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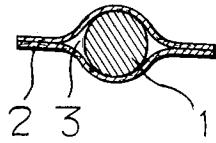
KYOHEI YOKOSE

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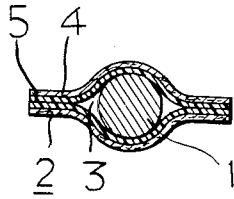
INSULATED CONDUCTOR FOR COMMUNICATION CABLES  
AND THE MANUFACTURING METHOD OF THE SAME

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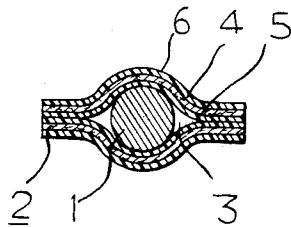
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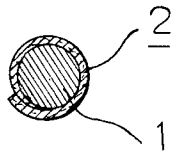
**Fig. 1**



**Fig. 2**



**Fig. 3**



**Fig. 4**

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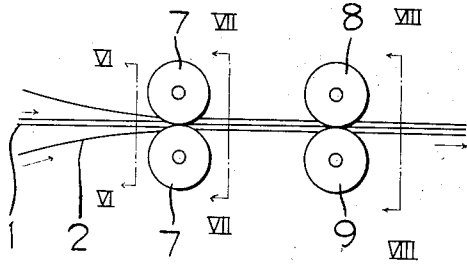


Fig. V

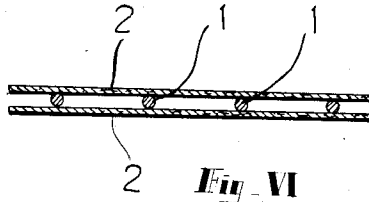


Fig. VI

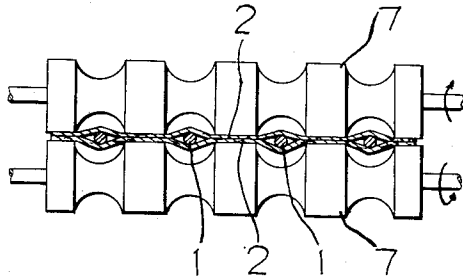


Fig. VII

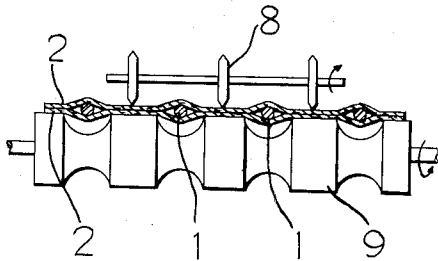


Fig. VIII

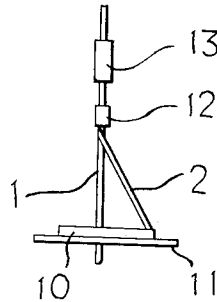


Fig. IX

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## INSULATED CONDUCTOR FOR COMMUNICATION CABLES AND THE MANUFACTURING METHOD OF THE SAME

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3 Claims. (Cl. 174—28)

This invention relates to insulated conductors for communication cables, and more especially to conductors insulated with insulating paper and a substance such as resin or rubber, and also the method of manufacturing the same.

One object of this invention is to obtain insulation for conductors which have a large mechanical strength and moisture-proof property, and make them suitable for use as communication cables.

Another object of this invention is to provide a method by which such insulated conductors for communication cables can easily be made.

The attached drawings show certain embodiments of the invention, in which

Fig. I is a sectional view of a single conductor sealed between two paper tapes impregnated with a thermoplastic substance.

Fig. II is a sectional view of a single conductor sealed between two paper tapes each having on their inside surfaces a thermoplastic coating.

Fig. III is a sectional view of a single conductor sealed between two paper tapes each having a thermoplastic coating on their inner surfaces and a thermo-hardening coating on their outer surfaces.

Fig. IV is a sectional view of a single conductor sealed in a rolled paper tape impregnated with a thermoplastic substance.

Fig. V is a view in side elevation of a hot sealing roll and a cutting roll operating opposite a backup roll in forming the insulation on a multiple of conductors.

Fig. VI is a sectional view taken on the line VI—VI of Fig. V.

Fig. VII is a sectional view taken on the line VII—VII of Fig. V.

Fig. VIII is a sectional view taken on the line VIII—VIII of Fig. V.

Fig. IX is a view in elevation showing the manner of winding an insulating tape about a conductor.

The insulated conductors for communication cables manufactured heretofore are generally insulated with paper or pulp. However, paper and pulp have a drawback that they are absorbent of moisture.

In recent years, insulation coating of a substance such as resin, for example polyethylene, is practised in order to eliminate the above-mentioned defects of paper or pulp insulation.

However, this method is not yet satisfactory, because, although polyethylene and other resins are excellent in their moisture-proof property, they have poor mechanical strength and are susceptible to external damage when used as a comparatively thin layer of insulation (for instance, 0.2 mm. or less).

This invention eliminates these defects and the manufacturing method thereof is as easy as, or easier than, the hitherto used method.

The insulated conductor of this invention consists of a conductor and an insulation covering applied on the

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conductor, the said covering consisting of insulating paper and a substance such as resin or rubber.

Hereunder, certain examples are given with reference to which we shall explain this invention in detail.

5 First—An insulated conductor, on which an insulation covering is applied by covering longitudinally the upper and the lower sides of the conductor with tapes of insulating paper and a substance such as resin or rubber and sealing the said tapes together at the left and the right 10 sides of the conductor by heat and pressure.

Insulated conductor:

15 *Example 1a.*—A conductor on which is applied an insulation covering of tapes which are made by impregnating insulating paper with a substance such as resin or rubber:

Figure I shows the cross section of this insulated conductor, in which 1 is the conductor, 2 the tapes which cover longitudinally the upper and the lower sides of the conductor 1 and are sealed together at the left and the right sides of the conductor 1 by heat and pressure, forming an insulating covering, and 3 the gap between the covering made of tapes 2 and the conductor 1. The said tapes 2 are made of insulating paper impregnated with a substance such as polyethylene, melamine, vinylidene chloride, rubber and latex.

25 In the insulated conductor of this invention as above-explained, it is desirable that the covering and the conductor are not completely sealed together, but a gap 3 is left between them. This is for the purpose of reducing the effective dielectric constant by leaving the largest possible gap within the insulation layer of the conductors for communication cables so that the electrostatic capacity of the insulated conductor can be made small. For this purpose, it is most effective to keep this gap 30 right over the conductor where the intensity of electric field is large.

The above insulated conductor is most suitable for an insulated conductor for communication cables. This is because the insulating paper maintains the mechanical strength and a substance such as resin or rubber gives moisture-proof property. The above insulated conductor is cheaper than an insulated conductor covered with tape solely of resin, such as polyethylene. Furthermore, the covering method of manufacture of the above insulated conductor, which will be explained further, is not difficult at all, but is easier than the manufacturing method of and insulated conductor covered with tapes solely of resin, such as polyethylene.

Insulated conductor:

35 *Example 1b.*—An insulated conductor with insulation covering of tapes made of insulating paper provided with a coating film of a thermoplastic substance, such as resin or rubber:

40 Figure II shows the cross section of this insulated conductor, in which 1 is the conductor, 2 the tapes which cover longitudinally the upper and the lower sides of the conductor 1 and are sealed together at the left and the right sides of the conductor 1 by heat and pressure, forming an insulating covering, and 3 the gap between the covering made of the tapes 2 and the conductor 1. The said tapes 2 are made by spreading or pasting the coating film of a thermoplastic substance such as polyethylene, vinylidene chloride, etc. 5 on the inner side of the insulating paper 4 facing the conductor.

45 As in the case of the insulated conductor illustrated in Figure 1, the mechanical strength is maintained by the insulating paper and the moisture-proof property is given by a substance such as resin.

50 The above insulated conductor is also manufactured by the covering method to be explained further. When the tapes are passed through the heating rollers for seal, they will never stick to the rollers because the thermoplastic 55

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resin or rubber film is provided on the side of the tapes facing the rollers. Seal can thus be effected in an easy and unfailling way. Consequently, no difficulty is experienced in regulating the heating temperature of the rollers and the passing speed of the tapes.

Insulated conductor:

*Example 1c.*—An insulated conductor with insulation covering of tapes made of insulating paper provided with a coating film of thermoplastic substance such as resin or rubber on one side and a coating film of thermoplastic resin or rubber or thermo-hardening resin or rubber on the other side:

Figure III shows the cross section of this insulated conductor, in which 1 is the conductor; 2 the tapes which covers longitudinally the upper and the lower sides of the conductor 1 and are sealed together at the left and the right sides of the conductor 1 by heat and pressure, forming an insulating covering, and 3 the gap between the covering made of the tapes 2 and the conductor 1. The said tapes 2 are made by spreading or pasting a coating of thermoplastic substance, such as polyethylene, vinylidene chloride, etc. 5 on the inner side of the insulating paper 4 facing the conductor 1; and a coating of thermoplastic resin or rubber or thermo-hardening resin or rubber such as polyethylene, melamine, etc. 6 on the other side, namely the outer side.

As in the case of the insulated conductors illustrated in Figures I and II, the mechanical strength is maintained by the insulating paper and the moisture-proof property is given by a substance such as resin or rubber.

The above insulated conductor is also manufactured by the covering method, which will be explained further. Such method is not difficult at all, but is easier than the manufacturing method of an insulated conductor covered with tapes of resin, such as polyethylene. Furthermore, if a coating film of thermo-hardening resin or rubber is provided on the outer sides of the tapes, they will never stick to the rollers when they are passed through the heating rollers for seal. Consequently, no difficulty is experienced in the regulation of the heating temperature of the rollers and the passing speed of the tapes.

Second—An insulated conductor, on which an insulation covering is applied by wrapping the conductor with tapes of insulating paper and a substance such as resin or rubber and sealing the said tapes.

Figure IV shows the cross section of this insulated conductor, in which 1 is the conductor and 2 the tapes of insulating paper and substance such as resin or rubber. The said tapes 2 wrap the conductor and are heated and sealed to form the covering. The tapes may be insulating paper impregnated with a substance such as resin or rubber, or insulating paper which has on one or both of its sides a coating of thermoplastic resin or rubber spread or pasted thereon, or insulating paper which has a coating of thermoplastic resin or rubber on the side facing the conductor and a coating of thermo-hardening resin or rubber on the other side, such substance being spread or pasted on each side.

As in the case of the insulated conductor in Example 1, the mechanical strength is maintained by the insulating paper and the moisture-proof property is given by a substance such as resin or rubber. The above insulated conductor is manufactured, as explained further, by wrapping the conductor with tapes which are then passed through a heating and molding device, such as dies or die-rollers; to effect the seal. The manufacturing method is very simple, however, the air gaps 3 are omitted.

The above-explained tapes for the conductor can be made by combining the method of impregnating the insulating paper with a substance such as resin or rubber and the method of spreading or pasting such substance on the insulating paper.

In the cable in which the insulated conductor of this invention, as illustrated and explained above, is used, it is

possible to use, as material for protective sheath, resin or rubber such as polyvinyl chloride or polyethylene.

Also, this invention has an advantage over that of an ordinary lead-sheath as it can be used without the fear of integration, which is caused by softening and welding of the lead insulation covering due to heat, for example when such lead sheath is jointed together.

Third—Example of the manufacturing method of the insulated conductor of Example 1.

Method of manufacturing insulated conductors for use in communication cables by longitudinally covering the upper and the lower sides of the conductors with tapes of insulating paper and resin or rubber which are sealed together by heating and pressing at the right and the left sides of the conductor and cut either at the same time or thereafter in order to separate the insulated conductors.

This method is illustrated in Figures V—VIII. Figure V is the side view of the apparatus for carrying out this method. Figure VI is the front view at the VI—VI section of Figure V; namely, a front view of conductors moving on in parallel whose upper and lower sides are longitudinally covered with tapes of insulating paper and resin or rubber. Figure VII is the front view at the VII—VII section of Figure V, namely, the front view of the tapes of insulating paper and resin or rubber, which cover longitudinally the upper and the lower sides of the conductors, and are sealed together, by heating rollers, at the right and the left sides of each conductor. Figure VIII is the front view at the VIII—VIII section of Figure V, namely, the front view of the sealed parts of the tapes being cut in order to separate the insulated conductors.

To the upper and the lower sides of a number of conductors 1 which are moving on in parallel, tapes of insulating paper and resin or rubber 2 are applied as shown in Figure VI. Then, the tapes 2 are heat-sealed by pressing the parts at the right and the left sides of each conductor 1, with grooved rollers 7 as shown in Figure VII. Thereafter, their central part is pressed and cut with a blade 8 and a roller 9 as shown in Figure VIII. Then, we can obtain the desired insulated conductor as that shown in Figure I, II or III. The temperature for sealing is, for instance, approximately 100° C. for tapes of insulating paper and polyethylene and approximately 140° C. for tapes of insulating paper and polyvinylchloride.

In the above-mentioned process, it is also all right to seal together tapes with a pair of high frequency rollers instead of the heating rollers. It is also all right to carry out the press cutting at the same time as the heat-sealing.

This method has an advantage that the desired insulated conductors can be manufactured in a large quantity very easily.

Fourth—Example of the manufacturing method of the insulated conductor of Fig. IV.

Method of manufacturing insulated conductor for use in communication cables by wrapping the conductor with tapes of insulating paper and substance such as resin or rubber, and then passing the same through a heating and molding device for seal.

Figure IX illustrates this method, in which 1 is the conductor, 2 the tapes of insulating paper and resin or rubber, 10 the pad of tapes, 11 the flyer on which the pad 10 is placed, 12 the polisher and 13 the heated molding device, such as heated dies or die-rollers.

The conductor 1 which is moving is wrapped with the tapes pulled out from the pad placed on the flyer. Then, they are passed through the heated molding device to have the rubber or resin tape sealed, whereby the covering is formed and insulated conductor is obtained.

In the above example the heating and molding device and the polisher are separately provided. However, these

two may be made as one. Also, the heating and molding device may be made to revolve around the conductor so as to facilitate the seal. The tapes may be heated before wrapping the conductor.

By using the above method, the insulated conductor can be manufactured in a very easy way.

As explained with reference to the insulated conductor of Fig. IV, various kinds of tapes may be used. In the case of tapes which have a coating of thermo-hardening resin or rubber on the sides opposite to those facing the conductor, there is no fear that they stick to the molding device when seal is effected by a heating and molding device.

We have explained, certain examples of the insulated conductor for communication cables of this invention and the method of manufacturing the same. However, it must be noted that such examples are given without limiting the invention or claims thereto.

I claim:

1. An insulated communication conductor consisting of a conductor of round cross section, a covering of insulating tapes of paper having great mechanical strength on different sides of said conductor, said tapes extending longitudinally of said conductor with both edges of each tape extending laterally beyond the conductor, a thermoplastic substance continuously sealing and securing the adjacent edges of said tapes together to enclose the conductor, the juncture of the inner surfaces of the longitudinal edges of said tapes making the largest possible permanent triangular air gap between the joined tapes adjacent both sides of said conductor to reduce the electrostatic capacity of the conductor, and a thermo-hardening substance covering the outer surface of said tapes.

2. An insulated communication conductor consisting of a conductor of round cross section, a covering of insulating tapes of paper having great mechanical strength on different sides of said conductor, said tapes extending longitudinally of said conductor with both edges of each tape extending laterally beyond the

conductor, a thermoplastic substance continuously sealing and securing the adjacent edges of said tapes together to enclose the conductor, the juncture of the inner surfaces of the longitudinal edges of said tapes making the largest possible permanent triangular air gap between the joined tapes adjacent both sides of said conductor to reduce the electrostatic capacity of the conductor, and said insulating tapes are paper having an inner coat of said thermoplastic substance and an outer coat of a thermo-hardening substance.

3. An insulated communication conductor consisting of a conductor of round cross section, a covering of insulating tapes of paper having great mechanical strength on different sides of said conductor, said tapes extending longitudinally of said conductor with both edges of each tape extending laterally beyond the conductor, a thermoplastic substance continuously sealing and securing the adjacent edges of said tapes together to enclose the conductor, the juncture of the inner surfaces of the longitudinal edges of said tapes making the largest possible permanent triangular air gap between the joined tapes adjacent both sides of said conductor to reduce the electrostatic capacity of the conductor, said insulating tapes are paper impregnated with a thermoplastic substance and having an inner coating of a thermoplastic substance and an external coat of a thermo-hardening substance.

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