

[54] **HOSE RETAINING DEVICE FOR LIQUID COOLED FLEXIBLE ELECTRICAL CABLE**

[75] Inventor: **Lawrence M. Talley**, Bay Village, Ohio

[73] Assignee: **Watteredge-Uniflex, Inc.**, Avon Lake, Ohio

[22] Filed: **Mar. 27, 1974**

[21] Appl. No.: **455,223**

[52] U.S. Cl. **174/19, 174/15 C, 219/130**

[51] Int. Cl. **H01b 7/34**

[58] Field of Search **174/15 R, 15 C, 19, 20, 174/60, 74 R; 339/15, 112, 117; 219/130**

[56] **References Cited**
UNITED STATES PATENTS

2,943,133	6/1960	Leathers	174/15 C
3,456,064	7/1969	Toto	174/19 X

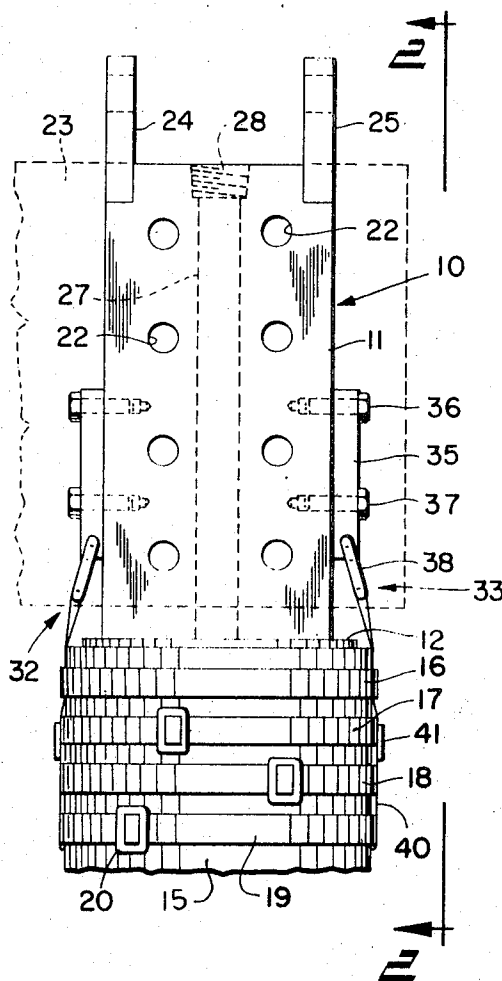
3,801,724 4/1974 Goodman 174/19 X

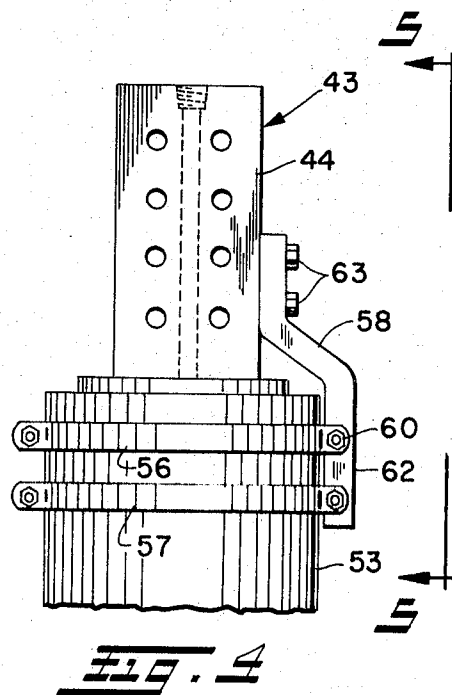
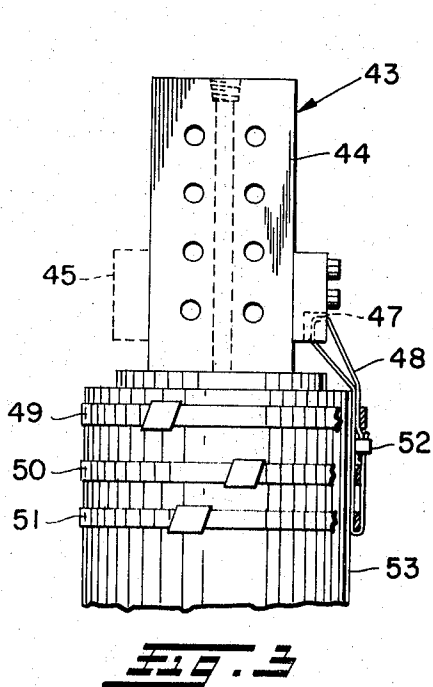
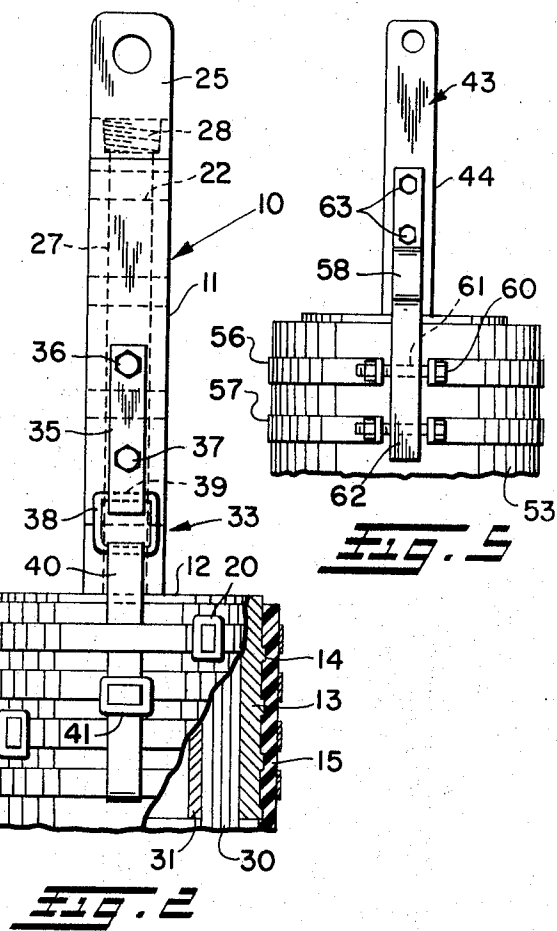
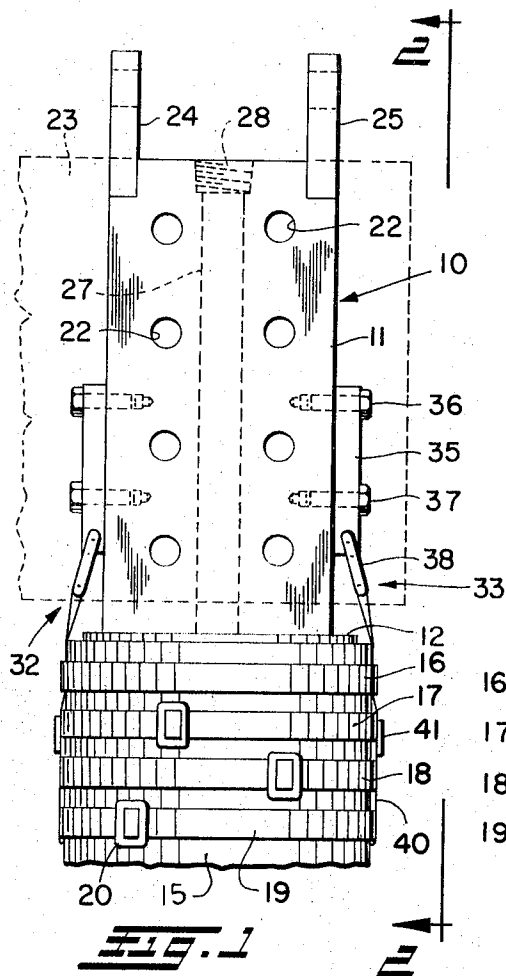
Primary Examiner—Arthur T. Grimley
Attorney, Agent, or Firm—Donnelly, Maky, Renner & Otto

[57] **ABSTRACT**

A liquid cooled flexible electric cable including a terminal having a projecting end which is adapted to be fixed to a conductor. A hose is clamped to the terminal with clamp means encircling the hose and clamping the same to the terminal to form a liquid-tight connection between the hose and terminal. A retainer either rigid or flexible is provided extending between the clamp means and the projecting end to maintain the hose connected to the terminal on continued use and flexing of the cable. Water or other coolant is circulated through the cable.

10 Claims, 5 Drawing Figures





HOSE RETAINING DEVICE FOR LIQUID COOLED FLEXIBLE ELECTRICAL CABLE

This invention relates generally as indicated to liquid cooled flexible electrical cable and more particularly to certain improvements in the hose-terminal connection which results in longer cable life.

Hollow core water-cooled cables are used in many applications transmitting electricity from fixed transformers, for example, to movable applications such as electric furnaces, welders, magnets, and the like. In many applications such as electric furnaces, considerable flexibility is required to permit, for example, electrodes to be removed, or the entire furnace to be tilted for pouring or charging.

In such hollow core electrical cable construction, the terminals are connected to the conductor in the cable which surrounds a hollow core and a hose is clamped to each terminal of the cable so that liquid coolant can be circulated therethrough.

The hose is generally of rubber or plastic and is attached to the terminal by banding or bolted clamps which in the service of the cable may tend to become loose. It has been found that the flexing of the hose is most severe at the terminal and over a period of time, the rubber or plastic material tends to extrude from under the bands or clamps which encircle the hose ends. The bands and clamps thus tend to become loose. Such extrusion is normally caused by pressure of the bands or clamps, flexing at the termination, or the hose experiencing tension due to such forces as pulling or stretching.

Most cable terminations are rigid in one plane, and the bending of the hose causes it to be placed in compression on one side of the terminal and in tension on the opposite side of the terminal. This creates a moment of force tending to peel the hose off the terminal or connector, such action being similar to the force produced to remove the cap from a soft drink bottle.

Moreover, with the hose carrying liquid under pressure, the pressure applied to the inner surface of the terminal in the same manner that force is transmitted to a piston inside a cylinder. The internal pressure can create a substantial force tending to push the terminal out of the hose, particularly with large diameter hose.

This phenomenon has become a very serious problem with the use of large water-cooled electrical cables used on electric arc furnaces. It is accordingly a principal object of this invention to overcome this problem.

Another object is the provision of a hose retaining device in liquid cooled flexible electrical cable which will preclude separation of the terminal and hose.

Another principal object is the provision of a hose retaining device for electrical cable which can quickly and simply be attached between the terminal and hose to obtain the benefits herein described.

Another object is the provision of an inexpensive and simple device which can be employed between the projecting end of a flexible cable terminal and the hose to resist the forces tending to peel the hose off of the terminal.

Other objects and advantages of the present invention will become apparent as the following description proceeds.

To the accomplishment of the foregoing and related ends the invention, then, comprises the features herein-after fully described and particularly pointed out in the claims, the following description and the annexed drawing setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawing:

FIG. 1 is a fragmentary side elevation of a cable terminal in accordance with the present invention;

FIG. 2 is an elevation of the cable terminal seen from the line 2—2 of FIG. 1 with the hose and terminal partly broken away and in section;

FIG. 3 is a view similar to FIG. 1 on a slightly reduced scale of another embodiment of the present invention;

FIG. 4 is a view similar to FIG. 3 of yet another embodiment of the invention utilizing a rigid retaining means between the terminal extension and the hose; and

FIG. 5 is a side elevation of the embodiment seen in FIG. 4 as seen from the line 5—5 thereof on a slightly reduced scale.

Referring now to the drawing and more particularly to the preferred embodiment of FIGS. 1 and 2 it will be seen that the cable terminal 10 comprises an elongated flat extension 11 and a cup-shape cylindrical portion 12 formed integrally therewith. The cup-shape portion 12 includes an annular skirt 13 having circumferential axially spaced ridges 14 to which the hose 15 is secured by clamp means encircling the hose. Such clamp means is in the form of a plurality of axially spaced clamping bands which encircle the end of the hose 15 compressing the same against the skirt 13 of the terminal. In the illustrated preferred embodiment there are shown four such clamp means, 16, 17, 18 and 19, although it will be appreciated that the number of such clamping bands may vary, as for example from 2 to about 5.

The bands may be tightened and secured in a variety of ways. As illustrated, buckles 20 may be employed wherein the band passes through a loop and then folds back on itself, being held in place by protrusions on the band. Other types of securing devices may be employed in connection with the band, such as crimped sleeves, or sleeves which are crimped and indented to lock the banding in place. Also, sleeves may be employed which are secured by screws. A preferred type of buckle is that manufactured and sold under the brand name BAND-IT by the Band-It Company of Denver, Colo.

The terminal 10 is preferably carefully machined from a copper or aluminum casting and is highly polished and silver-plated for improved electrical conductivity. The extension 11 is provided with a plurality of transverse holes seen at 22 so that such extension may be secured firmly to a transformer or furnace conductor as seen at 23 in phantom lines. The flat sides of the extension 11 thus provide flat silver-plated contact surfaces. The end of the extension 11 may be provided with lifting eyes seen at 24 and 25. The extension also has a longitudinally extending central passage 27, the end of which is tapped as indicated at 28. Such passage communicates with the interior of the cup-shape portion 12 so that cooling liquid may be circulated through the cable.

The cable conductor 30 may be in the form of copper cables or strands and is secured within the cup-shape

portion 12 of the terminal between the skirt 13 and sleeve 31. The conductor 30 may be secured by soldering or brazing and also preferably by a differential spring as seen for example in applicant's U.S. Pat. No. 3,548,077 entitled "Differential Spring Conduit Support".

Extending between the hose and the terminal extension 11 at each edge of the terminal extension is a hose retainer as seen at 32 and 33. Since such hose retainers are identical in form, only the hose retainer 33 will be described in detail. An anchor block 35 is secured to the edge of the extension 11 by the fasteners indicated at 36 and 37. A D ring 38 extends through a transverse hole 39 in the anchor block and provides a flexible link between the anchor block and banding 40. Such banding extends through the ring 38 and beneath the first band clamp 16 and around the other band clamps 17, 18 and 19 with the ends of such banding being secured together by buckle 41. Accordingly, the retainer includes the anchor, which is physically attached to the terminal extension, the D ring, which has been found to reduce wear, and the banding which is physically attached or interleaved with the banding clamps of the hose thus forming a flexible connection between the terminal and the hose clamping means. Accordingly, if the hose starts to slip down off of the terminal skirt outer surface, the retainers come under tension retaining the hose in its proper position.

The materials of the retainer are preferably a non-magnetic material such as copper, aluminum, bronze or bronze alloys, certain alloys of stainless steel, nylon strap or rod, glass fiber strips or rod, or high pressure phenolic laminates.

In the embodiment of FIG. 3, the terminal 43 has secured to the edges of the extension 44 anchor blocks 45 and 46. Again, such anchor blocks may be secured by the fasteners illustrated or other suitable means. In this embodiment, the anchor blocks are provided with L-shape passages 47 through which the band 48 may be threaded. Such band 48 extends beneath the first hose clamp band 49 and about the other two hose clamp bands 50 and 51. The two ends of the band 48 are then secured together by buckle or crimped sleeve 52. The hose 53 is thus retained against slippage with respect to the terminal 43.

In the embodiment of FIGS. 4 and 5, extension 44 of the terminal 43 is secured directly to the clamps 56 and 57 for the hose 53 through rigid retainer 58. The hose clamps 56 and 57 may be tightened by bolt-type fasteners 60 which on one side extend through apertures 61 in the offset projecting end 62 of the retainer 58. The other end of the retainer is secured directly to the edge of the extension 44 of the terminal 43 by the fasteners

seen at 63. In the embodiment of FIGS. 4 and 5, only one retainer is normally sufficient, although a second retainer may be employed.

Accordingly, there is provided a liquid cooled flexible electrical cable wherein retainers are provided extending between the clamp means for the hose and projecting end of the terminal to maintain the hose properly connected to the terminal on continued use and flexing of the cable. Thus by the use of a simple and inexpensive retainer, the useful life of large and expensive electrical cable is increased.

I, therefore, particularly point out and distinctly claim as my invention:

1. A liquid cooled flexible electrical cable comprising a terminal having a projecting end adapted to be fixed to a conductor, a hose surrounding said terminal, clamp means encircling said hose and clamping the same to said terminal to form a liquid-tight connection between said hose and terminal, and retainer means extending between said clamp means and said projecting end to maintain the hose connected to said terminal on continued use and flexing of said cable.

2. A cable as set forth in claim 1 wherein said retainer means is flexible.

3. A cable as set forth in claim 1 wherein said retainer means is rigid.

4. A cable as set forth in claim 1 wherein said retainer means includes an anchor block secured to said projecting end, and flexible band means secured to and extending from said anchor block to said clamp means.

5. A cable as set forth in claim 4 wherein said flexible band means to said anchor block by a D ring.

6. A cable as set forth in claim 1 wherein there are a plurality of clamp means, said retainer means extending beneath the clamp means adjacent the end of the hose and around one or more of those clamp means remote from the end of the hose.

7. A cable as set forth in claim 4 wherein said projecting end of said terminal is flat and said anchor block is secured to the narrow edge thereof.

8. A cable as set forth in claim 7 including two fasteners securing said anchor block to said projecting end of said terminal, and a transverse hole in said anchor block with a ring extending therethrough.

9. A cable as set forth in claim 7 including an L-shape passage in said anchor block, and banding threaded through said passage and secured to said clamp means.

10. A cable as set forth in claim 3 wherein said retainer means includes offset ends, one being fastened to said terminal extension and the other to said clamp means.

* * * * *