United States Patent

[11] **3,580,985**

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Oak Brook, Ill.
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[33] **Germany**
[31] **P. 17 65 078.1**

[54] **CABLE CONNECTOR AND MEANS TO MANUFACTURE SAME**
12 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **174/68.5,** 339/17
[51] **Int. Cl.** **H05k 1/08**
[50] **Field of Search** 174/68.5, 93, 88; 339/17, 176, 198; 29/625, 628, 629

[56] **References Cited**

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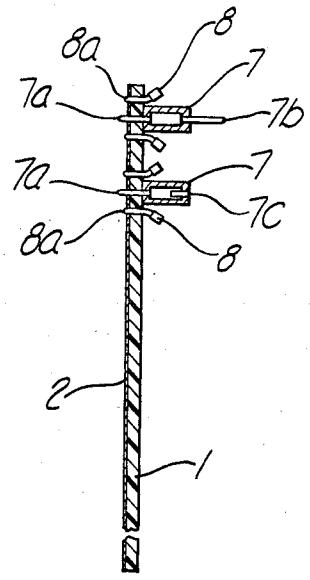
Primary Examiner—Darrell L. Clay
Attorney—Frederick M. Arbuckle

ABSTRACT: A novel cable connector and method of fabricating same is described wherein interconnecting conductor paths are defined on a printed circuit board, the board is perforated, a plug or socket connector is inserted in the perforations, and the bare ends of feed cables are inserted into perforations adjacent the solder pins of the plug or socket connector. The entire assembly is then batch soldered, thus economically and conveniently providing complete cable plug assemblies. A technique for rotatably mounting such completed cable plug assemblies is also described.



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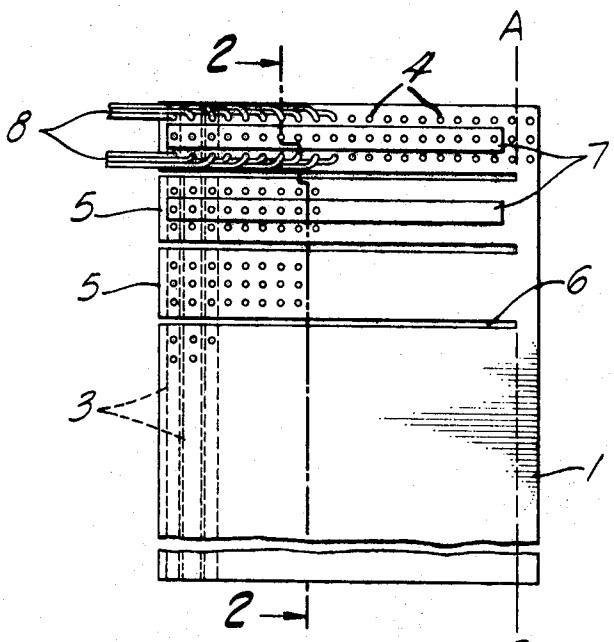

FIG. 1

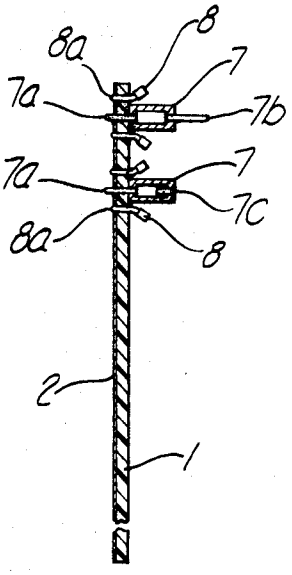

FIG. 2.

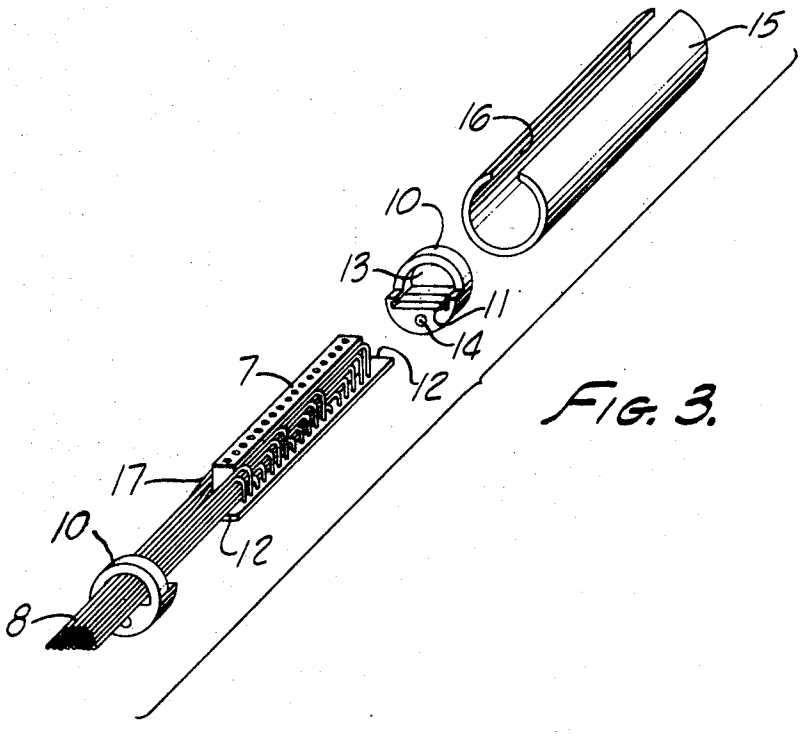

FIG. 3.

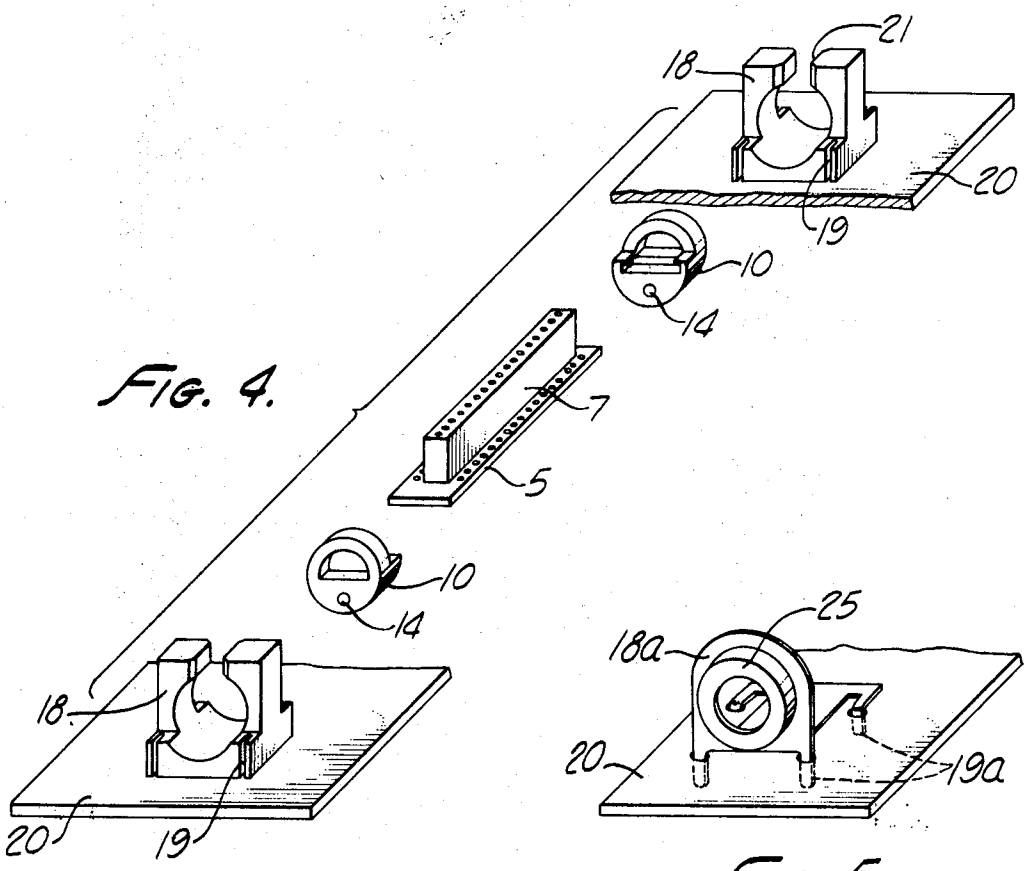

FIG. 4.

FIG. 5.

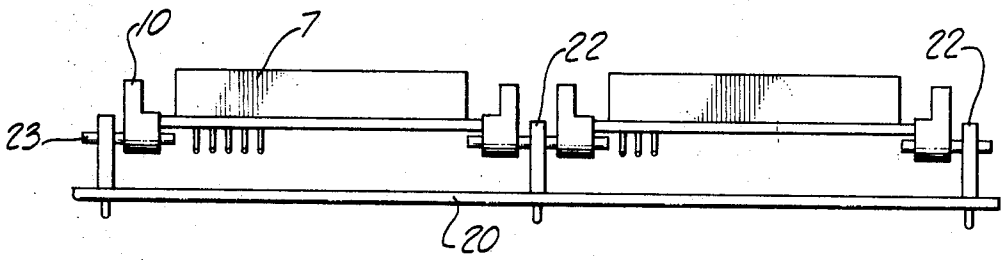

FIG. 6.

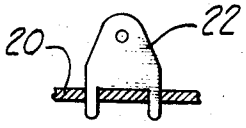

FIG. 7.

CABLE CONNECTOR AND MEANS TO MANUFACTURE SAME

BACKGROUND OF THE INVENTION

This invention relates to a method for the production of cable plug and socket connectors utilizing a plug or socket strip and a printed circuit board perforated in a grid pattern and provided with paths made of conducting material.

Many small dimension cable plug and socket connectors are known in which each wire must be individually connected with its corresponding plug or socket element by means of soldering, clamping or wrapping. This method is disadvantageous, since each connection must be made individually. Automation may be utilized only to a limited extent.

SUMMARY OF THE INVENTION

This invention overcomes this disadvantage in that it describes a method which is particularly adapted to the automatic production by machine of such a cable connection with a high packing density. The method allows high-volume production soldering techniques to be utilized, such as wave, dip, and splash-bath. However, all other known methods of soldering may also be utilized.

In accordance with the method of this invention, parallel conductor paths are defined on one side of a printed circuit board, such as by photoetching or other appropriate technique. The board is then perforated, such as by drilling or punching, in a gridlike matrix such that all the perforations are aligned with the parallel conductor paths. A plug or socket strip is then inserted into the board from the side opposite the parallel conductor paths and perpendicular to the direction of said parallel conductor paths.

Next, the bared ends of the feed cable wires are inserted in holes immediately adjacent to the plug or socket strip, with each of said feed cable wires protruding through the same conductive path as its corresponding contact pin of the plug or socket strip. The entire unit is then soldered by any of the conventional production soldering techniques, such as splash-bath, wave soldering, or dip soldering. Thus, the plug or socket strip and the feed wires which correspond to each of the contact pins of the plug or socket strip are electrically and mechanically attached to the printed circuit board in a single operation.

It is possible, by utilizing a printed circuit board of sufficiently large dimensions, to simultaneously fabricate a multiplicity of cable plug connectors in accordance with the above method by slotting the printed circuit board transversely to the longitudinal conductor paths. Separation of the individual plug connectors is achieved by cutting the board transversely to the slots at the terminus of the slots after all of the fabrication steps have been completed. It is necessary, of course, to effectuate the slotting operation at intervals of no fewer than two rows of perforations in order to allow one row of perforations to accommodate the plug or socket strip and a similar row of perforations to accommodate the bared ends of the feed cable.

The connector produced according to the method herein described can be rotatably or floatingly mounted by attaching appropriately relieved end pieces to both ends of the completely fabricated unit. A slotted sleeve is then inserted over the completed plug connector and its attached end pieces. The sleeve is preferably made of an insulating material. The entire unit is then rotatably or floatingly supported by means of two bearing blocks in which the end pieces engage.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a printed circuit board, showing the perforations, conducting paths, and slots;

FIG. 2 is a cross section taken along line 2–2 to better illustrate the structural configuration of the invention;

FIG. 3 is an assembly view showing a completed plug connector, fitted end pieces, and the slotted insulating sleeve which is superimposed thereover;

FIG. 4 is an assembly view showing the bearing mountings in which a rotatable plug connector may be mounted;

FIG. 5 is an assembly view of an alternate bearing mount;

FIG. 6 is a side view of yet another alternate method of rotatably mounting plug connectors made in accordance with the method described herein; and

FIG. 7 is an end view showing the apparatus of FIG. 6.

DETAILED DESCRIPTION OF THE INVENTION

FIGS. 1—3 illustrate the connector made in accordance with the method described herein.

Conducting paths 3 are defined on the bottom side 2 of the printed circuit board 1 by any conventional technique, such as photoetching or milling. Perforations 4 are provided in the board in a grid pattern such that a column of such perforations lies along each of the conducting paths 3. Slots 6 extend to the line A–B, thereby defining segments 5 containing at least two rows of perforations. For convenience of illustration, FIG. 1 shows the sections 5 as being comprised of three rows of perforations. The socket or plug strip 7 containing either pin elements 7*b* or pin receptacles 7*c*, depending upon whether it is desired to make a male or female connector, is inserted into one of the rows of holes by means of its solderable electrical contact pins 7*a*. Subsequently, the bared ends 8*a* of the feed cable 8 are inserted in the holes adjacent the contact pins 7*a* of the plug or socket strips 7. Thereafter, the entire board 1 is soldered on the side 2 according to any one of several known production soldering techniques, such as splash-bath, wave soldering, or dip soldering. Thus, the feed cable ends 8*a* are mechanically attached to the board 1 and electrically connected to their corresponding contact pins 7*a* of the connector strip 7 via the conducting paths 3. Subsequently, the printed circuit board is cut along the line A–B, thereby separating each of the individual board segments 5. It will be appreciated that the pin connectors 6 and the pin receptacle 7*c* can assume any shape or configuration, and have merely been shown in the form illustrated for purposes of convenience.

Referring specifically to FIG. 3, it is shown that end pieces 10 can be attached to the ends 12 of the connector made in accordance with the method described herein for purposes of mounting and protection of the completed connector strip and printed circuit board combination. The end pieces 10 are provided with grooves 11 adapted to receive the ends 12 of the printed circuit board segment 5 of the completed cable connector. Above groove 11 an opening 13 is provided and utilized as a cable outlet yielding a convenient clamp and strain relief means for the multiwire cable 8. Below groove 11 is a bore 14 provided for the purposes of fastening the end pieces 10 together or for providing rotatable positioning in cooperation with further mounting means. The end pieces 10 have a basic cylindrical form so as to permit a sleeve 15, having a slot 16 disposed longitudinally thereon, to be inserted over the completed plug connector and its attached end pieces 10. Slot 16 accommodates connector strip 7 and is disposed to enable access to connector strip 7 by a mating connector strip (not shown).

FIG. 4 shows the manner in which the completed connector, together with its end pieces 10 attached, can be rotatably or slidably mounted in a pair of bearing blocks 18 such that rotation or sliding is accomplished by the relative circumferential or axial movement of end pieces 10 within the confines of the cylindrical opening of bearing block 18. With the completed connector mounted in this manner, the rotatable or floating mounting, described earlier, is achieved.

The bearing blocks 18 may be constructed in a variety of ways, each affording its own distinctive advantages. The bearing block 18 of FIG. 4 is provided with a passageway 21 at its uppermost side to allow insertion of the connector strip 7 together with its associated board segment 5 and end pieces 10 into bearing blocks 18 after the bearing blocks 18 have been permanently mounted on a support 20. Thus, the completed connector with end pieces 10 attached can be easi-

ly removed and replaced, facilitating service and pin assignment changes. Bearing block **18**, as shown in FIG. **4**, is provided with mounting passages **19** at its base for the purposes of attaching the bearing block **18** to support **20** by means of rivets, screws, or other suitable fasteners.

An alternate bearing block configuration is shown in FIG. **5** wherein block **18***a* has a substantially cylindrical insulating tube member **25** and solderable mounting pins **19***a* which may be inserted into the holes of support **20** to provide adequate mechanical support for the bearing block **18***a*. The mounting pins **19***a* may be secured to support **20** be means of bending mounting pins **19***a* parallel to the surface of support **20** and, if desirable, to be soldered thereto.

A further alternative available for rotatably mounting the cable connector is seen in FIGS. **6** and **7**. These figures show a metal bearing fixture **22** having mounting feet **24** protruding through holes made in support **20** and affixed thereto by any suitable method such as soldering or crimping. A shaft means **23** connected to fixture **22** and extending perpendicular to the plane of bearing fixture **22** is adapted to accommodate the bore **14** of end piece **10** allowing end piece **10** to rotate about an axis defined by shaft means **23**. This type of rotatable positioning makes possible a considerable space savings by cascading a series of connectors in the manner shown in FIG. **6**.

The novel features described hereinabove and illustrated in the accompanying drawings are intended to be by way of illustration and example only and are not to be taken by way of limitation, recognizing that various modifications are possible within the scope of the invention claimed.

We claim:

1. An improved cable connector for terminating a multiwire cable comprising:

a printed circuit board having parallel conducting paths on one side and having a plurality of holes perforated in each of said paths; and

a connector strip having at least one row of contact pins extending from said strip and spaced longitudinally along said strip for purposes of affixing a permanent electrical connection, and having said contact pins being in electrical contact with corresponding electrical connections for purposes of engagement with a mating connector strip;

wherein said contact pins are inserted into said holes from the side of said board opposite said one side with said connector strip orientated transverse to said paths, and the bare ends of the wires of said multiwire cable being inserted into ones of said holes adjacent to corresponding ones of said contact pins; and

wherein said wires and said connector strip are mechanically and electrically connected to said conductive path.

2. The connector of claim **1** further comprising:

end pieces attached to each end of said connector strip and said printed circuit board.

3. The connector of claim **2** wherein each of said end pieces have a groove accepting an end of said board.

4. The connector of claim **3** wherein each of said end pieces have an opening therethrough situated above said groove to serve as a cable outlet, and a bore situated below said groove for acceptance of further mounting means.

5. The connector of claim **4** wherein said further mounting means is mounted in said bores and further comprises a pair of metal bearing fixtures having mounting feet at their bases and shaft means extending perpendicular from the plane of said fixture.

6. The connector of claim **3** including a sleeve positioned between said end pieces and to allow access to said connector strip by said mating connector strip.

7. The connector of claim **2** including a pair of fixed bearing blocks, said end pieces being rotatably mounted in said bearing blocks.

8. The connector of claim **7** wherein one of said bearing blocks has a passageway at least the width of said connector strip so that said connector may be inserted in said bearing blocks after the mounting of said blocks.

9. The connector of claim **7** wherein said bearing blocks have mounting passages for mounting said blocks to a support by means of any suitable fastener.

10. The connector of claim **2** wherein said blocks include mounting pins which may be inserted into a support having holes therein and bent parallel to the surface of said support.

11. The connector of claim **2** wherein said blocks are constructed of insulating material and contain a solderable mounting pins which may be inserted into a support having holes therein and soldered thereto.

12. The connector of claim **1** wherein said contact pins are bent parallel to the side of said board to aid in providing mechanical and electrical connections.