PRODUCTION OF FLOODED MULTISTRAND CABLE

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ABSTRACT

Flooded multistrand cable is produced by applying a coating of flooding compound onto a bare wire strand and then using the coated strand as a center strand in a stranding operation. The bare wire strand is coated with compound by passing same through a bath of viscous flooding compound and as the coated strand exits from the bath, it is drawn through a restricted opening in a rubber wiper disc. The wiper disc removes excess compound from the coated strand and forms the remainder thereof which adheres to the strand into a uniform coating. The coated strand is then used as the center strand in a stranding operation during which a plurality of bare wire strands are tightly wrapped in a helical fashion about the periphery of the coated center strand to thereby form the multistrand cable. A set of post-formers then compress and squeeze the multistrand cable into a symmetrically round cable product and the compressive action is sufficient to extrude and force the compound from the coated center strand outwardly through the interstices existing between the wrapped peripheral strands. The compressive action of the post-formers effectively distributes and spreads the flooding compound over the entire surface of each strand to thereby produce a flooded multistrand cable having a round cross-section and a uniform coating of flooding compound along its whole length.

5 Claims, 4 Drawing Figures
PRODUCTION OF FLOODED MULTISTRAND CABLE

The present invention pertains generally to the coating of multistrand cable and more particularly to a technique for applying a uniform coating of protective material onto multistrand cable during formation of the cable.

During wire stranding operations, a plurality of individual wire strands are twisted together to form a multistrand cable. The individual strands usually consist of bare wire and it has become common practice in the art to apply some type of protective coating compound onto the cable in order to protect the cable from deterioration. It has been found that without the presence of such a protective coating, moisture and other contaminants accumulate in the numerous interstices existing between the wire strands and such contributes to and accelerates the corrosion of the cable thereby shortening its useful life.

Depending upon the end use of the cable, it is frequently necessary to add an insulative coating over the cable and therefore the filling of the spaces existing between the cable strands with protective coating compound prior to the application of the insulative coating facilitates the formation of the insulative coating about the multistrand cable. In all events, it has now become standard practice to coat the bare wire strands with coating compound and this process is known in the art as "flooding" of the strands and means that the individual strands are flooded or completely covered with a suitable protective coating. The terms "flooding compound" and "coating compound" are used interchangeably throughout the disclosure to refer to compound which is flooded or coated about the bare strands to provide the protective coating.

The technique currently employed in the art is to flood the individual strands with flooding compound immediately prior to twisting the strands into cable form. One method used in the art is to spray the flooding or coating compound onto the strands at a location just upstream from the closing blocks of the strander so that the multistrand cable is coated with compound when it exits from the closing blocks. This technique is disadvantageous in that the compound is not uniformly distributed over the wire strands with the undesirable result that as the cable exits from the closing blocks, it has some portions which are lumped with an excessive amount of compound, other portions which are covered with a very sparse amount of compound, and even portions which are not covered at all. Since the compound is applied to the strands by spraying, much of the compound avoids contacting the strands altogether and therefore a recovery system must be used to collect the unused compound and recirculate it back to the spray nozzle. Furthermore, due to the uneven and inconsistent application of the compound, the resultant cable has a poor quality which detrimentally affects its commercial value as well as its possible fields of use.

It is therefore a primary object of the present invention to provide an improved technique for applying coating compound onto multistrand cable which overcomes the aforementioned problems and drawbacks of the prior art techniques.

It is another object of the invention to provide a system and method for manufacturing coated or flooded multistrand cable by which the coating compound is uniformly and evenly applied to the cable during formation of the cable.

It is still another object of the present invention to provide a system and method of manufacturing coated multistrand cable in which the coating compound is uniformly applied and which may be readily carried out on existing strander apparatus.

It is yet another object of the present invention to provide a technique for manufacturing coated multistrand cable which requires less equipment and is more rapid in production time and which yields a superior quality product than can be obtained by the prior art techniques.

It is yet another object of the present invention to provide a system and method of manufacturing coated multistrand cable by first applying a coating of compound onto a single strand and then utilizing the coated strand as the center strand in a subsequent stranding operation.

It is yet still a further object of the invention to provide a device and method for applying a uniform coating of compound onto a single strand.

It is a further object of the invention to provide a device and method for applying a uniform coating of compound onto a single strand without the loss or waste of any coating compound.

The above and other objects of the present invention are carried out by first coating a single strand of bare wire with coating compound and then using the coated strand as the center strand in a stranding operation. The single strand is coated by immersing same into a bath of coating compound and withdrawing the coated strand from the bath through a restricted opening. The restricted opening functions to remove some of the compound from the strand and form the remaining compound which adheres to the strand into a uniform coating. The coated strand is then used as the center strand in a stranding operation during which a plurality of bare wire strands are tightly wrapped about the center coated strand in a helical pattern to form a multistrand cable composed of a coated center strand and a plurality of bare peripheral strands. The multistrand cable is then fed through a set of post-formers which compress the cable to a degree sufficient to extrusively force the flooding compound from the coated center strand through the interstices existing between adjacent ones of the wrapped peripheral strands. The post-formers compress and shape the cable into a symmetrical product while distributing the extruded compound completely over the surfaces of all the strands to form a flooded multistrand cable.

Having in mind the above and other objects that will be evident from an understanding of this disclosure, the present invention comprises the combinations and arrangements of parts as illustrated in the presently preferred embodiment of the invention which is hereinafter set forth in sufficient detail to enable those persons skilled in the art to clearly understand the function, operation, construction and advantages of it when read in conjunction with the accompanying drawings, wherein like reference characters denote like parts in the various views, and wherein:

FIG. 1 is a side elevational view of a prior art system for manufacturing coated multistrand cable.

FIG. 2 is a perspective view of a device constructed in accordance with the present invention for applying coating compound onto a single strand;
FIG. 3 is a plan view showing how the device of FIG. 2 is used during a rewinding operation; and FIG. 4 is a side elevational view of a system utilizing a center coated strand for manufacturing coated multi-strand cable in accordance with the present invention.

Before delineating the present invention, a brief description of a typical prior art technique of manufacturing flooded multistrand cable will be given so that the numerous advantages and features of the present invention will be more readily appreciated and understood. FIG. 1 shows a conventional system for producing flooded multistrand cable and the system comprises a strand 10 of the center-strand type for forming a plurality of individual wire strands into a multistrand cable. The strand 10 includes a rotary cylinder assembly 12 having means for mounting six bobbins (not shown) of wire in circumferentially spaced relationship around the cylinder assembly. Each bobbin supplies a bare wire strand 13 which jointly will make up the peripheral strands of the cable and the strands 13 are threaded about guide rollers 14 and then fed into a set of closing blocks 15. Another bobbin (not shown) supplies a bare wire strand 16 which will make up the core or center strand of the cable and the strand 16 is fed axially through the cylinder assembly 12 and into the closing blocks 15. During operation of the strand 10, the peripheral strands 13 and the center strand 16 are pulled through the closing blocks 15 while the cylinder assembly 12 is rotated thereby helically winding and twisting the peripheral strands about the center strand to form a multistrand cable 17.

In accordance with the prior art technique, flooding compound 18 is sprayed onto the individual wire strands 13 and 16 at a location intermediate the guide rollers 14 and the closing blocks 15 by a distribution system comprised of a heater (not shown) for heating the compound to maintain it in a viscous, flowable state, and a conduit network 19 which terminates in a spray nozzle 20 for spraying the compound onto the individual wire strands. A recovery system including a collecting trough 21 recovers the flooding compound which is sprayed past the wire strands and circulates it back to the distribution system.

In this manner, each wire strand is partially and unevenly coated with compound prior to entering the closing blocks 15 and the partially coated strands are twisted together to form the flooded multistrand cable 17. A series of post-formers 23,23 receive the multi-strand cable 17 and mechanically shape and squeeze same into the desired configuration. During the shaping of the cable by the post-formers 23,23, the flooding compound tends to further distribute itself between adjacent cable strands as well as about the cable periphery.

However, a major drawback of the spray technique is that the flooding compound is so unevenly applied to the individual strands 13 and 16 prior to their being twisted into cable form that the subsequent shaping operation by the post-formers 23 is ineffective to distribute the compound throughout all the interstices which remain in the multistrand cable 17 between the cable strands along the length of the cable. This is evident from the fact that the upper surface portions of the wire strands which face toward the spray nozzle 20 receive a much greater quantity of the sprayed compound than the under surface portions which face away from the spray nozzle. Moreover, the strands situated closest to the spray nozzle 20 receive a more concentrated dosage of compound than do the several strands which are remote from the spray nozzle. The uneven application of compound to the individual strands results in a flooded multistrand cable 17 having random portions excessively laden with compound and other portions devoid of compound. In addition, much compound is permanently lost in the distribution and recovery systems which must be thoroughly flushed out and cleaned each time a different type of flooding compound is used.

The problems and disadvantages encountered in the prior art flooding-and-stranding system have been effectively overcome by the present invention which will now be described with reference to FIGS. 2-4. FIG. 2 shows a preferred embodiment of a single strand flooding device 30 used to thoroughly flood or coat one strand of wire which is then used as the center strand in the strand and one principal advantage of the invention is that no additional equipment or attachments whatsoever are needed aside from the flooding device in order to apply coating compound to the multistrand cable during the subsequent stranding operation.

The flooding or coating device 30 comprises a container 31 having a generally rectangular configuration for containing therein a bath 32 of flooding compound. The flooding compound per se is well known in the art and forms no part of the present invention. For example, the compound may comprise that sold under the tradename Farboil 1934 which has been found very satisfactory for use with metallic strands. At elevated temperatures, Farboil 1934 assumes a thick, viscous state while at ambient temperature, it rapidly solidifies into a pliable, solid state. A heater (not shown) may be disposed at the base of the container 31 for heating the flooding compound to maintain it in a flowable, viscous state.

In accordance with the invention, guiding means is provided for guiding an advancing flexible wire strand 33 through the bath 32 to enable the strand to become coated with compound. The guiding means comprises a guide wheel 35 rotatably mounted within an upstream portion of the container 31 and a guide roller 36 rotatably mounted within a downstream portion of the container. The guide wheel 35 is threaded onto a threaded shaft 37 which is rotatably connected to opposite side walls of the container 31 by a series of washers and nuts and in this manner, the axial position of the guide wheel may be easily adjusted by manually rotating same relative to the threaded shaft 37. The guide roller 36 is rotatably connected to the container 31 alongside the guide wheel by means of a pair of flanged support plates 38 which are respectively bolted to the opposite side walls of the container. The two ends of the guide roller 36 terminate in shafts which are rotatably received within respective ones of the flanged support plates 38 and a ball bearing unit 39 is interposed between each roller shaft and its associated flange thereby completing the rotary mount.

A guide channel in the form of an annular groove is provided around the periphery of both the guide wheel 35 and the guide roller 36. The guide channels are suitably dimensioned to receive therein wire strands of various size and the guide channels function to lead or guide the wire strand 33 into and through the bath 32 of flooding compound.
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The end wall of the container 31 which is adjacent the guide roller 36 is provided with an exit opening 40, as seen in FIG. 3, to enable the coated wire strand 42 to exit from the flooding device 30. The exit opening is quite large so as to accommodate wire strands of various size and in accordance with the invention, forming means is disposed over the exit opening 40 for forming the gelatinous mass of compound which adheres to the coated strand into a generally uniform coating as the coated strand 42 exits from the container. The forming means comprises a rubber wiper disc 44 having a restricted opening extending therethrough, and means removably mounting the wiper disc against the container end wall so that the disc opening remains in registry with the exit opening 40. As seen in FIGS. 2 and 3, the rubber wiper disc 44 has formed therein a generally conical recess which terminates at its conical tip in the restricted disc opening. By such a construction, an annular wiping lip is formed at the conical tip portion of the recess and such defines the restricted opening.

The wiping lip functions to evenly and smoothly wipe away the excess compound adhering to the coated wire strand as same is drawn through the restricted opening and in this manner, the restricted opening effectively limits and restricts the amount of compound which is allowed to remain on the coated strand and thereby determines the coating thickness.

The mounting means for removably mounting the wiper disc 44 comprise a U-shaped support 45 affixed to the end wall of the container and dimensioned to receive between the legs of the U, in a slightly compressed condition, the rubber wiper disc 44. A covering plate 46 is secured to the outer edge of the support 45 and defines therewith a housing for removably housing the rubber wiper disc. The covering plate 46 has an enlarged opening therein to permit passage of the coated wire strand. By such an arrangement, the rubber wiper disc 44 can be manually inserted into the housing and urged downwardly until the disc opening aligns with the exit opening in the container and the wiper disc is effectively maintained in this position by the slight force-fit by which it is received within the housing.

One important aspect of the present invention resides in the fact of interchangeable and/or replaceable wiper discs 44 in order to accommodate different size wires and also to enable easy replacement of the disc due to wear or breakdown. In accordance with the invention, a plurality of different wiper discs are provided at least some of which have restricted openings of different sizes so that the various discs may be readily interchanged with one another to either replace worn discs or to control the coating thickness depending upon such parameters as the gauge of the wire strand being processed, the viscosity of the particular flooding compound, and the desired thickness of the compound coating. Moreover, as described hereinafter, the particular thickness uniformity of the coating applied to the strand 42 is not at all critical since the distribution of flooding compound to the remaining strands which make up the multistrand cable is ensured by other means.

Referring to FIGS. 3 and 4, the operation of the flooding device 30 and its use in conjunction with the production of flooded multistrand cables in accordance with the invention will now be described. For illustration purposes only, the multistrand cable is shown as being formed from seven individual bare or plain wire strands and it is understood that the invention is equally applicable to the formation of cables having a different number of strands. As is common in all stranding operations, the individual wire strands are first rewound onto bobbins which are then mounted on the strands. During this rewinding operation, one of the seven strands is fed through the flooding device 30 and this is shown in FIG. 3 which depicts the bare wire strand 33 being fed from a payoff drum 47 to the container 31. The strand 33 is guided through the bath 32 of flooding compound by the guiding means 35-39 and the strand is immersed in the bath at one location by the coaction of the guide wheel 35 and guide roller 36 and withdrawn from the bath at another location beneath the level of the bath surface through the exit opening 40. The coated strand 42 is advanced through the bath by a rotationally driven take-up bobbin 48 upon which the coated strand is wound during the rewinding operation.

As the coated strand 42 exits from the container 31, the forming means 44-46 restricts the flow of compound adhering to the strand by wiping away excess compound and forming the remainder thereof into a generally uniform coating. The formation of the uniform coating is accomplished by the wiping action performed by the annular wiping lip of the wiper disc 44 on the compound as the coated strand is drawn through the restricted opening in the wiper disc. The wiping lip uniformly and circumferentially contacts the compound-coated strand to form the compound into a coating having the desired thickness. In accordance with the invention, the size of the restricted opening may be selectively varied by interchanging rubber wiper discs so as to accommodate single strands of different size as well as to control the coating thickness. Thus, for example, by selectively directing the coated strand through one of the differently sized restricted openings, the strand coating thickness may be accordingly controlled. It will be readily understood that the degree of uniformity of the coating depends primarily upon the viscosity of the bath and if the viscosity is quite high, the consistency of the coating will be thicker and hence the compound will tend to retain its shape whereas if the viscosity is low, the coating will assume a more flowable form and tend to drip down along the underside of the advancing strand. While the coated strand advances to the take-up bobbin 48, the compound coating is solidified sufficiently due to exposure to the ambient air such that the compound assumes a pliable, solid state which enables it to both retain its shape while being wound on the take-up bobbin yet deform and be extruded when sufficient force is applied thereto during a subsequent stranding operation as described hereinafter. Upon completion of the rewinding operation, the package of coated wire strand is ready for use as the center strand in a stranding operation.

Referring to FIG. 4, the method of producing flooded multistrand cable in accordance with the principles of the invention will now be described. The method employs a strand 50 of standard construction and hence the invention may be carried out using existing strander apparatus. The strand 50 is essentially similar to the type of prior art strander shown in FIG. 1 and differs therefrom only in the omission of the flooding device. The strand 50 does not include a separate flooding device as is necessary in the prior art stranders and instead, utilizes the coated wire strand 42 in order to ef-
fect flooding of the other plain strands making up the multistrand cable as described hereinafter. The strander 50 comprises a rotary cylinder assembly 52 on which are mounted in circumferentially spaced relationship six bobbins (not shown) of bare wire strand. These bobbins supply the six bare wire strands 53 which make up the six peripheral strands of the cable and another bobbin (also not shown) supplies the coated wire strand 42 which makes up the core or center strand of the cable. The coated strand 42 is fed axially through the rotary cylinder assembly 52 into closing blocks 55 whereas the six bare strands 53 are threaded around a set of guide rollers 54 and fed into the closing blocks.

During operation of the strander 50, the cylinder assembly 52 is rotationally driven to tightly wind the six peripheral bare strands 53 around the center coated strand 42 to form a multistrand cable 56. As the six bare strands are tightly wrapped in a helical fashion around the center coated strand, they compressively deform the pliable coating of flooding compound and tend to force same through the interstices which exist between the wrapped bare strands. In fact, if the peripheral bare strands are wrapped about the coated strand with sufficient tightness, some flooding compound may even be extrusively forced through the spaces which exist between adjacent peripheral strands but it should be noted that this initial extrusion of the compound between the strands is not needed in order to carry out the invention.

The multistrand cable 56 is then fed to a series of post-formers 58,58 which compress and shape the cable and mechanically squeeze the cable strands together with sufficient force to extrude the flooding compound through the spaces between adjacent ones of the peripheral strands. In this manner, the coating of flooding compound which was originally present only on the center coated strand 42 is distributed over the entire surface of each peripheral bare strand 53 thereby completely flooding or coating all the strands of the multistrand cable. Of course, it is understood that the post-formers 58,58 are not special equipment used for this purpose but rather are standard equipment employed in all cable-forming systems of this type. The post-formers function to compress and shape the cable into a symmetrical product of round cross section in a manner similar to the operation of the post-formers 23,23 depicted in the prior art system of FIG. 1. However, in accordance with the present invention, the compressive action of the post-formers is also utilized to extrusively force the flooding compound through the interstices of the cable and distribute the compound over all surface portions of each strand. Hence a more symmetrically round cable product is formed by the system of the invention than was heretofore possible by the prior art systems because of the more consistent application of compound.

After passing through the post-formers, the flooded multistrand cable may be passed through a final rubber wiper or the like in order to remove additional flooding compound prior to winding the cable upon a take-up drum. This final wiping is not normally needed but may be employed depending upon the intended use of the multistrand cable.

Thus it will be appreciated that the present invention provides numerous advantages over the prior art techniques of manufacturing flooded multistrand cable.

The invention minimizes waste of flooding compound and eliminates excessive and uneven application of compound to the multistrand cable. Furthermore, the invention may be carried out on existing stranders of the center-strand type without need for any modification. The invention yields increased cable production by allowing the stranders to run at full production speeds and produces a flooded multistrand cable of high commercial quality.

The invention has been described with reference to one preferred embodiment thereof and it is recognized that obvious changes and modifications will become apparent to those skilled in the art and the invention is intended to cover all such changes and modifications which fall within the spirit and scope of the invention as defined in the appended claims.

What I claim is:

1. Apparatus for applying a viscid coating of predetermined thickness on an advancing flexible strand comprising a housing for containing a viscid coating compound, said housing having side walls, end walls and a bottom, means for supplying a flexible strand for entry into said housing, means for taking up the strand after exiting said housing, means for guiding the strand downwardly beneath the surface of the coating compound in said housing, through the coating compound and outwardly through an exit opening in one wall of said housing disposed beneath the surface of the compound, forming means mounted concentrically with said exit opening for forming the coating compound into a strand coating as the advancing strand exits from said housing, and means facilitating ready removal and replacement of said forming means from its mounting whereby said forming means is selectively interchange-able with alternate ones of said forming means consonant with the diameter of the strand, the viscosity of the coating compound and the predetermined thickness of the coating.

2. Apparatus as defined in claim 1 wherein said forming means is a resilient wiper having an axial opening extending therethrough, and wherein said wiper is force-fit and compressed into its mounting so as to restrict said axial opening to a transverse dimension slightly less than the diameter of the coated strand advancing therethrough whereby said wiper will wipe away some of the coating compound from the coated strand and form the remainder thereof into a generally uniform coating.

3. Apparatus as defined in claim 2 wherein said wiper is in the form of a disc one face of which is in abutment with said one wall of said container, a generally conical recess formed in the other face of said disc and having a conical tip terminating at said axial opening, and wherein said conical tip forms a flexible annular wiping lip in engagement with the advancing coated strand.

4. Apparatus as defined in claim 1, said forming means being mounted in a generally U-shaped bracket mounted exteriorly of said housing, said bracket having a covering plate for retaining said forming means therein and for restraining movement of said forming means in the direction of advance of said strand, and wherein said bracket is open at its top for removal and replacement of said forming means.

5. Apparatus as defined in claim 1 wherein said guiding means includes a guide wheel having a peripheral guide surface extending downwardly into the coating compound, a guide roller rotatably mounted in said housing having an annular guide channel formed in the periphery thereof and extending beneath the surface of the coating compound, and wherein said guide wheel and said guide roller define a generally S-shaped path of travel for the strand through said housing.

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