(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 654 870 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **94117817.0**

(51) Int. Cl.6: **H01R 23/70**

(22) Date of filing: **11.11.94**

(30) Priority: **22.11.93 US 156171**

(43) Date of publication of application: **24.05.95 Bulletin 95/21**

(84) Designated Contracting States: **DE FR GB IT NL**

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(54) Receptacle mounting means for IC card.

(57) A receptacle connector (12) for an IC card (10) is provided for mounting on a surface of a circuit substrate (14). The connector includes a dielectric housing (40) having a forward mating face (42), a rearward terminating face (43), and a plurality of terminal-receiving passages (44)) extending therethrough. A plurality of conductive terminals (16) are received in the passages. Each terminal includes a surface mount tail portion (50) projecting from the rearward terminating face of the housing which includes a contact portion (52) for resiliently engaging an appropriate circuit trace (18) on the substrate. The contact portions are disposed in a generally coplanar elongate array. A mounting arm (46) is provided at each end of the housing for mounting the connector on the surface of the substrate. A pair of generally rectangularly configured mounting pegs (54) projects from a bottom mounting face of each mounting arm. Each pair of pegs "straddles" the elongated array of contact portions and is adapted to provide an interference fit within a corresponding mounting hole (56) in the circuit substrate to hold the connector to the substrate during processing.

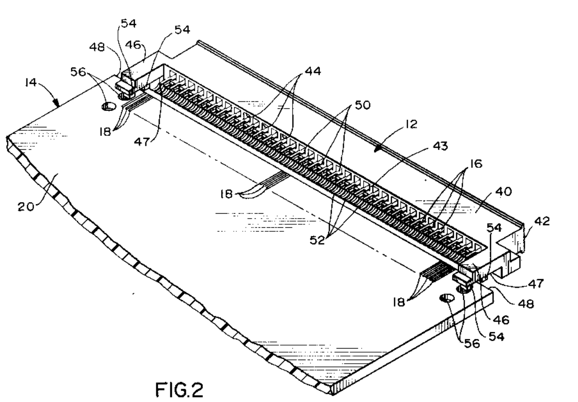

FIG.2

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Field of the Invention

This invention generally relates to an electrical connector for mounting on a surface of a circuit substrate and, particularly, to mounting means between the circuit substrate and the receptacle of an IC card.

Background of the Invention

Generally, IC cards or packs, such as memory cards, are data input devices which are electrically connected to an underlying electronic apparatus or storage device, such as a word processor, personal computer or other electronic apparatus. Upon insertion of the IC card into the underlying apparatus and electrical connection thereto, the data stored in the IC card is transferred to the electronic apparatus. The IC or memory cards are typically portable instruments which may be readily inserted and extracted from a connector apparatus as required, and are used with such connector apparatus for removably coupling the card to a printed circuit board of the underlying apparatus, for instance.

An IC card conventionally includes a rectangular frame which receives a circuit substrate, and on or around which is mounted a panel or cover that encloses the circuit substrate therewithin. The circuit substrate of an IC card conventionally comprises a generally planar support with at least one electrical component mounted thereon. The electrical component(s) may include semi-conductor devices, integrated circuits, batteries or the like. A surface mounted receptacle connector is electrically and mechanically coupled to an edge of the circuit substrate. The receptacle connector includes receptacle terminals mounted therein having surface mount tails with contact portions adapted to be surface mounted to corresponding circuit traces on one or both sides of the circuit substrate. Each receptacle terminal also includes a receptacle portion for mating with contacts of the main electronic apparatus, such as mating with the contacts of a header connector mounted on a printed circuit board of the main electronic apparatus.

Since the receptacle connector is surface mounted to the circuit substrate, and since subsequent to such processing the circuit substrate is assembled to the frame and cover, it is important that the connector be positioned correctly with respect to the substrate, that is, the surface mount tails of the receptacle terminals must be accurately positioned and the contact portions connected to their corresponding circuit traces, so that proper electrical connection is made and so that the connector/substrate assembly fits within the frame. Furthermore, it is often desirable, if not necessary, to hold the connector in place prior to and during the surface mounting process, so that movement prior to or surface tension during the process does not result in an inaccurately positioned connector.

Care must be taken, however, when holding the receptacle connector to the substrate. Too little retention to the substrate is of no use, and may result in open circuit conditions or intermittencies should the surface mount tails and their respective contact portions "float" off the circuit traces or move off their requisite positions. On the other hand, too much retention can cause excessive insertion force and make assembly of the connector to the substrate difficult, if not impossible. Furthermore, in the case of robotic or automated assembly of the connector, the substrate or components on the substrate may be damaged if excessive force is used to insert and assemble an improperly aligned connector.

One type of memory card receptacle connector configuration utilizes single-sided receptacle terminals wherein the contact portions of the surface mount tails are adapted to be coupled to circuit traces on only one side of the circuit substrate. This configuration allows a "top-to-bottom" direction of assembly of the connector to the substrate, thereby facilitating robotic "pick-and-place" assembly. One way of processing a connector having a single-sided terminal configuration is to simply place it on top of the substrate. Often a connector of this type will include a locating peg or other similar feature to correctly position the connector with respect to the substrate. However, since "perfect" coplanarity of the surface mount tails and/or contact portions is generally not attainable, connectors of this type will rest on the substrate supported only by the lowest contact portions, resulting in a gap between the substrate and the higher contact portions. The greater this gap, the greater the risk of a poor or non-existent solder connection between the connector and the substrate.

Another processing method overcomes this dependence on manufacturing control of coplanarity by using a single press-fit or retention peg on each side of the housing to hold the connector to the substrate, which, by design, presses the contact portions of the surface mount tails to the board, or "preloads" the contact portions. However, since these contact portions exert a force on the substrate, and since by the nature of memory card receptacle connectors the surface mount tails are outboard of the housing along only a single edge of the housing, the force exerted by the tails acts to rock or rotate the housing from its desired position, pivoting about the retention peg.

However, due to the small size of a memory card receptacle connector, press-fit or retention pegs are correspondingly small and, therefore, integrally molded compliant pegs or complicated peg shapes are generally not manufacturable. Furthermore, the miniature nature of the pegs magnifies the manufacturing tolerances, i.e. the change in peg diameter or size is a larger percentage of the peg size itself. Accordingly, an undersized peg may not provide any interference fit in an oversized substrate hole, and an oversized peg may provide too much interference in an undersized hole, resulting in ineffective and excessive insertion forces, respectively, as discussed above.

This invention is directed to solving the problems identified above by providing an improved receptacle mounting peg as described and claimed.

Summary of the Invention

An object, therefore, of the invention is to provide a new and improved electrical receptacle connector for mounting on a surface of a circuit substrate at an edge thereof.

Another object of the invention is to provide an improved mounting peg system between a circuit substrate and a receptacle connector of an IC card or pack, such as a memory card.

In the exemplary embodiment of the invention, the connector includes a dielectric housing having a forward mating face, a rearward terminating face, and a plurality of terminal-receiving passages therethrough. A plurality of conductive terminals are received in the passages. Each terminal includes a surface mount tail projecting outwardly from the housing from the rearward terminating face and having a surface mount contact portion at a distal end thereof for resiliently engaging an appropriate circuit trace on the substrate. The surface mount contact portions are disposed in a generally coplanar elongate array. A mounting arm is provided on each side of the housing for mounting to the surface of the circuit substrate. Generally, mounting pegs project from a bottom mounting face of the mounting arms.

Specifically, the invention is directed to an improvement in the mounting pegs. In particular, a pair of mounting pegs having a generally rectangular cross-section project from the bottom mounting face of the mounting arm for insertion into corresponding round mounting holes in the circuit substrate. Each pair of mounting pegs straddles the elongate array of surface mount contact portions to balance the uneven forces created by the single-sided receptacle connector and to prevent the "rocking" that may occur in the case of a single mounting peg configuration. Furthermore, each peg has a transverse dimension between diagonal corners of the rectangular peg configuration greater than the diameter of the respective round hole in the circuit substrate while the transverse dimension between adjacent corners of the peg is less than the diameter of the round holes, thereby establishing an interference or press fit between the receptacle connector and the circuit substrate. The rectangular peg configuration permits an acceptable interference fit within the round holes of the substrate for a wide range of dimensional tolerances, and holds or "pre-loads" the surface mount contact portions to their respective circuit traces to ensure a good electrical connection.

In the preferred embodiment of the invention, the dielectric housing is molded of plastic material, and the mounting pegs are molded integrally therewith. The pegs have a square cross section, and the corners of the plastic pegs are compliant or deformable for insertion into the generally round holes of the circuit substrate.

Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

Brief Description of the Drawings

The features of this invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with its objects and the advantages thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

FIGURE 1 is an exploded perspective view of the elements of an IC card in which the invention is applicable;

FIGURE 2 is a perspective view of the receptacle connector of the card elevated above an edge of the circuit substrate at which the connector is surface mounted;

FIGURE 3 is a bottom plan view of the receptacle connector;

FIGURE 4 is an elevational view of the terminating side of the connector;

FIGURE 5 is a fragmented vertical section through the connector;

FIGURE 6 is an end elevational view of the connector;

FIGURE 7 is an enlarged fragmented view of the right-hand end of the connector as viewed in Figure 3;

FIGURE 8 is a somewhat schematic, composite representation of different size mounting pegs with respect to different size mounting holes;

FIGURE 9 is a view similar to that of Figure 5, with the connector mounted to the circuit substrate;

FIGURE 10 is a view similar to that of Figure 6, with the connector mounted to the circuit substrate; and

FIGURE 11 is a view similar to that of Figure 7, with the connector mounted to the circuit substrate.

Detailed Description of the Preferred Embodiment

Referring to the drawings in greater detail, and first to Figure 1, the invention is embodied in an IC card, generally designated 10, which is provided as a data input device, such as a memory card, for connection to an electronic apparatus or storage device, such as a word processor, personal computer or other electronic apparatus (not shown). The data stored in memory card 10 is transferred to the electronic apparatus through the terminals within a receptacle connector, generally designated 12, which is edge mounted to a circuit substrate, generally designated 14, on which data storage units are mounted or stored.

More specifically, receptacle connector 12 is elongated and mounts a plurality of input terminals 16. The terminals mechanically and electrically engage contact pads 18 on a surface 20 of circuit substrate 14. Various electrical components or circuit elements 22 are surface mounted on surface 20, along with circuit traces 24 leading to contact pads 18 at the leading or front edge of the substrate. This edge is coupled to elongate receptacle connector 12, and the receptacle connector is interconnectable with an electrical connector, such as a header connector, mounted on a printed circuit board of the electronic apparatus to which data stored on circuit substrate 14 is transferred.

The above description of circuit substrate 14 is generally conventional, and, consequently, the depiction of the circuit substrate is somewhat schematic. However, it should be understood that, although electrical components 22 are shown in the drawings as being of uniform shape and size, the components will generally vary, and may comprise semi-conductor devices, batteries, and other parts of integrated circuits, all mounted on surface 20 of the circuit substrate.

Still referring to Figure 1, memory card 10 includes a frame, generally designated 30, which includes an opening 32 in a top surface 33 thereof for receiving circuit substrate 14. The frame includes support means, generally designated 34, facing opening 32 for supporting circuit substrate 14 within the frame in the orientation of Figure 1. A top panel or cover 36 is adapted to be fixably secured to top surface 33 for closing opening 32 and enclosing circuit substrate 14 within the frame 30. The frame is unitarily molded of dielectric material, such as plastic, and a plurality of cross braces 35 join the sides of the frame to provide integrity to the frame structure. In the illustrated embodiment, the frame also defines a bottom opening 37 in a bottom surface 39 of frame 30, which is closed by a bottom panel or cover 38.

Generally, the invention is directed to an improved mounting means between receptacle connector 12 and circuit substrate 14. More particularly, referring to Figure 2, receptacle connector 12 includes a dielectric housing 40 having a forward mating face 42, a rearward terminating face 43, and a plurality of terminal-receiving passages 44 arranged in two generally parallel rows and extending between the forward mating face and the rearward terminating face therethrough for receiving receptacle terminals 16. An end wing or mounting arm 46 is located at each end of the housing 40 and includes a bottom mounting face 47 which mounts on the top surface 20 of circuit substrate 14 adjacent an edge 48 thereof. Each receptacle terminal 16 includes a receptacle portion proximate the forward mating face of the housing, and a surface mount tail 50 which projects from rearward terminating face 43 and extends outwardly therefrom. The surface mount tails 50 each include a surface mount contact portion 52 for mechanically and electrically engaging contact pads 18 on the top surface 20 of the circuit substrate, adjacent edge 48. As will be seen hereinafter, in their "unumounted" or undeflected condition, contact portions 52 of surface mount tails 50 project below bottom mounting face 47 of receptacle connector 12. As can be seen quite clearly in Figure 2, surface mount tails 50 extend in a generally parallel elongate array outwardly of housing 40 of the receptacle connector. Correspondingly, the contact portions 52 form a generally coplanar elongate array, as will be seen hereinafter.

The improved mounting means of the invention is incorporated in a pair of mounting pegs 54 formed on each mounting arm, which are press fit or force fit into a respective pair of mounting holes 56 (Fig. 2) in circuit substrate 14. As seen in Figures 3 and 4, one pair of pegs depend from the bottom mounting face 47 of each mounting arm 46 of housing 40. The parallel array of the surface mount tails 50 of terminals 16 also are clearly seen in Figures 3 and 4.

Referring to Figures 5-7, it can be seen particularly in Figures 5 and 6 that the contact portions 52 of the surface mount tails 50 project below the bottom mounting face 42 of mounting arms 46 of the connector housing. The terminals are conventionally formed of stamped and formed sheet metal material, whereby the surface mount tails 50 are flexible and contact portions 52 exert forces against their respective contact pads when the connector is surface mounted to the circuit substrate. Receptacle portions 58 of the terminals are shown disposed in the two row arrangement described above. As can be seen in Figure 5, the top row of terminals 16 have different surface mount tail configurations than the bottom row terminals in order to effect a single parallel array of surface mount tails 50 while at the same time using a two row array of receptacle portions 58.

According to one aspect of the invention, it can be seen clearly in Figures 5 and 6 that each pair of mounting pegs 54 at each opposite end of the connector "straddles" the elongate array of contact portions of the surface mount tails. That is, one of the pair of mounting pegs 54 at each opposite end of the connector is positioned forward of the contact portions 52 of the surface mount tails 50 toward the forward mating face 42 of the housing, and the other of the pair of pegs is positioned rearward of the contact portions 52 of the surface mount tails 50 away from the forward mating face 42 of the housing. By providing mounting pegs which straddle the elongate array, the "rocking" problem discussed in the Background, above, is very simply and efficiently solved by balancing or supporting the uneven forces created by the single-sided configuration.

Furthermore, and according to another aspect of the invention, mounting pegs 54 have generally rectangularly-shaped cross-sections to provide an interference fit within a round hole, which serves to hold the connector and, in particular, the contact portions 52 of the surface mount tails 50 to the substrate to assure a good solder connection. In the preferred embodiment as illustrated, the mounting pegs are square in cross-section. Therefore, the generally rectangular configuration defines four corners 60 for each peg (see Fig. 8). The square pegs are forced into the round mounting holes 56 of circuit substrate 14. In essence, the transverse dimension between the diagonal corners of mounting pegs 54 is greater than the transverse dimension or diameter of the round holes 56, while the transverse dimension between adjacent corners is less than the diameter of the round holes, thus providing an interference fit between the receptacle connector and the circuit substrate generally at each corner of the square-shaped peg.

As stated in the Background, above, receptacle connector 12 of memory card 10 can be very small in size, and, therefore, manufacturing tolerances for tiny mounting pegs, such as pegs 54, and for mounting holes 56, are considerably magnified. In other words, any change in the transverse dimension or diameter of a mounting peg or hole is a large percentage of the size of the peg or hole, itself. However, due to the square shape of the peg, the corners of the peg are outside the hole in almost any undersize or oversize condition, i.e. within a given tolerance range of both peg size and hole size. Therefore, since only the corners 60 of the peg 54 are outside the hole, the corners deform when force-fit into round holes 56. This is particularly true when dielectric housing 40, including end wings 46 and pegs 54, is molded of plastic material. Figure 8 shows a variance in the size of a given mounting peg with respect to a round hole 56. In other words, peg 54' and hole 56' in Figure 8 represent minimal interference between a mounting peg and a round hole, peg 54 and hole 56 represent a nominal condition, and peg 54'' and hole 56'' represent maximum interference. However, the corners of the pegs can deform, or at least become compliant, upon force fitting any of the pegs into any of the round mounting holes. Most other cross-sectional peg shapes would cause either too little interference, if the hole diameter is on the high end of the tolerance range and the transverse dimension of the peg is on the low end of the tolerance range, or too much interference, if the hole diameter is on the low end of the tolerance range and the transverse dimension of the peg is on the high end of the tolerance range. The rectangular cross section of the peg, as shown particularly in Fig. 8, provides adequate, yet not excessive, interference of any size peg, within a given tolerance range, with respect to any size hole, within a given tolerance range.

Lastly, Figures 9-11 are similar to Figures 5-7, except that the receptacle connector is shown surface mounted to circuit substrate 14, with rectangular mounting pegs 54 press fit into mounting holes 56. Again, it can be seen particularly in Figure 9 how each pair of pegs straddle the elongate array of contact portions 52 of surface mount tails 50. Figure 9 also shows how the contact portions have been biased upwardly or "pre-loaded" in the direction of arrow "A" to create forces against the substrate and to assure connection between the contact portion 52 and the appropriate contact pad 18 of circuit substrate 14. Without the provision of both mounting pegs straddling or supporting the elongate array of contact portions 52, the receptacle connector 12 would have a tendency to "rock", and the connector would be unstable prior to and during processing.

It will be understood that the invention may be embodied in other specific forms without departing from the spirit or central characteristics thereof. The present examples and embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein.

Claims

1. In an electrical connector (12) for mounting at an edge of a circuit substrate (14), including:

a dielectric housing (40) having a forward mating face (42), a rearward terminating face (43) and a plurality of terminal-receiving passages (44) arranged in two generally parallel rows extending between the forward mating face and the rearward terminating face, the housing further including a mounting arm (46) on each end thereof for mounting on a surface of the substrate;

a plurality of conductive terminals (16) received in the passages, each including a surface mount tail portion (50) projecting from the rearward terminating face of the housing and extending outwardly therefrom, each surface mount tail portion having a surface mount contact portion (52) for resiliently engaging an appropriate circuit trace (18) on the surface of the substrate, wherein the surface mount contact portions define a generally coplanar elongate array between the mounting arms; and

a first integrally molded mounting peg (54) projecting from a bottom mounting face of each mounting arm for insertion into a first corresponding mounting hole (56) in the circuit substrate;

wherein the improvement comprises:

a second integrally molded mounting peg (54) projecting from the bottom mounting face of each mounting arm,

wherein the first mounting peg is positioned forward of the elongate array of surface mount contact portions toward the forward mating face of the housing and is adapted to provide an interference fit within the first corresponding mounting hole in the circuit substrate, and the second mounting peg is positioned rearward of the elongate array of surface mount contact portions away from the forward mating face of the housing and is adapted to provide an interference fit within a second corresponding mounting hole (56) in the circuit substrate,

whereby the first and second mounting pegs (54) straddle the elongate array of surface mount contact portions to hold the surface mount contact portions to the appropriate circuit traces of the substrate during processing of the substrate.

2. In an electrical connector as set forth in claim 1, wherein the mounting pegs have a generally rectangular-shaped cross-section.

3. In an electrical connector as set forth in claim 2, wherein the mounting pegs have a generally square-shaped cross-section.

4. In an electrical connector as set forth in claim 3, wherein each of the mounting pegs is adapted for insertion into a corresponding generally round mounting hole in the circuit substrate, each mounting peg having a transverse dimension between diagonal corners thereof greater than the diameter of the corresponding mounting hole in the circuit substrate, and having a transverse dimension between adjacent corners thereof less than the diameter of the corresponding mounting hole, thereby establishing an interference fit between each mounting peg and its corresponding mounting hole generally at the corners of each peg.

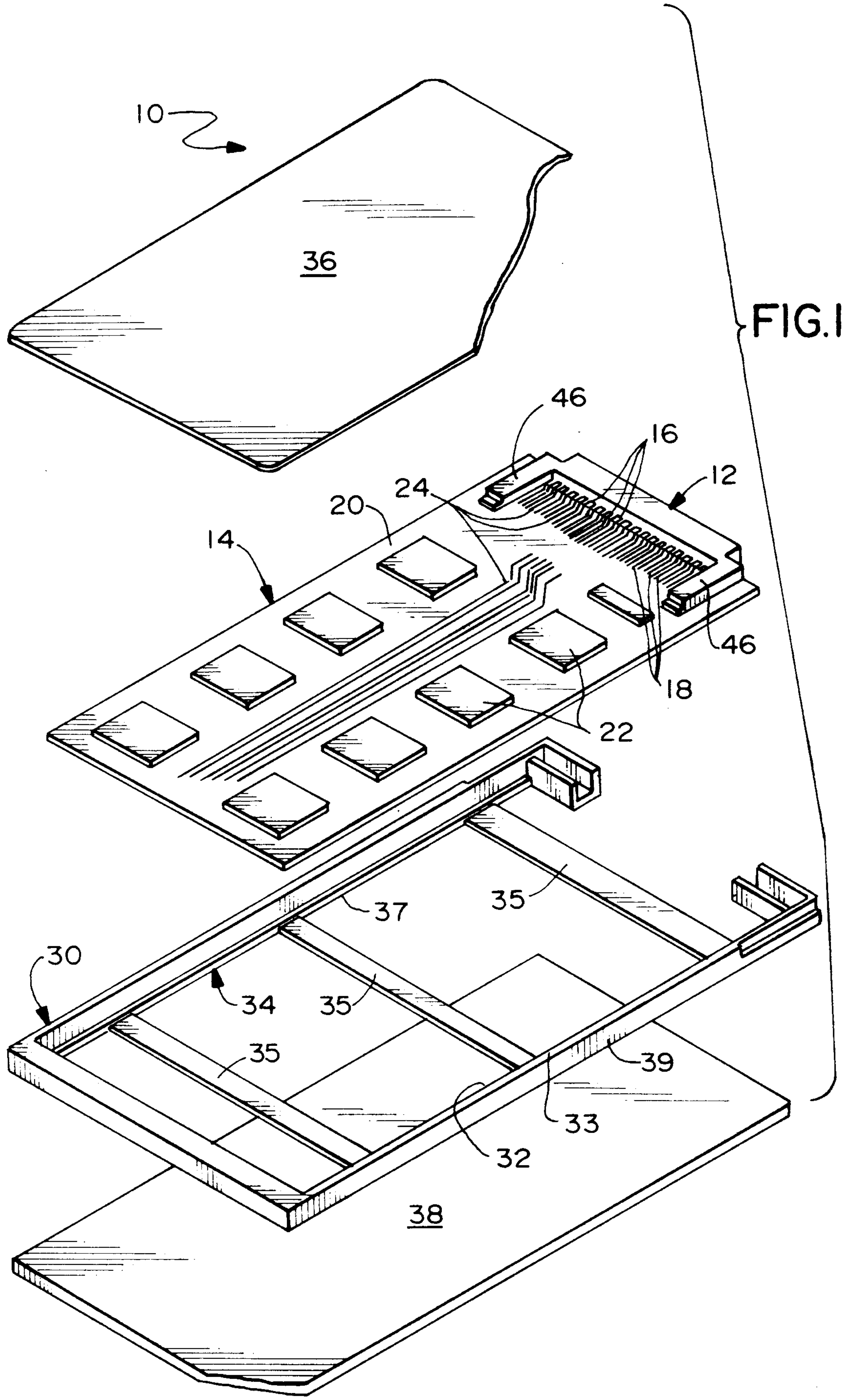

FIG.1

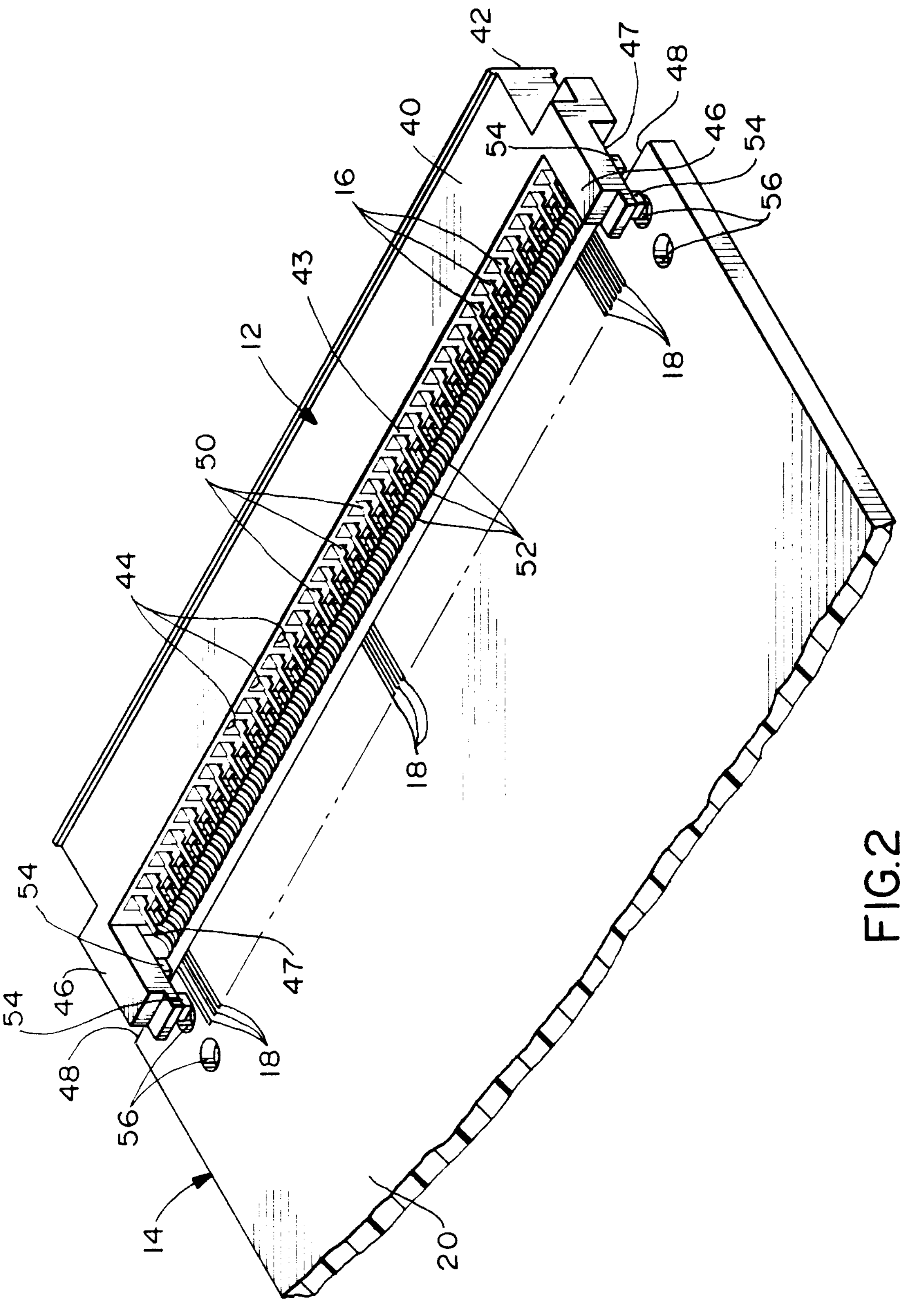

FIG.2

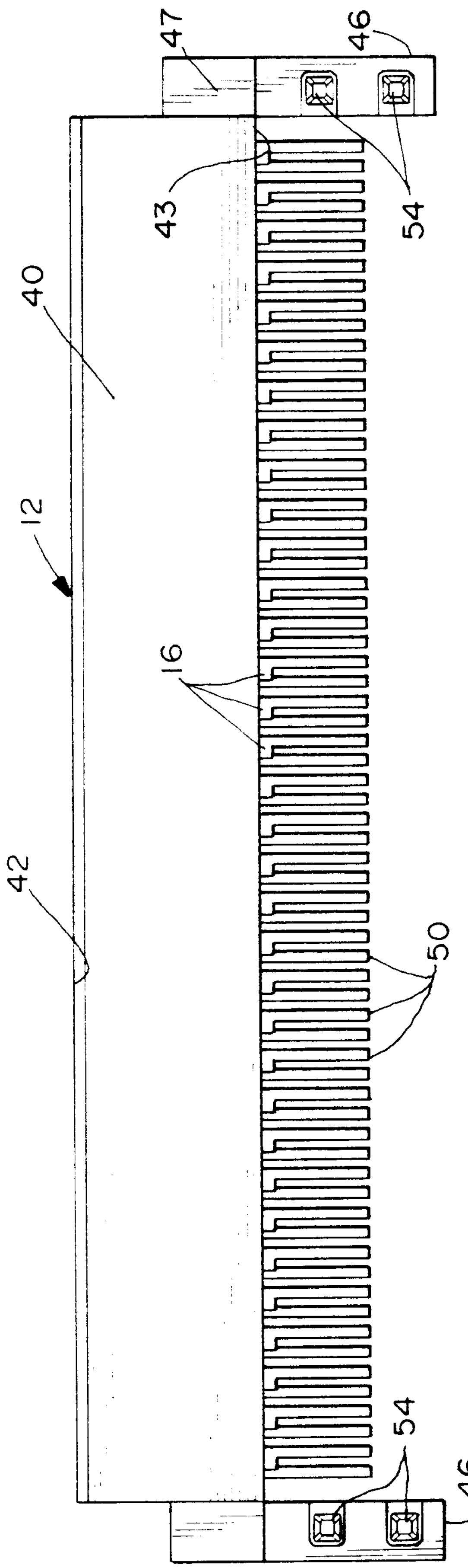

FIG.3

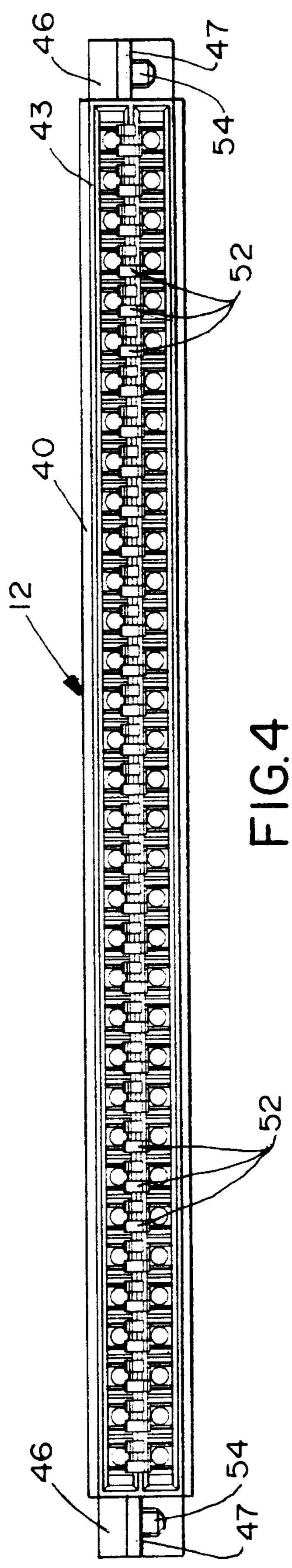

FIG.4

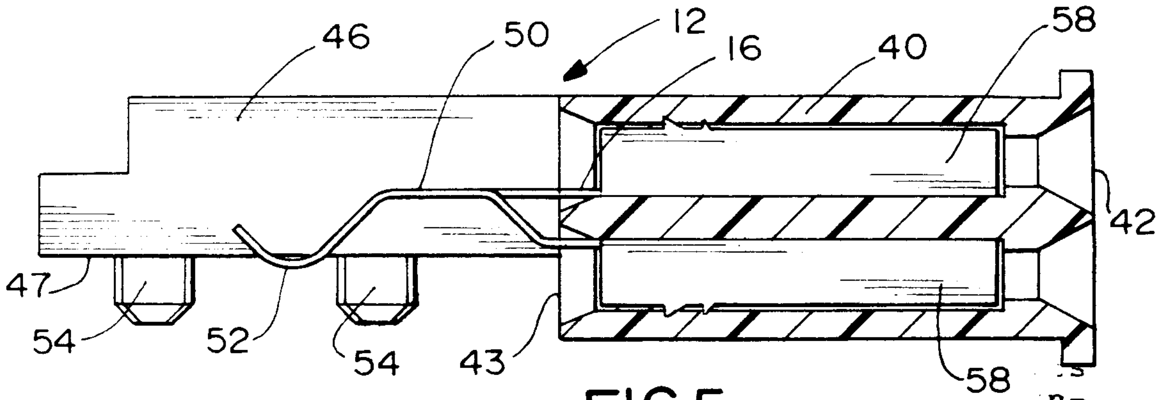

FIG.5

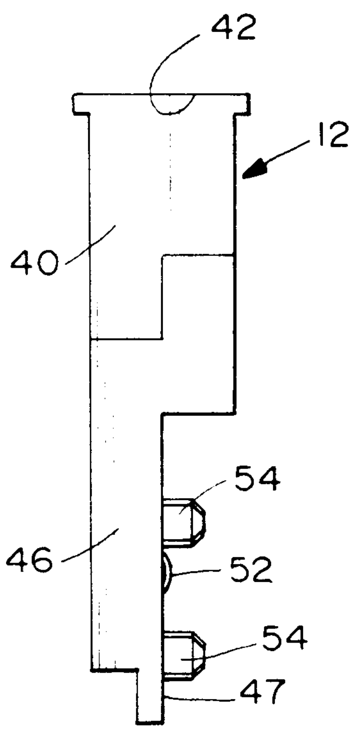

FIG.6

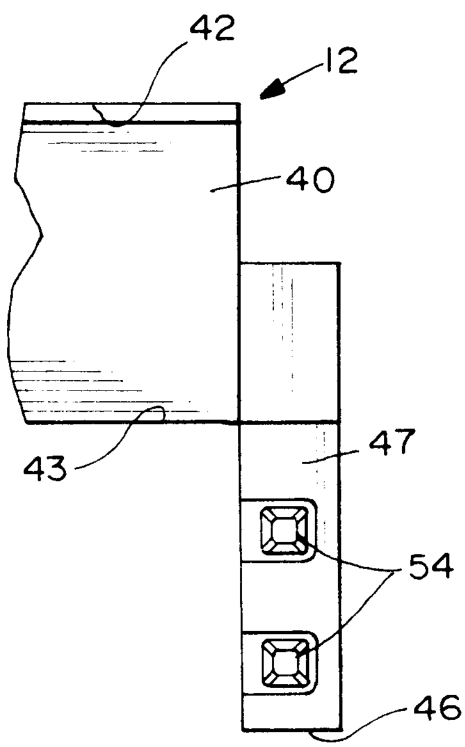

FIG.7

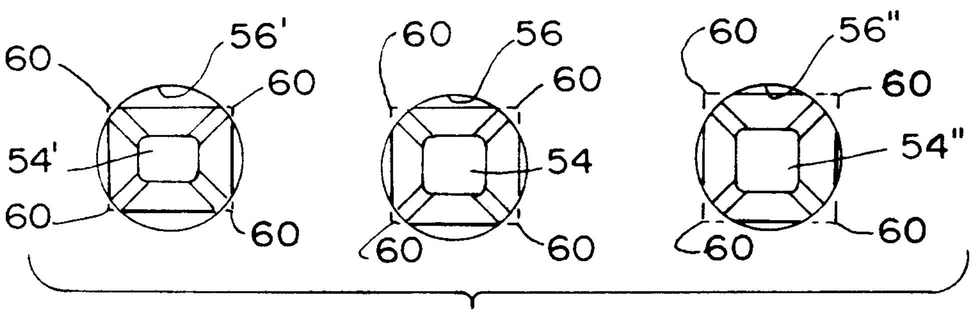

FIG.8

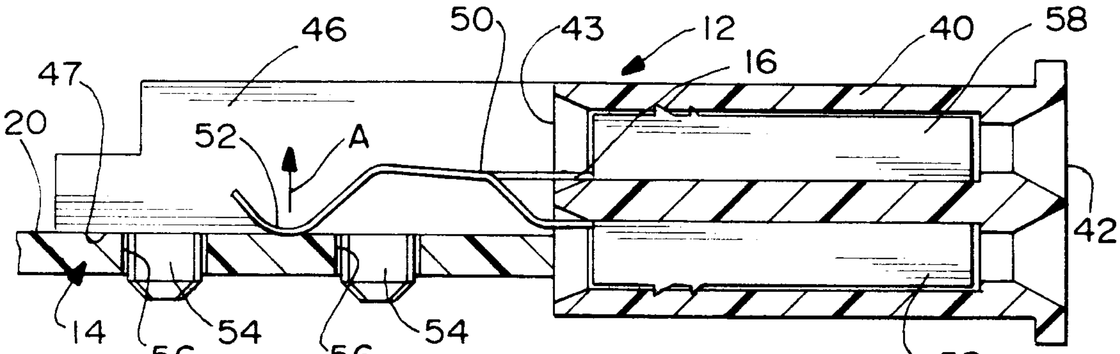

FIG.9

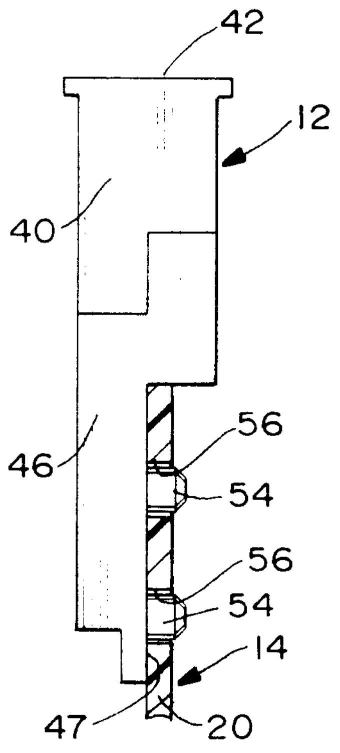

FIG.10

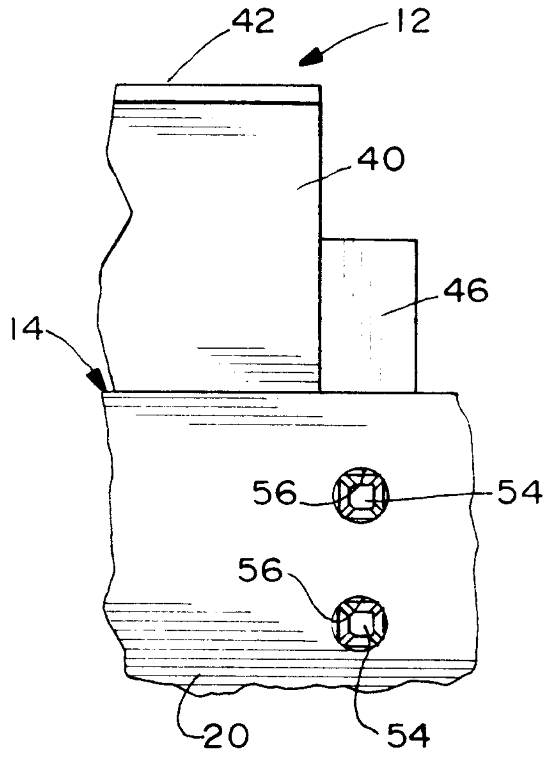

FIG.11