

March 2, 1954

H. H. WERMINE
ELECTRICAL CONNECTOR

2,671,205

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Fig. 1.

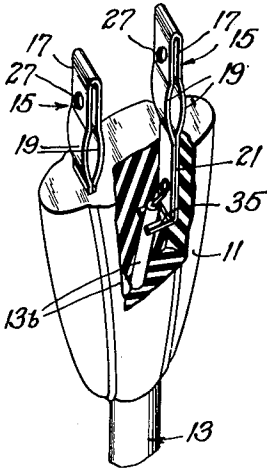


Fig. 2.

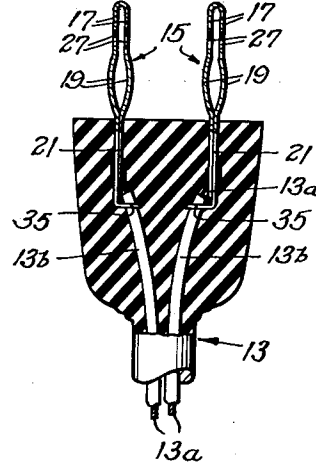


Fig. 3.

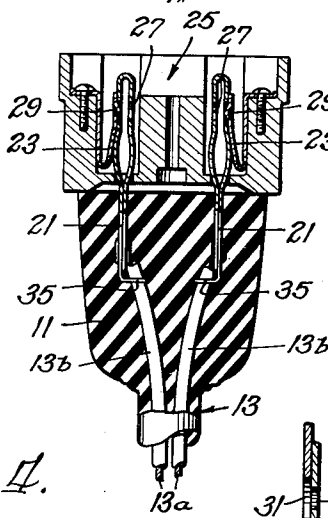


Fig. 4.

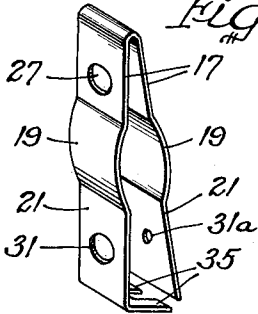


Fig. 5.

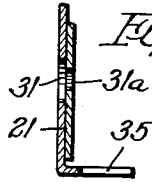


Fig. 10.

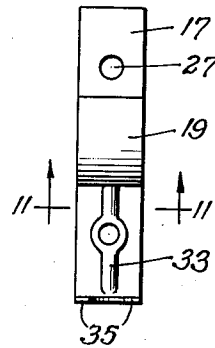


Fig. 7.

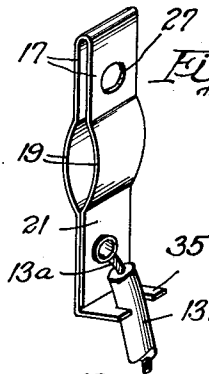


Fig. 6.

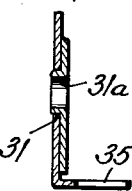


Fig. 9.

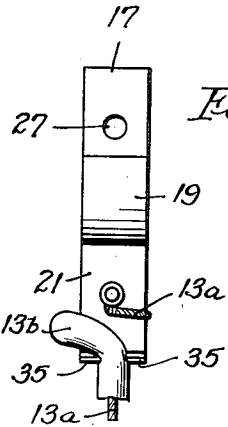


Fig. 8.

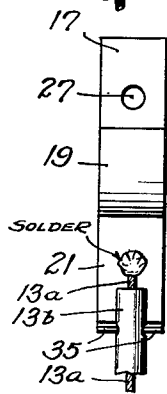
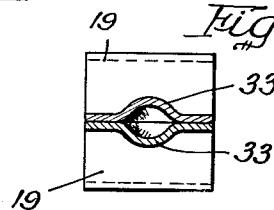


Fig. 11.



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UNITED STATES PATENT OFFICE

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ELECTRICAL CONNECTOR

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Application August 20, 1947, Serial No. 769,563

1 Claim. (Cl. 339-59)

1

2

The present invention relates generally to molded electrical connector plugs of the type wherein the terminal connectors are molded in place when the plug body is itself formed. These connector plugs are usually molded onto the cord or other conductor with which they are to be used, and the complete assemblage or cord set may be used for connecting an electrical appliance to a source of electrical power. The invention has particular relation to the blade terminals which form a part of such devices. This application is a continuation in part of my co-pending application, Serial No. 479,846, which was filed on March 20, 1943, now Patent No. 2,439,767, and which is assigned to the assignee of the present invention.

In the past, considerable difficulty has been experienced in providing good electrical contact between the blade terminals of connector plugs and the cooperating contacts of receptacles or other power outlets, particularly in the case of receptacles which have been in use for some time. To overcome this difficulty, it has been proposed that spring blades be used as the terminals for the plug, and in my aforesaid co-pending application there is disclosed a novel spring blade which overcomes the objections of the prior devices.

The usual molded electrical connector plug of the class described, comprises a body of resilient insulating material in which there has been molded two or more blade terminals for the cord conductors. During the molding operation, the insulating material of the plug becomes bonded to the outer insulating cover on the conductor cord; the blade terminals are supported in, and project outwardly from, the insulating body of the plug, so as to engage the contacts of the receptacle or other power outlet with which the plug is to be used.

During the manufacture of cord sets of the class described, a blade terminal is attached to each of the conductors of the conductor cord and the terminals are then supported in position in a suitable molding press. The proper amount of rubber or other moldable, insulating compound is placed in the mold cavities of the press, and heat and pressure are applied to effect the molding of the insulating body. In the production of such cord sets, many difficulties have been encountered because the cord conductors and the blade terminals become misaligned during assembly into the mold, with the result that the electrical connectors become stressed and, in extreme cases may even be broken during the mold-

ing operation. This mechanical stressing or breaking of the electrical connectors results in finished cord sets which are either liable to fail during use or which do not have a continuous electrical circuit. Another deficiency of the prior art plugs has been that the blades or prongs and their attached conductors are not strongly anchored in the molded body, so that pulls or jerks on the conductor cord during use, tend to pull the contact blades out of the insulating body and to break the electrical connection between the blades and their attached electrical conductors. These failures result in the scrapping of an excessively large number of molded cord sets because it is impossible to repair the device without re-molding the insulation.

The principal object of the present invention, therefore, is to overcome these deficiencies in the prior art molded connectors, and especially in molded connectors of the smaller sizes. This object is accomplished by providing an improved spring blade which embodies the advantages of the spring blade disclosed in my co-pending application and which possesses certain other advantages of particular utility in the manufacture of molded electrical connector plugs. As will hereinafter appear, the improved spring blade of the invention includes means which assures proper aligning of the blade and the associated conductor cord during the molding operation, this means serving the further function of anchoring the blade in place in the supporting body into which it is molded. The connector cord and blade aligning and anchoring means may also be employed to provide a strain relief intermediate the conductor cord and the contact blade.

The spring blade of the invention assures a good electrical connection with the contacts of standard receptacles or other power outlets regardless of wearing or loss of resiliency in the receptacle contacts, and in addition, it can be manufactured at a low cost on automatic equipment and it is easy to assemble and use.

Other objects and advantages of the invention will be made apparent by reference to the accompanying drawings and the following description of certain embodiments thereof. In the drawings:

Fig. 1 is a perspective view, partially in section, of a molded connector plug which is provided with spring blades constructed in accordance with the invention;

Fig. 2 is an elevational view, in section, of the connector plug shown in Fig. 1;

3

Fig. 3 is a sectional view showing the manner in which the plug illustrated in Figs. 1 and 2 is inserted into a receptacle;

Fig. 4 is a perspective view showing the spring blade before the individual plies or half-sections are fastened together;

Figs. 5 and 6 are side elevational views, in section, showing the manner of fastening the plies together by swaging;

Fig. 7 is a perspective view of a spring blade to which a conductor is attached in accordance with the invention;

Fig. 8 is an elevational view of a modified connection between the spring blade and the conductor, the connection providing a strain relief between the blade and the conductor;

Fig. 9 is an elevational view of the spring blade which forms a part of the connector plug illustrated in Fig. 1, the blade being connected to the cord conductor in a manner which provides a modified strain relief;

Fig. 10 is an elevational view of a modified spring blade; and

Fig. 11 is a sectional view taken on line 11-11 in Fig. 10.

The connector plugs illustrated in the drawings are of the molded, soft body, two conductor type. The body 11 is made of a resilient rubber compound or the like. During the molding operation, the body 11 becomes integrally joined with the outer insulation on the conductor cord, indicated at 13 in the drawings. In the structure illustrated, the cord 13 is of the duplex or two conductor type, and includes an outer covering of insulating material within which are enclosed a pair of individually insulated metallic conductors 13a, the individual insulating jackets are indicated at 13b in the drawing. Before the molding operation, a contact blade 15 is attached to each of the conductors 13a and the cord 13 and the blades 15 then positioned in a suitable molding press so that a plastic mass of the molding compound will surround the ends of the conductors 13a, their insulating jackets 13b, and the shanks of the contact blades 15.

As previously stated, the present invention is concerned with the terminal contacts or blades and with providing a combination conductor positioning and blade anchoring means, formed integrally with the blade. The standard specifications for terminal contacts or blades are determined by the Underwriters' Laboratory which is sponsored by the National Board of Fire Underwriters. The specifications set forth the proper dimensions for the equipment and the allowable manufacturing tolerances, and thus substantially all electrical equipment is interchangeable. It is understood that the dimensions of the blades and connector plugs which are herein described will fully comply with all of the requirements of this body.

The improved spring blade 15 of the present invention constitutes a two-ply, transversely resilient blade which, in its physical dimensions, fully conforms to the requirements of the Underwriters Laboratory. The blade 15 is manufactured by folding over and shaping a strip of suitable spring material of standard prong width (.25 inch) so as to provide two, longitudinally spaced, transversely resilient, contact portions 17 and 19, and a shank or support portion 21 which constitutes an extension of the contact portions and which is adapted to be molded into the plug body 11.

The outermost contact portion 17, comprises

4

co-extensive, substantially parallel sections of the strip which are spaced apart a short distance, of the order of about .008 inch, and which have a length which is between about .25 inch and .375 inch. In certain instances it has been found desirable to provide a slight taper of the order of from about 2 to 5 degrees to the two half-sections of the outermost contact portion 17, the taper being in such direction as to provide the minimum blade thickness at the outer extremity of the blade. The term "substantially parallel" as used herein is intended to include constructions which may be slightly tapering or which are truly parallel. The inner contact portion, 19, has a length approximately equal to the length of the outer contact portion 17 and comprises symmetrical, outwardly bowed arcuate sections of the strip, the radius of the defining surface in one particularly satisfactory embodiment of the invention being approximately .5 inch.

The strip material from which the blades are manufactured is preferably spring brass or phosphor bronze, and tests indicate that it should have a thickness within the limits of approximately .015 to .030 inch. The two halves of the strip are bent back upon each other along a smooth radius, and in the illustrated structure the two halves of the blade 15 are symmetrically disposed with reference to the longitudinal axis of the blade. The relative positioning of the bowed contact portion and the plug body should be such that the inner or shank end of the bowed contact portion 19 will be spaced outwardly from the face of the plug body, a distance equal to about .020 inch.

To provide an interlocking engagement with the stationary contacts 23 of the usual standard receptacle as illustrated at 25 in Fig. 3, the two blade sections which define the parallel sided contact portion 17 are preferably provided with opposed holes 27 which engage the usual projections 29 constituting a part of the receptacle contacts 23. The holes 27 may be formed by a straight punching operation, or by a combination punching and embossing operation. The size of these holes is determined by the Underwriters specifications which have been previously set forth.

Aligning holes 31 and 31a are punched or otherwise formed in the two-half sections of the shank 21. The aligning holes 31 and 31a are of differing cross sectional dimensions, the hole 31 in the outer half-section being larger in area than the hole 31a in the inner half-section. During the manufacture of the blade, material from the periphery of the smaller hole 31a is forced into the larger hole 31, by an inside swaging operation, thereby rigidly joining the two half-sections together, as shown in Figs. 5 and 6. In addition to joining the half-sections together, the swaged connection formed between the two holes 31 and 31a materially stiffens the blade shank 21, so that it is more resistant to bending stresses. The opening through the two-half sections which remains at the conclusion of the swaging operation can be used for receiving the conductor which is to be connected to the blade.

One or both of the two half-sections of the shank 21 may be provided with embossed reinforcing ribs 33 which extend downwardly from the bowed contact portion 19. The ribs may extend across about 1/2 of the width of the shank 21 and the remainder of each of the half-sections of the shank 21 may be flat. If the two shank

5

sections are joined together by means of the inside swage connection, as has been previously described, the embossed ribs 33 effect an added strengthening of the shank 21 and, under some conditions, are especially desirable.

The strip from which the blade 15 is made is folded along a line which is spaced from the mid-point of the strip so that one of the half-sections of the shank 21 is substantially longer than the other half-section of the shank 21. The lower end of the longer half-section is bent inwardly under the shorter half-section at substantially a right angle. The center section of the inwardly extending portion thus made, is cut away to form a pair of spaced-apart ears or tabs 35. The ears 35 are an important part of the cord positioning and anchoring means of the invention, and they may be used to accomplish a strain relief function.

When the spring blades 15 are to be attached to the cord conductors 13a, the insulating jacket 13b is stripped from each of the individual metallic conductors 13a for a short length. Each of the short lengths of bared conductor is inserted in the hole 31 of one of the blades 15 and is mechanically and electrically joined thereto, either by soldering or by means of an expansible eyelet. The adjacent portion of the jacketed cord conductor is then pressed between the ears 35 at the base of the shank portion so as to align the cord conductor with its associated blade.

After the spring blades 15 have been attached to the ends of the cord 13, and the blades and conductors have been aligned as above described, the assemblage is placed in a cavity in the plug mold together with a suitable amount of rubber compound or other similar material. The mass of compound is then heated and compressed to form the plug body around the shanks of the blades 15.

The ears 35 hold the conductor in a proper alignment during the handling and assembling of the blade in the mold and prevent the formation of damaging stress in the electrical connection with the blade. The ears also serve the added function of anchoring the blade in the plug body so that the blade is securely held in position after the moldable material has set.

When the added function of strain relief is desired, as when using high molding pressures or harder bodies or very low tensile strength conductors, the spaced-apart ears or tabs 35 in the base of the shank may be crimped into the insulating jacket for the cord conductor (Fig. 8). Greatly increased strain relief can be obtained if the conductor is wrapped around the shank of the blade one turn before it is passed between the projecting ears which extend at right angles between the shank (Fig. 9). The ears 35 are then crimped together so that they grip the insulating jacket 13b of the conductor 13a, thus firmly anchoring the insulating jacket to the spring blade 15.

The strain relief which is provided by crimping the ears 35 into engagement with the insulating jacket 13b, greatly reduces the number of mechanical failures which occur between the cord conductors and their terminal blades. A force which tends to separate the conductor from the blade is resiliently absorbed by the compression of the insulating jacket by the metallic conductors.

The terminal blade of the invention assures a good electrical connection with all standard power

6

outlet receptacles even though the receptacle has been badly worn. The shape of the blade is such that the blade may be easily inserted in a receptacle but after the blade is inserted, the bowed contact portions hold it securely in place. The swaged connection between the two half-sections of the blade provides an inexpensive method of joining the half-sections together, and at the same time reinforces the blade shank.

In addition to cooperating with all types of receptacles, the terminal blade connectors of the invention make possible the obtaining of a firmly anchored blade in molded connector plugs. The bendable tabs at the base of the shank preserve the alignment of the blade and the conductor in the mold and thus assures a stress-free electrical connection, with or without a strain relief, in combination with a spring prong blade of such size that it can be molded into a small plug. The structure of the invention has substantially overcome the breakage of electrical connections and over-stressing of the conductors during molding.

Various of the features of the invention that are believed to be new are set forth in the appended claim.

I claim:

In combination with a conductor cord having at least one metallic conductor which is enclosed in an insulating jacket, a molded connector plug of the class described which includes a molded body of resilient insulating material and at least one spring blade, said spring blade comprising a fiat metal strip of uniform width which is folded upon itself at the outer end of said blade and shaped to provide two longitudinally spaced resilient contact portions and a shank portion, one of said contact portions being located at the outer end of said blade and comprising co-extensive, substantially parallel sections of said strip which are spaced a short distance from each other, the other of said contact portions being located longitudinally adjacent said first-mentioned contact portion and comprising co-extensive sections of said strip which are spaced apart a substantially greater distance than said parallel sections, said other contact portion comprising a substantially greater maximum transverse width than said first-mentioned contact portion, and said shank portion comprising parallel sections of said strip, each of said parallel sections having an opposed opening, the opening in each of the sections being of a different size, said sections being joined together and strengthened by material from around the edges of the smaller of said openings, which is forced into the larger of said openings so as to leave a conductor receiving opening, means for attaching said metallic conductor into said conductor receiving opening, and bendable means including a pair of spaced apart tabs which project outwardly from the lower portion of the shank of said blade in a direction substantially perpendicular to the plane of said shank, said tabs being crimped together to grip the insulating jacket of said metallic conductor so as to position said conductor relative to said blade and to accomplish a strain relief function, the shank of said blade, the attached conductor, and the extending tabs being molded into said resilient plug body whereby said perpendicular tab portions are effective to resist removal of the blade from within the molded body.

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7

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