Nov. 15, 1932. E. D. EBY 1,888,075

TERMINAL FOR OIL FILLED CABLES AND METHOD OF EVACUATING THE SAME

Filed Feb. 17, 1930

Fig. 1.

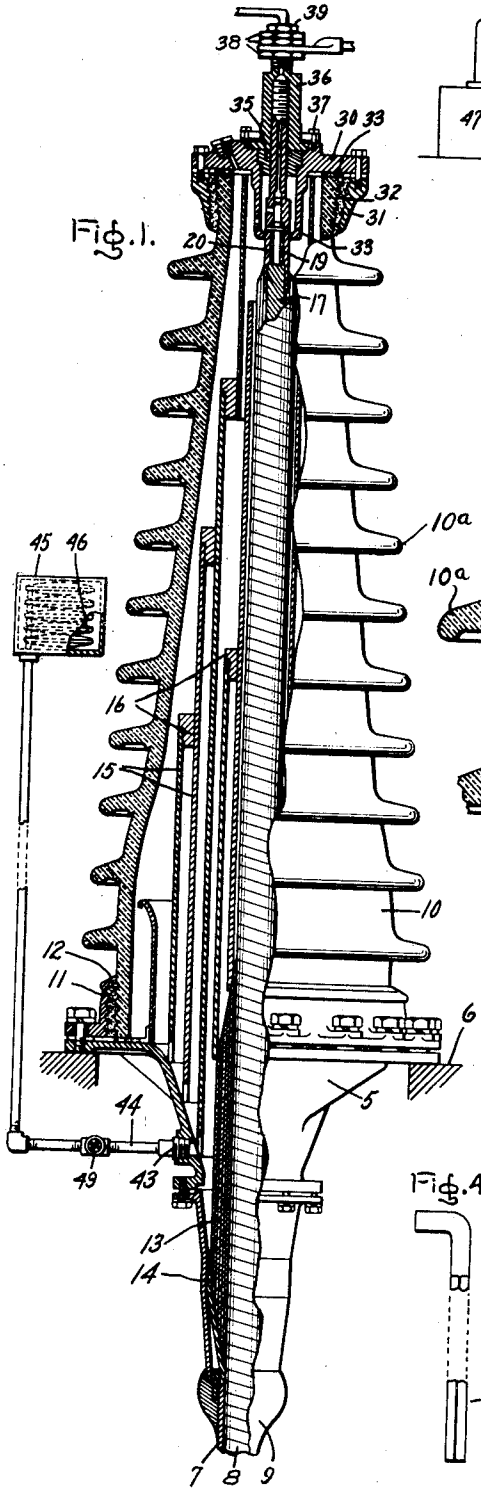

Fig. 2.

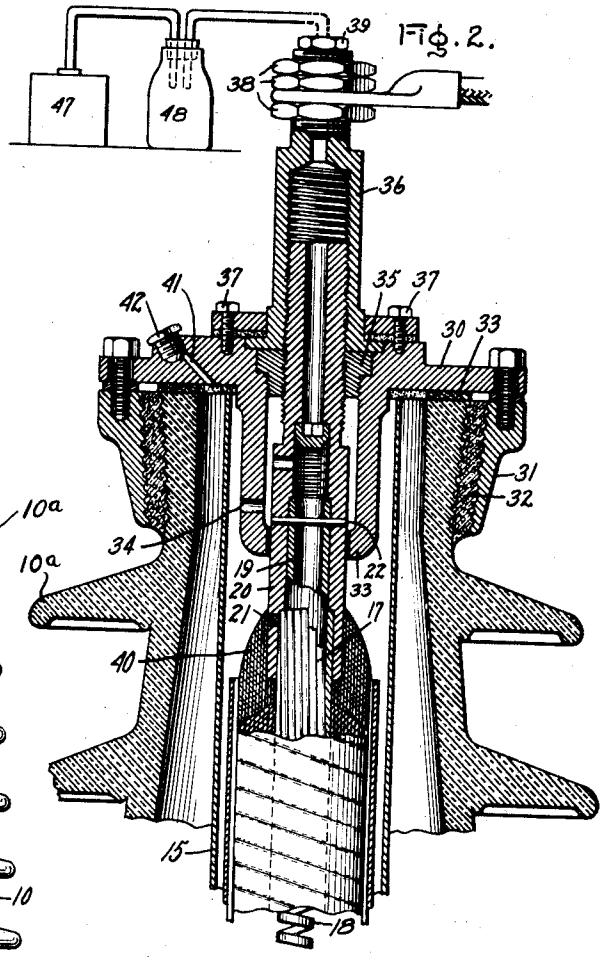

Fig. 3.

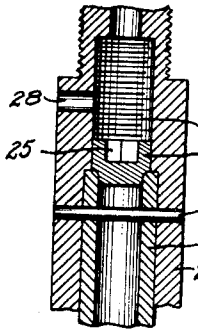

Fig. 4.

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1,888,075

UNITED STATES PATENT OFFICE

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TERMINAL FOR OIL FILLED CABLES AND METHOD OF EVACUATING THE SAME

Application filed February 17, 1930. Serial No. 428,925.

In high tension underground cable systems where the cable ends and the connection to a switchboard, conductor or apparatus utilizing the current is made, an insulated end or terminal is commonly employed. Such terminals should be of such character as to effectively insulate the conductor parts from the ground, of such a rugged construction as not to be easily damaged, and should also be so made as to permit of being easily assembled in place. They should also possess, in addition to the above, a simple arrangement of parts whereby on being assembled in position about the cable end the chambers or spaces between the cable and the insulator may be readily evacuated and subsequently filled with fluid insulation and so maintained.

The object of my invention is the provision of a cable end or terminal of improved construction which has all of the necessary and desirable features above referred to.

For a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

In the accompanying drawing which is illustrative of my invention, Fig. 1 is a view partly in elevation and partly in section of a cable terminal; Fig. 2 is a sectional view of a part of the terminal on an enlarged scale; Fig. 3 is a detail sectional view, and Fig. 4 a side view of a wrench.

5 indicates the metal base or bell member which is supported on a foundation 6 of any suitable character. The bell is made in two principal parts which are united by flanges and bolts. The lower part is connected to the lead sheath 7 of the cable 8 by a wiped soldered joint 9 in such manner as to be fluid-tight and thus prevent the escape of oil from the cable and terminal, or the admission of air thereto.

Rising vertically above the upper surface of the bell is a chambered casing 10 of any suitable insulating material, such as porcelain, which has a plurality of ribs 10^a occupying spaced parallel planes to increase the length of creepage surface or path for electric current. The casing or insulator is secured in place by the flanged metal collar 11 which is secured to the upper flange of the bell by bolts, there being a gasket between the end of the casing and the adjacent metal surface. The casing or insulator is secured in place within the collar by a cement filling 12. 13 indicates a wrapping of paper or varnished cambric which surrounds the paper or other insulation on the cable in the region of the bell. 14 indicates a metallic shield about the lower end of the wrapping to distribute the electrical stresses to which the insulation is subjected in this region. Inside of the bell and insulator is a plurality of concentric barriers 15 which serve as additional insulating means, said barriers being of different lengths for electrical reasons and are suited to the available space therein. They are held in spaced concentric relation as by spacers 16 at or near their upper ends. The lower ends are spaced either by engaging the wrapped-on tape 13 or the bell. Between the insulated end of the cable and the insulator 10 is a space, chamber or clearance which when the device is in use is filled with degasified oil.

The cable comprises a plurality of individual conductors 17 which are disposed with a long lay about a central support 18 which resembles a coiled spring. The support and conductors define the oil channel of the cable. At the upper end of the cable a short length of the internal support is removed and in its place is inserted a tube 19 which in turn is surrounded by a second and concentric tube 20. The lower end of the tube 20 is counterbored and extending into the counterbore or socket thus formed are the ends of the conductors which are sweated in place by solder. The tubes form the element which connects the cable with the terminal parts located outside of the insulator 10. On account of the various machine operations necessary it is desirable to use separate tubes and unite them by solder, but if desired they may be made in one piece by suitable arrangement. To facilitate the soldering operation the tube 20 is provided with one or more lateral openings 21 to receive solder. Prior to assembling the parts the conductors are coated with a suitable flux. When properly assembled the tubes and conductors are heated by a blow

torch and string solder fed into the opening 21. This soldering operation unites the conductors to both tubes. In order to hold the tubes in their respective positions prior to soldering they are united by a cross-pin 22. If desired the two tubes may be united by brazing prior to installation either with or without the pin. As will be seen from Fig. 3 the upper end of the inner tube 19 engages a shoulder formed by the counterbore. This upper end also forms a seat for the valve 23, the purpose of which will be referred to later on. The valve is screw threaded externally to engage the threads 24 in the bore of the outer tube whereby it may be raised and lowered. In the valve is a socket 25 having one or more flat surfaces to receive a wrench 50, Fig. 4, which is inserted from the upper end. In the side of the outer tube is a lateral port 28 communicating with the conduit within the tube and through which oil passes as will appear later on. The portion having the threads 24 terminates at its upper end in a square shoulder to form a stop for the valve. As arranged the travel of the valve is limited at its lower end by the valve seat and at its upper end by the shoulder, but the specific means for accomplishnig this result may be varied so long as they confine the valve within suitable limits and prevent it from getting out of place. When the valve is shut, i. e., in the position shown in Fig. 3, the fluid containing channel defined by the conductor support 18 and the conductors is shut off from communication with the interior or hermetically sealed chamber of the casing or insulator 10. When raised to its upper position where the port 28 is uncovered oil is free to flow between the cable proper and the chambers or spaces within the insulator.

The top of the insulator is provided with a cap or cover 30 which is connected thereto by a ring 31 and a series of retaining bolts. Between the ring and the insulator is a filling of cement 32. Between the metal head or cap and the upper end of the insulator is a suitable gasket 33 which forms a seal which is liquid and air tight and at the same time prevents the porcelain insulator or casing 10 from being cracked when the parts are bolted together. The cap is provided with a depending portion which is concentric with and loosely surrounds the outer tube 20 and acts as a guide therefor. It is provided with a lateral port 34 for the passage of oil and which also acts as a passage to permit air to pass in the evacuation of the chamber or clearance space within the insulator. The center of the cap is bored and counterbored to receive a collar in the form of a nut 35, which is screw threaded both internally and externally. The internal threads engage those on the outer tube 20 and the collar sustains the weight of the cable and prevents it from being pulled downward through the insulator and bell.

Secured to the cap above the collar and in such manner as to make a fluid and air tight joint is a conductor or terminal member 36 having a bottom flange which rests on a shoulder on the cap. It is internally threaded and screws down over the upper tube 20. Briefly stated the tubes 19 and 20 and member 36 are the means whereby current is conveyed from the cable to the conductor leading to another conductor, to a switchboard or other apparatus. The member 36 is also held in place by a ring and bolts 37 and between the latter and the cap is a suitable gasket to form a seal. The member is externally screw threaded at its upper end to receive three nuts 38, one of which serves as a support for the line conductor which conveys current from the cable to the switchboard or other apparatus, the second acts as a clamping nut for the conductor and the third as a check nut. The upper end of the member has a central bore of restricted size and through which the wrench 50 is inserted to adjust the valve 23 to both of its positions. The upper end of the bore is screw threaded to receive a closing plug 39. In the cap is a small passage 41 which is normally closed by a screw threaded plug 42. When the casing is being filled with oil, as will appear later, the plug may be removed so that oil will flow out and carry with it any entrained gases, after which it is secured in place. In many instances it is unnecessary to use the plug.

In assembling the bell is first mounted in place on its support 6 with the cable extending upwardly through it. The end of the cable is cut and the tube 19 and 20 sweated to the conductors, after which a wrapping of varnished cambric tape is applied as indicated at 40. Then the barrier and insulator are mounted in place and the cap and its associated parts mounted in the manner shown and described.

43 indicates a removable screw plug located in the bell-portion below the casing. When it is desired to fill the chamber or spaces within the insulator with oil the plug is removed and a pipe 44 connected thereto. Oil is supplied to the pipe by a reservoir 45 which may be located above the terminal by such an amount that the oil will be fed by gravity or the reservoir may be of the pressure type containing numerous sealed cells 46 (shown in dotted lines) which exert pressure on the oil. This latter construction may be used with advantage where it is inconvenient to place the reservoir in an elevated position.

The method of procedure in evacuating the hermetically sealed chamber of the terminal, and the upper end of the cable, and filling the same with oil is as follows: The valve 23 is raised to the position shown in Fig. 2 so that the lateral port 28 is opened. Oil under pres-

sure above that of the atmosphere is then applied to the other end of the cable as by means of a pressure reservoir, which may be similar to 45, which forces oil and any air in the cable end and inner tube 19 out through the port. After sufficient oil has passed through the port to carry out any trapped air, other gases, and moisture in the cable and tubes the valve is moved to its lower seat when further flow stops. A vacuum pump indicated at 47 is then connected by a pipe to the interior of the terminal conducting member 36 and the chamber or clearance space within the insulator or casing 10 evacuated. In the pipe is a bottle 48 or other device which will show any oil flow. Having suitably evacuated these parts and while a vacuum still exists the valve 49 in the pipe leading from reservoir 45 is opened and degasified oil flows from the reservoir in sufficient amount to completely fill the chamber or spaces within the insulator or casing 10. The pressure of this source should also be above atmosphere. When oil appears in the sight feed device 48 the valve 49 is closed and the suction pipe of the vacuum pump disconnected. Under these conditions the oil level corresponds with the top of the conducting member 36. The valve 23 is then moved to its upper seat as shown in Fig. 2 by means of the wrench 50, with the result that free communication is established between the channel within the cable and the interior of the insulator 10. The passage within the member 36 is then closed at its outer end by a screw plug 39 and its gasket. The pipe 44 of the oil reservoir is removed and the plug 43 used to close the opening in the bell. Because the pressure within the insulator and cable is above that of the atmosphere a small amount of oil will leak out before the plug 43 can be inserted but such leakage is desirable because it prevents the admission of air and moisture.

The invention has been described in connection with a high tension cable because it is particularly adapted for such a purpose but it may be used with other electrical apparatus containing oil and which requires that the terminal be evacuated and oil filled prior to use. Certain of the features of my invention are equally applicable to so-called "oil-stop joints", particular reference being made to the use of a valve located within the oil conduit or channel at some suitable point and so arranged that when in one position it shuts off the flow of oil outwardly from the channel and permits of the evacuation of the chamber or clearance space within the insulator which encloses an end of the cable, and when in the other of its two positions permits oil from the channel to freely pass into and from the said insulator, the valve being moved by means of a tool inserted through a tubular extension from a point distant from the valve itself. A type of oil-stop joint to which the present invention is applicable is shown in my application Serial No. 213,914 filed August 18, 1927. In such a joint the end of each cable section is provided with a terminal, and in using the term in its broadest sense in the claims I aim to include such a construction.

My invention has another advantage of great practical importance in that if an oil leak develops at any point in the terminal by reason of a defective gasket, a cracked porcelain or other injury, the flow of oil from the cable can be stopped by closing the valve 23 by merely removing the plug 39 and using the wrench 50. After this is done the insulator is drained by removing plug 43 after which the parts may be taken down and repairs or adjustments made. From the foregoing it will be seen that the cable itself is protected from the loss of oil, and because of that fact it is unnecessary after a repair of the character above mentioned to retreat the cable, which latter is a long and expensive operation. The amount of oil contained in the chamber of the terminal is relatively small and its cost is so low that it is unimportant.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A terminal for high tension electric conductors comprising an insulator having an hermetically sealed chamber, a hollow conductor containing fluid insulation under a pressure above that of the atmosphere, a conduit member connected to the conductor inside of the chamber and extending through a wall thereof, said conduit being in communication with the interiors of the conductor and chamber, a valve by means of which communication between the said interiors may be made and broken, and a fluid filling for the terminal.

2. A terminal for high tension electric conductors comprising an insulator having an hermetically sealed chamber, a hollow conductor containing fluid insulation under a pressure above that of the atmosphere, a conduit member connected to the conductor inside of the chamber and extending through a wall thereof, said conduit being in communication with the interiors of the conductor and chamber, a valve located wholly within the member and controllable from a point outside thereof by means of which the passage of fluid between the conductor and the chamber may be controlled, and a degasified fluid filling for the terminal.

3. A terminal for electric conductors comprising an insulator having an hermetically sealed chamber, a conductor extending into the chamber and having a channel containing fluid insulation, a terminal member extending outwardly from the chamber, a current carrying element connecting the conductor and the member and containing a con-

duit through which fluid may pass between the chamber and channel, a valve in the element for controlling the passage of fluid through the conduit, and a fluid filling for the terminal.

4. In a terminal for an electric conductor containing fluid insulation, the combination of an insulating casing enclosing the conductor, a support for the casing located at one end, a closing cap for the other end of the casing, a terminal member supported by the cap, a tubular element connecting the conductor with the terminal member and provided with a port communicating with the space within the casing, a valve which is arranged to open and close communication between the interiors of the conductor and the casing through said port, and a fluid filling for the terminal.

5. In a high tension electric terminal, the combination of a hollow conductor containing fluid insulation, an hermetically sealed chambered insulator into which one end of the conductor extends, a terminal member which is supported by the insulator outside of the chamber, a tubular element connecting the conductor at a point inside of the chamber to the terminal, said element having a port through which fluid may pass between the conductor and chamber, a valve situated inside of the element to control the port and which is accessible through the terminal, means for limiting the travel of the valve, and a fluid filling for the terminal.

6. In a terminal of the character described, the combination of an hermetically sealed chambered insulator, a metallic base for the lower end of the insulator, a metal cap for the upper end, a hollow fluid-containing conductor extending through the base into the chamber, a terminal member supported by the cap, a tubular element connecting the conductor and member, a means fastened to the tubular element and engaging the cap for supporting the weight of the conductor, valve controlled means for establishing communication between the interior of the conductor and the chamber in the insulator, and a degasified fluid filling for the terminal.

7. In a terminal of the character described, the combination of an hermetically sealed chambered insulator, a metallic base for the lower end of the insulator, a metal cap for the upper end, an extension on the cap extending downwardly into the chamber and serving as a guide, a port in the extension through which air from the conductor may be extracted and fluid admitted thereto, a conductor extending through the base into the chamber and extension, a terminal member supported from the upper side of the cap, a hollow element extending through the guide and connecting the conductor and terminal, a valve seat in the element, a valve cooperating therewith, a collar which is fastened to the element and rests on the cap to support the weight of the conductor, and a fluid filling for the terminal.

8. In a terminal of the character described, the combination of an hermetically sealed chambered insulator metallic end-closing means therefor, a hollow fluid containing conductor extending through one of the means into the chamber, a hollow terminal member mounted on the other closing means, an element for uniting the conductor and terminal comprising concentric tubes defining a socket to receive the conductor and in which it is secured, one of said tubes extending into the terminal and having a port for fluid, a valve located in the last mentioned tube to control the passage of fluid between the chamber and the conductor through the port, and a fluid filling for the terminal.

9. In a device of the character described, the combination of a body of insulation, a metal base therefor subjected to ground potential, a cap therefor subjected to line potential, said base and cap defining with the walls of said body an hermetically sealed chamber containing fluid insulation, an electric cable which extends within the chamber, contains fluid insulation and is in electrical communication with the cap, a valve controlled conduit by means of which the passage of fluid between said chamber and the cable is controlled, and a fluid filling for the terminal.

10. The method of treating a high tension terminal having an hermetically sealed chambered insulator into which one end of a conductor containing fluid at a pressure above that of the atmosphere projects, comprising shutting off the flow of fluid from the conductor into the chamber, evacuating the chamber and while under a vacuum filling the chamber with insulating fluid, and then opening communication between the conductor and chamber.

11. The method of removing gas and other impurities from a high tension terminal having an hermetically sealed chambered insulator into which a fluid filled conductor extends, comprising forcing sufficient fluid through the conductor into the chamber to remove the impurities in the conductor, shutting off the flow of fluid from the conductor, evacuating the chamber, filling the chamber with fluid from a separate source, opening communication between the conductor and chamber, disconnecting the said separate source, and sealing the point of connection of said source.

12. In combination, an insulated cable end having a channel containing fluid insulation, an insulator enclosing said end with clearance, a tubular element connected to the cable end whereby it may be connected to another conductor and is adapted to receive fluid from the cable, a port establishing communi-

cation between the interior of the cable and the space between said insulator and the cable end, a valve which controls the port, and a fluid filling for the terminal.

13. In combination, an insulated cable end having a central channel, fluid insulation in the channel at a pressure above that of the atmosphere, an insulator sealed fluid tight about the cable end, there being a clearance space between said parts, a tubular element electrically and mechanically secured to the cable end and projecting through one end of the insulator for connection to another conductor and adapted to receive fluid from the cable, a port in the element establishing communication between the inside of the cable and said clearance, a valve which when in one position shuts off the channel in the cable end and permits communication between said clearance space and the outside of the insulator through the tubular element, and when in another of its positions shuts off said communication and connects the interior of the cable with said clearance space, and a means for closing the outer end of the element when the valve is in the latter position.

14. The method of assembling a terminal on a high tension insulated and sheathed cable containing fluid under a pressure above that of the atmosphere, which comprises removing a portion of the sheath and insulation, mounting a connector on the end of the cable conductor, enclosing the end of the cable and connector in a hermetically sealed casing, temporarily shutting off the flow of fluid from the cable to the chamber, evacuating the chamber, and subsequently permitting fluid to flow from the cable into the chamber.

In witness whereof, I have hereunto set my hand this 12th day of February, 1930.

EUGENE D. EBY.