Dec. 28, 1948. C. E. BENNETT 2,457,436

HIGH TENSION ELECTRIC CABLE

Filed May 9, 1944

Fig. 1.

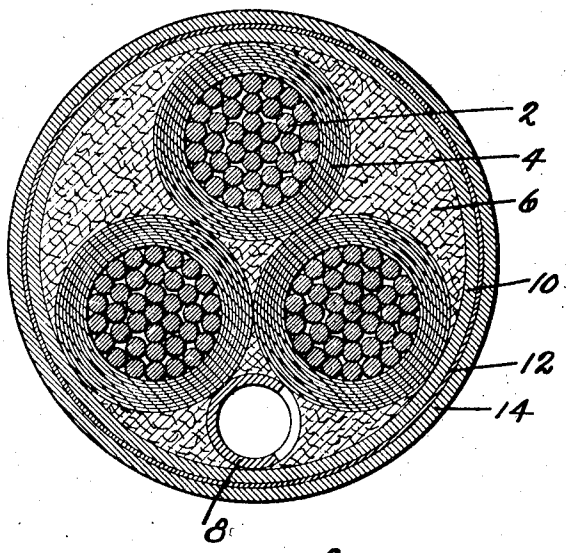


Fig. 2.

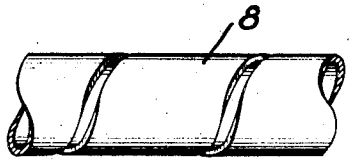
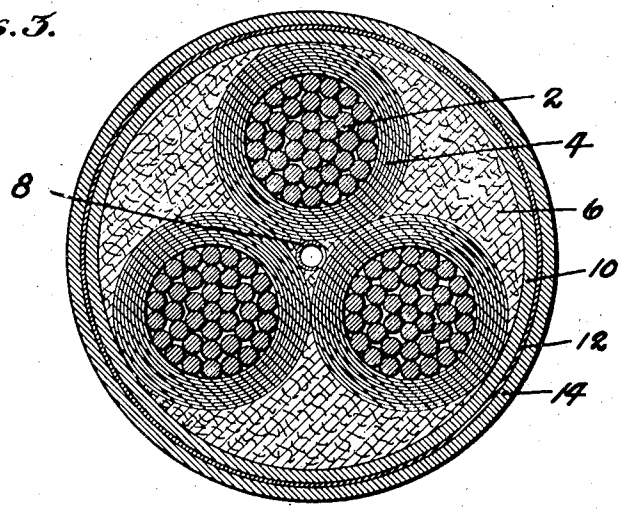


Fig. 3.



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HIGH-TENSION ELECTRIC CABLE

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1 Claim. (Cl. 174—26)

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My invention relates to an improvement in high tension electric cables, and is particularly directed to cables which customarily embody one or more conductors insulated with oil impregnated paper and enclosed in a lead sheath.

Such cables have gone into wide and extensive use, yet they possess certain inherent objectionable characteristics, such as inability to obtain complete impregnation of the cable; wide pressure fluctuations due to temperature changes in service; the development of negative pressures during cooling periods tending to draw air and moisture into the system; as well as danger of cumulative ionization damage during such negative pressure periods.

My present invention provides a construction in which the insulation for the conductors may or may not be oil permeable.

More specifically my invention provides a construction in which the insulating fluid is a mixture of materials, this fluid being of such a nature as automatically to maintain the cable under positive pressure under all conditions of cable operation, thereby avoiding the development of negative pressures during cooling periods and eliminating the danger of air and moisture being drawn into the cable.

Another advantage inherent in my invention is the ability of the insulating fluid thoroughly to fill all voids in the cable. One of the materials of this fluid is the usual insulating oil employed in cable practice, while the other material is very highly miscible in the oil and acts a diluent for the same, so that when employing oil permeable insulation such as paper for the conductor insulation I am assured of thorough impregnation of this paper under all conditions of operation, while, on the other hand, if I am using a paper treated so that it is not permeable, or if I am using an insulation such as varnished cambric which is impervious, these materials being applied in tape form as is customary, I have no difficulty in filling the spaces between overlapping wraps of the tape.

The fluid which I intend to employ in my improved cable is a mixture of oil and dichloro difluoromethane (CCl_2F_2). Dichloro difluoromethane is liquid at around 70° F. under a pressure of 70 lbs. per square inch and with a viscosity comparable to water. As above mentioned, this material is very miscible with the ordinary oil employed in electric cables.

As will be explained more fully hereinafter, no difficulty will be experienced in thoroughly filling all the voids of the cable with the mixture of oil and dichloro difluoromethane and inasmuch as

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this fluid is capable of maintaining the cable under a positive pressure under all conditions of cable operation, permanent migration of the fluid under temperature changes with the formation of voids and dry spots is successfully avoided.

Not only is the use of dichloro difluoromethane of advantage in the respects mentioned, but it is an excellent fire extinguishing material, so as to protect the cable against fire caused by short circuits, etc.

In the accompanying drawing I have shown two embodiments of my invention:

Fig. 1 is a cross sectional view of one embodiment of the invention;

Fig. 2 is a fragmentary elevational view of a fluid conducting conduit employed in the cable of Fig. 1; and

Fig. 3 is a view similar to Fig. 1 of another embodiment of the invention.

Referring to Figs. 1 and 2 in detail: 2 designates the cable conductors, each of the stranded type and enclosed in a solid insulating material 4. This material may be paper tape wrapped about each conductor layer upon layer until the desired wall thickness is obtained. In such case this insulating material is pervious to the insulating fluid I propose to employ. On the other hand, it is within the contemplation of my invention to employ a paper which may be treated so as to render it impermeable to the insulating fluid, or I may employ varnished cambric as the solid insulation for each conductor.

The insulated conductors may be disposed relatively as illustrated in the drawing and fillers 6 disposed about the conductors to build up the desired cross section. The fillers may be of oil pervious material, such as jute, or of impervious material, such as glass wool.

Disposed longitudinally of the cable in one of the filler spaces is a tubular fluid-distribution conduit 8. This tubular member extends continuously the length of the cable and is conveniently in the form of an open helix, as illustrated in Fig. 2, of metal or other suitable material, bearing in mind that it is sufficiently flexible so as not to interfere with reeling of the cable.

The cable is enclosed in a lead sheath 10 over which a metal braid or metal tape 12 is applied and a lead sheath 14 extruded over this braid or tape.

In the manufacture of this improved cable, the cable conductors are individually insulated with the insulation 4, each subjected to an impregnation operation, and then cabled together along with the fluid-conducting conduit 8.

The lead sheath above referred to is then applied and the cable shipped to the field.

Inasmuch as there is no impregnation at the factory other than the individual impregnation of each insulated conductor, it will be appreciated that at this stage there is no free oil in the cable.

After the cable has been installed I then introduce the insulating fluid. This is conveniently introduced at the joints. A suction pump is connected into the conduit 8 at one joint, for example, and the insulating fluid introduced at the next joint.

The insulating fluid introduced may be a mixture of cable oil and dichloro difluoromethane in liquid form, or it may be merely liquid dichloro difluoromethane. The amount of dichloro difluoromethane employed depends upon the pressure desired. For instance, dichloro difluoromethane in an amount approximating 5% by weight of the oil will give a positive cable pressure of the order of three or four pounds per square inch at 0° F. Under ordinary conditions say, for example, when installing at around 70° F. enough of the liquid dichloro difluoromethane or mixture of this material with oil is introduced until a pressure of from twenty-five to thirty pounds is built up.

The dichloro difluoromethane is very highly miscible in the oil, and as above pointed out, in its liquid state has a viscosity comparable to water, so that the entire cable is readily filled.

The cable is finally sealed and thereafter automatically maintains itself under internal superatmospheric pressure due to the presence of the dichloro difluoromethane. It will be understood, of course, that the pressure varies with variations in cable temperature, the pressure rising on temperature rise and decreasing on temperature fall. However, the cable is maintained automatically under a positive pressure under all conditions of cable operation, so that no negative pressure will be developed in the cable at any time.

The construction illustrated in Fig. 3 is identical with that just described except that the fluid conduit 8 is at the center of the cable instead of offset as in Fig. 1.

It is to be understood that changes may be made in the details of construction hereinabove described without departing from the spirit and scope of my invention.

What I claim is:

A sealed electric cable comprising in combination a plurality of separately insulated conductors, fillers about the exterior of said insulated conductors to build up the desired cross section, a tight fitting metal sheath extruded about said assembly of conductors and fillers, said conductor insulation consisting of an oil permeable tape wrapped about each conductor, said fillers consisting of oil permeable material, the tape and fillers being oil impregnated, a tubular fluid-distribution conduit within the cable, said conduit being in the form of a flexible open helix extending continuously the length of the cable, and cabled with the said conductors and means for maintaining the cable under superatmospheric pressure under all conditions of cable operation, said means comprising a mixture of oil and dichloro difluoromethane under superatmospheric pressure filling said conduit and the spaces between the overlapping tape wraps of the conductors and permeating and filling the voids and interstices of the fillers.

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