Sept. 28, 1943. J. C. QUAYLE 2,330,381

ELECTRIC COMMUNICATION CABLE

Filed May 12, 1942

FIG. 1.

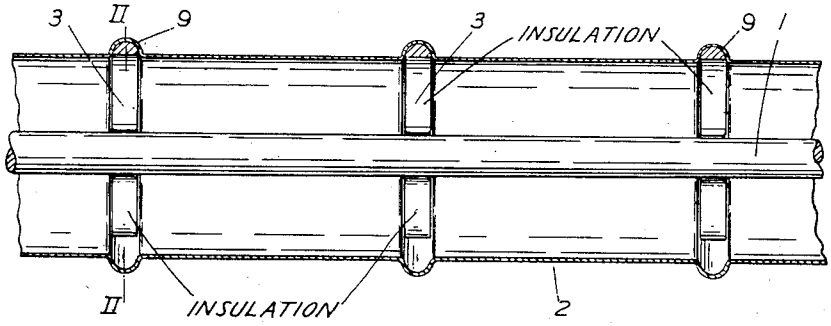


FIG. 2.

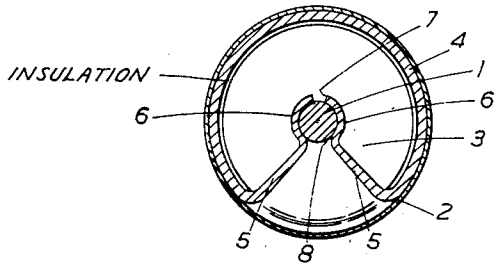


FIG. 3.

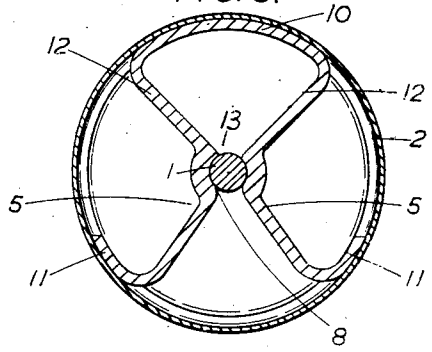


FIG. 4.

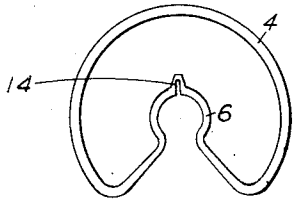
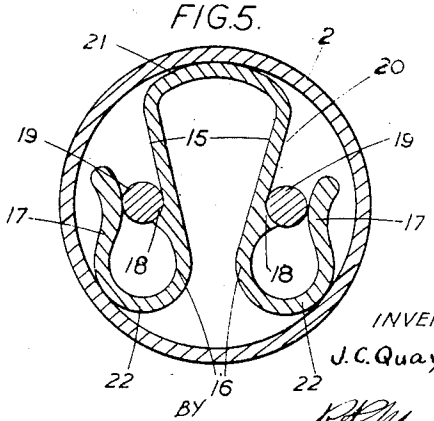


FIG. 5.



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ELECTRIC COMMUNICATION CABLE

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In Great Britain May 7, 1941

10 Claims. (Cl. 174—28)

This invention is concerned with electric cables of the kind in which a conductor or a pair of conductors is held in a symmetrical position in a tube by insulating bodies placed at intervals and serving as spacers so that a large proportion of the space between the conductor or conductors and the tube is occupied by air, or other gas, and not by solid material. The tube may be either of insulating or conducting material; commonly an outer tubular conductor is used. The invention is concerned with the form and material of the insulating and spacing pieces which are of a kind which can be slipped on to the conductor by a lateral movement and do not require to be threaded along the conductor from an end. The improved spacer piece may be manufactured from ceramic material, or from other low loss mouldable insulating material, for instance polystyrene. An object of the improved construction is to provide a firm support for the conductors while utilising a small proportion of solid material between the conductors and the tube at the spacing point. The improved spacing piece has the general form of a thin strip of short width in the axial direction, comprising both radial (or transverse) and circumferential portions. The latter give bearing for a spacing piece on the outer tube and the former extend inward from these bearing places towards or near the centre, where they provide parts of shaped recesses for holding the conductors. These recesses may have an opening at one side slightly less in width than the diameter of the conductor, so that the adjacent portions have to be sprung apart to permit the placing of the conductor in the recess. The parts of the strip which bear on the outer tube are distributed over substantially more than a semi-circle of the tube and the radial or transverse parts (or some of them) extending inward from these bearing parts provide the sides of an opening leading from the outer circumference of the spacing piece to the recess for the conductor.

The form of the strip is preferably such that a considerable length takes part in the deflection necessary for the opening of the recess for the entry of the conductor, this length being more than the distance from the outer circumference of the spacing piece to the recess.

In accordance with the invention, the spacers are preferably made of material of the magnesium titanate class, formed by sintering a mixture consisting wholly, or very largely, of magnesium oxide and titanium dioxide; and since the spacers are of skeleton form, the advantages of the good electrical properties of the specified insulating material are obtained, without disturbance of the transmission by the presence of localised regions of high capacity recurring along the conductor owing to the high permittivity of the spacer material.

The invention will be described further with the aid of the accompanying drawing wherein—

Figure 1 is a longtudinal elevation in section,

Figure 2 is a transverse section on II—II of Figure 1,

Figure 3 is a transverse section showing a modified form of spacing member,

Figure 4 is an end elevation of the spacing member shown in Figures 1 and 2 after manufacture and before its application to the central conductor, and

Figure 5 is a transverse section of a cable having two conductors enclosed within an outer tubular conductor.

Referring first of all to Figures 1 and 2, the co-axial cable shown therein comprises a central conductor 1 enclosed in an outer tubular conductor 2 of circular cross-section. The central conductor is supported by and spaced from the conductor 2 by a series of insulating spacers 3 made of moulded material and distributed along the conductor 1 at appropriate intervals. Each spacer consists of a thin strip which in the axial direction of the cable is of short width. The spacer has a circular circumferential portion 4 which makes contact with the outer conductor 2 over substantially more than half the circumference of that conductor. The circumferential portion 4 has a gap in it and the ends of that portion are continued as two portions 5 which extend radially inwards towards the centre of the circumferential portion 4. The inner ends of the radial portions 5 terminate in circular or arcuate portions 6 which form the sides of a recess which receives the central conductor 1. The ends of the circular portions 6 are spaced by a small gap 7 and the inner ends of the radial portions 5 provide an opening 8 which is of slightly less width than that of the central conductor 1. The spacer is placed on the central conductor by placing the radial portions 5 over the conductor and pressing the spacer against the latter to cause the portions 5 to spring apart and to widen the opening 8 sufficiently to permit the central conductor 1 to enter the recess. When this has occurred, the two radial portions 5 spring towards each other again to retain the conductor 1 in its recess, the side portions 6 gripping the conductor 1 so

that the spacers are retained in their appropriate relative positions on that conductor before and during the application of the outer tubular conductor 2.

The outer tubular conductor 2 is placed round the spacers 3 and has circumferential corrugations 9 which permit the diameter of the circumferential portion 4 to be increased and the reduction of capacity between the inner and outer conductors at these points assisted. The corrugations also increase the flexibility of the cable and they may also assist in locating the spacing members on the central conductor 1.

In Figures 1 and 2, the circular portion 4 makes contact with approximately three quarters of the circumference of the outer tubular conductor 2 and provides a single bearing surface for that conductor which is distributed over substantially more than a semi-circle of the outer tubular conductor. In the construction shown in Figure 3, on the other hand, there are three bearing surfaces, one being provided by a circular circumferential portion 10 and the other two, by the circumferential portions of the feet 11 of the radial portions 5, the circumferential portion 10 being distributed over one semi-circle of the tubular conductor 2 and the circumferential portions of the feet 11, over the other semi-circle of that conductor. As shown in the figure, the circumferential portion 10 is distributed over the upper half of the conductor 2, and the circumferential portions of the feet 11, over the lower half of that conductor. The bearing surfaces are thus distributed over substantially more than a semi-circle of the outer tubular conductor, although the total circumferential lengths of the portion 10 and of the two feet 11 do not amount to substantially more than the circumferential length of a semi-circle of the tubular conductor 2. As a matter of fact, the total circumferential length of the portions 10 and 11 in the example shown in Figure 3 is equal to somewhat less than the circumferential length of one half of the inner periphery of the conductor 2. The circumferential portion 10, however, lies on one side of a diameter of the conductor 10 and the feet 11 lie on the opposite side of that diameter.

Portions 12 extend radially inwards from the ends of the circumferential portion 10 towards the centre of the tubular conductor 2 where they make with each other an angle of approximately 90°. The radial portions 12 are continued as the radial portions 5 which project inwards towards the centre from the feet 11 which are turned outwardly away from each other. The inner ends of the radial portions 5 and 12 cooperate to form a central recess for the reception of the central conductor 1. The inner ends of the radial portions 5 provide an opening 8 which is of slightly less width than that of the conductor 1 and to enable the spacer to be slipped on to that conductor, the radial portions 5 are sprung apart to increase the width of the opening 8 and allow the central conductor 1 to enter the recess. After this has occurred, the radial portions 5 spring towards each other again to retain the conductor 1 in its recess, the inner ends of the radial portions 5 and 12 serving to grip the conductor 1 so as to retain the spacers in their appropriate relative positions on that conductor before and during the application of the outer conductor 2.

In both forms of construction the adjacent sides of the inner ends of the radial portions 5 providing the openings 8 may have sharp corners to facilitate the retention of the central conductor 1 within its recess.

In Figure 4, the two circular portions 6 of the spacer are shown joined by a thin bridge piece 14 on the side opposite to the opening 8. The provision of this bridge piece secures accuracy of form and dimensions of the spacer, particularly at the recess for the central conductor 1. The bridge piece prevents shrinkage during firing of a spacer made of ceramic material. It also prevents any tendency for a spacer made of any other material to change its shape and become distorted in its central region in the process of manufacture. The bridge piece 14 is made very thin and is removed prior to the application of the spacer to the central conductor as otherwise it would have the effect of preventing the sides of the recess springing apart. In Figure 3, the central parts adjacent the gap 13 will also be joined by a bridge piece before the spacer is applied to the conductor 1.

In the construction shown in Figures 1 and 2, the spacer is more flexible than that shown in Figure 3, practically the whole length of the strip taking part in the deflection required to increase the width of the opening 8 to allow the passage of the central conductor 1 into the recess in the spacer. In the alternative form shown in Figure 3, although the spacer is somewhat less flexible, it provides a stronger support for the central conductor 1.

In Figure 5, the cable comprises two inner conductors 19 and an outer tubular conductor 2, the inner conductors being spaced from the outer and from each other by a series of spacers 20, mounted on the inner conductors. Each spacer consists of a thin strip of short axial width which is shaped to form three lobes, the lobe 15 having a circumferential portion 21, and the two lobes 16 having circumferential portions 22. The circumferential portion 21 provides a bearing on the outer tubular conductor 2 on one side of a diameter and the circumferential portions 22 of the lobes 16, on the other side of that diameter. The lobe 15 extends across the conductor 2 from one side of the diameter to the other and its sides are inclined inwards towards each other and are joined to the inner limbs of the lobes 16. The latter have outer limbs 17 which form continuations of the peripheral portions and are inclined towards the sides of the lobe 15. The outer surfaces of the sides of the lobe 15 have shoulders 18 which form curved recesses or seatings for the two inner conductors 19, the latter being held in place by the outer limbs 17 which press at their outer ends against those conductors. The limbs 17 require to be opened out slightly to enable the inner conductors 19 to be placed on their seatings.

In Figures 1 to 4, the spacers are the equivalent, in skeleton form, of slotted discs.

While all the spacers which have been described above may be made of a suitable ceramic material, or of polystyrene or other mouldable substance, it is preferable, according to the invention, to use a material of the magnesium titanate class produced by sintering a mixture consisting principally or wholly of magnesium oxide and titanium dioxide.

It is to be understood that the examples given are by way of illustration and not with the object of indicating that the invention is limited thereto.

What is claimed is:

1. A spacing member for electric cables and

the like, comprising a continuous band of narrow material bent to form a skeletonized disc of predetermined diameter, the central part of said band being shaped to define a partial periphery for said disc, other parts of said band forming at least two points spaced from the center of the disc at a distance equal to the radius thereof and opposite to said partial periphery, and the rest of the band consisting of a pair of juxtaposed sprung legs spaced inwardly from the outer circumference of said disc, said legs forming between them a conductor-receiving opening of a diameter normally smaller than the diameter of the conductor, and adapted to be sprung apart to enlarge said opening and grip the conductor.

2. The combination according to claim 1, in which at least one of said legs is bent outwardly away from the other leg adjacent the space defined between them, whereby said conductor may be pressed directly into said conductor-supporting opening between said legs.

3. The combination according to claim 1, in which said other parts of the band comprise peripheral continuations of said central part to points opposite said central part, and said legs form opposite ends of said band and extend substantially radially inwardly to the center of said disc.

4. The combination according to claim 1, in which the other parts of said band are formed by its arcuate shaped ends, and said legs interconnect said ends with the central part of said band.

5. The combination according to claim 1, in which the rest of said band consists of two pairs of legs, each pair adapted to grip a conductor, and said other parts on each formed by a portion of the band interconnecting the legs of each pair.

6. The combination according to claim 1, in which said band is made of a sintered mixture of magnesium oxide and titanium oxide.

7. In an electric cable, an outer tube, an insulating skeletonized spacing disc comprising a thin continuous strip of mouldable insulating material of short width in the axial direction, said disc including a single, central circumferential portion forming part of a circle and adapted to make contact with the outer tube over substantially more than a semi-circle of that tube, and a pair of sprung radial portions extending inwardly from the ends of the circumferential portions toward the center, said radial portions forming between them the sides of a conductor-receiving recess of normally slightly less width than that of the conductor, and a conductor mounted in and gripped in said recess by said sprung radial portions.

8. The combination according to claim 7, in which said tube is provided with longitudinally spaced annular pockets for receiving a plurality of said discs.

9. In an electric cable, an outer tube, an insulating skeletonized spacing disc, comprising a thin continuous strip of mouldable insulating material of short width in the axial direction, said strip including a central circumferential portion forming part of a circle and adapted to make contact with the outer tube, and a pair of sprung legs connected to opposite ends of said central portion, each leg extending radially inwardly and then outwardly, the ends of each leg bearing on said tube oppositely to said central portion, said legs each being formed with a recess at its center and being positioned relatively to one another so that said recesses form between them a centrally positioned conductor-receiving space of a normal width less than that of the conductor, and a conductor mounted in and gripped in said space by said sprung legs.

10. In an electric cable, an outer tube, an insulating skeletonized spacing disc in the form of an inverted U having sprung legs, comprising a thin continuous strip of mouldable insulating material of short width in the axial direction, the base of said U forming part of a circle and adapted to make contact with the outer tube, and each leg of the U being formed with a turned-over end biased toward the legs and forming with its respective leg a conductor-receiving recess of normally less width than the conductor, and the intermediate portion of each leg between its end and the main leg section being positioned at a point the same distance from the center of the disc as the base of the U, whereby such intermediate portion also contacts said surrounding tube, and a conductor mounted in and gripped in each recess formed by the leg and its turned-over end.

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