July 9, 1968 MORIMITSU NAKAZAWA 3,392,366

MULTICONNECTOR HAVING AN INSULATING BASE AND PLURAL RESILIENT CONTACT STRIPS

Filed March 17, 1967 3 Sheets-Sheet 1

Fig. 1

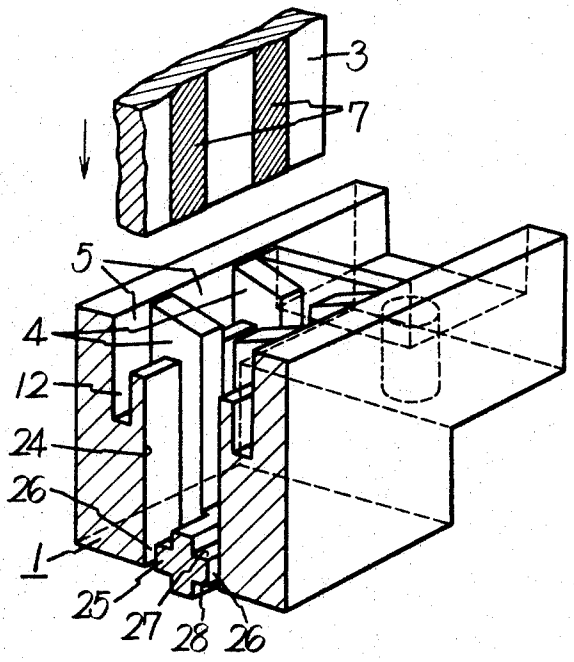



Fig. 2

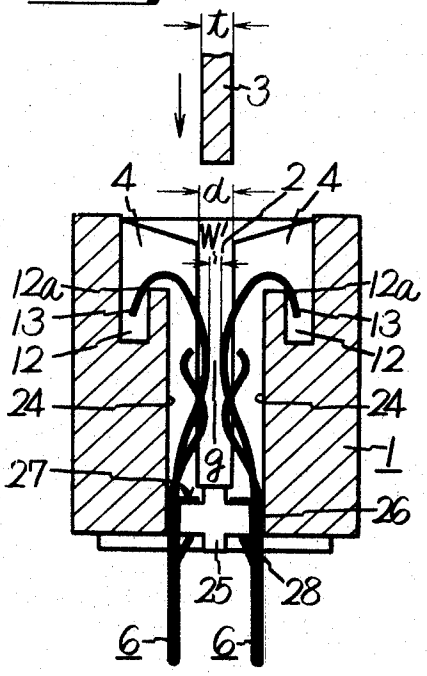



Fig. 3

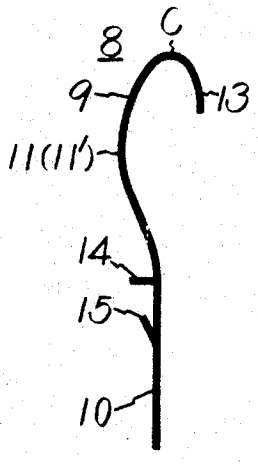



Fig. 4

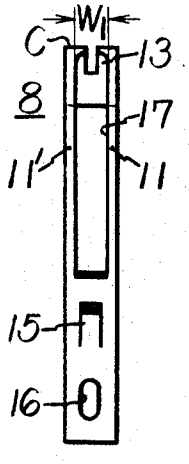



Fig. 5

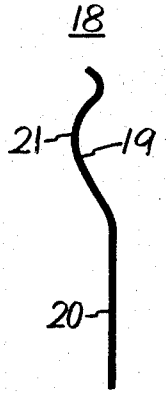
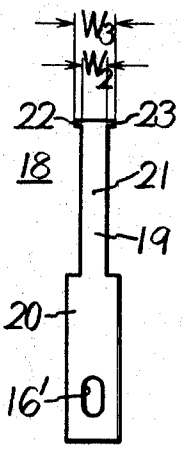



Fig. 6




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MULTICONNECTOR HAVING AN INSULATING BASE AND PLURAL RESILIENT CONTACT STRIPS

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Fig. 7

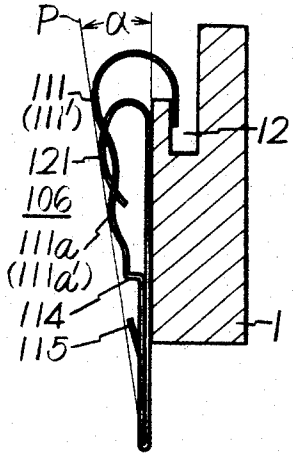



Fig. 8

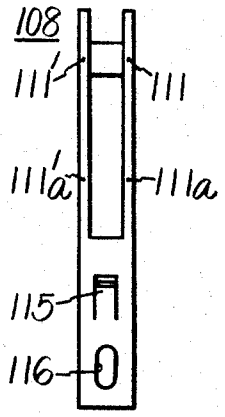



Fig. 9

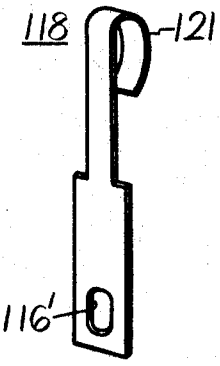



Fig. 10

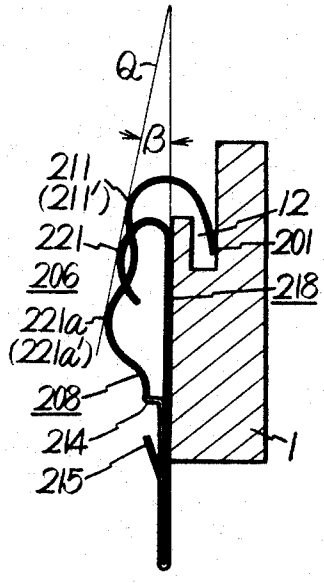



Fig. 11

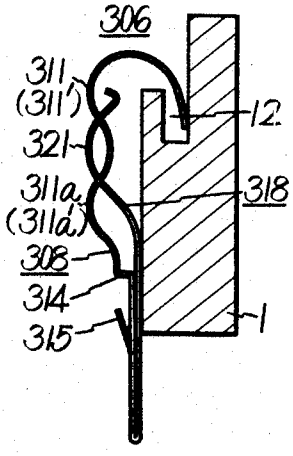



Fig. 12

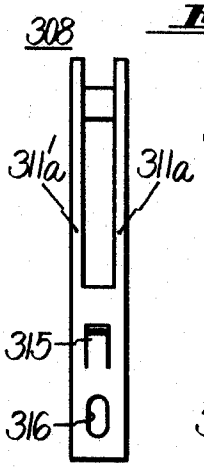
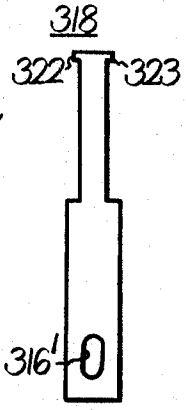



Fig. 13




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MULTICONNECTOR HAVING AN INSULATING BASE AND PLURAL RESILIENT CONTACT STRIPS

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Fig-14

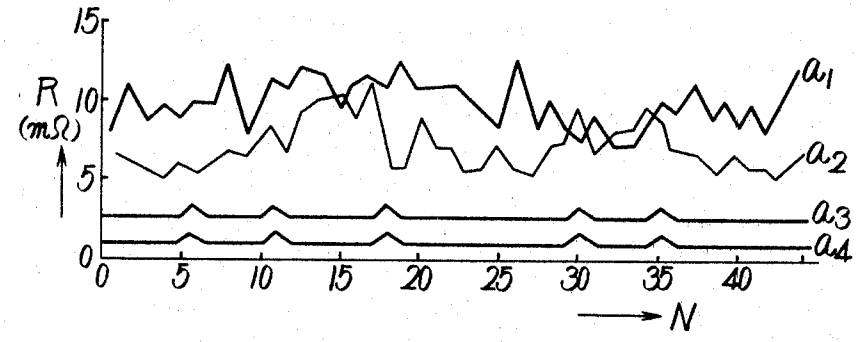



Fig-15

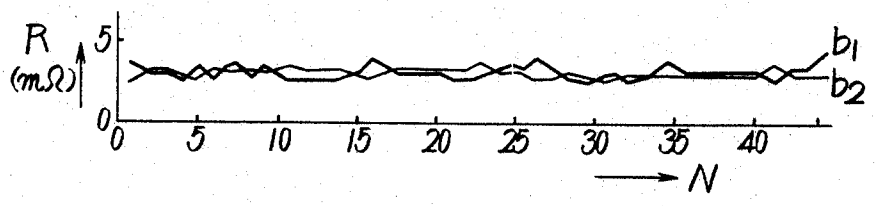
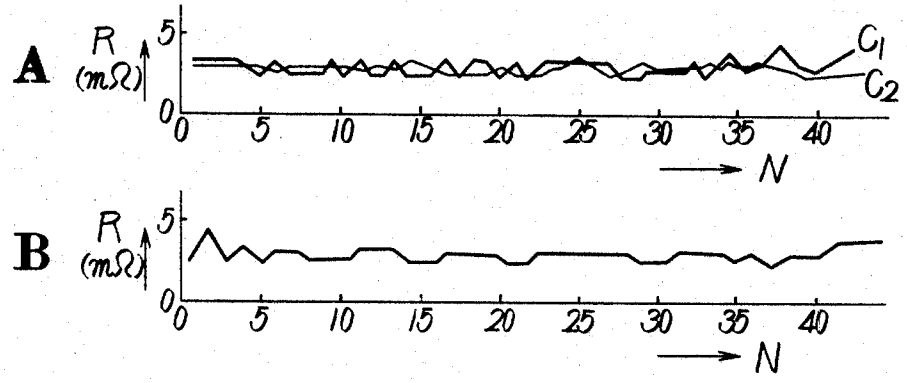



Fig-16




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United States Patent Office 3,392,366 Patented July 9, 1968



3,392,366

# MULTICONNECTOR HAVING AN INSULATING BASE AND PLURAL RESILIENT CONTACT STRIPS

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Filed Mar. 17, 1967, Ser. No. 624,089
Claims priority, application Japan, Oct. 26, 1966, 41/70,576
5 Claims. (Cl. 339—176)

## ABSTRACT OF THE DISCLOSURE

An apparatus for receiving a printed-circuit board having an insulating base and a female terminal. The female terminal consists of a plurality of resilient contact strips which are assembled with one another and inserted to each room formed in the insulating base so as to contact with the printed-circuit end at least three points.

## BACKGROUND OF THE INVENTION

*Field of the invention*

The present invention relates to an electric circuit connector or the so-called multiconnector, and more particularly to a new and novel multijack or multiconnector having a specific female terminal consisting of a plurality of resilient contact strips for positively and smoothly contacting with the circuit ends of a printed-circuit board with a possibly small contact pressure.

*Description of the prior art*

In general, a multijack or multiconnector having female terminal contacts with printed-circuit ends of the printed circuit board with rather great contact pressure. Accordingly, the metal plated on the printed-circuit ends is liable to wear away. Furthermore, due to constructional feature of resilient contact strips forming the female terminals, positive contact of the printed-circuit end with the female terminals cannot be appreciated.

## SUMMARY OF THE INVENTION

One object of this invention is to provide a multiconnector which electrically contacts the circuit ends of a printed-circuit board under as small a contact pressure as possible.

Another object of this invention is to provide a multiconnector having female terminals, each contacting each circuit end of a printed-circuit board at several points so as to minimize electric contact resistance therebetween.

Briefly, the multijack or multiconnector of the present invention utilizes a specific female terminal consisting of at least two resilient contact strips having specific construction so that the multiconnector of the present invention positively contact with the circuit end of the printed circuit board with small contact pressure so that almost no metal plated on the circuit end is worn away.

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

## BRIEF DESCRIPTION OF DRAWINGS

FIGURE 1 is an enlarged fragmentary perspective view illustrating an insulating base of a multiconnector according to the present invention;

FIGURE 2 is a cross-sectional view of the insulating base, shown in FIGURE 1, with which female terminals of the present invention are assembled;

FIGURE 3 is a side view illustrating one example of a first resilient contact strip of the female terminal shown in FIGURE 2;

FIGURE 4 is a front view of the first resilient contact strip shown in FIGURE 3;

FIGURE 5 is a side view illustrating one example of a second resilient strip of the female terminal shown in FIGURE 2;

FIGURE 6 is its front view;

FIGURE 7 is a side view illustrating another example of the female terminal according to the present invention;

FIGURE 8 is a front view illustrating a first resilient contact strip of the female terminal shown in FIGURE 7;

FIGURE 9 is a perspective view of a second resilient contact strip of the female terminal shown in FIGURE 7;

FIGURE 10 is a side view illustrating another example of the female terminal according to the present invention;

FIGURE 11 is a side view illustrating still another example of the female terminal used in the present invention;

FIGURE 12 is a front view illustrating a first resilient contact strip of the female terminal shown in FIGURE 11;

FIGURE 13 is a front view illustrating a second resilient contact strip of the female terminal;

FIGURE 14 is a graph showing the characteristics of the multiconnector of this invention, obtained in experiments, in comparison with those of a prior art multiconnector;

FIGURE 15 is a graph showing the wear-proof characteristics of the multiconnector of this invention obtained in experiments; and

FIGURES 16A and 16B showing other characteristics of the multiconnector of this invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the drawings one example of this invention will hereinafter be described in detail. In FIGURES 1 and 2 reference numeral **1** designates an insulating base made of an insulating material such, for example, as plastics or the like. Reference numeral **2** indicates a groove formed in the insulating base **1** along its center line for receiving a printed-circuit board **3**. On the opposite side walls of the groove **2** there are respectively provided at predetermined intervals a plurality of partition walls **4** made of an insulating material such as, for example, plastics or the like, each partition wall **4** on one side wall confronting each partition wall **4** on the other side wall. As a result of this, a plurality of rooms **5** are formed along the side walls, the rooms **5** on one side wall being precisely opposite those on the other side wall. While the partition walls **4** project centrally of the groove **2** from the side walls thereof, the confronting end faces of the opposed partition walls are spaced a predetermined distance, namely defining a gap therebetween. The width of the gap is selected to be slightly greater than the thickness *t* of the printed-circuit board **3** so as to facilitate inserting of the printed-circuit board **3** into the groove **2**. In this invention the aforesaid insulating base **1** and partition walls **4** can be formed integrally of the same material by means of, for example, molding.

A resilient female terminal **6**, made of conductive metallic material such as, for example, beryllium-copper alloy or the like, is attached to each room **5** formed in the insulating base, completing a multiconnector of this invention. Accordingly, when the printed-circuit board is inserted into the gap of the multiconnector, each female terminal **6** attached to each room **5** makes electrical contact with each circuit end **7** of the printed-circuit board **3** at several points.

A description will be given in connection with some

different female terminals employed in the multiconnector of this invention which are disposed on, for example, the right side walls of the groove in the drawing.

Referring now to FIGURES 3 to 6, the female terminal **6** will be described in detail. In FIGURES 3 and 4 reference numeral **8** indicates generally a first resilient contact strip made of a metal such as the aforementioned beryllium-copper alloy or the like. The first resilient contact strip **8** consists of a forked contact portion **9** making direct contact with the circuit end **7** of the printed-circuit board **3** and a base portion **10** equipped with means for attaching the female terminal **6** to the insulating base **1** and means for external connection. That is, the contact part **9** comprises a contact portion **11** projecting centrally of the groove **2** and making contact with the circuit end **7** of the printed-circuit board **3** when attached to the insulating base **1** and an engaging end portion **13** projecting in the direction opposite from the projecting contact portion **11** and bent downward for engagement with a top **12***a* of the inner wall of an engaging recess **12** formed in the insulating base **1**. The base portion **10** is generally substantially flat and has set up therefrom substantially at right angles thereto a lug **14** projecting centrally of the groove **2** in the vicinity of the portion contiguous to the contact part **9** and a tongue **15** set up under the lug **14** at a position spaced a predetermined distance therefrom. Further, the base portion **10** has bored therein an aperture **16** near the free end for external connection, as illustrated in FIGURE 4.

FIGURE 4 is a front view of the first resilient contact strip **8** depicted in FIGURE 3. As is apparent from the figure, the contact part **9** has formed therein a slit **17** in the lengthwise direction thereof and hence is fork-shaped. The width $W_1$ of the slit **17** is selected to decrease gradually from the vicinity of the bent portion C of the resilient contact strip **8** to its end so as to provide for enhanced mechanical strength of that portion. Due to the provision of the slit **17**, the resilient contact strip **8** makes contact with the circuit end **7** of the printed-circuit board at two points **11** and **11'**.

FIGURE 5 is a side view of a second resilient contact strip **18** which is employed in combination with the first resilient contact strip **8** and is made of the same material as the first contact strip **8**. The second resilient contact strip **18** consists of a portion **19** making direct contact with the circuit end **7** of the printed-circuit board **3** and a flat portion **20** contiguous to the portion **19**. The portion **19** is curved toward the center of the groove **2** as identified at **21**, extending upwardly of the flat portion **20** and making contact with the circuit end **7** of the printed-circuit board **3** when attached to the insulating base **1**. As is apparent from FIGURE 6 illustrating a front view of the second resilient contact strip **18**, the free end portion of the portion **19** is in the form of a T. Namely, the free end of the portion **19** has formed thereon projections **22** and **23** projecting in the lateral direction. The width $W_3$ of the free end of the portion **19**, the width $W_2$ of the portion **19** and the width $W_1$ of the groove **2** are selected in such a relationship that $W_3 > W_1 > W_2$. The projections **22** and **23** are provided to ensure that the portion **19** would not excessively project toward the center of the groove **2** through the slit **17**. As is clearly seen from FIGURES 2, 3 and 5, the curvature of the contact portion **19** of the second resilient contact strip **18** is greater than that of the projecting contact portion **11** of the first resilient contact strip **8**. Therefore, the contact portion of the second resilient contact strip **18** is subjected to a stress, by the end edge of the printed circuit end, greater than that applied to the projecting contact portion **11** of the first resilient contact strip **8** when the printed-circuit board **3** is inserted into the groove **2**. Especially, the contact portion of the second resilient contact strip is applied a considerably great downward force by the square end of the printed-circuit board **3** shown in FIGURE 2, with the result that the contact portion **19** of the second resilient contact strip **18** is likely to be curved excessively toward the center of the groove **2** and broken. By the provision of the projections **22** and **23**, however, such breakage of the contact portion **19** is prevented. That is, the width $W_3$ of the free end of the portion **19** is greater than the width $W_1$ of the slit **17**, so that when the projecting contact portion **21** of the second resilient contact strip **18** is pressed by the end of the printed-circuit board **3** to be excessively bent toward the center of the groove **2** the projections **22** and **23** come to engage with the slit **17**, thus effectively preventing the projecting contact portion **21** from being excessively curved.

The female terminal **6** of the present invention is constituted by the first and second resilient contact strips **8** and **18** assembled with each other. In FIGURE 2 there are ilustrated the female terminals **6** attached to the insulating base **1**. Further, the widths of the flat portions **10** and **20** of the first and second resilient contact strips **8** and **18** are selected to be the same. Accordingly, when the two resilient strips **8** and **18** are assembled with each other, the respective flat portions **10** and **20** join together and the contact portion **21** of the second resilient contact strip **18** may project toward the center of the groove **2** through the slit **17** of the first resilient contact strip **8**. The first and second resilient contact strips **8** and **18** are each made of a strip of resilient material and this facilitates attaching of the contact strips to the insulating base **1**.

The female terminal **6** thus assembled is attached to the insulating base **1** in such a manner as will hereinbelow be described. That is, the female terminal **6** is inserted into the groove **2** along the side wall **24** of the groove **2** until the lug **14** of the first resilient contact strip **8** arrives at the upper surface **27** of the bottom **25** of the base **1** while the flat portion of the female terminal **6** being inserted into a gap **26** defined by the side wall **24** and the bottom **25** of the base **1**. Then, the tongue **15** of the first resilient contact strip **8** is set up therefrom and at this position the free end of the tongue **15** engages with the underside surface **28** of the bottom **25** from underneath. In this manner, the female terminal **6** is firmly attached to the insulating base **1**, which is illustrated in FIGURE 2.

The multiconnector having the aforesaid female terminal **6** installed in each room **5** of the insulating base **1** is used for receiving the printed-circuit board **3**. The thickness and the width of the projecting contact portions of the first and second resilient contact strips are appreciably small, so that each resilient contact strip exhibits a high degree of flexibility. Further, as is apparent from FIGURES 3 to 5, the fulcra of the spring action of the contact portions **11**, **11'** and **21** are all different and hence these contact portions can each exhibit spring stress independently of the others. Since the contact portions **11** and **11'** are so designed as to be considerably flexible, these two contact portions can make contact with the circuit end of the printed-circuit board **3** in response to distortion of the circuit ends or irregularity of their thickness. While, the contact portion **21** engages the circuit end of the printed-circuit board **3** by a spring action which is quite different from those of the above-mentioned contact portions **11** and **11'**. Consequently, the female terminal **6** of this invention contacts the circuit end of the printed-circuit board **3** at three points.

With such an arrangement as has been described in the foregoing, the contact resistance of each contact portion resulting from contact with the printed-circuit board can be reduced to approximately one-third of that obtained with a female terminal of a single contact structure, in which the distance from the contact point to such a hole as identified at **16** in FIGURE 4 is the same as that in the female terminal of this invention. Further, with this invention, probability of contact of the female terminal with the printed-circuit board **3** can be raised up to approximately triple product of that obtainable with the female terminal of the single contact structure. Namely, the contact structure of this invention is highly reliable. My ex-

periments show that the contact resistance of the beryllium plated female terminal of this invention caused by contact with one side of a printed-circuit board having circuit ends plated with, for instance, rhodium, is approximately 2.0 to 2.5 milliohms and that the degree of variance of the measured resistance value is extremely low. According to my experiments, the contact resistance of the prior art female terminal resulting from contact with one side of the printed-circuit board is approximately 4 to 8 milliohms and the degree of variance of the resistance value is considerably high.

Further, in this invention, when the printed-circuit board **3** depicted in FIGURE 2 is inserted into a gap *g* between the contact portions of the opposing female terminals **6**, the both sides of the printed-circuit board **3** are subjected to stress by the contact portions **11**, **11'** and **21** of the female terminals **6**, since the width W' of the gap *g* is selected smaller than the thickness *t* of the printed-circuit board **3**. The stress mentioned just above is a unit of the force for inserting the printed-circuit board **3** into the groove **2** and for pulling out the board **3** from the groove **2**. Supposing that the force of the conventional right or left single female terminal exerted on one side of the printed-circuit board is 300*g*, the mathematical mean value of the force of contact portions **11**, **11'** and **21** of the female terminals of this invention exerted on the printed-circuit board held therebetween is 100*g* at each contact portion. That is, this leads to a considerable reduction of abrasion and fatigue of the contact portions **11**, **11'** and **21** as compared with that of the prior art female terminal. Consequently, the female terminal of this invention is excellent in shock resistance and is suitable for use in the case where the printed-circuit board is often inserted into and removed from a connector. Further, even if the printed-circuit board is left long inserted into the connector, probability of contact by the respective contact portions of the female terminal of this invention is high. Thus, this invention provides a multi-connector which is extremely stable in operation.

In FIGURES 7 to 9 there is illustrated another modified form of the female terminal for use in this invention. FIGURE 7 is a side view of a female terminal which consists of first and second resilient contact strips **108** and **118**. FIGURES 8 and 9 are front and perspective views of the first and second resilient contact strips **108** and **118**. The first and second resilient contact strips **108** and **118** are assembled with each other and attached to the insulating base **1** in substantially the same manner as in the case of the aforesaid female terminal **6**, and hence no detailed description will be given in this specification.

In the example depicted in FIGURE 7 the first resilient contact strip **108** has two pairs of contact points **111**, **111'** and **111***a*, **111***a'*. That is, the contact portion of the first resilient contact strip **108** forming the contacts is corrugated having at least two projections or dents. While, the second resilient contact strip **118** has a contact point **121** projecting between the two pairs of contact points of the first resilient contact strip **108**. That is, the second resilient contact strip **118** extends along the side wall **24** of the insulating base **1** up to its top and is bent downward in the direction of the center of the groove **2**, providing the contact **121** between the aforementioned two pairs of contacts, as illustrated in FIGURE 9. The female terminal **106** depicted in FIGURE 7 contacts the circuit end of the printed-circuit board at five points. In this female terminal **106** all the contact points are adjusted to project so as to make contact with the same plane P perpendicular with respect to the paper, as shown in FIGURE 7. In addition, the plane P crosses an extension (the flat portion itself in this example) of the flat portion of the female terminal **106** at an acute angle $\alpha$.

When the printed-circuit board is inserted into the groove **2** of the insulating base of the multiconnector equipped with the female terminals **106**, the upper and lower projecting contact portions **111**, **111'** and **111***a*, **111***a'* are displaced with the bent portion **114** as a fulcrum. In this case, however, the displacement degree of the upper projecting contact portions **111** and **111'** is greater than that of the lower projecting contact portions **111***a* and **111***a'* and the spring force of the upper projecting contact portions **111** and **111'** is weaker than that of the lower ones **111***a* and **111***a'*, so that the upper contact portions readily conform to the plane of the printed-circuit board and then the lower contact portions slightly conform to the plane of the printed-circuit board. In other words, the upper projecting contact portions are greatly bent to contact the printed-circuit board and the lower ones are slightly bent to contact the circuit end of the printed-circuit board. In order that the upper and lower projecting contact portions may closely contact the printed-circuit board, it is required that the contact portions **111'**, **111***a'* and **111**, **111***a* constituting the fork-shaped portion of the resilient contact strip **108** are fully small in thickness and in width so as to be flexible. Due to the flexibility, the free end of the first resilient contact strip **108** is easily shifted from the inner left wall to the right wall of the engaging recess **12** when the printed-circuit board is inserted, and hence the insertion of the printed-circuit board is completed without pressing the free end of the first resilient contact strip against the right wall of the recess **12**. Namely, it can be regarded that the contact portions **111**, **111'** and **111***a*, **111***a'* are scarcely subjected to spring stress with the right wall as a fulcrum. Accordingly, the force of the first resilient contact strip **108** acting on the printed-circuit board is produced only by a stress caused with the bent portion **4** as a fulcrum, and hence insertion of the printed-circuit board becomes smooth. Further, in the example it can be said that the second resilient contact strip **118** does not ever cooperate with the first resilient contact strip and has a spring fulcrum different from that of the first resilient, contact strip **108** and is bent down in the direction of the groove **2** of the insulating base **1** as illustrated in the figure. Consequently, the second resilient contact strip also facilitates insertion of the printed-circuit board. That is, the projecting contact portion **121** of the second resilient contact strip **118** constitutes a fifth contact strip of the female terminal **106**. Thus, an elongated strip of resilient material constitutes a female terminal having five contact points. In this case, the printed-circuit board is inserted into the groove until the angle $\alpha$ between the aforementioned plane P and the resilient contact strip becomes substantially zero, and the free end of the first resilient contact strip reaches the right wall of the engaging recess **12**.

FIGURE 10 is a side view of a female terminal **206** substantially similar to that depicted in FIGURE 7. As is apparent from a comparison of these two figures, the female terminal depicted in FIGURE 10 differs from that shown in FIGURE 7 in that a plane Q which is perpendicular with respect to the paper and with which projecting contact portions **211**, **211'**, **221**, **211***a* and **211***a'* of first and second resilient contact strips **208** and **218** contact crosses an extension of the flat portion of the female terminal **206** at an acute angle $\beta$ above the female terminal. In other words, the degree of each projection of the projecting contact portions toward the center of the groove **2** becomes increased as the bottom of the groove **2** is approached. That is, the projection state of the projecting contact portions is opposite to that in the example shown in FIGURE 7. Another difference lies in that the free end **201** of the first resilient contact strip **208** engages with the right side wall of the engaging recess **12** of the insulating base **1**, as shown in FIGURE 10. When the printed-circuit board is inserted into the groove of the insulating base equipped with the above female terminal **206**, the upper projecting portions **211** and **211'** of the first resilient contact strip **208** first come into contact with the printed-circuit board and are displaced to right (in FIGURE 10). In this case, however, since the free end **201** of the first resilient con-

tact strip is in engagement with the right side wall of the engaging recess **12** of the insulating base **1**, the engaging point functions as a fulcrum of the first resilient contact strip **208**. Accordingly, the rightward displacement of the upper projecting portions **211** and **211'** of the first resilient contact strip **208** does not exert so great influence upon the lower projecting contact portions **211***a* and **211***a'*. When the printed-circuit board is further inserted into the groove **2**, the printed-circuit board makes contact with the projecting contact portion **221** of the second resilient contact strip **218** and then readily engages with the lower projecting contact portions **211***a* and **211***a'* of the first resilient contact strip **208**. In this case, since the displacement degree of the projecting contact portions **211***a* and **211***a'* to right is greater than that of the upper projecting contact portions and the free end **201** of the upper projecting portions **211** and **211'** functions as a fulcrum, the displacement of the lower projecting contact portions **211***a* and **211***a'* to right hardly affects the upper projecting contact portions **211** and **211'** of the first resilient contact strip **208**. Accordingly, both the projecting contact portions can act substantially independently, so that the spring force of the trough portion of the first contact strip may be made small. Thus, contact is ensured of the printed-circuit board with the upper and lower projecting contact portions. In the present example, the insertion of the printed-circuit board is very easy, because the lower projecting contact portion **211***a* and **211***a'* are further to the center of the groove **2** than the upper projecting contact portions **211**, **211'** and **221**.

FIGURES 11 to 13 illustrate still another modification of the female terminal employed in this invention. In this example a first resilient contact strip **308** is substantially the same as those **108** and **208** of the female terminals **106** and **206** shown in FIGURES 7 and 10 in its construction but, as is apparent from FIGURES 11 to 13, a second resilient contact strip **318** is different from those **118** and **218** of the female terminals **106** and **206** but is exactly the same in configuration as that **18** of the female terminal **6** depicted in FIGURES 3 to 6 and is substantially the same in purpose and function. The female terminal identified at **306** in this example is different from the female terminal **6** in that the former has five contact points and is different from the female terminals **106** and **206** in that the projecting contact portions equally project toward the center of the groove. As will be understood from the foregoing, the female terminal **306** possesses the operational effect attained by combination of those of the aforementioned female terminals **6**, **106** and **206**.

In FIGURE 14 there are illustrated the characteristics of the multiconnector of this invention, obtained in experiments, in comparison with those of a prior art multiconnector. The female terminals of the multi-connectors of this invention and the prior art employed in the experiments were those made of a Be-Cu alloy and plated with gold, and the circuit ends of the printed-circuit boards inserted into such multiconnectors were plated with rhodium thereon. In the figure the ordinate represents the resistance value R in milliohm (mΩ) between the aperture to which a lead wire is connected and the point making contact with the circuit end of the printed-circuit board and the abscissa the number N of the female terminals of the multiconnector, the curves $a_1$ and $a_2$ indicating the characteristics of the prior art multiconnectors and the curves $a_3$ and $a_4$ indicating those of the multiconnectors of this invention. As is apparent from the figure, the resistance values of the multiconnectors of this invention are appreciably lower than those of the prior art multiconnector, and in addition the resistance value of each female terminal of this invention is substantially equal to those of the others.

FIGURE 15 illustrates results of my experiments conducted on the wearproof characteristics of the multi-connector of this invention. In this case the female terminal and circuit ends as used in the case of FIGURE 14 are used. The ordinate and the abscissa represent the same as those in FIGURE 14. Reference numeral $b_1$ indicates the resulted curve obtained after the circuit ends of the printed-circuit board had been inserted into and pulled out of the multiconnector 1000 times and $b_2$ the resulted curve similarly obtained after 100 times. In the experiments the power required for inserting the circuit ends into the multiconnector was about 10.5 kg. and that for pulling it out from the multiconnector was approximately 8.5 kg. It appears from this graph that the resistance value of each female terminal of the present invention multiconnector hardly varies, even after the circuit ends of the printed-circuit board are inserted into and pulled out from the multiconnector many times.

FIGURES 16A and 16B illustrate other characteristics of the multiconnector of this invention, obtained with the same female terminals and circuit ends as those used in the experiments of FIGURES 14 and 15. FIGURE 16A shows the resistance values of the female terminals of the multiconnector holding the printed-circuit board therebetween when subjected to vertical vibration. FIGURE 16B similarly shows the resistance values of the female terminals when subjected to horizontal vibration. In each graph the ordinate and the abscissa represents the same as those in FIGURES 14 and 15. The amplitude of the aforementioned horizontal and vertical vibration was 1.5 mm. and the time of its application was 120 minutes and its period was 60 seconds. As will be seen from the graphs, the resistance value of each female terminal hardly varies. In FIGURE 16A the curve $C_1$ represents the resistance values of the female terminals after the vibration test and the curve $C_2$ those before the test.

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 I claim is:

**1.** A multiconnector comprising an insulating base having a groove for a circuit end to be inserted therein and a gap contiguous to the groove, and a female terminal making contact with the circuit end inserted into the groove, the female terminal consisting of a first resilient contact strip and a second resilient contact strip cooperating therewith, the first resilient contact strip having a base portion to be passed through the gap and a contact curved portion contiguous to the base portion which has formed therein a longitudinal slit, the second resilient contact strip having a base portion to be passed through the gap and a curved contact portion contiguous to the base portion which has a pair of engaging projections formed at the free end thereof and projects from the wall of the groove to the center of the groove through the slit, the width of said engaging projections selected to be greater than that of the slit, the curvature of the curved contact portion of the first resilient contact strip being greater than that of the curved portion of the second resilient contact strip, the first and second resilient contact strip being arranged in such a manner that the curved contact portion of the first resilient contact strip is disposed at the insertion side of the circuit end.

**2.** A multiconnector as claimed in claim **1**, wherein the first resilient contact strip has two projecting contact portions and the second resilient contact strip has a projecting contact portion, the projecting contact portion of the second resilient contact strip being disposed between the two projecting contact portions of the first resilient contact strip, all the projecting contact portions of the first and second resilient contact strips being arranged substantially on the same plane which intersects the base portions of the first and second resilient contact strips at an acute angle.

**3.** A multiconnector as claimed in claim **1**, wherein the first resilient contact strip has two projecting contact por-

tions and the second resilient contact strip has a projecting contact portion, the projecting contact portion of the second resilient contact strip being disposed between the two projecting contact portions of the first resilient contact strip, all the projecting contact portions of the first and second resilient contact strips being arranged substantially on the same plane which intersects the extension of the inner wall of the groove above the groove at an acute angle.

4. A multiconnector as claimed in claim 1, wherein the first resilient contact strip has two projecting contact portions and the second resilient contact strip has a projecting contact portion, the projecting contact portion of the second resilient contact strip being disposed between the two projecting contact portions of the first resilient contact strip, all the projecting contact portions of the first and second resilient contact strips being arranged substantially on the same plane which is substantially parallel to the inner wall of the groove.

5. A multiconnector as claimed in claim 1, wherein the first resilient contact strip has a lug projected from the base portion in the vicinity of the portion contiguous to the curved contact portion and a tongue set up from the base portion spaced a predetermined distance from the lug so as to attach the female terminal to the insulating base.




**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 3,131,017 | 4/1964 | Mittler. | |
| 2,071,713 | 2/1937 | Terrill | 339—260 |
| 2,781,498 | 2/1957 | Maly | 339—258 |
| 3,040,291 | 6/1962 | Schweitzer et al. | |
| 3,172,718 | 3/1965 | Lalonde | 339—217 |
| 3,274,532 | 9/1966 | Engel. | |

FOREIGN PATENTS

| | | |
|---|---|---|
| 611,497 | 10/1948 | Great Britain. |
| 48,994 | 6/1966 | Germany. |


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