July 31, 1934. C. E. BENNETT 1,968,019

ELECTRIC CABLE

Filed Dec. 27, 1932

Fig. 1.

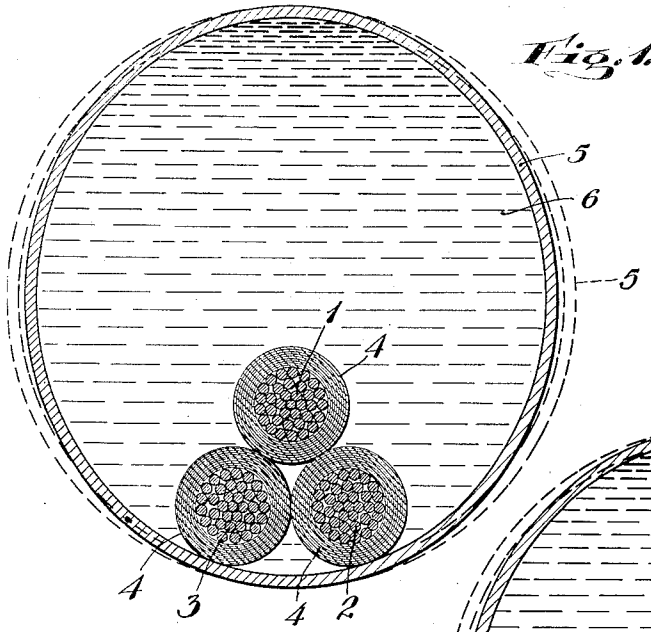


Fig. 2.

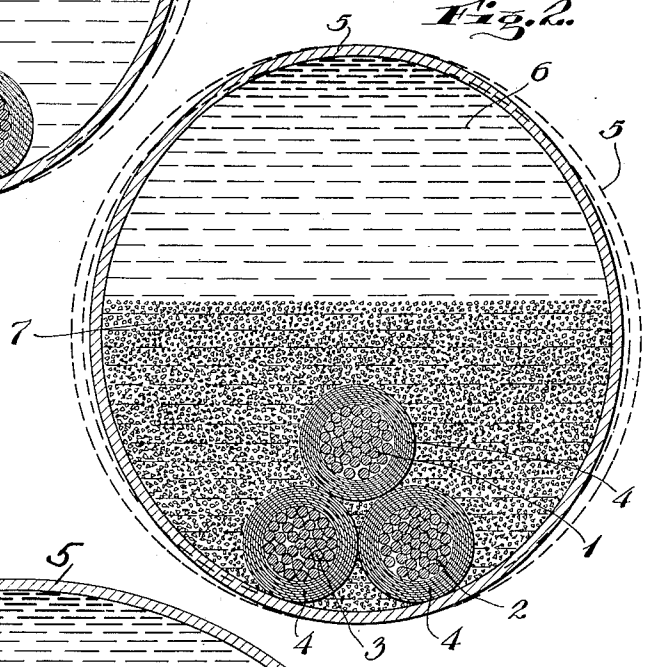
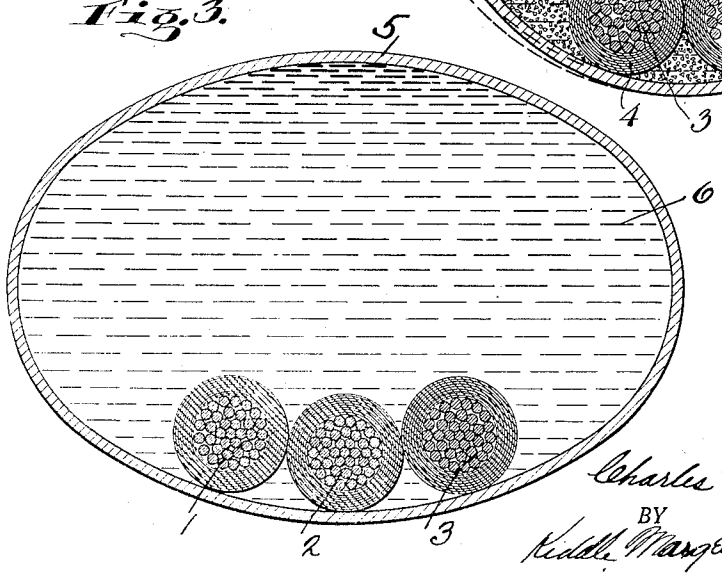


Fig. 3.



INVENTOR.
Charles E. Bennett.
BY
Riddle, Margeson and Hamidge.
ATTORNEYS.

Patented July 31, 1934 1,968,019

UNITED STATES PATENT OFFICE

1,968,019

ELECTRIC CABLE

Charles E. Bennett, Hawthorne, N. J., assignor to The Okonite-Callender Cable Company, Incorporated, Paterson, N. J., a corporation of New Jersey

Application December 27, 1932, Serial No. 648,897

11 Claims. (Cl. 247—3)

The present invention is directed to an improvement in cable systems and has for one of its objects the provision of a system wherein I take advantage of the pressures built up in the system due to temperature changes, to maintain my cable in good working condition at all times.

A further object of my invention is to provide a cable system of the pressure type such for example as disclosed in my copending application Serial No. 553,714, filed July 29, 1931, and in which cable system the insulated conductor or conductors are maintained submerged in an insulating fluid such as oil which is constantly maintained under high pressure.

In the system of the present application I propose to provide a sealed enclosure filled with oil or other insulating fluid and in which the insulated conductor is submerged, the present invention providing for permitting the casing or enclosure to expand under temperature rises and to return to its original size when temperature returns to normal to provide a "breathing" action, thereby to insure that the insulation of the conductor or conductors will be maintained filled with insulating fluid at all times and that voids and gas pockets in the insulation will be avoided.

In the accompanying drawing in which I have shown several embodiments of my invention:

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

Fig. 2 is a similar view of a modification; and

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

Referring to the drawing in detail and first of all to Fig. 1, my improved cable which for purposes of illustration has been shown as a three conductor cable, comprises conductors 1, 2 and 3, insulated by oil impregnated paper, for example, 4. The insulated conductors are drawn into a tubular casing, pipe or enclosure 5 of ferrous metal, such as steel, for instance, of the necessary wall thickness to withstand whatever pressures it may be desired to operate at but at the same time of sufficient elasticity to permit of the desired movement under pressure increase. I have shown an oval pipe for purposes of illustration but it will be understood that the pipe 5 may take other forms, the intent being to provide a pipe capable of being distorted under high pressure and of returning to initial condition when the pressure drops. The pipe 5 is filled with oil or other insulating fluid 6 in which the insulated conductors 1, 2 and 3 are submerged.

If an initial pressure is applied to the insulating fluid it will be of the order mentioned in my copending application above referred to, say for example, five atmospheres minimum up to several hundred pounds maximum, such pressures being sufficiently high to increase the dielectric strength of the oil.

As understood by those skilled in this art the operation of high tension cables causes the insulating fluid of the cable to expand in volume, the fluid returning to its original volume during the cooling cycle. I wish to avail myself of these changes in volume of the fluid insulating medium of the cable. Consequently I construct the pipe 5 of steel or other elastic material capable of being expanded by the pressures built up in the insulating fluid on the heating cycle and of returning to its initial or normal shape on the cooling cycle. Employing a pipe such as illustrated in the drawing it will be seen that when the fluid 6 in which the conductors are submerged heats up to increase its volume, the increase in pressure which results will expand the pipe 5 from the full line position to the dotted line position of Fig. 1.

On the cooling cycle the pipe will contract or return to its original shape due to the elasticity of the material of which it is constructed, thereby to provide a pulsating or "breathing" action tending to prevent the formation of voids or gas pockets in the insulation of the cable and insuring very desirable working conditions at all times. Furthermore, if the oil 6 is maintained under a pressure of the order above referred to, then it will be understood that not only will the "breathing" action above referred to be more pronounced but I am assured of the benefit of an increase in the dielectric strength of the oil resulting from the high pressure employed.

In the embodiment of my invention illustrated in Fig. 2 I employ the same type of construction as just described except that I partially fill the tubular casing or pipe 5 with a filler 7 of coarse sand, stone, or any other suitable freely movable solid material which does not pack readily so as not to destroy or interfere with the desired direct contact of the body of insulating fluid 6 with the exterior of the insulating envelope 4 of each conductor. The filler 7 reduces the volume of insulating fluid 6 necessary to fill the pipe 5, without sacrificing the area of the radiating surface of the pipe. The filler 7, particularly where sand is employed, for example, may be mixed with the insulating fluid 6 and the two materials introduced together into the casing 5, the sand particles, as will be understood, settling to the bottom of the casing.

In the embodiment of my invention as illustrated in Fig. 3 I have shown a pipe 5, and insulated conductors 1, 2 and 3, this pipe being oval shaped, as distinguished from round, but instead of making the wall of the pipe elastic it may be rigid, the purpose of this construction being to provide a very extensive heat radiating surface and a relatively small amount of oil as compared with a round pipe having the same radiating surface.

It is to be understood of course that in this embodiment of my invention having the insulating fluid initially at atmospheric pressure, or initially under pressures, such as above mentioned, sufficient to increase the dielectric strength of the oil come within the contemplation of my invention.

It is to be understood, furthermore, that shapes other than oval may be employed within the purview of my invention.

What I claim is:—

1. A cable system of the oil filled type for the underground transmission of high tension electrical energy, said system comprising in combination a conductor, oil impregnated insulation for the conductor, an all elastic metal non-circular tubular casing loosely enclosing the conductor and its insulation, liquid insulation in said casing and in which the conductor and its insulation are submerged, said enclosing casing expanding toward circular cross section by the building up of pressure in the casing due to heating of the liquid insulation on the heating cycle of the cable, to increase the capacity of the casing, the casing contracting to its original capacity on the cooling cycle.

2. A cable system of the oil filled type for the underground transmission of high tension electrical energy, said system comprising in combination a conductor, oil impregnated insulation for the conductor, an all elastic metal non-circular tubular casing of uniform wall thickness loosely enclosing the conductor and its insulation, liquid insulation in said casing and in which the conductor and its insulation are submerged, said enclosing casing expanding toward circular cross section by the building up of pressure in the casing due to heating of the liquid insulation on the heating cycle of the cable, to increase the capacity of the casing, the casing contracting to its original capacity on the cooling cycle.

3. A cable system of the oil filled type for the underground transmission of high tension electrical energy, said system comprising in combination a plurality of unsheathed cable conductors of the solid stranded type, oil impregnated insulation for each of said conductors, an all elastic metal non-circular tubular casing loosely enclosing said conductors and their insulation, liquid insulation in said casing and in which the conductors and their insulation are submerged, said enclosing casing expanding toward circular cross section by the building up of pressure in the casing due to heating of the liquid insulation on the heating cycle of the cable, to increase the capacity of the casing, the casing contracting to its original capacity on the cooling cycle.

4. A cable system of the oil filled type for the underground transmission of high tension electrical energy, said system comprising in combination a plurality of unsheathed cable conductors of the solid stranded type, oil impregnated insulation for each of said conductors, an all elastic metal non-circular tubular casing loosely enclosing said conductors and their insulation, liquid insulation in said casing and in which the conductors and their insulation are submerged, means for maintaining said liquid insulation under pressure, said enclosing casing expanding toward circular cross section by the building up of pressure in the casing due to heating of the liquid insulation on the heating cycle of the cable, to increase the capacity of the casing, the casing contracting to its original capacity on the cooling cycle.

5. A cable system of the oil filled type for the underground transmission of high tension electrical energy, said system comprising in combination a plurality of unsheathed cable conductors of the solid stranded type, oil impregnated insulation for each of said conductors, an all elastic metal non-circular tubular casing loosely enclosing said conductors and their insulation, liquid insulation in said casing and in which the conductors and their insulation are submerged, means for maintaining said liquid insulation under sufficiently high pressure to increase its dielectric strength, said enclosing casing expanding toward circular cross section by the building up of pressure in the casing due to heating of the liquid insulation on the heating cycle of the cable, to increase the capacity of the casing, the casing contracting to its original capacity on the cooling cycle.

6. A cable system of the oil filled type for the underground transmission of high tension electrical energy, said system comprising in combination a plurality of unsheathed cable conductors, oil impregnated permeable insulation for each conductor, an all elastic metal non-circular tubular casing loosely enclosing the conductors and their insulation, a loosely packed freely movable solid material within said casing for reducing the capacity thereof, and liquid insulation filling the space in said casing unoccupied by the insulated conductors and said loosely packed solid material, said conductors and their insulation being submerged in said liquid insulation and loosely packed solid material, said enclosing casing expanding toward circular cross section by the building up of pressure in the casing due to heating of the liquid insulation on the heating cycle of the cable, to increase the capacity of the casing, the casing contracting to its original capacity on the cooling cycle.

7. In the installation of multi-conductor high tension electric cable systems the method which comprises drawing a plurality of unsheathed conductors each provided with permeable insulation into a pipe line and filling the spaces in the pipe line unoccupied by the conductors and their insulation with oil and a loosely packed freely movable solid material so that the conductors and their insulation are at all times submerged in said oil and loosely packed material, and placing the oil under sufficiently high pressure to increase its dielectric strength.

8. In the installation of multi-conductor high tension electric cable systems the method which comprises drawing a plurality of unsheathed conductors each provided with permeable insulation into a pipe line and filling the spaces in the pipe line unoccupied by the conductors and their insulation with oil and a loosely packed freely movable solid material so that the conductors and their insulation are at all times submerged in said oil and loosely packed material, and placing the oil under a pressure not substantially less than

five atmospheres to increase its dielectric strength.

9. A multi-conductor high tension electric cable system comprising in combination a plurality of unsheathed cable conductors each conductor being independently insulated with permeable impregnated insulating material, a pipe line enclosing said conductors, the internal diameter of said pipe line relatively to the space occupied by the conductors and their insulation being such as to permit of said insulated conductors being drawn into the pipe line, oil and a loosely packed freely movable solid material filling the space unoccupied by said conductors and their insulation and in which the conductors and their insulation are submerged and in which the insulated conductors have free movement relatively to each other, and means for maintaining said oil under sufficiently high pressure to increase its dielectric strength.

10. A multi-conductor high tension electric cable system comprising in combination a plurality of unsheathed cable conductors of the solid stranded type each conductor being independently insulated with permeable impregnated insulating material, a pipe line enclosing said conductors, the internal diameter of said pipe line relatively to the space occupied by the conductors and their insulation being such as to permit of said insulated conductors being drawn into the pipe line, oil and a loosely packed freely movable solid material filling the space unoccupied by said conductors and their insulation and in which the conductors and their insulation are submerged and in which the insulated conductors have free movement relatively to each other, and means for maintaining said oil under a pressure of not substantially less than five atmospheres to increase its dielectric strength.

11. A multi-conductor high tension electric cable system comprising in combination a plurality of unsheathed cable conductors of the solid stranded type each conductor being independently insulated with permeable impregnated insulating material, a pipe line of elastic metal enclosing said conductors, said pipe line being sufficiently elastic to permit it to change its capacity in accordance with variations in the volume of the liquid insulation by reason of thermal changes in the system, the internal diameter of said pipe line relatively to the space occupied by the conductors and their insulation being such as to permit of said insulated conductors being drawn into the pipe line, oil and a loosely packed freely movable solid material filling the space unoccupied by said conductors and their insulation and in which the conductors and their insulation are submerged and in which the insulated conductors have free movement relatively to each other, and means for maintaining said oil under a pressure of not substantially less than five atmospheres to increase its dielectric strength.

CHARLES E. BENNETT.