April 7, 1931. L. EMANUELI 1,799,158

JOINT FOR ELECTRICAL CABLES

Filed Nov. 22, 1923

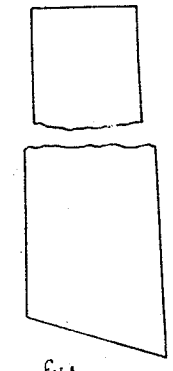

Fig. 1

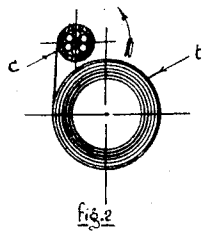

Fig. 2

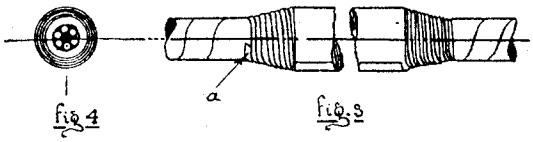

Fig. 4

Fig. 3

Fig. 5

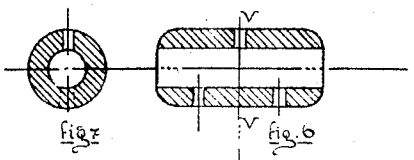

Fig. 7

Fig. 6

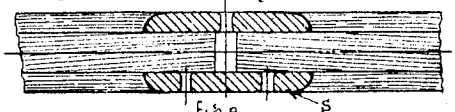

Fig. 8

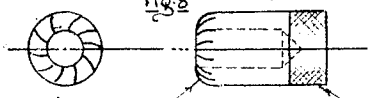

Fig. 10

Fig. 9

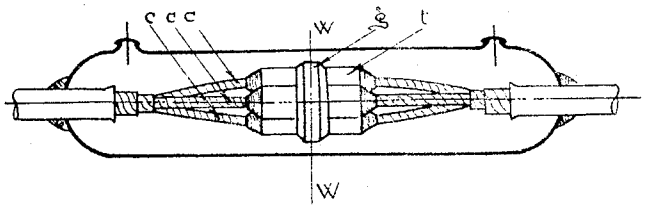

Fig. 11

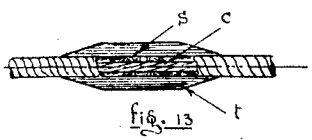

Fig. 13

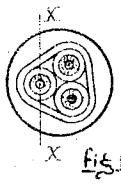

Fig. 12

Inventor:

Luigi Emanueli

By Louis Quinelle

Attorney.

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UNITED STATES PATENT OFFICE

LUIGI EMANUELI, OF MILAN, ITALY, ASSIGNOR TO FIRM PIRELLI & C., OF MILAN, ITALY

JOINT FOR ELECTRICAL CABLES

Application filed November 22, 1923, Serial No. 676,361, and in Great Britain December 4, 1922.

This invention relates to joints for electric cables.

Heretofore the insulation of such joints by means of tubes of paper impregnated with an insulating compound has only found practical application in the case when the conductors of the cable are subjected to comparatively low voltage, on account of the fact that when high voltages are employed an insulation of this character eventually fails, owing to carbonization of the inner surface of the tube. This carbonization is brought about because the centre of the inner surface of the tube is at the same potential as the conductor it insulates, while the outside surface of the tube is at a much lower potential, and hence a stress is set up along the surface of the tube, owing to liberation of heat eventually causes burning of the surface and gradual reduction of the thickness of the tube which in time breaks down.

With the present invention the difficulty above referred to is overcome by wrapping around the conductors or cores constituting the joint to be insulated a tubular roll of insulating material, such as paper, said roll being formed from a strip of material of such shape that the roll when in position over the joint is adapted to be tightened thereupon so as to make very close contact with the insulated covering of the said conductors or cores, the tightened roll being of the requisite radial thickness, for example, twice as thick as that on the conductors or cores of the cable, to ensure the joint against breakdown.

The tubular roll may be made from a single strip of paper or other suitable insulating material cut so that its width is greater at one end of the strip than at the other end, and it is wrapped or rolled around the joint to be insulated so as to form a tubular roll with tapered ends so as to leave protruding tabs when the strip is rolled up in order to easily tighten it.

The ends of the conductors or cores forming the joint to be insulated may be first enclosed in a cylindrically shaped socket as hereinafter described and the socketed joint thereafter insulated either by the application of a tubular roll of the kind mentioned above in or any other suitable manner.

In order that the invention may be clearly understood and readily carried into effect, the same will now be more fully described with reference to the accompanying drawings in which:

Figure 1 represents a strip of paper or other insulating material before it has been rolled into a tube.

Figure 2 represents a tube about to be wrapped around a socketed conductor or core.

Figures 3 and 4 represent side and end elevations respectively of a jointed conductor with a strip wrapped around it, the tube still being slack.

Figure 5 is a similar view to Figure 3 but with the paper tube tightened.

Figure 6 represents a socket or sleeve for joining the ends of two conductors.

Figure 7 is a section on the line V V of Figure 6.

Figure 8 is a sectional view of a socketed or sleeve joint prior to covering it with insulating material.

Figures 9 and 10 represent respectively side and end elevations of a special tool for cutting back the insulation of the conductors.

Figure 11 represents a side elevation (with the outer lead sleeves of the joint in section) of a completed joint on a three-core cable.

Figure 12 is a section on the line W W of Figure 11.

Figure 13 is a longitudinal section through one insulated core on the line X X of Figure 12.

The paper tube is made from a single strip of paper which as shown in Figure 1 is cut so that its width gradually increases from one end of the strip to the other. The dimensions of the strip are calculated according to the size and voltage of the cable for which it is intended, so that after it has been rolled into a tube around the conductors being jointed it will have a sufficient radial thickness to ensure the joint against breakdown, this thickness being normally (that is, before the tapered ends of the tube are reached) about 100 per cent greater than the thickness of the usual insulating material of the conductors

being jointed. The strip of paper or other material is loosely rolled up, dried and impregnated with the same compound as used for impregnating the usual insulation of the conductors of the cable, and then loosely rolled around the jointed conductors with the wide end of the strip inside so that protruding tabs *a* are left at the corners of the wide end of the sheet as shown in Figure 3. The commencement of the operation is indicated in Figure 2, where *t* represents a paper tube about to be rolled around the socketed conductor *c*, the direction of rotation being indicated by the arrow. The rolling is continued until the conductor *c* occupies the centre of the tube as shown in Figures 3 and 4. To tighten the tubular roll, the protruding tabs *a*, which are the ends of the inside edge of the paper, are pressed down onto the insulated conductor and firmly held while the outside of the tube is rotated in the direction which causes the tube to tighten itself around the conductor, the tube being tightened until all air bubbles and excess impregnating compound are sequeezed out.

The appearance of the tightened tube is shown by Figure 5. The tightening should be effected so that the layers of the paper tube make very close contact with the insulation of the conductor and become in effect an extension of the impregnated paper insulation already thereon. The tapered ends of the tubular roll when in position not only facilitate the tightening process but are also better from electrical considerations as they interpose longer surfaces between cores.

A convenient way of connecting together the ends of conductors or cores of single or multiple core cables is by means of a special socket as shown in Figures 6, 7 and 8. The socket *s*, which may be made of brass or other suitable material, has an outside diameter equal to the diameter of the insulated conductors being jointed, while its end surfaces are rounded, so as to make a perfect fit and leave no empty spaces with the corresponding portions of the insulation of the conductors, said insulation being cut away so as to conform with the shape of the rounded ends of the jointing socket as shown in Figure 8. For cutting away the insulation, there is provided a special tool with a hollow body as shown in Figures 9 and 10, one end of which is rounded and provided with cutting teeth *e* while its opposite end is formed with a milled outer surface or flange *f* to provide a suitable hand grip for holding the tool when in use.

In the case of the three core cable joint illustrated in Figures 11, 12 and 13, the ends of the conductors or cores to be jointed are each first enclosed in such a cylindrical shaped socket or sleeve *s* as described above. The socketed joints are then insulated with a tubular roll of paper or other suitable insulating material, in a similar manner to that previously described, and as the outside diameter of the socket is equal to that of the insulated conductors, an even surface is provided for the tubular roll to be tightened on and the inside of the said tubular roll is thus completely filled without any empty spaces being left therein. After each of the cores *c c c* has been jointed and insulated a narrow belt *g* of impregnated paper or other suitable material may be fixed so as to enclose all the insulated conductors of the joints as shown in Figures 11 and 12. This belt *g* is preferably applied in a similar manner to that in which the tubular rolls *t* are applied and it is preferably made with tapered ends similarly to the said rolls.

In the case of a single core cable, the ends of the conductors to be jointed will also of course be first enclosed in a socket or sleeve as above described before the application of a tubular roll to the joint for insulating it. The joint after it has been provided with an insulation comprising a tubular roll applied as described above, and has been washed with hot impregnating compound, can be finished off with a lead sleeve in the usual manner.

It is to be understood that the invention is applicable to the jointing of cables having sectoral as well as round conductors, and that with sectoral conductors a sector shaped socket with dimensions equal to those of the insulated conductor may be used.

I claim as my invention:

1. A joint for electric cables, comprising a cylindrical socket wherein the ends of the conductors forming the joint are inserted, having throughout its entire length an external diameter equal to the diameter of the insulated conductors, the end surfaces of the socket being rounded and the insulation at the ends of the conductors being cut away to form rounded recesses wherein said socket ends closely fit; and a relatively-thick tubular roll of insulating material tightly surrounding said socket and the adjacent portions of the conductors and having its opposite ends tapered.

2. A high tension cable joint enclosed by a multiplicity of layers of a closely wound roll of oiled insulating paper, the roll being formed of an elongated gradually tapering sheet wound wide end first about the joint.

3. A joint for a cable having conductors provided with insulation and a sheath of metal, said metal sheath and insulation being removed at the ends of the cable and said insulation being provided with tapering recess portions, a metallic connector applied to the meeting ends of the conductors, said connector being of a diameter substantially the same as the insulation and of substantially greater diameter than the conductors, said connector tapering towards its ends and fit-

ting snugly into the tapering recessed portions of the insulation.

4. A joint for a cable having conductors provided with insulation and a sheath of metal, said metal sheath and insulation being removed at the ends of the cable, said insulation being provided with tapering recess portions, a metallic connector applied to the meeting ends of the conductors, said connector being of a diameter substantially the same as the insulation and of substantially greater diameter than the conductors, said connector tapering towards its ends and devoid of sharp edges and fitting snugly into the tapered recessed portions of the insulation.

5. A joint for a cable having conductors provided with insulation and a sheath of metal, said metal sheath being removed at the ends of the cable and the insulation being provided with tapering recess portions, a metallic connector applied to the meeting ends of said conductors, said connector tapering towards its ends and devoid of sharp edges, the thickness of the connector at its greatest diameter being substantially equal to the thickness of the insulation, the tapering portions of said connector fitting snugly into the tapering recesses of the insulation.

6. A cable joint, comprising a pair of conductors each having an insulated covering, a continuous strip of insulating material wrapped a large number of times around the ends of the conductors to form a tubular roll which surrounds the joint and disposed in close contact with the insulated covering of the conductors; said strip having tightening tabs at its edges which protrude from the inner part of the roll.

7. A cable joint, comprising a pair of insulated conductors having the insulation cut away from their confronting ends to leave them bare and having smooth undercut recesses; a cylindrical socket wherein the said bare ends are received with a close fit, the ends of the socket fitting into the undercut portions of the insulation; and a tapered strip of insulating material wrapped a large number of times around said socket and the adjacent insulated portions of the conductors with the wide end inside so as to form a tubular roll having tapered ends.

8. A joint for electric cables, comprising a pair of insulated conductors, the ends of the insulation being undercut, a socket having ends which are free of sharp corners to prevent concentration of electrical stresses and which are snugly fitted into the undercut insulation on the conductors, said socket having an outside diameter approximately the same as that of the said insulation, and a tapered sheet of impregnated paper wound wide end first to form a compact roll about the insulated ends of the conductors and the socket.

9. A joint for high tension cables, comprising insulated conductors, a socket for uniting them, and an insulating covering for the socket and the adjacent ends of the insulated conductors which comprises a sheet of impregnated paper which is wider at one end than at the other and which is tightly wound around the socket and insulated conductors to exclude air and form a multiplicity of layers, said paper sheet being wound with its wide end located at the inside of the roll.

10. A high tension cable joint, comprising insulated conductors from the adjacent ends of which the insulation has been removed, a socket for uniting them, and a roll of insulating material surrounding the socket and the insulation on the conductors adjacent thereto, said roll gradually tapering from a maximum width on its inside to a minimum width on its outside.

11. A joint for a cable having conductors provided with insulation and a sheath of metal, said metal sheath and insulation being removed at the ends of the cable, and said insulation being provided with tapering recess portions, a metallic connector applied to the meeting ends of each pair of the conductors and fitting snugly into the tapering recessed portions of the insulation, said metallic connector having a cross-section large enough to carry the current from one conductor to the other at the joint, and having rounded surfaces to distribute and direct the electric potential stresses to which the joint insulation is subjected.

In testimony whereof I affix my signature.

LUIGI EMANUELI.