June 18, 1968 W. D. MAYNARD 3,389,371

ELECTRICAL CONNECTORS

Filed Aug. 27, 1965

FIG. 1

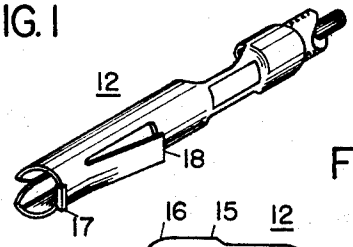


FIG. 2

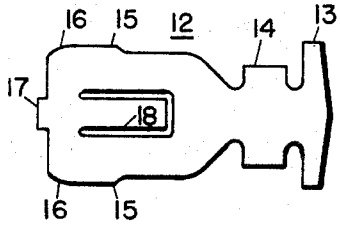


FIG. 3

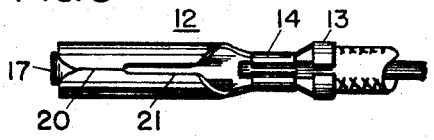


FIG. 4

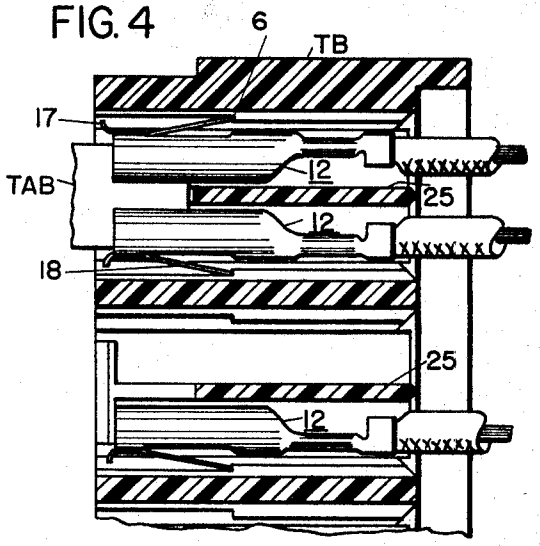


FIG. 5

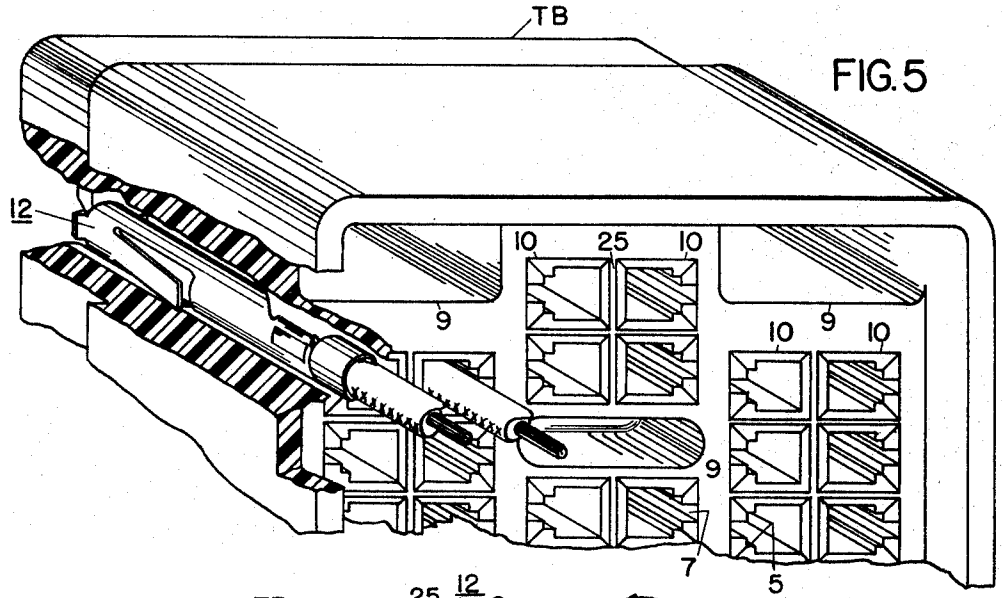


FIG. 6

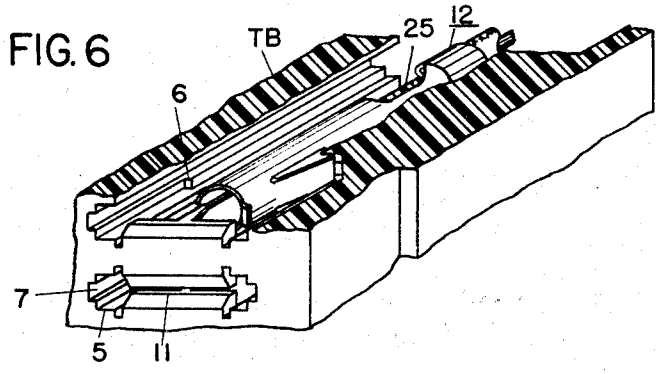
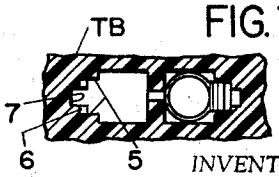


FIG. 7



INVENTOR.
W. D. MAYNARD
BY Forest H. Kirkbride
HIS ATTORNEY

United States Patent Office 3,389,371 Patented June 18, 1968

3,389,371

ELECTRICAL CONNECTORS

Wheeler D. Maynard, Mendon, N.Y., assignor to General Signal Corporation, Rochester, N.Y., a corporation of New York

Filed Aug. 27, 1965, Ser. No. 483,048
6 Claims. (Cl. 339—192)

ABSTRACT OF THE DISCLOSURE

The connector is made from a piece of flat material pressed into circular shape to have two thin fingers extending toward each other to tightly grasp the inserted blade or contacting tab. On the back of the connector is a stiff extending lip for preventing rotation of the connector in its socket. This lip is on the forward edge of the circular portion. A backwardly protruding locking spring has its distal end pointing towards the wire connection. Such distal end of the locking spring also prevents rotation of the connector in its socket or cavity. The entire connector with a wire attached is then inserted into a socket or cavity which is grooved for receiving the lip and locking spring. The front or face of the socket has a slit through which a blade or tab can be inserted and grasped by the fingers of the connector.

This invention relates to electrical connectors, and more particularly to a unique conformation of a dielectric terminal board adapted to receive a plurality of wire connectors on its one side and adapted to receive the tabs of a plug board on the other side.

In the making of a terminal board of the general type herein contemplated, it is highly desirable to maintain a high degree of contact between the current carrying interfaces of the wire connectors and the current carrying interfaces of the plug (or tab) connectors.

On the one hand, it is an object of the present invention to provide such intimate face-to-face contact with a fairly low total assembly force although the individual contact pressures are relatively high per unit area of contact.

It is also an object of the present invention to provide such a plug type electrical interconnection wherein the wire terminals fit in a relatively small space in such a manner that a pair of such wire terminals may be related to each plug or tab connector.

It is also an object of the present invention to provide a wire terminal which will fit in its respective cavity of the terminal board in only one position and when placed in such position automatically locks therein. On the other hand, the present invention provides that such wire terminal may be released by the insertion of a tool from either side of the terminal board so that it can be withdrawn independently of its associated wire terminals. Also, each wire terminal can be removed or replaced in the terminal board without disturbing its tab and plug board.

Another object of the invention is to provide the wire terminals or connectors in such a form as to have each connector grasp its associated tab or blade with bifurcated fingers, which connector is so formed of low rate spring material as to have a high degree of residual grasping force although often used to receive its associated tab.

Another object of the invention is to have each wire terminal located in its respective cavity in such a way that the tab or blade receiving end always assumes and holds a tab receiving position directly adjacent the tab receiving orifices in the plug side of the terminal board.

It is also another object of the present invention to form the wire terminals from flat metal stock in a way

that they can be fed to automatic machinery for attaching them to their respective wires.

A further object of the invention is to so form the terminal board that it has cavities arranged in pairs for receiving the wire terminals with such a design of the cavities as to appropriately receive the terminals and yet provide adequate freedom for minor movements to readily receive their respective tabs. Such cavities are also designed for facilitating in the molding of such terminal boards of suitable material so that the hardening and drying process of such material does not result in the warping or shrinkage of the terminal board. In other words, the terminal boards are reproducible in quantities to readily match with corresponding plug boards; and wherein the wire terminals cooperate to provide an unusually high degree of uniformity as to the insertion and withdrawal forces both before and after extended use.

Other objects and purposes of the present invention will become apparent to those skilled in the art as the reading of the following detailed description in conjunction with the drawings progresses; and it is to be understood that the embodiments shown herein are not intended to be limiting but are illustrative only.

In describing the invention in detail, reference will be made to the accompanying drawings, in which like reference characters designate corresponding parts throughout the several views, and in which:

FIG. 1 is an isometric view of the wire terminal as formed and connected to a wire ready for insertion into any cavity in a terminal board adapted to receive it;

FIG. 2 is a detailed top view of a single wire terminal stamped from sheet metal in preparation for forming it into a tab receiving portion as shown in FIG. 1;

FIG. 3 shows a top view of the wire terminal of FIG. 1;

FIG. 4 is a top sectional view of the terminal board to show how the wire terminals fit into their respective cavities for receiving their respective plugs or tabs;

FIG. 5 is an isometric view of the terminal board with portions removed to show how a wire terminal fits into its cavity, and how the terminal board has these cavities arranged in pairs for receiving the wire terminals;

FIG. 6 is a front isometric view of a wire terminal in position in the terminal board; and

FIG. 7 is a detailed cross-sectional front view of the terminal board of FIG. 6 showing the position of a wire terminal relative to the inner portion of its cavity.

The terminal board TB is shown in FIGS. 4, 5, 6 and 7. It is formed by a molding process using "Lexan" i.e. a 40% glass filled polycarbonate liquid injected into molds under high pressures and subjected to high temperatures. In addition to the wire terminal receiving cavities **10**, suitable inner openings, such as at **9**, are included so as to avoid any large masses of material in the formed block. This is to prevent undue warping and shrinkage when the material cools.

The terminal receiving cavities **10** are arranged in pairs, for receiving the wire terminals **12** shown in FIGS. 1 and 3. These cavities **10**, such as at the top central portion of FIG. 5 are so located that their inner grooves and slots are on opposite sides of the cavities in line with the outer ends of a horizontal slot such as **11** shown in FIG. 6. A horizontal slot **11** is provided for each pair of the cavities **10**, and is adapted to receive the flat plugs or tabs of a plug board.

The cavities **10** have suitable grooves and slots, as above mentioned, which run through the cavity as shown in FIG. 7. for example. More specifically, the groove **5** runs entirely through its cavity **10** and from the rear of the terminal board TB to the front of the terminal board TB as seen in FIG. 6 at 5. The bottom of this groove **5** has a step **6** as can be seen in FIG. 6 so that the forward end of the groove **5** is deeper than the rear

end of this groove. This step **6** occurs at an appropriate position as seen in FIG. 4 for receiving the distal end of a locking spring on the wire terminal as will be described later.

Running beneath the above described groove is a relatively narrow slot **7**. Its width is less than the width of the slot **5** because it is desired to have the steps **6** distinct and substantial and yet this slot **7** is sufficiently large to receive a releasing tool. Since the slot **7** runs from one side of the terminal board TB to the other, a releasing tool can be inserted into either side of the terminal board and such tool being of a wedge character at its end can act to push the distal end of the locking spring out of the steps **6** and thus release any one of the wire terminals located in the terminal board.

The wire terminals **12** are press cut from flat stock such as bronze, half hard brass, nickel silver, steel or other suitable materials preferably with a connecting link between successive terminals **12** so that in effect there is a continuous strip that can be run through a crimping machine for disconnecting the terminal portions **12** respectively and attaching thereto the wire ends inserted into the machine. This connecting link of material may be either serial connections, or it may be a single strip along which the respective terminal **12** portions extend individually so that the connecting strip is continuous and the terminals are in effect mounted horizontally and individually to the strip. In any event, and regardless of the particular manner of interconnecting the terminals for use in crimping machines, the flat terminal cutout is shown in FIG. 2. The wire terminal includes a wire attaching portion and a tab receiving receptacle portion. The wire receiving portion includes the extending parts **13** and **14**; whereas, the receptacle portion includes the grasping fingers **15**, the receiving portions **16**, the hanging lip or locating portion **17**, and the locking spring **18**.

These flat wire terminal blanks (or cut outs), whether attached to a feeding strip or used individually, are formed into wire terminals having generally circular characteristics as shown in FIG. 1. The wire receiving portions **13** and **14** are left open but the tab receiving receptacle portion is made circular with respect to the main body of the flat blank from which the locking spring **18** remains flat at its distal end extending away from the periphery of the receptacle portion a distance slightly greater than the extending short hanging lip portion **17**. The hanging lip **17** remains flat and square in its outward hanging portion as shown in FIGS. 1 and 2; but its attached end of course curved to conform with the circular portion of the receptacle as seen in FIG. 7.

Referring to FIG. 3, it will be seen that the leads **16** in effect form a gradual entrance for a plug or tab such as shown in FIG. 4 so that the point of contact between these fingers **15** at **20** (see FIG. 3) can be broken as they receive the tab. The receiving portion **16** provides a lead which is slightly greater than the width of the horizontal slot in the front of the terminal board TB as can be seen in FIG. 7, and such lead performs a cam action sufficiently gradual so that the insertion of a multiplicity of tabs may be effected with a minimum of force. On the other hand, the contacting finger portions **15** having a limited surface because of their edge contacts allow their respective tabs or contact blades to rubbingly slide into position to make good contact and the entire spring pressure produced on these fingers by the expansion is applied at relatively small contacting areas.

When the wires for the respective wire terminals are crimped in the wire receiving portions, as shown in FIGS. 1 and 3, which is a usual form of crimping, a semi-circular portion extends from the wire receiving portion which gradually slopes into the circular form of the receptacle portion. The receptacle portion completes the circle at the fingers **16**, but in approach to the fingers the semi-circular portion of the part rising from the wire terminal portion enters into an open slot **21** as seen in FIG. 3. This means that the opening of the fingers **15** in effect is with respect to two different forces, i.e. the spring portion of the entire circular portion of the receptacle ending in the cam portion **16** as seen in FIG. 2; but with the additional spring force supplied from the twisting action applied to the longitudinal sides of the receptacle portion being formed and terminated in the wire receiving portion. The combination of these spring forces means that the fingers **15** can be separated a large number of times or left in a separated position for long periods of time without the pressure changing on the tabs inserted between such fingers. This is because the movement with regard to the thickness of the tabs is relatively small and is many times below the amount of movement required to cause movement of the fingers beyond their electric limit, so to speak. Thus, the fingers retain their grasping strength indefinitely and this grasping strength is applied to the inserted tabs or blades over a relatively small contacting area to maintain a good dual or bifurcated contact for extended periods of time. However, the cam effect of the receiving portions **16** is relatively gradual so that the tabs or plugs can be inserted relatively easy, particularly if the tabs have a sloping cam surface at their extremities.

When the respective wires have been crimped to their respective wire terminals, these wire terminals may be inserted into the terminal board at their respective positions determined by any suitable wiring diagram. It will be noted that any particular one of these wire terminals can be inserted into its respective cavity from the rear of the terminal board as viewed in FIG. 5 with or without their tabs in place. These cavities **10** are beveled at their outer edges so as to assist the wire terminal in being located; but it will be observed that a wire terminal can enter its cavity only if the positioning lip **17** is in line to be received by the groove **5**.

Looking at FIGS. 6 and 7, it will be noted that this lip portion **17** remains in the groove and holds the front end of the wire terminal in an appropriate position so that the receiving portions **16** are directly opposite the slot **11** as can be best seen in FIG. 7. When the wire terminal **12** is inserted all the way, it will abut the projections formed adjacent the slot **11** and the distal end of the locking spring **18** will drop into the steps **6**. This holds the wire terminal in its longitudinal position. These springs **18** thus located in the deeper portion of the slot **5** also prevent the turning of the wire terminal in its cavity. In this way the fingers **16** are maintained in line with the tab receiving slot **11** (see FIG. 6).

In FIG. 4 the locking spring **18** and the distal end of the locking spring **18** are shown in position. The tab is inserted and enters between the fingers of its respective wire terminals **12**. It is noted that the slot **11** (see FIG. 6) continues towards the back of the terminal board to a point to supply clearance for the tab, but the separator **25** continues toward the back of the terminal board TB to form a complete separation between the two wire terminals of the pair associated with that tab. This separating portion **25** can be seen in FIGS. 4, 5, 6 and 7.

Although the prior art shows locking springs for holding wire terminals longitudinally in position, there is no prior art known where the locking spring holds the wire terminal in particular position and prevents it from rotating for receiving a tab between grasping fingers thereof and allowing such tab to slightly expand the wire terminal so that the entire wire terminal provides the tensioning force for the fingers. Additionally, the lip projection acts as a key to guide and positively hold the extreme front end of the wire terminal in position for receiving a tab.

In this connection, the lip projection **17** is shown as an extension in FIG. 2 which is turned outwardly as shown in FIGS. 1 and 3, 5 and 6. However, it could well be a cut portion wholly falling within the border of the wire terminal blank of FIG. 2, so that such cut portion could be bent outwardly and fit into the slot **5** in the same fash-

ion. This form of a lip portion might well require that the left ends of the slots for the lock spring 18 would have to be terminated (seen in FIG. 2) a little sooner, so as to provide a sufficient material for the solid portion of the receptacle end of the terminal. This is mentioned so as to bring out that the hanging lip 17 does not necessarily have to be an extension as shown in FIG. 2, but may be within the periphery or boundary of the wire terminal blank of FIG. 2.

Having thus shown one particular form of a terminal board and its specific parts as one embodiment of the present invention, it is desired to be understood that this form is selected to facilitate in the disclosure of the invention rather than to limit the number of forms which it may assume; and, it is to be understood that various modifications, adaptations, and alterations may be applied to the specific form shown to meet the requirements of practice, without in any manner departing from the spirit or scope of the present invention.

What I claim is:

1. An electrical wire terminal including a tab receiving receptacle portion and a wire attaching portion, said receptacle portion comprising a strip of sheet metal formed to define a slit circular grasping member to present two relatively thin edges substantially contacting each other for receiving a flat contact tab between such edges by a spreading thereof, an integral resilient spring member extending from said receptacle portion in a backward direction toward said wire attaching portion and away from the periphery of said circular member for a limited distance, and an extending lip located on the outer periphery of said circular member opposite said slit and in longitudinal alignment with said spring member but extending for a distance less than said limited distance.

2. An electrical wire terminal according to claim 1 wherein said extending lip stiffly protrudes outwardly from said circular member in exact alignment with said holding spring member, said extending lip being on the forward peripheral edge of said circular member.

3. An electrical wire terminal according to claim 1, wherein said extending lip stiffly protrudes outwardly from said receptacle portion in exact alignment with said resilient spring member but the distal end of said resilient spring member normally located further away from the periphery of said circular grasping member than said extending lip to provide an outward spring tension when compressed level with said extending lip.

4. In a plug coupler for detachably supporting a device having a plurality of flat contact tabs protruding from the device, a terminal board of insulating material with a plurality of slots respectively opposite said flat contact tabs for cooperatively receiving said contact tabs, two holes entering said terminal board from the rear thereof for each of said slots and extending towards their respective slots but stopping short of the face of said board, and each pair of holes located to approach their respective slots near the ends thereof, wire terminals for each of said holes, each terminal including a tab receiving portion and a wire attaching portion, said receiving portion comprising a strip of sheet metal formed to define a slit circular grasping member to present two relatively thin edges substantially contacting each other for receiving a portion of one flat contact tab between such edges by a spreading thereof, a sub-groove running the length of each of said holes in such a position as to be in horizontal alignment with said associated slot, and an integral hanging-lip projection located on the outer circle of said receptacle opposite its slit and attached to be received in said sub-groove when its wire terminal is inserted into one of said holes, whereby said hanging lip projections hold their respective wire terminals in position for receiving their corresponding one of said tabs.

5. A plug coupler according to claim 4, wherein said wire terminal has a locking spring with its distal end extending outwardly from said tab receiving portion, a stepped notch in said sub-groove for receiving said distal end of said locking spring.

6. A plug coupler according to claim 5, wherein a releasing slot narrower than said stepped sub-groove runs below each said sub-groove from the front to the back of said terminal board, whereby a relatively long releasing tool with a cam end can be inserted from either side of the terminal board to release each wire terminal individually.

References Cited

UNITED STATES PATENTS

2,691,147	10/1954	Sutton et al.	
2,753,408	7/1956	Tuchel	339—111
2,822,529	2/1958	Heath	339—192 X
2,989,724	6/1961	Woofter.	
3,085,220	4/1963	Sitz	339—19 X
3,273,109	9/1966	Moulin.	

FOREIGN PATENTS

644,385	7/1962	Canada.
378,967	8/1964	Switzerland.

MARVIN A. CHAMPION, *Primary Examiner.*

J. R. MOSES, *Assistant Examiner.*