

June 19, 1962

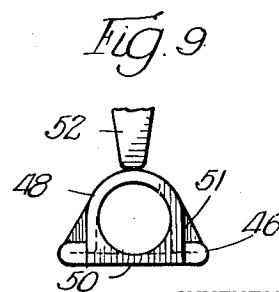
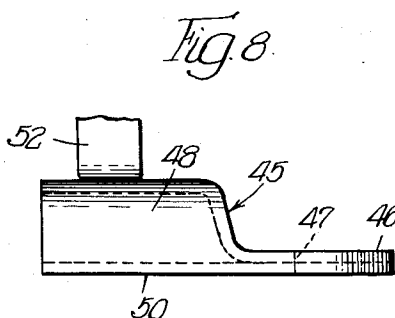
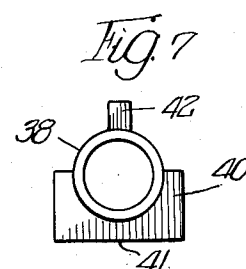
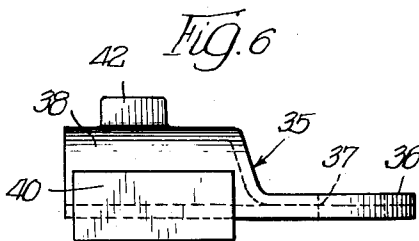
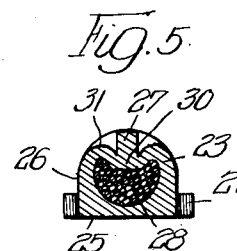
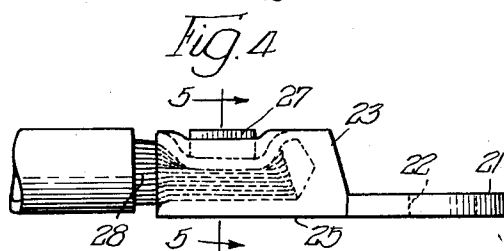
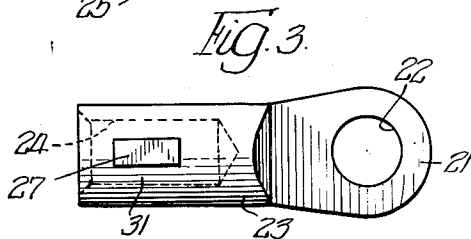
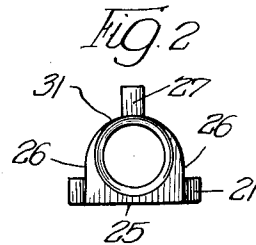
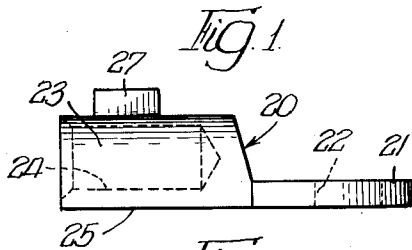
A. A. BERNARD ET AL

3,040,292

CABLE CONNECTOR

Filed July 15, 1959

2 Sheets-Sheet 1



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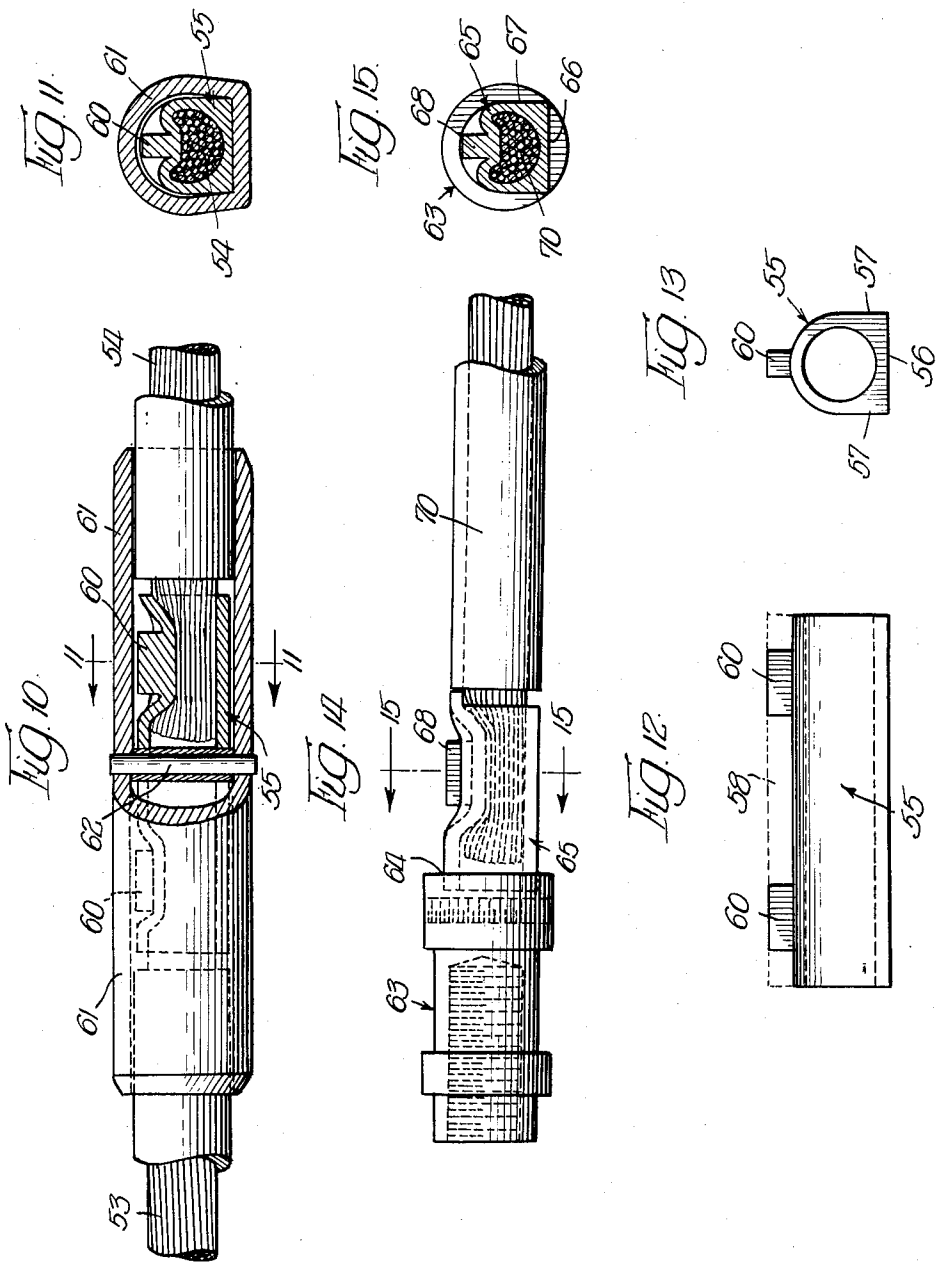
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CABLE CONNECTOR

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2 Sheets-Sheet 2



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3,040,292

CABLE CONNECTOR

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7 Claims. (Cl. 339—276)

The invention relates to electrical connectors and has reference in particular to a connector having novel and improved means for mechanically and electrically joining the same to a current carrying cable so that the cable can be conveniently connected to other components.

Generally, all conventional makes and types of cable connectors, whether they are lugs, splicers or crossovers are provided with hollow cylinders or barrels, into which the ends of the stranded wire cables are inserted and anchored. At least three different methods are used for anchoring the ends of the cables to the cylinders such as by soldering, or by clamping the cable using a screw having a threaded relation with the wall of the cylinder or by indenting the side wall of the cylinder to a depth and in such a way that the cylinder and the stranded cable are compressed into a relatively solid unit substantially free of space and voids between the individual strands of wire and between the wires and the wall of the cylinder. The indent method is preferred since this type of connection has high conductivity and great mechanical strength. Both of these are the result of the greater compactness developed by the indent method as compared with the other methods particularly the clamping by a screw.

There are many different kinds and makes of tools, devices and machines available for forming the indent in the side wall of the cylinder-type connectors. However, all use a saddle shaped form fitting block of steel to support and hold the cylindrical shape of the connectors while a round-end punch is forced into the wall to form the indent. The most simple and lowest priced apparatus for forming the indent consists merely of a saddle shaped block of steel held in the jaws of a bench vise and an ordinary hammer for driving the round-end punch into the top of the cylinder. In the more elaborate and costly devices the force which presses the round-end punch into the wall of the cylinder is developed with a ratchet lever action and with other devices and machines the force is developed with air pressure or with hydraulic pressure.

With regard to all of these different makes and types of devices and machines the fact is that special tools or machines must be available when needed and since they are used only intermittently they are often misplaced or they become lost and valuable time is spent in finding them.

Accordingly the main objective of the invention is to provide a cable connector that can be attached to the end of a current carrying cable by the indent method and which will not require any special tools, devices or machines.

In the preferred form of the invention, the need for both the conventional round-end punch and the conventional saddle shaped die are both eliminated. The only tool required to form the indent for compressing the barrel portion of the connector into the stranded cable is

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an ordinary hammer or a bar of iron such as can be used as a hammer. The foregoing is made possible because the present connector is self-contained. The essential elements including the saddle shaped die and the punch are formed integrally with the connector and are thus available when needed for the indenting operation.

Another important object of the invention is to provide a cable connector which permits making electrical connections at a very low overall cost. For installing a particular piece of electrical apparatus such as an arc welding machine, only a few cable connectors are required for making the complete welding current circuit. However, with conventional connectors, if the special tool, machine or device required to form the indent is not available then one must be purchased and which may never be used again or at least not until the welding operator or maintenance man installs another arc welder at some future date. The cable connector of the invention has particular utility in such cases since it eliminates the necessity of purchasing special tools or machines of any kind.

With these and various other objects in view, the invention may consist of certain novel features of construction and operation, as will be more fully described and particularly pointed out in the specification, drawings and claims appended thereto.

In the drawings which illustrate an embodiment of the device and wherein like reference characters are used to designate like parts—

FIGURE 1 is an elevational view of a self-contained cable connector coming within the invention;

FIGURE 2 is an end view of the cable connector shown in FIGURE 1;

FIGURE 3 is a top plan view;

FIGURE 4 is an elevational view of the cable connector of FIGURE 1 illustrating the lug in depressed position for indenting the connector wall for attaching the cable;

FIGURE 5 is a cross sectional view taken substantially along line 5—5 of FIGURE 4;

FIGURE 6 is a modified form of cable connector coming within the invention;

FIGURE 7 is an end elevational view of the cable connector of FIGURE 6;

FIGURE 8 is another form of cable connector which embodies the improvements of the invention;

FIGURE 9 is an end elevational view;

FIGURE 10 is an elevational view, with parts in section, showing the present cable connectors employed as a splicer;

FIGURE 11 is a cross sectional view taken substantially on line 11—11 of FIGURE 10;

FIGURE 12 is an elevational view of the tube with integral lugs which forms the connector for the splice of FIGURE 10;

FIGURE 13 is an end elevational view of the connector shown in FIGURE 12;

FIGURE 14 is an elevational view illustrating how the cable connector of the invention can be used for connecting the welding current cable to the body member of an arc welding electrode; and

FIGURE 15 is a sectional view taken substantially along line 15—15 of FIGURE 14.

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The connector shown in FIGURES 1, 2 and 3 of metal such as copper, aluminum or the like includes the tongue 21 having a hole 22 for bolting the connector to a component part in an electrical circuit. The cylindrical part 23 is integral with the tongue and the same has the bore 24 which extends for a depth of about two and one-half times the diameter of the bore. The cylinder 23 is provided with a flat base 25 and which is substantially a continuation of the flat bottom surface of the tongue portion 21. The flat base 25 forms the straight walls 26 on respective sides of the cylindrical part. The lug 27 projects upwardly from the center of the semi-circular top half of the cylinder part 23 and the said lug extends longitudinally of the part. For the best results the length of the lug 27 should be slightly less than one-half of the depth of the bore, its thickness should be about one-third of the diameter of the bore and its height should be about one-half of the bore's diameter.

FIGURES 4 and 5 show the end of the stranded wire cable 28 to be tightly compressed by the indent 30 which is formed by applying hammer blows to the lug 27. It will be noted that the hammer blows applied to lug 27 have not flattened the cylinder, but that the blows have only indented the top wall. It is important that the cylindrical part of the connector and the inserted end of the stranded wire cable do not become compressed by merely flattening the cylinder part, because if the part is flattened, then the compression force is not locked in and the same is lost due to spring-back. Accordingly, the present connector has been so designed that the compressive force which is built up with each hammer blow on the lug 27 is locked in so that there is substantially no spring-back of the indented area, all of which will be fully understood as the description proceeds.

It will be noted that the thickness of the cylinder wall 31 adjacent its lug 27 is less than the thickness of the cylinder in the vicinity of the sides 26. Thus, when hammer blows are applied to the lug 27, the top wall of the cylinder part collapses more readily along areas 31 adjacent the lug. With each hammer blow the wall will collapse to a greater extent, thereby reducing the cross sectional area of the cavity and eventually the strands of the cable will be squeezed into the shape of a cluster of hexagons. This is the closest condition to a complete solid. Thus, little if any space will exist between the strands or between the strands and the cylinder wall for air to enter and oxidize the connection. If excessive oxidation of an electrical connection can be prevented, then the efficiency of the connection is retained.

As previously explained, the peak compactness produced by the formation of the indent can be retained by preventing spring-back of the indented area. This is accomplished by restricting the length of the indent to about one-half the depth of the bore and thus the circular shape of the cylindrical part is retained at both ends. By retaining the said circular shape at both ends, the metal at these areas is required to stretch circumferentially before the indent can recede, and as long as the indent does not recede, there is no loss in the compactness of the connection. The connector 20 of FIGURES 1 to 5, inclusive, comprises the preferred form of the invention and the same produces the very maximum in efficiency, that is, in current conduction at the joint between the strands of the cable and the connector. Also, the connector of this modification has the maximum strength. The dimensions of the parts are not particularly critical and a limited range can be resorted to while still achieving the benefits of the invention. For example, the depth of the bore may be somewhat more or less than about two and one-half times the diameter of the bore. Also, the length of the lug 27 may be somewhat greater or less than about one-half the depth of the bore and likewise the width of the lug may vary slightly either more or less than about one-

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third the bore's diameter. However, in all cases the major improvement resides in the provision of a self-contained connector, the same having an integral saddle shaped portion provided by the flat base and also having an integral lug. The flat base of the cylindrical part prevents the lower half of the bore from losing its curvature as the indent is driven into the top portion of the cylinder.

FIGURES 6 and 7 illustrate a connector generally indicated by the numeral 35 and which is preferably formed from a length of seamless copper tubing or a copper pipe. By flattening one end of the tubing the tongue 36 is formed and the same is provided with an opening 37 by means of which the connector can be bolted to a component part in the electrical circuit. The remaining part 38 of the connector 35 is cylindrical, the said part having a form fitting saddle block 40 for supporting it and which provides the required flat base 41. Thus, the round shape of the cylindrical part 38 of the connector is retained as a result of the support provided by the saddle block 40 when hammer blows are applied to the lug 42 in the operation of forming the indent. In this modification the lug 42 may be a separate piece and which is silver soldered to the top surface of the cylindrical part 38.

The connector 45, FIGURES 8 and 9, is substantially the reverse of the connector as illustrated in FIGURES 6 and 7. The said connector is conveniently formed from a piece of seamless copper tubing or a copper pipe by flattening one end to form the tongue portion 46 and which is provided with the opening 47 by means of which the connector may be bolted to the component part of an electrical circuit. The remaining cylindrical part 48 of the copper tubing is provided with a base portion which provides the flat base 50 and the vertical walls 51 on respective sides of the flat base. As a result, the base portion of the cylindrical part 48 has walls which are somewhat greater in thickness than that of the semicircular top portion of the part. In this modification the lug is omitted and for indenting the cylindrical part the operator must use the conventional punch 52.

FIGURES 10, 11, 12 and 13 illustrate a cable-connector splice which has utility for connecting the ends of two separate cables such as 53 and 54. The cable splicer is conveniently formed from a length of extruded copper tubing 55, although it is also possible that the cable splicer may be cast such as by the shell-mold casting method. In its extruded or cast form the copper tubing 55 is formed with a base portion which provides a flat base 56 and side walls 57 having a right-angle relation with the base. Also, the extruded copper tubing 55 is formed with a projection 58 which extends for its entire length. In order to form the lugs 60, it is only necessary to remove the unwanted sections of the projection 58 as indicated by the dotted lines in FIGURE 12. The unwanted sections can be removed by a milling or a shearing operation. Accordingly, by the application of hammer blows to the lugs 60, respective indents will be formed at the ends of the cable splicer for compressing and gripping the ends of the cables 53 and 54. The cable splice may be completed by the tubular insulating member 61 which has surrounding relation with the cable splicer 55 and with the adjacent ends of the cables 53 and 54. The member 61 may be formed of vulcanized fiber or similar insulating material and the same can be locked in place by means of the plastic pin 62.

The connector of FIGURES 14 and 15 is employed for connecting the body member of an arc welding electrode holder to its welding current cable. The holder may comprise a device such as shown and described in the Bernard Patents 2,364,507 and 2,364,508, granted December 5, 1944. The body member of the holder is generally indicated in FIGURE 14 by the numeral 63 and in actual

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practice the said body member may be made from an extruded brass rod and which is silver soldered at 64 to the cable connector 65. Said connector may likewise be made from a length of extruded copper tubing or piping and which will provide a base portion having the flat base 66 and the approximately right-angled side walls 67. The top half of the connector 65 is semi-circular and the walls of the same will be somewhat less in thickness than those in the vicinity of the base portion. The semi-circular top half of the connector is provided with a lug 68 and which is instrumental in producing the detent when hammer blows are applied to the same. In this manner the strands of the cable 70 are compressed within the connector 65 to an extent where the end of the cable is substantially solid with the connector to thereby materially facilitate the flow of the welding current from the cable to the arc welding electrode holder.

The invention is not to be limited to or by details of construction of the particular embodiment thereof illustrated by the drawings, as various other forms of the device will, of course, be apparent to those skilled in the art without departing from the spirit of the invention or the scope of the claims.

What is claimed is:

1. A cable connector comprising a tubular body member adapted to receive a cable end, and a connecting portion extending therefrom, that portion of the tubular body member lying on one side of a plane extending through the axis of said tubular body member having a greater cross-sectional area than the portion of said tubular member lying on the opposite side of said plane to resist substantial deformation during the operation of attaching said body member to said cable end, and that portion of the tubular body member lying on the opposite side of said plane having an exterior lug integrally formed thereon and surrounded by metal of said tubular body member capable of flexing and deforming to provide, when said lug is depressed by applied force, a hemi-spheroidal indent extending into the interior of said tubular member, whereby said indent, when formed by the depression of said lug, is surrounded by metal which maintains the formation of said indent, and said indent being of a linear extent that will cause said indent to constrict the end of said cable in an area intermediate the extremities of that portion thereof lying within said tubular body member.

2. A cable connector as defined by claim 1 wherein said tubular member has a bore therein and said integral lug is spaced from the respective ends of the bore a distance which is not less than one-fourth the diameter of said bore, wherein the transverse width of the integral lug is not more than three-fourths and not less than one-fourth the diameter of said bore, and wherein the height of said integral lug is not less than one-fourth of the diameter of said bore and not in excess of the full diameter.

3. An electrical cable connector having a cylindrical body portion provided with a round bore extending longitudinally for receiving the end of a cable to be anchored to the body portion by compression, the improvement which includes an exterior projection integral with the wall of said body portion, said integral projection being located inwardly from the extremities of said bore and being restricted in width to less than the diameter of the bore such that the operation of depressing said projection by an applied force for anchoring the body portion to the cable end inverts less than one half the circumference of the body portion into a hemi-spheroidal formation when viewed in cross section, whereby said round bore is transformed into a reduced cross sectional area of crescent shape to tightly compress the inserted cable, and whereby said body portion retains substantially its original shape at respective ends of the hemi-spheroidal formation to prevent spring back of said formation and to thus retain the compressed state which anchors the body portion to the cable end, and said body portion being

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further characterized by a bore which is non-concentric with the outer surface of the cylindrical body portion, whereby a wall portion of minimum thickness is provided diametrically opposite a wall portion of maximum thickness, said integral projection being located on the center line of the thin wall portion and which is thus more easily inverted for transforming the round bore into said reduced cross sectional area of crescent shape, and whereby said wall portion of maximum thickness resists deformation and adequately withstands the compression forces caused by the depressing of the projection by an applied force.

4. A cable connector having a tubular body portion of malleable metal and which is self-contained for its attachment to the inserted end of a cable except for requiring an outside compressive force, said body portion having approximately one-half of its circumference formed to provide a flat base section having a cross-sectional area sufficient to resist substantial deformation during the operation of attaching said body portion of said cable end, the remaining circumferential half section of the body portion being semi-circular, a projection integral with the wall of the semi-circular section and being located exteriorly on the longitudinal center line of the semi-circular section, said projection being spaced inwardly from the ends of the internal bore and being restricted in width to less than the diameter of the bore such that said compressive force will invert less metal than that of the semi-circular section into an hemi-spheroidal formation, whereby said bore when viewed in cross section is transformed into a reduced cross sectional area of crescent shape to tightly compress the inserted cable, and whereby said body portion retains its original shape at respective ends of the hemi-spheroidal formation to prevent spring back and to thus maintain the compressed state which anchors the body portion to the cable.

5. A cable connector as defined by claim 4 wherein said integral projection is spaced from the respective ends of the bore a distance which is not less than one-fourth the diameter of the bore, wherein the transverse width of the integral projection is not more than three-fourths and not less than one-fourth the diameter of said bore, and wherein the height of the integral projection is not less than one-fourth the diameter of said bore and not in excess of the full diameter.

6. A cable connector as defined by claim 4, wherein two or more of said integral projections are located on the center line of the semi-circular section of the tubular body portion, and wherein the space between said integral projections is not less than one-half the diameter of the bore.

7. In a cable connector of the type including a tubular body portion of malleable metal and which is adapted to be mechanically and electrically connected to the telescoped end of the cable by the indenting method, the improvement which consists of a lug on the exterior of the tubular body portion and integral therewith, said lug extending longitudinally of the body portion for a distance at least equal to its width and wherein the length of the lug is sufficiently less than the depth of the internal bore to leave portions at respective ends of the lug, when indented, which retain the original shape of the tubular body portion, said lug having a height which is not less than one-fourth of the diameter of the bore and not more than the full diameter and a width which is not more than three-fourths and not less than one-fourth the diameter of the bore, and a base section also integral with the tubular body portion and extending longitudinally of the same diametrically opposite the lug, said base section providing a flat bottom supporting surface of a width not substantially less than the diameter of the bore and having a cross-sectional area sufficient to resist substantial deformation during the operation of attaching said body portion to said cable end.

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