

①②

EUROPEAN PATENT APPLICATION

②① Application number: **83112602.4**

⑤① Int. Cl.⁴: **H 01 R 9/09**

②② Date of filing: **15.12.83**

③③ Priority: **05.08.83 US 520868**

⑦① Applicant: **Elfab Corporation, 4200 Wiley Post Road, Addison Texas 75001 (US)**

④③ Date of publication of application: **20.02.85**
Bulletin 85/8

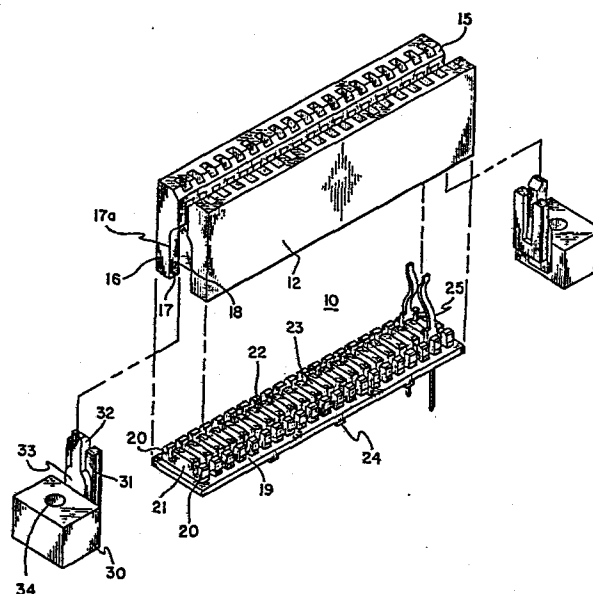
⑦② Inventor: **Ammon, J. Preston, 5074 Lakehill Court, Dallas Texas 75220 (US)**
 Inventor: **Kendall, Jerry A., 3980 Cobblestone Circle, Dallas Texas 75229 (US)**
 Inventor: **Martens, John D., 1927 Robin Meadow, Carrollton Texas 75007 (US)**

⑧④ Designated Contracting States: **BE CH DE FR GB IT LI**

⑦④ Representative: **UEXKÜLL & STOLBERG Patentanwälte, Beselerstrasse 4, D-2000 Hamburg 52 (DE)**

⑤④ **Modular connector.**

⑤⑦ A modular printed circuit card edge connector or a cable connector plug is made in several parts including the connector body, a bottom plate, two separate end caps and a plurality of connector terminals. The body of the connector can be cut to any length and assembled with the other parts to provide a card edge connector or cable connector of a desired length. In a second embodiment of the invention, a press fit connector is made up of the modular parts. The base plate is not used and the body of the connector is used to press fit the terminals into a circuit board.



BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

This invention relates to connectors and more particularly to a modular connector that can be customized as to length by cutting an insulator body thereof to the desired length and then assembling the insulator with other parts to complete the connector.

DESCRIPTION OF THE PRIOR ART

In general, prior art connectors have been assembled by molding connectors into a body of insulating material which forms a structural member to support the contacts and hold them rigidly within the insulating body. Other connectors may have the connectors press fitted into the insulating material body or press fitted into a printed circuit board with the insulating material body fitted over the contacts and the body secured to the printed circuit board with screws or rivets. Still other connectors may utilize a combination of the above features. Regardless of how the connector is structured or assembled, the length of the body of the connector and the number of contacts in the body is a fixed number for each specific application. If an equipment manufacturer utilizes a large number of connectors of various lengths (a different number of contacts), then a large variety of connectors must be stocked.

Connectors representative of the prior art are described in U.S. Patents 3,671,917, 4,035,047 and 4,094,573.

In patent 3,671,917, contact terminals are inserted into a substrate by press fitting the contact terminals into the substrate and then attaching an insulating housing over the contact terminals. The housing comprises an outer shell open at the bottom to permit it to be placed over and enclose the contact terminals. This connector depends upon the printed circuit board to serve as one enclosing surface for the connector.

Another prior art connector is found in U.S. Patent 4,035,047. In this patent the connector is not a card edge connector, but is used with another connector. The contact terminals are press fitted into the mounting substrate and then the housing is pressed over the terminals and engage the terminals in a press fit relationship.

In patent 4,094,573, the terminal contacts are press fitted into the substrate, but the housing is held in place by the contact terminals. Each terminal has a tongue that is depressed while the housing is being put into place and then springs into a recess in the housing and engages a shoulder on the housing, holding it in place against the substrate.

U.S. patent 4,220,393, each contact has a press fit collar formed on the contact and the connector insulator body serves as the seating tool. The contacts are held in place by the insulator and are simultaneously press fitted into the substrate by continuously applying pressure to the top of the insulator until each contact is in place.

In each of the above references, the housing is of a fixed length and cannot be modified to hold a lesser number of contact terminals.

This inability to modify the number of contact terminals requires the circuit board manufacturer to stock a large number of connectors to ensure that a connector of the correct length and number of contact terminals is on hand and available when needed. In patent 4,220,393, the contacts are pressed into place by the insulator but it is required that the contact have a press fit collar thereon. Also the insulator is not adaptable as to size.

SUMMARY OF THE INVENTION

The invention is a modular socket or connector made up of standard parts that can be assembled to make connectors of different lengths. The connector includes a body part that can be cut at intervals to the desired length. Repeating sections in the body accept terminals that extend through the body part and are held in place by a bottom plate in conjunction with the body. End caps are placed on each end to close the ends of the body, and in some configurations, secure the connector to a printed circuit board with screws or rivets.

The insulator is versatile in that it can be used with more than one type of contact and can be used with or without a bottom plate depending upon whether it is to be used as an assembled connector or whether the insulator is to be used as the connector housing and as a tool to press the contacts into a circuit board.

In order to make a connector of a desired size, the body insulator is cut at a specific location at one of the repeating sections. The cut end is then milled with a simple end mill tool to provide an opening that mates with the end cap. The connector parts are then snapped together and remain in place by frictional forces. The same insulator and end caps can be used in either configuration, a press fit connector, a card edge connector with solder or wire wrap terminals.

THE DRAWINGS

Figure 1 is an exploded view of the modular connector illustrating the individual parts of the connector;

Figures 2a, 2b and 2c illustrate three different end caps for the connector;

Figures 3a, 3b, 3c and 3d illustrate the bottom plate of the connector;

Figures 4a, 4b, 4c illustrate the body of the connector;

Figures 5a, 5b, 5c illustrate the end of the body before and after the end of the body has been cut and milled;

Figures 6a and 6b illustrate a section of the body showing the contact terminals;

Figure 7a and 7b illustrate the contact terminals in the base plate;

Figure 8 illustrates a single contact terminal;

Figure 9 illustrates a tool for cutting a connector to a desired length and for preparing the cut end to accept an end cap;

Figure 10 illustrates the contact terminal to be used with the press fit insulator;

Figures 11a and 11b illustrate a section of the insulator body showing the placement of the contact terminals;

Figure 12a is a sectional end view of the insulator as in Figure 11a with out the terminals; and

Figure 12b is a bottom view of the insulator without terminals.

DESCRIPTION OF A PREFERRED EMBODIMENT

Figure 1 illustrates the different parts of the modular connector 10. The body 12 is generally rectangular and has a plurality of identical compartments extending from one end to the other. Each end has an opening therein to receive an end cap. The opening 17 is wide at one end and narrow at the other end. The narrow end 17a and the wider end 17 match similarly shaped portions of the end caps 30. Each compartment in the body 12 is separated from the other by walls 18.

The end cap 30 slides into the end of the body 12. The vertical plate 31 on end cap 30 slides into the end compartment between end wall 16 and compartment wall 18. The opening at 17a is closed by ridge key 32 of end cap 30 and the opening 17 is closed by key 33. After the end cap is properly placed in the end of the body 12, the body end is closed, providing a mounting means for the connector via hole 34 in the end cap 30. With an end cap on each end of the connector body, the connector may be secured to a printed circuit board with screws or rivets.

Connector bottom plate 19 is positioned in the lower part of the body part 12. The bottom plate has a number of raised ridges 20 and 21 extending the length of the bottom plate. The ridges are spaced so that they fit into the compartments in the body 12. The space 23 between ridges provide spaces to receive the walls between the compartments in the body.

Contacts 25 are placed in the openings 22 between ridges 21 and 20 and are held in place as hereinafter explained.

Different end caps may be used with the connector. Three variations are illustrated in Figures 2a, 2b and 2c. Figure 2a illustrates an end cap to be used with a cable connector which is not to be connected to a printed circuit board or a press fit connector. There is no provision on end cap 2a for securing the connector to a surface. The plate 41 is positioned into the end of the body 12 between compartment wall 18 and end wall 16. The ridge part 42 matches the opening 17a and the end plate 40 enclosed and provides an end closure of the connector body. The end cap in Figure 2a would be used, for example, with the press fit insulator described below.

The end caps in Figure 2b and 2c are essentially the same except that the body 30 is positioned higher with respect to the plate 31 in one embodiment than it is in the other.

While only three contact terminals 25 are illustrated, there will be a terminal in each of the openings 22 along the length of the bottom plate.

After all the terminals are in place, and the end caps have been properly placed on each end of body 12, body 12 will be placed over the bottom plate, with the terminals extending up through the body, one pair of opposing terminals in each body compartment.

The connector assembly is completed by snapping the bottom plate 19 into the bottom of body 12. The connector is held together by frictional mating surfaces, hereinafter explained in detail.

Figures 3a, 3b, 3c and 3d illustrate different views of the bottom plate 19. In Figure 3a a bottom view of the bottom plate shows the cross support members 24 and the holes 60 through which the contact terminals 25 (not shown) extend.

The side view 3b, illustrates the ridges 20 and the openings 23 which separate the ridges 20 and 21. The end view 3d gives a clearer illustration of the ridges 20 and 21 separated by the openings 22. Each of the outer shoulder of ridges 20 have a rounded shoulder 20a and an enlarged shoulder 20b. The rounded area 20a permits easy insertion of the base plate 19 into the bottom of connector body 12, and the enlarged shoulder frictionally engages the inside of the side wall of body 12 to hold the bottom plate in position.

Figure 3c is a top view of the bottom plate 19. Of particular note in this view are the holes 60 through which the contact terminals 25 extend. The holes 60 are centered in the openings 22 between the ridges 20 and 21.

Cut line 65 illustrates, in Figures 3a - 3c, where the bottom plate is to be cut when a connector of a predetermined size, less than the original length of the connector body 12 and bottom plated 19, is desired.

The top, side and bottom views of the connector body are illustrated in Figures 4a, 4b and 4c. The side view is shown in partial section and a cut line 70 extends through each of the views to show where the connector body would be cut in relation to the internal compartments and walls to make a connector of a desired length.

The side view, Figure 4b, illustrates the internal walls 14 of the body 12, the face of which is designated 18. The cut line 70 is made along the face 18 of one of the walls 14. After the cut, the end of the connector body will be as illustrated in Figure 5a. The end 16 was originally a face 18 of wall 14.

The top view of the connector body, Figure 4c, shows the internal support wall extending across the connector body. The bottom view, Figure 4a, of the connector body, further shows protrusions 74 extending out from the surface 18 of the transverse wall 14. The protrusions frictionally contact with the contact terminal 25 when the connector is assembled as hereinafter explained.

Figures 5b and 5c show the end of the connector body after the end 16 has been milled to opening 17 so that an end cap, such as those illustrated in Figures 2a, 2b and 2c, may be mounted onto the end of the connector.

In Figures 6a and 6b is illustrated part of an assembled connector showing the contact terminals as they are positioned in the compartments within the connector body.

Figures 7a and 7b illustrate the contact terminals positioned in the base plate 19, and Figures 8a and 8b illustrate a typical contact terminal.

The contact terminal 25 has at the midsection thereof shoulders 81 that are used to hold and stabilize the terminal when the connector has been assembled. As shown in Figure 7b, the shoulders 81 extend past the ridges 21 into the opening 23 between the ridges 21. When the connector is assembled as illustrated in Figure 6b, the protrusions 74 on transverse walls 14 engage the contact terminals at shoulders 81a and prevent movement of the terminals in a direction along the length of the connector. The terminals 25 are stabilized in the direction across the connector by the ridges 20 and 21. As illustrated in Figure 7a, the connector terminal 25 is positioned in the opening 22 between the ridges 20 and 21 to prevent movement of the terminal in a direction transverse to the length of the connector.

The terminals are also secured in the bottom plate by the portion 82 of the connector. The area 82 of the connector is slightly larger than the opening 60 in the bottom plate 19 so that when the terminal 25 is pulled down into the opening 60, the contact area 82 frictionally engages the sides of the openings 60 and is held firmly within the opening.

The terminals are additionally stabilized and firmly held in the connector body 12 by virtue of the fact that the area 80 of the connector is curved and presses against the side wall 71 of the compartment of the body in which it resides. The general positioning of the terminal is illustrated in Figures 6a and 7a.

Figure 10 illustrates a contact terminal to be used when the insulator body is used for a press fit connector. Terminal 125 is similar to terminal 25 illustrated in figure 8b. Terminal 125 has a similar top portion 180 and intermediate portion 181, however terminal 181 has a partially punched out region 183 that is used in the press fit mounting of the connector.

Terminal 125 also has a compliant region 182. Region 182 is that part of the terminal that is press fitted into a circuit board.

Figures 11a and 11b illustrate terminal 125 positioned in the insulator body 12. The end of region 183 abutts the shoulder 185. It is the pressing of shoulder 185 against part 183 and projection 74 pressing against shoulder 181a of terminal 125 that presses the terminals 125 into a circuit board on which the connector is to be mounted.

Figures 12a and 12b are respectively an end view of the insulator and a bottom view of the insulator without terminals. These views illustrate the shoulders 185 and 74 which are use to press fit the terminals into a printed circuit board.

In another embodiment of the invention a solder tail terminal is used. The terminal (not illustrated) is similar to the terminal illustrated in Figure 10. The solder tail terminal would not have the

compliant region 182 of terminal 125, but is straight from intermediate region 181 to the end of the terminal. The insulator for the solder connector is the same as for the above described connector. The end cap illustrated in Figure 2c is used.

A bottom plate need not be used. The end cap holds the insulator body above the surface of the printed circuit board on which the connect is to be mounted so that it will not interfere with solder flow during the flow solder procedures used to bond the solder tail terminal to the printed circuit board. In the event, for some reason, a bottom plate is used with the solder tail connector, then the transverse ridges 24 on the bottom plate holds the connector above the printed circuit board to allow for solder flow.

From the above description of the invention it may be seen that a modular connector can use the same insulator body and end caps to make up a press fit connector or a connector to be mounted on a printed circuit board using solder, screw or rivet means to mount the connector. The only variation between the two type connectors is that a different terminal contact is used and that a bottom plate is not used with the press fit connector since the circuit board on which it is mounted is used as the bottom plate.

Each of the above described connectors may be repaired in the event a terminal is damaged. The insulator body only frictionally engages the terminals so it may be lifted off the terminal, the damaged terminal replaced, and the insulator placed over the terminals and pressed into engagement with the terminal.

With the versatility of the connector embodiment of the present invention, connectors of different lengths and mounting methods can be made up of a few standard parts eliminating the need for a large variety of different connectors.

A tool for cutting a connector to the desired length and for milling the cut end to receive an end cap is illustrated in Figure 9. A connector body 92 is placed on the carrier 93 and indexed to the corrected position by stop 108. Carrier 93 has a sliding member 94 that slides in groove 96. As the carrier 93 is moved toward blade 98, the connector body 92 is cut to the desired length. Carrier 93 is moved past blade 98 so that the cut end 110 of the connector body is milled to form the opening 17 as illustrated in Figure 5c. The opening is milled to the correct depth by setting stop 106 which may be adjusted by set screw 107.

Both the saw 98 and the mill 99 may be turned by the same motor (not shown). The motor drives the saw blade and mandrel 100. Mandrel 100 is powered by belt 101. A protective cover 105 covers both the saw blade 98, the mandrel 100 and the mill 99.

It is to be understood that the forms of the invention shown and described are preferred embodiments thereof and that various changes may be made in detailed configurations thereof and in proportional sizes of the various parts thereof without departing from the spirit and scope of the invention.

WHAT IS CLAIMED

1. A modular printed circuit card edge connector including modular parts adaptable to at least two connector configurations of a desired length, including a press fit configuration, characterized by an insulator body (12) divided into a plurality of identical compartments, each compartment having two shoulder regions, end caps (30) attached to the insulator body, and a plurality of contact terminals (25), each terminal having a part (18a) thereof punched outwardly and extending upwardly from a central region of the terminal, wherein each compartment is fitted with two terminals and the part of the terminal punched outwardly from the central region of the terminals resides in the shoulder region of the insulator body.
2. The connector, according to claim 1, characterized in that a bottom plate (10) is used in one configuration and has ridges (22) thereon to prevent movement of the terminal transverse to the length of the connector.
3. The connector, according to claim 1, characterized in that each compartment is formed in part by two transverse walls (18), that the two transverse walls engage said terminals preventing movement of the terminals in a direction along the length of the connector.
4. The connector, according to claim 2, characterized in that the bottom plate (19) has openings (60) between adjacent ridges through which the terminals extend.
5. The connector, according to claim 1, characterized in that the identical compartments in the connector body have transverse walls dividing the body into the identical compartments.

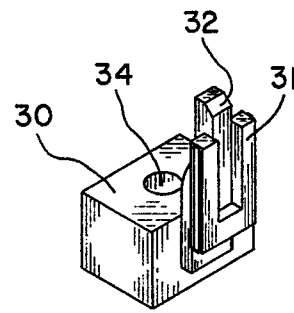
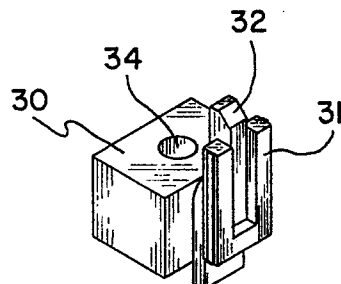
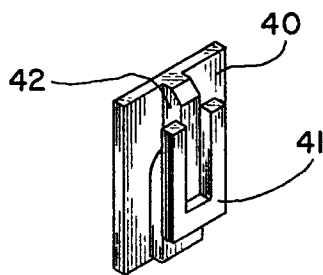
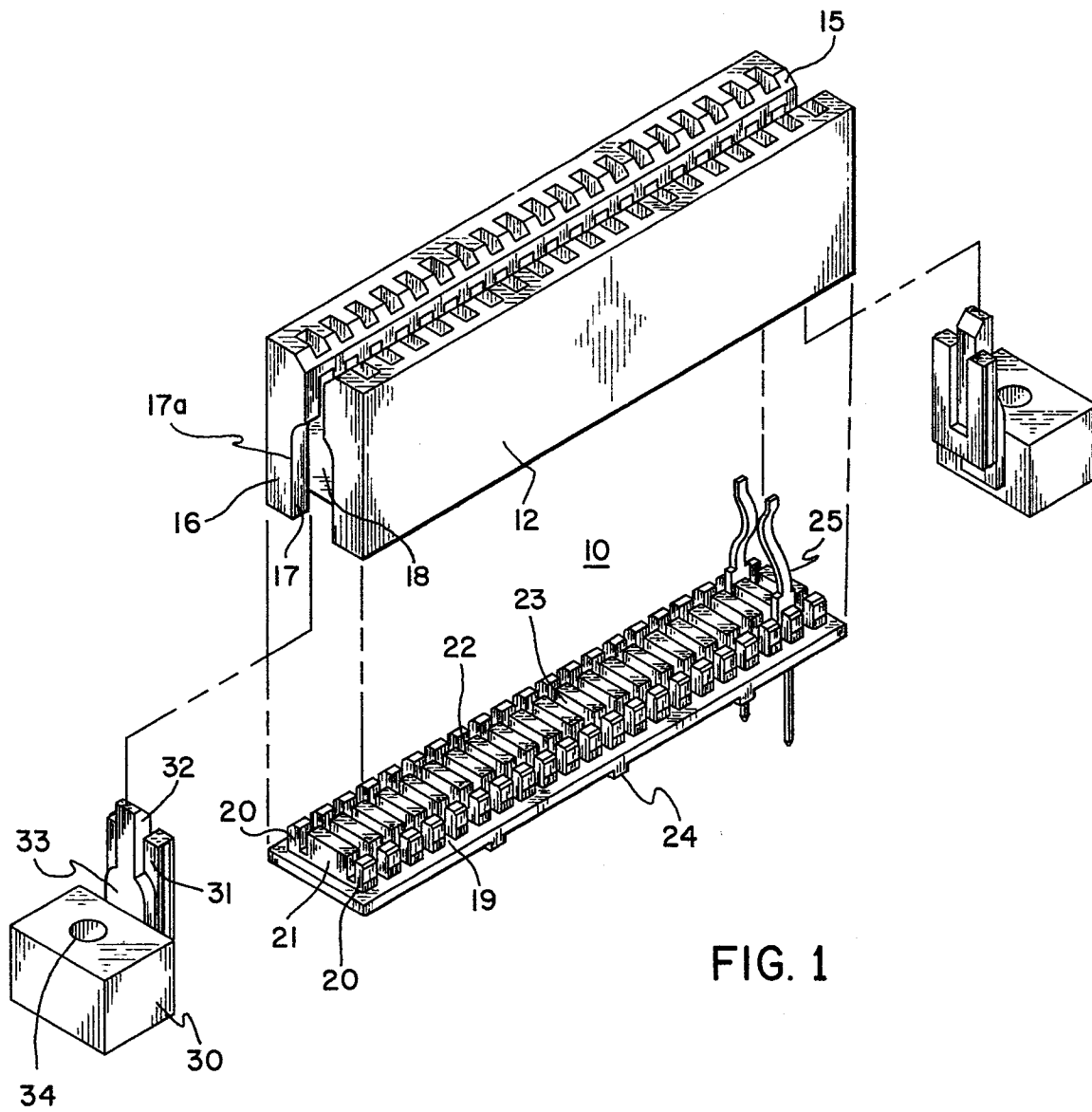
6. The connector, according to claim 5, characterized in that the structure of the transverse wall allows the connector to be cut to a desired length without altering the structure or strength of the connector other than the length thereof.

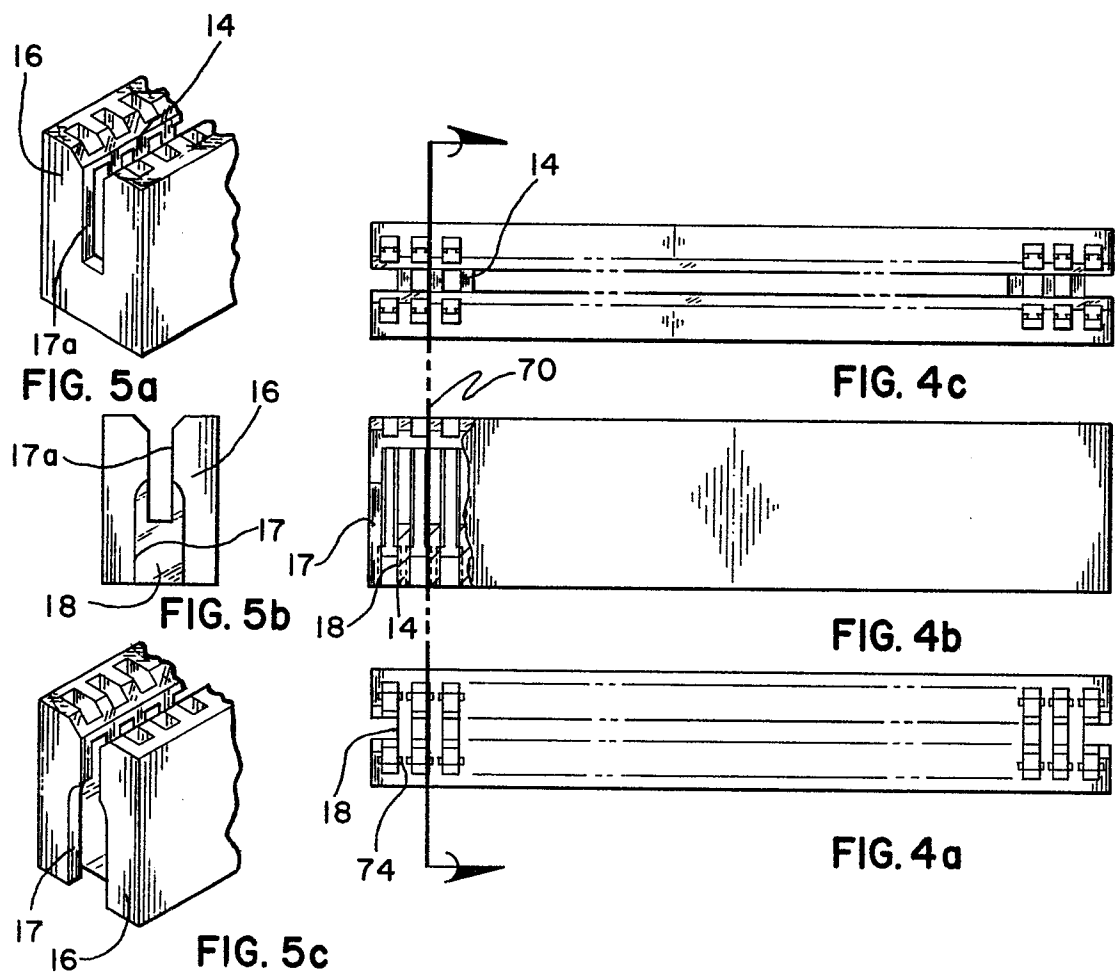
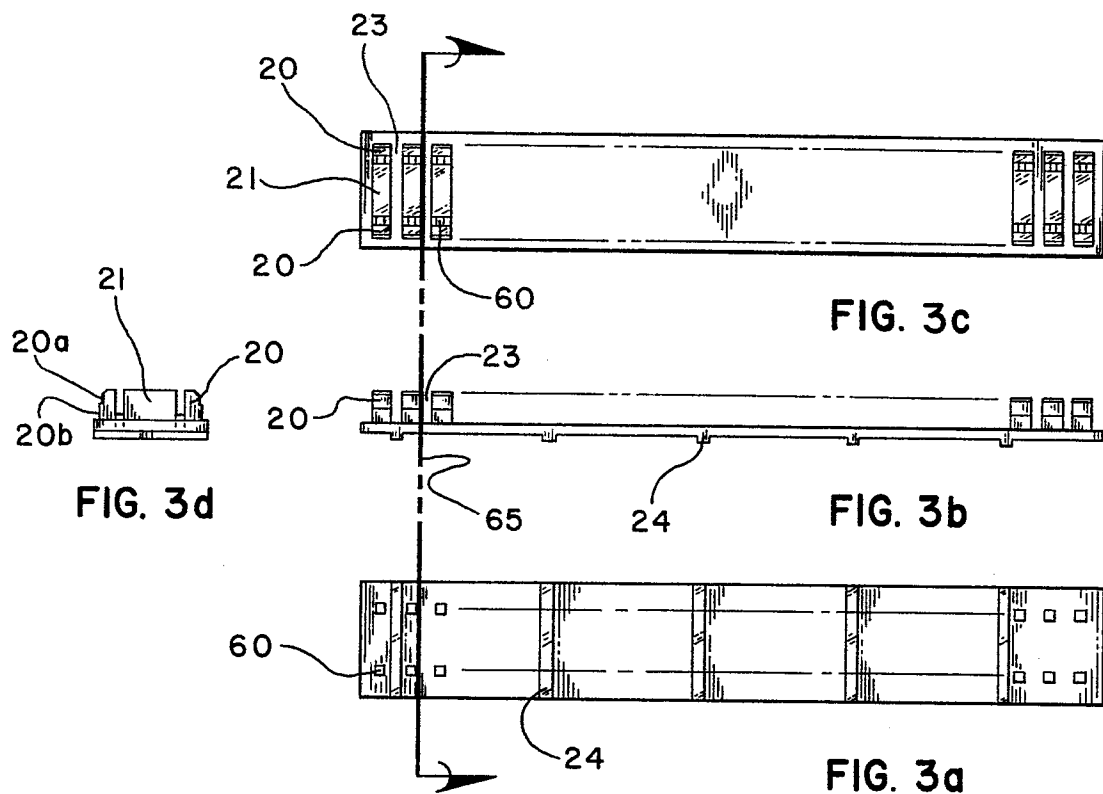
7. The connector, according to claim 1, characterized in that each terminal has shoulders (81a) on each side thereof which engage the transverse walls (18) of the compartment in which they reside in the connector body when the body is placed over and joined with the bottom plate (19).

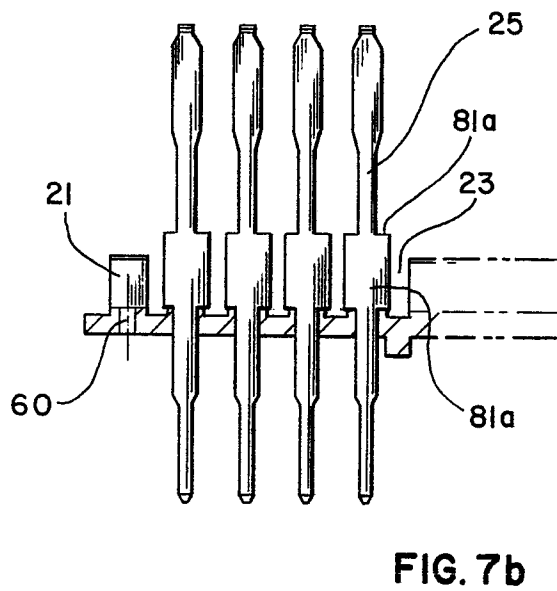
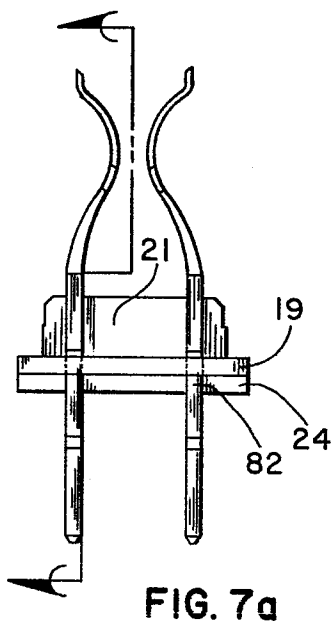
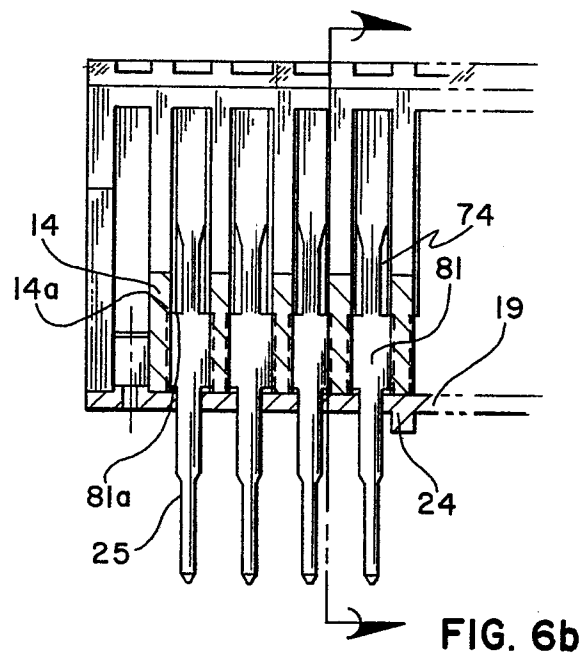
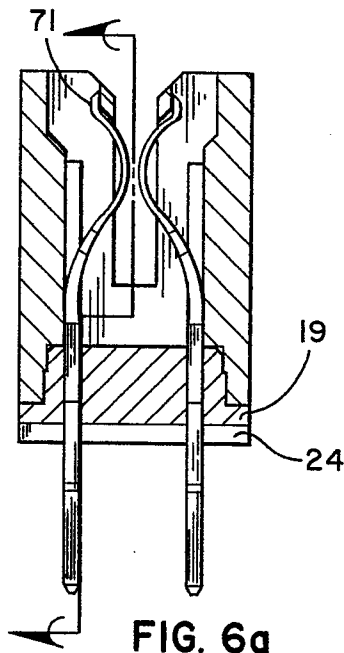
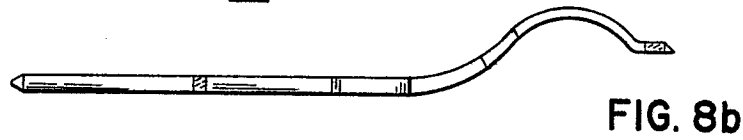
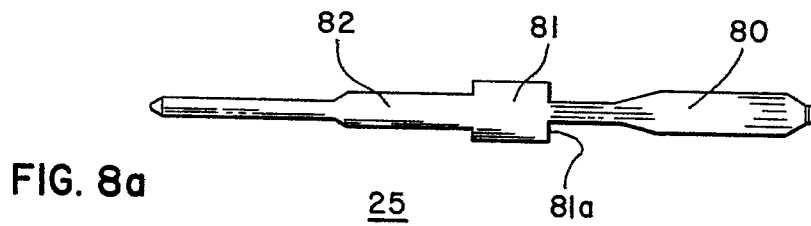
8. The connector, according to claim 1, characterized in that there are two end caps which reside in and close openings in the end of the connector body and are held in position by frictional forces.

9. A method of making a connector, according to claim 1, to a desired length from modular parts including a connector body having a plurality of identical compartments formed by transverse walls within the connector body, a bottom plate, two end caps, and a plurality of terminals, characterized by the steps of; cutting the connector body adjacent to one of the transverse walls to provide a connector body of the desired length and milling a slot in the cut end of the connector body, joining an end cap to each end of the connector body, and joining the bottom plate to the connector body, the bottom plate having a plurality of terminals extending through the bottom plate so that one end of each terminal is positioned within the connector body, and joining an end cap to each end of the connector body.

10. The method, according to claim 9, characterized in that the milled slot has a rounded end to match with a rounded ridge key on the end cap.
11. The method, according to claim 1, characterized in that the assembly of the connector is by frictionally engaging the connector parts to hold the connector together.







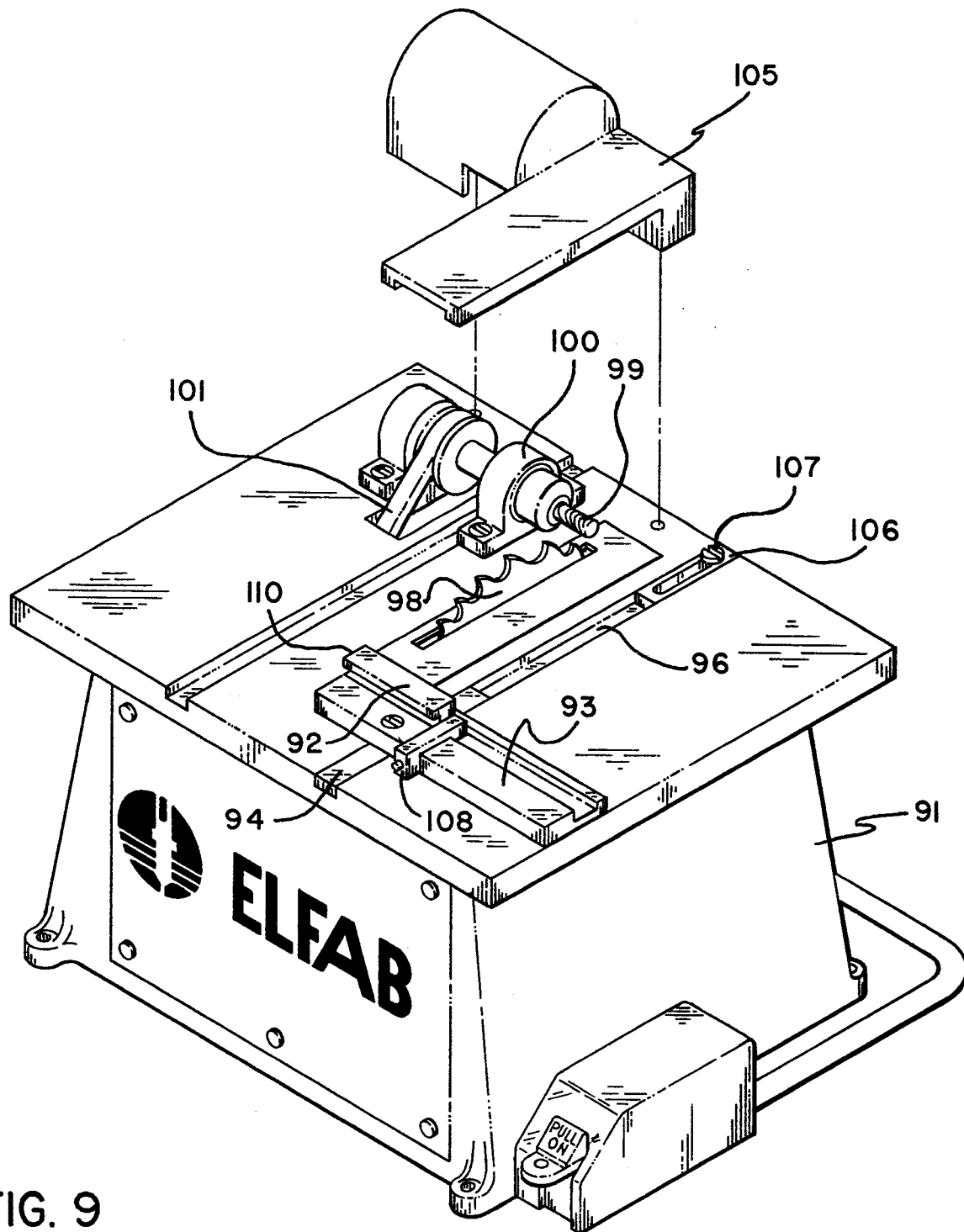


FIG. 9

