

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

0 273 589
A1

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 87310471.5

(51) Int. Cl.4: H01R 23/72, H01R 13/658

(22) Date of filing: 27.11.87

(30) Priority: 22.12.86 US 945930
16.11.87 US 119081

(43) Date of publication of application:
06.07.88 Bulletin 88/27

(84) Designated Contracting States:
DE FR GB NL

(71) Applicant: **AMP INCORPORATED**
470 Friendship Road P.O. Box 3608
Harrisburg Pennsylvania 17105(US)

(72) Inventor: **Grabbe, Dmitry G.**
2160 Rosedale Avenue
Middletown Pennsylvania 17057(US)
Inventor: **Granitz, Richard Francis**
4477 Nantucket Road
Harrisburg Pennsylvania 17112(US)
Inventor: **Bakker, Roel Johan**
3120 Starlight Drive
York Pennsylvania 17402(US)
Inventor: **Milbrand, Donald Wayne, Jr.**
506 West Main Street Apartment 2
Mechanicsburg Pennsylvania 17055(US)
Inventor: **Masterson, Earl Edgar**
4905 Girard Avenue South
Minneapolis Minnesota 55409(US)

(74) Representative: **Gray, Robin Oliver et al**
BARON & WARREN 18 South End Kensington
London W8 5BU(GB)

(54) High density coax connector.

(57) The present invention is directed to a multi-pin coax connector assembly (2) having connector housings (22,24,26) made of metal or conductive plastic which serves as a reference ground for all signals. The connector housings (22,24,26) have passages (12,14,16) extending therethrough. Pin and socket terminals (18,20) are insert molded with insulating material (48,90) and are positioned in the passages (12,14,16). The insulating material (48,90) spaces the terminals (18,20) from the conductive connector housing (22,24,26) as well as providing air gaps along most of the length of the terminals (18,20). The air gaps cooperate with the insulating material (48,90) to provide controlled impedance. As the signals travel at a high rate of speed along the terminals (18,20), the terminals (18,20) are bent to minimize the reflection of the signal. The connectors (22,24,26) are provided with power and ground bus-

ses (100,102,104,106) along the outside surfaces thereof, the busses (100,104) of the first connector (22,24) making electrical connection with the respective busses (102,106) of the second connector (26). A camming assembly means (118) is also provided to cam the terminals (18,20) of the connectors together, which provides for a positive wipe action as the terminals (18,20) of the connectors are cammed into electrical engagement with each other. The camming assembly means (118) also allows for reduced insertion force of the connectors (22,24,26), as the terminals (18) of one connector (22,24) do not engage the terminals (20) of the other connector (26) until the camming assembly means (118) is operated.

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HIGH DENSITY COAX CONNECTOR

The present invention relates to an electrical connector for printed circuit boards and more particularly to a high speed coaxial connector for electrically connecting two circuit boards together.

Current technology utilizes removably connected printed circuit boards. A daughter board is removably connected to a mother board allowing the daughter board to be replaced as needed. Terminals of the connector electrically connect contact areas of the daughter board to contact areas of the mother board. This requires connectors with multiple rows of closely spaced terminals (0.100 inch centerlines or less) therein. The connectors employ stamped and formed terminals which are inserted into plastic, metal or metallized housings using dielectric sleeves which are molded onto the terminals.

In current electronic circuits, the use of increasingly higher speed switching signals has necessitated control of impedance for signal transmission. At the connector interfaces between mother boards and daughter boards this has been accomplished primarily by alternating ground terminals with signal terminals in the connectors in order to provide a signal reference path and shielding for the signal path. Traditionally, large numbers of terminals are used for ground, with as many as eight terminals being used as ground for every one that is used for signal. Thus in the prior art, the number of terminals used for signal transmission is drastically limited, which in turn limits the amount of contact areas which can be beneficially connected between the mother board and the daughter board for signal connection purposes.

In an attempt to provide a connector which allows all terminals to be used for signal transmission, a coaxial type connector described in U.S. Patent Number 4,451,107 was devised. Although some of the above mentioned problems were solved, other serious problems arose. At high speed transmission the right angle of the terminals caused reflection of the signals, limiting the effectiveness of the connector at high speed transmission. Also limiting the effectiveness of the connector is the fact that the molded dielectric constant of the material of the housing cannot by itself be low enough for high speed transmission in the high gigahertz range.

Other problems include insertion and manufacturing difficulties. As the number of terminals required increases, the insertion force of the male connector into the female connector becomes impractical. In other words, the insertion force becomes so great that the mating halves of the connector cannot be mated together, or the housing

and contacts are damaged as insertion occurs. The manufacturing of the connector described in U.S. Patent Number 4,451,107 is also made impractical by the manufacturing process of die casting the metal housing, injection molding a nylon sleeve, and casting the terminals through the nylon sleeves in the housing. This process of manufacturing is very difficult to control and can lead to faulty connections. Therefore, the configuration of the invention of the above cited reference is impractical for many reasons.

A multi-pin coax connector assembly having connectors made of metal or conductive plastic is described. The conductive material serving as a reference ground for all signals. Pin and socket terminals, placed in respective connectors are insert molded with insulating material. The insulating material provides the space required between the connector housing and the terminals. The configuration of the insulating material provides for air gaps along most of the length of the terminals, allowing the effective dielectric constant to be lower than any plastic enabling the required controlled impedance of the signal pathway and required speed of the signal to be attained. The connectors are provided with power and ground busses, as well as a camming means. The camming means allows the connectors to be mated under low insertion force conditions. As the connectors are mated together the power and ground busses engage and make electrical engagement with the respective power and ground busses of the mating connector. Once the connectors are mated, the camming means is engaged, forcing the pins and sockets to be completely mated thereby providing a positive wiping action and ensure that a positive electrical connection is effected for all signal pins after the ground and power are connected.

The present invention is directed to an electrical connector assembly having a first electrically conductive connector with housing means. The housing means has at least one row of terminal receiving passages extending from a first surface to a second surface, the terminal receiving passages having an angle therein. First terminals are located in the passages, the terminals having essentially the same configuration as the terminal receiving passages. Dielectric material coaxially surrounds the terminals in designated areas, insulating the terminals from the housing means and providing the spacing required to properly position the terminals in the terminal receiving passages.

A second electrically conductive connector is also provided, the connector having housing means which have at least one row of terminal receiving

passages extending therethrough. The passages of the first connector and the second connector are in alignment. Second terminals are located in the terminal receiving passages, mating ends of the second terminals cooperate with mating ends of the first terminals. The second terminals have dielectric coaxially surrounding the terminals in designated areas of the terminal receiving passages. The dielectric insulates the terminals from the housing means and provides the spacing required to properly position the terminals in the passages.

A further object of the present invention is to provide a connector assembly which has reduced insertion force, while still providing a positive wiping action between the first and the second terminals.

A further object of the present invention is to provide a connector assembly which allows for high speed transmission of signals while minimizing reflections and discontinuities which distort the signals.

A further object of the present invention is to provide engagement and connection for power and ground terminals prior to engagement and connection of signal terminals or pins.

The invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a perspective view of a connector assembly showing a plug connector exploded from a receptacle connector.

FIGURE 2 is an exploded perspective view of the plug connector.

FIGURE 3 is an exploded perspective view of the receptacle connector.

FIGURE 4 is a cross-sectional view of the connector assembly when the plug connector is fully inserted into the receptacle connector.

FIGURE 5 is a partially exploded cross-sectional view of the plug connector.

FIGURE 6A is a diagrammatic view of a pin just prior to insertion into a terminal.

FIGURE 6B is a view similar to that shown in Figure 6A, showing the pin inserted into the terminal.

FIGURE 7 is a partially exploded cross-sectional view of the receptacle connector.

FIGURE 8 is a partial elevational view of a camming member.

FIGURE 9 is an end elevational view of the camming member and assembly.

FIGURE 10 is a fragmentary view showing an alternative embodiment of the camming rod.

A low insertion force (LIF) coaxial connector assembly 2 for electrically connecting a mother board 4 to a daughter board 6 is comprised of an electrical plug connector 8 and an electrical receptacle connector 10 which mate together to form

connector assembly 2. Each connector 8, 10 has a plurality of terminal receiving passages 12, 14, 16 extending therethrough, each of which is profiled to receive a respective terminal 18, 20 therein. Terminals 18, 20 are insulated from the conductive housings of the connectors by an appropriate dielectric material.

Connectors 8, 10 have housings 22, 24, 26 which are molded from metal or metallized plastic having the appropriate conductive characteristics. Metal plating may be performed on a molded plastic housing to provide these required conductive characteristics.

Plug connector 8, as shown in Figures 2, 4 and 5 is comprised of mating conductive housing 22 and terminal support conductive housing 24. Rear surface 28 of mating housing 22 abuts front surface 30 of terminal support housing 24 when plug connector 8 is fully assembled.

Rear surface 28 of mating housing 22 has embossments 27 provided thereon. The embossments, as best shown in Figure 3, are provided in parallel rows which extend between passages 12. Recesses 29 are provided in the front surface of terminal support conductive housing 24. The configuration of the recesses 29 corresponds to the configuration of the embossments 27. Consequently, as mating housing 22 and terminal support housing 24 are joined together, the embossments 27 cooperate with the recesses 29 to provide an interference fit therebetween.

In this assembled position a plurality of passages 12, 14 extends through connector 8 from front surface 32 of housing 22 to rear surface 34 of housing 24. Passages 12, 14 are arranged in three parallel rows, with the first row being adjacent side surface 36 of housing 22 and side surface 38 of housing 24, the third row being adjacent surface 40 of housing 22, and the second row being between the first and third rows. It should be noted that although three parallel rows are shown and described, any possible configuration of rows is possible.

As shown in Figures 4 and 5, each housing 22, 24 has passages 12, 14 which cooperate to form the continuous passages when housings 22, 24 are joined together. However, as passages 14 of support housing 24 are positioned at an angle relative to front surface 30, an angle or bend 42 is necessarily provided in the continuous passages when housings 22, 24 are joined together. Bend 42 shown in Figure 4 is essentially one hundred thirty-five degrees, but the actual angle can range between one hundred and one hundred seventy degrees, as will be more fully explained below. It should be noted that bend 42 may also be arcuate in shape.

Passages 14 of support housing 24 have uni-

form cross sections throughout the length of passages 14. However, passages 12 of mating housing 22 have varied non-uniform cross sections. Wide portions 44 of passages 12 are proximate front surface 32 of housing 22 and have a larger diameters than narrow portions 46 of passages 12 which are proximate rear surface 28 of housing 22. This shape of passages 12 enables terminals 18 to be properly secured therein, as will be discussed.

Stamped and formed terminals 18 with dielectric member 48 molded onto terminals 18 are positioned in passages 12. The configuration of dielectric member 48 varies according to the characteristics desired. In the embodiment shown, dielectric member 48 is molded in cylindrical shapes proximate forked ends 50 of terminals 18. Each cylindrical dielectric member 48 has projections 52, 54 extending from either end to secure terminals 18 in passages 14, as well as to provide the spacing required to prevent terminals 18 from engaging housing 22. A dielectric member 56 of spiral configuration is provided proximate cylindrical dielectric member 48. Each spiral dielectric member 56 resembles that of a coil spring which has been slightly stretched, leaving air spaces between the coils, as will be discussed. It should be noted that passages 12, closest to surface 40 are not long enough to support spiral dielectric member 56, therefore cylindrical dielectric member 49 are provided.

The combination of spiral dielectric members 56 with cylindrical dielectric members 48, 49, as shown in Figures 2, 4 and 5, not only accurately positions terminals 18 in passages 12 but also provides for air gaps 58 over most of the length of terminals 18. This allows the effective dielectric constant of each passage 12 to approach 1.1, whereas the plastic dielectric constant is substantially higher, for example 3.2. The effective dielectric constant of 1.1 permits the controlled impedance to be approximately 50 ohms with 5 amps per contact and 68 ohms with 3 amps per contact where terminals are positioned on a .100" grid. These numbers are merely an example and are not meant to limit the scope of the invention.

Each terminal 18 has forked end 50 which is positioned proximate front face 32 of housing 22. Forked end 50 is twisted relative to the rest of terminal 18, allowing forked end 50 to cooperate with a respective pin terminal 20 of receptacle connector 10, as will be discussed. As shown in Figures 6A and 6B, each forked end 50 has arcuate surfaces 60 which act as a lead in when pin terminal 20 and forked end 50 are mated together, thereby eliminating the need for pin 20 and forked end 50 to be perfectly aligned when mating occurs.

Extending from forked ends 50 are dielectric engagement portions 62 which have the dielectric

inserts molded thereon, as was previously discussed. Portions 62 are of varying lengths, the length depending on passages 12 in which the respective terminals 18 are disposed. Bends 64 are provided in portions 62. Bends 64 correspond to the bends of the continuous passages. The angle of bends 64 is such that reflection of the high speed signals is minimized. Daughter board contact ends 66 are positioned at the end of portions 62 opposite forked ends 50. Ends 66 can be either short, arcuate projections as shown in Figure 4, or long, straight posts. These alternative mounting means allow for terminals 18 to be respectively surface mounted to board 6 or on plated through holes via compliant section 66a of the type disclosed in U.S. Patent No. 4,186,982. Whichever shape, ends 66 extend from rear surface 22 of support housing 24 to make electrical engagement with daughter board 6.

Terminals 18 with dielectric members 48, 56 molded thereto are inserted into passages 12 through front surface 32 of housing 22. As insertion occurs, projections 52 engage walls of narrow portions 46 of passages 12, causing an interference fit therebetween. Insertion continues until surfaces 68 of projections 54 of dielectric members 48 engage shoulders 12a of passages 12 which are the transitions between wide portions 44 and narrow portions 46 of passages 12. It should be noted that as this occurs projections 54 also provide an interference fit with respective walls of wide portions 44 of passages 12. Therefore, terminals 18 are maintained in passages 12 by the interference fit of projections 52, 54 of dielectric member 48 in engagement with walls of passages 12. The portions of terminals 18 extending from rear surface 28 of mating housing 22 are then bent at an appropriate angle as shown in Figures 4 and 5. Support housing 24 is inserted over the exposed portions of terminals 18 until front surface 30 of support housing 24 engages rear surface 28 of mating housing 22. To ensure that support housing 24 is not improperly inserted over terminals 18, projection 70 of housing 22 is engaged by housing 24 to ensure that these housings are properly positioned relative to one another.

After housing 24 is positioned onto housing 22, terminals 18 extend beyond rear surface 34 of support housing 24. The remaining exposed portions of terminals 18 is then bent according to the use of assembly 2. Either terminals 18 are cut and bent into arcuate projections of the type required for surface mounting or terminals 18 are bent as needed, enabling the exposed posts to be used in cooperation with a circuit board that requires plated through hole mounting to ensure electrical engagement. Projections 72 extend from rear surface 34 of housing 24 to cooperate with daughter board 6

when connector 8 is positioned on board 6, maintaining the spacing required between connector 8 and board 6. Daughter board 6 is maintained in contact with connector 2 by screws or the like which extend through holes in mounting members 74 of support housing 24 to cooperate with respective holes of board 6. Mounting members 74 have projections 75, and slots 77 which cooperate with projections 79, 81 on respective housings 24, 22 to secure housings 22, 24 together, as well as secure housings 22, 24 to members 74.

Receptacle connector 10 includes conductive housing 26 having a front surface 76 and a rear surface 78. Passages 16 extend through housing 26 from front surface 76 to rear surface 78. Passages 16 are arranged in three parallel rows, with the first row being adjacent sidewall 80, the third row being adjacent sidewall 82, and the second row being between the first and third rows. The rows of passages 16 of receptacle connector 10 align with the rows of passages 12 of mating housing 22 of plug connector 8 enabling the connectors to be electrically mated together. It should be noted that although three parallel rows are shown and described, any possible configuration of rows is possible, as long as rows of receptacle connector 10 align with rows of plug connector 8.

Passages 16 of housing 26 have non-uniform cross sections as shown in Figure 7. Portions 84 of passages 16, adjacent rear surface 78, have a larger diameter than portions 85 which extend front surface 76. This non-uniform shape of passages 16 enables terminals 20 to be properly secured therein, as will be discussed.

Stamped and formed pin terminals 20, shown in Figures 3-5, are positioned in passages 16. Terminals 20 are essentially straight and have a narrow end 88 at one end thereof. Dielectric member 90 is insert molded over the terminals such that the configuration of dielectric member 90 varies according to the characteristics desired. In the embodiment shown in Figures 3-5, dielectric member 90 is molded in a cylindrical shape having projections 92, 94 extending from ends thereof to secure terminals 20 in passages 16, as well as to provide the spacing required, ensuring that terminals 20 are positioned a proper distance away from the wall of passages 16, permitting controlled impedance.

Narrow ends 88 of terminals 20 extend from housing 26, past front surface 76 into a cavity 95 formed by the walls 80, 82 of housing 26. Extending from ends 88 are dielectric engagement portions 96 which have dielectric members 90 insert molded thereon. Mother board contact ends 98 are positioned at the end of portions 96 opposite ends 88. Ends 98 extend from rear surface 78 of housing 26 to make electrical engagement with mother

board 4. Figure 3 shows connector 10 having terminals 20 with posts including compliant sections for electrical connection with plated through holes of mother board 4, however, connector 10 can have terminals 20 which have arcuate ends suited for electrical engagement with contact pads of mother board 4, i.e. surface mounting.

Terminals 20 with dielectric members 90 molded thereto are inserted into passages 16 of receptacle connector 10 through rear surface 78. As insertion occurs, projections 92 cooperate with the walls of narrow portions 85 to provide an interference fit. Insertion continues until surfaces 99 of projections 94 engage shoulders 86 between narrow portions 86 and wide portions 84 of passages 16, thus defining a stop position. Projections 94 also provide an interference fit with the walls of wide portions 84 of passages 16. Therefore, terminals 20 are maintained in this position by the interference fit of projections 92, 94 in cooperation with the walls of passages 16 of connector 10. Mother board 4 acts as a secondary securing means for terminals 20. As connector 10 is brought into contact with board 4, the dielectric members 90 engage board 4, causing mother board 4 to act as a securing means, maintaining terminals 20 in connector 10. Mother board 4 is secured to connector 10 by screws or the like which cooperate with holes in mounting members 97 of housing 26 of connector 10 and respective holes of mother board 4. Mounting members 97 have projections 89 which cooperate with cavity 95 to maintain connector 10 to board 4 when the screws are secured in place. The screws have positioning posts 93 extending upward therefrom, posts 93 cooperating with openings 91 in members 74 to align connector 8 with connector 10.

It should be noted that mounting members 74 and 97 have recesses and projections which cooperate with the ends of connectors 8 and 10 respectively to secure members 74, 97 to connectors 8, 10. If a longer connector assembly is desired a special end block is provided which enables connector assemblies to be connected together in one long connector. The special end blocks actually being intermediate blocks which allow connection of the connector while providing periodic securing means.

It is important to realize that all the various metallized plastic housings must be in electrical engagement with each other in order for a continuous electrical ground path to be provided. As was previously discussed, embossments 27 and recesses 29 are provided to insure that a positive electrical ground connection is provided between housings 22 and 24. However, this same solution cannot be used between circuit board 4 and housing 26, between housing 26 and housing 22, and between

housing 24 and circuit board 6. Consequently, a different solution must be employed. In order to provide the electrical connection required, interconnections members 160,162,164 are provided between circuit board 4 and housing 26, between housing 26 and housing 22, and between housing 24 and circuit board 6.

Interconnection members 160,162,164, as best shown in Figures 2, 3 and 4, are essentially identical. For ease of description, only interconnection member 162 will be discussed in detail. The reference numbers used will be used on the other interconnection members 160,164, as the parts are identical.

Interconnection member 162 is stamped and formed from any material having the desired conductive characteristics. Member 162 has a first major surface 166 and a second major surface 168. Openings 170 extend from first major surface 166 through second major surface 168. The pattern in which openings 170 are arranged corresponds to the pattern of the terminals. Cantilever spring arms 172, 174 are provided proximate openings 170. Cantilever spring arms 172, 174 are positioned in parallel rows, the pattern of spring arms 172, 174 is essentially identical to the pattern of embossments 27 provided on housing 22. Spring arms 172 extend beyond first major surface 166 and spring arms 174 extend beyond second major surface 168. Consequently, as the various housings and circuit boards are mated together, interconnection members 160, 162, 164 will cooperate with the mating surfaces to provide the electrical connection required. This is insured because spring arms 172, 174 will engage respective surfaces as mating occurs. In fact, spring arms 172, 174 will create a slight wiping action to insure that a positive electrical connection is made. Therefore, as all the housings and circuit boards are in electrical engagement, a uniform electrical ground path is provided around each terminal insuring that the proper signal reference path and shielding is present.

As shown in Figures 5 and 7, power busses 100, 102 and ground busses 104, 106 are provided on connectors 8, 10. The general shape of busses 100, 102, 104, 106 of connectors 8, 10 are essentially the same as the shape of the outside surfaces of the respective connectors 8, 10 with which the busses cooperate. Power busses 100, 102 have a layer of dielectric material provided thereon, to prevent the power from travelling from the busses to the metallized housing. Each bus has pins 101 extending from the end of the bus which is adjacent the respective circuit board. Pins 101 are provided on 0.100 inch centerlines, such that upon placement of the busses on appropriate circuit boards, pins 101 may be removed according to need. Accordingly, only pins 101 which correspond

to appropriate areas of engagement with the circuit board are retained, the rest are removed.

Power and ground busses 100, 104 of plug connector 8, Figure 5, are inserted into channels 108 of mating housing 22 and retained therein by an interference fit. Busses 100, 104 are provided to span the entire length of connector 8. The shape of the ends of busses 100, 104 which cooperate with board 6 can be either arcuate or straight to correspond to the shape of the ends of terminals 18 which allows for surface mounting or through hole mounting respectively.

Power and ground busses 102, 106 of receptacle connector 10, Figure 7, are inserted into respective passages 110 of housing 26 of connector 10. Projections 112 of passages 110 cooperate with busses 102, 106 to provide an interference fit to maintain busses 102, 106 in position. As can be seen from Figure 7, ground bus 106 and power bus 102 have similar configurations. Arcuate sections 114 are provided periodically at an end of each bus 102, 106, such that sections 114 cooperate with the walls of housing 26 to prevent movement of busses 102, 106 relative to connector 10, as shown in Figures 1 and 7. The ends of busses 102, 106 may be either arcuate or straight to correspond to the shape of the ends of terminals 20 and to allow for either surface mounting or through hole mounting.

Projections 116 are present on busses 102, 106 of connector 10 such that projections 116 electrically and wipingly engage busses 100, 104 of connector 8 when connectors 8, 10 are mated together. This ensures that that as connectors 8, 10 are mated together, power and ground busses 100, 104 make electrical contact with the respective power and ground busses 102, 106 of the mating connector. Consequently, a power and a ground bus is supplied between mother board 4 and daughter board 6, providing the required power supply necessary to ensure that daughter board 6 functions properly, as well as providing a shielding to shield the connector assembly 2 from outside interference.

Connector assemblies 2 are designed such that the number of terminals which can be used in a small space is maximized. This important feature causes problems when the connectors are to be mated together. The force required for proper insertion is too great and, therefore, improper insertion or failure of the connectors is a likely occurrence. Consequently, a zero or low insertion connector assembly is essential for effective operation.

One form of zero or low insertion force connector requires the use of a camming assembly. Figures 8 and 9 show one type of camming assembly 118 which can be used in conjunction with connector assembly 2. Camming assembly 118 extends the entire length of connector assembly 2. Mount-

ing projections 120 extend from ends 129, 130 of member 119 such that openings 122, provided in mounting projections 120, are configured to accept bolts 124 which align with corresponding holes of board 4. The use of bolts 124 allows camming assembly 118 to be secured to board 4.

Referring to Figure 8, opening 126 extends through member 119 from end 129 to end 130. Camming rods 134a, 134b are movably positioned in opening 126. Recesses 128 are provided in member 119 adjacent ends 129, 130 and extend from top surface 131 in communication with opening 126. Recesses 128 are provided to accept rods 132 which extend from connector 8 of connector assembly 2 through board 6 (as shown in Figure 9). Recesses 136 of rods 134a, 134b align with recesses 128 such that rods 132 are disposed in recesses 136, as shown in Figure 8. As rods 134a, 134b are moved, recesses 136 cause rods 132 to move within recesses 128. This movement forces connector 8 to move in a direction which is parallel to the plane of board 4. Consequently, connector 8 moves relative to connector 10, forcing terminals 18 into electrical engagement with terminals 20 as will be explained.

Terminals 20 of receptacle connector 10 are inserted to the side of terminals 18 of plug connector 8 as connectors 8, 10 are mated together, as shown in Figure 6. In other words as connectors 8, 10 are mated together terminals 18 and terminals 20 do not contact or barely contact each other. This allows connectors 8, 10 to be mated together under low insertion force conditions and also provides the important feature of assuring that power busses 100, 104 and ground buss 102, 106 are in electrical engagement before signal terminals 18, 20 are placed in electrical engagement with each other. Once connectors 8, 10 have been brought into engagement, camming assembly 118 is operated, causing plug connector 8 to move relative to receptacle connector 10. Consequently, pins 20 are forced into engagement with lead in arcuate surfaces 60 of forked ends 50 of terminals 18, shown in Figure 6a. As this camming motion occurs, terminals 20 contact the sides of forked ends 50, thereby providing a wiping action to ensure that a positive electrical connection is effected. In the fully cammed position, Figure 6b, terminals 20 are fully inserted into forked ends 50, thereby maintaining a positive electrical connection.

The movement of rods 134a, 134b is caused by the movement of action lever 138, as shown in Figures 8 and 9. Action lever 138 is connected to activation rod 140 which is in turn connected to a camming wheel 142. Wheel 142 is connected to rods 134 by pins 144 disposed in arcuate camming slots 146 of wheel 142, as shown in Figure 8. Consequently, as lever 138 is turned in the direc-

tion of the arrow in Figure 8, rod 140 is rotated causing wheel 142 to rotate which in turn causes pins 144 to move in camming slots 146. The configuration of camming slots 146 cause rod 134a to move outwardly, away from wheel 142, while rod 134b is moved inwardly, toward wheel 142. The movement of rods 134a, 134b cause rods 132 to move in the same direction, which in turn causes connector 8 to move as previously described. Consequently, as lever 138 is turned, terminals 18 are moved into electrical engagement with terminals 20.

Wheel 20 is positioned in opening 148 of member 119 which extends through camming assembly 118 from side 150 to side 152 (Figure 9). To hold wheel 142 in place rods 134a and 134b have slots positioned at the ends thereof which cooperate with opening 148. Wheel 142 is positioned in the slots and pins 144 are inserted through openings 154 provided in rods 134a and 134b, thereby securing wheel to rods 134a, 134b. In order to change wheel 142 and camming rods 134a, 134b, pins 144 are removed allowing the wheel and the camming rods to be replaced as required.

Another configuration of camming assembly 118 has camming rods 135 which have a sloping surface 137, as shown in Figure 10. Recesses 139 are narrower and longer than the recesses 128 previously described. Arcuate camming slots 146 are also configured in a slightly different manner, such that as wheel 142 is turned, rods 135 are moved outward, away from wheel 142. Consequently, as rods 135 are moved outward, away from wheel 142. Consequently, as rods 135 are moved, surfaces 137 cooperate with rods 132, forcing them downward. As rods 132 are attached to connector 8, the downward motion of rods 132 forces connector 8 to move downward relative to connector 10. This downward motion causes terminals 18 to be electrically connected to terminals 20, thereby providing a positive locking action between terminals 18 of connector 8 and terminals 20 of connector 10.

Camming assembly 118 also acts as a stiffening member. Board 4 is subject to warpage and bending, which causes the string of connected assemblies 2 to bend accordingly, causing an unreliable electrical connection to occur between terminals 18 and terminals 20. Consequently a stiffening member can be useful. Camming assembly 118, is manufactured from a metal and other material having the required characteristics and is secured to board 4 by bolts 124 and therefore, provides the stiffening required to insure that the board is only subjected to minimal bending, which in turn insures that a reliable electrical connection is effected between the terminals.

It must be noted that although camming as-

sembly 118 is shown in detail, other types of camming assemblies will perform equally as well. The camming assembly must move the terminals into electrical engagement, ensuring that a positive electrical connection is effected and maintained.

Claims

1. An electrical connector (22,24) comprising a first and a second electrically conductive housing (22,24), the first electrically conductive housing (22) having at least one row of first passages (12) therein, each first passage (12) extending from a first surface (32) to a second surface (28) of the first housing (22), the second electrically conductive housing (24) having at least one row of second passages (14) therein, each second passage (14) extending from a first surface (30) to a second surface (34) of the second housing (24), each second passage (14) is at an angle relative to the first and the second surface (30,34) of the second housing (24), such that as the first and second housings (22,24) are brought together the passages (12,14) of the respective housings (22,24) align to form terminal receiving passages (12,14) which extend through the connector (22,24), the terminal receiving passages (12,14) having a bend at the juncture of the housings (22,24), terminals (18) positioned in the passages (12,14), each terminal (18) having a first end (50) proximate the first surface (32) of the first housing (22) and a second end proximate the second surface (34) of the second housing (24), the electrical connector being characterized in that:

the terminals (18) are configured to follow the shape of the terminal receiving passages (12,14), such that bends (64) are provided in the terminals (18) to allow high speed transmission of a signal transmission across the terminal (18) while minimizing reflection of the signal, thereby ensuring that the high speed signal is properly transmitted across the terminals (18) of the connector (22,24),

the first and the second housings (22,24) are metallized plastic such that the properties of the surface layers of the first and the second housings (22,24) have conductive characteristics;

dielectric sleeves (48) are coaxially positioned around the terminals (18), portions of the sleeves (48) cooperate with walls of the passages (12,14) and with the terminals (18) to provide spacing between the housing (22,24) and the terminals (18), the dielectric sleeves (48) having spaces provided therein, the spaces providing air gaps which allows the characteristic impedance to be such as to permit the high speed signals to be transmitted properly across the terminals (18).

2. An electrical connector (22,24) as recited in claim 1 characterized in that the first ends (50) of the terminals (18) are formed into a fork, the fork having arcuate surfaces (60) on one side thereof, the surfaces (60) act as a lead-in when the electrical connector (22,24) is mated to a mating electrical connector (26).

3. An electrical connector (22,24) as recited in claim 1 characterized in that the dielectric sleeves (48) proximate the first end of the terminals (18) are cylindrical in configuration.

4. An electrical connector as recited in claim 3 characterized in that the dielectric sleeves 48 have projections (52,54) which cooperate with walls of the passages (12) to provide an interference fit, maintaining the terminals (18) in the passages (12,14), the projections (52,54) also providing an air gap over most of the length of the terminals (18), allowing for controlled impedance.

5. An electrical connector (22,24) as recited in claim 1 characterized in that the bends (64) are angles which are in the range from one hundred degrees to one hundred seventy degrees.

6. An electrical connector assembly (2) for connecting conductive areas of a first substrate (4) to conductive areas of a second substrate (6), the connector assembly characterized in that:

a first electrical connector (22,24) having electrically conductive housing means (22,24), the housing means (22,24) having at least one row of first terminal receiving passages (12,14) extending from a first surface (32) of the housing means (22,24) to a second surface (34) of the housing means (22,24), the terminal receiving passages (12,14) having a bend therein, first terminals (18) located in the terminal receiving passages (12,14) and having essentially the same configuration as the terminal receiving passages (12,14), the first terminals (18) having a mating end (50) proximate the first surface (32) of the housing means (22,24) and a board engagement end proximate the second surface (34) of the housing means (22,24), dielectric means (48) surrounding the first terminals (18) in the first terminal receiving passages (12,14), the dielectric means (48) insulating the first terminals (18) from the housing means (22,24) and providing spacing to properly position the first terminals (18) in the first terminal receiving passages (12,14);

a second electrical connector (26) having electrically conductive housing member means (26), the housing member means (26) having at least one row of second terminal receiving passages (16) extending therethrough, second terminals (20) located in the second terminal receiving passages (16), a mating end (88) of the second terminals (20) cooperating with the mating end (50) of the first terminals (18), dielectric material

means (90) surrounding the second terminals (20) in the second terminal receiving passages (16), the dielectric material means (90) insulating the second terminals (20) from the housing member means (26) and providing spacing to properly position the second terminal (20) in the second terminal receiving passages (16); 5

the housing means (22,24) and the housing member means (26) are metallized plastic such that the properties of surfaces of the housing means (22,24) and housing member means (26) have conductive characteristics; and, 10

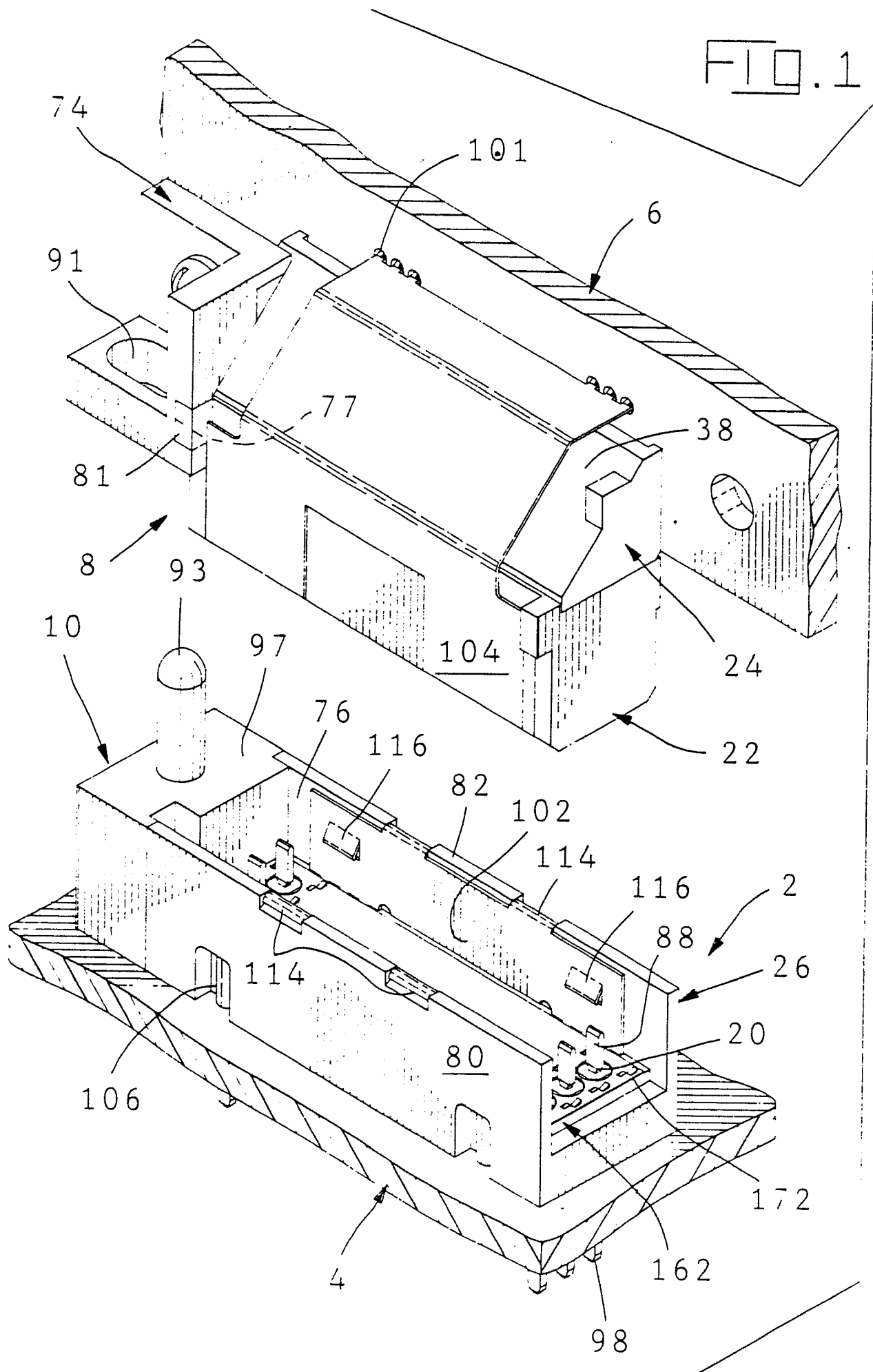
the dielectric means (48) and the dielectric material means (90) have spaces provided therein, the spaces provide air gaps which allow the characteristic impedance to be such as to permit high speed signals to be transmitted properly across the first and the second terminals (18,20). 15

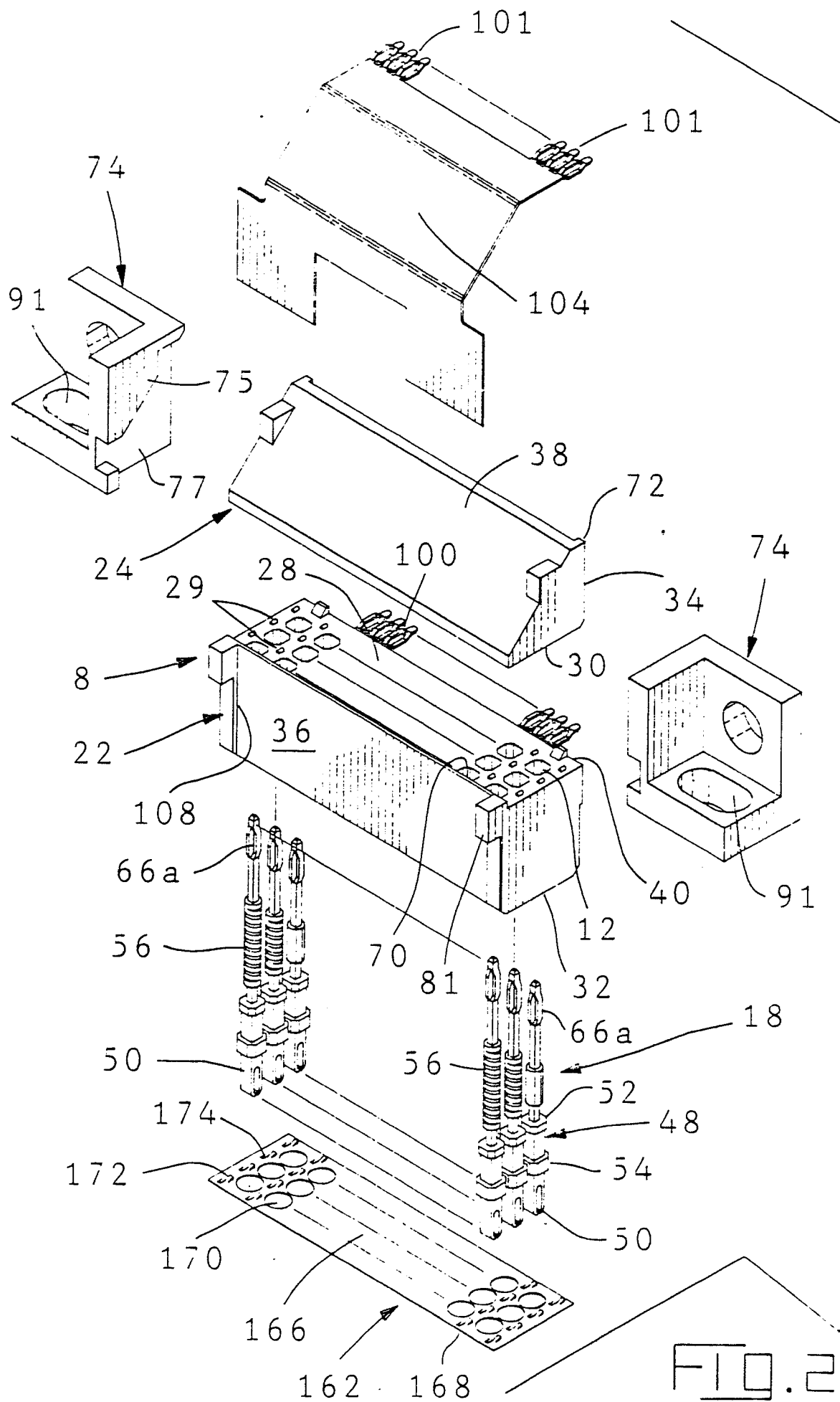
7. An electrical connector assembly (2) as recited in claim 6 characterized in that each connector (22,24,26) has power and ground busses (100,102,104,106) positioned proximate outside surfaces thereof, the power and ground busses (100,104) of the first connector (22,24) being in alignment with respective power and ground busses (102,106) of the second connector (26) such that electrical engagement is provided between corresponding busses when the connectors (22,24,26) are mated. 20 25

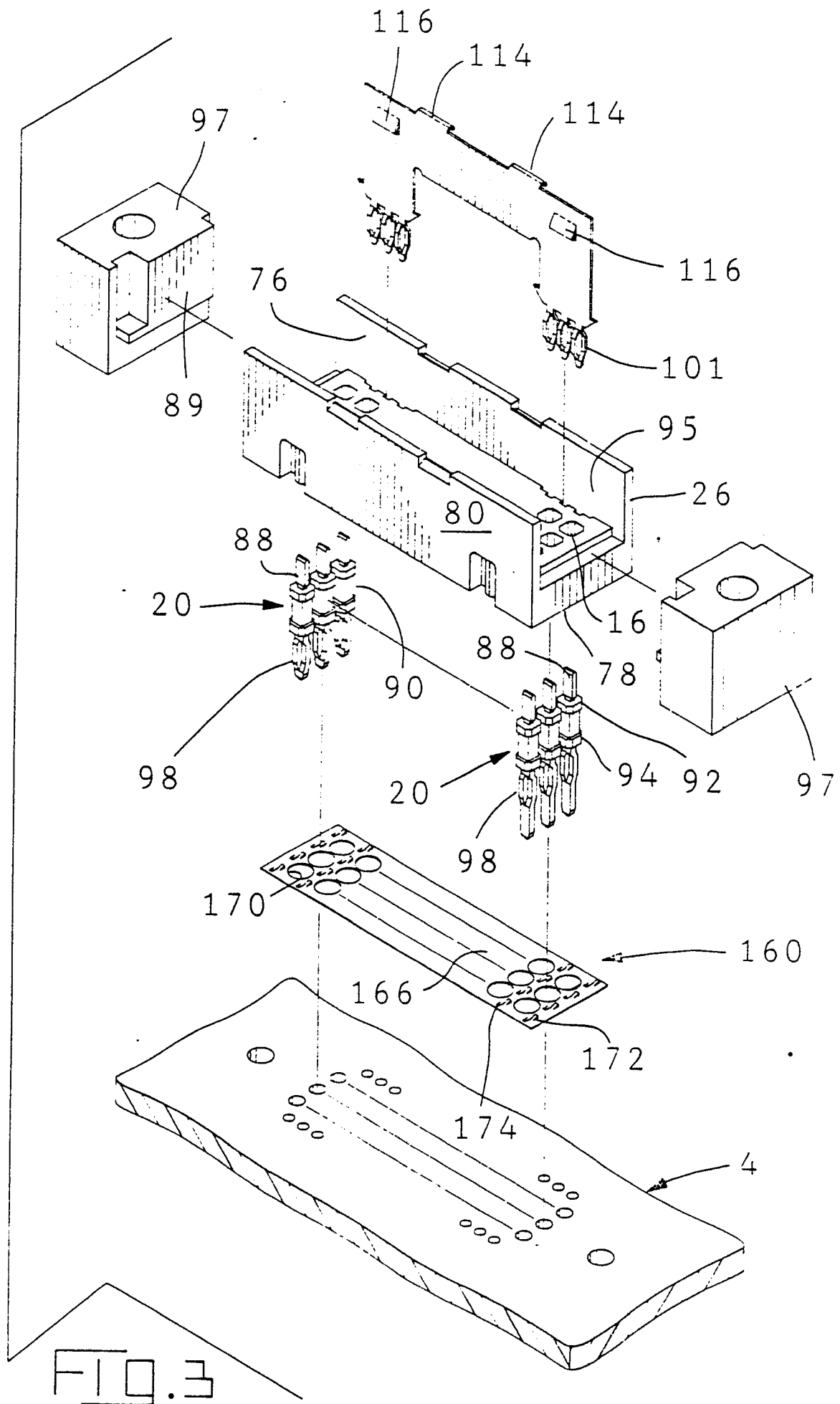
8. An electrical connector assembly (2) as recited in claim 6 characterized in that camming means (118) is provided to cam the first terminals (18) of the first electrical connector (22,24) into electrical engagement with the second terminals (20) of the second electrical connector (26). 30 35

9. An electrical connector assembly (2) as recited in claim 8 characterized in that a power and a ground bus (100,104) of the first electrical connector (22,24) is electrically engaged to a respective power and ground bus (102,106) of the second electrical connector (26) before the first terminals (18) of the first electrical connector (22,24) are cammed into electrical engagement with the second terminals (20) of the second electrical connector (26). 40 45

10. An electrical connector assembly (2) as recited in claim 6 characterized in that the housing means (22,24) of the first connector (22,24) has two parts, a support member (24) and a mating member (22), the bend occurring proximate the juncture of the two members. 50







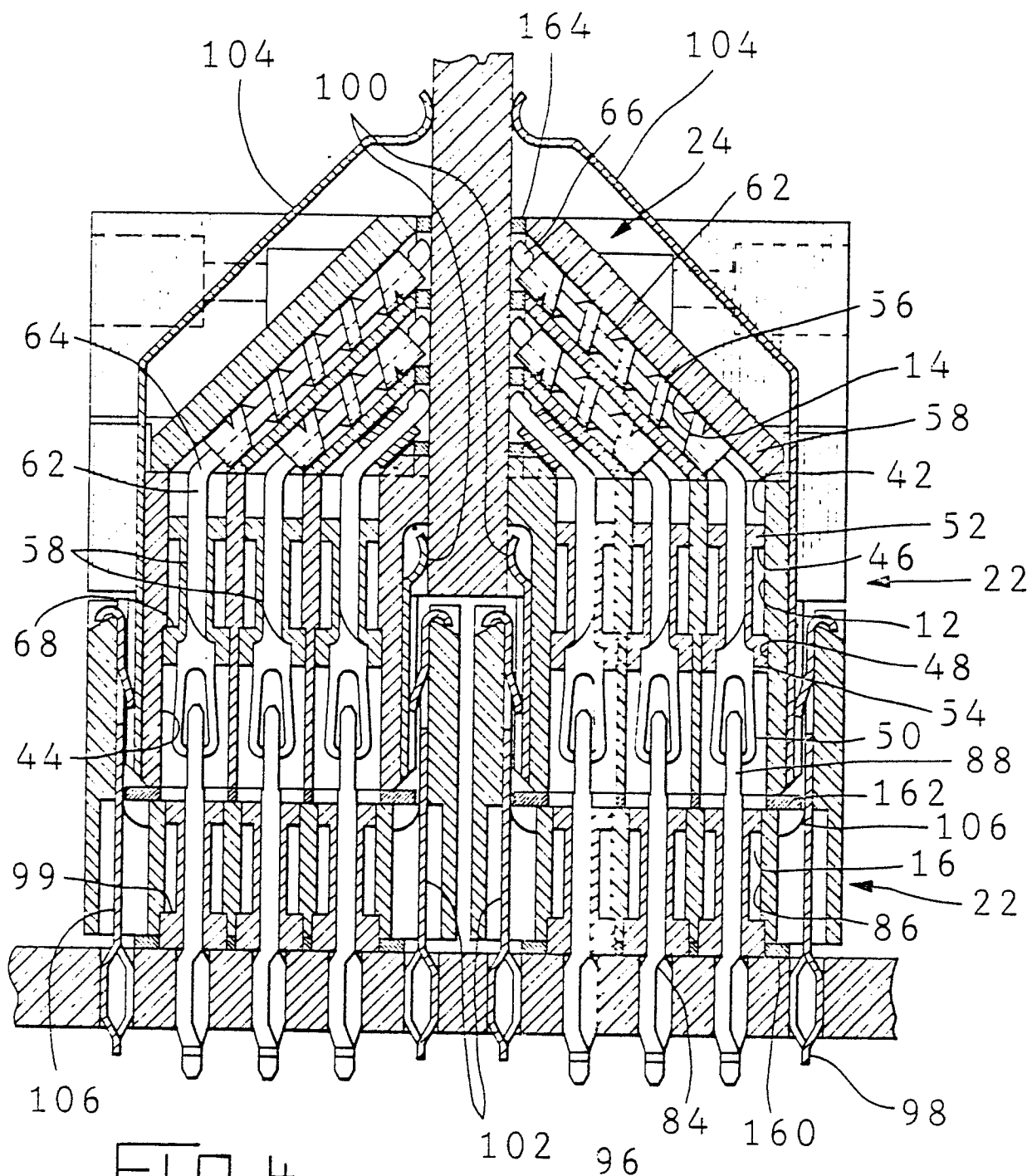


FIG. 4

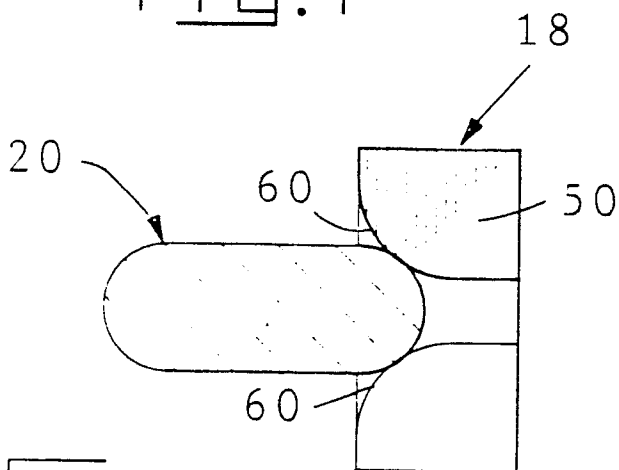


FIG. 6A

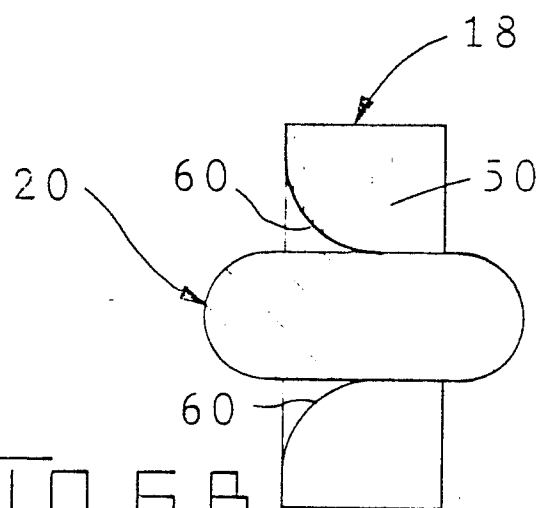


FIG. 6B

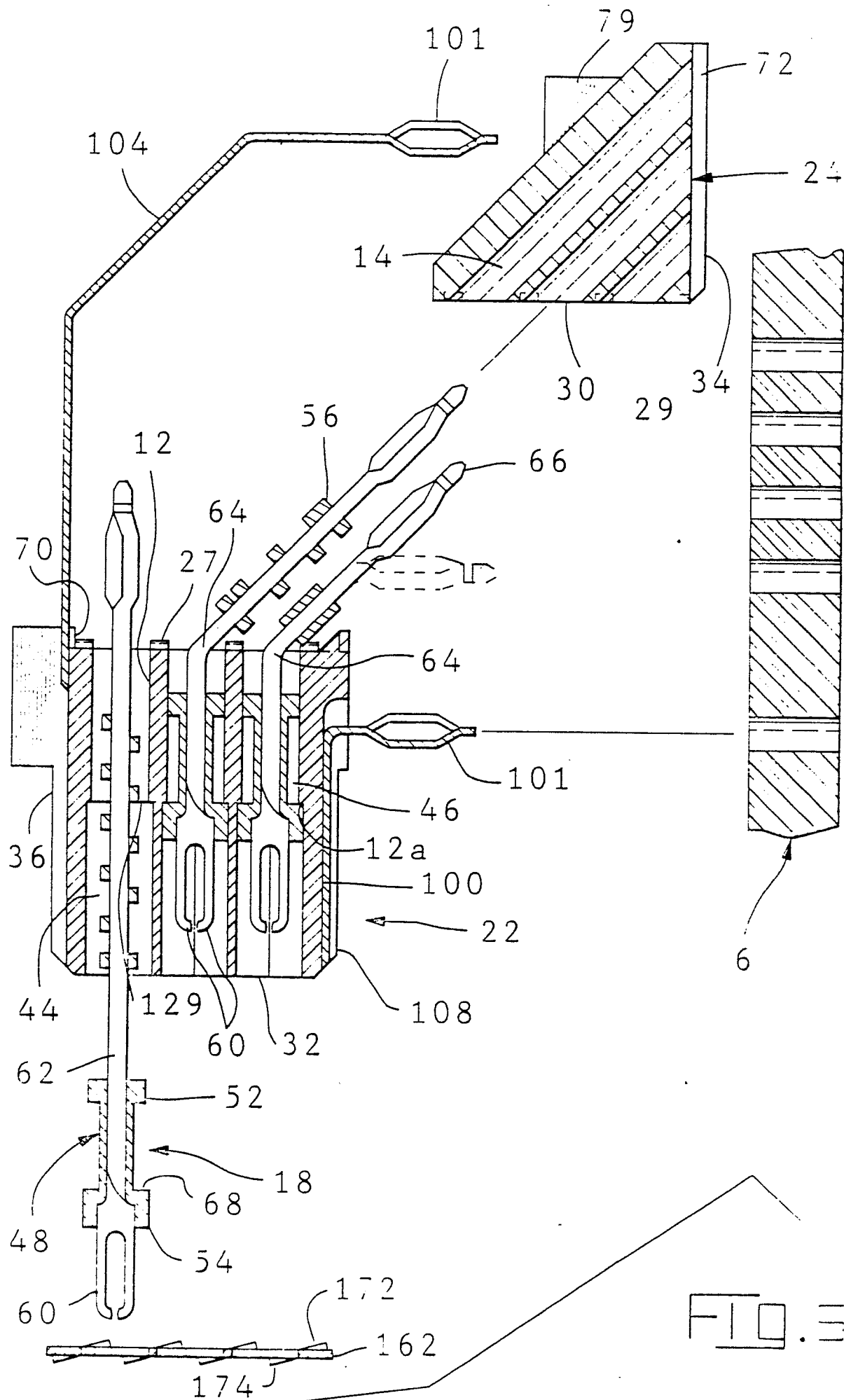
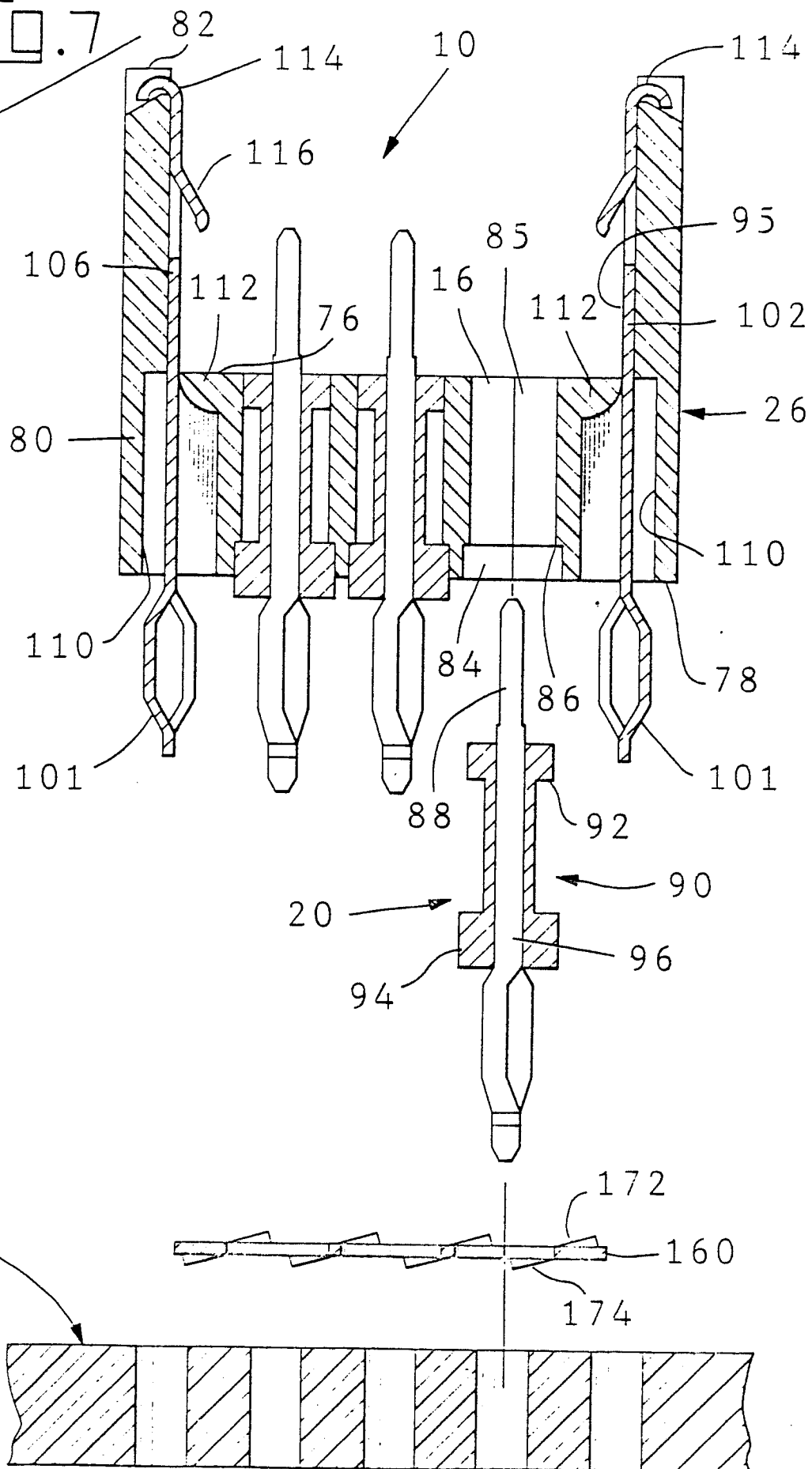
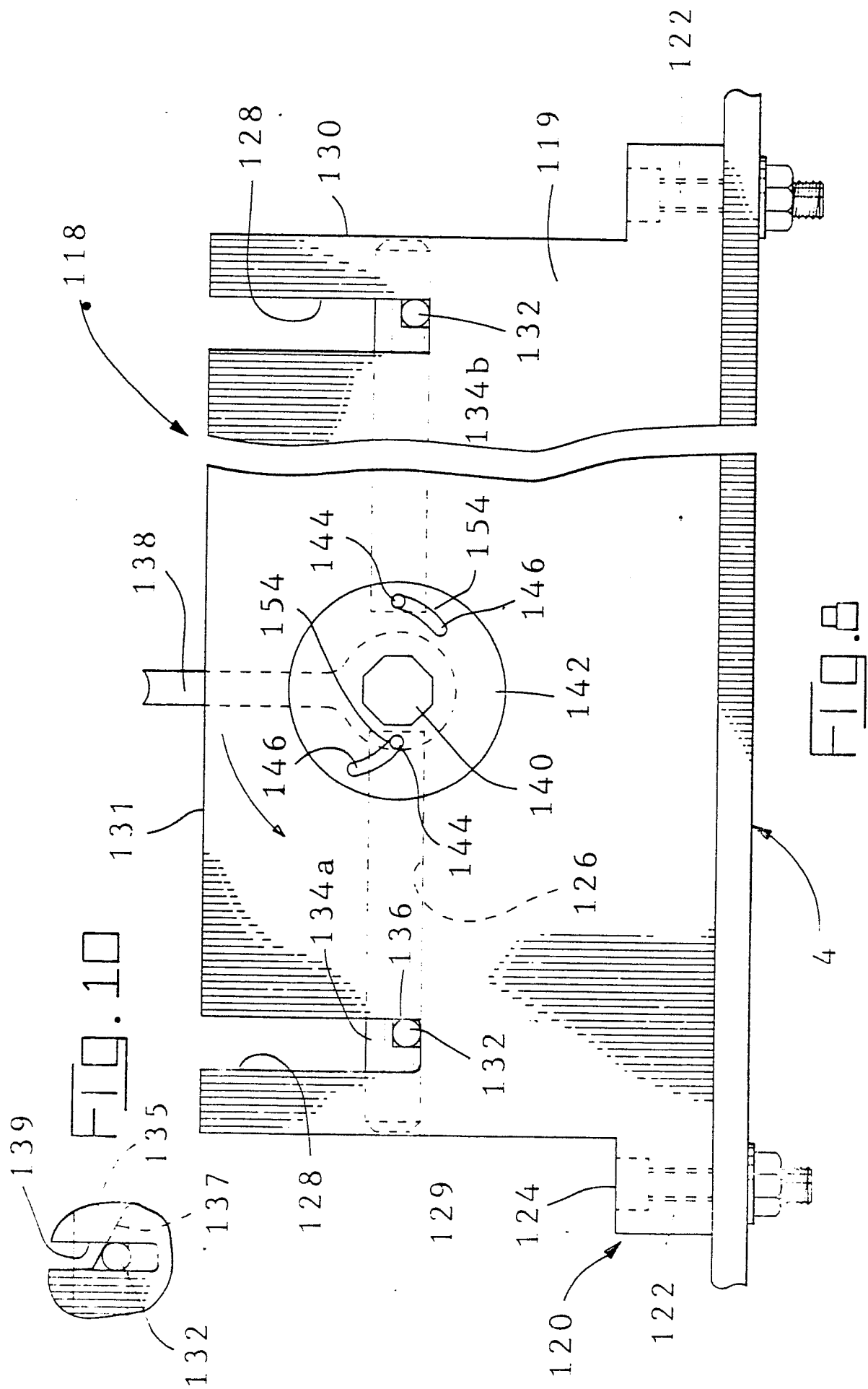


FIG. 7





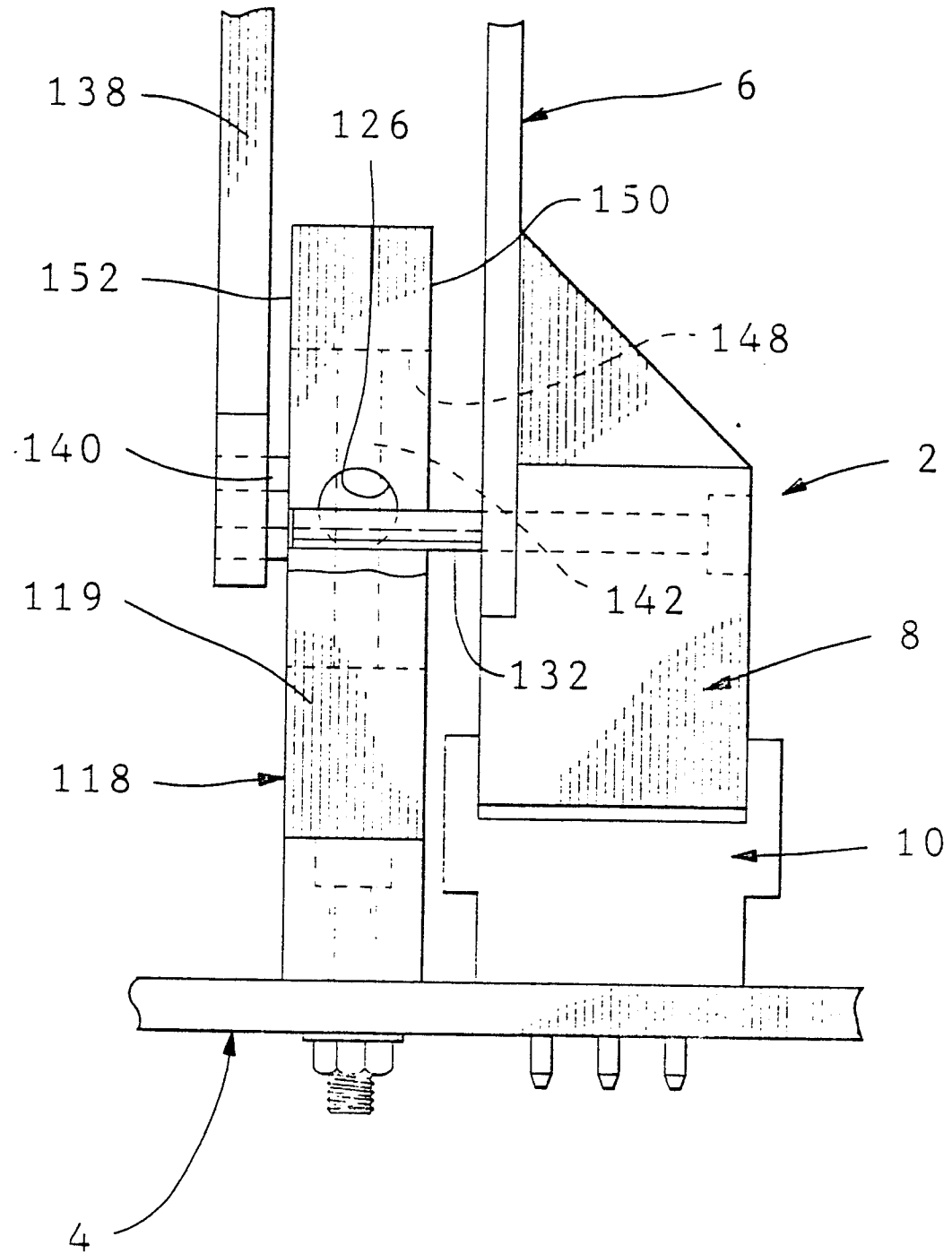


FIG. 9



EP 87 31 0471

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
Y,D	US-A-4 451 107 (DOLA) * Column 1, line 28 - column 2, line 11; column 2, lines 31-56; column 3, line 46 - column 4, line 24; figures 3,4,7 *	1,5-10	H 01 R 23/72 H 01 R 13/658
Y	US-A-4 200 347 (SINCLAIR) * Column 3, line 67 - column 4, line 10; figures 2,5,7 *	1,5-10	
Y	GB-A-2 163 305 (TERADYNE) * Page 1, lines 5-53; figures 1,2,5 *	6-9	
X		2	
A	DE-U-8 517 334 (AMP) * Page 2, lines 8-33; figure 4 *	1,6	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			H 01 R 23/00 H 01 R 13/00
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 18-02-1988	Examiner CRIQUI J.J.
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	