Nov. 20, 1962 N. E. ANDERSON 3,065,438

TERMINAL CONNECTOR

Filed May 25, 1960

FIG. 1

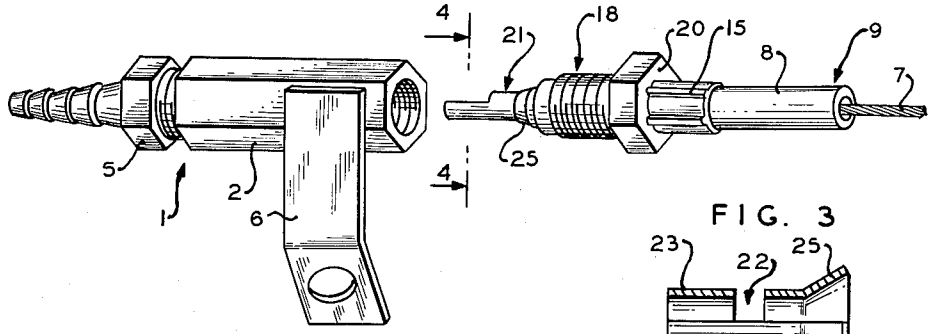


FIG. 3

FIG. 2

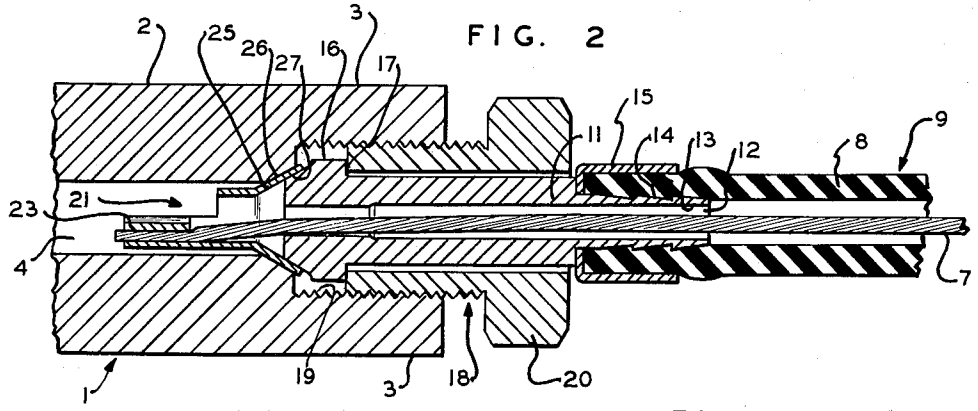


FIG. 5

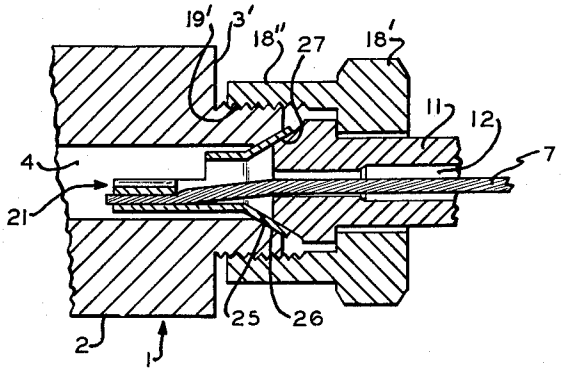
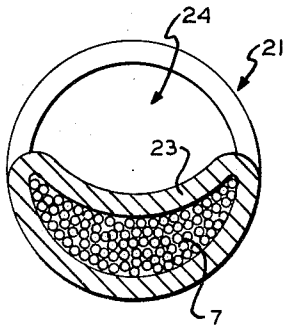


FIG. 4



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TERMINAL CONNECTOR

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This invention relates to terminal connectors for fluid-jacketed electric cables. While not in all aspects necessarily limited thereto, it is nevertheless especially useful in connection with such cables which are used for portable work devices.

An example of a portable work device with which the invention has great utility is an electric arc-welding torch with which inlet and outlet water-supply lines are connected, the water flow accommodated by these lines being used internally of the torch for cooling of its working elements. Such a torch may, by way of further example, be of the general class represented by those disclosed in U.S. Patent No. 2,512,706, issued, on application of Nelson E. Anderson, to the assignee of the present invention.

It is common practise in connection with such torches (although the particular ones shown in that patent employ a somewhat different arrangement) to place an electric cable furnishing power to the torch within one of the water-supply lines, with the advantages not only of simplicity but also of some cooling effect of the water on the cable and resulting permissibility of using a somewhat smaller cable than would otherwise be required. This invention has excellent utility in providing for detachable connection of such a water-jacketed cable to such a portable torch, but unnecessary limitations to that particular background of use are not intended.

A typical fluid-jacketed electric cable to be connected to a portable work device may consist of stranded cable, itself bare, disposed within a hose having an internal cross-section substantially larger than the cross-section of the cable, the space between the inner wall of the hose and the cable serving as the fluid jacket or conduit. For connecting such a cable to the work device it is common to provide a terminal connector element from which there extends inwardly (i.e., toward the fixed extremity of the cable) a lug portion to which the outlying end of the cable proper is attached. This lug portion must of course be exposable for original connection thereto of the cable proper—and, if the system is to be capable of repair at all at this point, then also for such repair. But by hypothesis some fluid-conducting member must surround this lug portion, and the known ways of providing it have entailed serious disadvantages.

Thus if the surrounding fluid-conducting member be only the hose itself—which to accommodate handling of the work device is of course desirably flexible—frequent flexings of the hose in this region which are unavoidable in the intended use of the work device will recurrently flex the cable at and close to the point of its juncture with the lug portion; premature breakage of strands of the cable, or even of the cable in its entirety, is the almost inevitable result. On the other hand if this surrounding fluid-conducting member be the hose supplemented by an in-turn surrounding rigid member rigidly secured to the connector element, there are obviously required both the

addition of an element and a special provision for—as well as the added burden of—its detachment and reattachment as circumstances may require.

There is an additional disadvantage in either of these cases. Unless excessive length of cable proper be provided, the hose itself both during original attaching of the cable to the lug portion and during any attempted repairs must be temporarily retracted along the cable inwardly (i.e., toward the source of the cable); this is troublesome, may strain the hose, and usually will be attempted with the aid of claspings of the hose in the immediate region of its extremity that tend to damage that region—which is the very one on which the fluid-tight connection of the hose itself to the connector element will later depend. On the other hand if excessive length of cable proper be provided, this must after attachment to the lug portion be stuffed back into the hose—again with risk of damage or strain, this time to both cable and hose.

A still alternative approach is to use a rigid fluid-conducting member only to surround the lug portion under discussion. This, however, entails the need for two detachable fluid-tight connections rather than one—i.e., such a connection of this member to the connector element and another of the hose to this member—and will usually require that one of the two connections be a swivellable one; construction, attachment and detactment obviously all become rather complicated.

It is an object of my invention to obviate these disadvantages in a simple, sturdy and inexpensive manner.

When a cable proper breaks at or near its point of attachment to a lug, then in repair of the system it is as a practical matter necessary to discard that lug and everything that is integral with it. In the known connecting systems (e.g., in those briefly discussed above) it is common to make the lug an integral part of a connector element which serves several other functions as well and is therefore relatively elaborately machined or otherwise formed, and hence relatively costly; thus repair, whether necessitated by cable breakage or otherwise, is relatively costly. Not only is it an object of the invention (as above stated) to provide sturdiness and thus to minimize need for repairs, but it is also an object to render relatively inexpensive and very easy any repair which does for any reason prove necessary.

The usual serving by a single terminal connector element of several functions simultaneously results in the necessity to use for that element a single material not necessarily ideally suited to each of the functions individually. It is an object of my invention to effect the connection of the jacketed cable to the work device by a simple assembly of elements each performing more restricted functions and each of which may therefore be of material more ideally suited to those functions which it does perform.

It is a general object of the invention to provide an improved connector for a fluid-jacketed electric cable, and it is a particular object to provide a specially shaped ferrule useful in such a connector. Still other and allied objects will more fully appear from the following description and the appended claims.

As hereinafter more fully described, I accomplish these objects by a connector whose principal elements are a terminal tube and a specially shaped ferrule through both

of which the cable proper passes, the tube and ferrule being terminal elements for hose and cable respectively, and the ferrule having a portion positionable between the terminal tube and the receptacle member of the work device and constituting a gasket when the terminal tube is clamped against that member.

In the description of my invention hereinafter set forth reference is made to the accompanying drawing, in which:

FIGURE 1 is a perspective view both of a typical receptacle member forming part of a work device to which a jacketed cable is to be connected and, disconnected from the receptacle member, of such a cable having at its outlying end an assembly according to my invention for effecting such connection;

FIGURE 2 is a longitudinal cross-sectional view of the receptacle member and, now connected thereto, of the assembly and cable of FIGURE 1;

FIGURE 3 is a view partly in elevation and partly in section of the ferrule which forms part of the assembly;

FIGURE 4 is an enlarged cross-sectional view taken along the line 4—4 of FIGURE 1; and

FIGURE 5 is a cross-sectional view corresponding to FIGURE 2 but illustrating a modification of the assembly according to my invention.

Reference being had to FIGURES 1 and 2, there will be seen the receptacle member, designated generally as **1**, which may form a part of the work device. This may for example consist of an exteriorly hexagonally cross-sectioned element **2** provided along its axis with a fluid-conducting bore **4**, this bore communicating at the left-shown end of the element **2** with the bore of a fitting **5** which in turn provides for fluid communication with other parts of the work device but which forms no part of the present invention. Purely by way of example, bore **4** may constitute the conduit through which cooling water, after circulating through such other parts, leaves the work device. The bracket **6** appearing as part of the receptacle member **1** is simply a means of typical nature for providing mechanical and electrical connection of the receptacle member to the remainder of the work device.

Attention now being turned from the lefthand to the righthand portions of FIGURES 1 and 2, there will be seen a stranded flexible electric cable proper designated as **7** and for example of copper, this being spacedly surrounded by a hose **8** of plastic or other suitable flexible material. Both cable **7** and hose **8** will be understood to continue to the right for any suitable distance to some fixed extremity at which power will be supplied to the cable and fluid will be supplied to—or, consistently with the above exemplifying statements as to bore **4**, received from—the hose. The fluid-jacketed cable thus described is designated generally as **9**.

In effecting a connection of the jacketed cable **9** to the receptacle member **1**, I subdivide four functions usually performed by a single connector element into two pairs. The first pair consists of the functions (*a*) of providing a terminal for the hose **8**, and (*b*) of providing for the securing of the connector to the receptacle member **1**. The second pair consists of the functions (*c*) of providing a terminal for the cable proper **7**, and (*d*) of providing for the fluid-tight seating of the connector against the appropriate part of the receptacle member **1**.

To perform the first pair of functions I employ a suitably formed terminal tube **11**, to be seen in FIGURE 2, which is provided with an appropriate bore **12**. At its inlying extremity—i.e., its extremity (rightward in the drawing) facing toward the fixed extremity or source of the cable—it may have a portion **13** of constricted external diameter so that it may fit within the hose, this portion being provided with circumferential corrugations **14** suitably shaped to facilitate its insertion into the end portion of the hose but to hinder its withdrawal therefrom. The holding of the terminal-tube portion **13** in its thus inserted position may be aided, in accordance with well known practice, by the use of cement between

that portion and the interior of the hose and by the crimping, after the insertion, about the end portion of the hose of a suitable flanged band **15**. The bore **12** of the terminal tube of course communicates with that of the hose **8**, and the terminal tube obviously forms a terminal for the hose and thus performs function (*a*).

To perform function (*b*) the terminal tube near its outlying extremity may have a portion **16** of enlarged diameter which at its inlying (right-shown) extremity will form a shoulder **17**. By suitable pressure exerted against this shoulder the terminal tube **11** may be clamped against a portion (hereinafter pointed out) of the receptacle member **1**, thus providing for the securing of the connector to the receptacle member. The pressure against shoulder **17** is readily provided in accordance with practice itself well known—for example in the structure of FIGURES 1–2, by externally threaded elongated collar **18** surrounding the main portion of the terminal tube **11** and screwed into suitable female threading **19** in a rightwardly shown extension **3** of the receptacle member **1**, which extension is for the purpose of providing for such threading. The collar **18** may be provided with an enlarged hexagonally formed inlying portion **20** to facilitate its being turned.

It is of course to be understood that the means for exerting pressure against the shoulder **17** may be widely varied. Exemplifying such variation I have shown in FIGURE 5 an alternative arrangement in which the externally threaded and relatively long collar **18** is replaced by a relatively short collar **18′** from which there extends outwardly (leftwardly in the drawing) an annular portion **18″** of larger internal diameter and internally threaded. The annular portion of this collar is screwed over a suitable male threading **19′** on the receptacle member **1**, which threading is provided for by a cut-back (instead of extension) of the receptacle member, the end of this cut-back being designated in FIGURE 5 by the numeral **3′**.

To perform the second pair of functions I employ a specially shaped ferrule designated generally as **21**, seen not only in FIGURES 2 and 5 but also, in its originally fabricated form, in FIGURE 3. This ferrule is basically a cylindrical element, having through most of its length an external diameter freely insertible within the bore **4** of the receptacle member. Its inlying extremity is located adjacent the outlying extremity of the terminal tube **11** and, like the terminal tube, it surrounds the cable **7**. Its outlying portion is made to furnish a hollow lug for mechanically and electrically connecting the end of the cable to the ferrule. For this purpose, as seen in FIGURE 3, a longitudinally intermediate side portion of the ferrule is provided with a void **22**, beyond which there is left an outlying portion **23** which may be collapsed around the end portion of the cable **7** thereby furnishing a hollow lug surrounding that end portion of the cable. As best illustrated in FIGURE 4, that end portion may be clamped in the lug in the final phase of the collapsing process, and further is desirably soldered to the lug.

Thus function (*c*) is accomplished. In its accomplishment a substantial cross-sectional area, designated in FIGURE 4 as **24**, is left free for fluid conduction between the bores **12** and **4** of terminal tube and receptacle member, respectively. Note is made that the provision of some void, such as **22**, at a portion of the ferrule spaced away from its inlying extremity facilitates generally the connection of the cable to the ferrule, independently of the specific attaching means employed. Note is also made that in preparation for the process of attaching the cable to the ferrule, which will be carried out after the hose has been secured to the terminal tube, there is no requirement that the cable or hose—or the terminal tube or the ferrule—be manipulated into any set of positions relative to each other, other than that which they are finally to occupy; thus there are avoided any strains of or potential damage to cable or hose such as

discussed early hereinabove. At the conclusion of the cable-attaching process the ferrule is held by the cable with its inlying end closely adjacent—although not with fluid-seal tightness, which is as yet unnecessary—to the outlying end of the terminal tube, and the asssembly on the end of cable **9** is complete (although not yet herein quite completely described) and available for its connecting function.

The ferrule **21** at its inlying end is left circumferentially continuous and is provided with a portion clampable between the terminal tube **11** and the receptacle member **1**. For this purpose it may conveniently be there provided with a flare **25**, for example of bell-like nature; accommodating to this formation of the flare, the inlying end of the receptacle member proper (i.e., that end, disregarding the extension **3** in FIGURES 1–2 or the cutback whose end is designated as **3'** in FIGURE 5) may be provided with a female conical seat **26** about the bore **4**, and the outlying end of the terminal tube **11** may be provided with a generally corresponding male conical seat **27**. Whatever be the configuration of the flare **25**, these seats are desirably approximately, but by no means necessarily precisely, conformed to that configuration—and they are desirably approximately, but again by no means necessarily precisely, adapted to seat against each other were they to be assembled in the absence of the ferrule. The ferrule being present, the pressure of the terminal tube **11** against it serves to deform the ferrule not only into fluid-tight contact with the seat **26** of the receptacle member, but also into such contact with the seat **27** of the terminal tube. Thus the ferrule accomplishes the purpose stated above as function (*d*). In other terms the ferrule, present for the first purpose of providing a terminal for the cable **7**, also serves the independent purpose of acting as a gasket for rendering fluid-tight the coupling of the connector to the receptacle member.

It will be understood that when the connector is coupled to the receptacle member, the outlying end and the body portion of the ferrule are held within the bore **4** of the receptacle member, into which they are freely insertible, and that it is the flare **25** of the ferrule which makes dependable electrical contact to the receptacle member.

In view of the separation of functions between terminal tube and ferrule, it is possible to make more ideal choices of the materials to be used than would be possible for a single member called on to perform all those functions. On the one hand the terminal tube, subjected to various stresses in the normal use of the work device, may be made of a material, such for example as a suitable brass, just as hard as may be desirable for resistance to deformation, abrasions of its threads while in unconnected condition, etc. On the other hand the ferrule, quite protected during all use of the work device by its enclosure within the bore of the receptacle member, may be and desirably is made of a readily deformable material such for example as soft copper.

It will now be appreciated that, while the terminal tube is clamped to the receptacle member and the cable **9** as an entirety thus attached to the work device, the cable **7** proper is proofed against appreciable flexure, either due to handling of the work device or otherwise, throughout the entire distance from its point of attachment to the ferrule to the inlying end of the terminal tube—in other words, throughout a distance even greater than the length of the terminal tube. Again, it will be appreciated that there are avoided the disadvantages of the arrangement in which there is employed a terminal connector element from which there extends inwardly a lug portion for cable attachment—as well as the disadvantages of the several typical remedial expedients possible to be employed with that basic arrangement and discussed above. Still further, it will be obvious that in the extraordinary case wherein a repair is needed, the only element that need be replaced is the small, simple and inexpensive ferrule.

While I have disclosed my invention in terms of particular embodiments thereof, I intend no unnecessary limitations thereby. Modifications in many respects will be suggested by my disclosure to those skilled in the art, and such modifications will not necessarily constitute departures from the spirit or scope of the invention, which I undertake to define in the following claims.

I claim:

1. In combination with a fluid- and electricity-conducting receptacle member and an electric cable, surrounded by a fluid-conducting hose, of which the outlying end is to be connected to said member: a connector comprising a terminal tube to the inlying end of which the outlying end of the hose is secured and within which the cable passes, a ferrule having an inlying end adjacent the outlying end of the terminal tube and having an outlying end and a body portion adapted for insertion into the receptacle member, the cable passing within the ferrule and being mechanically and electrically connected thereto at a point spaced away from the inlying end thereof, said inlying end of the ferrule having a flare, and the outlying end of the terminal tube having a seating surface which engages the flare of the ferrule when it is inserted into the receptacle member and clamped against a seating surface therein by the terminal tube.

2. A connector for use at the outlying end of an electric cable surrounded by a fluid-conducting hose to couple the cable and hose to a fluid- and electricity-conducting receptacle member, comprising a terminal tube to the inlying end of which the outlying end of the hose is secured and within which the cable passes, a ferrule having an inlying end adjacent the outlying end of the terminal tube and having an outlying end and a body portion adapted for insertion into the receptacle member, the cable passing within and being attached to the ferrule at the outlying end of the ferrule and the ferrule being adapted when in inserted position to make both fluid and electrical connections with the receptacle member, and clamping means bearing against the terminal tube for holding it in fluid-tight relationship with the ferrrule and for holding the ferrule in fluid-tight relationship with the receptacle member when it is in its inserted position therein.

3. A connector for use at the outlying end of an electric cable surrounded by a fluid-conducting hose to couple the cable and hose to a fluid- and electricity-conducting receptacle member, comprising an elongated terminal tube to the inlying end of which the outlying end of the hose is secured and the outlying end of which is adapted to be detachably clamped to the receptacle member, and an elongated generally cylindrical ferrule having an inlying end adjacent the outlying end of the terminal tube, and having at its said inlying end a portion clampable between the terminal tube and the receptacle member with its outlying end and its body portion within the receptacle member, the cable being attached to the ferrule at a point close to the axis of the ferrule and spaced away from the inlying end of the ferrule, and the cable passing within the inlying portion of the ferrule and within the terminal tube.

4. A connector for coupling the outlying end of an electric cable surrounded by a fluid-conducting hose to a fluid- and electricity-conducting receptacle member, comprising a fluid-conducting element to which the hose is terminally secured and through which the cable passes, said element being clampable to the receptacle member, and an electrically conductive element to which the cable is terminally attached, the second element having a portion positionable between the first element and the receptacle member, said portion of the second element constituting a gasket for the fluid-tight seating of the connector against the receptacle member.

5. A connector for coupling the outlying end of an electric cable surrounded by a fluid-conducting hose to

a fluid- and electricity-conducting receptacle member, comprising a fluid-conducting element to which the hose is terminally secured and through which the cable passes, said element being clampable to the receptacle member and being of relatively hard material, and an electrically conductive element to which the cable is terminally attached, the second element having a portion positionable between the first element and the receptacle member and being of relatively soft material, said portion of the second element constituting a gasket for the fluid-tight seating of the connector against the receptacle member.

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