Oct. 22, 1968 MORIMITSU NAKAZAWA ETAL 3,407,379

MULTI-CONNECTOR

Filed Oct. 31, 1966 2 Sheets-Sheet 1

Fig. 1

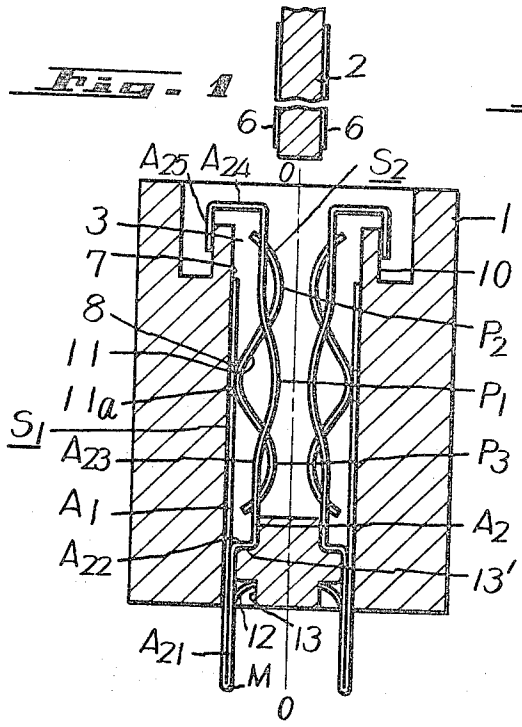


Fig. 2

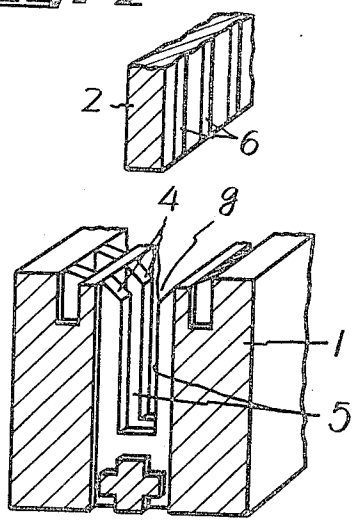


Fig. 3

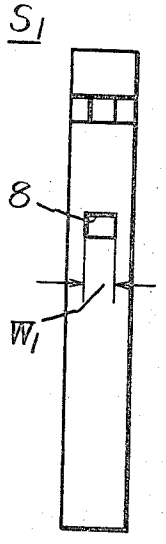


Fig. 4

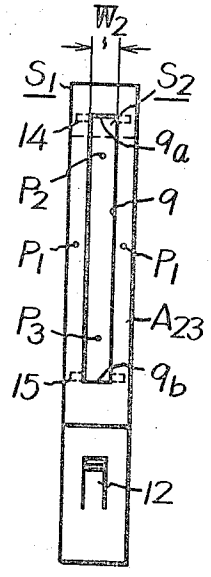
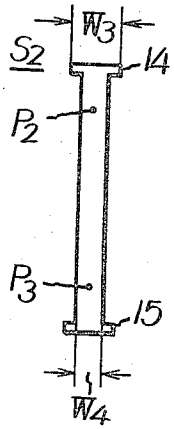


Fig. 5



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Fig. 6

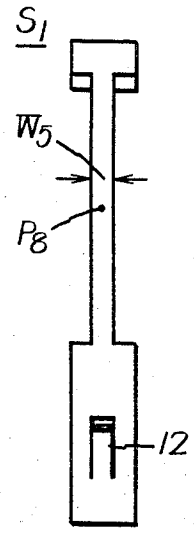


Fig. 7

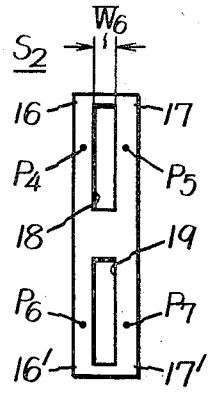
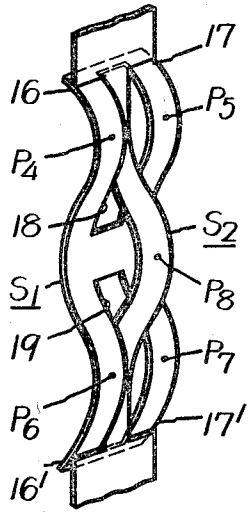


Fig. 8



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MULTI-CONNECTOR

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5 Claims. (Cl. 339—176)

ABSTRACT OF THE DISCLOSURE

This invention relates to a connector adapted to receive a printed circuit board. Each contact of the connector is composed of two bowed resilient members. One member is secured to the insulating body of the connector and the other member is resiliently seated in longitudinal slots in the first member.

This invention relates to an electric circuit connector and more particularly to an electric circuit connector having a plurality of specific female terminals or jacks, which connector holds a marginal edge of a printed-circuit board and positively connects circuit ends of the printed-circuit thereto when the end of the printed-circuit is inserted thereinto.

In general, circuit ends of a printed-circuit board is plated with silver or gold. Such plated metal of circuit ends is worn away by friction when the circuit ends are inserted into a plurality of jacks or connector which is hereinafter referred to as a multi-jack or multi-connector. In order to decrease such abrasion, the circuit ends are plated with rhodium. It, however, is not released from some extent of abrasion. As apparent from the foregoing, it is necessary that contact mechanism of a multi-jack, which electrically contacts with circuit ends of a printed-circuit board having plated very thin metal layer, must be one which positively contacts with the circuit ends without increasing contact pressure therebetween.

Accordingly, one object of the present invention is to provide a multi-connector which positively contacts, with possibly small contact pressure, to circuit ends of a printed-circuit board having plated metal layer.

Another object of the present invention is to provide a multi-connector which contacts with circuit ends of a printed-circuit board at several points with possibly small contact resistance.

Still a further object of the present invention is to provide a multi-connector which is easily assembled and positively holds circuit ends of a printed-circuit board.

Another object of the present invention is to provide a multi-connector having contact portions which positively contact with ends of a printed-circuit board for a long time without variation in resiliency of the contact portions.

Other objects, features and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a schematic enlarged cross-sectional view illustrating an example of a multi-connector according to the present invention;

FIGURE 2 is its partial perspective view of the example shown in FIGURE 1;

FIGURE 3 is the left side view of a first resilient contact strip of the example shown in FIGURE 1;

FIGURE 4 is the right side view of the same resilient contact strip;

FIGURE 5 is the right side view of a second contact strip of the same example;

FIGURE 6 is the front view of a first resilient contact strip of another example;

FIGURE 7 is the front view of a second resilient contact strip which is assembled with the first resilient contact strip shown in FIGURE 6; and

FIGURE 8 is a perspective view of a resilient contact strip which is composed by assembling the resilient contact strips shown in FIGURES 6 and 7.

Referring to the drawings, one example of the present invention will hereinafter be explained. Reference numeral **1** designates an insulating base made of, for example, molded insulating material. Along the center line of the insulating base there is provided a groove **3** into which is inserted a printed-circuit board **2**. As illustrated in FIGURE 2, on the both sides of the groove **3** are provided a plurality of longitudinally extended partition walls **4** in the lateral direction thereof with a suitable space, which define a plurality of rooms **5**. Into each room **5** there is inserted a resilient contact strip which will hereinafter be explained. Each printed-circuit end of the printed-circuit board **2**, namely a contact portion **6** resiliently contacts with the resilient contact strip when the printed-circuit ends are inserted into the groove **3**.

The partition walls **4** of the insulating base **1** project from the both inner side walls of the groove **3** to the center line **0—0** of the insulating base **1** and each of partition wall **4** of one inner side wall confronts with each partition wall **4** of the other inner side wall and further a space *g* for receiving the printed-circuit board **2** is formed between the confronting partition walls **4** of the both inner side walls of the groove **3**. Each resilient contact strip is fitted into each room **5** for receiving the printed-circuit end in contact relationship therewith.

By way of example, the resilient contact strip fitted into each of the left side room will be hereinafter explained. That is, in the present invention the contact portion for receiving the circuit end **6** in contact relationship therewith is made of the first resilient contact strip S_1 and the second resilient contact strip S_2, the strips S_1 and S_2 being made of, for example, resilient metallic material. One part of the strip S_1 is engaged with an inner wall **7** of the groove **3**. The first resilient contact strip S_1 has a first arm A_1 engaged with the inner wall **7** of the groove **3** in the insulating base **1** which is formed by holding the first resilient contact strip S_1 at a suitable middle part M. An aperture **8** is formed in the first arm at the position near the upper end thereof. The shape of the aperture **8** is square and the width of the aperture is W_1, as has been shown in FIGURE 3. The portion of the first resilient contact strip S_1 other than the first arm A_1 form a second arm A_2. The second arm A_2 has a portion A_{21} extending upward in parallel and contact relationship with the first arm A_1, a bent portion A_{22} and a portion A_{23} extending upwards in substantially parallel with the first arm A_1 and spacing apart a suitable gap therefrom. The portion A_{23} has a slit **9** as shown in FIGURE 4. The part of the portion A_{23} having the slit **9** forms projecting contact portions P_1 and P_1 at the both sides of the slit **9** so as to receive the contact portion **6** of the printed-circuit end. The shape of the slit **9** is rectangular along the longitudinal direction of the portion A_{23}. The width of the slit **9** is W_2. The second arm A_2 has a portion A_{24} bent substantially 90 degrees in the opposite direction with respect to the center line **0—0** and a portion A_{25} bent downwards from the portion A_{24} substantially 90 degrees. The portion A_{25} engages with an engaging concave portion **10** of the insulating base **1**. Furthermore, the second arm A_2 has a tongue **12** set up from the portion A_{21}. The tongue **12** engages with an engaging concave portion **13** of the insulating base **1** at the position near the center thereof. The bent portion A_{22} engages with a shoulder portion **13'** opposite the

concave portion **13**. Thus the first resilient contact strip S_1 is engaged with the insulating base **1** at the upper and lower portions thereof so that the resilient contact strip S_1 can be positively kept in the insulating base **1**.

The second resilient contact strip S_2 is made of resilient metallic material similar to that of the first resilient contact strip S_1 and has a wave-shaped portion as shown in FIGURE 5. The wave-shaped portion has two upper and lower contacting portions P_2 and P_3 projecting to the center line **0—0** and also an engaging convex portion **11**. The engaging convex portion **11** protrudes to the direction opposite to the center line **0—0** through the rectangular slit **9** formed in the second arm A_2 and a top portion **11***a* of the convex portion **11** is inserted into the aperture **8** formed in the first arm A_1. In some cases, the top portion **11***a* can be welded to the arm A_1.

The second resilient contact strip S_2 has two engaging portions **14** and **15** at both the upper and lower ends thereof, each of said engaging portions being extended laterally from the strip S_2. The second resilient contact strip S_2 is engaged with the first resilient contact strip S_1 by respectively inserting the engaging portions **14** and **15** into the both ends **9***a* and **9***b* of the rectangular slit **9** of the second arm A_2. In the above assembled condition of the resilient contact strips, the contacting portions P_1 and P_1 of the second arm A_2 are extended to the center of the insulating base **1**, namely the center line **0—0** to be aligned with the contacting portions P_2 and P_3 of the second resilient contact strip S_2. Accordingly, the circuit end **6** contacts with the resilient contact strip at the portions P_1, P_1, P_2 and P_3 with substantially the same resilient pressure.

In the construction set forth above, the width W_1 of the aperture **8** shown in FIGURE 3 is slightly larger than the width W_4 of the second resilient contact strip S_2 shown in FIGURE 5 so that the projected portion of the second resilient contact strip S_2 can be just inserted into the aperture **8**. Width W_3 of the engaging portions **14** and **15** formed at the both sides of the second resilient contact strip S_2 is large enough not to slip out therefrom than the width W_2 of the rectangular slit **9** of the second arm A_2.

As apparent from FIGURE 4, the left and right contacting portions P_1 and P_1 projected to the center line **0—0** of the groove **3** of the insulating base **1** are formed on the second arm A_2 of the first resilient contact strip S_1 and the rectangular slit **9** is formed along and between the contacing portions P_1 and P_2. The convex portion **11**, projected through the rectangular slit **9** to the opposition direction with respect to the center line **0—0**, of the second resilient contact strip S_2 engages with the aperture **8** of the first arm A_1. The contacting portions P_2 and P_3 projected to the center line **0—0** of the insulating base **1** are formed on the second resilient contact strip S_2. In this case the contacting portions P_2 and P_3 are respectively positioned at the upper and lower sides with respect to the contacting portion P_1 of the first arm A_1. Thus, the contacting portions P_1, P_1, P_2 and P_3 can respectively contact with the same circuit end **6** in the similar manner.

In this case, it is preferable to little move extended the contacting portion P_3 to the center line **0—0** than the other contacting points P_1 and P_2 so that the contacting portion P_3 will make sure contact with the circuit end **6** of the printed-circuit board **2** even though the contacting point P_3 lies far position with respect to the opening of the groove **3**.

Moreover by the above construction the contacting point P_2 exerts comparatively small pressure to the circuit end **6** during insertion of the printed circuit board **2** and thereafter the pressure increases so as to make positive contact with the circuit end **6** when the printed circuit board **2** comes into contact with the extended contacting portion P_3 with large contacting pressure and due to reaction of the latter contacting pressure. In practice the contacting portion P_2 will be subjected to a strong inserting force by the square end of the printed circuit board especially when the printed circuit board is inserted oblique to the center line **0—0**, which causes the undesired deformation and break down of the contact portion P_2. However, such a disadvantage will be avoided by the above construction.

FIGURES 6 and 7 show another example of the resilient contact strips S_1 and S_2 of the present invention. That is, as illustrated in FIGURE 6 a contacting portion P_8, which projects to the center line **0—0**, of the second arm of the first resilient strip S_1 is made narrow to be width W_5. As illustrated in FIGURE 7 two rectangular slits **18** and **19** are formed along the longitudinal direction in the second resilient contact strip S_2 so that two pairs of arms **16** and **17** and arms **16'** and **17'** are formed respectively at the both upper and lower sides of the second strip S_2. The widths of the respective slits **18** and **19** are selected to be W_6. The width W_6 is also selected to be slightly larger than the width W_5. The center portions of the arms **16** and **17** are projected to the center line **0—0** to form contacting portions P_4 and P_5 and also the center portions of the arms **16'** and **17'** are projected to the center line **0—0** to form contacting portions P_6 and P_7. Then the upper and lower curved portions of the second arm of the first resilient contact strip S_1 pass through the slits **18** and **19**. The resultant assembly of the first and second resilient contact strips S_1 and S_2 are shown in FIGURE 8. In this case the circuit end of the printed circuit board can contact with the resilient contact strip at the five points P_4, P_5, P_6, P_7 and P_8 when the printed circuit board is inserted into the gap *g*.

The foregoing has been described in connection with the left contacting part set in the left side of the room **5** of the insulating base **1** but the contacting part same to the left contacting part is also set in the right side of the room **5** opposite the left contacting part for holding the circuit end **6** of the printed-circuit board **2** therebetween.

Since the construction of the right contacting part is correctly same to that of the left contacting part, the explanation thereof is omitted for the sake of simplicity.

As set forth above, the first and the second resilient contact strips S_1 and S_2 of the present invention can be made from the different materials so that the circuit end of the printed-circuit board **1** can be hold in contact with the different resilient contact strips S_1 and S_2 having different resiliencies when the printed circuit board **2** is inserted therebetween. Accordingly, the contact condition of the present invention between the board **2** and the contact strips can be more effective than that of using only one specie of the contact strip. That is, if the circuit end does not positively contact with one contact strip the other contact strip can positively contact with the circuit end. Accordingly, there almost never occur that the circuit end does not contact with any one of the contact strips. Furthermore, the contact strip of the present invention is assembled by combining two resilient contact strips so that contact condition between them and the contacting portions of each resilient contact strip can be selected to be four to five, namely many contacting portions can be formed. Accordingly, whole contact between the circuit end and the resilient contact strip can be positively attained and contacting resistance therebetween can be reduced. Contacting pressure applied to the metallic layer formed on a terminal of the printed-circuit board **2** can be also reduced due to the fact that contact points between the circuit end and the resilient contact strip are plural. According to the above fact, the metallic layer on the terminal of the present invention is scarcely damaged and furthermore there is no heat produced due to small contacting resistance when a current passes therethrough.

Since the circuit ends of the printed-circuit board **2** respectively contact with separated resilient contact strips having respective resiliencies as set forth above, the resilient contact strips respectively apply separated resiliencies to the circuit end of the printed-circuit board **2**.

Accordingly, disadvantage that distortion or warp is occurred in the resilient contact strips is eliminated so that the device of the present invention is durable without substantially no damages.

Furthermore, according to the present invention assembly of the first and the second resilient contact strips is very easy and any clamp means, for example, a bolt is unnecessary for attaching the contact strips to the insulating base so that assembling of the device of the present invention can be easily done. The right and left contact strips are symmetrically disposed and assembled in the groove of the insulating base with respect to the center line **0—0** so that the resilient contact strips of the present invention can hold the circuit end of the printed-circuit board between the left and right contact strips with substantially same pressure with respect to the both sides of the circuit end when the printed-circuit board is inserted therebetween along the center line **0—0**.

It will be apparent that many modifications and variations may be effected without departing from the scope of the novel concepts of this invention.

What we claim is:

1. A multi-connector comprising an insulating base having a groove for receiving a circuit end, and a resilient contact strip composed of first and second resilient contact strips, said first resilient contact strip being formed of one resilient strip folded at a middle portion thereof, one part of said folded resilient strip forming a first arm which engages with the inner side wall of said groove and another part of said first arm having an aperture, the other part of said folded resilient strip forming a second arm which has a slit and a convex contacting portion projecting toward the center of said groove for contacting with said circuit end, said second resilient contact strip being curved to form convex contacting portions projecting into the center of said groove for contacting said circuit end, said second resilient contact strip having a convex engaging portion passing through said slit of said second arm towards the opposite direction of the center of said groove for engaging with said aperture, said second resilient contact strip having engaging portions extended laterally at the both ends thereof, said engaging portions of said second resilient contact strip being inserted into respective end portions of said slit and engaging therewith, said convex contacting portions of said second arm and said second resilient contact strip projecting to the center of said groove in substantially same degree, whereby said convex contacting portions positively

contacts with said circuit end when said circuit end is inserted.

2. A multi-connector as claimed in claim **1**, wherein one end of said second arm of said first resilient contact strip is bent in the opposite direction of the center of said groove to engage with a concave engaging portion of said insulating base and a tongue is provided in the vicinity of the other end of said second arm to engage with a concave engaging portion provided in said insulating base, whereby said first resilient contact strip can be positively engaged with said insulating base.

3. A multi-connector as claimed in claim **1**, wherein said second arm of said first resilient contact strip has a contacting convex portion projecting to the center of said groove; a rectangular slit is formed on said second arm along said convex contacting portion thereof through which said engaging convex portion of said second resilient contact strip passes to engage with said aperture of said first arm; and said second resilient contact strip has convex contacting portions projecting to the center of said groove at the upper and lower positions of said contacting portion of said second arm for contacting with said circuit end.

4. A multi-connector as claimed in claim **1**, wherein a pair of said first and second resilient contact strips are disposed in said groove of said insulating base symmetrically with respect to the center of said groove, whereby said circuit end can be held by said resilient contact strips therebetween when said circuit end is inserted therein.

5. A multi-connector as claimed in claim **3**, wherein the lower convex contacting portion of said second resilient contact strip is extended little more to the center line of said groove than the upper convex contacting portion of said second resilient contact strip.

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