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A. RINGEL

1,976,804

TRANSMISSION CABLE

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Fig. 1

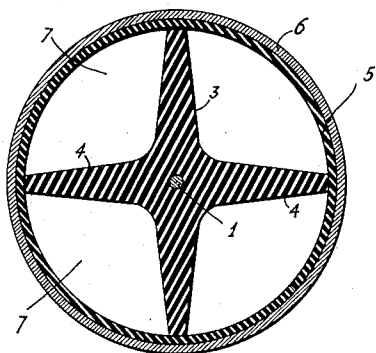


Fig. 2

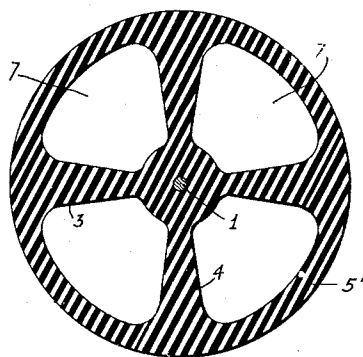


Fig. 2a

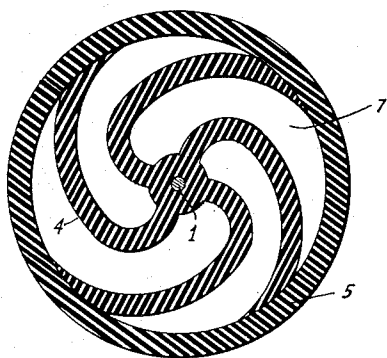
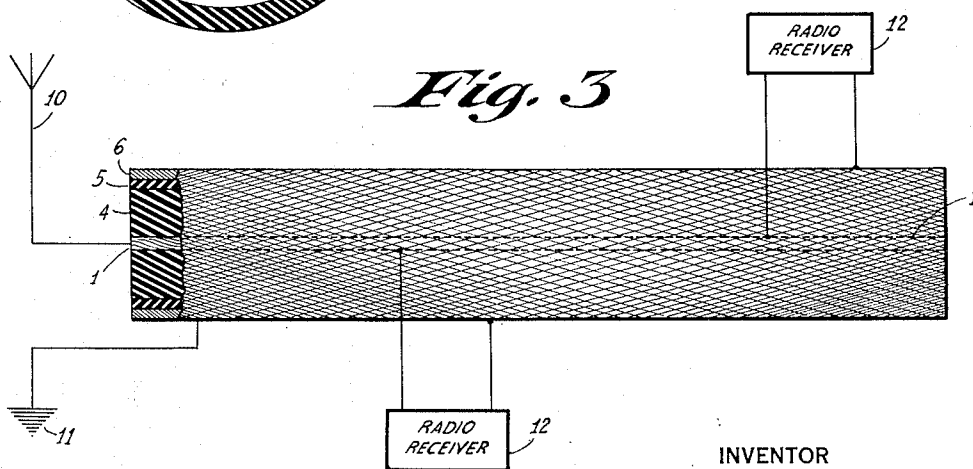


Fig. 2b



Fig. 3



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1,976,804

TRANSMISSION CABLE

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Application April 6, 1931, Serial No. 528,074

4 Claims. (Cl. 173—265)

My present invention relates to electric transmission cables, and more particularly to a novel, and improved form of, low capacity transmission cable.

It is well known that transmission cables utilized in connection with condenser microphones, television and radio frequency distribution lines require special design. The ideal type of cable for these purposes should not only be moisture-proof and flexible, but should also possess a low capacity and be well shielded. This is particularly the case in radio frequency distribution systems employing a central signal energy collecting means and a plurality of remote receivers. It is highly important in such systems, as well as other electric wave distribution systems, that attenuation be reduced to a minimum, but at the same time the distribution line be highly economical both in design and cost.

Accordingly, it is one of the main objects of my present invention to provide a low capacity, shielded, flexible and moisture proof cable, particularly adapted for use in connection with condenser microphones, television and radio frequency transmission lines and the like, such cable essentially comprising a construction wherein predetermined portions of the interior of the cable possess a low average dielectric constant.

Another important object of the present invention is to provide a flexible, low capacity transmission cable comprising a conductor disposed within a metallic shielding sheath, there being one or more air spaces provided between the sheath and the conductor, the air spaces being provided within a flexible, insulating material.

Another object of the present invention is to provide a transmission cable, particularly adapted for use in radio frequency distribution systems, comprising a conductor disposed within a resilient, insulation core having a cross section shaped to provide a plurality of spaced arms, and a flexible sheath surrounding the said core providing a plurality of air spaces between the sheath and the core whereby a low average dielectric constant is secured.

Still other objects of the present invention are to improve generally the simplicity and efficiency of transmission cables, and to particularly provide an electric transmission cable which is not only economical, durable and reliable in operation, but economically manufactured.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims, the invention itself, however, as to both its organization and

method of operation will best be understood by reference to the following description taken in connection with the drawing in which I have indicated diagrammatically several constructions whereby my invention may be carried into effect.

In the drawing,

Fig. 1 is a cross section of a transmission cable according to the present invention,

Fig. 2 is a modified form of the core of the cable,

Fig. 2a shows another modified form of core,

Fig. 2b is still another modified form of core,

Fig. 3 diagrammatically shows one use to which the cable in Fig. 1 may be applied.

Referring to the accompanying drawing wherein like characters of reference indicate the same parts in the different figures, there is shown in Fig. 1 a cross section of a transmission cable constructed according to the present invention. The cable comprises an inner lead, or conductor, 1 running, of course, the length of the entire cable. Usually, the lead 1 is a very fine conductor, and consists of a plurality of intertwined fine wires. The conductor 1 is threaded through an aperture 2 provided in the center of a form-retaining spider 3 made of rubber, gutta-percha, para, or any similar resilient, insulator. The spider has a cross section which has a shape substantially similar to a cross in one of its forms. The rubber arms, or ribs, 4 of the spider are preferably of equal length, so as to hold the inner lead approximately centered, thereby giving somewhat lower capacity than when it is near the outer sheath.

An outer rubber sheath, or hose, 5 is arranged in confining relation with the ribs 4 of the interior spider, the outer edge of each rib 4 being in contact with the inner periphery of the hose 5. The latter may be arranged in the relationship shown in Fig. 1 by pulling the same over the inner rubber form. In the same way an outer, metallic sheath, or hose 6 is provided about the rubber sheath 5. The metallic sheath may also consist of molten metal sprayed on the outside of the rubber hose.

The outer metallic sheath 6 is preferably composed of metal braid, and in order to render the cable more readily flexible, is preferably constructed of so-called Belden braid, a material well known to those skilled in the art to possess flexibility. Or it may consist of a coating of molten metal, such as copper, sprayed on the rubber by any of the well known metal spraying processes. The outer sheath 6 functions as a shielding for the cable, and may be pulled over the rubber tubing 5, in the same manner as de-

scribed heretofore in disposing the tube 5 about the spider 3.

The construction shown in Fig. 1 is not only moisture proof because of the utilization of the rubber sheath and spider surrounding the conductor 1, but it will be noted that a plurality of air spaces 7 are provided between each pair of ribs 4. This also, results in a cable having very little leakage. This feature is advantageous because it results in a low average dielectric constant, and therefore, a low capacity cable. Of course, due to the fact that the spider 3 and sheath 5 are made of rubber, and the outer sheath 6 is made of Belden braid, or a sprayed metal coating, the cable is readily flexible and can be utilized with great facility in wiring, as for example in apartment houses, where frequent bending of the cable is required.

In Fig. 2 there is disclosed a modified form of rubber core which comprises a unification of the sheath 5 and the spider 3. It will be seen that in this modified form of construction the spider 3 and sheath 5 are made in a single piece, the ribs 4 being joined in this case with the rim 5' of the core. In fact, the rubber core may be considered in this modification as a rubber tubing provided with a central aperture to receive the conductor 1, and a plurality of air spaces 7 disposed between the rim 5' and the central aperture containing the conductor. In this case, of course, the metallic shielding sheath would be pulled over the outer periphery of the rim 5', the metallic sheath not being shown.

In Fig. 2a there is shown another modified form of core construction. The ribs 4, in this form, are curved as shown whereby long, curvilinear arms are provided for centering the lead 1. Of course, as in Fig. 2, the ribs may be integral with the sheath 5.

In order to secure a longer leakage path, the rib surfaces may be corrugated. For example, in Fig. 2b one of the ribs 4 is shown provided with corrugations 13 over its surfaces. It will be understood that these corrugations can be provided on the surfaces of the ribs of the cores in Figs. 1, 2 and 2a. Also, the inner periphery of the sheath 5, or rim 5', may be corrugated for the same purpose.

In order to show the advantage of using a relatively fine inner lead 1, the following demonstration is given:

The capacity of two concentric cylinders per centimeter length is given by the well known expression:

$$C = \frac{K}{2 \log_e \frac{b}{a}}$$

where C is the capacity in centimeters, K is the dielectric constant of the medium between the cylindrical surfaces; b is the radius of the outer cylinder, and, a the radius of the inner cylinder.

A small capacity is obtained by either making b larger or a smaller. There is generally some limit to the outside diameter 2b beyond which it is inconvenient to go because of the excessive bulk thereby obtained. Fully as great an effect in reducing capacity may be secured by reducing a a corresponding amount.

In Fig. 3 there is diagrammatically shown a particular use to which the transmission cable of the present invention may be applied. The system shown comprises a well known form of radio frequency distribution system wherein signal energy, carrying visual or audible intelli-

gence, is collected by means of a central antenna system 10 which is grounded, as at 11. A plurality of radio receivers 12, usually situated at independent points remote from the central antenna system, are connected to the antenna 10 and ground 11 by means of a transmission cable.

As shown, the ground 11, in such a case, would be connected to the outer metallic shielding sheath 6, while the antenna lead would be connected to the inner conductor 1. A portion of the interior of the cable is shown, the form of the rubber core shown in Fig. 1 being shown in connection with Fig. 3. Each radio receiver at the remote points, as for example in different rooms of an apartment house, would be connected between the inner conductor 1 of the cable and the outer metallic sheath 6, since the latter functions as the ground connection in the use shown in Fig. 3.

The advantages of the use of a cable of the present invention in a system of the type shown in Fig. 3 are many. It is extremely desirable to have the transmission line of low capacity in order to keep attenuation of the radio frequency energy being distributed at a minimum, and, as explained heretofore, the cable employed has a low capacity due to the air spaces within the rubber core. Furthermore, the use of the outer metallic sheath not only enables it to be used as a ground connection, but effectively results in good shielding, and ready installation of the cable in existing structures.

Of course, it is to be clearly understood that the use shown in connection with Fig. 3 is not the only use to which the cable may be put. For example, it can be employed to great advantage in connection with transmission systems employing condenser microphones, and, also, in systems wherein television signal energy is to be distributed. However, it is believed that the specific illustration in Fig. 3 is sufficiently instructive of further uses to which the present invention may be put.

Furthermore, it is to be understood that in specifying rubber as the material out of which the spider 3 and sheath 5 may be made, that these materials are mentioned merely by way of illustration, since various other materials having the functions desired may be employed. Again, instead of Belden braid for the outer sheath 6, any other equivalent type of material may be utilized, such as a layer of molten metal sprayed on the rubber 3, or any other flexible metallic sheath, although for some installations the outer sheath need not even be flexible.

While I have indicated and described several systems for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organizations shown and described, but that many modifications may be made without departing from the scope of my invention as set forth in the appended claims.

What I claim is:

1. In combination, in a flexible cable, a resilient insulator core having a cross section designed to provide a plurality of long curvilinear spaced arms, each arm having a plurality of corrugations formed on its exterior surfaces, said core being provided with an aperture through its hub, a conductor disposed within said aperture, a moisture proof resilient sheath surrounding said core, there being an opening of substantial area provided between each pair of arms of said core, and

a metallic shielding sheath surrounding said moisture proof sheath.

2. In a conductive system for the distribution of radio frequency signals, a resilient insulator core having a cross section designed to provide a plurality of spaced arms, the surfaces of said arms being corrugated whereby a long leakage path over each arm is provided, said core being provided with an aperture through its hub, a conductor disposed within said aperture, a moisture proof resilient sheath surrounding said core, there being an air space of larger cross sectional area than that of each of said arms provided between each pair of arms of said core, and a metallic shielding and conductor sheath surrounding said moisture proof sheath.

3. A transmission cable for the distribution of radio frequency energy comprising a rubber core having a cross section designed to provide a plurality of long arms with wide spaces therebetween,

said core also having a central aperture, a conductor of minute diameter formed of fine wire mounted in said aperture, a separate rubber insulation sheath having a closed periphery in engagement with the outer ends of said arms and a return conductor comprising a thin layer of metal sprayed onto the exterior surface of said rubber insulation sheath.

4. A transmission cable for the distribution of radio frequency currents comprising, a flexible insulator core having a cross section designed to provide a plurality of long, spirally shaped arms, said core being provided with a small aperture through its hub, a wire of small diameter disposed within said aperture, a rubber sheath surrounding said core and engaging the ends of said spirally shaped arms and a metallic return conductor surrounding said rubber sheath.

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70	145
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