Jan. 10, 1950 A. L. LOUCKS 2,494,050

METHOD AND APPARATUS FOR APPLYING TAPES TO CABLES

Filed May 23, 1946 7 Sheets-Sheet 1

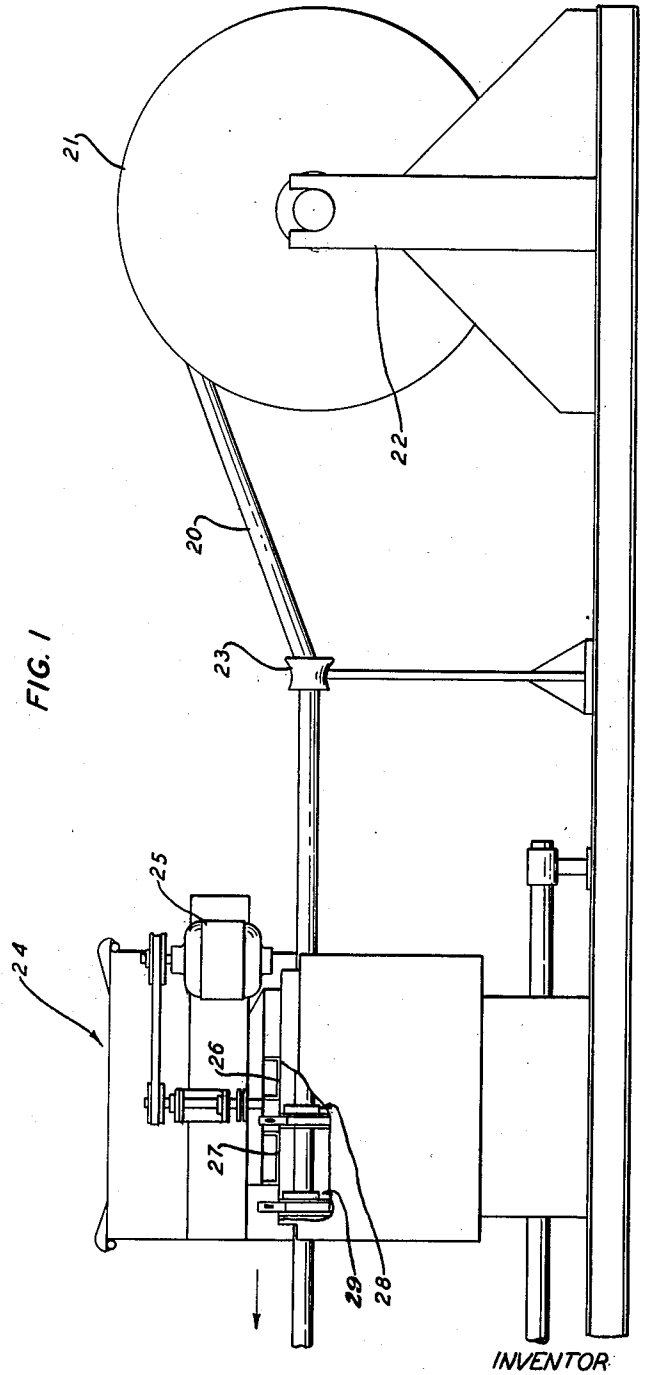


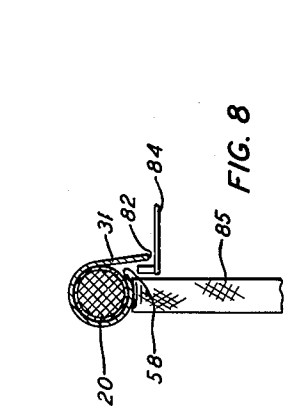
FIG. 1

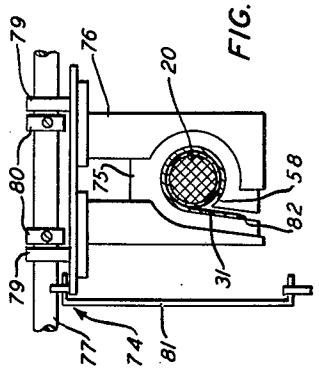
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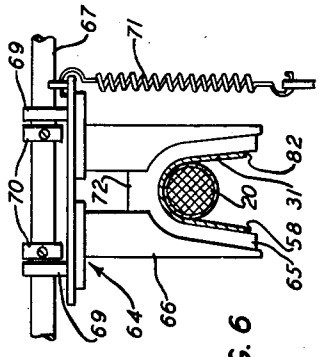
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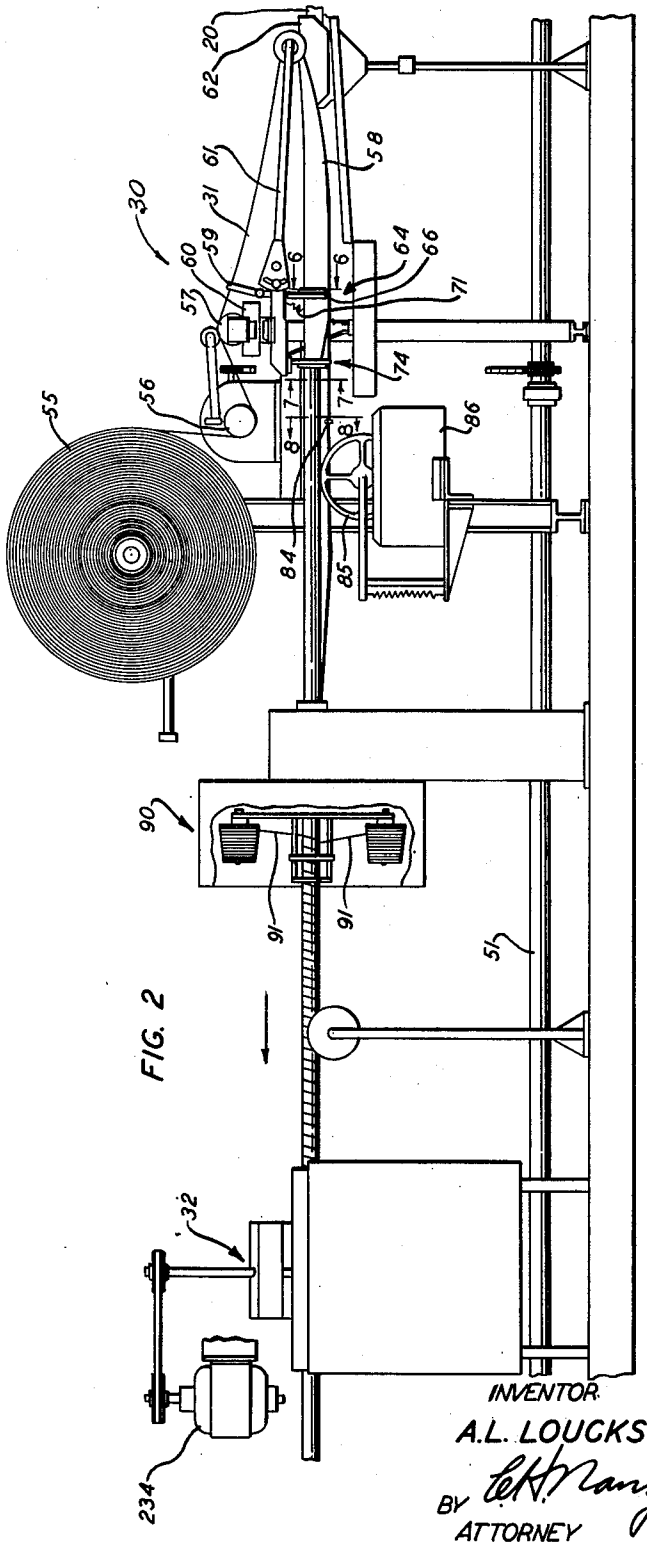
METHOD AND APPARATUS FOR APPLYING TAPES TO CABLES

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METHOD AND APPARATUS FOR APPLYING TAPES TO CABLES

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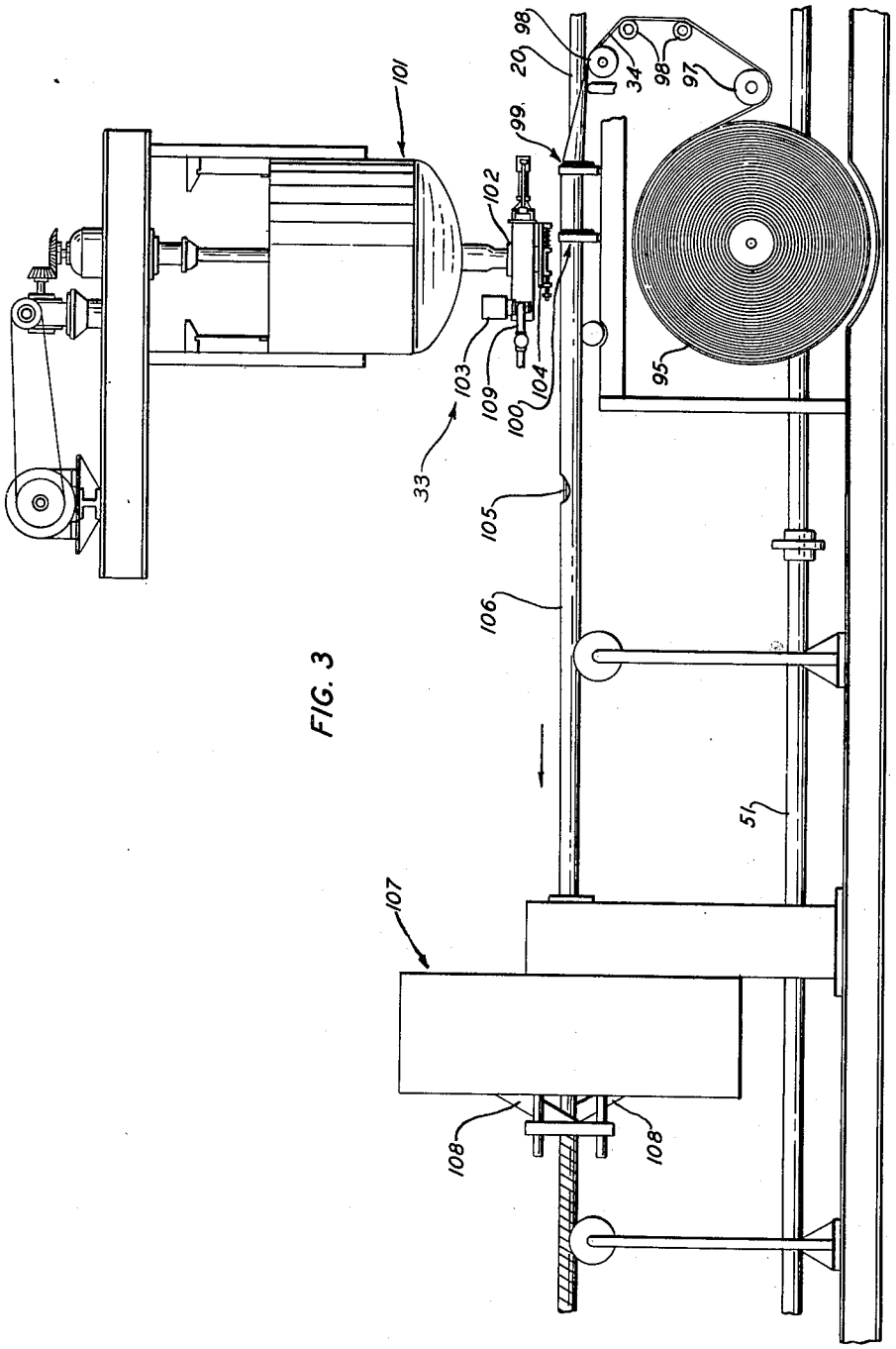


FIG. 3

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METHOD AND APPARATUS FOR APPLYING TAPES TO CABLES

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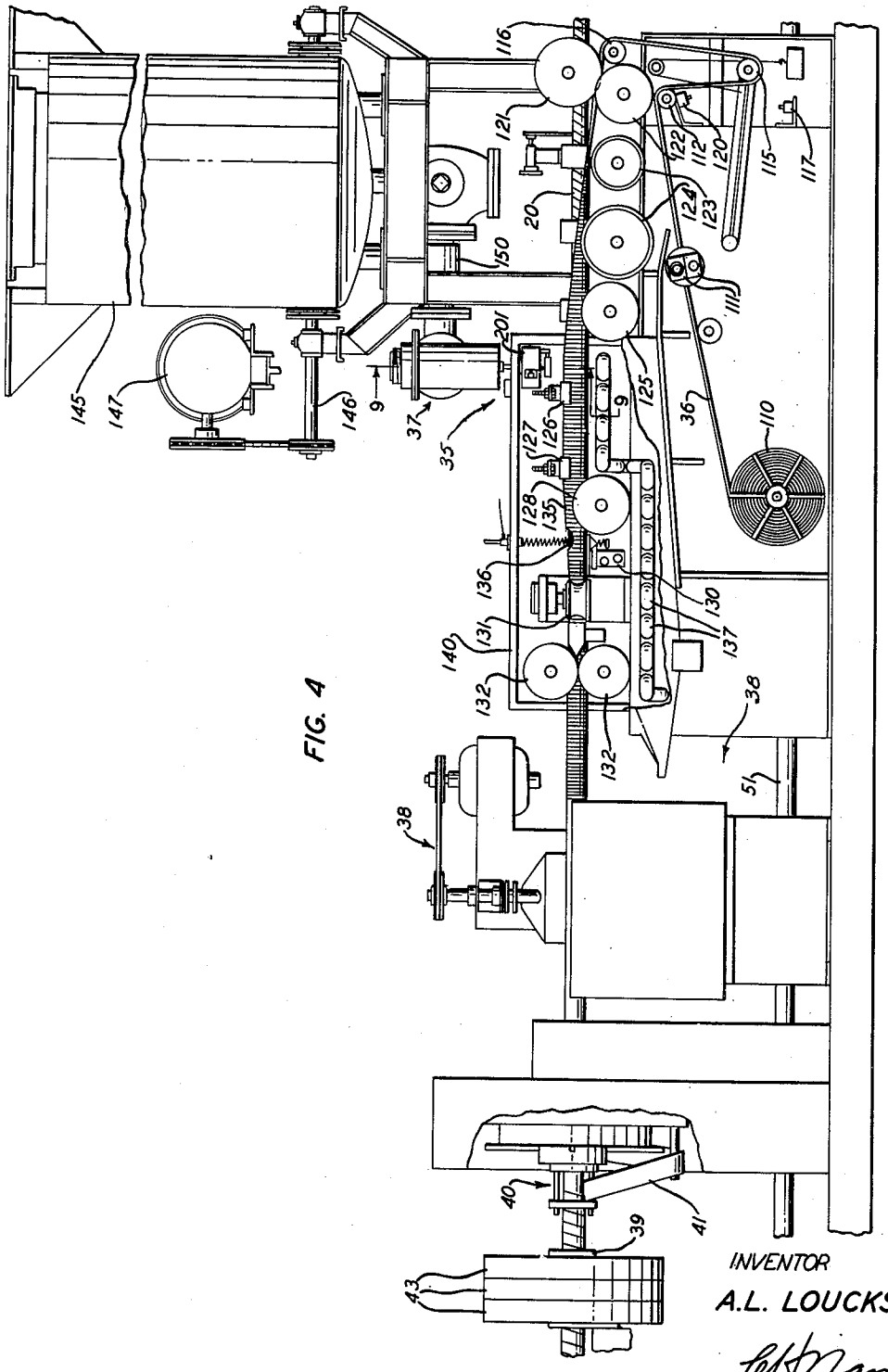


FIG. 4

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METHOD AND APPARATUS FOR APPLYING TAPES TO CABLES

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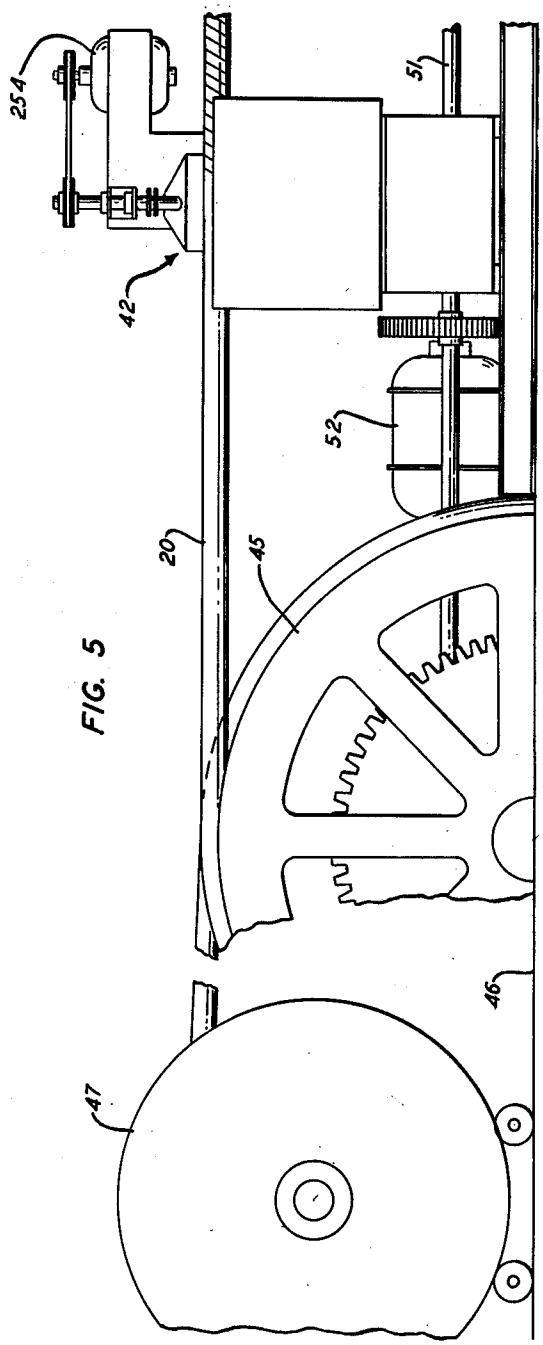


FIG. 5

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METHOD AND APPARATUS FOR APPLYING TAPES TO CABLES

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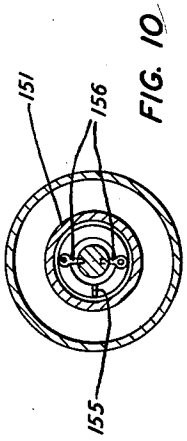


FIG. 10

FIG. 9

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METHOD AND APPARATUS FOR APPLYING TAPES TO CABLES

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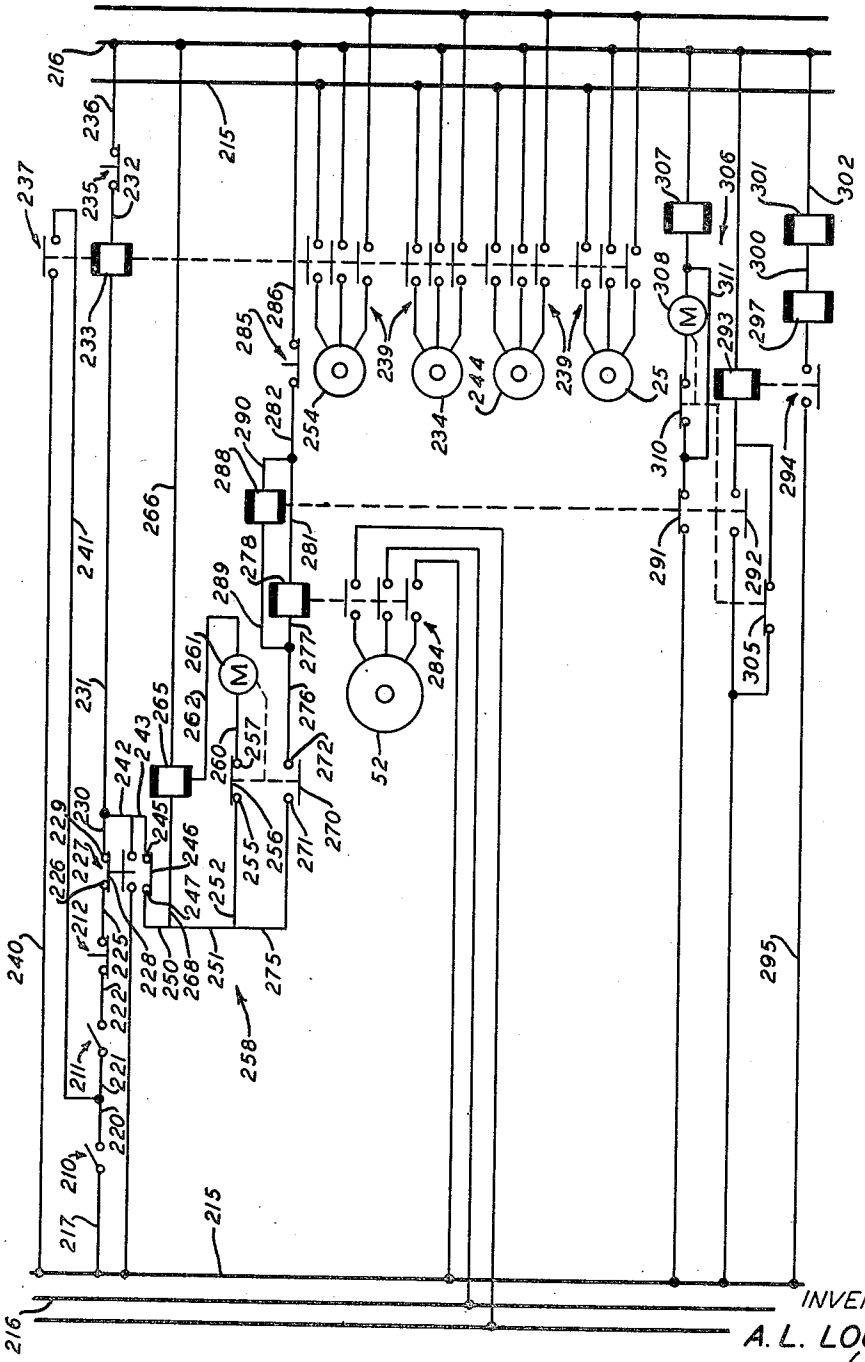


FIG. 11

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UNITED STATES PATENT OFFICE

2,494,050

METHOD AND APPARATUS FOR APPLYING TAPES TO CABLES

Alton L. Loucks, Baltimore, Md., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application May 23, 1946, Serial No. 671,835

20 Claims. (Cl. 57—7)

1

This invention relates to methods of and apparatus for applying tapes to cables.

In the manufacture of cables it is sometimes necessary to wrap tapes transversely on cables. In the past, various types of forming dies have been used to form tapes transversely around cables. Most of these dies include means for wrapping one edge of a tape against the cable and means for wrapping the other edge of the tape over the first-wrapped edge of the tape. Dies known in the past for so wrapping tapes around cables have not been suitable to wrap the tapes completely around the cables and to overlap the edges of the tape without either damage to the tape or imperfect application of the tape to cables.

An object of the invention is to provide new and improved methods of and apparatus for applying tapes to cables.

A further object of the invention is to provide new and improved methods of and apparatus for applying thermoplastic tapes to cables without damage to the tapes or cables.

In applying a tape longitudinally to a cable in accordance with one method embodying the invention, a cable and a thermoplastic tape are advanced continuously, and a tape is partially wrapped around the cable by a U-shaped forming die. The tape and the cable travel through a second forming die, which wraps one edge of the tape tightly against the cable. The tape and the cable travel to a serving head in this condition and the serving head wraps either servings of textile or plastic cords or tapes around the thermoplastic tape in a direction tending to snug the thermoplastic tape upon the cable and to wrap the free edge of the thermoplastic tape over the edge thereof positioned against the cable. Before the thermoplastic tape and the cable travel through the serving head, a coating of cement is applied to the edge of the thermoplastic tape which is held against the cable so that when the other edge of the tape is wrapped thereover, the overlapped edges of the tape are sealed together.

A complete understanding of the invention may be obtained from the following detailed description of methods and apparatus forming specific embodiments thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a side elevation of a portion of an apparatus constituting a specific embodiment of the invention;

Fig. 2 is a side elevation of another portion of the apparatus;

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Fig. 3 is a side elevation of still another portion of the apparatus having parts thereof broken away;

Fig. 4 is a side elevation of an additional portion of the apparatus showing parts thereof in section;

Fig. 5 is a fragmentary, side elevation of a further portion of the apparatus;

Fig. 6 is an enlarged, fragmentary, vertical section taken along line 6—6 of Fig. 2;

Fig. 7 is an enlarged, fragmentary, vertical section taken along line 7—7 of Fig. 2;

Fig. 8 is an enlarged, fragmentary, vertical section taken along line 8—8 of Fig. 2;

Fig. 9 is an enlarged, fragmentary, vertical section taken along line 9—9 of Fig. 4;

Fig. 10 is an enlarged, vertical section taken along line 10—10 of Fig. 9, and

Fig. 11 is a diagrammatic view of an electrical circuit of the apparatus.

Referring now in detail to the drawings, a lead-sheathed cable 20 having a previously applied coating of tallow on the outer surface thereof is advanced toward the left, as viewed in Fig. 1, from a supply reel 21 mounted on a supply stand 22. The cable passes through a bellmouth 23 through a cleaning and coating flooding tank 24, the operation of which is disclosed fully and claimed in copending application Serial No. 671,838, filed May 23, 1946. The flooding tank 24 includes an electric motor 25, which drives a pump (not shown) to pump hot thermoplastic cement upon the cable through troughs 26 and 27. The hot cement applied to the cable by the trough 26 melts the tallow, and a tight wiper 28 wipes the cement and the melted tallow from the periphery of the cable. The hot cement flowing through the trough 27 then covers the wiped periphery of the cable and the excess thereof is wiped from the cable by a relatively loose wiper 29. The tallow on the cable is completely removed from the cable by the hot cement applied by the trough 26 and the wiping action of the tight wiper 28 so that the tallow does not prevent adhesion between the cement applied by the trough 27 and the cable.

The cable 20 passes from the flooding tank 24 to a tape applicator 30, which applies an insulating tape 31 formed of thermoplastic material longitudinally upon the cable. The tape 31 and the cable then pass through a flooding tank 32 of a second tape applicator 33. The flooding tank 32 is of standard construction and applies hot thermoplastic cement to the exterior of the thermoplastic tape 31. The cable as thus

built up is advanced from the flooder 32 on through the remainder of the second tape applicator 33, which applies a thermoplastic tape 34 longitudinally upon the cable.

The covered cable then travels through a corrugating and forming device 35, which corrugates a copper strip 36 and forms the corrugated strip around the cable. A thermoplastic cement applicator 37 applies thermoplastic cement into the partially formed copper strip just before the strip is completely formed around the cable. The applicator 37 is described in detail and claimed in copending application Serial No. 671,836, filed May 23, 1946.

The cable thus built up is advanced through a flooding tank 38, identical with the flooding tank 32, which applies hot asphalt to the exterior of the formed copper strip. A tape 41 formed of protective material, for example impregnated burlap, is applied to the continuously moving cable by a serving head 40 of a suitable type, which carries a suply pad 44 of the tape. A holder 39 serves to hold extra pads 43—43 of the tape 41 in positions over the cable so that they may be used when the tape pad 44 is exhausted.

The taped cable 20 is advanced from the serving head 40 through a flooding tank 42, which is identical with the above-mentioned flooding tanks 32 and 38, and the flooding tank 42 applies hot asphalt to the exterior of the tape 41. A capstan 45 advances the cable from the flooding tank 42 through a pit 46 containing a suspension of whiting, in which the cable is coated with whiting, and finally the cable is wound upon a reel 47 driven by rollers 50—50.

The tape applicators 30 and 33, the corrugating and forming device 35, the cement applicator 37, the serving head 40 and the capstan 45 are all driven by a line shaft 51, which is rotated by a main electric motor 52 through suitable gears (not shown). The cement applicator 37 is driven through a variable gear box so that its speed can be varied with respect to that of the capstan to coordinate their operations.

As the cable 20 is advanced through the tape applicator 30, the thermoplastic tape 31 is advanced from a tape supply pad 55 by means of an overrunning drive roll 56, which tends to advance the tape 31 from the supply pad 55 at a rate of speed greater than that at which the tape is applied to the cable and thereby prevents stretching of the tape 31. The tape 31 is advanced from the drive roll 56 over a lubricating roll 57, which dips into a tank 60 containing a supply of lubricant, such as a mixture of rosin oil and turpentine, or the like, and the roll 57 coats the outer surface of the tape 31 with the lubricant except for the portion thereof near the edge 58 of the tape which is not coated with the lubricant. An adjustable guide 59 guides the tape 31 so that the portion of the exterior surface of the tape 31 near the edge 58 thereof extends beyond and is not contacted by the lubricating roll 57.

The tape 31 travels from the roll 57 over a vertically adjustable guide 61 and back over a supporting guide 62, which holds the tape 31 out of contact with the cement-covered cable. The cable 20 and the tape 31 are advanced through a former 64 (Fig. 6) having a replaceable semihard rubber forming insert 65 positioned within a holder 66 thereof. The forming insert 65 forms the flat tape 31 into a trough-like member having a cross section the shape of a U, and simultaneously presses the tape 31 into contact with the cemented cable 20. The lubricant applied to the outer surface of the tape 31 eliminates undue friction between the forming insert 65 and the tape 31 so that little or no stretch is created in the tape 31 as it is continuously drawn through the former 64. Since the tape 31 does not contact the cement-covered cable until the tape enters the former 64, any stretching of the tape does not cause wrinkles therein which might be formed if the tape should contact the cable before the tape enters the former 64.

The holder 66 is pivotally mounted on a rod 67 by lugs 69—69, and is held against undue lateral movement by collars 70—70 fastened adjustably to the rod 67. However, slight clearances between the collars 70—70 and the lugs 69—69 permit the former 64 to float laterally with the cables. A tension spring 71 serves to urge the holder 66 and the insert 65 downwardly, as viewed in Fig. 6, so that the forming insert 65 presses the tape 31 against the upper portion of the cable 20.

The half of the tape 31 adjacent to the edge 58 (Figs. 2 and 7) thereof then is wrapped tightly against the cement-covered cable 20 by a former 74, which includes a replaceable semihard rubber forming insert 75 held in a holder 76, which is held on a rod 77 by lugs 79—79, bracketing collars 80—80 fastened adjustably to the rod 77, and a rod 81. The collars 80—80 may be loosened on the rod 77 to permit lateral adjustment of the holder 76 with respect to the cable 20, and are so spaced that the holder 74 may float laterally with the cable.

The tape 31 and the cable 20 travel from the former 76 past a resiliently mounted blunt guide 84 and over a spring-pressed applicator wheel 85, which dips into a tank 86 having thermoplastic cement therein and applies the cement to the unlubricated portion of the outer surface of the tape 31 adjacent to the edge 58 thereof. The guide 84 holds an edge 82 of the tape 31 outwardly so that it does not contact the wheel 85, whereby damage to the tape 31 is prevented. The periphery of the wheel 85 is concave so that it conforms to the shape of the portion of the tape 31 adjacent to the edge 58 thereof. Also, the periphery of the wheel 85 is knurled slightly so that slippage between the wheel and the tape 31 is prevented.

After passing over the applicator wheel 85, the tape 31 and the cable 20 pass through a serving head 90 (Fig. 2) of the tape applicator 30, which is driven by the line shaft 51 in synchronization with the speed of the capstan 45 (Fig. 5). The serving head 90 winds textile cords 91—91 around the tape 31 in a clockwise direction, as viewed in Fig. 8, to lap the edge 82 of the tape 31 over the cemented portion of the tape 31 near the edge 58 thereof, to bind the tape 31 tightly against the cement-covered cable and to bind the edge 82 against the cemented portion of the outer surface of this tape so that a moistureproof seal is formed therebetween. The cords 91—91 also serve to hold the tape 31 tightly against the cable 20 so that it is stuck thereto by the cement. The cords may be composed of a high strength plastic material rather than textile material, if so desired. The cable thus built up travels from the serving head 90 to the flooding tank 32, which completely coats the outer portion of the tape 31 and impregnates the textile cords 91—91 with a thermoplastic waterproofing and electrically insulating cement.

The cable 20 travels from the flooding tank 32 of the tape applicator 33 (Fig. 3) on through the tape applicator 33, which applies the thermoplastic tape 34 thereto. The tape 34 is advanced

from a tape supply pad 95 under an overrunning drive roll 97. The tape 34 travels from the drive roll 97 over guide rolls 98—98 and a lubricating roll 96 to a position spaced slightly below the cable 20. The tape 34 and the cable 20 are drawn continuously through a former 99, which is identical in shape with the former 64 (Fig. 6) except that the former 99 is inverted with respect to the former 64, and through a former 100 (Fig. 3), which is identical in shape with the former 74 (Fig. 7) except that the former 100 is reversed with respect to the former 74. The former 99 presses the tape 34 into contact with the cement-covered cable, and forms the tape 34 in such manner that the tape is the shape of an inverted U in cross section, as viewed in Fig. 3. The former 100 presses the half of the tape 34 adjacent to an edge 105 thereof tightly against the cable 20 to stick that portion of the tape 34 to the cable, but holds an edge 106 away from the edge 105 and from the cable.

The tape 34 and the cable then are advanced from the former 100 beneath a thermoplastic cement applicator 101, which is disclosed completely and claimed in copending application Serial No. 671,837, filed May 23, 1946. The cement applicator, which includes an air operated valve 102 controlled by an air valve 109 actuated by a solenoid 103, discharges a small stream of thermoplastic cement at a constant rate through the valve 102 and a flow-control valve 104 upon the portion of the tape 34 near the edge 105 thereof. The cable 20 with the tape 34 formed partially around and stuck thereto is advanced from under the cement applicator 101 to and through a serving head 107 of the tape applicator 33, which serving head is of a well-known type.

The serving head 107 is driven by the line shaft 51 in synchronization with the speed of the capstan 45 (Fig. 5), and wraps tapes 108—108 (Fig. 3), composed of impregnated fabric, paper or other suitable insulating materials, around the thermoplastic tape 34 in a counterclockwise direction, as viewed from the left end of the serving head 107 as seen in Fig. 3. As the tapes 108—108 are served upon the thermoplastic tape 34, they wrap the edge 106 of the tape 34 over the cemented edge 105 thereof, and press them tightly together whereby the edge 105 is cemented and sealed to the edge 106. The tapes 108—108 also press the tape 34 tightly against the cement-covered cable 20 so that the tape 34 is sealed thereto, and since they are wound upon the tape 34 in a direction tending to wrap the edge 106 of the tape 34 over the edge 105 thereof, any wrinkles in the tape 34 are prevented. In addition to these functions, the tapes 108—108 serve as mechanical protection for the thermoplastic tapes 31 and 34.

The cable 20, including the coverings thereon, travels from the serving head 107 to the corrugating and forming device 35 (Fig. 4), which corrugates the copper strip 36 and forms the corrugated strip around the cable to form a longitudinally extending, conductive shield on the cable. The copper strip 36 is advanced from a pad 110 thereof by corrugating rolls 111—111, which are driven from the line shaft 51 through a clutch (not shown). The rolls 111—111 corrugate the strip and advance it therebetween, and the corrugated strip passes over a guide roll 112, a floating feeler 115 and a guide roll 116. The corrugating rolls 111—111 advance the corrugated strip 36 at a rate of speed greater than the rate of speed at which the cable 20 is advanced, at which latter rate the strip 36 is applied to the cable, so that slack accumulates in the portion of the strip between the corrugating rolls 111—111 and the cable 20. When a predetermined amount of slack in this portion of the strip has accumulated, the feeler 115, which is counterweighted, drops into engagement with a microswitch 117 and the microswitch is actuated. The microswitch 117 is associated with a solenoid (not shown), which when actuated by the microswitch causes the clutch driving the corrugating rolls 111—111 to be disengaged so that the rolls 111—111 stop. As the slack in this portion of the strip 36 is used up, the strip raises the feeler 115 and moves it into engagement with a microswitch 120, which causes the clutch to be reengaged so that the corrugating rolls 111—111 restart and advance and corrugate the strip 36. Thus, excess slack of or tension upon the strip 36 are prevented.

The corrugated strip 36 and the cable 20 are advanced through sets of forming rolls 121, 122, 123, 124 and 125, which gradually form the strip 36 transversely into the shape of a U. Guides 126 and 127 hold the edges of the strip 36 in an open position between the set of forming rolls 125 and a set of forming rolls 128. The set of forming rolls 128 serves to further form the strip 36 around the cable and to partially tuck an edge 136 of the strip under an edge 135 thereof. A support 130 guides the strip 36 and the covered cable 20 into a set of horizontally disposed rolls 131, which tuck the edge 136 of the strip 36 further under the edge 135 thereof. Vertically disposed forming rolls 132—132 lap the edge 135 over the edge 136 of the strip 36 so that the cable 20 is completely enclosed in the formed copper strip 36 and the strip shields the cable.

The thermoplastic cement applicator 37 discharges thermoplastic insulating and waterproofing cement upon the cable 20 at a point to the right of the guide 126, as viewed in Fig. 4, and the cement flows around the cable and is retained in the U-shaped portion of the strip 36. The portions of the cable 20 and the strip 36 passing from the set of forming rolls 125 to beyond the final forming rolls 132—132 are enclosed in an oven 140, which has steam coils 137—137 therein. The steam coils 137—137 heat the oven to a high temperature, and are controlled thermostatically to regulate the temperature of the oven 140 so that the cement applied to the cable 20 by the applicator 37 is prevented from congealing whenever the apparatus is stopped. Hence, the cement flows completely around the cable 20. The oven 140 is of particular importance when the advancement of the strip 36 and the cable 20 is stopped because it prevents congealing of and keeps fluent the thermoplastic cement in the portion of the strip 36 which is not completely wrapped around the cable.

The cement applicator 37 delivers cement to the cable 20 at a rate slightly in excess of that needed to thoroughly cement the strip to the cable and to thoroughly insulate the cable 20 from the copper strip 36, and the excess of the cement is squeezed out of the formed strip 36 by the forming rolls 132—132 when they complete the wrapping of the strip 36 around the cable. The high fluidity of the cement on the portion of the cable in the oven 140 permits it to flow easily, and when the strip 36 is formed completely around the cable by the forming rolls

131 and 132—132, the cement is distributed uniformly around the periphery of the cable 20 and fills the space between the strip and the cable completely.

The cement applicator 37 includes a steam-jacketed melting kettle 145 having positioned in the lower portion thereof an agitator 146 driven by an electric motor 147 for stirring the cement therein. A steam-jacketed conduit 150 (Fig. 9) extends from the bottom of the melting kettle 145 to a manually operable valve 149, which is connected to a steam-jacketed conduit 151. A conveyer shaft 152 having a helical ribbon 155 fastened thereto by arms 156—156 (Fig 10) is rotated by a sprocket 157 driven by the line shaft 51 (Fig. 4) through a variable speed unit (not shown) in synchronization with the capstan 45 (Fig. 5). The left end of the shaft 152, as viewed in Fig. 9, is mounted in a thrust bearing 160, and a packing gland 161 seals the interior of the conduit 151 from the atmosphere.

The helical ribbon 155 is spaced a short distance from the shaft 152, and likewise is spaced a short distance from the conduit 151 so that the ribbon urges rather than positively forces the cement along the conduit and agitates the cement to keep its fluidity high. The helical ribbon 155 urges the hot cement along the conduit 151 to a steam-jacketed strainer 162, which is disclosed fully and claimed in copending application Serial No. 673,580, filed May 31, 1946, now Patent No. 2,461,647, dated Feb. 15, 1949. The strainer includes a split, removable screen 165, which has a straight portion 166 and a slanting portion 167. The screen 165 strains any debris such as large lumps, or the like, from the cement, which is forced through the screen. The slanting portion 167 of the screen 165 directs debris downwardly into a sump 168 of the strainer. A bottom plate 169 may be detached from the strainer 162 to remove the split screen 165 for cleaning or repair, if necessary. A discharge pipe 170 is secured in a tapped bore 171 formed in the plate 169, and a valve 172 connected to the discharge pipe may be opened to flush debris out of the strainer 162.

The strained cement is advanced from the strainer 162 through a steam-jacketed conduit 173, which contains a spider 174 supporting a bearing 179, and through an entry port 175 of a steam-jacketed, constant displacement pump 176. The pump 176 includes a body 177 enclosed in a steam jacket 178, which heats the pump to keep the fluidity of the thermoplastic cement high. The pump 176 is of a type operating on the tri-rotor principle and includes a rotor 180, which is fastened to the conveyer shaft 152 by a coupling 181. A piston 182 and a shuttle 183 of the pump 176 are rotated by the rotor 180, and positively feed for a constant speed of rotation of the rotor a constant quantity of cement per unit of time from the entry port 175 of the pump 176 to a discharge port 185 thereof. The operation of the rotor, the piston and the shuttle are identical with the operation of the corresponding elements in a pump manufactured by the Yale and Towne Mfg. Co. and designated 200A. The helical ribbon 155 is spaced sufficiently from the conduit 151 and the shaft 152 to permit slippage of the cement so that it agitates the cement to promote fluidity of the cement. However, the ribbon 155 propels the cement through the conduit 151, and keeps the entry port 175 of the pump 176 filled with cement so that the discharge of the pump 176 is uniform for a constant rate of operation thereof.

The cement forced through the discharge port 185 of the pump 176 passes through a pipe 186 connecting the pump 176 to a steam-jacketed filter 187, which includes an open-end steam-jacketed cylinder 190 and a plug 191 threaded into the open end of the cylinder. A screen basket 192 having a handle 193 and a rim 194 is supported in the cylinder 190 by lugs 195—195 projecting from the interior of the cylinder, which engage the rim 194 of the basket. The cement is forced from the filter, which screens out any oversized particles into the basket 192, through a steam-heated discharge pipe 200 and through a steam-heated valve 201, which is pneumatically controlled by an air valve 202. The valve 201, the air valve 202 and the elements associated therewith are disclosed and claimed in copending application Serial No. 671,839, filed May 23, 1946. The cement flows through the valve 201 onto a V-shaped divider 205, which is positioned over the portion of the cable 20 which is enclosed in the portion of the strip 36 formed into the shape of a U. Thus, the cement flows onto the cable and into the strip 36 on opposite sides of the centerline of the cable 20 and is carried with the strip 36 and the cable as the strip 36 is completely formed around the cable.

An electrical circuit for controlling the apparatus described hereinabove is shown in Fig. 11, and includes a normally open, manually operable switch contact 210, a manually operable switch 211, and a safety switch 212. To start the main motor 52, the switch contact 210 and the switch 211 are closed. Electrical current then flows from a conductor 215 of a power line, which also includes a conductor 216, through a conductor 217, the switch 210, conductors 220 and 221, the switch 211, a conductor 222, the switch 212, a conductor 225, a contact 226 of a testing switch 227, a contactor 228 of the switch 227, a contact 229 of the switch 227, conductors 230 and 231, a relay winding 233, a conductor 232, an overload switch contact 235, and a conductor 236. This energizes the winding 233 and closes a holding switch 237, which is connected in parallel with the switch 210 by conductors 240 and 241 so that the switch contact 210 may be opened without breaking the circuit, and also closes relay switches 239—239. When the switches 239—239 are closed, motors 25, 234, 244 and 254 of the flooding tanks 24 (Fig. 1), 32 (Fig. 2), 38 (Fig. 4), and 42 (Fig. 5), respectively, are started so that the flooding tanks begin to operate.

Current also flows through a conductor 242 (Fig. 11) connected to the conductors 230 and 231, a conductor 243, a contact 245, a contactor 246 and a contact 247 of the testing switch 227, conductors 250, 251 and 252, a contact 255, a contactor 256 and a contact 257 of an adjustable timer 258 of a well-known type, a conductor 260, an electric motor 261 of the timer 258, a conductor 262, a winding 265 of a clutch-controlling solenoid of the timer 258 and a conductor 266 connected to the conductor 216 of the power line, and also through a conductor 268 from the conductor 250 to the winding 265. This energizes the timer motor 261 and the solenoid winding 265 of the timer 258 and starts the timer motor 261.

While the timer motor 261 is running, the flooding tank motors 25, 234, 244 and 254 drive the flooding tank pumps (not shown) and insure that the materials in the flooding tanks 24, 32, 38 and 42 are fluent. After a predetermined

period of time has elapsed, the timer 258 (Fig. 11) moves the contactor 256 out of engagement with the contacts 255 and 257, and moves a contactor 270 into engagement with contacts 271 and 272 of the timer 258. This closes a circuit from the conductor 251 through a conductor 275, the contact 271, the contactor 270, the contact 272, conductors 276 and 277, a relay winding 278, conductors 281 and 282, an overload switch 285 and a conductor 286 to the conductor 216 of the power line. This energizes the relay winding 278, which closes a relay switch 284 to start the main motor 252 and the apparatus described hereinabove. Thus, the timer 258 prevents the operation of the main motor 252 until the flooding tank motors 25, 234, 244 and 254 have been in operation a predetermined period of time.

When the timer 258 (Fig. 11) moves the contactor 270 into engagement with the contactors 271 and 272, it also moves the contactor 256 out of engagement with the contacts 255 and 257, whereby the circuit to the timer motor 261 is broken, and the timer motor 261 is deenergized. The conductor 268 in parallel with the timer motor 261 to the winding 265 of the clutch-controlling solenoid of the timer 258 maintains the energization of the winding 265 even after the contactor 256 is moved out of engagement with the contacts 255 and 257 so that the contactor 270 is held in engagement with the contacts 271 and 272 and the circuit to the relay winding 278 holding the relay switch 284 closed is kept closed.

When the main motor 52 is energized, as described hereinabove, a relay winding 288, connected in parallel with the relay winding 278 by conductors 289 and 290, is energized. The relay winding 288 opens a normally closed switch 291, and closes a normally open switch 292. When the switch 292 is closed, a relay winding 293 is energized whereby a switch 294 is closed. When the switch 294 is closed the following circuit is completed between the conductors 215 and 216 of the power line: a conductor 295, the switch 294, a conductor 296, a winding 297 of the solenoid 103 (Fig. 3), a conductor 300 (Fig. 11), a winding 301 and a conductor 302.

When the winding 297 is energized it operates the solenoid 103, which causes the valve 102 to be opened so that thermoplastic cement is applied to the edge 105 of the tape 34 by the cement applicator 101. The winding 301 is a part of a solenoid (not shown) controlling the air valve 202 (Fig. 9) of the cement applicator 37, and when it is energized that solenoid actuates the air valve 202 to open the valve 201 so that cement is discharged upon the V-shaped divider 205 and flows down upon the portion of cable 20 directly beneath the divider 205. The valves 201 and 102 (Fig. 3) are opened and the line shaft 51, which drives the conveyer shaft 152 (Fig. 9), the constant displacement pump 176 (Fig. 9) and the cable-advancing capstan 45 (Fig. 5), are started substantially simultaneously so that the cement is applied to the tape 34 by the cement applicator 101 and cement is discharged upon the cable 20 and the copper strip 36 (Fig. 4) simultaneously with the start of the advancement of the cable 20, the tape 34 and the copper strip 36 through the apparatus.

When either the switch 211 (Fig. 11) or the switch 212 is opened, the circuit to the relay winding 233, the relay winding 278 and the relay winding 288 is broken thereby deenergizing the motors 25, 52, 234, 244 and 254. When the main motor 52 is deenergized, the drive shaft 51 (Fig. 4) is stopped so that the capstan 45 (Fig. 5), the conveyer shaft 152 (Fig. 9) and the pump 176 are not driven. However, the capstan 45 (Fig. 5) and the line shaft 51 coast after the deenergization of the main motor 261, and the cable 20, the copper strip 36 (Fig. 4) and the tape 34 (Fig. 3) are advanced slightly through the apparatus during the period that they are coasting. To insure that the valve 102 and the valve 201 (Fig. 9) remain open as long as the cable 20 moves through the apparatus, an adjustable timer 306 of a well-known type is provided. When the main motor 52 is stopped by opening the switch 211, or the switch 212, to deenergize the relay winding 278, the relay winding 288 is deenergized so that the switch 291 thereof closes and the switch 292 thereof opens. However, a switch 305 of the timer 306 in parallel with the relay switch 292 remains closed so that the relay winding 293 remains energized to hold the switch 294 closed. This holds the solenoid windings 297 and 301 energized so that the valves 102 (Fig. 3) and 201 (Fig. 9) are kept open. When the switch 291 closes as the relay winding 288 is deenergized, a timer motor 308 of the timer 306 is energized and a clutch-controlling solenoid winding 307 of the timer 306 also is energized. After the timer motor 308 has been energized a predetermined period of time, which period of time is substantially equal to that in which the capstan 45 and the line shaft 51 (Fig. 5) coast to a stop, the timer 306 opens the switches 305 and 310 thereof. When the switch 305 is opened, the winding 293 is deenergized and the switch 294 is opened. This deenergizes the solenoid windings 297 and 301 so that the valves 102 (Fig. 3) and 201 (Fig. 9) are closed. When the switch 310 is opened by the timer 306, the motor 308 of this timer is deenergized, but the clutch-controlling solenoid winding 307 of the timer 306 remains energized from a conductor 311 in parallel with the switch 310 and the motor 308 so that the switches 305 and 310 are kept open until the apparatus is restarted, at which time the relay switch 291 is opened and the solenoid winding 307 is deenergized so that switches 305 and 310 close.

In the operation of the apparatus described hereinabove, first the switches 210 and 211 are closed to start the motors 25, 234, 244 and 254 and the timer 258. After a predetermined period of time has elapsed, the main motor 52 is started by the timer 258 and the relay winding 278, and the relay winding 288 is energized so that the switch 291 is opened, which deenergizes the clutch-controlling solenoid winding 307, and the switch 292 is closed. This energizes the relay winding 293, which closes the relay switch 294 to energize the solenoid windings 297 and 301. The valve 102 (Fig. 3) and the valve 201 (Fig. 9) then are opened. The starting of the main motor 52 starts the line shaft 51 (Fig. 5), which drives the capstan 45 to advance the cable 20 through the apparatus and also drives the conveyer shaft 152 (Fig. 9) and the pump 176 to force cement through the valve 201 onto the cable 20. Hence, the opening of the valves 102 and 201 is simultaneous with the start of the line shaft 51.

The cable 20 is advanced through the flooding tank 24 (Fig. 1) and the tape applicator 30. The tape applicator 30 forms the thermoplastic tape 31 around the cable 20, seals the edges thereof together and binds the tape 31 tightly around the cable 20 with the cords 91—91, which are applied over the tape 31. The thermoplastic

cement on the cable sticks the tape 31 to the cable. The composite cable, including the cords 91—91 and the tape 31, travels from the serving head 90 through the flooding tank 32, which covers the exterior of the tape 31 and impregnates the cords 91—91 with thermoplastic cement. The cable next travels through the second thermoplastic tape applicator 33 (Fig. 3), which forms the thermoplastic tape 34 around the cable with the overlapped edges 105 and 106 of the tape 34 sealed together by cement applied to the edge 105 by the cement applicator 101. The cement between the tape 34 and the tape 31 sticks the tape 34 tightly to the tape 31. The tapes 108—108, which are wound around the tape 34 by the serving head 107, wrap the tape 34 tightly around the cable core.

The built-up cable travels from the serving head 107 to the corrugating and forming device 35 (Fig. 4), which corrugates and forms the copper strip 36 into the shape of a U. The cement applicator 37 supplies the U-shaped portion of the copper strip with hot cement, and then the device 35 forms the strip completely around the cable 20 with the edges 135 and 136 of the strip in overlapping positions. The resultant cable, which includes the portion of the copper strip 36 formed around the cable, then is passed through the flooding tank 38, which applies hot asphalt to the exterior of the formed copper strip and through the serving head 40, which wraps the tape 41 thereover. The cable then passes through the flooding tank 42, which covers the tape 41 with hot asphalt, and is advanced through the whiting pit 46 (Fig. 5) by the capstan 45, after which the cable is wound upon the take-up reel 47.

When it is desired to stop the apparatus, the toggle switch 211 is opened, which breaks the circuit to the relay winding 233, the timer 258, the relay winding 278, and the relay winding 288. Deenergization of the relay winding 233 deenergizes motors 25, 234, 244 and 254, and deenergization of the relay winding 278 deenergizes the main motor 52. The solenoid winding 265 is deenergized so that the contactor 256 moves back into engagement with the contactors 255 and 257 of the timer 258, and the contactor 270 moves out of engagement with the contacts 271 and 272 of the timer 258 so that the motor 261 of the timer 258 may be restarted when the apparatus again is started.

When the relay winding 288 is deenergized, the switch 291 recloses to start the timer 306 and the switch 292 is opened. When the timer 306 has run a predetermined period of time, which time is equal to that of the coasting time of the capstan 45 (Fig. 5) and the line shaft 51, the timer 306 (Fig. 11) opens the switches 305 and 310 thereof. The opening of the switch 305 deenergizes the solenoid windings 297 and 301, which cause the valve 102 (Fig. 3) of the cement applicator 101 to close and the valve 201 (Fig. 4) of the cement applicator 37 to close. The clutch-controlling solenoid winding 307 (Fig. 11) remains energized and holds the switches 305 and 310 open until the apparatus described hereinabove is restarted at which time the relay switch 291 is opened, the switches 305 and 310 are closed, and the switch 292 closes to close the circuit to the relay winding 293.

The methods of and apparatus for applying thermoplastic tapes to cables described hereinabove apply the tapes 31 and 34 seriatum to the cable 20. The tape 31 is wrapped around the cable 20 with the edges 58 and 82 thereof in overlapped and sealed, adhering relationship. The textile cords 91—91 applied by the serving head 90 serve to wrap the edge 82 of the tape 31 over the edge 58 in overlapped relationship with respect thereto, and to wrap the tape 31 tightly around the cemented cable 20 to stick the tape 31 thereto. The seam formed by the overlapped edges 58 and 82 of the tape 81 is positioned on the bottom of the cable, as viewed in Fig. 2.

The tape 34 (Fig. 3) is wrapped around the tape 31 and the edge 106 of the tape 34 is wrapped in overlapping and sealing engagement with the edge 105 thereof. The tape 34 is snugged up around and is stuck to the cement-covered tape 31 (Fig. 2) by the tapes 108—108, which are wrapped around the tape 34 by the serving head 107 of the applicator 33, and the cement covering the tape 31 cements the tape 34 to the tape 31. Thus, the cords 91—91 and the tapes 108—108 serve not only to complete the wrapping of the tapes 31 and 34, respectively, around the cable 20, but also serve to aid the cement in holding the tapes 31 and 34 in their wrapped positions, and do so without wrinkling or stretching the tapes 31 and 34. The seam formed by overlapping the edge 106 of the tape 134 over the edge 105 thereof is formed substantially 180° around the cable 20 from the seam formed by the edges 72 and 82 of the tape 31 (Fig. 8). Since both of these seams are sealed and are spaced apart, and since the thermoplastic cement applied to the outside of the tape 31 by the flooding tank 32 and to the outer surface of the tape 34 by the cement applicator 37 (Fig. 4), the copper strip 36 is completely insulated from and sealed from the original cable 20.

It is believed to be obvious that the methods and apparatus described hereinabove may be used to apply tapes to articles other than cables.

In the use of the terms "filament," "filaments," "filamentary article," "filamentary articles," or terms of similar import, it is intended to mean cords, tapes, ribbons, or other elements of similar form composed of textile, plastic or other suitable high strength materials.

What is claimed is:

1. The method of applying tapes to cores, which comprises advancing a core along a predetermined path, advancing a tape with the core, pressing all of the tape except a portion adjacent to one edge of the tape against the core, applying cement to the other edge of the tape which is pressed against the core, and winding a filament around the tape in such a direction that the filament snugs the tape, folds the free edge of the tape over the cemented edge thereof, presses the free edge firmly against the cemented edge to seal the edges of the tape together and holds the tape upon the core.

2. The method of applying tapes to cables, which comprises advancing a cable along a predetermined path, advancing longitudinally with the cable a tape whose width is greater than the circumference of the cable, folding a portion of the tape adjacent to one edge thereof against the cable, holding that edge of the tape against the cable, and winding a filament around the cable in such a direction that the filament folds the free edge of the tape over the edge thereof pressed against the cable and binds the tape tightly upon the cable.

3. The method of applying tapes to cores, which comprises advancing a core along a predetermined path, advancing longitudinally with the

core a tape whose width is greater than the circumference of the core, folding one edge of the tape against the core, holding that edge of the tape against the core, applying cement to the outer surface of the portion of the tape adjacent to the last-mentioned edge thereof, and winding a filament around the core in such a direction that the filament folds the free edge of the tape over the edge thereof pressed against the core and binds the tape tightly upon the core.

4. The method of applying tapes to cores, which comprises advancing a core along a predetermined path, advancing a tape whose width is greater than the circumference of the core longitudinally with the core, folding one edge thereof in a predetermined direction to move that portion against the core, holding that portion of the tape against the core, and winding a filament around the core in a direction opposite to that in which said portion of the tape is folded so that the filament folds the portion of the tape adjacent to the other edge of the tape over the edge thereof pressed against the core and snugs and binds the tape tightly upon the core.

5. The method of applying a tape to a core, which comprises advancing a core along a predetermined path, advancing a tape with the core, holding the tape against the core, wrapping the tape partially around the core to a position in which the tape has a U-shaped cross section, folding one edge portion of the tape around the core in a predetermined direction to press that edge portion of the tape against the core, and winding a filament tightly around the tape in a direction opposite to the direction of folding of said edge portion of the tape to complete the wrapping of the core.

6. The method of applying tapes to cores, which comprises advancing a core along a predetermined path, advancing a tape along the bottom of the path, folding one edge of the tape against one portion of the core, winding a filament around the tape to fold the other edge of the tape against that portion of the core and to bind the tape tightly to the core, advancing a second tape with the core and the first-mentioned tape, moving one edge of the second tape against a portion of the periphery of the first-mentioned tape, and winding a filament around the second tape to complete the wrapping of the second tape around the first-mentioned tape.

7. The method of applying tapes to cables, which comprises advancing along a predetermined path a cable having a predetermined circumference, advancing along the top of the path a tape whose width is greater than the circumference of the cable, pressing one edge of the tape in a predetermined direction to press that edge of the tape against the upper portion of the cable, applying cement to the outer surface of the portion of the tape adjacent to said edge, winding a filament around the tape in a direction opposite to that in which said edge of the tape is pressed to move the other edge of the tape into overlapping and sealing relationship with respect to the first-mentioned edge of the tape and to bind the tape tightly to the cable, advancing upon the bottom of the first-mentioned tape with the cable and the first mentioned tape a second tape whose width is greater than the circumference of the first-mentioned tape, pressing one edge of the second tape in a predetermined direction to press that edge against the upper portion of the periphery of the first-mentioned tape, applying cement to the outer surface of the portion of the second tape

adjacent to the edge thereof pressed against the first-mentioned tape, and winding a filament around the second tape in a direction opposite to that in which said edge of the second tape is pressed to complete the wrapping of the second tape around the first-mentioned tape and to move the free edge of the second tape into overlapping relationship with respect to the first-mentioned edge of the second tape so that the edges of the second tape are cemented together.

8. The method of applying tapes to cores, which comprises advancing a core along a predetermined path, covering the periphery of the core with cement, advancing a tape longitudinally with the core, holding the tape out of contact with the cemented periphery of the core, pressing the central portion of the tape against the cemented periphery of the core, pressing the portion of the tape adjacent to one edge thereof against the cemented core, and winding a filamentary article around the core to press the portion of the tape adjacent to the other edge thereof against the cemented core.

9. The method of applying tapes to the core, which comprises advancing a core along a predetermined path, covering the core with thermoplastic cement, advancing a thermoplastic tape longitudinally to the core, pressing the central portion of the tape against the cement covered core, forming the half of the tape adjacent to one edge thereof around the core to stick that portion of the tape to the core, applying cement to a portion of the tape adjacent to said edge, and winding a filamentary article around the tape in a direction in which the filamentary article presses the half of the tape adjacent to the other edge thereof against the core and moves the portion of the tape adjacent to the last-mentioned edge of the tape into overlapping engagement with the first-mentioned edge of the tape.

10. The method of applying tapes to cores, which comprises advancing a core along a predetermined path, covering the periphery of the core with thermoplastic cement, advancing a tape longitudinally with the core, forming the portion of the tape adjacent to one edge thereof around the cement-covered core, winding a filamentary article around the tape in a direction tending to wrap the portion of the tape adjacent to the other edge thereof around the core and the first-mentioned edge of the tape to form a seam between the two edges of the tape, covering the filamentary article and the tape with cement, advancing a second tape with the core, pressing a portion of the second tape between the edges thereof against the portion of the first-mentioned tape at the seam formed by the edges thereof, pressing the portion of the second tape adjacent to one edge thereof against the cement-covered first-mentioned tape, and winding a filamentary article around the second tape to press the portion of the tape adjacent to the other edge thereof against the cement-covered first-mentioned tape and the first-mentioned edge of the second tape and to form a seam between the two edges of the second tape at a point spaced from the seam formed by the edges of the first-mentioned tape.

11. The method of applying tapes to cores, which comprises advancing a core having a predetermined diameter along a predetermined path, covering the periphery of the core with cement, advancing a thermoplastic tape whose width is greater than the circumference of the

core longitudinally with the core, pressing the central portion of the tape against the cement-covered core, forming the portion of the tape between the central portion thereof and one edge thereof around the cement-covered core, applying cement to the outer surface of the portion of the tape adjacent to the last-mentioned edge thereof, winding a filamentary article around the tape to form the portion of the tape between the central portion thereof and the free edge thereof around the cement-covered core and to overlap the two edges of the tape to form a seam therebetween, covering the tape and the filamentary article with cement, advancing a second tape whose width is greater than the circumference of the built-up core with the built-up core, pressing the central portion of the second tape against the seam of the first-mentioned tape, forming the portion of the second tape between the central portion thereof and one edge thereof around the first-mentioned tape, applying the cement to the outer surface of the portion of the second tape adjacent to said edge thereof, and winding a filamentary article around the second tape in a direction tending to form the portion of that tape between the central portion thereof and the other edge thereof around the first-mentioned tape and to overlap the edges of the second tape.

12. An apparatus for applying tapes to cores, which comprises means for advancing a core along a predetermined path, means for advancing with the core a tape in contact with the core at the central portion of the tape, means for pressing the portion of the tape between one edge thereof and the central portion thereof against the core, and means for winding a filament around the tape to snug the tape against the core and to complete the wrapping of the tape around the core.

13. An apparatus for applying a tape to a core, which comprises means for continuously advancing a core, means for advancing a tape with the core, a forming die for forming only a portion of the tape adjacent to one edge thereof around the core, and a serving head for winding a filament around the tape to form the remainder of the tape around the core.

14. An apparatus for applying thermoplastic tapes to cores, which comprises means for continuously advancing a core along a predetermined path, means for covering the core with cement, means for advancing a tape longitudinally with the core, means for holding the tape out of contact with the cement-covered core, a forming die for pressing one edge of the tape against the cement-covered core, means for applying cement to one edge of the tape, and means for winding a filament around the tape to fold the portion of the tape including the free edge thereof around the core.

15. An apparatus for applying tapes to cores, which comprises means for continuously advancing a core along a predetermined path, means for covering the core with cement, means for guiding the central portion of the tape into contact with the cement-covered core so that the tape is advanced with the core, a die for pressing the portion of the tape between the central portion thereof and one edge thereof against the periphery of the core, means for applying cement to the portion of the tape adjacent to said edge thereof, means for winding a filament around the tape to form the rest of the tape against the core and to form the other edge of the tape over the first-mentioned edge thereof to form a seam, means for covering the tape and the filament with cement, means for guiding the central portion of a second tape into contact with the first-mentioned tape at a point near the position of the seam of the first-mentioned tape, a die for pressing the portion of the second tape between the central portion thereof and an edge thereof against the first-mentioned tape, means for applying cement to the portion of the second tape adjacent to said edge thereof, and means for winding a filament around the second tape to form the rest of the second tape around the first-mentioned tape and to form the other edge of the second tape over the first-mentioned edge thereof to form a seam.

16. An apparatus for applying tapes to cores, which comprises means for advancing a core along a predetermined path, means for advancing a tape with the core, means for pressing only one edge of the tape around the core in a predetermined direction, and means for winding a filament around the tape in a direction opposite to the direction in which said edge of the tape is pressed to snug the tape tightly upon the core and to form the rest of the tape around the core.

17. An apparatus for applying tapes to cores, which comprises means for continuously advancing a core along a predetermined path, means for guiding a tape longitudinally with the core, means for pressing a portion of the tape adjacent to one edge thereof against the core, a roll for engaging the outer surface of the portion of the tape adjacent to said edge thereof for applying cement to said portion of the tape, and means for wrapping the portion of the tape adjacent to the other edge thereof over the cemented portion of the tape to form a seam between the two edges of the tape.

18. An apparatus for applying tapes to cores, which comprises means for continuously advancing a core along a predetermined path, means for guiding a tape longitudinally into contact with the core, means for pressing a portion of the tape adjacent to one edge thereof against the core, a concave roll for engaging the outer surface of the portion of the tape adjacent to said edge thereof, means for applying cement to the periphery of the roll so that the roll applies cement to said portion of the tape, and means for wrapping the portion of the tape adjacent to the other edge thereof over the cemented portion of the tape to form a seam between the two edges of the tape.

19. An apparatus for applying tapes to cores, which comprises means for continuously advancing a core along a predetermined path, means for guiding a tape into contact with the core, means for pressing a portion of the tape adjacent to one edge thereof against the core, a roll having a concave, roughened periphery, means for urging the roll against the outer surface of the portion of the tape adjacent to said edge thereof, means for applying cement to the periphery of the roll so that the roll applies cement to said portion of the tape, and means for wrapping the portion of the tape adjacent to the other edge thereof over the cemented portion of the tape to form a seam between the two edges of the tape.

20. The method of applying tapes to cores, which comprises advancing a core along a predetermined path, advancing longitudinally with the core a tape, folding a portion of the tape ad-

jacent to one edge thereof against the core, and winding a filament around the core in such a direction that the filament folds the portion of the tape adjacent to the free edge thereof against the core.

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