

April 3, 1951

E. S. HEBELER
SPRING CLAMP CONNECTOR

2,547,080

Filed July 20, 1948

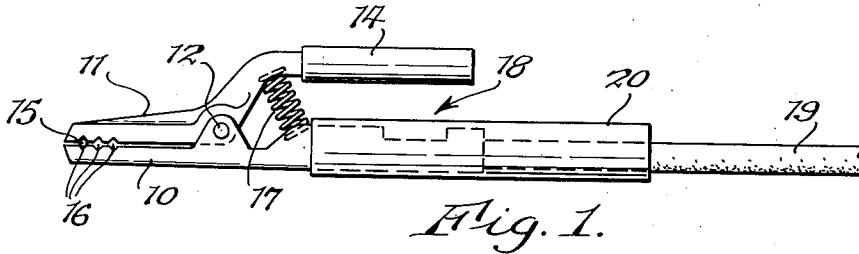
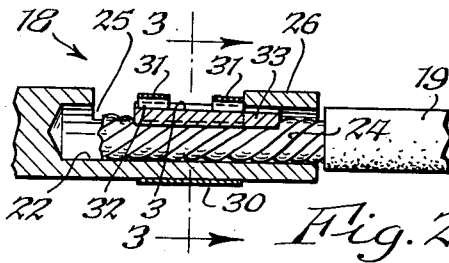
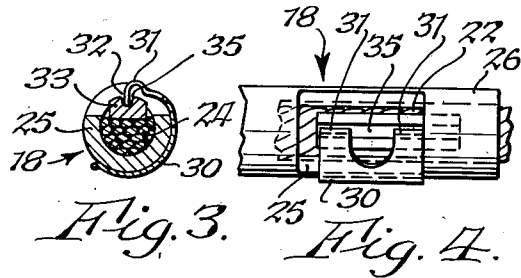
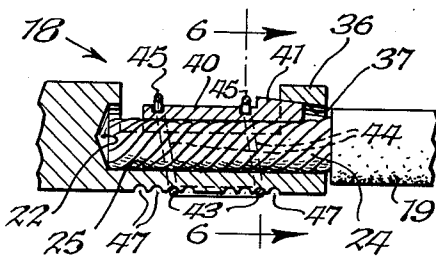
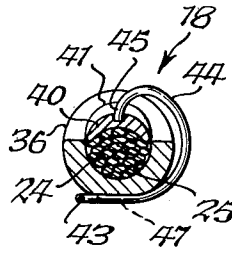
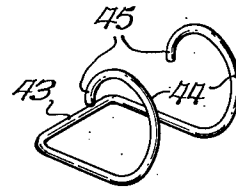


Fig. 5. Fig. 6. Fig. 7.

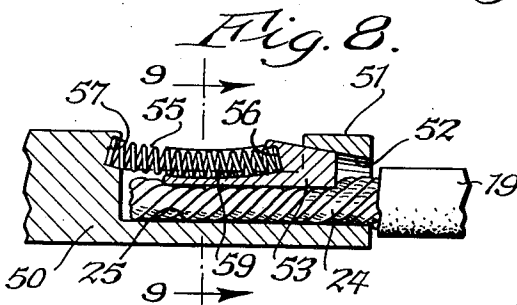
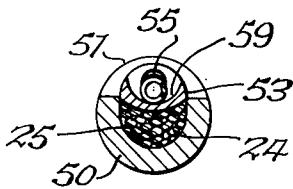


Fig. 9.

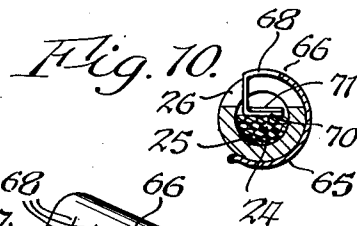
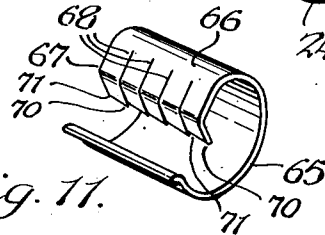


Fig. 11.

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UNITED STATES PATENT OFFICE

2,547,080

SPRING CLAMP CONNECTOR

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Application July 20, 1948, Serial No. 39,699

6 Claims. (Cl. 173-269)

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This invention relates to improvements in connections between electrical conducting cables of the type including many relatively small wires to provide flexibility of the cable, and a connector therefor.

Cables of the type made of numerous small diameter wires, in such a manner that they will be readily flexible, are commonly used in connection with welding and other apparatus in which the cable is flexed, twisted and bent during the use of the apparatus, and difficulty has been experienced in the past in making a good connection between an end of a cable of this type and a connector, unless the end of the cable is soldered to the connector. This, however, has been found objectionable, for the reason that the solder tends to run along the cable and to render that part of the cable in which the wires are connected by solder stiff. Consequently, at the end of the solder, the thin wires will bend to a greater extent than at those parts of the cable which are free from solder, thus causing rapid breaking of the wires at the ends of the soldered parts of the cable, because the small wires will be subjected to the maximum bending at the portion thereof adjacent to the portion of the cable rendered rigid by the solder.

Unsoldered cable ends are very difficult to hold in clamped tight and rigid electrical connection with a connector by means of the usual clamping screws or bolts, since even if such screws or bolts are initially tight and form a good electrical connection, it has been found that such connections become loosened during the use of the connection, so that eventually there is not sufficient pressure between the cable and the connector. This reduction in pressure results in a poor electrical connection and in heating of the connector and the cable end and the heating in turn results in forming an oxide on the surface of the wires or connector which in turn further increases the resistance of the connection and results in further heating of the same, so that eventually the connection becomes excessively hot and fails to transmit the required amount of current from the cable to the connector. In some cases, the connector becomes too hot to be handled and may constitute a fire hazard.

I have found that the reason for this rapid heating of the connection between the cable and the connector is due to the shifting of wires of the cable at the point or points where the pressure is applied, due to the fact that the connector, when used in connection with welding or other operations is moved, turned and twisted. This shifting of the wires of the cable gradually reduces the pressure urging the cable into contact with the terminal, so that even if a very good electrical connection is originally made by clamping the screws or bolts up tightly, yet as the wires

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of the cable shift relatively to each other, this pressure gradually decreases, thus resulting in a gradually increasing resistance and consequent heating of the connection.

One of the objects of this invention is to provide an electrical connection between a cable end and a connector by means of which a constant pressure is exerted on the cable, pressing the same toward the connector, which pressure is maintained in spite of the shifting of the wires of the cable.

A further object of this invention is to provide a connection of this type in which a spring is employed which exerts a substantially constant pressure urging the cable into contact with the connector at all times, regardless of the shifting of the wires of the cable relatively to each other. A further object of this invention is to provide a connection between a cable and connector which also serves to prevent the pulling of the cable out of the connector. A further object is to provide a connection which is so constructed that any pulling of the cable relatively to the connector in a direction to disengage the same from the connector will result in increased tension and gripping of the cable to the connector.

Other objects and advantages of this invention will appear from the following description and claims.

In the accompanying drawings, which illustrate by way of example certain embodiments of this invention:

Fig. 1 is a side elevation of a holder for a welding rod to which a cable connection embodying this invention may be applied.

Fig. 2 is a fragmentary, longitudinal, central, sectional view thereof.

Fig. 3 is a transverse section thereof, on line 3-3, Fig. 2.

Fig. 4 is a fragmentary, top plan view thereof.

Fig. 5 is a fragmentary, longitudinal, central sectional elevation of a connection of modified construction.

Fig. 6 is a transverse sectional view thereof, on line 6-6, Fig. 5.

Fig. 7 is a perspective view of a spring which may be employed to form a connection between the cable and the connector.

Fig. 8 is a fragmentary, longitudinal, central, sectional elevation of a connection of another modified form.

Fig. 9 is a transverse sectional elevation thereof, on line 9-9, Fig. 8.

Fig. 10 is a transverse sectional view of a connector showing a connection of modified construction.

Fig. 11 is a perspective view of the combined spring and pressure pad shown in Fig. 10, on an enlarged scale.

I have in Fig. 1 illustrated a holder for a weld-

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ing rod to which a flexible cable may be connected by means of connections embodying my invention. It will be understood, however, that it is not intended thereby to limit this invention for use with welding rod holders, since it will be obvious that the improvements embodying this invention may be applicable to any connection between a flexible cable and a rigid connector therefor.

In Fig. 1, the welding rod holder includes a pair of gripping members 10 and 11 which are pivotally connected, for example, by means of a pivot 12. The gripping member 11 has a handle 14 arranged thereon by means of which the pivoted gripping member 11 may be swung about the pivot 12 to enable a welding rod 15 to be gripped in any of the notches or recesses 16 in the jaws of the gripping member. The rod is securely held in the jaws by means of a compression spring 17 acting on the two gripping members 10 and 11 in a direction to close the jaws.

The rod gripping member 10 is provided at the rear thereof with a connector, indicated in general by the reference character 18, for connection with a flexible cable 19. A sleeve 20 of insulating material is usually slid over the connector so that the operator, in using the device, grips the insulating handle portion 14 and the sleeve 20 to avoid contact with current-carrying metal parts of the device.

The connector 18 may be of any usual or suitable construction, and in the form illustrated by way of example, it is of substantially hollow, cylindrical or tubular form, the interior of the cylindrical portion having a substantially cylindrical aperture 22 of sufficient size to receive the bare wire portion 24 of the cable. A part of the cylindrical portion of the connector intermediate of the ends thereof is omitted or removed, thus forming a trough-shaped portion 25 and a cylindrical portion 26 at the end of the connector, through which the wire portion of an end of the cable may be passed to lie in the trough-shaped portion 25. In these connectors as heretofore constructed suitable clamping means including screws, bolts or the like were employed for pressing the wire portion of the cable into the lower or trough-shaped portion 25 of the cylindrical part of the connector.

In the use of an implement such as an electrode or rod holder of a welding apparatus, the connection between the cable 19 and the connector 18 is subject to substantially continuous movement of the connector 18 during the time that the operator uses the welding rod holder. The welding operation requires bending, twisting, turning and other movements of the welding rod holder, and all of these movements are transmitted to the end of the cable which is connected with the connector. It is, therefore, necessary that these cables have a high degree of flexibility and, consequently, they are made of a large number of fine or small gage current-conducting wires. Usually the connection between the cable and the connector includes screws or bolts which are tightened to apply pressure to the cable for attaching the same to the connector and, as heretofore stated, the repeated movements of the rod holder results in the fine wires of the cable shifting and readjusting themselves at the point or points at which the clamping pressure is applied, so that the pressure acting on the cable is gradually reduced due to lateral slipping of the wires of the cable, thereby producing a poor connection

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between the cable and connector, which results in the heating of the connector and adjacent parts of the cable, which in turn results in the covering of the wires and connector with a film of oxide which makes the electrical connection worse.

In order to overcome the difficulties heretofore experienced with clamping devices for securing the cables to connectors, I have found that the heating of the cables and the connectors can be greatly reduced by providing a yielding or spring member for exerting a resilient force against a portion of the cable within the connector. By means of this construction, if the wires of the cable, during the continued use or moving of the connector, become shifted or readjust themselves, this shifting or readjusting will be followed with a corresponding movement of the yielding or spring member, so that substantially the same force will be exerted on the cable as was exerted on it before the shifting or adjusting of the wires of the cable took place.

In order to accomplish this result, I have provided in Figs. 2 to 4, a leaf spring 30 which is curved to follow approximately the contour of the outer surface of the cylindrical portion of the connector and which has a plurality of spring arms 31 extending therefrom over the trough-shaped part 25 of the connector, two such arms being shown in the construction illustrated. The outer ends of the arms have a portion 32 bent toward the axis of the connector 18, and a pressure pad or intermediate pressure transmitting member 33 is arranged between the bare portion 24 of the cable and the downwardly extending portions 32 of the arms of the spring. This intermediate member may be provided with a lower surface formed to contact with the wires of the cable and a groove 35 in the upper surface in which the extensions 31 of the arms may seat. This spring member may be sprung around the trough portion of the connector, whereupon the arms 31 will exert a force against the pad or intermediate member 33, urging the same against the wires of the cable to press the same into the trough-shaped part 25. By means of this construction, the shifting of the wires of the cable relatively to each other will not result in any material reduction of pressure on the cable, since if the wires of the cable become more compacted or spread laterally under the intermediate member 33, this member will be urged farther into the trough of the connector by means of the spring pressure of the arms 31.

One end of the intermediate member 33 may extend under the cylindrical portion 26 of the connector, and this cylindrical portion also serves as a stop against which one of the arms 31 of the spring member may bear to resist pulling of the cable out of the connector. The pad or intermediate member may also be of slightly tapering or wedge-shaped form with the end thereof of least height extending into the cylindrical portion 26. Consequently, any pulling on the cable 24 will cause the wedge-shaped intermediate member 33 to enter farther into the cylindrical part 26, thus causing this member to press more tightly against the cable, and thus form an improved electrical connection, supplementing the action of the spring 30 and also gripping the cable more securely in the connector to resist removal of the same lengthwise therefrom. The wedging of the intermediate member 33 into the cylindrical part 26 exerts pressure against the part of the cable adjacent

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to the smaller end of the wedge-shaped intermediate member 33 and the spring arms 31 serve to apply adequate pressure to the other end of the intermediate member 33 to assure a good electrical connection between the cable and the connection throughout the length of the wedge-shaped intermediate member 33. The wedging action of the cylindrical part 26 supplements the pressure applied to the cable, but the spring arms 31 alone are capable of pressing the cable against the connector with sufficient force to ensure a good electrical connection.

In the modified construction shown in Figs. 5 to 7, the connector is similar to the one shown in Figs. 1 to 4, except that the annular or cylindrical end portion 35 is provided on the upper portion of its inner surface with a tapered or inclined face 37. A pressure pad or intermediate member 40 of somewhat different construction is employed, that shown having at one end thereof a wedge-shaped portion 41 adapted to cooperate with the inner tapered surface 37 of the cylindrical part 36. The pressure pad or intermediate part 40 is urged into engagement with the wire portion 24 of the cable by means of a wire spring member having a U-shaped portion 43 which engages the underface of the trough portion 25 of the connector. The ends of the legs of the U-shaped member are curved upwardly as shown at 44 and terminate in downwardly extending end portions 45 which are adapted to enter into grooves or recesses formed in the upper face of the pressure pad or intermediate member 40. The outer surface of the connector below the trough 25 may be provided with a series of notches 47 into which the legs of the U-shaped portion 43 may enter to hold this part of the spring against movement lengthwise of the connector 18.

In applying this spring to the pressure pad or intermediate member 40, this member 40 is first forced to the right in Fig. 5, so that the wedge part 41 will be forced into the cylindrical part 36 of the connection, and the spring may then be applied to the pad or intermediate member 40 by inserting the ends 45 into the grooves or recesses in the upper face of the pad. The lower U-shaped part 43 of the spring is then moved to the right in Fig. 5 as far as possible and entered into two of the notches 47, so that the curved parts 44 of the spring member will assume inclined positions, as shown by broken lines in Fig. 5. This spring will, consequently, serve the two-fold purpose of pressing the pressure pad or intermediate member 40 directly against the wire part of the cable to force the same into the trough 25, and the upper ends of the curved parts 44 of the spring will also have a tendency to assume vertical positions. Since the notches 47 prevent the lower U-shaped part of the spring from moving to the left in Fig. 5, it will be obvious that the spring will, consequently, tend to urge the pad or intermediate member 40 to the right to retain the same in wedging relation to the cylindrical part 36.

In this construction, as well as that described in connection with Figs. 2 to 4, the spring member will provide a continuous force on the pressure pad so that if the wires of the cable become readjusted or shifted laterally to occupy a smaller space vertically, the pad, because of the pressure of the spring, will follow up the wire part of the cable so that substantially the same pressure will be applied thereto after re-

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adjustment of the wires of the cable as before the re-adjustment took place.

Figs. 8 and 9 show still another modified form of my invention, in which a connector 50 also has a cylindrical portion 51 arranged between the end of the connector and the cutout portion of the same, and this cylindrical portion is provided with a tapered inner surface 52 similar to the surface 37 shown in Fig. 5. The wire portion 24 of the cable 19 is pressed into the trough 25 of the connector by means of a pressure pad or intermediate member 53. In this construction, the pressure pad or intermediate member 53 is pressed into wedging relation with the cylindrical part 51 and into engagement with the wire part 24 of the cable by means of a coil spring 55, one end of which enters a seat or recess 56 formed on the pressure pad 53, the other end of which is seated in a recess 57 formed in the connector 50. The upper face of the pressure member has the upper surface 59 thereof curved downwardly lengthwise thereof, which causes the coil spring 55 to assume a curved position when the ends thereof are arranged in the seats 56 and 57. This upper surface is also trough-shaped to receive the intermediate portion of the spring 55. Consequently, the coil spring 55 exerts pressure lengthwise of the connector against the part of the pressure pad which is formed to be wedged into the inclined inner surface of the cylindrical part 51 of the connector. This pressure exerted by the coil spring also tends to cause the coil spring to become bowed and thus exert a pressure against the upper face of the pressure pad or intermediate member, thus urging the same toward the wire part of the cable to press the same into the trough 25 of the connector. In this construction, it will also be obvious that readjustment of the wires of the cable relatively to each other will be followed by a movement of the pressure pad toward the cable, due to the action of the spring 55, so that a loose connection between the wire portion of the cable and the connector is prevented. By urging the pressure pad or intermediate member into wedging relation with the cylindrical part 51, the spring further assures compression of the wire part of the cable adjacent to the cylindrical part 51 against the trough of the connector 50.

In the construction shown in Figs. 5 to 9, it will be noted that the springs shown exert both transverse pressure on the intermediate member to force the cable into the trough of the connector, and lengthwise pressure against the intermediate member to produce a wedging action of the cable against the connector.

In the construction shown in Fig. 10, the connector shown is the same in construction as the one shown in Figs. 1 to 4, including a trough-shaped portion 25 and a cylindrical end portion 26. In this construction, the spring and the pressure pad or intermediate member are formed in one piece. The spring is in the form of a band or strip of spring metal having a part 65 formed to extend partly around the outer surface of the trough portion 25 and a part 66 which extends over the open face of the trough portion. This latter part terminates in a part 67 which constitutes a pressure pad or intermediate member which is formed to engage the wire portion 24 of the cable and to press the same into the trough 25. This pressure pad portion 67 and the adjacent portions of the spring part 66 are preferably provided with a plurality of slits 68 which divide this part of the spring into

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a plurality of fingers, each of which may engage a part of the cable independently of the other fingers. Preferably the ends of the fingers which form the pressure pad are slightly inclined in such manner that the lower edge portions 70 thereof grip the cable. In securing this spring on a connector, the higher edges 71 of the fingers of the pad are arranged adjacent to the cylindrical portion 26, so that if a pull is exerted on the cable to pull the same from the connector, the lower edges of the pressure pad fingers will tend to bite into the cable and oppose such pull, and the spring itself will abut against the cylindrical portion 26 and will be held on the connector thereby.

It will be understood that various changes in the details, materials, and arrangements of parts which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention, as expressed in the appended claims.

I claim as my invention:

1. An electrical connection for a flexible current-carrying cable comprising a large number of small wires, including a rigid connector having a hollow cylindrical portion at one end thereof through which the cable may extend and a trough-shaped portion adjacent thereto into which a part of said cable may be laid lengthwise, an intermediate pressure-transmitting member overlying said trough-shaped part of said connector and having an end portion thereof formed to extend into said cylindrical portion and to cooperate therewith to wedge said intermediate member against said cable, and a spring acting on said intermediate member to force the same against the portion of the cable lying in said trough-shaped part.

2. An electrical connection for a flexible current-carrying cable comprising a large number of small wires, including a rigid connector having a trough-shaped part into which a part of said cable may be laid lengthwise, and a hollow cylindrical portion through which an end of a cable extends before entering said trough-shaped part, an intermediate pressure-transmitting member overlying said trough-shaped part of said connector and entering said hollow cylindrical portion of said connector, and a resilient member acting on said intermediate member to urge the same against the cable to force the cable into said trough, said cylindrical member forming a stop which said resilient member may engage to resist pulling said cable out of said connector.

3. An electrical connection for a flexible current-carrying cable comprising a large number of small wires, including a rigid connector having a hollow cylindrical portion at one end thereof through which the cable may extend and a trough-shaped portion adjacent thereto into which a part of said cable may be laid lengthwise, an intermediate pressure-transmitting member overlying said trough-shaped part of said connector and having an end portion thereof formed to extend into said cylindrical portion and to cooperate therewith to wedge said intermediate member against said cable, and a spring acting on said intermediate member to force the same against the portion of the cable lying in said

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trough-shaped part, said spring also exerting pressure on said intermediate member to urge the same in the direction of its length into wedging relation to said cylindrical portion of said connector.

4. An electrical connection for a flexible current-carrying cable comprising a large number of small wires, including a rigid connector having a substantially cylindrical part at an end thereof and a trough-shaped part adjacent to said cylindrical part into which a part of said cable may be laid lengthwise after passing through said hollow cylindrical part, an intermediate member having one end thereof wedge-shaped and formed to enter said cylindrical part to wedge said cable therein, and a coil compression spring having one end thereof engaging said connector and the other end engaging said intermediate member to force the same into wedging engagement with said cylindrical part and said connector, said coil spring being bowed to engage another portion of said intermediate member to yieldingly urge the same toward said trough to compress said cable between said intermediate member and said trough.

5. An electrical connection for a flexible current-carrying cable comprising a large number of small wires, including a rigid connector having a trough-shaped part into which a part of said cable may be laid lengthwise, and a hollow cylindrical portion through which an end of a cable extends before entering said trough-shaped part, a yielding member exerting pressure on said cable in a direction to press the same into said trough, an intermediate member interposed between said cable and said yielding member and having a tapering end portion extending into said cylindrical portion of said connector and serving to wedge said cable and intermediate member into said cylindrical portion when said cable is subjected to a pull in a direction to withdraw the end thereof from said connector.

6. An electrical connection for a flexible current-carrying cable comprising a large number of small wires, including a rigid connector having a trough-shaped part into which a part of said cable may be laid lengthwise, a spring member extending partly around said connector and having a plurality of arms extending above said trough, and an intermediate member interposed between said spring arms and said cable, said spring arms acting on said intermediate member to press the same against said cable.

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