Aug. 26, 1941. G. B. SHANKLIN 2,253,987

TERMINAL FOR GAS FILLED CABLES

Filed May 11, 1940

Fig. 1.

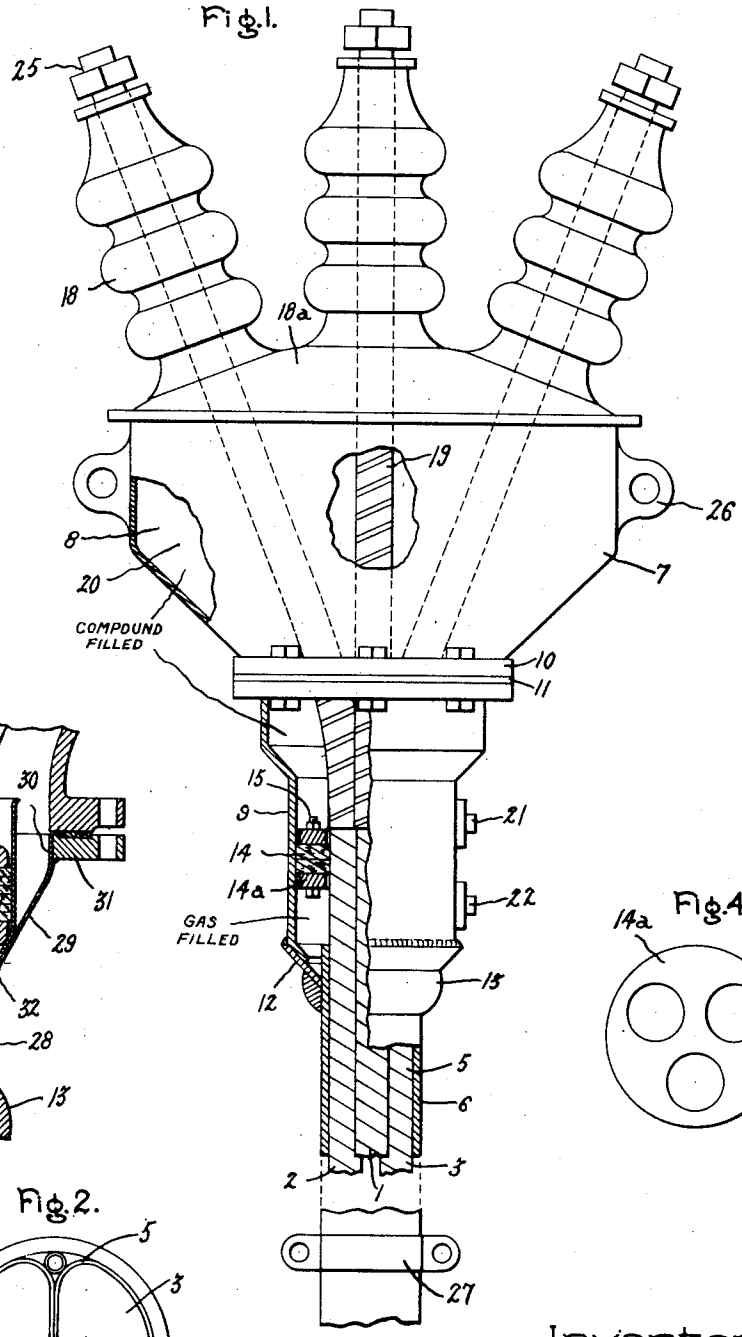


Fig. 3.

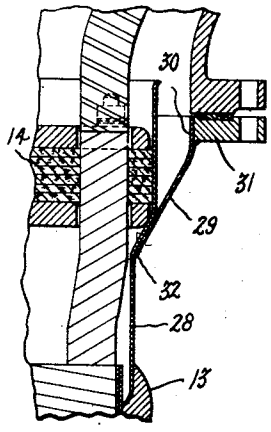
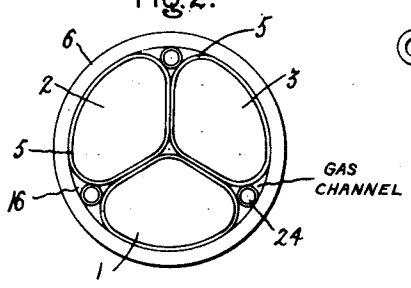


Fig. 4.

Fig. 2.



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TERMINAL FOR GAS FILLED CABLES

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Application May 11, 1940, Serial No. 334,630

4 Claims. (Cl. 174—20)

The present application is a continuation in part of my prior application Serial No. 224,170, filed August 10, 1938.

My invention relates to terminals for electric cables of the type having relatively small, well defined free feed channels therein containing insulating gas under low positive pressure.

Terminals for such cables present problems which are not present with terminals for ordinary types of solid cable. The natural thought is to fill the chamber of the insulator with the same gas that is used in the cable and under the same pressure. However, for electrical reasons, the terminals have to be of considerable size and some parts thereof necessarily have relatively large space volumes. The gas while entirely suitable for the cable due to its construction is less suitable for the terminal because at the low pressure employed, the dielectric strength of the gas in large space volume, such as necessarily exists in terminals, is inadequate for the purpose. Stated another way, the low pressure gas in the cable has ample dielectric strength to prevent ionization discharge in small voids such as exist in the cable insulation but not in large volume gas spaces, even though the electrical stresses in terminals are ordinarily and purposely made less than those in the connected cable.

The object of my invention is the provision of an improved terminal for a cable of the type containing insulating gas under low positive pressure, and having one or more free feed gas conveying channels extending longitudinally thereof.

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 shows a cable terminal partly in elevation and partly in section, Fig. 2 is a simplified or schematic illustration of the cable, Fig. 3 is a modification of the stop, and Fig. 4 is a plan view of one of the clamping rings for the stop.

1, 2 and 3 indicate insulated conductors which may be of sector or other shape. The insulation on the conductors is desirably made of wrapped on paper which is impregnated with insulating liquid and subsequently drained except for the liquid retained by capillary action. Over the insulation on each conductor is applied a metallic shielding tape 5 which is grounded to the sheath by contact therewith and hence the gas in the free feed gas channels, which are described later, is also at ground potential. Surrounding the insulated conductors is an impervious sheath 6, usually of lead. The casing 7 of the terminal may be made of cast metal and is shaped to afford room for the conductors which fan or diverge outwardly with respect to the cable axis and are spaced apart in the same plane or in triangular arrangement. The particular shape of the casing is not essential to the invention. However, it is so shaped or formed that it contains a relatively large chamber 8 through which the insulated conductors extend. The casing is supported by a chambered housing 9 having a flange at the top to receive the bolting flange 10 of the casing 7. A fluid tight gasket or packing 11 is located between the flanges. Into the lower end of the housing the sheath of the cable is extended and connected thereto by a conical or other part 12, the parts being united, desirably at the factory, by a fluid tight joint. The housing is secured to the cable sheath 6 in a manner to ensure a fluid tight joint, as by a wiped soldered joint 13.

Located within the housing with parts thereof firmly engaging the coverings on the conductors and an inner wall of the housing is what for convenience is termed a stop. It comprises in the present case a number of elastic disks 14 made, for example, of cork and placed in contact, one above the other, each having as many axial holes as there are conductors and of a size and shape approximately the same as the external covering of the conductor located therein. The peripheral edges of the disks engage a cylindrical surface forming a part of the housing. Above and below the disks are rings 14a, desirably of metal, which when the bolts and nuts 15 are screwed into place exert pressure on the disks and lateral pressure on the individual conductor coverings as well as on the inner wall of a cylindrical part of the housing. Such an arrangement of parts, while not absolutely tight, is sufficiently so for the purposes hereof. The cable sheath 6 terminates within the housing and below the stop means. The free feed gas channels 16 of the cable open into the chamber 17 so that the under side of the stop is always exposed to the positive gas pressure of the cable which, for example, may be of the order of 10 to 15 pounds. The conductors with their coverings diverge outwardly and each passes through an insulator 18 supported by the top or cover 18a of the casing. The portion of each conductor above the stop is provided with an electrostatic shield 19, extending up and terminating near the base of insulator 18, and forming a continuation of the electrostatic

shield 5 within the cable. The cable part within the insulator 18 and beyond the shield is covered with factory applied insulation and may also have any usual form of hand applied reinforcement taping, including a stress cone where desired, said cone being covered to its maximum diameter with metallic tape, electrically connected to the shield as usual. For the compound filling the casing above the stop, it is desirable to use a viscous compound 20 such as petrolatum, although a more solid compound can be used, if desired. Such a compound overcomes the objection to the use of the same gas in the terminal that is used in the cable. To facilitate manufacture and assembly, the casing is made in two principal parts which for convenience have been termed a casing and a housing.

As previously indicated, a filling of gas for the chamber 8 and insulator 18 is not satisfactory where the desired electrical strength is to be obtained. To this end, the casing as well as all spaces between the conductors therein is filled with the viscous compound 20. The housing is provided with a removable screw threaded plug 21 by means of which compound may be supplied to the casing 7. It is also provided with a removable screw threaded plug 22 on the other side of the stop for supplying gas to the free feed gas channels 16 of the cable. The stop shuts off communication between the gas in the cable and the filling compound in the chamber 8 of the casing. This means that the under side of the stop is subjected to gas pressure and the upper side to compound. It is to be noted that at the start a substantial difference of pressure exists between the materials on opposite sides of the stop. The construction ultimately allows the transmission of sufficient gas pressure slowly to pass through the stop to maintain the whole terminal under positive pressure. It also prevents the compound from entering the free feed gas channels of the cable which is important since the presence thereof would tend to plug them. This means that any leakage from the terminal will be outward and hence the admission of foreign matter to the terminal and therefore to the cable is prevented. With a superior pressure under the stop, the viscous compound will not leak downwardly.

In Fig. 2, 1, 2, and 3 indicate insulated segmental conductors and 5 the thin metal electrostatic shielding tape. 16 indicates the free feed gas channels which may, if desired, contain thin walled metal tubes 24 having suitable openings therein to permit gas to escape laterally so as to act on the insulated coverings of the conductors.

In assembling the parts, the housing will be applied first. The next step is to apply the stop, spread the conductors, and compress the cork disks. The holes in the disks are of sufficient size to permit the disks to be slipped into position, after which the bolts and nuts 15 are tightened which squeezes the cork between the metal disk into firm contact with the conductor coverings and also with the wall of a cylindrical part of the housing. Later, the conductors are separated or spread the required amount and extended through the insulators 18 and suitable connectors 25 applied to the ends thereof. Compound is supplied to the casing and upper part of the housing through the opening normally closed by the plug 21. Gas may be supplied to the cable through the opening normally closed by the plug 22, as for example through a pipe screwed into the plug opening. The gas may be supplied from a suitable tank containing gas at the desired pressure.

The casing 7 has lugs or equivalent supports 26 by means of which it may be secured by suitable bolts to a support. The cable is also supported by suitable clamps 27 likewise secured to the same or different support so that the weight thereof will not result in injury to the wiped joint 13 between the cable and the housing. The nature of the stop is such that whereas it effects separation of compound and gas, it is not adapted to sustain any substantial downward pull on the conductors. This is made evident from the fact that the stop engages the electrostatic shields overlying the paper insulation on the conductors, neither of which is adapted to support any appreciable weight without injury. Also, it is to be noted that the shields are made of very thin metal and that the layers of paper are also thin. It is desirable to make the housing and casing of separate parts so that easier access may be had to the stop.

To illustrate the principle of properly insulating the conductors within the terminal and also of segregating the compound from the gas in the cable, I have shown the stop with its periphery engaging the main cylindrical inner wall of the housing but my invention is not limited to this precise arrangement. The point is that the stop or partition must separate the compound content of the terminal from the gas in the cable and to do this most effectively, the surface engaging the periphery of the cork disks should be round and of a diameter closely approaching that of the disks. Stated another way, since the disks have only a limited amount of elasticity, the diameters of the disks and the selected part of the housing designed to engage therewith should be substantially the same.

It is also desirable to use as small diameter openings in the disks as possible, having due regard to the size of the conductors, because the larger the diameter of these openings, the greater will be the opportunity for leakage between contacting surfaces.

From the foregoing, it will be seen that my improved terminal has the advantage that different kinds of insulating material best suited to the operating conditions are employed, 1. e., gas for the cable and viscous compound for the terminal, that the two materials are separately maintained, the gas being always under positive pressure and the compound also under positive pressure if there is even the smallest gas leak through or around the stop, that because the stop or partition is not called upon to support any weight, it can be made small and of suitable elastic material such as will not injure the rather delicate conductor coverings, that it can be taken apart for inspection or repair without removing the stop, and that the over 18a only may be removed or both the cover and upper casing part 7 without disturbing the stop or the part of the casing containing it. By removing the screw plug 21 above the stop, the upper part of the casing may be drained of compound without disturbing the cable and that by removing the plug 22 below the stop, gas may be admitted to the cable or permitted to escape therefrom.

In Fig. 3 is shown a modification of the stop means which is advantageous when the stop is located in that portion of the housing having a tapered wall so as to reduce height. In this figure, 28 indicates a thin wall member which is

sealed at the bottom in the wiped joint 13. It first rises vertically as a true cylinder and then diverges or is coned outwardly at 29 to enlarge the diameter so that room will be afforded for the spaced or spread conductors, and then rises vertically at 30 in the form of a true cylinder to receive the peripheral surface of the stop which is constructed as previously described. The part 28 is united with the conical part of the housing located below the supporting flanges or ring 31 by fusion, as by a soldered or brazed joint 32. The upper part of the housing is similarly secured to flange or ring 31.

In Fig. 4 is shown one of the clamping rings 14a of the stop having three openings 33 through which the insulated conductors extend. The small holes for the several bolts 15 have been omitted to avoid confusion.

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

1. A cable of the type comprising a conductor, impregnated insulation thereon, an enclosing sheath, and a free feed channel within the sheath filled with insulating gas under positive pressure, a terminal located above the level of the cable comprising an insulator, a chambered means sealed at one end to the cable sheath and supporting the insulator, a partition means through which insulated parts of the conductors extend located in the chambered means below the insulator and exposed on its under side to the positive pressure of the insulating gas contained within the cable, and a filling of insulating compound for the chambered part of the means above the partition means, the gas from the feed channel acting to maintain the compound under positive pressure and prevent it from entering the free feed channel.

2. A cable of the type comprising multiple conductors, impregnated insulation on each of the conductors, an enclosing sheath common to the conductors and free feed channels within the sheath filled with insulating gas under positive pressure, a terminal located above the top of the cable comprising an insulator for each conductor end, a chambered member sealed at one end to the cable sheath and supporting the insulators at its other end, a stop engaging the insulation on the conductors located in the chambered member below the insulators and exposed on its under side to the pressure of the gas within the free feed channels and a filling of heavy insulating compound for the chamber of the member and the insulators located above the stop, the pressure of the gas below the stop maintaining the compound above the joint under positive pressure and preventing it from entering the free feed channels.

3. A cable of the type comprising multiple conductors, impregnated insulation on each of the conductors, an enclosing sheath enclosing the conductors, and free feed channels between the conductors filled with insulating gas under positive pressure, a terminal for the cable comprising a housing secured fluid tght to the sheath, a stop located in the housing through which the insulated conductors pass, the periphery of the stop engaging an inner wall of the housing and the conductor coverings, a casing having a relatively large chamber supported by the housing through which the conductors extend, a filling of heavy compound for the chambers, insulators supported by the casing, one for each conductor, and means on the casing side of the stop through which compound may be supplied to the upper end of the housing and to the casing for filling them.

4. A cable comprising multiple conductors, porous insulation on each of the conductors, thin metal electrostatic shields surrounding the insulation, and free feed channels containing insulating gas under positive pressure and supplying it to the conductor insulations, a terminal therefor comprising a metallic chambered member, a portion of which has a cylindrical inner wall, a stop separating the contents of the upper part of the member from the gas channels of the cable, the conductors passing through the stop with their respective coverings in engagement therewith, the peripheral surface of the stop engaging the cylindrical wall of the member, and a filling of viscous compound for the upper chamber separated from the gas in the channels by the stop and which is prevented by the stop from entering the gas channels of the cable, the gas from the channels gradually working its way through the stop to raise the pressure of the compound.

GEORGE B. SHANKLIN.