Oct. 9, 1951 Q. BERG 2,570,753

SPADE CONNECTOR CONVERTIBLE TO RING CONNECTOR

Filed Feb. 8, 1949 2 Sheets-Sheet 1

Fig. 1.

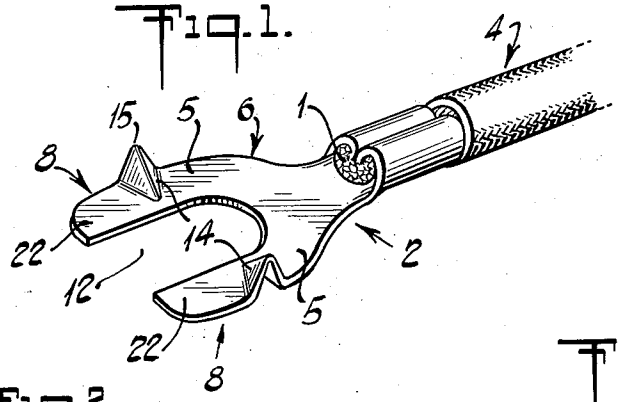



Fig. 2.

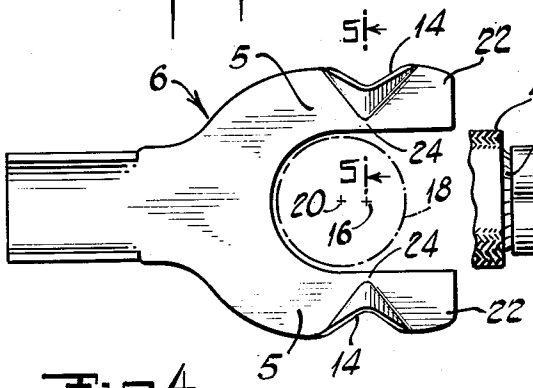



Fig. 3.

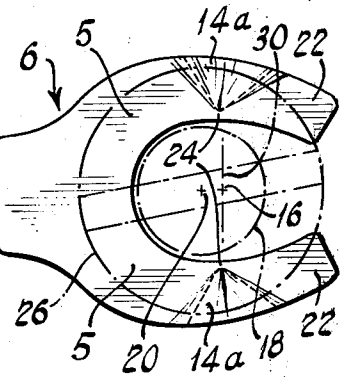



Fig. 4.

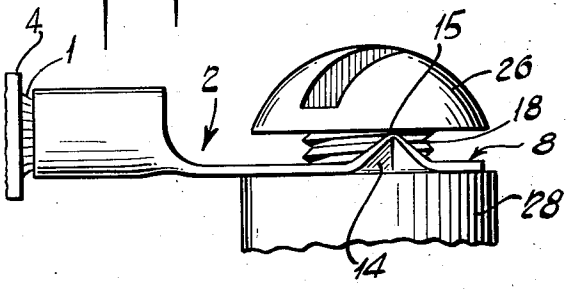



Fig. 5.

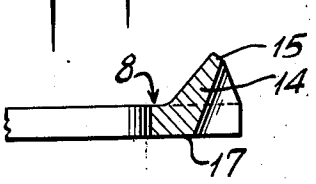
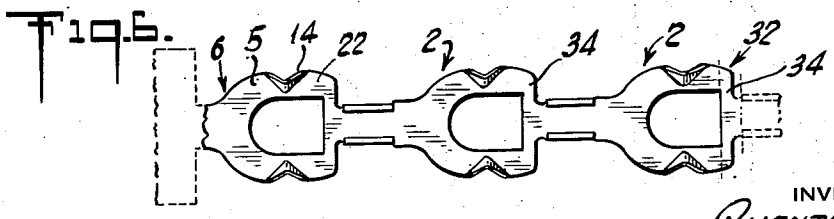



Fig. 6.




INVENTOR
QUENTIN BERG.
BY
Curtis, Morris & Safford
ATTORNEYS

Oct. 9, 1951 Q. BERG 2,570,753

SPADE CONNECTOR CONVERTIBLE TO RING CONNECTOR

Filed Feb. 8, 1949 2 Sheets-Sheet 2

Fig. 7.

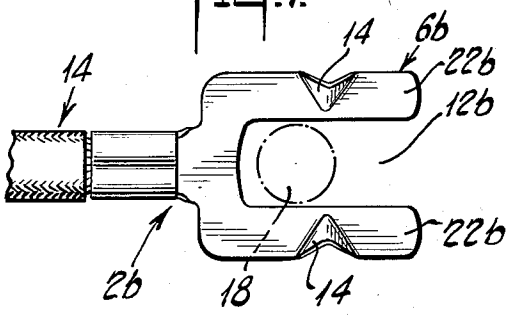
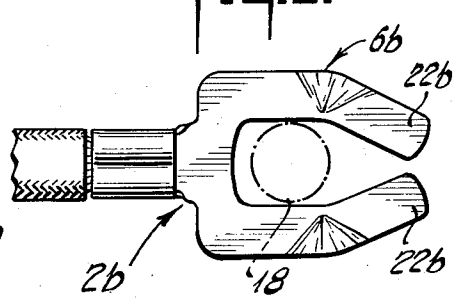



Fig. 8.




INVENTOR
QUENTIN BERG.
BY
Curtis, Morris & Safford
ATTORNEYS

Patented Oct. 9, 1951 2,570,753

# UNITED STATES PATENT OFFICE

2,570,753

## SPADE CONNECTOR CONVERTIBLE TO RING CONNECTOR

Quentin Berg, New Cumberland, Pa., assignor to Aircraft-Marine Products, Inc., Harrisburg, Pa.

Application February 8, 1949, Serial No. 75,183

1 Claim. (Cl. 173—269)

1

This invention relates to electrical terminals, and more in particular to tongue terminals of the types which are attached to a wire or the like, preferably by a crimped or pressure-formed connection, and which then form the female terminal by which the wire is connected to a male terminal.

Many different types of terminals have been developed for attaching a wire to a male terminal or a like member, such as, a binding post, a rod, a rivet, or the shank of a screw or bolt. Among these terminals are the spade or spade-tongue type having the spade-tongue forked to form two parallel spade legs with an entry slot therebetween into which the male terminal is received. This spade-tongue type of terminal is easily attached to the male terminal by slipping the spade legs onto the opposite sides of the male terminal and then tightening a nut or screw, or the like, so as to clamp the spade-tongue in position. Thus, in many mass production operations spade-tongue terminals are used with the advantage that the male terminals may be in the form of screws assembled onto a terminal plate prior to the wiring operation and then the terminals are slipped onto their respective screw shanks and the screws are merely tightened up. However, difficulties have been encountered with spade-tongue terminals particularly because of the relative ease of disconnection from the male terminal when the tongue-clamping pressure is relieved as might occur under vibratory or impact conditions.

For example, with household appliances which are mass produced and which are created and shipped to the ultimate consumer for installation by inexperienced hands, the disconnection of a single terminal may render the appliance inoperative and this may cause a disproportionately large service expense and may even damage the goodwill of the manufacturer.

The simple loosening of the clamping action of a male terminal will not cause this difficulty if the spade-tongue terminal is replaced by a ring-shaped terminal having its tongue formed by a ring. However, ring-tongue terminals are relatively unsatisfactory for use in many operations because they must be slipped onto the end of the male terminal. That is, when the male terminal is a screw, the terminal must be held on the screw or over the screw hold while the screw is started and turned into the hole; and, when the male terminal is a bolt or stud, the ring-tongue must be slipped over the bolt prior to the starting of the nut or other clamping device thereon.

2

It is an object of the present invention to provide an improved terminal construction and mode of applying the same which avoid the difficulties encountered with similar terminals in the past. It is a primary object of this invention to provide a terminal-tongue construction which has the advantages of the prior spade-tongue terminals and also the advantages of the ring-tongue terminals. Another object of the present invention is that of providing improved terminals which may be easily attached to male terminals with a simple unidirectional movement and then are free of danger of accidental disconnection. A further object is to provide a terminal of the above character which will not become disconnected accidentally and yet which may be disconnected when desirable. Another object is to provide for the manufacture and use of terminals of the above character with maximum efficiency and economy. A still further object is to provide for the manufacture of terminals in such a manner as to use a minimum amount of sheet metal and require a minimum amount of work in the manufacture as well as in the attachment of the terminals to their male terminals.

In connections utilizing terminals of this general character, including spade-tongue terminals and ring-tongue terminals, the loosening of the clamping action associated with a male terminal is accompanied by an increase in the contact resistance between the two terminals, and with low voltages the resistance may be of such magnitude that it produces the effect of an open circuit even though the terminals are still physically connected. Further, under heavy current conditions such a loose connection may become excessively hot, even to the extent of melting and deforming the assemblies. It is a further object of the present invention to overcome this difficulty by preventing the loosening of the clamping action and also by maintaining a relatively low contact resistance even when the clamping action is not entirely right.

Ring-tongue terminals have the advantage of providing an annular zone or area of contact substantially throughout the periphery of the male terminal, whereas spade-tongue terminals provide an area of contact which is substantially less than that of the ring-tongue terminal. Furthermore, this area of contact with spade-tongue terminals is quite variable depending upon the position of the tongue with respect to the axis of the male terminal. It is among the objects of the present invention to provide terminals which are of the spade-tongue type and yet

which have contact area which approaches or equals that of the ring-tongue terminals and which is constant.

These various objects are met by providing terminals of the spade-tongue type having pressure-sensitive means to obtain a wrapping effect and increase the amount of circumferential enclosure by said spade-tongue terminals of male terminal members received therein when transverse pressure is applied to the spade-tongue of said terminals.

In this specification and the accompanying drawings, I have shown and described a preferred embodiment of my invention and various modifications thereof; it is to be understood that these are not intended to be exhaustive or limiting of the invention, but on the contrary are given principally for purpose of illustration in order that those skilled in the art may fully understand the invention and principles thereof and the manner of applying it in practical use so that they may modify and adapt it in various forms, each as may be best suited to the conditions of a particular use.

In the drawings:

Figure 1 is a perspective view of a terminal constituting one embodiment of the invention;

Figure 2 is a top plan view of the terminal of Figure 1 prior to being crimped to a wire;

Figure 3 is a view similar to Figure 2, but showing the terminal crimped to a wire as in Figure 1 and after attachment to a male terminal; the male terminal and the flattened ruffle portions are shown with dotted lines;

Figure 4 is a side elevation of the terminal as shown in Figure 3 prior to being clamped by a male terminal member;

Figure 5 is a sectional view on the line 5—5 of Figure 2;

Figure 6 is a top plan view on reduced scale of a strip of terminals of the type shown in Figures 1 to 4; and

Figures 7 and 8 are similar to Figures 2 and 3, but show another embodiment of the invention.

Referring particularly to Figure 1 of the drawing, crimped to the bared end 1 of an insulated wire 4 is a terminal 2, which has a spade-tongue shown generally as 6 bifurcated to form a pair of spade legs 8. Between legs 8 is a slot 12 which is adapted to receive a male terminal such as the shank of a screw. Each of legs 8 has an edge pleat-like ruffle or fold 14, shown here as being located approximately centrally of its longitudinal extent (see Figure 2). These folds are shown oppositely disposed with respect to the longitudinal axis of the terminal that is, the axis parallel to the insulated wire 4 and the common central axes of the folds are on a line which crosses this longitudinal axis at a point 16, referring to Figure 2 which is nearer the mouth of slot 12 than the normal position of the axis 20 of a male terminal to which terminal 2 is to be connected. For example, the shank 18 of such a male terminal is indicated in broken lines and has an axis 20 which is positioned to the left of point 16.

Each of legs 8 has an end segment 22 which is integrally connected to the base portion 5 of its legs with its fold 14, and a relatively narrow flat portion 24 adjacent slot 12 at the junction of the two. Each of the folds 14 is formed by two angularly disposed triangular portions which (see Figure 5) are somewhat tapered to a relatively narrow edge at the peak 15 of the fold from the base 17 of the fold integral with and of substantially the same thickness as the adjacent flat portions of its leg; this form is obtained by pressure forming or drawing the fold 14 from the flat spade legs 8. In use a terminal 2 is first crimped to the end of an insulated wire as in Figure 1 and its spade is then slipped onto a male terminal, illustratively at shank 18 of a screw which is positioned as indicated in Figures 2 through 4. The screw is then tightened with the head 26 of the screw (see Figure 4) engaging the peaks 15 of folds 14 and with the bottom surface of the spade resting on a terminal plate 28. As the screw is tightened from the position shown in Figure 4, the folds 14 are flattened down toward the plane of the flat portions of legs 8. During this flattening operation, the two triangular portions of each fold exert strong forces toward each other, as their areas are greater than the area beneath them which they are driven to occupy, and the reactions of these forces are resolved to effectively push the outer peripheral areas of the end segments 22 away from the base portion of the leg. Segments 22 therefore move toward each other with the narrow flat portions 24 acting as pivot zones around which the segments swing. Thus, the mouth of slot 12, is partially closed by these end segments 22 with the result that the shank 18 of the male terminal will no longer slip from the slot.



The pleat-like ruffles or folds 14 shown in the embodiment of Figures 1 through 6 are of the triangular plane type, and in fact, resemble somewhat one-half of a dimple. When desirable, other types of folds or ruffles may be used to obtain the advantages of the present invention. The general characteristic of such folds or ruffles is that they have greater surface area at the outer margin of the leg than at the inner margin, and therefore, when flattened by being subjected to pressure they increase the length of their respective legs at their outer periphery; this causes the leg to bend and wrap around the male terminal located at the inner margin of the leg. For simplification, the term ruffle is used herein as a generic expression for such folds or ruffles.

In effect, the flattening of the ruffles causes each of the legs of the tongue to wrap around the shank and the terminal has the characteristics of securely gripping a male terminal which previously has been associated with ring-tongue terminals. It is thus seen that the terminal 2 may be applied to a male terminal in the same manner as a standard spade-tongue terminal is applied, that is, moved in a plane parallel to itself, but after the tightening of the clamping means of the male terminal, the terminal 2 resembles a ring-tongue terminal in that it will not slip readily from the male terminal. Referring to Figure 3, note that since the terminal 2 has its segments 22 wrapped around shank 18, they are contacted over a considerable portion of their area by the clamping surfaces of the male terminal. Note also that the shank 18 is held near the bottom of the slot 12, thus insuring that the thus increased area of contact provided between the two terminals is maintained substantially constant.

After terminal 2 is clamped in position on a male terminal and ruffles 14 are flattened, these ruffles tend to return toward their original shape due to their residual elasticity, and therefore, they exert pressures upwardly onto head 26 of the screw. Terminal 2 is illustratively made of copper and the cold working hardens it and tends to raise its elastic limit with the result that the portions of the legs which previously formed

ruffles **14** are relatively hard and elastic thus giving beneficial results. The use of spade-legs made of spring metal such as beryllium copper would augment this upward pressure as well as provide other advantages. For some applications a combination of a rigid flat spade-tongue with one or more attached spring members having edge ruffles might be employed. Referring to Figure 3, the compressed ruffles **14***a* create the upward forces on a line **30** which is at the right-hand side of shank **18**, and therefore, these forces tend to cock or tip the screw. This advantageous location of the edge ruffles thus gives a locking effect as a screw thus tipped does not loosen easily, while maintaining constant contact pressure.

With this embodiment of the invention, the arrangement is such that when the edge ruffles **14** are flattened the mouth of slot **12** is closed sufficiently to hold shank **18** in the slot; however, under some circumstances it is desirable to close the slot more or less than is here shown. For example, the wrapping action may be only enough to slightly close the mouth of the slot thus enabling terminal **2** to be removed from the shank **18** by releasing the clamping pressure and exerting a firm pull; the resiliency of legs **8** is sufficient to permit repeated removal in this manner and reattachment to shank **18**. Under some circumstances the mouth of slot **12** is substantially closed causing segment **22** to swing into abutting relationship. These variations in the amount of wrapping are effected by changing the relative sizes and shapes of the base portions **5** and end segments **22** of the spade legs **8** and by varying the shape, size, and number of edge ruffles **14**.

The use of more than one ruffle on a given spade leg, besides enabling more complete enclosure of the male terminal, is advantageous when a terminal tongue which was generally flatter prior to its being clamped by means associated with a male terminal is desired. For a given amount of wrapping, the wrapping effect of two ruffles on a given spade leg could be made equal to or greater than that of one ruffle of comparatively larger size. If two such ruffles are used on a given spade leg, the ruffle disposed



nearest the opening of the spade-tongue might not be easily located sufficiently under the clamping means of a male terminal to be properly clamped thereunder. However, the other ruffle on said leg could be of a greater height so that its initial wrapping effect would bring the second, smaller ruffle properly under said clamping means, after which further clamping completes the wrapping by flattening both ruffles simultaneously.

The terminal of Figures 1 to 5 may be manufactured in strip form as indicated at **32** in Figure 6, and when the terminals are applied each is cut from the strip with there being a discarded portion **34** between each terminal and the next.

In the embodiment of Figures 7 and 8 a rectangular spade-tongue terminal **2***b* is provided which has longer end segments **22***b* in order that they, **22***b*, move very close to each other when the ruffles **14** are flattened.

I claim:

An electrical connector construction having a tongue embodying a pair of adjacent spade portions, the inner edge of one spade portion being substantially parallel to the inner edge of the other spade portion and said edges defining therebetween a substantially parallel-sided slot-like recess of greater length than width, said spade portions including a nonplanar ruffle-like formation on their respective outer edges, and said nonplanar formations having a line of bend extending across each spade portion to a point adjacent the inner edge thereof, nearer the inner end of said recess than the distance between said edges but further from the inner end of said recess than one-half said distance.

QUENTIN BERG.


## REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 955,747 | Barcy | Apr. 19, 1910 |
| 1,026,653 | Brunt | May 21, 1912 |
| 1,703,325 | Smarr | Feb. 26, 1929 |
| 1,978,115 | Roper | Oct. 23, 1934 |