The present invention relates to improvements in a cable connector and more particularly to a connector designed for conducting electric current and for sustaining tensile load, and to the method of forming the same.

An object of the invention is to provide a connector designed as an electrical terminal or joint for effectively conducting electric current uniformly into or from the wire strands of a stranded electric cable and also designed to take high tensile load while conducting the electric current.

Another object is the provision of a connector embodying an actual fusion of metal provided by a welded joint particularly between an aluminum cable and an aluminum connector member, which insures an efficient electrical connection, and also embodying compression features insuring a connection capable of carrying high tensile load without endangering the welded electrical connection.

Further object is the provision of the foregoing features together with a mechanical connection between connector members.

A still further object is to provide a novel method of forming the connector.

Other objects and advantages of the invention will be more apparent from the following description taken in connection with the accompanying drawings which are exemplary and in which:

Fig. 1 is a view partly in section of a cable received in a section or member of the connector, at one stage of the formation thereof.

Fig. 2 is a view, partly in section and partly broken away, of the connector section and cable of Fig. 1 welded together.

Fig. 3 is a view partly in section and partly broken away, of the assembled connector.

Fig. 4 is an end view of the device of Fig. 3.

Fig. 5 is a view of the connector of Fig. 3 taken at 90° from that of Fig. 3.

Fig. 6 is a view of a modification.

The connector of the present invention is designed as a termination or joint for conducting electric current uniformly into or from the wire strands of a conductor such as an electric cable of aluminum, for example.

The relatively pure hard drawn aluminum used for electrical conductors has, on every surface exposed to oxygen, a film of aluminum oxide which is relatively impermeable and of high electrical resistance, as compared to the underlying metal.

Connectors heretofore used for aluminum cable are, in general, electrically unsatisfactory, since the inner wires of a rope stranded conductor do not carry an equitable share of the total current load, as a result of the aluminum oxide coating on all of the wires.

By the connector of the present invention, an actual fusion of metal is provided which insures a uniform and efficient electrical connection, and the connector provides a joint mechanical advantage by compression features insuring a connection capable of sustaining high tensile load without impairing the electrical connection.

The use of tin or other solder for soldering the wires of the aluminum cable to the block of the connector is satisfactory as an electrical joint where intimate contact is achieved between the solder and the wires and between the solder and the connector surface. However, the physical bond between solder and an aluminum surface is generally of an unpredictable nature, and unpredictable under tension. Welding is preferred as the means of joining the aluminum cable wires to the connector member of aluminum.

As shown in the drawings illustrating an embodiment of the invention, the connection comprises two main members or sections 1 and 2, one received within the other and preferably having a threaded connection 3 between the threads on the member 2 and the threads in the bore of the member 1.

One section 1 may desirably be made of brass and the other 2, of aluminum.

The aluminum section 2 preferably is in an annealed condition, having been annealed, following machining, for example at 800° F. with a subsequent cooling rate of 50° F. per hour.

In assembly, the stranded cable conductor 4 is cut off square and inserted into the aluminum section 2 so that the end of the cable is just inside of the beveled head 5 as seen in Fig. 1.

The stranded conductor cable 4 preferably of aluminum, and the aluminum connector section 2, are then preferably welded together, preferably using an oxy-acetylene flame and a pure aluminum welding rod. The shank of the connector is then compressed around the aluminum conductor. The connector section 2, welded at 6 and compressed at 7 on to the conductor cable 4, is shown in Fig. 2.

In the embodiment shown in Fig. 2, the compressed connector section 2 is shown as comprising several annular depressed or compressed portions, each providing an external annular depression 7 and an internal projection or annular rib 8 engaging and depressing the stranded cable 4 in interlocking engagement.
Following the welding and the compression operations on the aluminum cable 4 and connector section 2, in the embodiment shown in Fig. 4, with the connector section 2 with its attached section 4 is screwed tightly into the connector section or member 5 which may be of brass, and has a lug 9 constituting a terminal for the cable and suitably apertured at 13.

The screw connection is desirably fastened or locked in place by two brass pins 10 and 11 which may desirably be about ½ inch in diameter, and which are inserted through both of the sections 1 and 2 at the threaded area, aligned holes receiving the pins being provided in the sections 1 and 2 for the purpose. This is shown in Figs. 3 and 5.

The connector section 1a of Fig. 6, instead of having the lug 9 formed thereon as in Fig. 5, may have formed thereon a tubular portion 14, similar to the tubular member 2, and may receive a conductor 15 therein, which may be secured therein in any suitable manner as by soldering or by compression. As shown in Fig. 6, illustrating this modification, a stranded conductor 15 is shown received within the tubular portion 14 of the connector section 1a. The conductor or other electrical circuit element 15 may desirably be stranded, as indicated, and may be of copper or other suitable conducting metal, secured within and in electrical contact with the tube 14 of section 1a desirably of brass. The conductor 15 is shown in Fig. 6 as being secured within the tube 14 by means of a plurality of indentations 16 which provide internal projections 17 depressing the conductor 15 and providing an interlocking engagement therewith.

The compression may be produced at a compressive load of approximately 20,000 pounds.

The arrangement shown in Fig. 6, makes of the device as shown, a cable joint instead of a terminal connection.

In the operation of the cable connector of the present invention, the cable current is transmitted from or into the aluminum cable 4 through the weld 6, the threaded portion 12 of the cable section 2 and the brass section 1. The fusion of metal at the weld allows uniform distribution of the total current in all wires of the aluminum cable conductor 4.

The cable connector device of the present invention thus incorporates the electrical advantages of an actual fusion of metal as obtained in the welded joint, and the mechanical advantages obtained by the compression features of the joint.

The connector is capable of transmitting high electrical loads uniformly into or from the conductor while under high tensile load.

Physical tensile load on the aluminum cable is transmitted from the aluminum cable conductor 4 to the aluminum connector section or member 2 at the compressions 1, through the compressed shank of the section 2 and through the threaded connection 3 into the brass section 1 at the threads. With this construction, the physical load is impressed only slightly, if at all, on the main electrical connection, i.e., the weld area.

The compression of the aluminum conductor cable 4 by the connector section 2 forms the mechanical load-carrying point or points removed from or beyond the weld, and the full tensile strength of the hard drawn aluminum wires is retained at the compressed mechanical connection. Aluminum wire as used for electrical conductor purposes has a tensile strength of about 25,000 to 30,000 pounds per square inch. The high temperatures employed in soldering or welding tend to reduce the hard drawn tensile property of the portions of the wire involved in the welding or soldering, by performing what is essentially an annealing cycle in the metal. Soldered or welded connections alone are therefore physically unsatisfactory for sustaining the main portion of the pressure tensile load.

By the device of the present invention, the electrical path through the connector utilizes the high conductivity of the fused mass of relatively pure annealed aluminum in ideal electrical contact with every wire of the cable conductor, while the compressed mechanical connection sustains the tensile strength to sustain the tensile load, and protects the electrical connection.

It will be understood that various changes in the size, shape, and arrangement of parts may be made without departing from the spirit of the invention and it is not intended to limit the invention other than by the terms of the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:
1. In combination in an electrical cable connector capable of sustaining high tensile load while providing a highly efficient fused electrical connection, a tubular connector member, a stranded wire cable in said tubular connector member, said wire cable being of a metal which when subjected to high temperature tends to be reduced in tensile strength, a fusion of metal closing the end of said tubular connector member and constituting a fused electrical union between said tubular connector member and the end of said stranded wire cable, a second connector member having a bore, the closed fused end of said tubular connector being received within said bore of said second connector member, and means providing a connection securing said connector members together, said tubular connector member having a compressed portion providing an external depression therein and an internal projection disposed in a depression in the cable in interlocking engagement therewith and providing a mechanical connection for sustaining the tensile load to which the cable and connector are subjected and protecting and relieving the said fused electrical union of tensile load, said compressed mechanical connection being at a point removed from the fused electrical union so that the full tensile strength of the wires of the cable is retained at the compressed mechanical connection.

2. In combination in an electrical cable connector capable of sustaining high tensile load while providing a highly efficient fused electrical connection, a tubular connector member, a stranded wire cable in said tubular connector member, said wire cable being of a metal which when subjected to high temperature tends to be reduced in tensile strength, said tubular connector member being of the same metal as that of the wire cable, a weld closing the end of said tubular connector constituting a fused electrical union between said tubular connector member and the end of said stranded wire cable, the exterior surface of said tubular connector member at the closed welded end portion thereof being provided with screw threads, a second connector member having a threaded bore,
said threaded end portion of said tubular connector member being received within said threaded bore of said second connector member in a threaded connection, pin means extending through the walls of said connector members and securing said threaded connection, said tubular connector member having a compressed portion providing an external depression therein and an internal projection disposed in a depression in the cable in interlocking engagement therewith and providing a mechanical connection for sustaining the tensile load to which the cable and connector are subjected and protecting and relieving the said fused electrical union of tensile load, said compressed mechanical connection being at a point removed from the fused electrical union so that the full tensile strength of the wires of the cable is retained at the compressed mechanical connection.

3. In combination in an electrical cable connector capable of sustaining high tensile load while providing a highly efficient fused electrical connection, a tubular connector member, a stranded wire cable in said tubular connector member, said wire cable being of a metal which when subjected to high temperature tends to be reduced in tensile strength, said tubular connector member being of the same metal as that of the wire cable, a weld closing the end of said tubular connector member and constituting a welded electrical union between said tubular connector member and the end of said stranded wire cable, the exterior surface of said tubular connector member at the closed welded end portion thereof being provided with screw threads, a second connector member having a threaded bore, said threaded end portion of said tubular connector member being received within said threaded bore of said second connector member in a threaded connection, pin means extending through the walls of said connector members and securing said threaded connection, said tubular connector member having a compressed portion providing an external depression therein and an internal projection disposed in a depression in the cable in interlocking engagement therewith and providing a mechanical connection for sustaining the tensile load to which the cable and connector are subjected and protecting and relieving the said fused electrical union of tensile load, said compressed mechanical connection being at a point removed from the fused electrical union so that the full tensile strength of the wires of the cable is retained at the compressed mechanical connection.

DONALD MACINNES.

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