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

(11) EP 0 959 538 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
24.11.1999 Bulletin 1999/47

(51) Int. Cl.[6]: **H01R 43/16**, H01R 43/24

(21) Application number: **99109801.3**

(22) Date of filing: **19.05.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **22.05.1998 US 83222**

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(54) Method of manufacturing an electrical connector

(57) A method is provided for manufacturing an electrical connector module (12). The method includes the steps of stamping from conductive sheet metal material a blank (36) including a plurality of circuits (18). At least two of the circuits are joined by a web (38) of the sheet metal material. The stamped blank (36) is placed into a first molding die (46). A second molding die (58) is closed onto the first molding die and the web (38) is concurrently sheared. A dielectric housing (16) is molded about portions of the sheared circuits (18) to form the connector module (12).

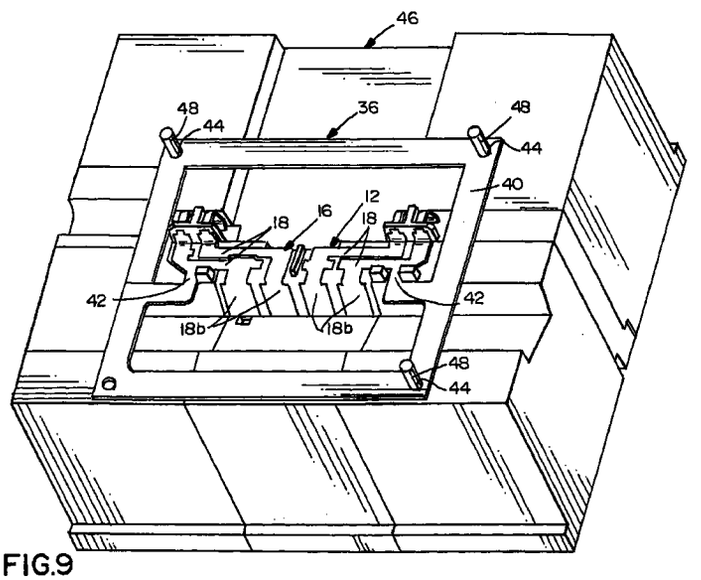

FIG.9

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Description

Field of the Invention

[0001] This invention generally relates to the art of electrical connectors and, particularly, to a method of manufacturing an electrical connector, such as a small motor mounting connector.

Background of the Invention

[0002] Generally, a basic electrical connector includes some form of dielectric housing which mounts a plurality of conductive circuits, contacts and/or terminals. For instance, the dielectric housing typically is a molded plastic housing. The circuits or terminals often are stamped and formed from sheet metal material. The circuits or terminals are mounted in the housing. In some applications, the plastic housing may be overmolded about portions of the circuits or terminals. With the ever-increasingly miniaturization of electronic components, it is increasingly difficult to manufacture such electrical connectors as described above. For instance, the stamped and formed circuits or terminals often are very small and delicate. If they are stamped as discrete elements, it is very difficult to insert these tiny elements into a dielectric housing. It also is extremely difficult to hold the tiny and intricate circuits or terminals during an overmolding process and maintaining proper positions of the circuits. The present invention is directed to providing a method of manufacture which solves these various problems.

Summary of the Invention

[0003] An object, therefore, of the invention is to provide a new and improved method of manufacturing an electrical connector module, such as a small motor mounting connector.

[0004] In the exemplary embodiment of the invention, the method includes the steps of stamping from conductive sheet metal material a blank including a plurality of circuits. At least two of the circuits are joined by a web of the sheet metal material. The stamped blank is placed into a first molding die. A second molding die is closed onto the first molding die and the web is concurrently sheared and bent creating a gap between the sheared edges. A dielectric housing is molded about portions of the sheared circuits to form the connector module. By using the molding dies to shear and separate the circuits, the circuits do not have to be individually manipulated into the molding die or inserted into a premolded housing.

[0005] As disclosed herein, shearing and bending of the web that joins the circuits is carried out by a shear portion of the second molding die. Terminals for the circuits may be formed from the blank prior to positioning the blank into the first molding die.

[0006] According to another aspect of the invention, the blank may be stamped with a carrier strip joined to at least one of the circuits by a bridge section. The molded module then can be moved on the carrier strip to another fabricating station whereat the bridge sections can be subsequently severed.

[0007] Another feature of the invention contemplates coining edges of at least one of the circuits during the stamping step. The dielectric housing then is molded about the coined edges to anchor the circuit on the housing.

[0008] 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

[0009] 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 a perspective view of a motor mounting connector fabricated according to the invention and mounted on a printed circuit board;

FIGURE 2 is a perspective view similar to that of Figure 1, with the connector mounting a small motor;

FIGURE 3 is a top perspective view of the blank stamped and formed from sheet metal material;

FIGURE 4 is a bottom perspective view of the blank;

FIGURE 5 is a top perspective view of the first molding die on which the blank is positioned;

FIGURE 6 is a perspective view of the first molding die with the blank positioned thereon;

FIGURE 7 is a perspective view of the second molding die which closes onto the first molding die;

FIGURE 8 is a view similar to that of Figure 6, but showing the blank sheared and bent by the molding die of Figure 7, this depiction normally not being visible in actual practice because the second molding die would be positioned on top of the first molding die;

FIGURE 9 is a perspective view showing the second molding die removed after the connector module is molded;

FIGURE 10 is a perspective view of the molded connector module removed from the molding dies and still joined to the carrier strips of the blank; and

FIGURE 11 is a section through one of the circuits showing the overmolded housing about coined edges of the circuit.

Detailed Description of the Preferred Embodiment

[0010] Referring to the drawings in greater detail, and first to Figure 1, the invention involves a method of manufacturing an electrical connector module, such as a small motor mounting connector, generally designated 12. The connector module is mounted on top of a printed circuit board 14. The module includes a one-piece dielectric housing, generally designated 16, unitarily molded of plastic material or the like. The housing mounts four circuits 18. The circuits have tail portions 18a for connection, such as by soldering, to appropriate circuit pads 20 on printed circuit board 14, along with circuit pads 18b. One of the circuits includes a side contact arm 22. A separate terminal, generally designated 24, also is mounted on housing 16 and includes an end contact arm 26, along with a tail portion 28 for engaging a circuit pad 30 on the printed circuit board.

[0011] Figure 2 shows connector module 12 of Figure 1 mounting a small motor 32. The motor has a side contact (not visible) for engaging side contact arm 22 of one of the circuits 18. The motor also has an end contact 34 for engaging end contact arm 26 of terminal 24. Motor 32 may be a small vibratory motor, such as is used in a mobile telephone system.

[0012] The first step of the method of manufacture according to the invention is shown in Figures 3 and 4. Specifically, a blank, generally designated 36, is stamped and formed from conductive sheet metal material. It can be seen that the blank includes circuits 18, tail portions 20 of the circuits and side contact arm 22 of one of the circuits. It should be noted that the circuits are joined by five web portions 38. In addition, the two outside circuits are joined to a rectangular carrier strip 40 by a pair of bridge sections 42. Finally, locating holes 44 are stamped through the four corners of carrier strip 40.

[0013] Figure 5 shows a first or bottom molding die, generally designated 46, for carrying out the method of manufacture according to the invention. At this point, it should be understood that the precise shape or configuration of connector module 12 and particularly motor housing 16 can vary quite extensively depending upon the connector application involved. The concepts of the invention have wide applications for plastic molded modules involving overmolded circuits, contacts or terminals. Therefore, the precise intricacies of the various cavities and cavity portions in the molding dies will not be described in detail herein. Suffice it to say, bottom molding die 46 will have mold cavities for receiving molten plastic material conforming to the desired configuration of the connector housing.

[0014] With that understanding, bottom molding die 46 has a plurality of upstanding locating posts 48. Bottom molding die 46 also has four platforms 50 on top of which blank 36 will be placed as described hereinafter. Each platform 50 has a shear-form receiving notch or slot 52. This notch 52 provides not only a shear surface allowing one edge of web portion 38 to be cut but also allowing the web portion to bend about its opposite edge creating a gap between the sheared edges. In addition, one of the platforms defines an additional shear surface 54. Suffice it to say, bottom molding die 46 has cavity means, generally designated 56, for receiving plastic material during an injection molding process. Finally, the bottom molding die has angled side surfaces 57.

[0015] Figure 6 shows blank 36 placed onto bottom molding die 46, with locating posts 48 of the die projecting through locating holes 44 of the blank. It can be seen that the four circuits are still joined by webs 38, and the network of circuits are still joined to carrier strip 40 by bridge sections 42.

[0016] After blank 36 is placed onto bottom molding die 46 as shown in Figure 6, a top molding die, generally designated 58 (Fig. 7), is closed onto the top of the bottom molding die. Figure 7 shows the underside of top molding die 58. The top molding die includes a planar area 60 which will engage the combined planar area of circuits 18. The top molding die also includes a block 62 which forms a side planar surface 64 for engaging circuit pads 18b. Therefore, when the molding dies are closed and molten plastic material is injected into cavity means 56, the plastic material will flow around the side edges of circuits 18 and the side edges of circuit pads 18b but not onto the outside planar surfaces of the circuits and circuit pads because planar portions 60 and 64 of the top molding die engage the outer surfaces of the circuits and circuit pads.

[0017] Still referring to Figure 7, top molding die 58 includes five knife or shearing portions 66 which, when the molding dies are closed, are aligned with shear-form receiving slots 52 and 54 in platforms 50 of the bottom molding die as shown in Figure 5 and described above. When the dies are closed, shearing portions 66 are effective to shear or sever and bend the five web portions 38 which join the four circuits 18. This shearing and bending action takes place substantially concurrently with the final closing action of the molding dies which is effective to sandwich circuits 18 between planar area 60 of the top molding die and platforms 50 of the bottom molding die, as well as sandwiching contact pads 18b between planar surface 64 of the top molding die and side surfaces 57 of the bottom molding die. In other words, the circuits are severed substantially simultaneously with the circuits being gripped between the molding dies, so that the precise relative positioning of the stamped circuits are maintained.

[0018] Figure 8 shows blank 36 on bottom molding die 46, with the webs between the circuits having been severed and bent. This depiction is shown simply for providing a better understanding of the invention. It should be understood that this condition cannot occur in actual practice unless the top molding die is removed from the bottom molding die before the plastic material is injected into the assembled dies. This would not nor-

mally occur in actual practice, but the depiction is shown herein to facilitate a complete understanding of the invention.

[0019] The next step in the method according to the invention is to injection mold the motor housing 16 (Fig. 1) within cavity means 56 (Fig. 5) between bottom and top molding dies 46 and 58, respectively, when the dies are closed and circuits 18 have been separated by severing web portions 38.

[0020] Figure 9 shows the motor housing having been fully molded about the circuits and their related components, with top molding die 58 removed. The circuits and their related components now are electrically isolated from each other except for bridge sections 42 still joining the outermost circuits to carrier strip 40.

[0021] The overmolded subassembly of motor housing 16 and circuits 18 still joined to carrier strip 40, then is removed from bottom molding die 46 as shown in Figure 10. The connector module is fully completed except that it is still attached to the carrier strip by bridge sections 42. Therefore, the overmolded module can be moved, manipulated or otherwise shipped to subsequent fabricating stations. For instance, the overmolded module can be moved to a station where it is connected to printed circuit board 14 as shown in Figure 1. Either before or at the subsequent fabricating station, bridge sections 42 (Fig. 10) are severed, as at 70 (Fig. 1), to leave connector module 12 as a complete finished product. For instance, the module can be soldered to printed circuit board 14 as shown in Figure 1 for receiving motor 32 as shown in Figure 2 and, thereby, interconnect the motor to appropriate circuit traces on the printed circuit board.

[0022] Finally, Figure 11 shows an aspect of the invention wherein circuits 18 and/or circuit pads 18b can be coined, as at 72, to facilitate anchoring the circuits or circuit pads in the plastic material of motor housing 16. In particular, the coining of the edges can take place during the stamping and forming process of blank 36. With the edges or corners of the circuits and/or circuit pads being coined or recessed, plastic material can flow over the coined edges, as at 74 in Figure 11, to anchor the circuits and/or circuit pads on the motor housing.

[0023] 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. A method of manufacturing an electrical connector module (12), comprising the steps of:

   stamping from conductive sheet metal material a blank (36) including a plurality of circuits (18), with at least two of the circuits joined by a web (38) of the sheet metal material;

   placing the stamped blank (36) into a first molding die (46);

   closing a second molding die (58) onto the first molding die and concurrently shearing said web (38); and

   molding a dielectric housing (16) about portions of the sheared circuits (18) to form the connector module (12).

2. The method of claim 1 wherein said shearing of the web (38) is carried out by a shear portion (66) of the second molding die (58).

3. The method of claim 1, including forming terminals (18a, 22) for said circuits (18) from said blank (36) prior to positioning the blank into the first molding die (46).

4. The method of claim 1 wherein said blank (36) is stamped with a carrier strip (40) joined to at least one of the circuits (18) by a bridge section (42).

5. The method of claim 4, including the step of moving the molded module (12) on the carrier strip (40) to another location and severing said bridge section (42).

6. The method of claim 1, including coining edges (72) of at least one of the circuits (18) during said stamping step, and molding (74) the dielectric housing (16) about the coined edges (72) to anchor the circuit in the housing.

7. A method of manufacturing a small motor mounting connector (12), comprising the steps of:

   stamping and forming from conductive sheet metal material a blank (36) including a plurality of circuits (18) having at least one contact arm (22), with at least two of the circuits joined by a web (38) of the sheet metal material;

   placing the stamped and formed blank (36) into a first molding die (46);

   closing a second molding die (58) onto the first molding die (36) and concurrently shearing said web (38); and

   molding a dielectric motor housing (16) about portions of the sheared circuits (18) to form the motor mounting connector (12).

8. The method of claim 7 wherein said shearing of the web (38) is carried out by a shear portion (66) of the second molding die (58).

9. The method of claim 7 wherein said blank (36) is stamped with a carrier strip (40) joined to at least

one of the circuits (18) by a bridge section (42).

10. The method of claim 9, including the step of moving the molded connector (12) on the carrier strip (40) to another location and severing said bridge section (42).

11. The method of claim 7, including coining edges (72) of at least one of the circuits (18) during said stamping step, and molding (74) the dielectric housing (16) about the coined edges (72) to anchor the circuit in the housing.

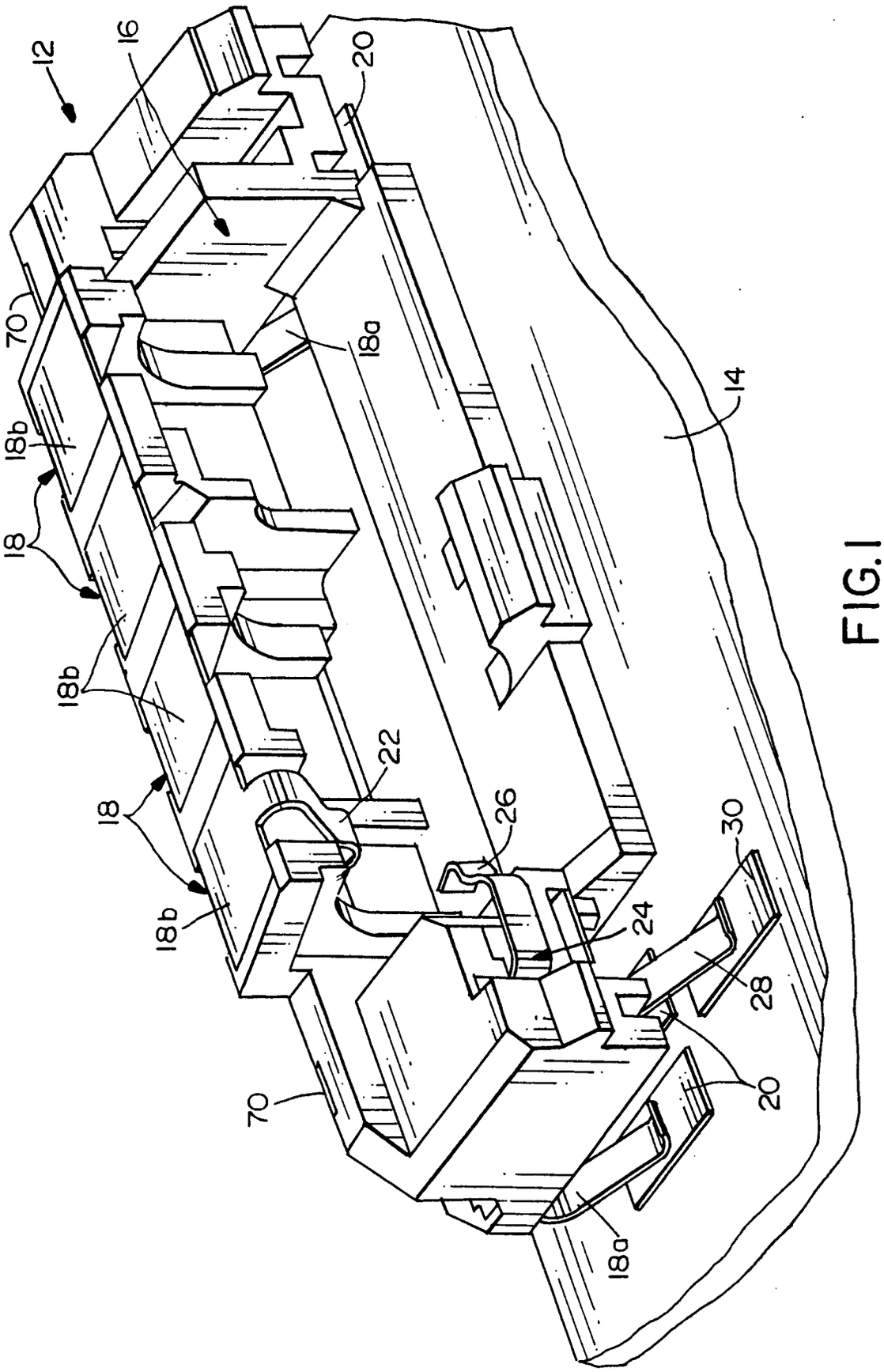

FIG.1

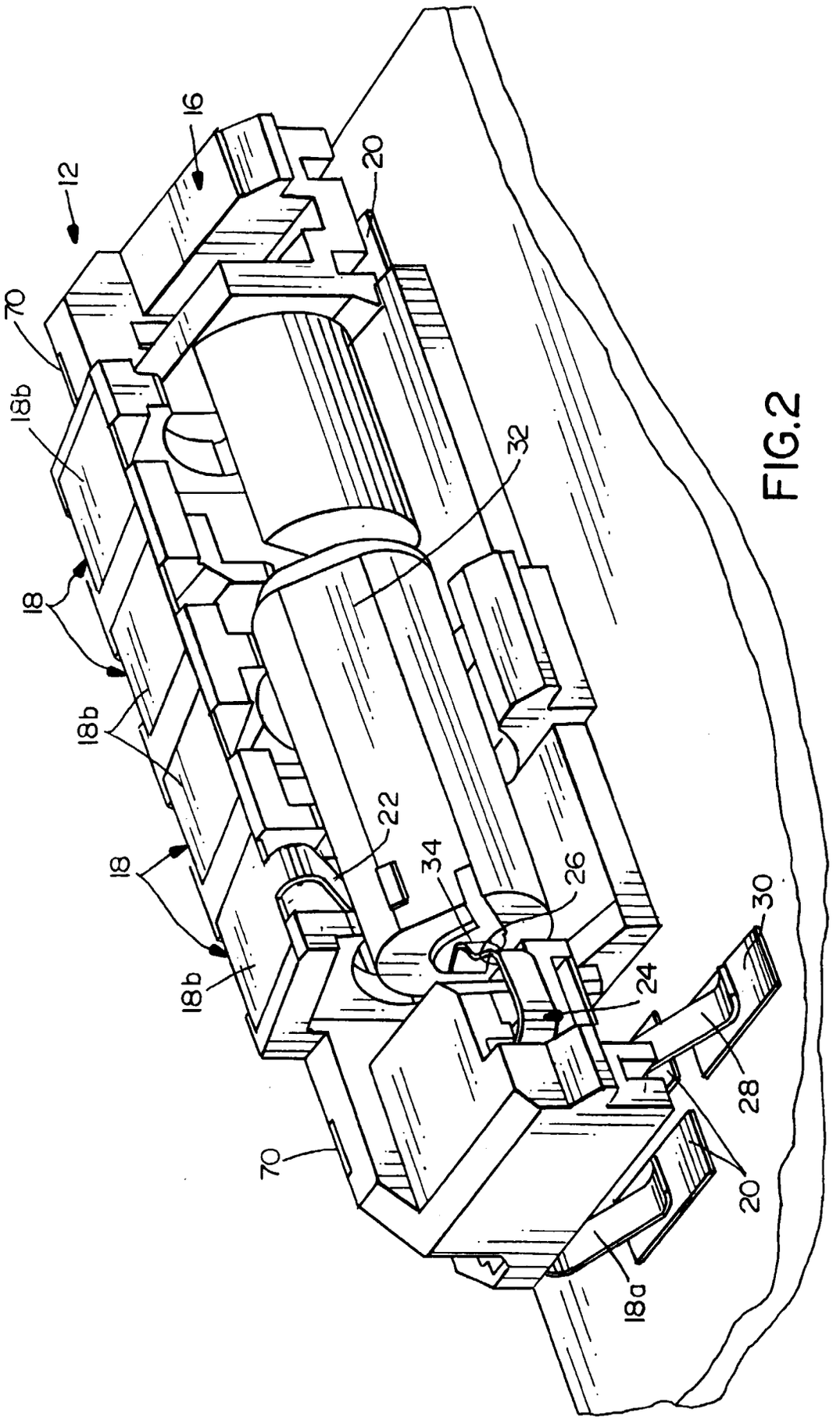

FIG.2

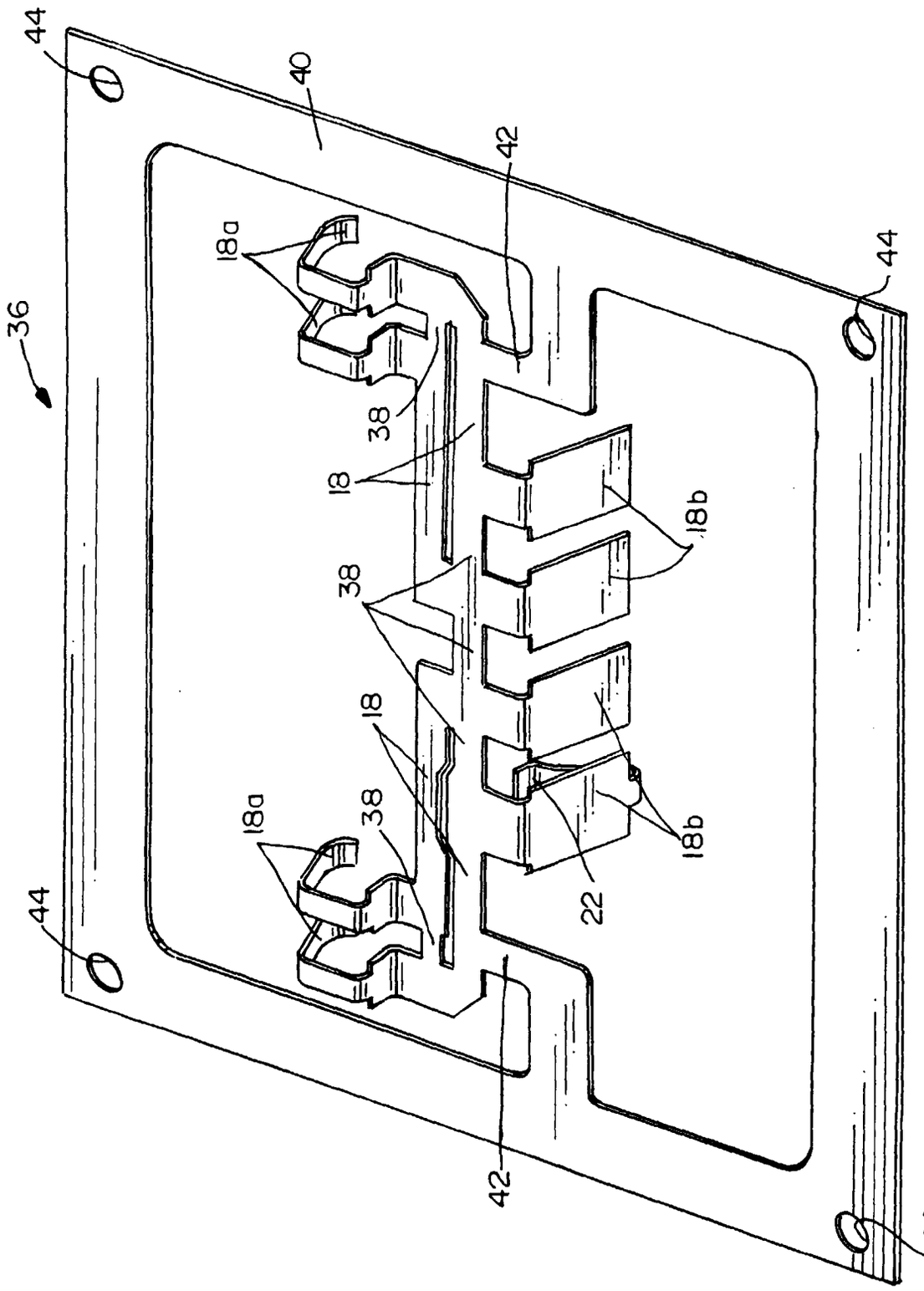

FIG.3

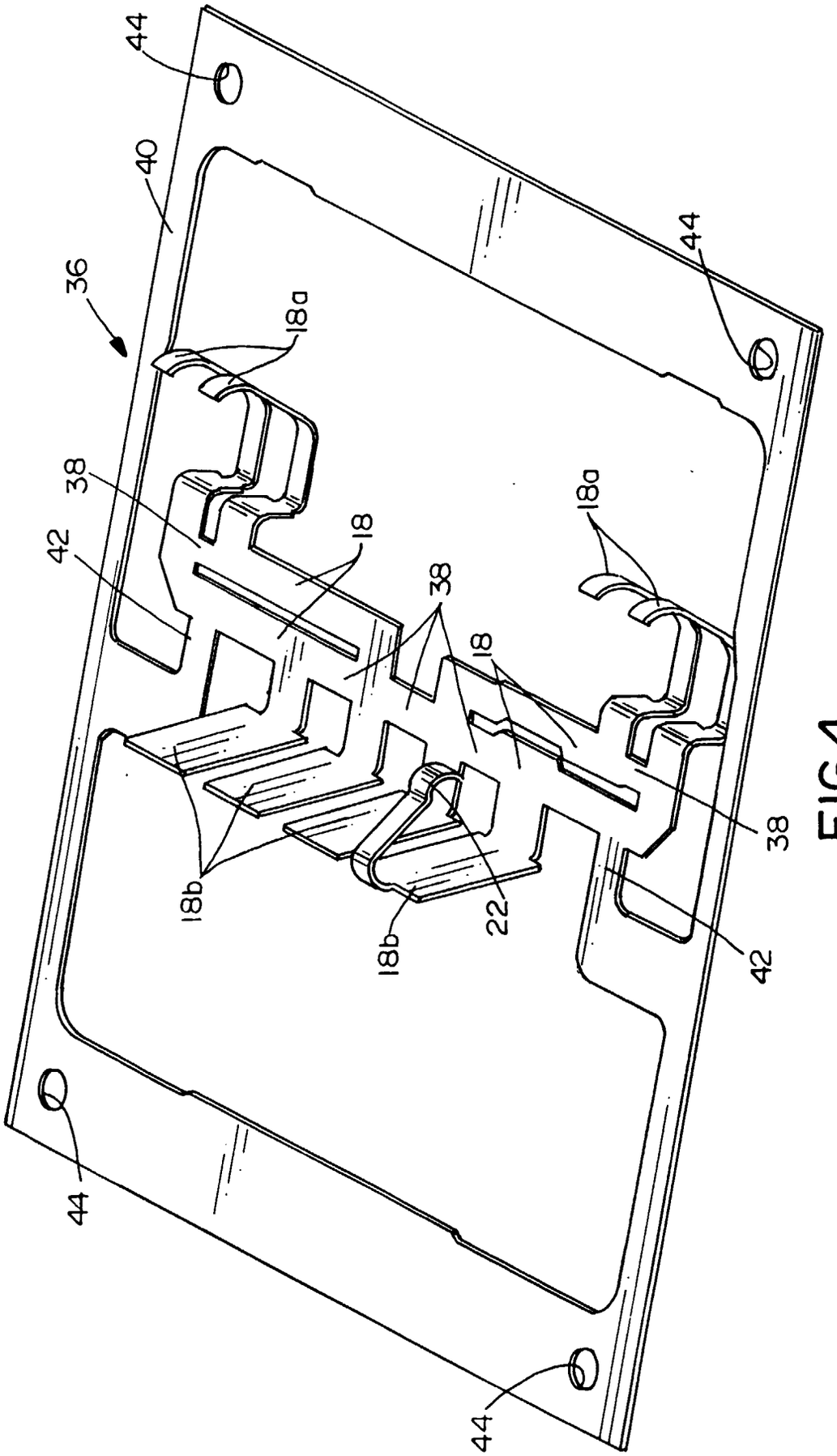

FIG.4

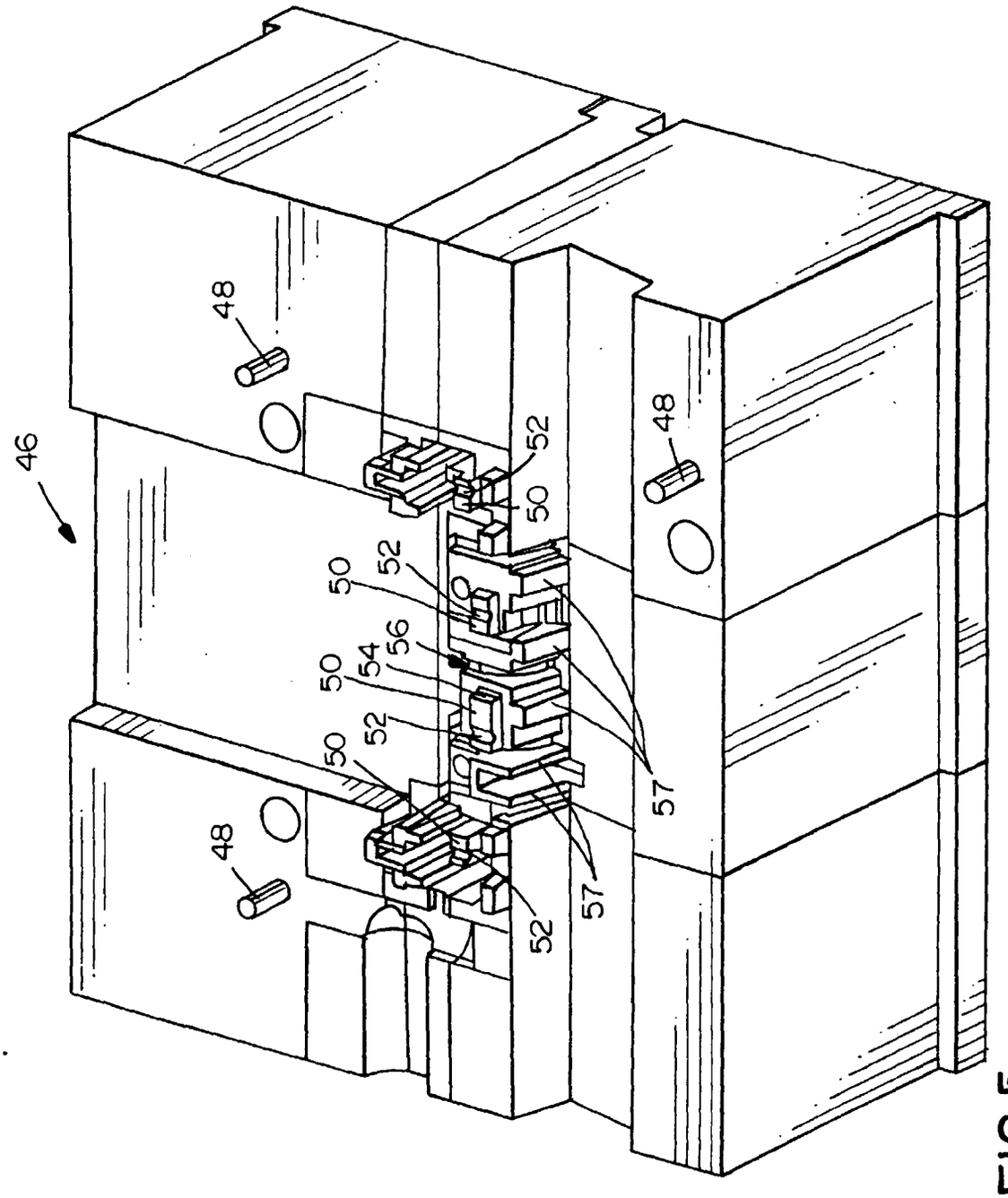

FIG.5

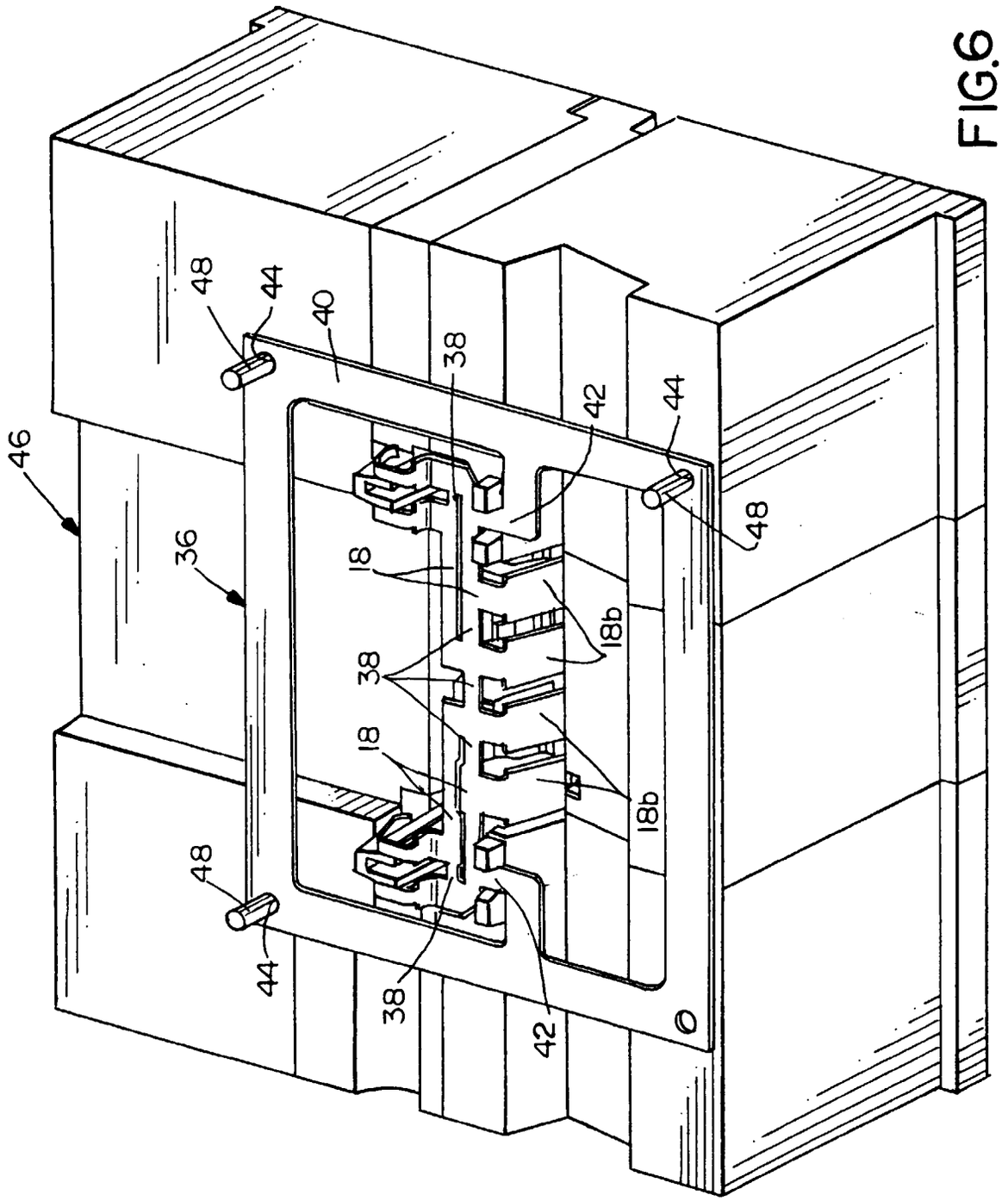

FIG.6

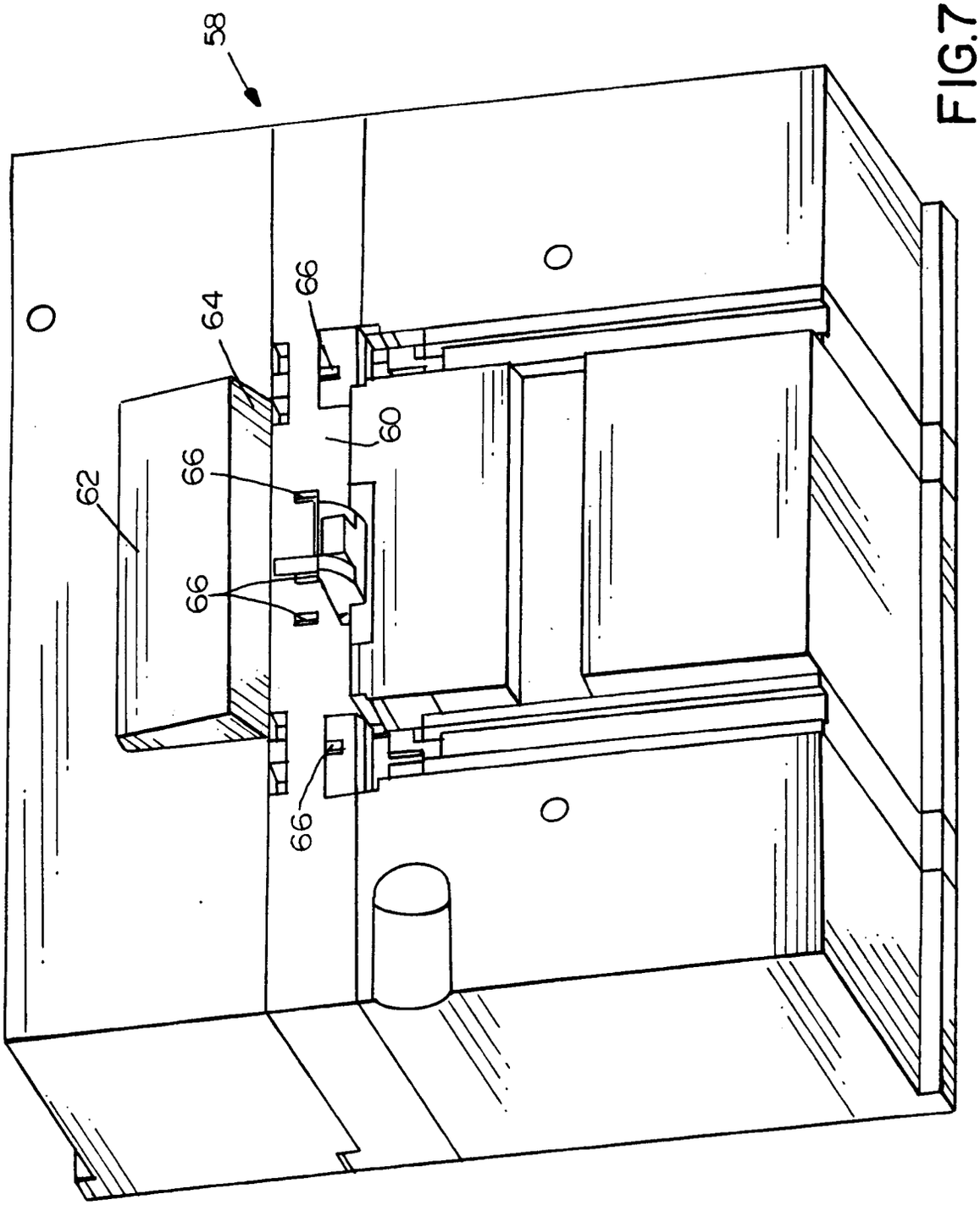

FIG.7

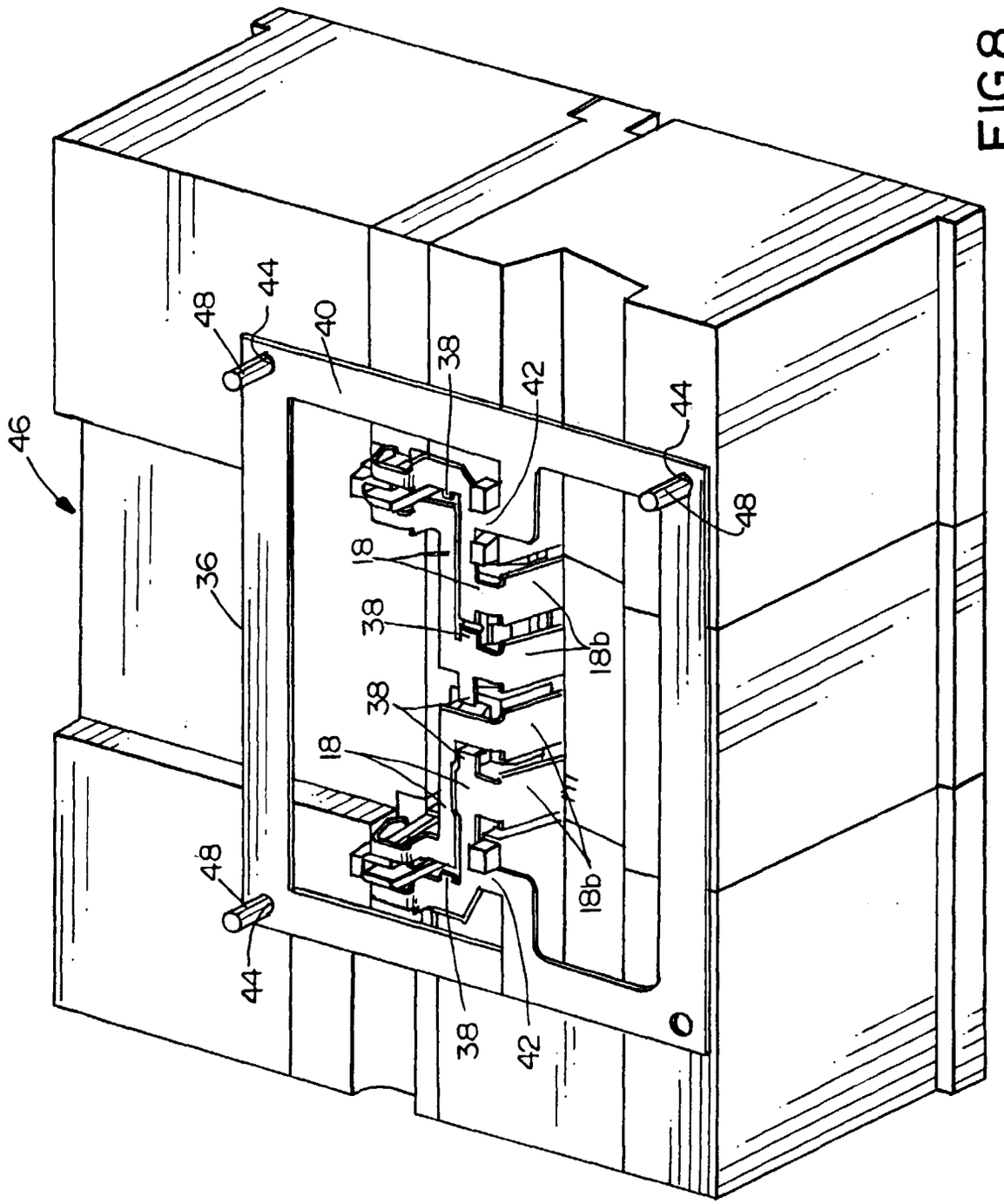

FIG.8

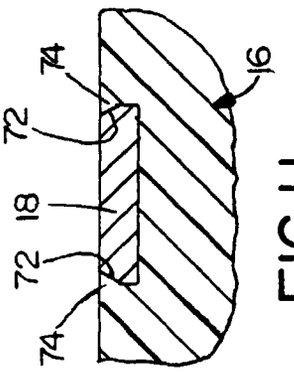

FIG.11

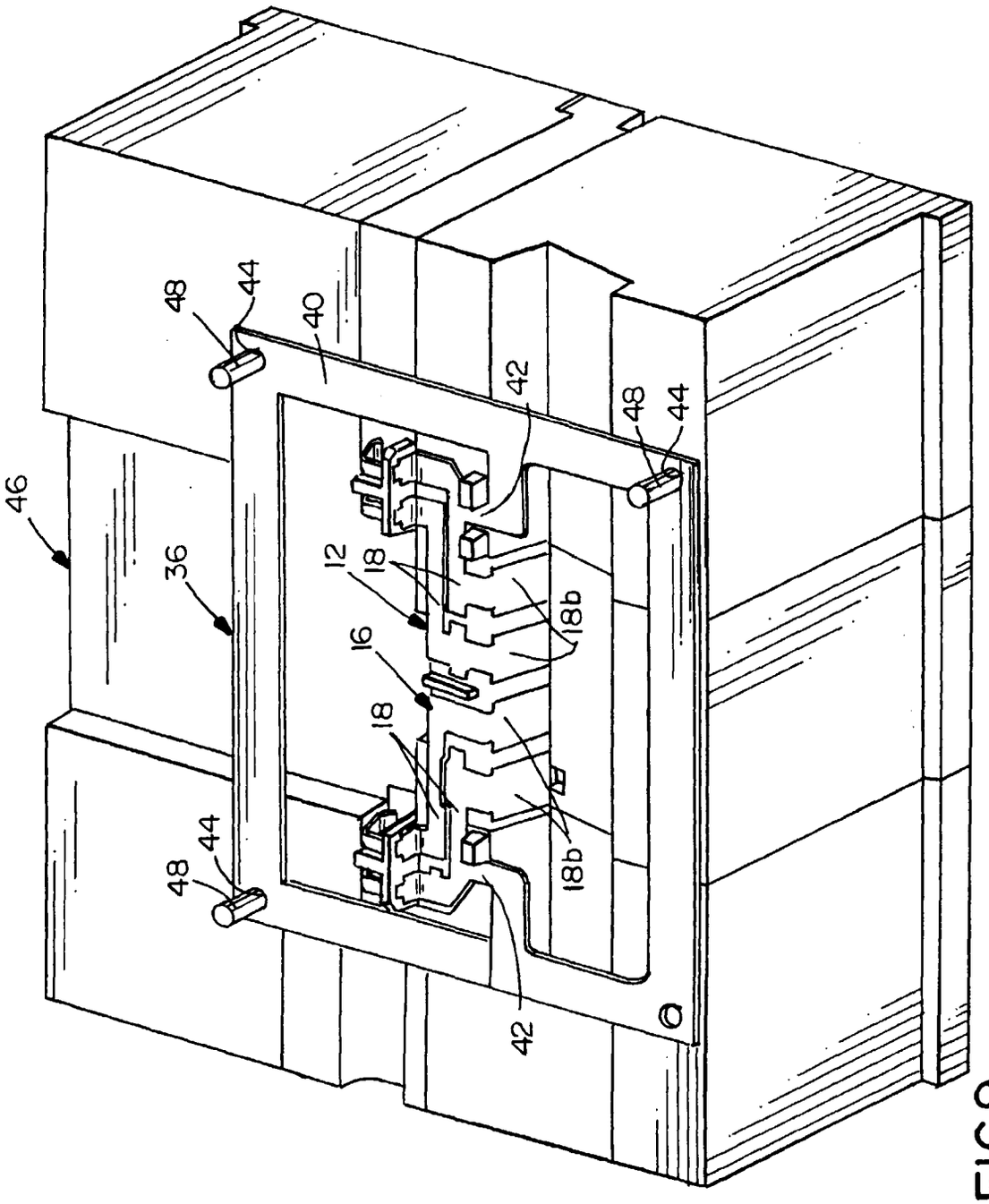

FIG.9

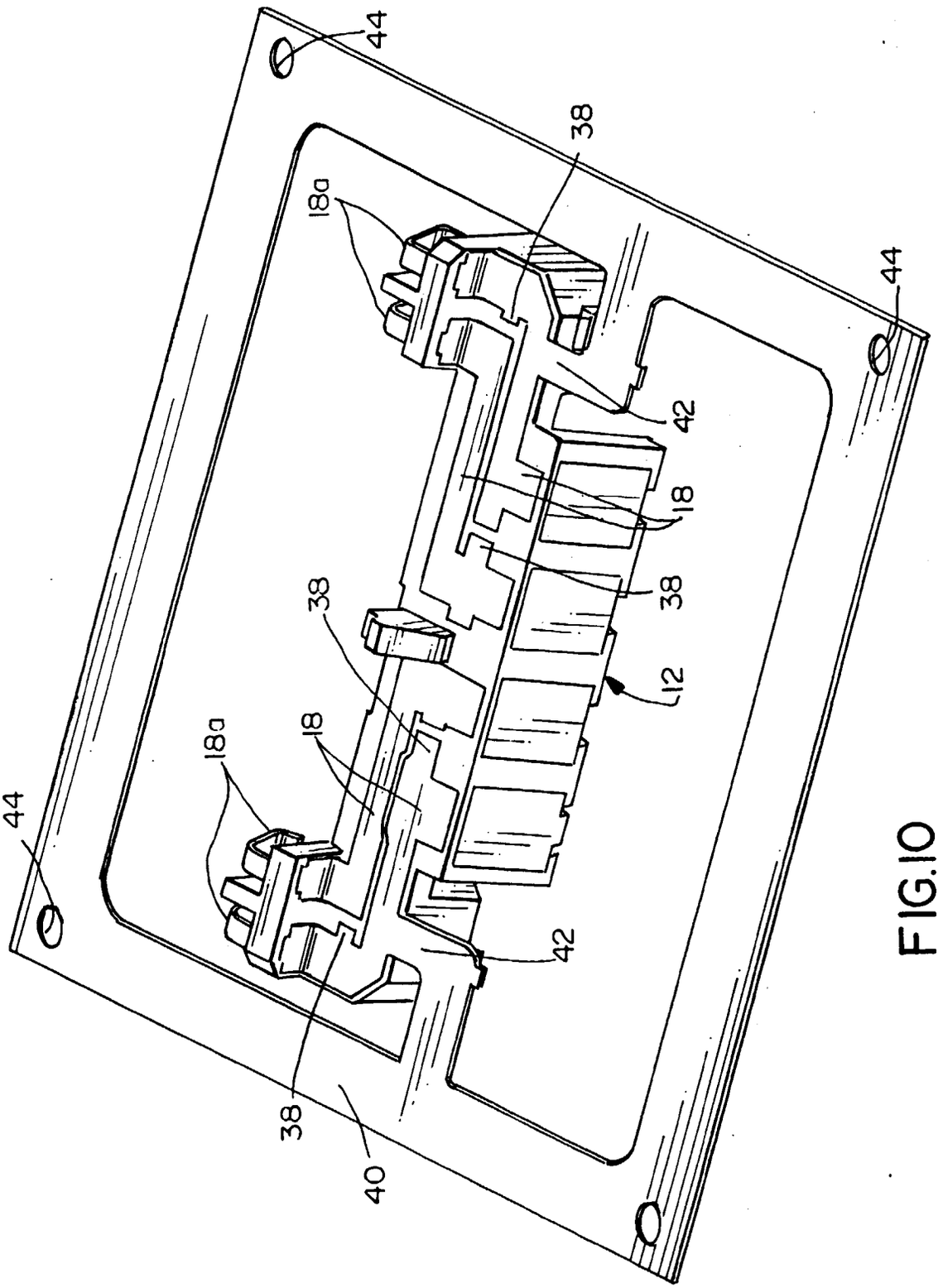

FIG.10