June 28, 1938. E. P. BARRETT 2,121,942

ELECTRIC CABLE AND METHOD OF MANUFACTURING IT

Original Filed June 23, 1932

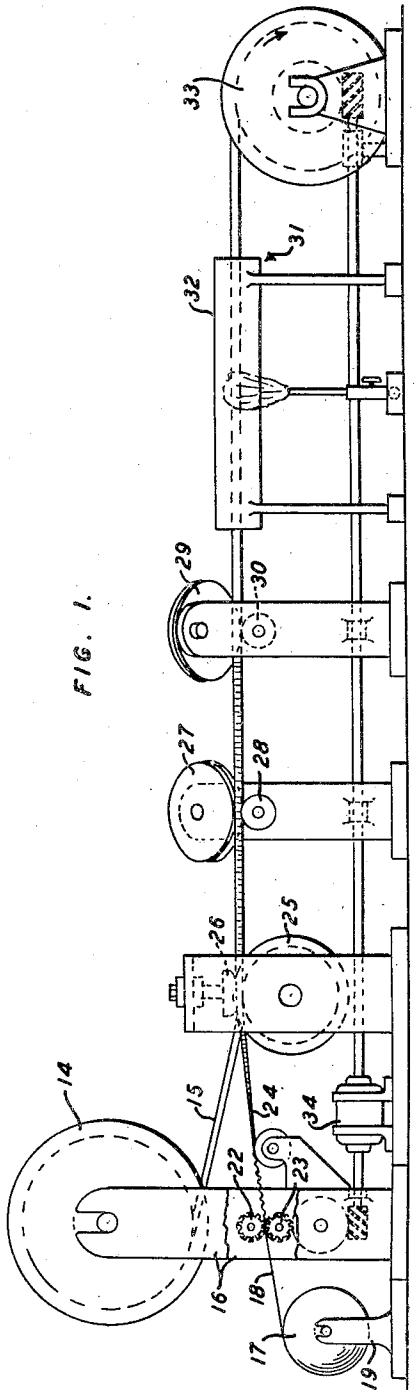


FIG. 1.

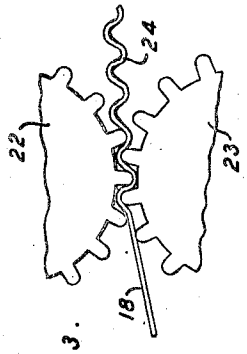


FIG. 3.

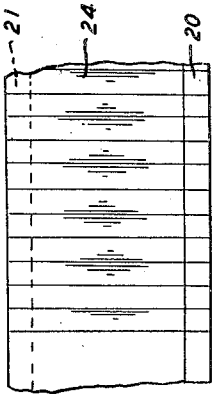


FIG. 2.

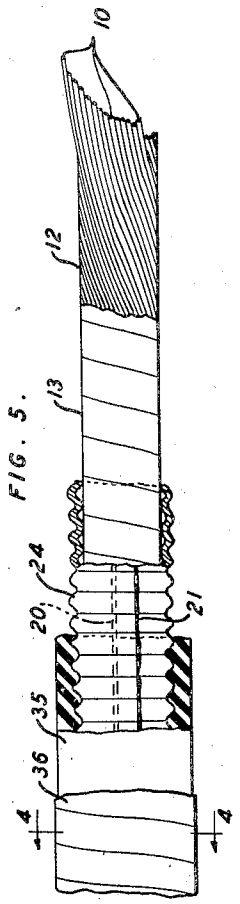


FIG. 5.

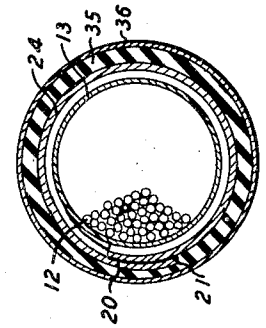


FIG. 4.

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ELECTRIC CABLE AND METHOD OF MANUFACTURING IT

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12 Claims. (Cl. 173—266)

The invention relates to an electric cable and method of manufacturing it and more particularly to the type of cables employed in transmitting intelligence electrically.

Objects of the invention are to provide an improved electric cable and a method of forming the cable.

In the prior art it has been the practice in some instances in connection with the manufacture of cables for transmitting intelligence electrically to form the cable by stranding pairs of paper insulated conductors together, binding the conductor pairs in a group and finally extruding a sheath of lead or lead alloy over the insulated conductors.

If in place of the lead sheath a thin metal sheath of copper, zinc, or similar metal is applied as a tape directly over a group of assembled conductors having its abutting edges secured in a manner to provide a water-proof cable joint, the tape may have a tendency to rip and crack if the assembled cable is flexed beyond certain limits.

According to one embodiment of the invention herein illustrated and described, a flexible cable is constructed by forming pairs of paper insulated conductors, binding the pairs of conductors into a group, covering the group with a layer of paper applied helically, applying a deformed metal tape around the conductor core, the deformation preferably having the form of or including embossings or corrugations transverse to the insulated conductor portion, and the edges of the tape longitudinal to the conductor portion and soldering or otherwise joining the edges of the metal tape together to form a water-tight cable sheath and applying a suitable protecting coating over the deformed metal tape such as rubber or a wrapping of a textile material impregnated with a preserving material.

Other objects and advantages of the invention will appear from the following detailed description when considered in connection with the accompanying drawing, in which

Fig. 1 is an elevation view of one embodiment of an apparatus, with a portion thereof cut away, for forming an electric cable such as shown in Figs. 4 and 5, and by means of which the method may be practiced;

Fig. 2 is a plan view of one embodiment of the deformed tape having corrugations transverse to tape, before it is applied over the insulated conductor pairs;

Fig. 3 is an enlarged partial end view of the deforming or corrugating rollers shown in Fig. 1 for corrugating the tape;

Fig. 4 is a vertical sectional view of a cable taken along the line 4—4 of Fig. 5, and

Fig. 5 is a plan view, partially in section, of one embodiment of the cable.

Referring to the drawing (Figs. 4 and 5) a plurality of conductors 10, preferably of copper and having low resistance, insulated with paper, textile or other suitable material and preferably twisted together in pairs are stranded together loosely in layers to form a group or bundle 12. The group or bundle 12 may be formed in any suitable manner but preferably by the usual and well known form of strander, which has associated therewith a tape serving head by which a paper wrapping 13 may be applied spirally to retain the group comprising the conductors within a predetermined diameter.

A supply reel 14 (Fig. 1) containing a length of the paper covered conductor group 15 is mounted on suitable supporting members 16. Another supply reel 17 containing a length of a suitable metallic tape 18 such as brass, copper, or zinc tape is preferably mounted on supporting members 19. A pair of corrugating rollers 22 and 23 are preferably mounted on the supporting members 16, (a portion of one of which has been shown cut away) to form a corrugated metal tape 24, the corrugations preferably extending the entire width of the tape and at right angles to the tape as shown in Fig. 2. When the edges of the tape 24 are to be lapped and soldered after the tape is formed around the conductor group 15, they are preferably coated with solder along the edges, as shown at 20 and 21 in Fig. 2. The solder coating is preferably applied to the edges before the corrugating operation.

The forming or corrugating rollers 22 and 23 (Figs. 1 and 3) are preferably constructed so that they will form corrugations by an approximately pure bending operation and without appreciably elongating the metal tape 18 and to form corrugations having approximately the shape of a sine wave. In a particular embodiment the following dimensions for the rollers were found satisfactory for producing corrugations having the above characteristics in tape approximately .005 in. thick; outside diameter 1.006 in.; 30 teeth with straight sides .030 in. wide, .05 in. deep and .015 in. radius at ends thereof, distance between centers of adjacent teeth .1 in. at a distance of .478 in. from the roller centers. Corrugating rollers having these dimensions will produce a corrugated tape having approximately .1 in. between

corrugations extending in the same direction and approximately .05 in. between the upper and lower corrugations, when the teeth of one roller are kept centered in the spaces between the teeth of the other roller.

A forming roller **25** having a half-round peripheral groove therein and a forming shoe **26** are provided so that the conductor group **15** can be forced against the central portion of the corrugated tape **24** to form or curve the bottom or central portion of the tape. A forming roller **27** having a half-round peripheral groove therein and a guide roller **28** are provided to form or curve one side of the corrugated tape **24** around the insulated conductor group **15** and another similar forming roller **29** with its associated guide roller **30** are provided to form or curve the other side of the corrugated tape **24** around the insulated conductor group **15**. A suitable device **31** is provided to join the edges of the corrugated tape **24** in order to form a water-tight joint between the edges of the tape. Where the edges of the tape are to be lapped and have been previously coated with solder, this device may take the form of a tube **32** heated to melt the solder and secure the edges of the tape together to form a water-tight joint. Obviously, if the edges of the tape **24** are to be joined by welding or brazing the heated tube **31** may be replaced by suitable apparatus to hold the tape edges together and weld or braze them to form a water-tight joint. A take-up spool **33** is preferably provided to receive the assembled corrugated tape covered conductor group. The take-up spool **33** and the corrugating rollers **22** and **23** may be driven through suitable driving means from a suitable source of power such as a motor **34**.

The operation of the device as shown in Fig. 1 is as follows:

As the motor **34** rotates the take-up spool **33**, the paper covered conductor group **15** is drawn from the supply reel **14**. The rotation of the corrugating rollers **22** and **23** causes the metal tape **18** to be drawn from the supply reel **17** through the rollers and forms the corrugated tape **24** which passes between the forming roller **25** and the forming shoe **26**. The paper insulated conductor group **15** is drawn between the forming roller **25** and forming shoe **26** above the central portion of the corrugated tape **24**. As the forming roller **25** is curved the paper covered conductor group **15** is forced against the corrugated tape **24** and forms the central portion of the corrugated tape **24**. As the corrugated tape **24** and the conductor group **15** pass between the forming roller **27** and its associated guide roller **28**, one side of the corrugated tape **24** is formed and as the conductor group and corrugated tape pass through the forming roller **29** and its associated guide roller **30** the other side of the corrugated tape is formed. As the conductor group with the corrugated metal tape formed around it pass through the device **31** the edges of the tape are joined to form a cable which is water-tight and shielded from extraneous inductive interference. In the corrugated sheath thus made, the corrugations are complete rings around the sheath, as clearly indicated in Fig. 5, each corrugation being independent of any other. Hence of the corrugated sheath be damaged by external force or accident water or any other foreign substance so permitted to enter is dammed back at the first undamaged corrugation instead of being led along as would be the case if the corrugation were a continuous spiral. Damage by accident is thus confined to the immediate neighborhood of an injury.

In some instances it is preferable to apply a non-metallic covering over the corrugated tape. A suitable protective coating **35** (Figs. 4 and 5) such as tough rubber, gutta percha, or gutta percha substitute, may be applied by forcing the cable through an extruding machine of any suitable type well known in the art which applies a covering in one or more layers around the entire length of the cable or the protective coating may take the form of a textile material impregnated with a suitable preserving compound preferably such as asphalt flooded burlap wrapped around the cable and covered with a layer of paper **36** spirally applied over the impregnated textile material. The textile material may be impregnated either before or after being applied to the cable and the preserving compound may be asphalt or any other similar compound capable of resisting chemical decomposition and also serving as a mechanical reenforcement for the cable.

The above described methods of forming an electric cable provide a flexible cable which when flexed will cause the sheath **24** to crinkle uniformly and the finished cable can withstand many flexures and may be flexed to a greater degree without the tendency of the water-tight sheath **24** to rip or crack. The fact that the corrugated sheath **24** touches the smoothly cylindrical, wrapped core **12**, **13** substantially only at the bottoms of the troughs of the corrugations (as clearly shown in Fig. 5) is one reason for the greater flexibility of the completed cable as compared with some cables of the prior art in which corrugations have been pressed into a completed smoothly cylindrical sheath, and in which the corrugations are pressed into and filled with the insulating material of the core.

It is to be understood that the invention is not to be limited to the particular embodiments shown, nor to the particular arrangements that have been described and shown in detail, but only by the scope of the appended claims.

What is claimed is:

1. The method of making a flexible water-tight and electrically shielded electric cable which comprises forming transverse corrugations in a metal tape, forming the tape longitudinally over an insulated conductor, and joining the edges of the tape together to form a continuous transversely corrugated water-proof sheath.

2. The method of making a flexible water-tight and electrically shielded electric cable which comprises forming transverse corrugations in a metal tape by crimping without materially elongating the tape, forming the tape longitudinally over an insulated conductor, and joining the edges of the tape together to form a continuous transversely corrugated water-proof sheath.

3. The method of making a flexible water-tight and electrically shielded electric cable which comprises forming transverse corrugations in a metal tape, forming the tape longitudinally over an insulated conductor, joining the edges of the tape together to form a continuous transversely corrugated water-proof sheath, and applying a non-metallic covering over the corrugated sheath.

4. The method of making a flexible water-tight and electrically shielded electric cable which comprises forming transverse corrugations in a metal tape, forming the tape longitudinally over an insulated conductor, joining the edges of the tape together to form a continuous transversely

corrugated water-proof sheath, and applying a wrapping of textile material impregnated with preserving material over the corrugated sheath.

5. The method of making a flexible water-tight and electrically shielded electric cable which comprises forming transverse corrugations in a metal tape, forming the tape longitudinally over an insulated conductor, and joining the edges of the tape together to form a continuous transversely corrugated water-proof sheath, in which each corrugation is a ring around the sheath independent of any other corrugation.

6. The method of making a flexible water-tight and electrically shielded electric cable which comprises forming transverse corrugations in a metal tape, forming the tape longitudinally over an insulated conductor, and soldering the edges of the tape together to form a continuous transversely corrugated water-proof sheath.

7. The method of making a flexible water-tight and electrically shielded electric cable which comprises forming transverse corrugations in a metal tape, forming the tape longitudinally over an insulated conductor, and soldering the edges of the tape together to form a continuous transversely corrugated water-proof sheath, in which each corrugation is a ring around the sheath independent of any other corrugation.

8. The method of making a flexible water-tight and electrically shielded electric cable which comprises forming transverse corrugations in a metal tape, forming the tape longitudinally over an insulated conductor, and joining the edges of the tape together with the ends of each corrugation matched together to form a continuous transversely corrugated water-proof sheath.

9. In an electric cable, a central insulated conductive core, and a flexible water-proof metallic sheath thereover consisting of a metallic tape extending longitudinally of the core and formed into a tube therearound and having its edges joined together and formed with transverse corrugations each corrugation being a ring around the tube independent of any other corrugation, the metal sheath touching the insulated conductive core substantially only at the bottoms of the troughs of the corrugations.

10. In an electric cable, a central insulated conductive core, and a flexible water-proof metallic sheath thereover consisting of a transversely corrugated metallic tape extending longitudinally of the core and formed into a tube therearound in which the ends of each transverse corrugation are matched together and having the edges of the tape joined together, the metal sheath touching the insulated conductive core substantially only at the bottoms of the troughs of the corrugations.

11. In an electric cable, a substantially non-plastic central insulated conductive core, and a flexible waterproof corrugated metallic sheath thereover consisting of a precorrugated metallic tape extending longitudinally of the core and formed into a tube therearound, the bottoms of the troughs of the corrugations tightly engaging the substantially non-plastic central insulated conductive core, the tops of the troughs of the corrugations being out of engagement with the conductive core, the corrugations extending transversely entirely around the cable, and the ends of each corrugation matched together.

12. In an electric cable, an inner insulated conductor portion and a flexible, metallic sheath thereover formed with circumferential corrugations, each corrugation being a complete ring around the sheath independent of any other corrugation, and the metallic sheath touching the inner insulated conductor portion substantially only at the bottoms of the troughs of the corrugations, the parts being so disposed and proportioned that seepage of accidentally introduced liquid along the insulated conductor is prevented by the corrugations.

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