April 14, 1970 D. B. APPLETON ET AL 3,506,945

SIX-WAY PLUG CONNECTOR

Filed July 22, 1968

Fig. 1.

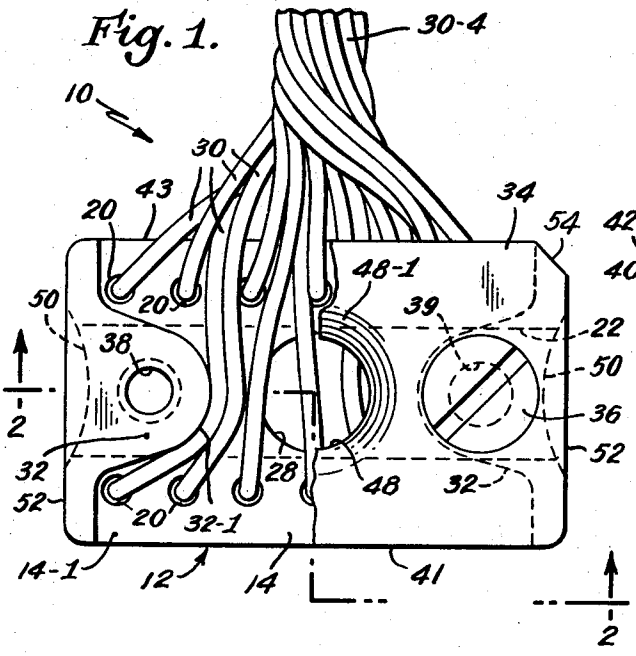


Fig. 4.

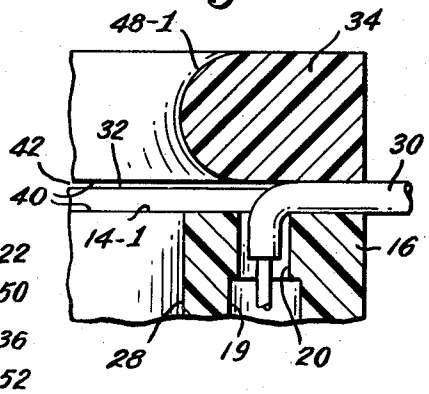


Fig. 2.

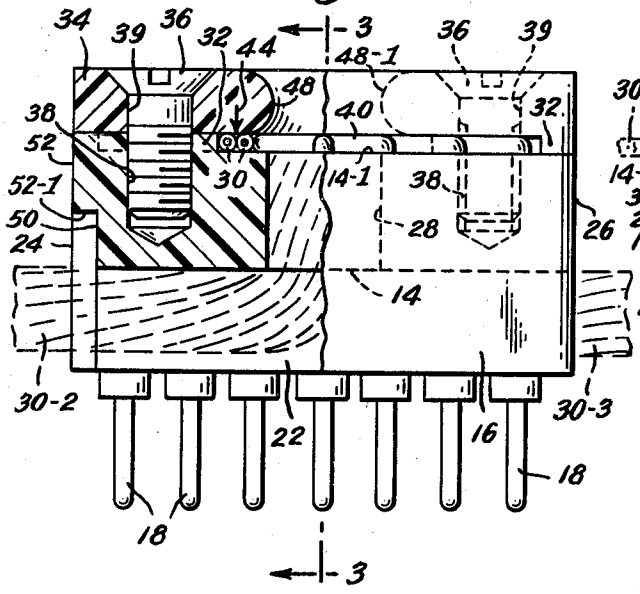
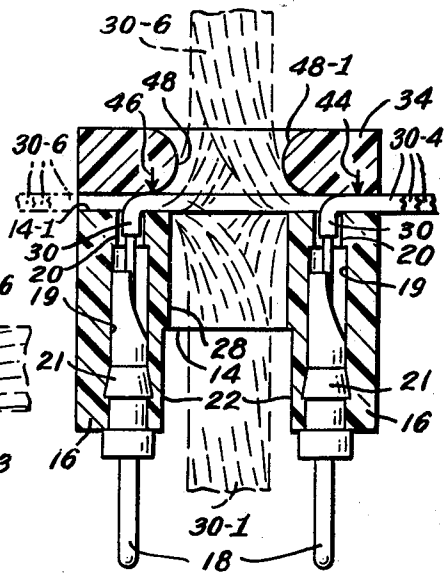


Fig. 3.



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SIX-WAY PLUG CONNECTOR

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U.S. Cl. 339—107 6 Claims

ABSTRACT OF THE DISCLOSURE

A plug connector for electrical applications is provided, which has a capability of bringing the electrical cable out in six different directions. The plug body has a generally table-like configuration. The wires emerge from the top of the table and can be brought vertically upward through an opening in the plug cover, or can go horizontally in either direction out the side of the plug connector through a gap between the cover and the top surface of the plug body. The wire can also go downward through an opening in the plug body and then horizontally through a longitudinal channel formed between two depending legs of the plug body, and emerge in either direction. The cover of the plug connector is raised up on a pair of bosses which are so dimensioned in relation to the diameter of the wires, that a clamping relationship is achieved so as to relieve flexure strain on the wire terminations.

FIELD OF THE INVENTION

This invention relates generally to electrical connectors, and in particular to a miniature plug which is used to terminate an electrical cable and can be plugged into an appropriate receptacle.

THE PRIOR ART

The state of the prior art can be briefly summarized by saying simply that many different plug-in connector constructions are used for various specific electrical applications. These connections are usually designed to bring the wire out from the body of the plug in one direction only, or at most a choice of only a few wire exit directions is provided by the construction of the plug. Another consideration in the design of electrical connectors is the provision of some form of strain relief so that flexure of the wire at the point where it emerges from the plug body does not have an undue tendency to break the wire and thereby cause an open circuit. Still another problem in the design of electrical connectors is the provision of some means on the exterior surfaces of the connector which enables the connector to be gripped so that a pulling force can be applied to it to extract the connector from its receptacle.

SUMMARY OF THE INVENTION

A principal object of this invention is to provide a novel plug connector construction which provides a choice of six different exit directions for the wire emerging from the connector. Additional objects are the provision of a clamping arrangement which prevent strains on the wires from being transmitted to the connections between the wires and the pins, and the provision of a suitable gripping surface so that the connector can easily be pulled out of engagement with its receptacle.

In pursuit of these and other objects, there is provided a plug connector comprising a body of insulating material having a generally table-like configuration. Conductive plug-in prongs depend from the legs of the "table." The wires connected to these prongs emerge from a series of holes extending upwardly through the table. The legs

are spaced apart to define a wire-receiving channel therebetween, which runs horizontally through the plug body below the top of the table. This channel opens through one or both end faces of the plug body. A wire-receiving opening extends vertically down through the top of the table and communicates with the channel, so that the emerging wires may overlie the top surface of the table and pass downwardly through the opening and then horizontally through the channel to emerge from one of the end faces.

A cover is spaced above the top of the table so as to leave a gap between the cover and the table top within which the wires may be disposed. The wires can emerge from this gap at either side face of the connector. The cover also has a hole vertically through it to enable the wires to be brought straight up. The bosses which support the cover are sized so that the cover exerts a clamping relationship upon the wires within the gap, so as to afford strain relief. The bosses are also curved so that the wires can bend smoothly around them within the gap.

Finally, a pair of reliefs are cut into the vertical end faces of the connector to provide overhanging ledges beneath which means can be inserted to grip the plug connector for upward extraction from the receptacle into which the prongs have been inserted.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view, with parts broken away for clarity of illustration, of a plug connector and wire assembly in accordance with this invention.

FIG. 2 is a sectional view of the same assembly taken along the lines 2—2 of FIG. 1.

FIG. 3 is still another sectional view of the same assembly taken along the lines 3—3 of FIG. 2.

FIG. 4 is an enlarged detail view of the upper right hand corner of FIG. 3. FIG. 4 shows the condition which exists prior to tightening the screws to squeeze the wires between the strain relief and the plug body, and may be contrasted with FIG. 3 which shows the structure after final assembly.

DESCRIPTION OF THE INVENTION

The plug connector **10** of this invention includes a plug body **12** which is molded of a suitable insulating material and has the general configuration of a table. There is a table top member **14** which is seen in section in FIGS. 2–4, and in plan in the view of FIG. 1 so that we are looking directly down upon the top surface **14–1** thereof. As best seen in FIG. 3, a pair of legs **16** depend vertically from the opposite sides of the top member **14**, and each of the legs **16** is also of generally planar configuration, as will be appreciated by referring to the view of FIG. 2.

Depending from the bottom surface of each of the legs **16** is a plurality of plug-in prongs **18** adapted to be inserted into an appropriate receptacle for achieving electrical connection thereto. In the particular construction shown for the purposes of illustration in these drawings, there are a total of fourteen of the plug-in prongs **18**, these being arranged in two rows of seven prongs, each row depending from one of the legs **16**. This particular configuration of plug-in prongs is particularly adapted for insertion into a fourteen-hole dual in-line integrated circuit receptacle, for connection to a circuit board having a plurality of integrated circuit modules mounted thereon. Therefore the present invention, particularly in the form illustrated here, is especially adapted for use in making electrical connections to an electronic system employing dual in-line integrated circuits.

The prongs **18** are mounted within prong-receiving holes **19**, which are formed in the depending legs **16** and open vertically downward through the bottom surface of these legs. The prongs **18** are secured within the

holes 19 either by means of a force fit or by having been molded in place. A ridge 21 formed on each of the prongs 18 within its respective hole 19 engages with the interior wall of the hole so as to prevent extraction of the prong.

Each of the prongs 18 is soldered, crimped or otherwise reliably electrically connected to the exposed end of an electrical wire 30 which enters the respective prong-receiving hole 19 through a respective wire-receiving hole 20 extending upwardly from the hole 19 and opening through the top surface 14–1.

One of the principal advantages of this invention is the fact that the wires 30 can be brought out of the plug connector 10 in any one of six directions. One of the various openings which permits this is a wire-receiving channel 22, i.e. the space between the two depending legs 16. This channel 22 runs the length of the plug connector 10, and intersects both vertical end faces 24 and 26 of the device, as seen in FIGS. 2 and 3. The upper boundary of the channel 22 is formed by the lower surface of table top member 14.

There is also a wire-receiving opening 28 which extends vertically through the center of the table top member 14 and communicates with the longitudinal channel 22. This permits the wires 30 emerging upwardly from the wire receiving holes 20 to lie horizontally over the table top surface 14–1 and then turn downwardly through the wire-receiving opening 28 so as to exit vertically downwardly from the plug connector 10.

The next two alternative wire exit directions are illustrated in FIG. 2 where it is seen that the same cable comprising all the wires 30 twisted together and extending downwardly through the opening 28 can be turned horizontally to the left or right within the longitudinal wire-receiving channel 22 so as to emerge horizontally from the vertical end face 24 as cable 30–2 or the vertical end face 26 of the plug connector 10 as cable 30–3.

The top surface 14–1 is formed with a pair of bosses 32, one at each end of the top surface 14–1, which project upwardly a predetermined distance from the top surface. The plug connector 10 also includes a cover member 34 which overlies the top surface 14–1, and rests upon the bosses 32 at either end so as to be spaced by the bosses above the level of the table top surface 14–1. Tapped holes 38 extend downwardly through the bosses 32 and into the plug body 12 for cooperation with screw fasteners 36. The latter pass through countersunk clearance holes 39 which are formed in the cover 34 and aligned with the tapped holes 38.

The spacing of the cover 34 above the level of the table top surface 14–1 by the bosses 32 leaves a flat-shaped wire-receiving gap 40 bounded by the cover 34 above, the surface 14–1 below, and the bosses 32 at either end. The gap 40 opens outwardly through both side faces 41 and 43 of the plug connector 10. As seen in FIG. 1, the wires 30 can be brought out separately through the flat gap 40 to emerge from the side face 43 of the plug connector 10, and then twisted into a cable 30–4. Although it is not specifically illustrated, it will be readily appreciated that a similar exit path is available through the other side of the gap 40 so that the wires 30 can emerge from the side face 41 of the connector 10. The flat shape of the gap 40 would also permit such exit paths for flat "ribbon" type cables, as well as the twisted cable actually illustrated. These two exit directions are the fourth and fifth alternatives available as a result of the novel design of this connector plug.

When the wires 30 are arranged as shown in FIG. 1, it will be appreciated that some of the wires must be bent around the boss 32. In particular, and as aforementioned, the holes 20 from which the wires emerge through the top surface 14–1 are arranged in two rows of seven holes each. The bosses 32 project to some extent between the two rows of holes as best seen at the left in FIG. 1. Accordingly, the wire 30 emerging from the left-most hole 20 in the lower row must be bent around the adjacent boss 32. Therefore the bosses 32 are appropriately curved as indicated at 32–1 to provide a gentle curvature for the wires 30 and thus avoid sharp bends which would otherwise have a tendency to strain and perhaps break the wires and thus cause electrical failure due to an open circuit condition. The bosses 32 are, of course, symmetrical with respect to the longitudinal center line of the top surface 14–1, so that if it were desired to bring the wire 30 from the upper left hole 20 in FIG. 1 out through the side face 41, it would be also able to bend smoothly around the adjacent boss 32.

From a point just above their connection to the plug-in prongs 18, the wires 30 are provided with conventional insulation which is made of a somewhat compressible material such as Teflon. The portion of each wire 30 which passes through the gap 40 between the cover 34 and the table top surface 14–1 is provided with an annular jacket of such compressible insulating material, and the outside diameter of the wire with its insulating jacket is somewhat larger than the height of the boss 32 above the table top surface 14–1. Thus, if the cover 34 were assembled over the wires 30 and the table top surface 14–1, and the fastening screws 36 were not yet tightened, the situation shown in the enlarged detailed drawing of FIG. 4 would occur. In particular, a small clearance space 42 would exist between the cover 34 and the top of the bosses 32. The size of this clearance space 42 would be equal to the difference between the outside diameter of the wire 30 with its insulating jacket and the height of the boss 32.

Subsequently, when the plug connector 10 is fully assembled, the fastening screws 36 are screwed down tightly into the tapped holes 38 so that the cover 34 then is clamped tightly against the wires 30. Moreover, this is true regardless of which exit direction the wires 30 may take. For example, in FIG. 3 it is seen that when the wires 30 take the exit direction indicated at 30–4, they are clamped between the cover 34 and the top surface 14–1 at the location indicated by arrows 44. On the other hand, if the wires 30 turn toward the central region of the plug connector 10, they are similarly clamped at the location illustrated by the arrows 46.

It will be therefore appreciated that whenever the portion of the wires 30 external to the plug connector 10 is subjected to any pulling force, the force so exerted is absorbed at the point where the wires are clamped. The force is not transmitted beyond that point further down the length of the wire. Accordingly, the wire is not pulled tightly against the edges of the exit holes 20 at the point where these holes intersect the top surface 14–1. This avoids pulling the wire into a sharp bend over the edges of these holes, which in turn avoids unnecessary strain upon the wires which might otherwise cause a breakage leading to an open circuit and consequent electrical failure. At the same time, and of even greater importance, the aforesaid strain relief prevents undesirable pull and strain between the wires and their respective terminal pins.

The clamping position indicated by the arrows 46 is equally applicable to any cable exit direction which involves bringing the wires 30 vertically downward through the opening 28, including the downward exit direction 30–1 and the horizontal exit directions 30–2 and 30–3 through the opposite ends of the longitudinal channel 22.

This clamping position is also applicable to a sixth exit direction for the wires 30, namely vertically upward through an opening 48 in the central portion of the cover 34. This exit direction is illustrated in FIG. 3 by the twisted cable designated 30–6. In order to further avoid bending stresses upon the wire 30 as they turn upwardly through the opening 48, this opening is provided with a curved or chamfered configuration at the upper and lower edges of the hole, as seen at locations 48–1. Thus, the policy of protecting the wires 30 from

strain and sharp bends is followed consistently throughout the design of the plug connector **10**.

An additional way in which the wires **30** can be protected from unnecessary strain is to remove the temptation for pulling on the wires **30** as a means of dislodging the plug connector **10** from its receptacle. Accordingly, reliefs **50** are cut into the end faces **24** and **26** of the top member **14**, as seen in FIGS. 1 and 2. These reliefs leave overhanging ledges **52** at both ends of the plug connector. This enables some appropriate means, either an extraction tool or a person's fingers, to be inserted into the reliefs **50** underneath the overhanging ledges **50** so that upward pressure can then be exerted against the underside **52–1** of each ledge in order to pulls the plug connector **10** upwardly out of its receptacle.

The bevel **54**, shown in FIG. 1, is a polarizing bevel to allow visual polarization when inserting the plug **10** into a panel.

It will now be appreciated that the present invention provides a novel and versatile miniature plug construction ideally suited for integrated circuit board applications, which permits the electrical wires to emerge therefrom in any of six different directions according to the user's choice and environmental requirements, and which provides strain relief and other protection for the electrical wires in a variety of ways so as to promote circuit reliability. In addition, the plug connector inherently provides its own means of convenient extraction from its receptacle on the integrated circuit board.

What is claimed is:

1. A plug connector comprising a body of insulating material having a generally table-like configuration including a generally planar top member, and a pair of generally planar legs depending from opposite sides of said top member; and a plurality of conductive plug-in prongs depending from said legs; said top member being formed with a plurality of individual wire-receiving holes extending upwardly from respective prongs through the top surface of said top member; said depending legs being spaced apart to define a wire-receiving channel therebetween running horizontally through said plug body below said top member and opening through at least one vertical face of said plug body; and a wire-receiving opening extending vertically through said top member to said channel whereby wires emerging upwardly from said holes may overlie said top surface and pass downwardly through said opening and then horizontally through said channel to emerge from said vertical face.

2. The plug connector of claim **1** further comprising a pair of spaced bosses projecting upwardly from said top surface; and a cover secured in place over said bosses and spaced above said top surface by said bosses whereby to define a wire-receiving gap bounded by said cover, said top surface, and said bosses, said gap intersecting said opening and at least one vertical face of said plug connector whereby wires emerging upwardly from said holes may be disposed within said gap to overlie said top surface and pass horizontally through said gap either to said opening or to emerge horizontally from said gap.

3. The plug connector of claim **2** wherein said holes are arranged in a pair of rows; and said bosses project horizontally to some extent between said rows of holes, and are smoothly curved so that a wire emerging upwardly from the last hole in one of said rows on one side of said plug connector can curve smoothly around an adjacent boss in passing horizontally across to the opposite side of said plug connector there to emerge from said gap.

4. The plug connector of claim **3**, wherein said cover has a wire-receiving opening extending vertically therethrough and communicating with said gap therebelow whereby to provide upward egress for said wires from said gap.

5. The plug connector of claim **1**, further comprising a pair of reliefs cut into vertical surfaces of said plug body on opposite sides thereof below said top surface to define a pair of opposed overhanging horizontal ledges beneath which means can be inserted to grip said plug connector for upwardly extracting it when said depending prongs have been inserted downwardly into a receptacle.

6. The plug connector of claim **3** assembled in combination with a plurality of said wires disposed within said gap and overlying said top surface; the height of said bosses above said top surface being less than the outside diameter of said wires when said wires are unstressed; and means securing said cover tightly against said bosses whereby to compress said wires, thereby gripping them to provide flexure strain relief.

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RICHARD E. MOORE, Primary Examiner

U.S. Cl. X.R.

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