May 2, 1939. E. P. BARRETT 2,156,934

APPARATUS FOR MANUFACTURING ELECTRIC CABLES

Original Filed June 23, 1932

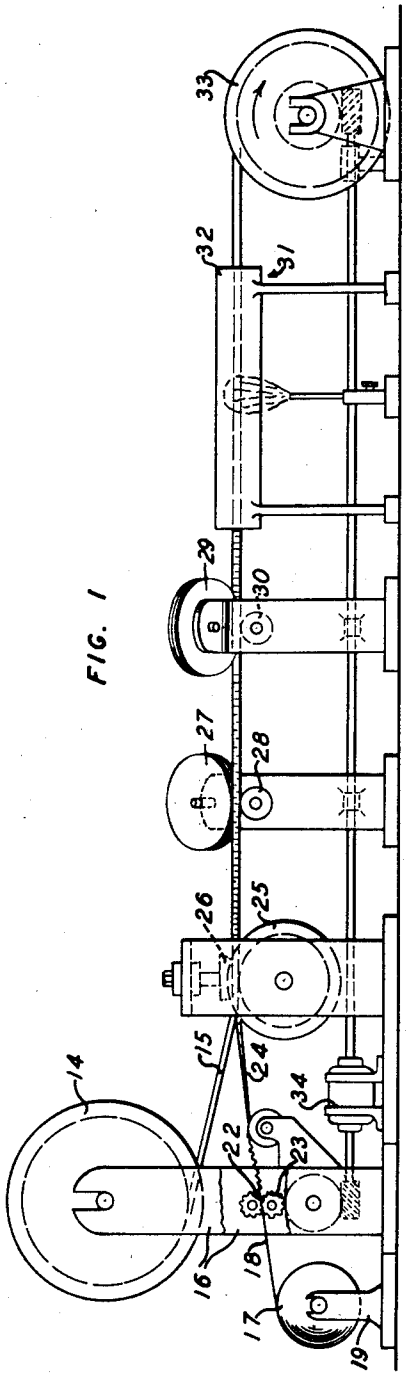



FIG. 1

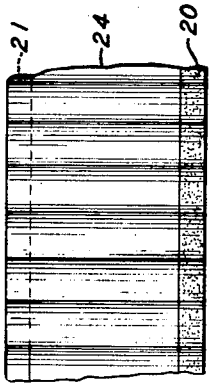



FIG. 2

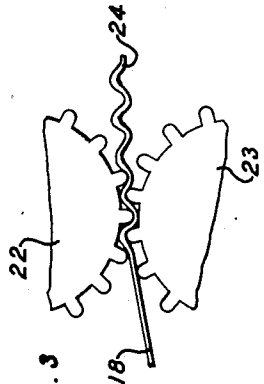



FIG. 3

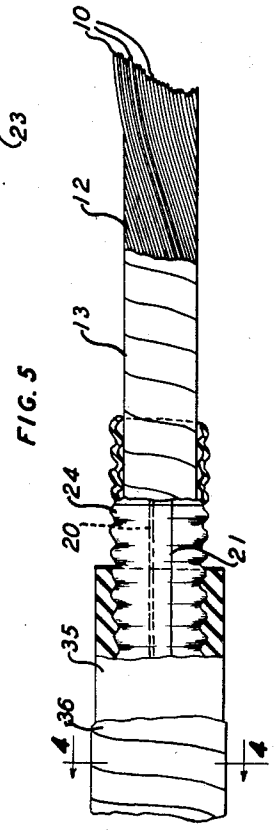



FIG. 5

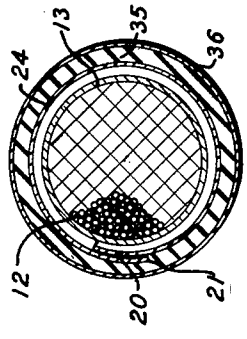



FIG. 4

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## APPARATUS FOR MANUFACTURING ELECTRIC CABLES

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Original application June 23, 1932, Serial No. 618,861, now Patent No. 2,121,942, dated June 28, 1938. Divided and this application October 9, 1936, Serial No. 104,810

11 Claims. (Cl. 113—33)

This invention relates to an apparatus for manufacturing electric cables and more particularly to an apparatus for manufacturing a type of cable for use in communications.

Objects of the invention are to provide an improved apparatus for manufacturing electric cable by continuous process.

The present invention is a division of that disclosed and claimed in copending application Serial No. 618,861 filed June 23, 1932 (now Patent No. 2,121,942, June 28, 1938) by the present inventor.

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, an apparatus is provided having means for 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;

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 if 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 means for 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. In an apparatus for making a flexible, water-tight and electrically shielded electric cable, supply means for a metal tape, supply means for a central cable portion containing a conductor, a pair of corrugating rollers for corrugating the tape transversely without appreciable elongation, means for forming the tape around the central cable portion and longitudinally thereof, means for securing the edges of the tape together to form a continuous and water-proof sheath, take-up means for the sheathed cable, and means for driving the corrugating rollers and the take-up means.

2. In an apparatus for making a flexible, water-tight and electrically shielded electric cable, supply means for a metal tape, supply means for a central cable portion containing a conductor, a pair of corrugating rollers for corrugating the tape transversely, means for forming the tape around the central cable portion and longitudinally thereof, means for securing the edges of the tape together to form a continuous and water-proof sheath over the central cable portion, take-up means for the sheathed cable, and means for driving the corrugating rollers and the take-up means.

3. In an apparatus for making a flexible, water-tight and electrically shielded electric cable, supply means for a corrugated metal tape, supply means for a central cable portion, means for forming the tape around the central cable portion, means for joining the edges of the tape to form a continuous and water-proof sheath, take-up means for the sheathed cable, and means for driving the take-up means.

4. In an apparatus for making a flexible water-tight and electrically shielded electric cable means to supply a metal tape, means to supply an insulated conductive core, means to form transverse corrugations in the tape, means to form the corrugated tape longitudinally into a sheath around the core, and means to join the edges of the tape together to form a continuous transversely corrugated water-proof sheath about the core.

5. In an apparatus for making a flexible water-tight and electrically shielded electric cable means to supply a metal tape, means to supply an insulated conductive core, means to crimp without materially elongating the tape to form transverse corrugations therein, means to form the corrugated tape longitudinally into a sheath around the core, and means to join the edges of the tape together to form a continuous transversely corrugated water-proof sheath about the core.

6. In an apparatus for making a flexible water-tight and electrically shielded electric cable means to supply a metal tape, means to supply an insulated conductive core, means to form transverse corrugations in the tape, means to form the corrugated tape longitudinally into a sheath around the core, and means to solder the edges of the tape together to form a continuous transversely corrugated water-proof sheath about the core.

7. In an apparatus for making a flexible water-tight and electrically shielded electric cable means to supply a metal tape, means to supply an insulated conductive core, a pair of coacting toothed rollers to form transverse corrugations in the tape, means to form the corrugated tape longitudinally into a sheath around the core, and means to join the edges of the tape together to form a continuous transversely corrugated water-proof sheath about the core.

8. In an apparatus for making a flexible water-tight and electrically shielded electric cable means to supply a metal tape of thickness *t*, means to supply an insulated conductive core, a pair of coacting toothed rollers to form transverse corrugations in the tape, the teeth on each roller each being about $6t$ wide and $10t$ high and rounded at the top thereof with a radius of about $3t$ and the teeth on each roller being spaced apart about $20t$ from center to center, means to form the corrugated tape longitudinally into a sheath around the core, and means to join the edges of the tape together to form a continuous transversely corrugated water-proof sheath about the core.

9. In an apparatus for forming a cable having a transversely corrugated metallic tape formed into a sheath, means to transversely corrugate a metallic tape comprising a pair of coacting toothed rollers, the teeth on each roller each being about $6t$ wide and $10t$ high and rounded at the top thereof with a radius of about $3t$ and the teeth on each roller being spaced apart about $20t$ from center to center, means to form the corrugated tape longitudinally into a sheath around the core, and means to join the edges of the tape together to form a continuous transversely corrugated water-proof sheath about the core.

10. In an apparatus for forming a cable having a transversely corrugated metallic tape formed into a sheath, means to transversely corrugate a metallic tape, and means to form the corrugated tape longitudinally about an insulated conductive core, the said forming means comprising a forming roller having a peripheral groove therein to receive the tape and the core upon the tape, a pressure member to force the core and tape into the groove of the roller to form the central portion of the tape about the core, a guide roller to receive the core and tape from the said forming roller and to support the same, a folding roller to fold down one edge of the tape over the core while on the guide roller, a second guide roller to receive the core and tape from the said folding roller, and a second folding roller to fold down the other edge of the tape over the core while on the second guide roller.

11. In an apparatus for forming a cable having a transversely corrugated metallic tape formed into a sheath, means to transversely corrugate a metallic tape, and means to form the corrugated tape longitudinally about an insulated conductive core, the said forming means comprising a forming roller having a peripheral groove therein to receive the tape and the core upon the tape, a pressure member to force the core and tape into the groove of the roller to form the central portion of the tape about the core.

ELLIOTT P. BARRETT.