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

(11) Publication number: **0 451 525 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91103828.9**

(51) Int. Cl.[5]: **H01R 13/33**

(22) Date of filing: **13.03.91**

(30) Priority: **11.04.90 US 507434**

(43) Date of publication of application:
16.10.91 Bulletin 91/42

(84) Designated Contracting States:
DE FR GB

(71) Applicant: **International Business Machines Corporation**
Old Orchard Road
Armonk, N.Y. 10504(US)

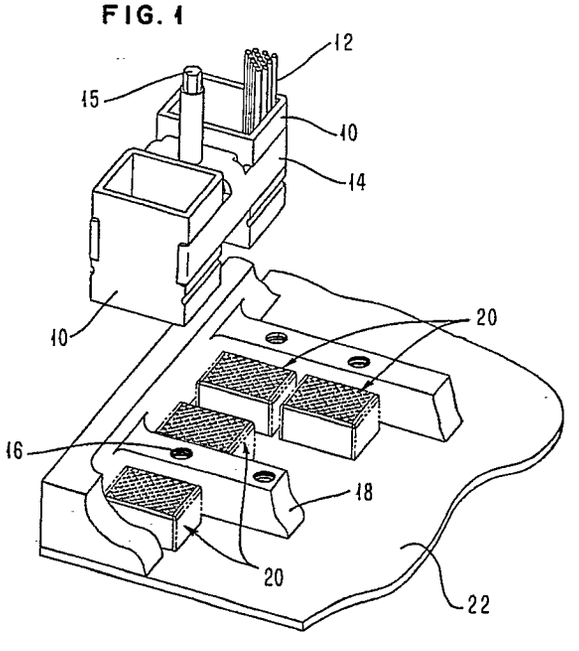
(72) Inventor: **Bahri, Kanwal**
7 Applesauce Lane
Wappingers Falls, N.Y. 12 590(US)
Inventor: **Johnson, Richard Alfred**
66 Round Hill Road
Poughkeepsie, N.Y. 12 603(US)

(74) Representative: **Klocke, Peter, Dipl.-Ing.**
IBM Deutschland GmbH Patentwesen und Urheberrecht Schönaicher Strasse 220
W-7030 Böblingen(DE)

(54) Electrical connector of the pin and socket type.

(57) An electrical connector of the pin (10) and socket (20) type wherein the socket includes a bent tube (50) into which the pin (28) of the connector is inserted. The tube includes a double bend such that when the pin is fully inserted, it is deflected making three point contact between the pin and the sides of the tube. The described connector thus results in wiping action between the pin and the tube as the pin is inserted, providing good electrical contact between the pin and the tube.

FIG. 1



EP 0 451 525 A2

The present invention relates to an electrical connector of the pin and socket type, and more particularly relates to a connector in which a first connector member has a multitude of pins which engages with corresponding sockets in a dense configuration on a second connector member when the connector members are co-engaged.

Pin and socket connectors are well known in the art. U. S. Patent No. 3,277,422 discloses a connector having multiple pin terminals on one connector member which engage with terminal-receiving bores on the other connector member. The terminal-receiving bores have cylindrical forward portions with which the respective forward pin portions engage. The forward pin portions may be enlarged or formed of strands of spring-like wire to ensure contact between the pins of one connector member with the cylinders of the other connector member to ensure electrical contact.

U. S. Patent No. 3,838,381 discloses a safety current outlet and plug device wherein the outlet has sockets designed to deform elastic blades on a plug member to ensure good electrical contact.

U. S. Patent No. 4,138,180 discloses a plug of the kind comprising a first element having at least one pin and a second element having at least one socket designed to take the pin. The pin is cylindrical in shape and has an enlarged end which is designed to engage with the socket having a square-section hole whose diameter of the circle inscribed in the hole substantially equals the maximum diameter of the enlarged end of the pin.

U. S. Patent No. 4,840,588 discloses a socket contact wherein electrical connection is obtained by permanent deformation of the socket to make contact between the socket walls and a pin inserted therein.

IBM Technical Disclosure Bulletin, Vol. 18, No. 11, April 1976, page 3588, discloses a solderless board connection element comprising a barrel sleeve adapted to fit over and tightly clamped to a standard module pin. The barrel sleeve includes an extension which forms a spring that deflects as it contacts a pad for wiping the pad and forming an electrical path of high integrity between the pad, the spring extension of the barrel sleeve and the module pin.

IBM Technical Disclosure Bulletin, Vol. 30, No. 6, November 1987, page 292, discloses a circuit board which carries an array of tubes and a circuit card that is pluggable into the board. The board carries an array of pin-like bendable beams that fit loosely into matching tubes when the card is initially positioned on the board. The card or the board is moved laterally such that the bendable pins contact the rim of the tubes and one other point on the sidewall of the tubes such that there is electrical connection between each pin-like bendable beams and two points of the matching tubes.

The present invention is intended to remedy drawbacks of the prior art and to provide an improved electrical connector of the pin and socket type.

The electrical connector of the present invention as claimed includes a first connector member having a pin-like extension and a second connector member having a socket into which the pin-like extension is inserted for making electrical contact. The socket of the second connector member has a double bend such that the pin being inserted therein is deflected to make three points of electrical contact between the socket and the pin.

The present invention provides an improved pin and socket type electrical connector having a near zero insertion force connection formed without moving parts. Further the invention has electrical shielding around the pin and socket connection.

The pin and socket type electrical connector which may be configured in a dense array and can be provided for connecting multiple cables each carrying a signal conductor to an electrical circuit in a simple yet reliable manner.

For a better understanding of the present invention, together with further objects and advantages, preferred embodiments of the invention are described in the following with reference to the accompanying drawings, in which

Fig. 1
is a perspective drawing of a connector of the present invention wherein multiple cables are connected to terminals in a first connector member for electrical connection to terminals in a second connector member mounted on a printed circuit board;

Fig. 2
is a sectioned view showing co-engaging terminals of the first and second connector members of Fig. 1; and

Figs. 3A, 3B and 3C
show a sequence of the co-engagement of a pin terminal of the first member of Figs. 1 and 2 as it is inserted into a socket terminal in the second connector member of Figs. 1 and 2.

Fig. 1 is a perspective drawing showing a connector member 10 which engages with and provides an electrical connection between a plurality of signal cables, a portion of which are shown at 12, and a closely spaced matrix of terminals in a second connector member 20. Connector members 10 may be clamped together in pairs by a carrier bracket 14 and secured in place by a fastening device such as a bolt 15 having a threaded end (not shown) which screws into a threaded bore 16 in a support member such as a printed circuit board stiffener 18 as shown in Fig. 1. The connector members 10 and 20 may be engaged, as will

be described, to make electrical connections between signals carried by the cables 12 and electrical terminals in the connector member 20 which are connected to signal leads in, for instance, an electrical circuit on printed circuit board 22, or other electrical circuits, as desired.

Fig. 2 is a sectioned view of the connector members 10 and 20 showing a single connection between a cable 24 of the cable bundle 12 of Fig. 1, and a socket terminal 25 of the connector member 20. The cable 24 has a signal conductor 26 which is welded or soldered to a center pin 28 at 29. The cable 24 also includes a ground conductor 30, which may be a separate conductor or a concentric foil around the signal conductor to provide shielding, as desired. The ground conductor 30 is crimped or otherwise electrically connected to a tube 32. The pin 28 is aligned with and held concentrically within the tube 32 by electrical insulating rings 33, 34, 35 and 36.

The connector member 10 has a chamber 38 formed by an extension 39 for receiving a forward portion 40 of the connector member 20. The leading edges of the extension 39 and the forward portion 40 are tapered at 41 and 42, respectively, to assist in the aligning of the connector members 10 and 20 as they are mated together for engagement. The forward portion 40 includes a countersunk bore 44 forming a socket for receiving the free end of the pin 28 and a portion of the tube 32 as the connector members 10 and 20 are engaged. The countersunk bore 44 includes an enlarged portion 46 in which is located a pair of concentric tubes 48 and 50. The outer tube 48 is sized to slidably receive the free end of the tube 32, and includes bent spring portions 52 which are bent inwardly to make electrical contact with the tube 32. The inner concentric tube 50 is sized to slidably receive the free end of the pin 28 as the connector members 10 and 20 are engaged. The inner concentric tube 50 has a double bend to insure electrical contact between the tube 50 and the pin 28 as will be further discussed. The inner concentric tube 50 is connected to a signal lead 54, and the outer concentric tube 48 is connected to a ground lead 56. Leads 54 and 56 are connected to an electronic circuit, as desired. The concentric tubes 48 and 50 are electrically insulated from each other by an insulator 55. In the present embodiment, tubes 32, 48 and 50 and pin 28 are concentric and have circular cross-sections, but it will be understood that other cross-sections such as ovals or squares, or a combination, could be used.

Figs. 3A, 3B and 3C show a progression of steps as the pin 28 is inserted into the tube 50 of the terminal 25 of Fig. 2. The tube has a slightly flared end 60 for assisting in making final alignment of the end of the pin 28 as it is inserted in the end of the tube 50, as shown in Fig. 3A. As earlier mentioned, the tube 50 has a double bend for providing at least three contact points, A, B and C, between the tube 50 and the pin 28.

In Fig. 3B, the pin 28 is shown partially inserted into the tube 50 making electrical contact at point A, and just starting to make electrical contact on the opposite wall of the tube 50. Fig. 3C is an illustration of the pin 28 fully inserted into the tube 50 and making electrical contact at points A, B and C.

In the disclosed connector, the pin is the compliant member whereas the bent tube 50 is rigid. For a given geometry and material, the magnitude of the bend will depend upon the desired contact force. During the insertion, the pin 28 is guided into the lead-in area of the tube by the slightly flared end 60. As the pin 28 is inserted into the tube, the rigid tube geometry deflects the pin in such a way that three points of contact are established, but without exceeding the limits of elasticity of the pin 28 such that constant electrical contact is maintained between the pin 28 and the inner walls of the tube 50.

The small angle of approach encountered by the pin 28 as it is inserted into the tube 50, is very desirable because it results in a small insertion force. Also, during withdrawal, the pin 28 can be pulled out of the tube 50 with relative ease. It will be understood that the edges 41 and 42 align the pins 28 to their corresponding sockets formed by bores 44, and that engaging and withdrawing force of the connector members 10 and 20 as they are mated, may be supplied by the action of the threaded fastening device 15 in the threaded bore 16.

The disclosed connector results in a three point contact, adequate wipe between the pin 28 and the inner walls of the tube 50, and a ZIF (zero insertion force) like connection having no moving parts. This results in good and reliable electrical connection having very small insertion force. Since there are no moving parts in the connector, this design also results in very high density packaging. The use of the co-axial tubes 32 and 48 for making the ground connections also lends itself to co-axial packaging schemes which will provide 360 degrees electrical shielding. Based on systems packaging requirements, the disclosed concept may be used in several configurations. These configurations may include surface mounted packaging for the front and back of the board, as well as traditional pin to board connectors.

Although the connector member 20 is shown as a separate member mounted on a printed circuit board 22, it will be understood that the socket terminal 25 could be located in bores in the circuit

board 22 itself. In that case the extension 39 of connector member 10 would not be used.

Claims

1. An electrical connector of the pin and socket type comprising:

   a plurality of socket means (25) for forming electrical contacts of said electrical connector (10), each of said socket means having an intermediate bent portion (50) and an open end (44) such that a pin (28) inserted into said socket means through said open end is deflected past said intermediate bent portion an electrical contact making means (A, B, C) in each of said socket means, each of said electrical contact making means for making electrical contact in at least three places with a pin as it is inserted into an open end of each of said socket means;

   socket housing means (20) for placing said plurality of socket means in a dense geometric arrangement for receiving a plurality of pins in a corresponding geometric arrangement; and

   insulating means (55) in said housing means for electrically insulating each of said socket means from one another;

   a pin housing means (39) engageable with said socket housing means; and

   a plurality of pins fixed in said socket housing means in a dense geometric arrangement corresponding to the geometric arrangement of said plurality of socket means in said socket housing means, each of said plurality of pins having a free end extending from said pin housing means for insertion into the open end of one of said socket means when said pin housing means in engaged with said socket housing means;

   each pin having a portion surrounded by a first electrical shield (32) and each socket means having a portion surrounded by a second electrical shield (48), said first and second electrical shields being co-engageable for forming a continuous electrical shield when said pin housing means is engaged with said socket housing means.

2. The electrical connector of claim 1 wherein each of said socket means is a tube, and said electrical contact making means is a bent portion in each tube for making multiple point contacts with an inserted pin.

3. The electrical connector of claim 1 or 2 further comprising alignment means (41, 42) on said pin housing means and said socket housing means for aligning said plurality of pins such that their free ends will enter the open ends of said socket means as said pin housing means is engaged with said socket housing means.

4. The electrical connector of claim 3 wherein said alignment means comprises an extension (39) extending from said pin housing means and sized to fit over and surround said socket housing means as said pin housing means is engaged with said socket housing means, and beveled surfaces on said extension and said socket housing means for providing sliding alignment between said extension and said socket housing means.

5. The electrical connector of anyone of the preceding claims further comprising a fastening means (52) between said socket housing means and said pin housing means for securing said socket housing means to said pin housing means.

6. The electrical connector of claim 5 wherein said fastening means comprises a first carrier means (14) connected to said pin housing means;

   a second carrier means (18) connected to said socket housing means; and

   a bolt (15) extending between said first carrier means and said second carrier means for joining said first and second carrier means together.

7. The electrical connector of claim 6 wherein said second carrier means comprises a stiffener for a printed circuit board on which socket housing means is mounted, said stiffener having a threaded bore for engagement with threads on the end of said bolt.

8. The electrical connector of anyone of the preceding claims wherein said first electrical shield is a first tube and said second electrical shield is a second tube, said first and second tubes having portions which are concentric and co-engaged when said pin housing means is engaged with said socket housing means.

9. The electrical connector of claim 8 further comprising bent spring means between said

first and second tubes for making electrical contact between said first and second tubes when said first and second tubes are co-engaged.

10. An electrical connector comprising:

a first tube (50) forming a first signal contact;

a second tube (48) concentrically surrounding and insulated from said first tube for forming an electrical shield around the first signal contact formed by said first tube;

a pin (28) insertable into said first tube for forming a second signal contact;

a third tube (32) concentrically surrounding at least a portion of and insulated from said pin and aligned for slidable engagement with said second tube when said pin is inserted into said first tube, said third tube for forming an electrical shield around the second signal contact formed by said pin;

first contact making means for making electrical contact between said first tube and said pin when the pin is inserted into said first tube; and

second contact making means for independently making electrical contact between said second tube and said third tube when the third tube is engaged with said second tube thereby forming an electrical shield completely around the first and

second signal contacts of said pin and first tube when they are electrically engaged.

11. The electrical connector of claim 10 wherein said first contact making means is a bent portion in said first tube for making multiple point contacts (A, B, C) with said pin when said pin is inserted into said first tube.

12. The electrical connector of claim 10 wherein said third tube is inserted into said second tube and said second contact making means is a plurality of bent spring means (52) between said second and third tubes for making electrical contact between said second and third tubes when said third tube is inserted into said second tube.

13. The electrical connector of claim 10 where said first and second tubes are part of a first housing (20) and said pin and third tube are part of a second housing (10) co-engageable with said first housing, said electrical connector further comprising pin alignment means on one of said first and second housings for aligning said pin and concentric first tube for insertion into said second and third tubes respectively, as said first and second housings are co-engaged.

FIG. 1

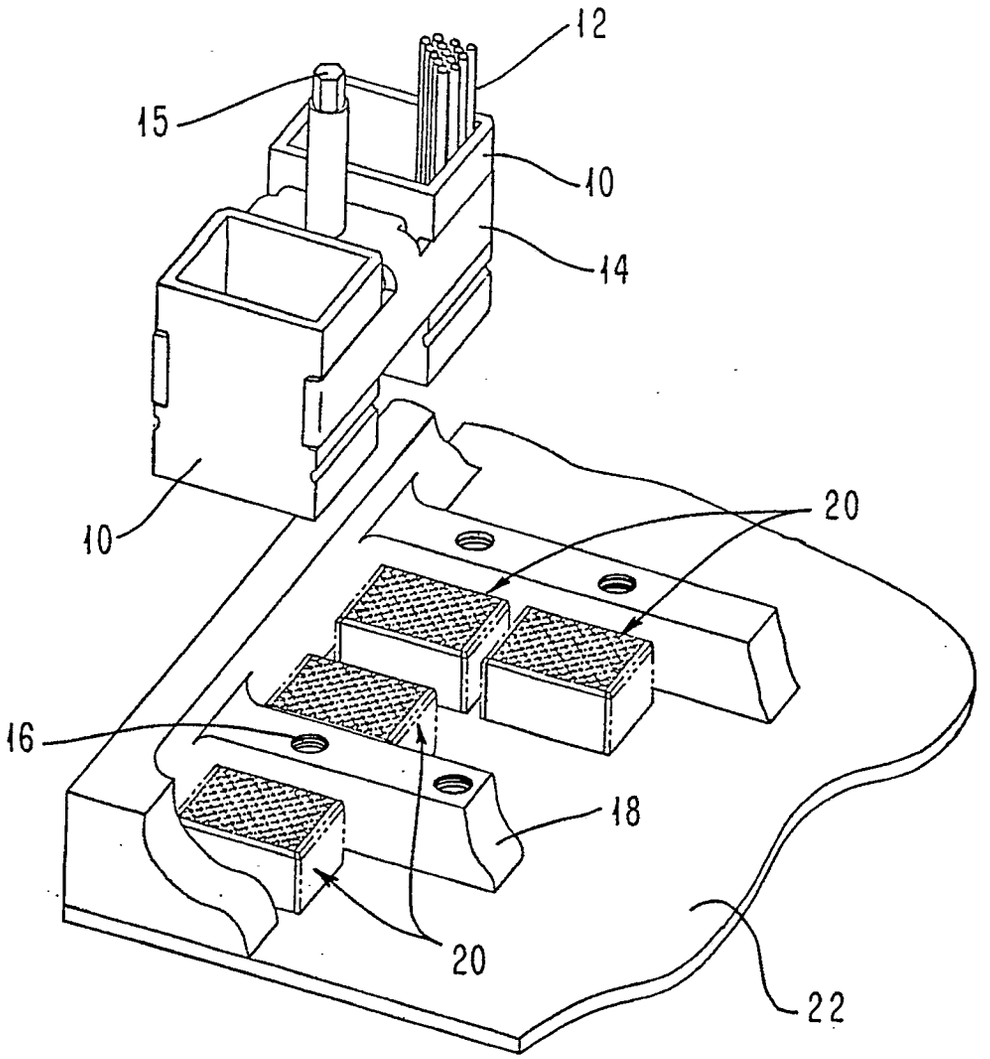


FIG.2

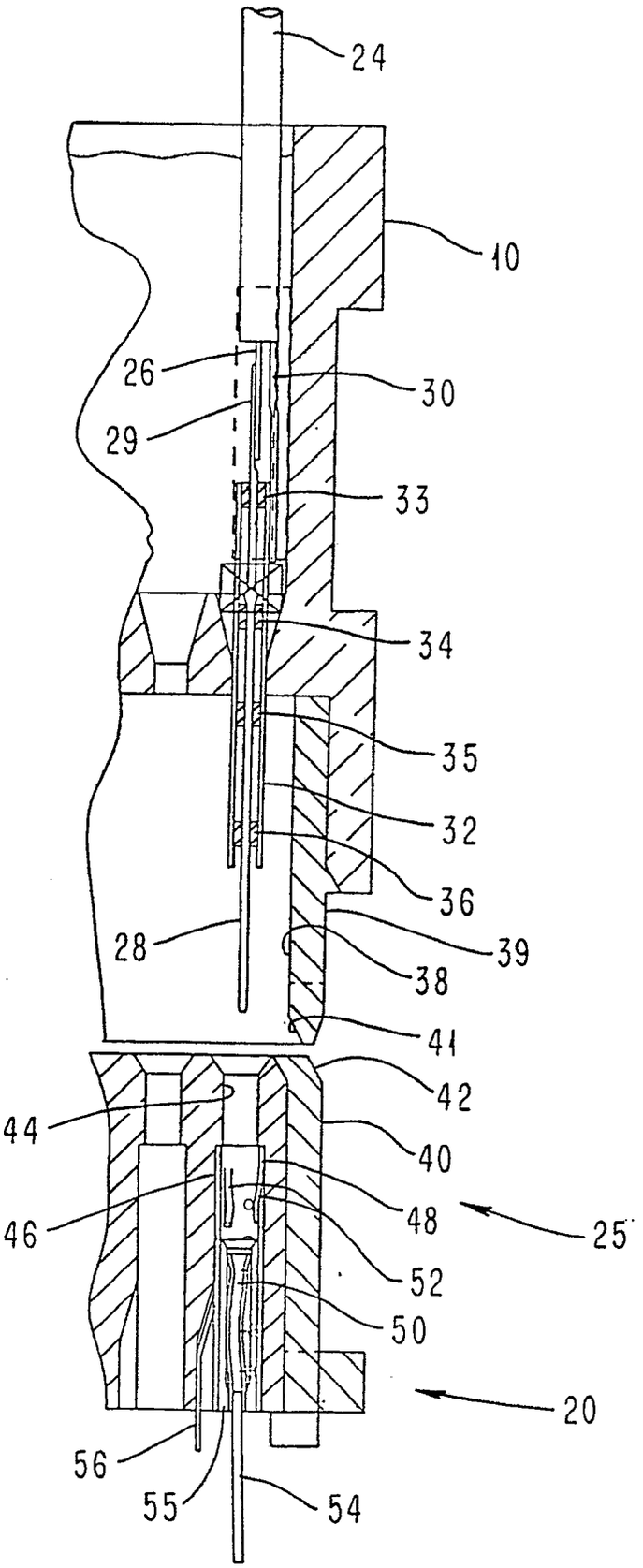

24
10
26
30
29
33
34
35
32
36
28
39
38
41
42
44
40
48
25
46
52
50
20
56
55
54

FIG. 3A

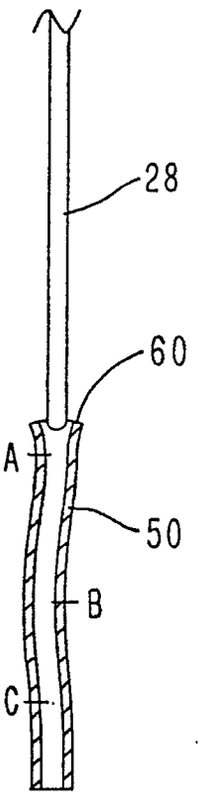


FIG. 3B

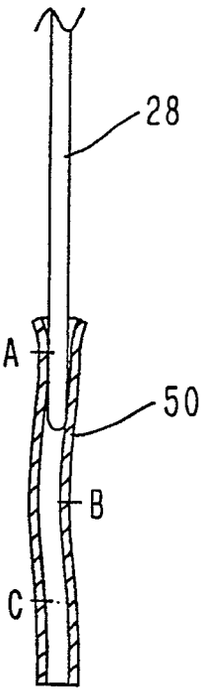


FIG. 3C