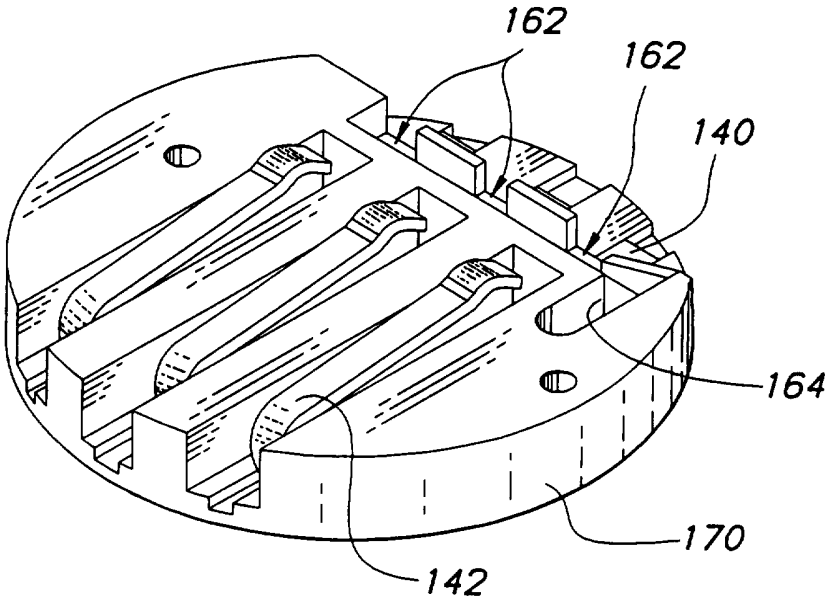


FIG. 19

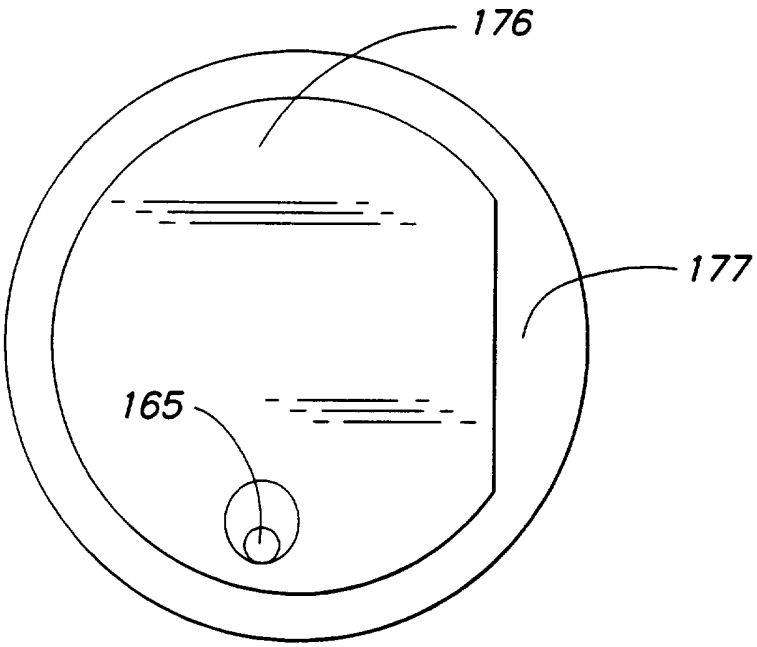


FIG. 20

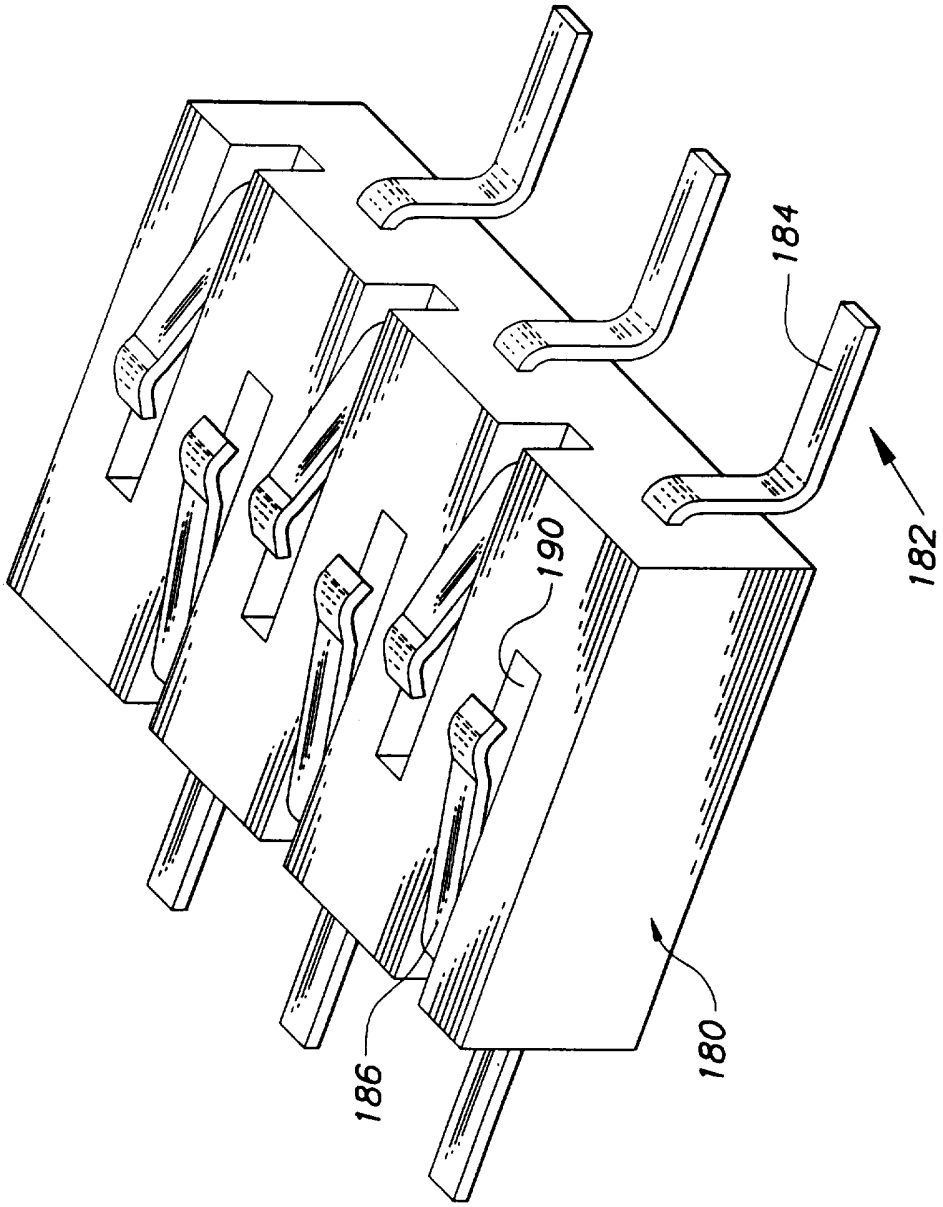


FIG. 21

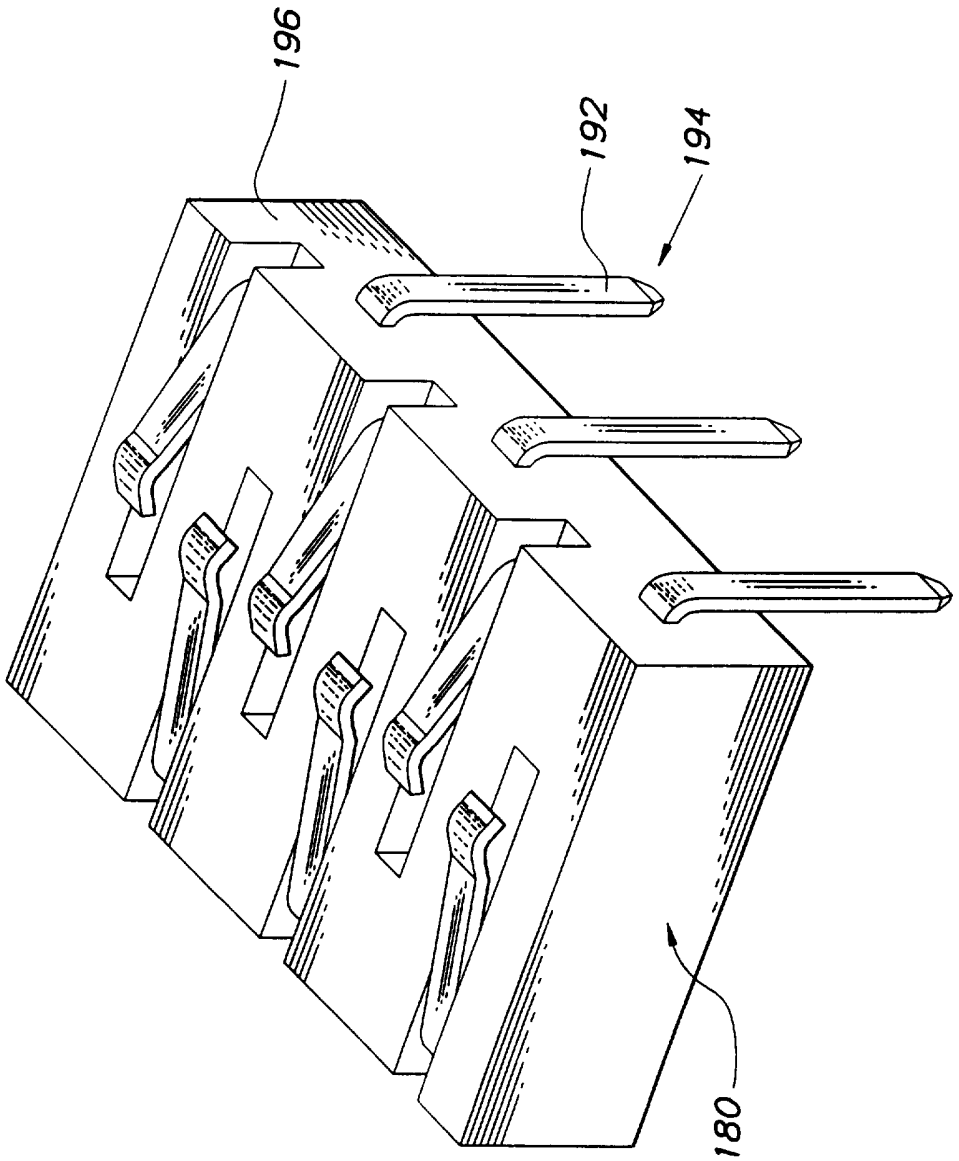


FIG. 22

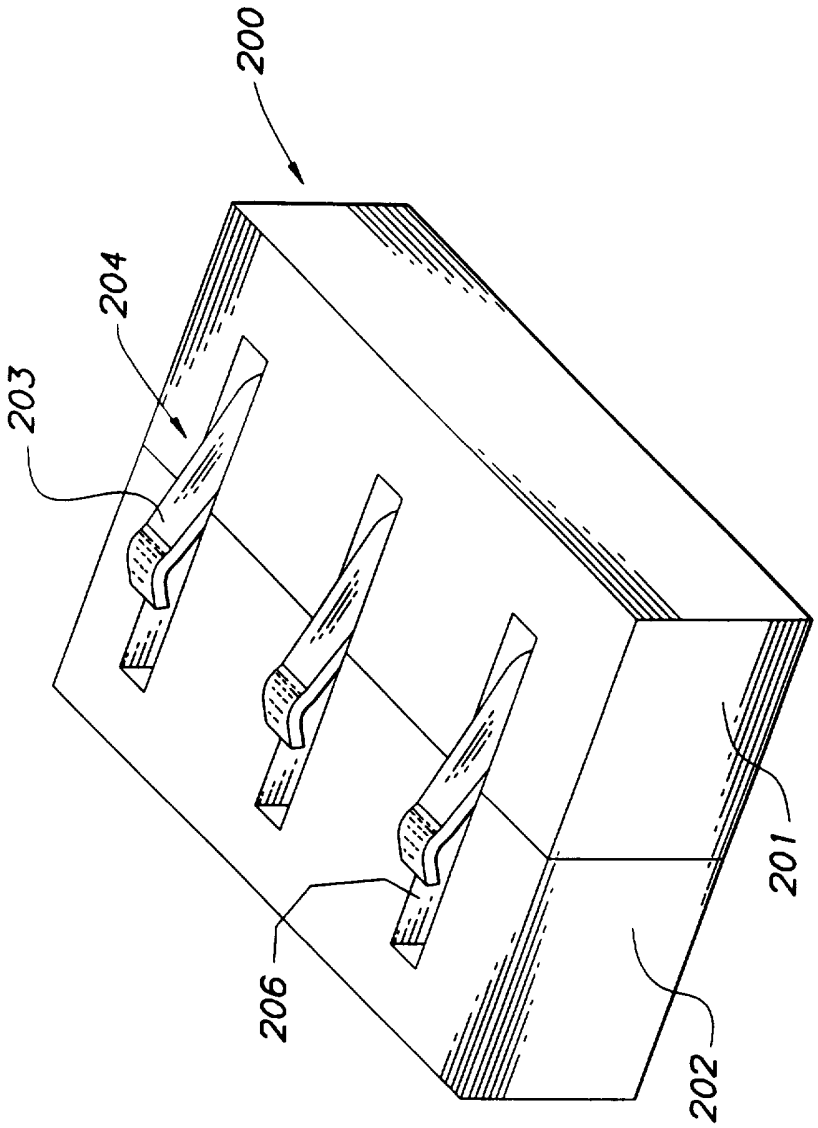


FIG. 23

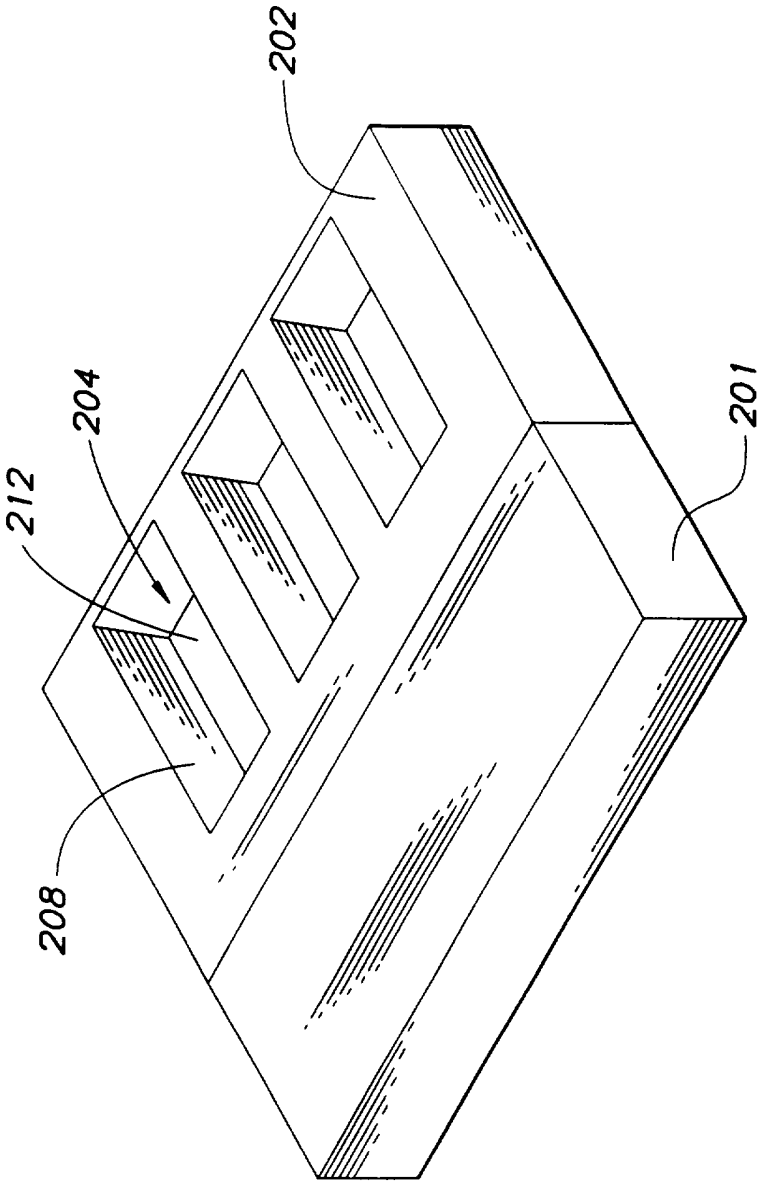


FIG. 24

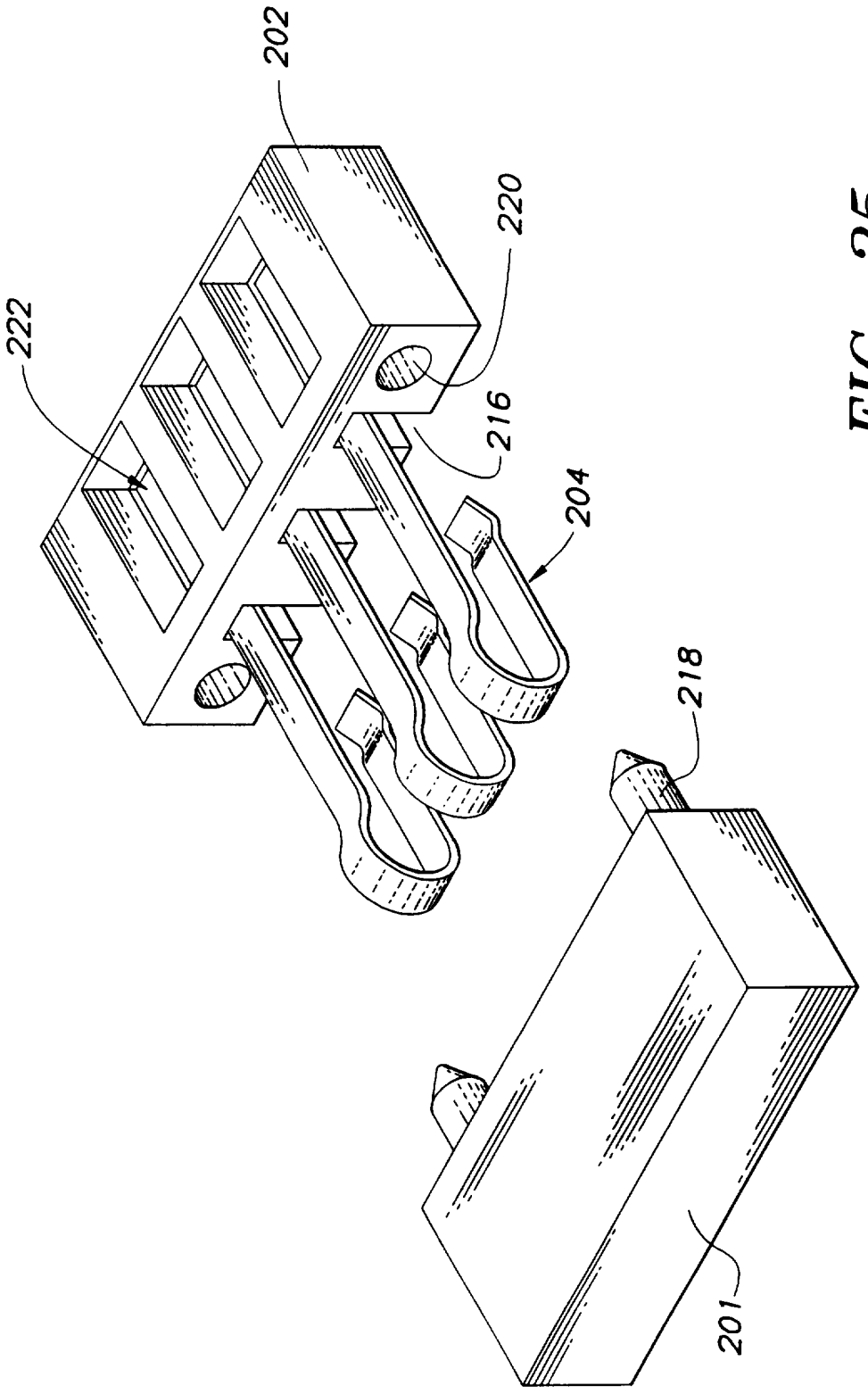


FIG. 25

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/08577

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :G11B 5/012; H01R 9/09, 13/15
US CL :360/97.01; 439/65, 80
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 360/97.01, 97.02, 97.03, 97.04, 98.01, 98.07; 439/65, 80, 50, 52, 66, 81, 82, 83, 271, 273, 519, 556, 559

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

none

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS, search terms: connector#, wipe#, air tight, moire, taper?, gas tight, mating force, deflect?

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US, A, 4,830,623 (OWENS ET AL) 16 May 1989, col. 8, line 23.	1-11
Y	US, A, 4,990,107 (FORTUNA) 05 February 1991, Figures 1, 10.	1-11
Y	US, A, 5,243,495 (READ ET AL) 07 September 1993, col. 5, lines 1-14.	6
A, P	US, A, 5,337,202 (JABBARAI ET AL) 09 August 1994, Figure 7.	6
A	US, A, 4,341,433 (CHERIAN ET AL) 27 July 1982, Figure 2.	1-11
A	US, A, 4,533,203 (FELDMAN ET AL) 06 August 1985, Figure 2.	1-5, 7-11

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 16 AUGUST 1995	Date of mailing of the international search report 22AUG1995
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer DAVID OMETZ Telephone No. (703) 308-1296

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/08577

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4,553,192 (BABUKA ET AL) 12 November 1985, Figure 2.	1-5, 7-11