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E. J. LARSEN ET AL

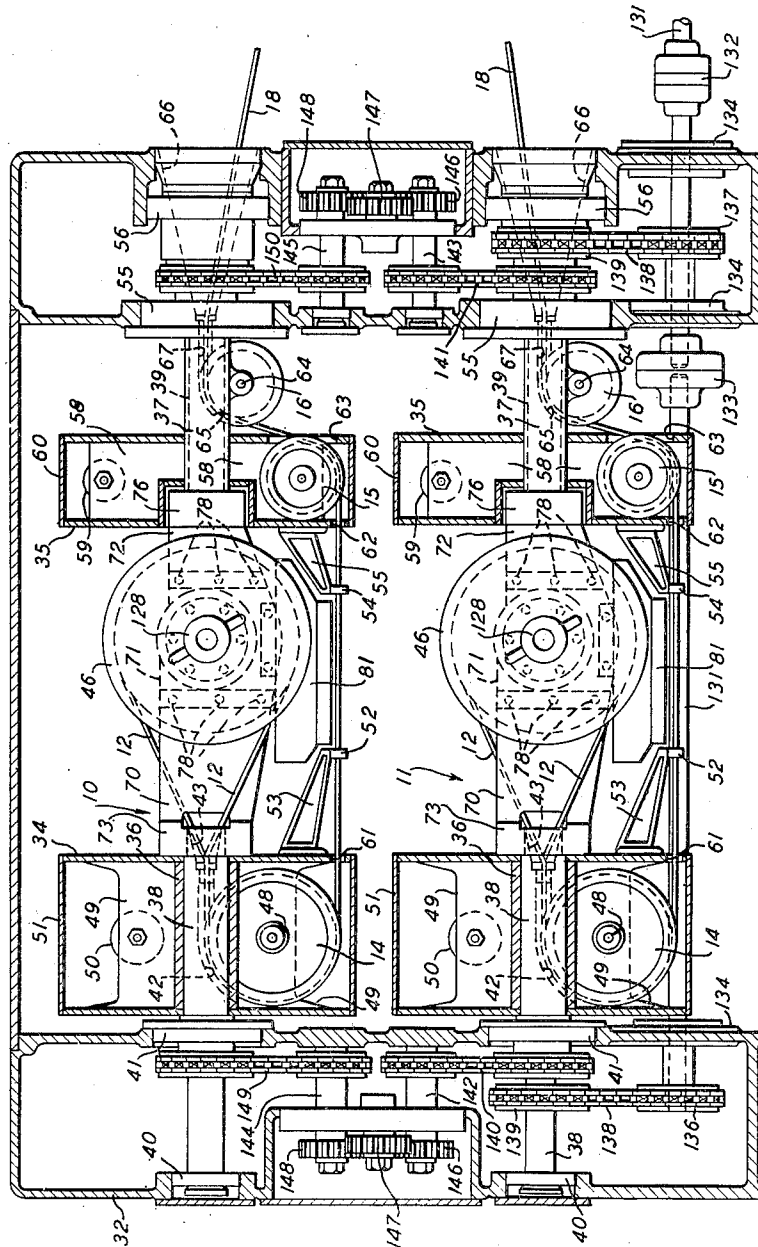
2,364,984

STRAND HANDLING MACHINE

Filed July 23, 1942

3 Sheets-Sheet 1

FIG. 1



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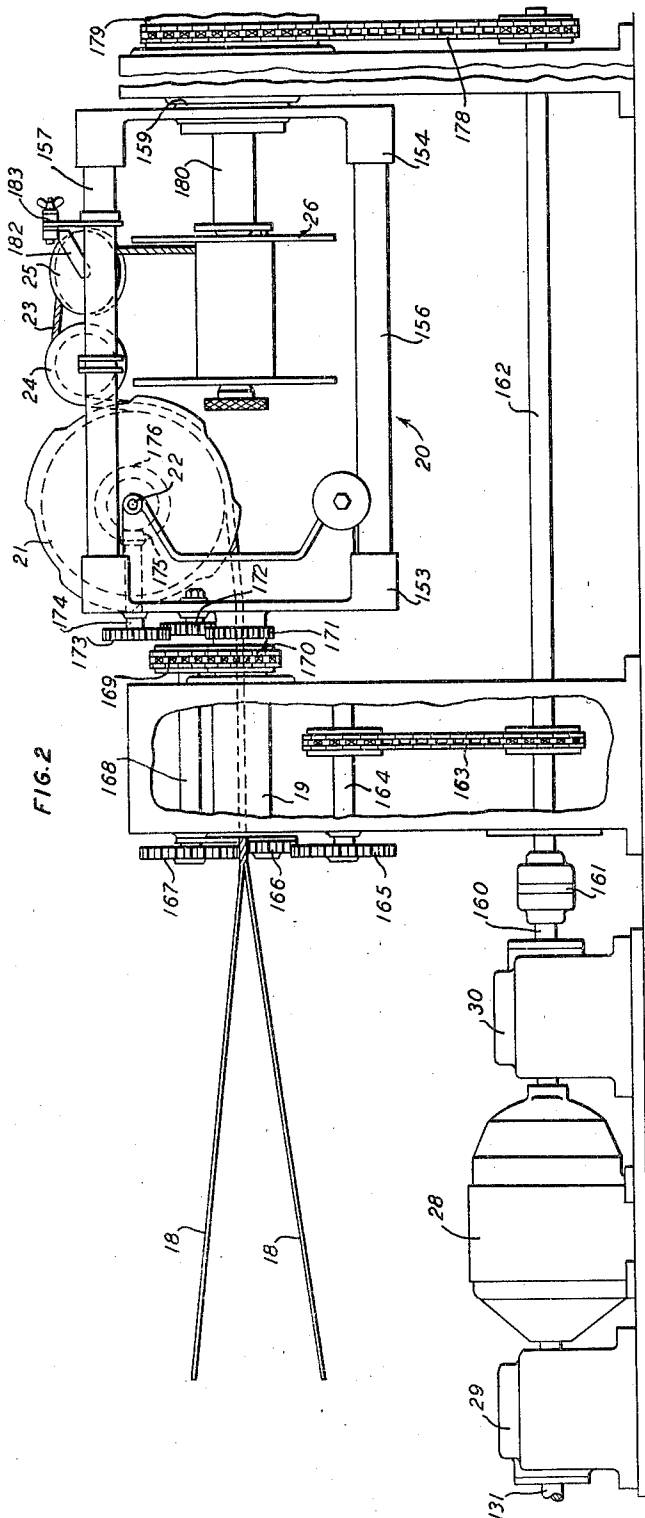
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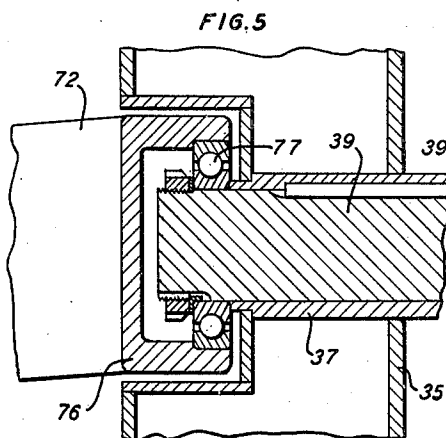
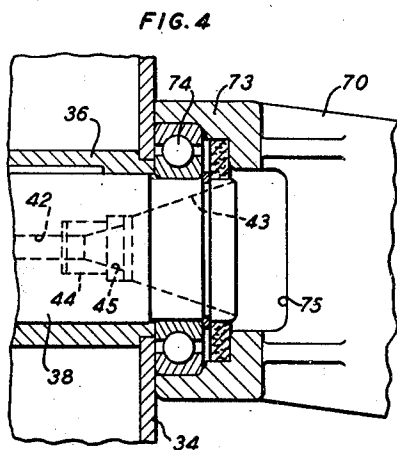
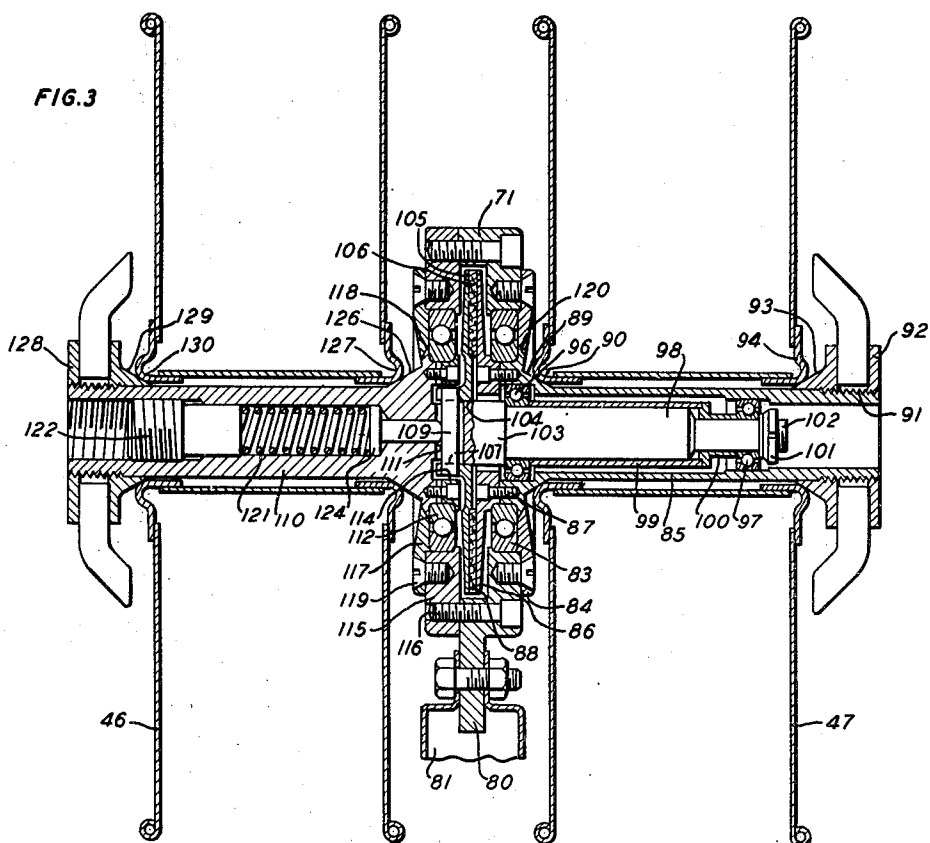
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UNITED STATES PATENT OFFICE

2,364,984

STRAND HANDLING MACHINE

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Application July 23, 1942, Serial No. 452,027

5 Claims. (Cl. 57—60)

This invention relates to strand handling machines, and more particularly to machines for twisting electrical conductors into cables.

Cables have been formed of pairs of insulated electrical conductors, but heretofore such cables have been made by first twisting the conductors into pairs and accumulating them so twisted on reels. Thereafter, desired groups of the pairs of conductors were intertwisted to form a cable in another machine by withdrawing the pairs from their reels.

An object of the invention is to provide a strand handling machine, and more particularly one which is highly efficient in twisting electrical conductors into pairs and twisting these pairs into a cable.

With this and other objects in view, the invention comprises a strand handling machine having a plurality of fliers actuatable in a given direction and each adapted to intertwist strands into a pair, another flier in tandem therewith and fed therefrom adapted for actuation in a reverse direction, the first fliers being driven at a speed to form an overtwist in the pairs to offset the tendency of the last mentioned flier to untwist the pairs.

Other objects and advantages will be apparent from the following detailed description when taken in conjunction with the accompanying drawings, wherein

Fig. 1 is a vertical sectional view of the pair forming portion of the machine;

Fig. 2 is a front elevational view of the remaining portions of the machine;

Fig. 3 is an enlarged sectional view of one of the supply reel units;

Fig. 4 is an enlarged fragmentary detailed view of one end of the reel supporting portion of one of the fliers, and

Fig. 5 is an enlarged fragmentary sectional view of the other end of the same portion shown in Fig. 4.

Referring now to the drawings, attention is first directed to the machine in general shown in Figs. 1 and 2. By placing these figures in numerical order side by side, their base lines will align one with the other and a view of the entire machine may be had. In Fig. 1 two flier units, indicated generally at 10 and 11 and each having two supply reels as shown in Fig. 3, are actuated to twist conductors 12, withdrawn from the reels in each unit, into pairs, the conductors receiving one twist per revolution of their respective fliers upon approaching their sheaves 14 and another twist after passing over sheaves

15 and 16 of their fliers. The fliers 10 and 11 are driven in like directions at speeds sufficient to place overtwists in the pairs of conductors to offset the tendency of the structure shown in Fig. 2, from untwisting the pairs when these pairs are twisted together in an opposite direction from that of their original twist.

When leaving the portion of the machine shown in Fig. 1, the conductors are then in twisted pairs identified by reference numerals 18, these pairs passing through a hollow shaft 19 to a flier indicated generally at 20, in which a capstan 21 is disposed. The capstan 21 is driven counterclockwise about a shaft 22, to cause advancement of the conductors 12, from their respective supply reels through the fliers 10 and 11, and the pairs 18 through the hollow shaft 19. The pairs 18 are twisted together in a direction opposite their original twists to form a cable indicated at 23. The cable 23 is passed around the capstan 21 to effect a pulling connection between the capstan and the cable, after which the cable is fed over a fixed sheave 24 and an adjustable sheave 25 to a takeup reel 26. The flier 20 is driven in a direction opposite that of the fliers 10 and 11, to twist the pairs together in the form of the cable 23.

With the general understanding of the machine and what it accomplishes, attention is now directed to the detailed structure thereof. A common power means, such as a motor 28, is provided for driving the various parts of the machine, although separate speed reducing units 29 and 30 may be employed for the separate units shown in Figs. 1 and 2 respectively.

Referring now to Fig. 1, it will be observed that the fliers 10 and 11 are disposed in a housing 32 formed to provide bearing supports for the various shafts and other rotatable structures. The fliers 10 and 11 are identical in structure and a description of one will apply to well to both fliers. Consider, for example, the flier 10. There are provided spaced cylindrical heads 34 and 35 which have hub portions 36 and 37 respectively at their centers for mounting on their respective shafts 38 and 39. The shaft 38 is journaled in bearings 40 and 41 supported by the housing 32. The portion of the shaft disposed in the hub 36 is grooved, at 42, to rotatably receive the sheave 14 and to allow passage of the conductors 12 therethrough and around the sheave as shown. A more detailed illustration of the inner end of the shaft 38 is shown in Fig. 4, which illustrates a conical end 43 of the groove 42 and also a die 44 with a conical aperture 45

therein. This formation permits free travel of the conductors 12 from their respective reels 46 and 47 into the shaft 38 and around the sheave 14. The sheave 14 is rotatably supported, at 48, upon a rib 49 of the head 34, the diametrically opposed rib 49 supporting a weight 50 to counterbalance the sheave. A cylindrical cover 51 disposed upon the head 34 encloses the parts therein and completes a truly cylindrical structure to eliminate windage during the high speed of rotation of the flier.

A guide 52, integral with a bracket 53 mounted upon the inner side of the head 34, serves to guide the conductors 12 from the sheave 14 to a similar guide 54 of a bracket 55 mounted upon the head 35. The guide 54 guides the conductors to the head 35. The head 35 is substantially identical in structure to the head 34 except in its width, the hub 37 extending laterally beyond the head 35 to a bearing 55 which, together with a bearing 56, supports the shaft 39. One of two supporting fins 58 of the head 35 rotatably supports the sheave 15, while the other supports a weight 59 to counterbalance the sheave. A cover 60, cylindrical in contour, encloses the parts of the head 35 to complete a truly cylindrical structure to eliminate windage during rotation of the flier.

Attention at this point is directed to an aperture 61 in the head 34 and apertures 62 and 63 in the head 35 for the advancement of the conductors 12. The conductors upon passing through the aperture 63, pass over the sheave 16 which is rotatably supported, at 64, by the hub 37. The shaft 39 is grooved, at 65, for the free rotation of the sheave 16 therein, the hub 37 being similarly grooved for this purpose. In both instances heads 34 and 35 are fixed through hubs 36 and 37 to their respective shafts 38 and 39. The shaft 39 has various diameters in its outer or right hand portion of increasing sizes to accommodate a conical aperture 66 therein which communicates with the groove 65 through an aperture 67 for the diagonal travel of the conductors which are then called a pair.

Interposed between the heads 34 and 35 of the flier, is a reel supporting unit composed mainly of three portions 70, 71 and 72. The portion 70 and the manner in which it is supported by the shaft 38 is shown in Fig. 4. The portion 70 is of a flat structure excepting the end 73, which is cylindrical to receive a bearing 74 which is mounted upon the end of the shaft 38, a cutaway portion 75 short of the end 73 permitting travel of the conductors 12 from opposite sides of the portion to enter the aperture 43 of the shaft. The supported end of the portion 72 is shown in Fig. 5, this portion being substantially flat excepting its cylindrical end 76 which is mounted upon a bearing 77, the latter being supported by the shaft 39. The central portion 71 is rigidly secured to the end portions 70 and 72 by overlapping connections and through the aid of screws 78. Attention is now directed to Fig. 3, which illustrates the central portion 71 as having a projection 80 at its lower end to receive a weight or holding means 81 which is suspended between the heads 34 and 35 and serves to hold the reel supporting structure against rotation during the rotation of the shafts 38 and 39 and their respective heads.

The portion 71 has a circular aperture therein to receive a bearing 83 held in place by an annular plate 84. A spindle 85 has its inner end rotatably mounted on the bearing 83 and sup-

ports a brake member 86 which is secured thereto by means of screws 87. The brake member 86 is disc-shaped and has a friction surface 88 for a purpose hereinafter described.

Returning now to the spindle 85, attention is directed to a conical portion 89 at the inner end thereof for wedging engagement with a hub portion 90 of the reel 47. The outer end of the spindle 85 is threaded at 91 to receive a nut 92, a conical portion 93 thereof serving to wedgingly interengage a hub portion 94 of the reel 47. With this structure the reel 47 is removable and fixedly mounted on the spindle 85 for rotation therewith on the bearing 83. Bearings 96 and 97 are disposed in the spindle 85 to rotatably support a shaft 98. Interfitting sleeves 99 and 100 are disposed concentric with the shaft 98 between the bearings 96 and 97 and serve as spacers for the bearings. A nut 101 is disposed upon a threaded end 102 of the shaft, to hold the shaft against displacement. An enlarged end 103 of the shaft is rotatably supported in a central aperture of the brake member 86 and extends into a central aperture 104 of a brake member 105. The brake member 105 is similar in contour to the brake member 86 but is recessed to receive and support a brake or friction element 106 of a suitable structure. Diametrically opposed slots 107 are formed in the hub portion of the brake member 105, to movably receive a pin 109 which serves as an interengaging means between the brake member 105 and a spindle 110, the latter having an inner end, extending into the central aperture of the brake member 105, slotted at 111 to receive the pin 109.

The spindle 110 is formed at its inner end for mounting upon a bearing 112 through the assistance of an annular retaining member 114 secured thereto and also supported by the bearing 112 as shown in Fig. 3. The bearing 112 is supported by a plate 115 centrally apertured for the bearing, as shown, and rigidly secured to the central portion 71 through the aid of screws 116. A retaining member 117, annular in general contour and formed for retaining engagement, as at 118, with the spindle 110, is secured to the plate 115 through the aid of screws 119. A similar retaining connection is provided at 120 between the plate 84 and the spindle 85.

Means is provided, through the aid of the pin 109, to apply pressure to the brake member 105 to move the friction element 106 thereof into intimate engagement with the brake member 86. This means consists mainly of a spring 121 disposed in the spindle 110 and whose force, controlled through an adjusting screw 122, may be varied and applied to the pin 109 through a plunger 124. The outer contour of the spindle 110 is similar to that of the spindle 85, there being provided a conical portion 126 for engagement with a hub portion 127 of the reel 46 and a removable nut 128 threadedly mounted upon the outer end of the spindle and provided with a cone portion 129 for engagement with a hub portion 130 of the reel 46. Thus it may be observed from this structure, that each flier 10 and 11 is provided with two supply reels of conductors 12 and that these conductors may be withdrawn from their reels to cause their reels to rotate in opposite directions; that is, one reel of each flier will rotate clockwise while the other reel thereof rotates counterclockwise, resulting in relative rotation of the brake members 86 and 105 to create tension on the conductors which

will be uniform due to the intermediate braking means.

Referring now to the power means for driving the fliers 10 and 11, attention is directed to the motor 28 which drives the unit 29. An output shaft 131, which may be found in Fig. 2, is, in actual structure, formed of a plurality of parts joined by couplings 132 and 133, and extends through the housing 32 to a point short of the left end thereof. The shaft 131 is journaled in suitable bearings 134.

Viewing now the portions of the shaft disposed in the ends of the housing, it will be observed that sprockets 136 and 137 are mounted thereon. These sprockets drive the shafts 38 and 39 respectively, through chains 138 and their respective sprockets 139. Through sprocket and chain connections 140 and 141, shafts 142 and 143 respectively are driven. Rotation of the shafts 142 and 143 will rotate their respective shafts 144 and 145 through their respective gears 146, 147 and 148. Finally, sprocket and chain connections 149 and 150, operatively connecting their respective shafts 144—38 and 145—39, will complete the driving means for the two fliers 10 and 11. The gears 146, 147 and 148 at each end of the fliers are identical to cause rotation of the heads 34 and 35 of the flier 10 in synchronism one with the other, the same result being accomplished for the flier 11 due to the likeness of the sprocket and chain connections 37, 38 and 39.

Attention is now directed to Fig. 2, wherein the flier 20 is composed of heads 153 and 154 connected by rods 156 and 157. The head 153 is mounted upon the inner end of the shaft 19 and is rotated therewith, the head 154 being rotatably mounted at 159 through any suitable means not shown.

Considering first the driving means for the capstan 21, attention is directed to the motor 28 which drives the unit 29, the output shaft 130 of which is coupled at 161 to a shaft 162. The shaft 162 is rotatably supported in any suitable bearings (not shown) and through a sprocket and chain connection 163, rotates a shaft 164. Through a chain of gears 165, 166 and 167, rotation of the shaft 164 will rotate a shaft 168. A sprocket and chain connection 169 continues the driving means from the shaft 168 to a sleeve or hollow shaft 170 which is free for rotation on the shaft 19 and includes a gear 171. The gear 171 drives an idler gear 172 which in turn drives a gear 173, the latter being mounted upon a shaft 174. The shaft 174, when driven, drives a bevelled gear 175 which is mounted upon the inner end of the shaft and interengages a gear 176. The gear 176 is mounted upon the shaft 22 or fixed to the capstan 21, to cause rotation of the capstan in a counterclockwise direction through the driving means just described, linking it with the shaft 162. The flier 20 is rotated through a sprocket and chain connection 178 connecting the shaft 162 to a hollow shaft 179. The flier is thus rotated through this means in a direction opposite the direction of rotation of the fliers 10 and 11.

The takeup reel 26 is mounted upon a rod 180 which is movably disposed in the hollow shaft 179 and adapted, through any suitable mechanism not shown, to be reciprocated yet held against rotation so that the cable 23 may be wound on the reel during rotation of the flier. The purpose of the reciprocation of the rod 180 is to cause suitable reciprocatory movement of the reel to effect distribution of the cable thereon.

Such means for reciprocating the rod and reel is shown in the copending application of O. G. Nelson and J. A. Wagner, Serial No. 420,444, filed November 28, 1941.

Attention is directed to the sheave 25 which is supported by an arm 182 adjustable on a bracket 183 to direct the cable 23 to either side of the reel 26, depending upon the direction of rotation of the flier 20. With this structure it is possible to direct the complete travel of the cable to either side of the reel without causing damage to the insulation on the conductors forming the cable.

Upon considering the operation of the apparatus, let it be understood that the reels 46 and 47 of both fliers 10 and 11 are filled with insulated electrical conductors 12 and that the reels in each flier are mounted on their spindles so that the conductors will appear to have been wound in opposite directions. In other words, one reel, for example reel 46, is mounted on its spindle 110 so that the conductor will be withdrawn from the bottom of the reel as a result of the apparent clockwise winding of the conductor on the reel, whereas the conductor on the reel 47 will be withdrawn from the top as a result of the apparent winding of that conductor in a counterclockwise direction. As shown in Fig. 1, the conductors of the fliers 10 and 11 pass upon their respective sides of the portions 70 and enter the conical apertures 43 of their shafts 38. In setting up the machine for operation, the conductors of the pairs may be manually twisted together and fed through the apertures just mentioned around the sheave 14 through the guides 52 and 54, around the sheaves 15 and 16, through the grooves 65 of their respective shifts, the apertures 67 and 68, where they merge in pairs from their fliers and then pass through the hollow shaft 19 through which they are drawn from the capstan 21, and finally reach the takeup reel 26, a completed cable of the two pairs of conductors.

The common power means 28 causes simultaneous and synchronous driving of the various parts of the machine. Upon considering the structure in Fig. 1, the fliers 10 and 11 may each be considered as having three parts, the head 34 and 35 being two of the parts and the intermediate reel supporting unit the third part. The heads have their separate driving means which are linked to the common driving means and are rotated in synchronism in like directions. As the fliers 10 and 11 are rotated, the conductors are advanced in the paths previously described. The conductors in each pair upon leaving their respective reels and before reaching their sheaves 14, receive one twist for each revolution of their fliers. The pairs thus twisted travel to the opposite end of the fliers, where they receive another twist for each flier revolution. These twists are predetermined in number, depending upon the characteristics of the conductors and their insulating coverings, and upon the number of turns desired for a perfect lay of the conductors in each pair and the pairs in the completed cable after passing through the entire machine. To eliminate kinking and loosening of the conductors, it is important that the desired number of turns be given to the pairs as well as to the conductors forming the pairs. Furthermore, the tendency of the twisting of the pairs in the opposite direction from their original twist to intertwist the pairs into the cable, must also bear consideration. Therefore, the fliers 10 and 11 are rotated at like speeds in a given direction, to twist the

conductors of their respective pairs to form an excess twist in the pairs to offset the tendency of the flier 20 to untwist the pairs during its rotation in the direction opposite that of the fliers 10 and 11. As a result, the correct twist of the pairs is present in the final cable due to the tendency of the fliers 10 and 11 to overtwist the pairs.

It is further important, in establishing uniformity, in the pairs of conductors, that the conductors travel at like speeds under like and constant tensions. This is accomplished through the mechanism shown in Fig. 3, the reel supporting portion of the fliers 10 and 11. As was previously described, the reels 46 and 47 of each flier are caused to rotate in opposite directions as a result of the withdrawal of the conductors 12 therefrom. Therefore, the brake members 86 and 105, together with the friction element 106 of the latter, are rotated in opposite directions against the frictional force existing therebetween. The friction exists between the member 86 and element 106 and its effect is determined and varied by the force of the spring 121 holding the brake member and element together. Thus the desired tension on the conductors is determined and the spring 121 set accordingly through the adjustment of the screw 122, the force of the spring being transmitted through the plunger 124 and the pin 109 to the brake member 105 and element 106. Thus the brake member 105 and element 106 are movable relative to the brake member 86, this movement being on a common axis of the brake members.

The removal of the conductors from their reels will cause rotation of their respective spindles 85 and 110 in opposite directions with their respective brake members 86 and 105-106 and the braking force there created will be transmitted equally to the conductors leaving their reels. Therefore, with equal braking force applied in each flier 10 and 11, the tension of all the conductors will be the same.

In each instance the tensions on the conductors of the two fliers may vary. This may be readily accomplished through the adjustment of their respective springs 121. It may also be desired under such circumstances to cause rotation of the fliers 10 and 11 at different speeds. This may be accomplished by changing the gears 146, 147 and 148 for gears of different ratios, to bring about the desired variation in speed of the two fliers. In either case, the gears of each set would be identical to cause simultaneous rotation of the heads 34 and 35 of the flier 10.

During the rotation of the fliers 10 and 11, it will be apparent that the mounting of the central units thereof upon their bearings, as illustrated in Figs. 4 and 5, together with the weights 81, will cause the central or reel supporting unit of the fliers to remain stationary during the rotation of the fliers, thus resulting in the forming of the twists in the pairs of conductors during their advancement through the fliers.

Although specific improvements of the invention have been shown and described, it will be understood that they are but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention as defined by the appended claims.

What is claimed is:

1. A strand handling machine comprising a pair of supply reels for strands, a support therefor, means to advance the strands to withdraw the strands from their reels and thus cause rotation of the reels in opposite directions, braking means interposed between the reels to create equal tensions on the advancing strands, an enclosed cylindrical hollow head mounted for rotation relative to the support, and means in the head to guide the advancing strands and twist them together.

2. A strand handling machine comprising a flier having enclosed cylindrical hollow heads, separate means to support the heads for rotation, a supply unit interposed between the heads to supply strands thereto, means in the heads to successively receive the strands and twist them together, and separate means to rotate the heads in synchronism with each other.

3. A strand handling machine comprising a flier having enclosed cylindrical hollow heads, separate means to support the heads for rotation, a supply unit interposed between the heads to supply strands thereto, means in the heads to successively receive the strands and twist them together, separate means to rotate the heads in synchronism with each other, and means to hold the unit against rotation with the heads.

4. A strand handling machine comprising a flier rotatable to twist two advancing strands together, supply reels for the strands rotatable in opposite directions by the advancement of the strands, axially aligned spindles for the reels, means interposed between the reels to rotatably support the spindle, and cooperating brake elements connected to the inner ends of their respective spindles for rotation therewith in opposite directions to create a given brake drag divided between the spindles and reels to cause application of equal tensions on the strands.

5. A strand handling machine comprising a flier rotatable to twist two advancing strands together, axially aligned spindles for the reels, one of the spindles being longitudinally apertured, means to rotatably support the spindles, cooperating brake elements connected to the inner ends of their respective spindles for rotation therewith in opposite directions to create a given brake drag divided between the spindles and reels to cause application of equal tensions on the strands, and means disposed in the apertured spindle to apply a variable force to the brake elements to vary the given brake drag and thus vary the tension on the strands.

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