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E. R. OLSON

2,279,794

ELECTRICAL CONNECTOR

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Fig. 1.

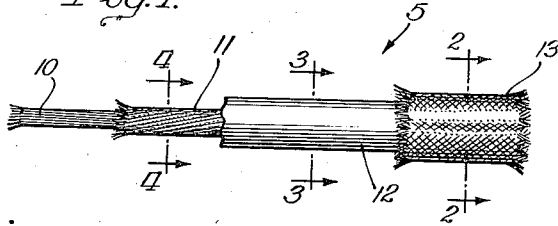


Fig. 2.



Fig. 3.

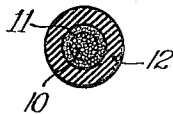


Fig. 4.

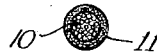


Fig. 5.

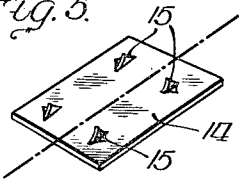


Fig. 6.

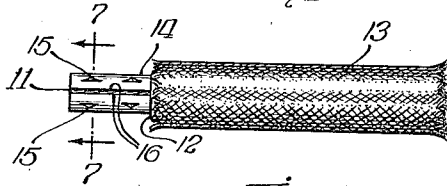


Fig. 8.

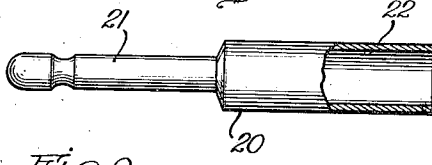


Fig. 9.

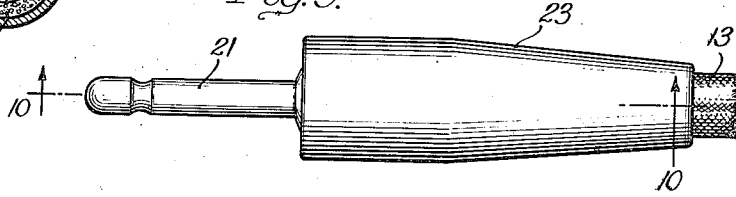
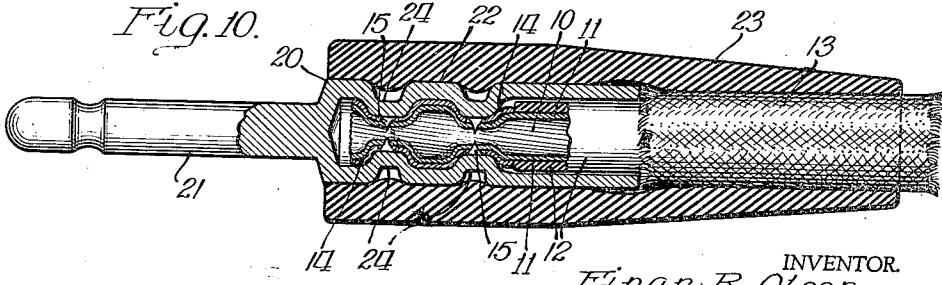


Fig. 10.



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UNITED STATES PATENT OFFICE

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ELECTRICAL CONNECTOR

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Application January 8, 1941, Serial No. 373,529

4 Claims. (Cl. 173-269)

My invention relates generally to mono-cord electrical connectors of the plug-in type, as for example, the jack plug connectors used in conjunction with electrically operated business and tabulating machines, switchboards, and the like. The invention is particularly concerned with the provision of an improved electrical and mechanical connection for the terminals and conductors of connectors of this general type, this connection reducing breakage and extending the service life of these devices.

Connectors of the subject type usually comprise a cylindrical, metallic, terminal or contact member of the plug-in type, a flexible, insulated lead wire or cord having a stranded conductor which is attached to the rear portion of the contact member, and a suitable grip or sleeve, preferably of resilient rubber, enclosing the rear portion of the contact member and the adjacent portion of the lead wire. This resilient grip or sleeve serves to enclose the electrical and mechanical connection between the terminal and the lead wire, and facilitates the grasping of the connector during its use. The grip or sleeve may also provide a certain amount of strain relief support for the lead wire.

Although connectors of this type now in use are generally satisfactory for the purposes intended as long as they remain in good condition, the breakage and failure thereof due to the repeated flexing, bending, and tension stresses which accompany the ordinary use of these connectors is relatively high.

The principal object of my invention is to provide plug-in connectors of this type which have a much greater service life than that of connectors heretofore available in the art. An additional object of my invention is to provide improved long-life connectors which can be manufactured at little or no greater cost than the present connectors intended for the same purposes.

According to my invention, the usual fabric or thread separator which overlies the conductor of the lead wire portion of the connector, contrary to the prior practice, is not removed when the connector is assembled. A clip of thin metal overlies the end of the lead wire and the separator which is left in place thereon. Projections provided on the inside of the clip extend through the serving to engage the strands of the lead wire conductor. The terminal or contact member is crimped or pressed onto this end of the lead wire with the metal clip thereon. The separator, which is left on the end of the conductor, serves both to support the conductor, and as a sleeve

housing or retainer for the ends of any of the conductor strands which may become broken through extended use. This construction contrasts with the usual connector assembly and construction wherein the end of the lead wire conductor is completely bared and stripped of all insulation, including the inner separator, and a terminal is then fastened to the bare end.

For a more complete understanding of the nature and scope of my invention, reference may now be had to the following detailed description taken in connection with the accompanying drawing, in which:

Fig. 1 shows a lead wire with the different layers or parts of the insulation stripped therefrom so as to show the construction thereof;

Figs. 2, 3, and 4 are sectional views taken on lines 2-2, 3-3 and 4-4, respectively, of Fig. 1;

Fig. 5 is a perspective view of a thin metal clip member before it is applied to the end of the lead wire;

Fig. 6 is a view showing the metal clip applied over the stripped end of a lead wire;

Fig. 7 is a sectional view taken on line 7-7 of Fig. 6;

Fig. 8 is a fragmentary view of a terminal or contact member which is to be applied to the end of a lead wire;

Fig. 9 is a side view of a completely assembled electrical plug-in connector; and,

Fig. 10 is a sectional view taken on line 10-10 of Fig. 9.

Referring now to Figs. 1 through 4 of the drawing, a lead wire or cord is indicated generally at 5 having a flexible, central, stranded conductor 10. The conductor 10 is covered with a separator 11 made up of threads wound in long spirals of relatively few turns per unit length, around the conductor. This type of covering, when thus formed by winding threads around a conductor, is referred to in the art as a "serving" or "serve." And, when the threads are wound in long spirals so as to be nearly lengthwise with the conductor, the covering is referred to as a "long serve." Such a serving has considerable longitudinal strength. It will be understood that the separator 11, instead of being in the form of a serving as shown may also be in other forms such as a long single braid. The threads making up the separator 11 are preferably formed of long staple cotton fibers. However, certain other fibrous materials such as wool fibers, silk, synthetic fibers, spun glass, etc., may be used.

A sheath of rubber insulation 12 is extruded over the separator or serving 11. Ordinarily the

lead wire will be provided with an outer woven or braided fabric sleeve 13 over the outside of the rubber insulation 12, as shown. However, the braided sleeve 13 is not essential, and may be omitted. The lead wire or cord 5 shown and described is representative of different types and grades of wire or conductor cord that are regularly available on the market, in large quantities.

Figs. 5 through 10 of the drawing to show the assembly and construction of one form of electrical plug-in connector which embodies the features of my invention. In Fig. 5 a thin metal clip 14 is shown having four projections or points 15 punched out and turned up therefrom, as shown. The clip or member 14 may be formed of tin, iron, copper, zinc, cuprous alloys, etc. In attaching a terminal or connector to the end of a lead wire, the braided sleeve 13 and rubber insulation 12 are stripped away from one end of the lead wire, leaving the separator 11 intact thereon. The clip 14 is then wrapped around the stripped or trimmed end of the lead wire, as shown in Fig. 6. The rear of the clip 14 should preferably fit against the end of the rubber insulation 12, and the edges of the clip 14 should be spaced apart, or separated, as indicated at 16 (Fig. 6). By having the edges of the clip 14 thus spaced apart, the clip 14 may be readily pressed and crimped without having to distort the cylinder that would be formed if the edges of the clip 14 abutted each other. This same result may be obtained by having the edges of the clip 14 overlap each other. The prongs or projections 15 on the inside of the clip 14 project into the strands of the central conductor 10 as shown in Fig. 7. When a terminal member, such as the terminal member 20 shown in Fig. 8, is crimped onto or over the end of the lead wire, the projections 15 will be further pressed or forced into the center of the conductor 10.

The terminal or contact member 20 comprises a solid end portion 21 with a larger diameter tubular or hollow section 22 extending integrally from the rear thereof. After the clip 14 is placed on the prepared or stripped end of a lead wire, as shown in Figs. 6 and 7, the terminal 20 is slipped over this end of the lead wire and the tubular portion is squeezed or crimped thereto as shown in Fig. 10. Finally, a resilient grip or sleeve 23, which may have been previously slid back on the lead wire, is pulled over the tubular portion 22 of the terminal 20, as shown. The grip 23 fits tightly or snugly around the rear end 22 of the terminal 20 and the adjacent end of the lead wire, and covers the end of the braided sleeve 13. In this manner, a neat and sturdy electrical connector assembly and construction is readily made.

A good electrical and mechanical connection between the terminal 20 and the central conductor 10 is made through the clip 14 and the prongs or projections 15 projecting deeply into the heart of the conductor. The indentations 24 in the tubular portion 22 provide good electrical contact with the clip 14. The indentations 24 and crimping also serve to securely fasten the terminal 20 to the end of the lead wire.

Although the grip 23, braid 13 and insulation 12 provide a certain amount of strain relief support for the end of the central flexible conductor 10, the same as in prior constructions, it must still withstand repeated flexure stresses at the end to which the terminal 20 is attached. Extended tests and observations of my improved connectors have shown that the strong separator

or serving 11, which extends clear out to the end of the conductor 10, gives a material amount of strain relief support to the end of the conductor 10 where it is fastened to the terminal 20.

In order to obtain an indication of the longevity of service to be obtained from connectors of this type, they may be subjected to repeated bending and flexing in a suitable testing machine, so as to closely approximate actual service conditions. Actual extended tests have been made to show the ruggedness and serviceability of connectors made according to my invention. Samples of connectors of the construction shown in Fig. 10 withstood up to 800,000 to 900,000 bending cycles without failure. Similar plug-in connectors without the separator 11 failed at only 80,000 cycles of bending.

In addition to the above flexure tests, sample connectors both with and without the separator removed from the ends thereof have been tested for tensile strength. In making these tests, the force required to "pull out" the lead wire from the connector is measured. Samples of connectors having a construction as shown in Fig. 10, wherein the separator extends to the end of the conductor were found to have an average "pull out" strength of about 23 pounds. Similar plug-in connectors having the separator removed from the trimmed end had an average "pull out" strength of about 15 lbs. It is thus apparent from these flexure and "pull out" strength tests that electrical connectors made according to my invention will give much longer service in use.

Besides the above outlined advantages and improved wear and strength properties of my connector constructions given by retaining the separator or serving at the end of the lead wires, the elimination of the additional step of removing this part of the insulation is an important manufacturing advantage. Heretofore, this separator has been removed by a slow burning operation which was an additional cost item in the manufacturing cost of these connectors.

Since further changes may be made in the foregoing construction and different embodiments of my invention may be made without departing from the scope thereof, it is intended that all matter shown in the accompanying drawing, or described heretofore, shall be interpreted as illustrative and not in a limiting sense, and that the claims shall be given a construction as broad as is consistent with the state of the prior art.

I claim as my invention:

1. Electrical connector means comprising, in combination; a lead wire having, a central, flexible conductor, a fibrous covering over said conductor, and a sheath of insulation over said fibrous covering; a thin metal clip on one end of said lead wire from which said rubber insulation has been removed, said clip enclosing said fibrous covering and portions of said clip being in electrical conductive relationship with said flexible conductor; and a contact member having a tubular portion for receiving the end of said lead wire having said clip thereon, said tubular portion of the terminal being crimped onto the clip at the end of the lead wire to provide a mechanical and electrical connection between the lead wire and the terminal.

2. Electrical connector means comprising, in combination; a lead wire having, a central stranded conductor, a separator enclosing said stranded conductor, and a sheath of rubber insulation over said separator; a thin metal clip

wrapped around one end of said lead wire from which said rubber insulation has been stripped, said clip enclosing said separator and having at least a portion thereof projecting into said stranded conductor; and a plug-in terminal member having a tubular portion on the rear thereof for receiving the stripped end of said lead wire having said clip thereon, said tubular portion of the terminal being crimped onto said clip at the end of said lead wire to provide a mechanical and electrical connection between said lead wire and the terminal; said separator providing both a strength support and housing for the end of said stranded conductor.

3. In an electrical connector, in combination; a lead wire having, a central stranded conductor, a fabric separator enclosing said stranded conductor with the threads of said separator extending generally longitudinally of the length of the conductor, and a sheath of rubber insulation extruded over said separator; a thin metal clip around one end of said lead wire from which said rubber insulation has been removed, said clip enclosing the ends of said separator and conductor; a plurality of integral projections on the inside of said clip projecting into said stranded conductor providing electrical contact therewith; and a plug-in terminal member having a tubular portion on the rear thereof for receiving the stripped end of said lead wire having said clip thereon, said tubular portion of the terminal being crimped onto the clip and the stripped end of the lead wire therein so as to fasten the terminal thereto and provide a good electrical connection with the clip; said separator provid-

ing both a support for the end of said stranded conductor in flexure stressing and a retaining closure for broken ends of the conductor strands.

4. A plug-in electrical connector construction adapted to withstand repeated flexing comprising, in combination; a lead wire having, a central stranded conductor, a serving around said stranded conductor in which the threads of said serving are in long spirals of relatively few turns per unit length of the conductor, a sheath of rubber insulation extruded over said serving, and a braided sleeve over said rubber sheath; a thin metal clip pressed around one end of said lead wire from which said rubber insulation and braided sleeve have been stripped, the edges of said clip being apart, said clip enclosing the ends of said serving and conductor, a plurality of integral projections on the inside of said clip projecting into said stranded conductor to provide electrical contact between the clip and conductor; a plug-in terminal member having a tubular portion on the rear thereof for receiving said stripped end of the lead wire having said clip thereon, said tubular portion of the terminal being crimped onto the stripped end of the lead wire therein so as to fasten the terminal thereto and provide a good electrical connection with said clip; and a resilient grip fitting over the tubular portion of said terminal member and the adjacent portion of said lead wire; said serving providing both a support for the end of said stranded conductor in flexure stressing and a retaining closure for broken ends of the conductor strands adjacent the rear end of said clip.

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