No. 873,216. PATENTED DEC. 10, 1907.

C. W. DAVIS.

ELECTRIC CABLE.

APPLICATION FILED AUG. 29, 1906.

FIG. 1.

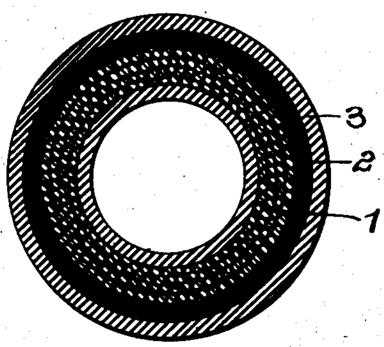


FIG. 2.

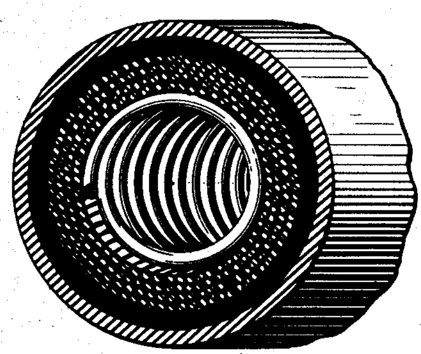
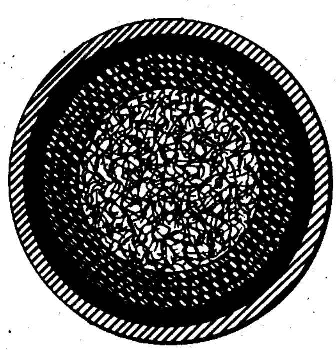


FIG. 3.



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ELECTRIC CABLE.

No. 873,216. Specification of Letters Patent. Patented Dec. 10, 1907.

Application filed August 29, 1906. Serial No. 332,496.

To all whom it may concern:

Be it known that I, CHARLES W. DAVIS, residing at Edgeworth, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful Improvements in Electric Cables, of which improvements the following is a specification.

My invention relates to a construction of conductors for electric currents, and more particularly to what are known as insulated stranded cables—that is, cables with conductors of relatively large size which to meet the requirements of flexibility are composed of an aggregation of individual wires, usually of copper, laid together without intervening insulation, so that each strand carries a part of the current, the whole mass of wires being covered by an envelop of insulating material, protected or not protected by an inclosing metallic sheath, as the nature of the insulating material requires.

The object of my improvement is to increase the current carrying capacity of such stranded cables according to the principle and in the manner hereinafter stated and described.

When a current of electricity passes through any conducting medium a certain portion of the current is transformed into heat. This heat tends to raise the temperature of the conducting medium, the temperature finally attained being dependent among other things upon the resistance of the conductors, the superficial area of the conductors, the amount of the current, the temperature of the surrounding medium and the ability of both conductor and surrounding medium to dissipate by radiation or conduction the heat generated in the conductors. If the insulating medium around the conductors, and the various mediums which in turn surround the insulation are of high thermal conductivity, the energy transformed into heat within the conductor itself, will easily be dissipated from the conductor with a relatively small increase in temperature in both the conductors and the surrounding medium; if, on the other hand, the various mediums surrounding the conductors are of relatively low thermal conductivity there will of necessity be a relatively high temperature attained by the conductors and the material which lies in close proximity thereto, the temperature at any point outside of the conductors being lower as it is more remote from the conductors.

As the insulating materials commonly made use of, such as rubber, paper, jute, varnished cloth, etc., are deleteriously affected by high temperature—the actual effect being dependent upon the degree of heat as well as the length of time it is applied, it becomes necessary from a practical standpoint to prevent the insulation from becoming exposed to temperatures of such value as to bring about this deterioration. It will readily be seen, therefore, that for any given size of conductor, made up as I have indicated above, surrounded by the usual insulating wall of some one of the usual insulating materials, and placed in an environment of any given character, there would be a limiting value to the current carried, in order that the temperature finally attained by the conductor and the insulating material in contact therewith shall not be above the temperature selected as being the maximum to which that kind of insulation should be exposed.

It is a well known fact, that as insulated conductors solid as distinguished from annular in cross section are increased in cross sectional area, their carrying capacities, although actually greater, are relatively less. That is to say, under like environment, the larger the cable conductor becomes the lower will be its current carrying capacity per unit of cross sectional area for any given limit of maximum temperature. And this result is due, among other things, to the fact that the superficial area of the conductor in contact with the insulating material, or in other words the area through which the heat is transmitted from the conductor to and through the surrounding insulating walls, is relatively greater in the small sized cable than in the large sized cable, this being clearly explained by a consideration of the well known geometrical fact that the peripheral area of a cylinder varies as the diameter while the circular cross section varies as the square of the diameter. That is, given two cables, the conductor having in one case twice the cross-sectional area of the other—the larger is not capable of carrying a current (other conditions being the same) twice as large as the smaller.

It is to increase the carrying capacity of the conductors, for any limiting maximum temperatures, by taking advantage of my knowledge of the fact that increased superficial area of the conductor increases the radiating power and consequently reduces the temperature, that my present invention is designed.

In the accompanying drawings forming a part of this specification I have shown in transverse section three forms or embodiments of my improvement.

My invention in broad terms consists in forming the body of the cable proper of annular cross section as distinguished from circular cross section—that is, in forming through the center of such a standard conductor a space or a hole. Such a construction is indicated in Figure 1, and, assuming that the cross sectional area of the conductor shown in Fig. 1 is the same as the cross sectional area of the solid conductor, I find that the maximum current which may be passed through the cable of Fig. 1 without injury to the insulating envelop very materially exceeds in strength the maximum current which the cable having the solid conductor may carry. It is manifest from the form of the cable that (assuming their cross sectional areas equal) the outer surface of the body of the conductor of Fig. 1 is of greater extent than the outer surface of the body of a solid conductor of the same current carrying capacity. Accordingly, the heat radiated is in the former case spread over a larger surface and into a larger body of the insulating envelop; and for any given current flow the temperature attained after a stable condition is reached, is less than with cable having the solid conductor. I have found that in such a construction the increase in carrying capacity is at a greater rate than the increase in cost, within practical limits, and from this the practical benefit of the invention becomes apparent. For example, I have found in a particular instance that whereas the cost of construction of such a cable exceeded the cost of a cable of ordinary form ten per cent, the carrying capacity was increased about thirty per cent.

As to specific construction, I have shown three alternative forms in the drawings, and further like modifications may obviously be made without departing from the field of my invention in its broadest terms. In Fig. 1 I show the strands of the cable laid up on a lead pipe, in Fig. 2, a coiled spring forms the hollow core, and in Fig. 3 the core is composed of hemp or jute. Practical conditions demand a cable sufficiently flexible for insertion through surface manholes into underground conduits, and the various forms shown possess such flexibility—otherwise, there is no need that the core be flexible.

With a form such as shown in Figs. 1 and 2 a hollow core is present; and in such case a cooling stream of air, water or other fluid may be made to circulate therethrough, to carry off a portion of the heat generated in the conductor, and in so doing to increase to still greater degree its maximum carrying capacity. This additional cooling means will in suitable conditions of service be found of practical value.

It is characteristic of my invention that the strands forming the conductor are so arranged that the conductor shall have such cross-sectional and peripheral areas, as to be capable of carrying a given current and of radiating heat at such a rate that the heat generated by such current will not raise the temperature of the cable to a value sufficient to injuriously affect the cable.

I claim as my invention:

A stranded cable for electrical purposes composed of a sheaf or bundle of strands in conductive contact with one another and surrounded by an envelop of insulating material of such character or nature as to be injured when heated beyond a certain critical temperature, the said sheaf or the strands composing said sheaf being disposed in annular form of such peripheral extent that the rate of radiation from the conductor when carrying a current of desired strength will prevent a rise in the temperature of the insulation beyond the critical point thereof, substantially as described.

In testimony whereof, I have hereunto set my hand.

CHARLES W. DAVIS.

Witnesses:
CHARLES BARNETT,
WILLIAM H. WILSON.