Dec. 25, 1962 B. E. OLSSON ET AL 3,070,772

TERMINAL

Filed Aug. 31, 1959

Fig. 1

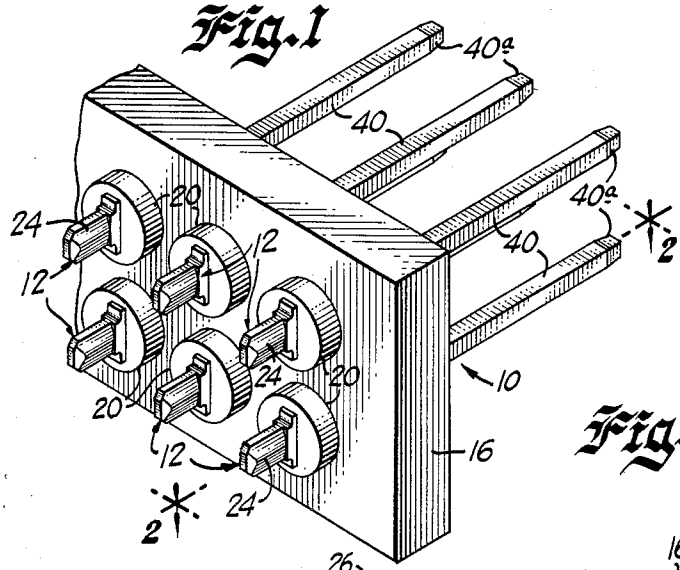


Fig. 4

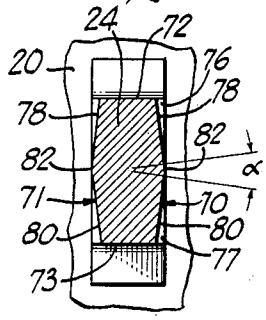
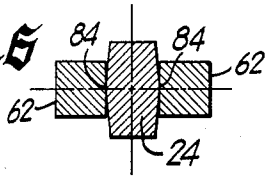


Fig. 6



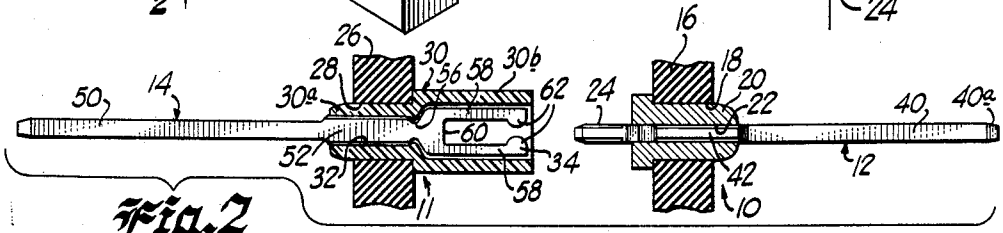


Fig. 2

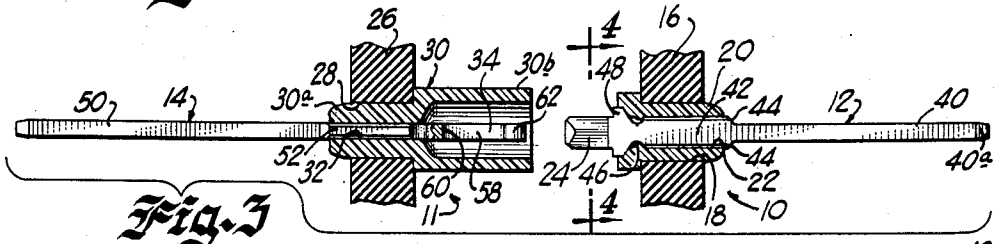


Fig. 3

Fig. 7

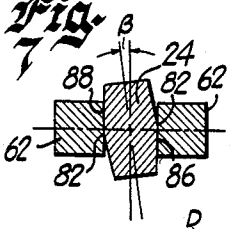


Fig. 8

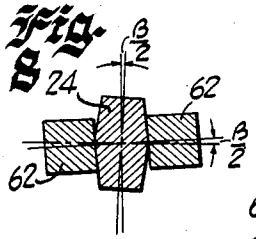


Fig. 9

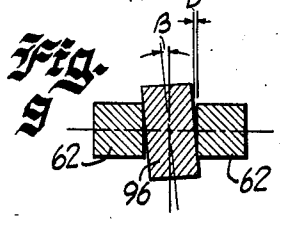


Fig. 5

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3,070,772

TERMINAL

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8 Claims. (Cl. 339—278)

The present invention relates to electrical terminals and, more particularly, to a male blade terminal adapted to mate with a female terminal.

It is an object of the present invention to provide a new and improved blade-type terminal.

It is another object of the present invention to provide a new and improved blade terminal that provides good electrical connection with a female connector, even though the male and female terminals are slightly misaligned.

It is yet another object of the present invention provide a male blade terminal that is so constructed that when the male terminal mates with a misaligned female terminal, permanent deformation of the female terminal does not result.

It is still another object of the present invention to provide a blade terminal that is adapted to be readily inserted between the tines of a fork-type female terminal, whereby good electrical connection is made between the opposite sides of the blade terminal and the respective tines of the fork-type female terminal, irrespective of misalignment of the male and/or female terminals.

It is a further object of the present invention to provide a blade-type terminal embodying double-beveled opposite surfaces for permitting slight misalignment between the male and a female terminal without permanently deforming the female terminal.

It is another object of the present invention to provide a blade-type terminal that exhibits characteristics similar to a round pin terminal in the sense that the tines of a fork-type terminal are uniformly spaced apart by the blade-type terminal irrespective of relative misalignment of the terminals.

The above and other objects are realized in accordance with the present invention by providing a new and improved male terminal of the blade-type that is particularly suited to mate with a fork-type female terminal having spaced-apart tines. The female terminal is also of the blade-type and, accordingly, when mated with the male terminal is 90 degrees related to the male terminal. Although not necessary, the female terminal preferably embodies at the end of its tines inwardly extending contact portions which specifically engage the opposite contacting surfaces of the male terminal. In accordance with an aspect of the present invention, the male, blade-type terminal is so constructed that its opposite contacting surfaces engage the tines of a misaligned female terminal without permanently distorting the tines of the terminal. In contrast to existing male terminals wherein a misalignment between a male and a female terminal effects a permanent setting or deformation of a female terminal, the contacting sides of the male terminal are configured to be received by a misaligned female terminal without permanently distoring either of the terminals. Furthermore, a good electrical connection is provided between the contacting sides of the male terminal and the tines of the female terminal when the terminals are within a relatively wide range of their normal 90 degree orientation.

The invention, both as to its organization and method of operation, taken with further objects and advaantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawing, in which:

FIG. 1 is a perspective view of a male terminal assembly embodying the features of the present invention;

FIG. 2 is a sectional view of a male terminal embodied in the male terminal assembly of FIG. 1 shown in position to engage a female terminal of a female terminal assembly;

FIG. 3 is a view similar to FIG. 2, illustrating the male and female terminals 90 degrees displaced from their positions illustrated in FIG. 2;

FIG. 4 is an enlarged fragmentary, sectional view taken along line 4—4 of FIG. 3;

FIG. 5 is an enlarged, perspective view, illustrating the terminals of FIG. 2 in mated relation;

FIG. 6 is a sectional view taken along line 6—6 of FIG. 5;

FIG. 7 is a view similar to FIG. 6 illustrating the positions of a female terminal and a misaligned male terminal;

FIG. 8 is a view similar to FIG. 7, illustrating the relative positions of a misaligned male terminal and a misaligned female terminal; and

FIG. 9 is a view similar to FIG. 7, illustrating the deformation of a female terminal resulting from a prior art male terminal.

Referring now to the drawing and in particular to FIG. 1, a terminal assembly or connector embodying the features of the present invention is illustrated and is identified generally by reference numeral **10**. The terminal assembly **10** embodies a plurality of spatially arranged male terminals **12**, only a few of which are illustrated. The male terminal assembly **10** is adapted to mate with a female terminal assembly, shown fragmentarily in FIGS. 2 and 3 and identified generally by reference numeral **11**. The female terminal assembly **11**, similar to the male assembly **10**, embodies a plurality of spatially arranged female terminals, only one of which is illustrated in FIGS. 2 and 3 and identified by reference numeral **14**. The male terminals **12** and female terminals **14** are so spaced on their respective blocks **16** and **26** that incident to mating of the male and female terminal assemblies **10** and **11**, oppositely related terminals **12** and **14** register and engage one another. As described in greater detail hereinafter, the terminals **12** and **14** are detachably connected to one another to permit facile engagement and disengagement of the terminal assemblies **10** and **11**. In use, the free ends of the male and female terminals **12** and **14** are respectively connected to suitable electrical leads, for example, conductors and leads of electrical components, with the result that a plurality of solderless electrical connections are obtained between pairs of the electrical leads through the male and female terminal assemblies **10** and **11**.

The male terminal assembly **10** specifically comprises a generally rectangular block **16** made of aluminum, for example, and is provided with two parallel rows of spaced-apart openings **18** (see FIGS. 2 and 3) for accommodating, respectively, a plurality of bushings **20**. Although only two rows are illustrated, it will be appreciated that the block **16** may have any number of rows of openings **18** in accordance with the requirements of the particular installation. Each bushing **20** is made of suitable insulating material and includes a longitudinally extending bore **22** (see FIGS. 2 and 3) for respectively accommodating the male terminal **12**. The bushing **20**, made of suitable insulating and somewhat resilient material, extends through the support **16** and terminates slightly beyond the opposite sides of the support **16** as clearly shown in FIGS. 2 and 3. By this construction, the bushing **20** spaces and insulates the terminal **12** from the support **16**. The connector part or head **24** of the terminal **12**, how-

ever, extends beyond the left end of the bushing **20** to coact with the female terminal **14** as described below. The male terminal **12** and the insulating bushing **20** are mounted and secured to the block **16** in accordance with an appropriate method, for example, the method described and illustrated in the Just et al. Patent No. 2,995,617 entitled "Self-Locking Terminal," and assigned to the same assignee as the present application.

The female terminal assembly **11**, shown only fragmentarily in FIG. 2, likewise includes a generally rectangular block **26** made from aluminum, for example, and is provided with two rows of openings **28** (only one of which is shown in FIGS. 2 and 3) for respectively accommodating a plurality of insulating bushings **30**. Similar to the block **16**, the block **26** alternatively may have any number of rows of openings **28**. The bushings **30** and terminals **14** are also mounted and secured to the block **26** in accordance with the method disclosed in the above-identified patent. Each bushing **30**, similar to the bushing **20**, is made of suitable insulating and somewhat resilient material and includes an axially extending bore **32** for accommodating the female terminal **14**. The bushing **30** has a block engaging portion **30***a* extending through the block **26** for spacing and insulating the terminal **14** from the block **26**, and also has, in contrast to the bushings **20**, a shielding portion **30***b* extending to the right of the block **26** to substantially surround the connector part or head **34** of the female terminal **14**. Accordingly, when the male terminal assembly **10** and the female terminal assembly **11** are in mated position, oppositely related bushings **20** and **30** abut one another to entirely surround the connector parts **24** and **34** of the terminals **12** and **14**, thereby to isolate the connector parts **24** and **34** from foreign matter, dust and the like.

As best seen in FIGS. 2 and 3, the male terminal **12** embodying the features of the present invention and the female terminal **14** are identically constructed, with the exception of the connector parts **24** and **34**. Considering first the detailed construction of the terminal **12**, it is formed by stamping or the like, from any relatively hard metallic substance having good electrical conductive characteristics, for example, brass or the like. The terminal **12** includes a wire-wrap shank **40** of generally rectangular cross section having relatively sharp corners about which wiring leads (not shown) are tightly wrapped to form a permanent electrical connection between the leads and the terminal **12**. The bottom end **40***a* of the wire-wrap shank **40** is beveled as indicated at **40***a* to facilitate entrance of the terminal **12** into suitable automatic wire wrapping machinery (not shown). The wire-wrap shank **40** is integrally connected to an enlarged gripping shank **42** by a pair of inclined shoulders **44** (see FIG. 3). During the mounting of the terminal **12** and the bushing **20** to the support **16**, the gripping shank **42** functions to expand the bushing **20** into frictional engagement with the opening **18** of the block **16**, thereby providing a good frictional connection between the gripping portion **42** and the bushing **20** and between the bushing **20** and the block **16**. The gripping shank **42** is of generally rectangular cross section but, in contrast to the wire-wrap shank **40**, the edges of the gripping shank **42** are beveled (see FIGS. 2, 3 and 5). The left end of the gripping shank **42** includes a pair of locking notches **46** which extend inwardly to accommodate portions of the bushing **20** that are compressed during mounting of the terminal **12**. To properly position the terminal **12** relative to the bushing **20**, a pair of outwardly extending flanges **48** are located intermediate the locking notches **46** and the connector part **24**, which flanges **48** coact with the left end of the bushing **20**, as viewed in FIGS. 2 and 3. As described in detail below, the connector part **24** comprises a generally blade-like structure that is coplanar with the gripping shank **42** and the wire-wrap shank **40**. The female terminal **14**, similar to the male terminal **12**, is formed by stamping or the like, from any relatively hard metallic substance having good electrical conductive characteristics, for example, a Phosphor bronze alloy.

As stated above, the female terminal **14** is identically constructed to the male terminal **12**, with the exception of the connector parts **24** and **34** and, accordingly, the terminal pin **14** likewise embodies a wire-wrap shank **50** and a gripping shank **52**. Similar to the terminal **12**, locking notches **56** are located adjacent the end of the gripping portion **52** for the purpose of accommodating compressed portions of the insulating bushing **30**. However, in contrast with the terminal **12**, outwardly extending flanges **48** are not provided but, instead the right end of the terminal **14** terminates in a flat, fork-type connector part **34** that receives the blade connector part **24**.

More specifically, the fork-type connector part **34** comprises a pair of spaced-apart tines **58** interconnected by a web portion **60**, the tines **58** having generally rectangular cross sections. The tines **58** are generally elongated and, since the terminal **14** is constructed from Phosphor bronze, the tines **58** are somewhat resilient, i.e., they are capable of limited relative planar movement toward and away from one another. To assure good electrical connection between the fork-type connector part **34** and the blade connector part **24**, semi-cylindrical contact portions **62** extend inwardly to coact with opposite longitudinal surfaces of the blade connector part **24**, as shown in FIGS. 2 and 5. By this semi-cylindrical structure, a good electrical connection between the contact portions **62** and the blade connector part **24** is assured. In addition, since the tines **58** are somewhat resilient, the contact portions **62** move apart to accommodate the blade connector part **24** of the terminal **12** as it mates with fork-type connector part **34** and, furthermore, when the blade connector part **24** and the fork-type connector part **34** are mated, the resiliency of the tines **58** urges the contact portions **62** toward the opposite sides of the blade connector part **24** to provide a good pressure contact between the connector parts **24** and **34**. Thus, irrespective of variations in the dimensions of the connector part **24** caused by commercially acceptable tolerances, a good electrical connection between the male and female terminals **12** and **14** is assured.

It will be appreciated from viewing FIGS. 2, 3 and 5 that terminals **12** and **14** must be 90° related to one another in order that their connector parts **24** and **34** mate. Although the male and female terminals **12** and **14** are accurately mounted on the supporting blocks **16** and **26**, respectively, the terminals **12** and **14** are infrequently mounted in other than the desired position so that the connector parts **24** and **34** are not 90° related to one another. It has been observed that exceptionally slight misalignment of existing or prior art male and female terminals does not subsequently render the male and female terminals **12** and **14** inoperative. However, when the misalignment exceeds a relatively slight amount, for example, three degrees, the misaligned prior art terminals cause the material of the tines **58** to be deformed beyond its elastic limit. Consequently, a permanent setting or deformation of the tines is obtained, with the result that thereafter a lower retentive force is produced by the tines, and, hence the connector part. For example, the retentive force developed by the female terminal after mating with a misaligned male terminal is reduced to approximately fifty percent of the retentive force developed by the female terminal after mating with a properly aligned male terminal. Thus, a substantially reduced pressure contact is obtained between the male and female terminals and, hence, a poor electrical connection results.

In order to obviate the above-described disadvantages of the prior art terminals, the blade connector part **24** of the male terminal **12** is constructed in accordance with the principles of the present invention. Accordingly, terminals **12** and **14** can be misaligned over a relatively wide range but can be readily mated without permanently deforming the tines **58** and reducing the retentive force

of the female terminal **14**. Specifically, and referring primarily to FIGS. 1 and 5, the connector part **24**, as indicated above, comprises a generally blade-like construction and includes a pair of spaced-apart contacting or longitudinal sides **70** and **71** respectively interconnected by a pair of flat, laterally extending sides **72** and **73**. The sides **70**, **71**, **72** and **73** terminate in an end **74** having beveled corners **75** to facilitate entry of the blade connector part **24** into a female terminal having a construction different than the one described above. In accordance with the features of the present invention, the contacting or longitudinal sides **70** and **71** are nonplanar in construction so that irrespective of the misalignment of the terminals **12** and **14** the contacting sides **70** and **71** coact with the contact portions **62** without permanently deforming the tines **58**.

More particularly, each of the contacting sides **70** and **71** is identical in construction and, thus, only the contacting side **70** will be described. As shown in FIGS. 4 and 5, the contacting side **70** is generally peaked outwardly, and is formed by removing or cutting away portions of the terminal, thereby defining a pair of generally triangular shoulders **76** and **77**. Specifically, the contacting side **70** includes a pair of flat surfaces **78** and **80** which extend from the edges of the lateral flat sides **72** and **73**. These surfaces **78** and **80** converge toward one another but do not intersect in planar fashion since the center portion of the contacting side **70** indicated by reference numeral **82**, is rounded throughout a relatively small angle of twelve degrees. Thus, the contacting side **70** comprises a pair of converging surfaces **78** and **80** which are interconnected by a rounded or cylindrical surface **82**, the surfaces **78**, **80** and **82** providing a continuous and uninterrupted surface. It will be appreciated that by virtue of the diverging construction of the surfaces **78** and **80** the tines **58** of the fork-type connector part **34** are not unduly spread even though a slight misalignment exists between the male and female terminals **12** and **14**.

Since the side **71** is identically constructed to the above described side **70**, the structure embodied in the side **71** is identified by the same reference numerals as the corresponding structure in side **70**. As shown in FIGS. 1 and 5, the forward ends of the contacting surfaces **70** and **71** are beveled as indicated at **83** to facilitate the disposition of the blade connector part **24** between the contact portions **62** of the fork-type connector part **34**.

If the terminals **12** and **14** are exactly 90 degrees related to one another, the blade connector part **24** and the fork-type connector part **34** assume the positions indicated in FIG. 6. As shown, the contact portions **62** coact respectively with the centermost points of the rounded surfaces **82**, as indicated at **84** and, consequently, the flat surfaces **78** and **80** are spaced apart from the balance of the contact portions **62**. As a result of this clearance between the surfaces **78** and **80** and the contact portions **62**, misaligned terminals **12** and **14** may be mated without permanently deforming the tines **58** of the female terminal **14**.

If it be assumed that the male terminal is improperly mounted to the support **16** so that it is turned by angle beta from its desired position, then the blade connector part **24** and fork-type connector part **34** assume the positions illustrated in FIG. 7. As shown, the tines **58** are not spread apart because of the diverging relationship of the flat surfaces **78** and **80** and the tines **58** are spaced apart the same amount as when the male and female terminals **12** and **14** are 90 degrees related to one another. With the above described construction, the angle beta may be as great as six degrees and the tines **58** are not permanently distorted, whereas a misalignment of only three degrees with the prior art terminals effects the permanent deformation of the tines **58**. In any event, as shown in FIG. 7, the right contact portion **62** coacts with the lowermost point of the rounded surface **82** of the contacting side **70**, as indicated at **86**, while the left contact portion **62** coacts with the uppermost point of the rounded surface **82**, as indicated at **88**. On the other hand, if it be assumed that both the male terminal **12** and the female terminal **14** are improperly mounted on their respective supports **16** and **26**, for example, both are positioned at an angle equal to half of beta, for example, three degrees from their desired positions, then the blade connector part **24** and the fork-type connector part **34** assume the positions illustrated in FIG. 8. As seen, the tines **58** are spread apart no more than when the male and female terminals **12** and **14** were properly mounted to the supports **16** and **26** and, accordingly, the tines **58** are not permanently deformed although the terminals **12** and **14** are misaligned by six degrees.

To emphasize the advantage of the present invention, an improperly mounted prior art male terminal and terminal similar to the above-described female terminal **14** are illustrated in FIG. 9. It it be assumed that the male terminal **96** is improperly mounted to its support such that it is located in a position displaced from its desired position by an angle beta, for example, six degrees, then the contacting portions **62** of the tines **58** are spread and deformed outwardly by a distance equal to D. The outward deformation of the tines **58** by a distance of D is adequate to effect a permanent deformation in the tines **58**. Thus, the deformed female terminal illustrated in FIG. 9 does not develop the desired or necessary retentive force when thereafter used with a properly mounted prior art male terminal. As a result, a relatively low contact pressure is thereafter produced between the connector parts of the properly mounted male terminal and the deformed female terminal.

It should be understood that within a six degree range of misalignment a male terminal embodying the features of the present invention uniformly spreads the tines of the female terminal so that a substantially uniform retentive force is produced by the female terminal. In this sense, the blade-type terminal of the present invention functions similarly to a pin type terminal which spreads the tines a uniform amount regardless of its rotary position. Hence, by virtue of the rounded contact surfaces **82**, the desirable result of uniform spreading of the tines is achieved; this result, however, would not be achieved by a terminal having converging and intersecting planar surfaces (and no rounded surfaces **82**) since the tines of the female terminal would be spread by progressively lesser amounts for progressively greater amounts of misalignment of the terminals. This result obtains because the effective width of the terminal having no rounded surfaces decreases as the misalignment increases and, therefore, the tines are not adequately spread to produce the necessary retentive force—which is assured by the terminal of the present invention within a relatively wide range of misalignment.

From the foregoing description it will be appreciated that a blade-type terminal constructed in accordance with the present invention permits mating of misaligned male and female terminals without effecting a permanent setting or deformation of the tines of the female terminal. In those installations in which a plurality of male terminal assemblies are successively mated with one female assembly, it is extremely important that the female assembly provide good electrical connections with each of the subsequently mated male terminal assemblies, irrespective of the fact that the male or female terminals are slightly misaligned.

While the embodiment described herein is at present considered to be preferred, it is understood that various modifications and improvements may be made therein, and it is intended to cover in the appended claims all such modifications and improvements as fall within the true spirit and scope of the invention.

What is desired to be claimed and secured by Letters Patent of the United States is:

1. A terminal for coacting with a female terminal hav-

ing spaced apart contact surfaces, said terminal comprising a generally blade-like structure having a pair of generally opposing sides, portions of each of said opposed sides being adapted to engage said contact surfaces of said female terminal, each of said sides including relatively inclined surfaces permitting said portions to engage said contact surfaces without permanently deforming said contact surfaces, irrespective of whether the terminals are properly aligned or slightly angularly misaligned.

2. The terminal of claim 1 wherein each portion includes a transversely extending, curved surface for engaging said contact surface.

3. A terminal for coacting with a female terminal having spaced apart contact surfaces, said terminal comprising a generally blade-like structure having a pair of generally opposing sides, portions of each of said opposed sides being adapted to engage said contact surfaces of said female terminal, each of said sides including non-arcuate surfaces permitting said portions to engage said contact surfaces without permanently deforming said contact surfaces, irrespective of whether the terminals are properly aligned or slightly angularly misaligned.

4. A terminal for coacting with a female terminal having spaced apart contact surfaces, said terminal comprising a generally blade-like structure having generally opposing, laterally spaced sides for coacting with said contact surfaces, each of said sides including outwardly extending first portions for engaging said contact surfaces and, further, including second non-arcuate portions laterally spaced apart less than the contact portions, said second portions being configured to permit said first portions to engage said contact surfaces without effecting permanent deformation of said contact surfaces, irrespective of whether the terminals are accurately aligned or slightly angularly misaligned.

5. A terminal for coacting with a female terminal having spaced apart contact surfaces, said terminal comprising a generally blade-like structure having generally opposing sides, each of said sides being generally peaked outwardly to coact with one of said contact surfaces, said generally peaked sides assuring good electrical contact between the terminals yet permitting limited angular terminal misalignment without spreading and permanently deforming the contact surfaces.

6. A terminal for coacting with a female terminal having spaced apart contact surfaces, said terminal comprising a generally blade-like structure having a pair of generally opposed sides, each of said sides including relatively inclined surfaces, each of said relatively inclined surfaces including a portion engaging said contact surface of said female terminal, whereby said inclined surfaces assure good electrical contact between the portions and the contact surfaces without permanently deforming the contact surfaces, irrespective of whether the terminals are correctly aligned or angularly misaligned.

7. A terminal for mating with a female terminal having spaced-apart contact surfaces, said terminal comprising an elongated blade having a generally rectangular cross-section including oposite sides, each of said sides including relatively inclined sections converging in a transversely extending, curved section, said curved sections being engageable with said contact surfaces and being symmetrically located on said sides to permit mating of said terminals when angularly misaligned without permanently spreading the contact surfaces.

8. A terminal for coacting with a female terminal having spaced apart contact surfaces, said terminal comprising a generally blade-like structure having a pair of generally opposing sides, portions of each of said opposing sides being adapted to engage said contact surfaces of said female terminal, each of said sides being constructed so as to permit said portions to engage said surfaces without permanently deforming said contact surfaces, irrespective of whether the terminals are properly aligned or slightly angularly misaligned.

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