T. W. NORMAN.

CORD AND ROPE WINDING MACHINE.

APPLICATION FILED FEB. 24, 1902

1,031,366.

Patented July 2, 1912.

3 SHEETS—SHEET 1.

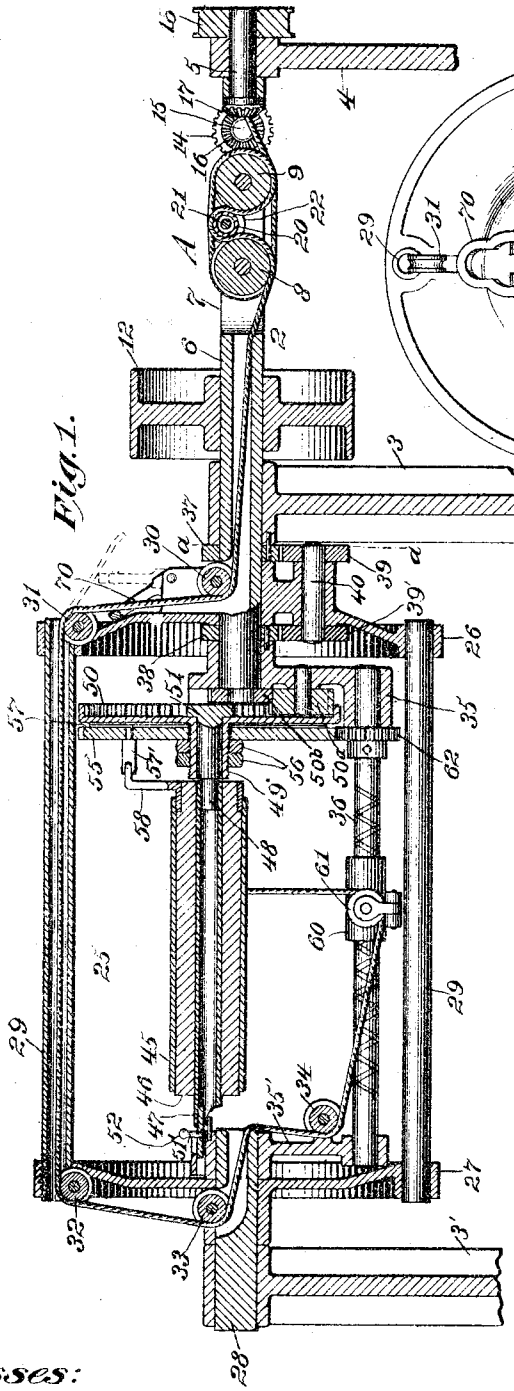

Fig. 1.

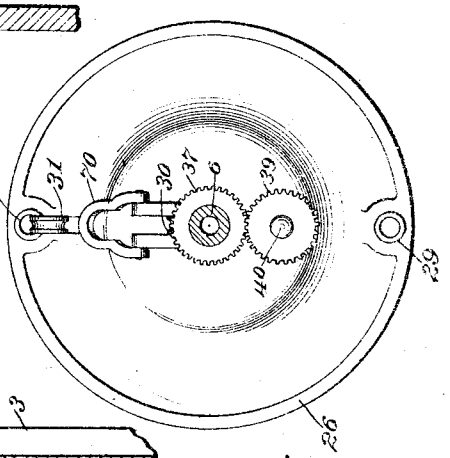

Fig. 2.

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CORD AND LOOP WINDING MACHINE.

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3 SHEETS—SHEET 2.

Fig. 3.

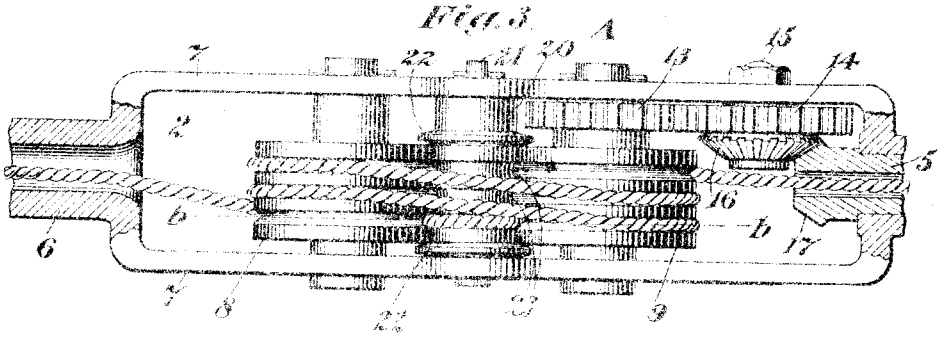


Fig. 4.

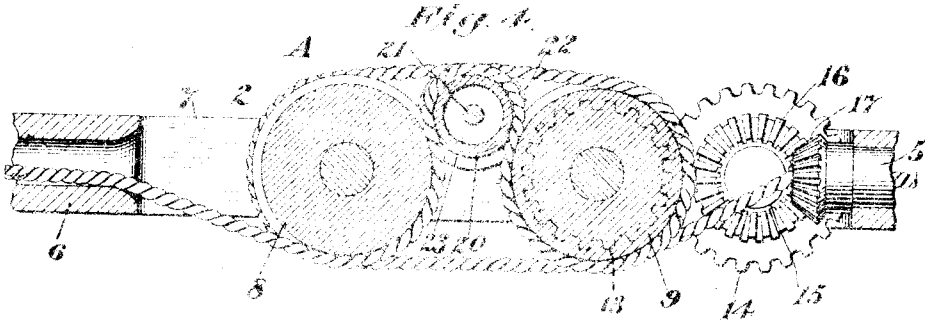
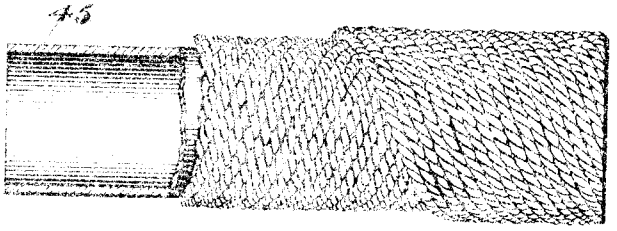


Fig. 5.



Witnesses:

[illegible]

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3 SHEETS—SHEET 3.

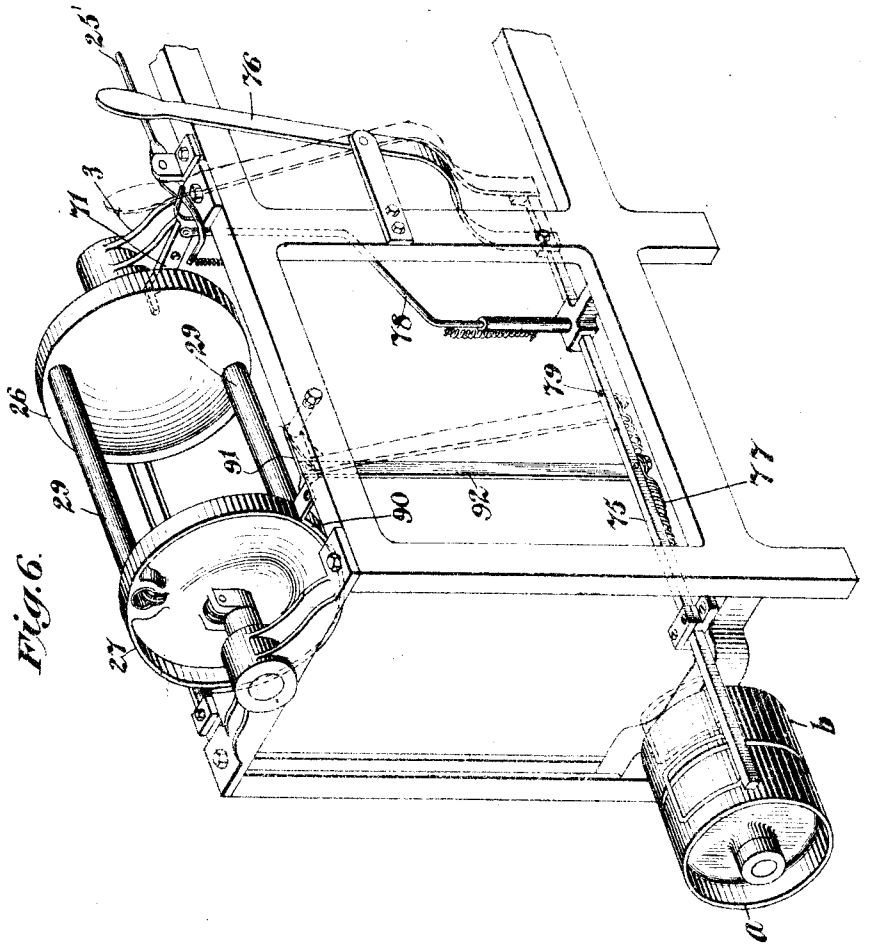

Fig. 6.

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UNITED STATES PATENT OFFICE.

THOMAS W. NORMAN, OF NEWTON, MASSACHUSETTS.

CORD AND ROPE WINDING MACHINE.

1,031,366. Specification of Letters Patent. Patented July 2, 1912.

Application filed February 24, 1902. Serial No. 95,153.

To all whom it may concern:

Be it known that I, THOMAS W. NORMAN, a subject of the King of Great Britain, and residing at Newton, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Cord and Rope Winding Machines, of which the following is a specification.

This invention relates to winding or take-up machines, the object of the invention being to provide an improved organization of mechanism for winding the material upon which organization is simple in construction and operation, and durable in use.

A further object of the invention is to provide an improved feeding means or pull-down for the material or product fed to the winding mechanism and which will insure equality in twist, foot for foot, in any given length of product, and also equality in the length of the strands laid up, foot for foot, in any given length of cord, twine or rope or other product.

A further object of the invention is to provide improved means whereby on the breakage of the material being wound the machine will be automatically and instantaneously stopped.

In the drawings accompanying and forming a part of this specification, Figure 1 is a longitudinal sectional view of the winding or take-up mechanism, and this improved pull-down connected therewith; Fig. 2 is a partly sectional view taken in line *a*—*a* Fig. 1; Fig. 3 is a plan view of this improved pull-down mechanism; Fig. 4 is a longitudinal sectional view thereof taken in line *b*—*b* Fig. 3; Fig. 5 is a view of a portion of a spool or drum and Fig. 6 is a perspective view of the mechanism for automatically and instantaneously stopping the machine on the breakage of the material being wound, only so much of the flier and the framework being shown as is necessary to illustrate this part of the mechanism.

Similar characters of reference indicate corresponding parts in the different figures of the drawings.

As a preface to a further description of this improved mechanism, I desire to state that the various details may be more or less modified without departing from the scope of the invention and that the improved pull-down herein shown and described may be used in connection with other machines.

In that form of pull-down shown and described in my contemporaneously pending application, Serial No. 63,799, filed June 8, 1901, now Patent No. 693,887 dated February 25, 1902, the capstans or rolls are each driven by gearing, whereby each may be considered as independently or positively driven. I have found, however, that in practice it is only necessary to drive one of these capstans or rolls by gearing, thus dispensing with a pair of gears, the other roll being rotated through its frictional contact with the rope and the bodily movable roll. Since, in the present instance, this improved pull-down is shown in operative connection with a rope or twine winding or take-up mechanism, it will be understood that when this winding or take-up mechanism receives the product from a strand or other machine the rope or other product formed from the laid together strands or from plain yarn is drawn forward by the pull-down (designated in a general way by A), which, in the preferred form thereof herein shown and described, comprises a suitable frame 2 supported for rotary movement on a pair of uprights 3, 4, of the framework, by a pair of tubular shafts 5 and 6 one carried by each of said uprights. The frame in the present instance comprises a pair of longitudinally extending members 7, connected at their ends to said shafts, the shaft 6 being shown as forming a part of one end of said frame, while the shaft 5 is journaled in the opposite end thereof. The rope passes through the outer shaft 5, and thence over and around the capstans or rolls of the pull-down, comprising in the present instance, a pair of rolls 8 and 9, one of which will be hereinafter termed the driven roll or capstan, and the other the driving roll or capstan) and a loosely movable roll 20. The pull-down may be rotated by any suitable connection with an active element of the machine, but in the present instance, it is rotated by a belt pulley 12 fixed to the shaft 6. Gearing could be used if preferred for imparting rotary movement to the pull-down frame.

The driving and driven rolls 9 and 8 respectively, which are shown in the present instance as grooved, are journaled transversely in the frame and spaced apart, the rope engaging the grooves during its passage over and around such rolls. In practice the depth of the seats of the grooves is less than their width, so that the rope will project beyond the peripheries of the cap-

stans. Motion is imparted to the driving roll or capstan 9 by means of a pair of spur-gears 13 and 14, one carried by the roll or capstan and the other carried by a stub-shaft 15 mounted in one of the members of the pull-down frame. This stub-shaft also carries a beveled-gear 16 meshing with a similar beveled-gear 17, fixed to or formed on the end of the tubular shaft 5 journaled in the upright 4 and to which tubular shaft motion is imparted by any suitable means, such for instance, as a belt pulley 18 mounted on the end thereof, and by means of which the desired speed or pull-down force is given to the capstans, the driven capstan being rotated by its frictional engagement with the bodily shiftable roll and the rope. Motion may be imparted to the pulley 18 by a belt (not shown) in engagement with a pulley (not shown) carried by the driving shaft, (not shown) which at its opposite end carries the fast and loose pulleys *a* and *b*. The speed of rotation of the pulley 18 relative to that of the pulley 12 is such that the product is taken up by the flier substantially as fast as it is passed through the pull-down by the pulley 12. During the travel of the rope around the capstans, the pull-down frame is rotated to twist such rope in the manner just described, so that during the twisting of the rope the desired pull-down force is given thereto to regulate the number of twists per foot in the finished product. To obtain an accurate bearing or grip of the rope on the capstans, there is located between them a bodily movable roll 20, and the rope or line by straddling this roll 20 is carried nearly around the capstans causing a greater grip on the same. This roll is shown as a hollow cylinder and is mounted loosely, that is, with sufficient clearance on a fixed shaft 21 extending across the frame 2, to enable the roll to properly perform its work, or, if preferred, this shaft could be loosely mounted in the members of frame 2, thereby allowing the roll to have a gripping effect on the cord or rope as it is drawn around the capstans, and also allowing said roll to be pushed away from the capstans when a lump or knot in the rope passes. By forming the loose roll hollow it is lightened and the force of centrifugal action is reduced. The roll is preferably sufficiently small relatively to the capstans so that the cord or rope which passes partly around the capstans and straddles this roll will under draft cause the roll to become wedged between the capstans and bear hard upon the cord or rope, and in order to secure a superior wedging effect, at least one-half of the roll, when regarded as divided diametrically, should be included within the space bounded by the peripheries of the capstans, a plane embracing the axes of the latter, and a plane tangential to their peripheries. By so proportioning and organizing the capstans and rolls as to secure this relation, a wedging effect is produced which resists draft upon the rope, such wedging effect being obviously superior to a simple pinching of the rope. This improved pull-down, and that illustrated in my contemporaneously pending application hereinbefore referred to, is believed to accomplish what has never before been accomplished in rope making machinery, namely, the absolutely accurate registering of the twisted strand or rope, that is, the uniform pulling down of exactly the same extent of twisted rope for every repetition of a specified number of rotations of the pull-down capstans, and for every corresponding number of twisting rotations. This is of the utmost importance since it insures absolute uniformity in the product as to number of twists per unit of length, as to length of measurement governed by known time and machine elements and as to character and weight. Obviously a pull-down operating with such accuracy as does the present one insures unvarying effects in the treatment of the strands preparatory to their reception at the pull-down mechanism both prior to and including the twisting together of the strands. Furthermore, an important point to be noted is that the accurate registry in the operation of this pull-down device, does not at all depend upon the forward draft of the rope,—that is, a draft in the direction of the take-up mechanism; the pull-down would continue to operate, accurately registering, if there were no such forward draft whatever on the rope; hence a take-up mechanism employed in connection with this pull-down is merely required to perform the simple functions that its name implies, namely, caring for the finished product as it arrives: so that the additional function heretofore required of the take-up mechanism, namely, the exertion of a force to maintain a powerful forward draft on the rope as it emerges from the pull-down, is entirely eliminated.

The grooves in the capstans or rolls which receive the rope as it passes around such capstans, control and guide the rope so as to maintain it in proper position on the capstans, while at the same time the character of the grooves insures the projection of the rope for the engagement therewith of the bodily movable roll. The central or bodily movable roll 20, in the present instance, is shown provided with guide-flanges 22 at the outer sides of the pull-down rolls or capstans, and is also shown provided with grooves 23 which prevent the flattening of the rope. The rope is preferably doubled in the pull-down, that is, brought back and passed a second time around the capstans and thence over the bodily movable roll,

from which it passes to the bore of the twisting shaft 6, from which it is fed forward to the winding or take-up mechanism.

The winding or take-up mechanism, in the present instance, comprises a suitable flier 25 comprising a pair of heads 26 and 27, one fixed to the twisting shaft 6 and the other fixed to a shaft 28 mounted in an upright 8'. These heads are connected adjacent to their peripheries by tubular members 29 which may be formed in various ways if desired.

Carried by the head 26 in a cut-away portion thereof is a guide-roll 30 for the rope as it is fed through the shaft 6 and to the ends of one of the hollow tubes and to guide-rolls 21 and [illegible] around which the rope passes, a similar roll [illegible] being located in a cut-away portion of the head 27 and adjacent to its shaft 28 for guiding the rope which passes through the bore of this shaft 28 to another guide-roll 21 carried by a depending arm about to be referred to.

Depending from the inner ends of the shafts 6 and 28 is a pair of arms 35 and 35' forming a cradle. These arms are connected by a screw or worm shaft 36 for the purpose hereinafter described, and also by rods not shown. To prevent rotation of this cradle with the flier, planet gearing is provided, one of which gears 37 is mounted on the shaft 6 and is fixed to the upright 8 by a suitable [illegible], a similar gear 38 being fastened to the hub of the depending arm 35. These gears mesh with a pair of planet gears or pinions [illegible] and 39' mounted on a shaft 40 carried by the hub of the flier. By this organization it will be seen that the gear fixed to the upright 8 being [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] being [illegible] [illegible] the depending arm [illegible] will be [illegible] [illegible] as the pinions carried by the flier swing [illegible] [illegible] [illegible] the axis of rotation.

The [illegible] [illegible] upon which the rope or cord is wound [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] upon a core 49 which is slightly tapered to facilitate the removal of such tube. This core is detachable [illegible] spindle [illegible] one end of which receives the reduced end [illegible] of the bracket 51. The other end of the spindle is supported by a projection carried by the hub of the depending arm 35' and is maintained in position by a bolt 51' having a finger-piece 52 mounted in a slot of such hub. On shifting the bolt the core and its spindle can be removed to enable the spool to be slipped therefrom. To impart rotary movement to this drum or spool so as to take up or wind the rope or cord an internal gear 49 is mounted loosely upon the bracket 51 bolted to the hub of the depending arm 35 and motion is imparted thereto by a gear 50ᵃ mounted on a stub shaft carried by an arm of the cradle and which gear is rotated by a gear 50' fixed to the end of the shaft 6. This internal gear has loosely mounted upon its hub 49 a toothed friction disk 55 maintained thereon by a pair of nuts 56, turned on a threaded portion of such hub 49, and by means of such nuts any desired adjustment and degree of frictional contact may be obtained with the disk or disks 57 interposed between the internal gear and such toothed friction disk 55. Carried by this geared disk is a dog 57' engaging an arm 58 secured to the core or barrel of the spool or drum, and by means of which rotary movement is given to such drum, the connection being such that the barrel may be readily connected and disconnected from its driving means. By this organization a take-up mechanism is provided which winds the rope upon the spool only as fast as it is twisted and released from the pull-down, while at the same time the rope is maintained at a uniform tension and is wound tightly upon the spool.

Mounted on the worm shaft 36 for reciprocation is a carriage 60 to which is pivoted for swinging movement a sheave or guide-roll 61 for the rope or cord. By hinging this sheave to the carriage it can follow the direction or angle of the rope as the spool fills up, that is to say, as the spool increases in diameter this roll will be thrown farther and farther away from the carriage so as to maintain a proper angle of the rope at all times relative to the spool. For imparting movement to this shaft so as to feed the carriage from end to end thereof a spur gear 62 is shown fixed thereto in position to mesh with the teeth of the geared friction disk 55. This geared friction disk 55 should have its number of teeth slightly less than a multiple of the number of teeth on the small gear 62; for instance if the small gear has twenty-five teeth, the large gear should have about forty-nine or seventy-four or ninety-nine teeth which is one less than double or triple or quadruple the number of teeth. This will cause the cord on the drum or spool to lie side by side. The ratio will depend upon the width of the rope. In the present instance these gears are shown as about one to four, hence while one turn of rope is being fed around the barrel by one revolution of the large gear 55, the carriage will travel approximately four turns of the worm shaft sidewise, and this will continue the same until the full layer is made. The difference in the size of the two gears 55 and 62, together with the inclination of the threads of the worm shaft, will determine the angle of the cord being wound with relation to the axis of the drum or spool.

From the foregoing organization it will be seen that the movement of the worm shaft, and therefore of the carriage, is determined by the rope being wound as it is taken up on its drum so that the rope may be wound on the drum without flanges at the ends thereof, as shown in Fig. 5, that is to say, it may be wound in the form of crossed helices in a similar manner to that shown and described in the patent to Wardwell, Reissue No. 11,856 dated September 18, 1900. From this it will be seen that by the improved mechanism shown and described a cop wound in the manner just stated may be obtained.

During the operation of the machine the rope is twisted as it passes through the shaft 5 to the pull-down capstans, from thence it passes through the bore of the shaft 6 around the guide-rolls 30 and 31 to the flier tube, through such tube to the guide-rolls 32 and 33 and through the shaft 28 to the guide-roll 34, and from thence to the carriage, around the sheave 61 from which the rope passes to the drum. Another twist is given to the rope at a point intermediate the rolls 33 and 34 and this twist will be a second twist.

In order to stop the machine instantaneously on the breakage of the rope or cord, I provide an improved mechanism, one part of which comprises a shiftable member shown in the form of a yoke 70 pivoted to the hub of the flier head 26, and normally held down against the head by the engagement of the rope with the free end thereof as it passes from the guide-roll 30 to the roll 31. Should the rope or cord break this shiftable member will swing out by centrifugal force and carry its free end into position to engage a projection or finger 71 pivoted on the upright 3 and which finger controls the shifting of the belt from the fast pulley to the loose pulley and the braking of the flier.

A suitable belt shifting mechanism is mounted on the frame-work and comprises a belt shifter 75 actuated by a suitable hand lever 76 to shift the driving belt from the loose pulley *a* to the fast pulley *b*, it being automatically returned by a suitable spring 77 to shift the belt back from the fast pulley to the loose pulley. For maintaining the belt shifter in its shifted position and against the action of its spring, a suitable spring actuated bolt is provided comprising a rod 78 adapted to project into an opening 79 in the belt shifter. This rod is connected at its upper end with the pivoted finger or projection 71 which as hereinbefore stated is in position to intercept the yoke when it is thrown out by centrifugal force on the breakage of the cord. From the foregoing it will be seen that the belt shifter having been shifted to carry the belt to the fast pulley and locked in such position, should the rope or cord break, the yoke, by centrifugal force, will be thrown outward and engage the finger 71, move it downward and so raise the bolt from the belt shifter, whereupon the spring will throw such shifter, which will move the belt from the fast to the loose pulley, the transmission of power to the winding mechanism being thus intercepted. The finger 71 may also be shifted by a suitable hand lever 25′ pivoted on the machine and normally held in its inoperative position by a spring.

While the mechanism just described will interfere with the transmission of power to the winding mechanism, it is desirable that such winding mechanism be instantaneously stopped on the breakage of the cord or rope, and for this purpose a suitable brake is provided comprising a brake band 90 in position to engage the periphery of one of the heads, as the head 27 of the flier. This band 90 is connected by a pivoted arm 91 and lever 92 with the belt shifter 75 in such manner that when the belt is shifted to the fast pulley the friction band will be held out of engagement with the head, but when the bolt has been withdrawn from the opening in the belt shifter by the engagement of the yoke with the finger, the return of the belt shifter under the action of its spring will throw the brake band 90 into engagement with the head and stop the rotary movement of the flier substantially instantaneously.

It is to be understood that this winding mechanism may be used for other purposes than winding rope or cord, and therefore such term "rope" or "cord" as used herein and in the claims, is to be interpreted to include any article capable of being wound with this organization of mechanism.

Having thus described my invention, I claim—

1. In a rope or cord winding machine, the combination with a rotary take-up flier, of means for stopping said flier, and comprising a brake engaging the periphery of said flier, and means for throwing said brake into operation on the breakage of the cord or rope and including a centrifugally operated device carried by and rotatable with the flier and controlled by the cord or rope.

2. In a rope or cord winding machine, the combination with a rotary take-up flier having a head, of a brake band for engaging the under face of the periphery of said head, means for moving said band upward to engage said head on the breakage of the cord or rope, and including a centrifugally operated device carried by and rotatable with said flier and controlled by the cord or rope.

3. In a rope or cord winding machine, the combination with a rotary take-up flier, of means for transmitting power thereto including a fast and a loose pulley, belt shifting mechanism, means for maintaining the

belt shifting mechanism with its belt in engagement with the fast pulley, a brake connected with said belt shifting mechanism for engaging and stopping the flier, means including a centrifugally operated device carried by and rotatable with said flier and operative on the breakage of the rope or cord to release the maintaining means, thereby to permit the shifting of the belt onto the loose pulley.

4. The combination with a rotary take-up flier having a head, of means for rotating said flier including a fast and a loose pulley, a spring actuated belt shifting rod maintained in one position by its spring, a lever for manually shifting said rod into position to carry the belt from the loose to the fast pulley, a brake band for engaging the periphery of said flier and connected with said rod and maintained out of engagement with the flier head when the belt is in engagement with the fast pulley, a locking device for maintaining said belt-shifting rod in position with its belt in engagement with the fast pulley, and centrifugally operated means carried by and rotatable with the flier and thrown into operation on the breakage of the cord to operate said locking device and release the belt shifting mechanism and permit the belt to be shifted on to the loose pulley and simultaneously throw the brake into engagement with the head and stop the flier.

5. The combination with a rotary take-up flier having a head, of means for rotating said flier, including a fast and a loose pulley, a spring actuated belt shifting rod maintained in one position by its spring, a lever for manually shifting said rod into position to carry the belt from the loose to the fast pulley, a brake band for engaging the periphery of said flier and connected with said rod and maintained out of engagement with the flier head when the belt is in engagement with the fast pulley, a locking device for maintaining said belt shifting rod in position with its belt in engagement with the fast pulley, means for manually releasing the locking device, and centrifugally operated means carried by and rotatable with the flier and thrown into operation on the breakage of the rope or cord to operate said locking device and release the belt shifting rod and permit the belt to be shifted onto the loose pulley and simultaneously throw the brake into engagement with the head and stop the flier.

6. In a rope or cord winding machine, the combination with frame work, of a rotary take-up flier having a head, means for rotating said flier and including a fast and a loose pulley, a spring actuated belt shifting rod, a lever for throwing said rod in one direction, its spring throwing it in the opposite direction, a locking bolt engaging said rod to maintain it in that position in which it is shifted by said lever, a pivoted latch adjacent to one of the heads of said flier, a centrifugally operated device carried by and rotatable with said flier head and maintained in its normal position by the cord and effective on the breakage of said cord to swing into a position to operate said latch and release the bolt, an arm pivoted to said frame a brake band connected thereto, and a lever connecting said arm and belt shifting rod, whereby on the release of the latter by the bolt, the band will engage said head and stop the flier.

7. The combination with a rotary flier, of a spool or drum located therein, a cradle within said flier, means for positively preventing the rotation of the cradle comprising planetary gearing, a reciprocating carriage mounted on said cradle for locating the cord or rope on the drum, means for reciprocating said carriage, and a swinging guide carried by the reciprocating carriage.

8. The combination with a flier, of a spool or drum located within said flier, means for positively preventing the rotation of said cradle comprising planetary gearing, a double worm shaft mounted on said cradle, a reciprocating carriage on said shaft for locating the cord or rope on the drum, means for rotating said shaft to reciprocate the carriage, and a swinging guide hinged to said carriage at the outer side of the axis of said shaft.

9. The combination with a flier carrying a spool or drum, of a cradle located within the periphery of said flier; means for maintaining said cradle stationary a reciprocating carriage carried by said cradle for locating the cord or rope on the drum and also disposed within the periphery of said flier; a swinging guide carried by said carriage; and means for reciprocating said carriage; said means comprising a friction disk having gear-teeth on its periphery and gearing and a worm shaft driven thereby.

10. The combination with a rotary flier, of a drum or spool located therein, means for rotating the same, embodying a friction disk having teeth on its periphery; a reciprocatory carriage for locating the rope on said drum, a worm shaft on which said carriage is mounted, a gear on said shaft in mesh with said toothed friction disk for rotating the shaft, said disk and gear having an approximate multiple of teeth whereby the rope is wound upon the drum in cross helices.

11. A combined twisting and balling mechanism effective to twist and to wind in crossed helices, comprising in combination in a single structure a single rotary take-up flier, a drum or spool located therein, means for rotating said drum and including a gear, a reciprocatory carriage for locating the

rope or cord on said drum, means for reciprocating said carriage including a pair of gears in which the number of teeth on the larger gear is slightly less than a multiple of the number of teeth on the smaller gear, the organization being effective to wind the rope upon the drum is crossed helices.

12. A combined twisting and balling mechanism effective to twist and wind in crossed helices, comprising in combination in one single structure a single rotary take-up flier, a drum or spool located therein, a reciprocatory carriage for locating the rope on said drum, and a pair of gears for reciprocating said carriage in which the number of teeth on the larger gear is slightly less than the multiple of the number of teeth on the smaller gear.

13. The combination with a rotary flier and its shaft of a friction disk having internal gear teeth mounted within said flier; a cradle supported within said flier; a gear carried by said cradle and in mesh with the teeth of said friction disk; a gear carried by the flier shaft and in mesh with said cradle gear for imparting motion to the friction disk; a drum within said flier; friction means intermediate said drum and friction disk gear for imparting motion to said drum; a reciprocating carriage supported by said cradle; and means for imparting motion thereto, and including gearing one member thereof comprising a part of said friction means and having external gear teeth.

14. The combination with a rotary flier, of a stationary cradle supported thereby; a drum supported within said flier; a reciprocating carriage supported by said cradle; and means for rotating said drum and reciprocating said carriage and comprising friction disks, one having external gear teeth constituting the driver for the carriage and the other having internal gear teeth.

15. The combination with a rotary flier, of a stationary cradle supported therein; a worm shaft carried by said cradle; a reciprocating carriage mounted on said shaft; a rotary drum supported within said flier; means for rotating said shaft and drum and comprising friction disks, one having external gear teeth coöperating with a gear connected with said shaft, said gear and friction disk having an approximate multiple of teeth whereby the cord is wound upon the drum in cross helices, and the other friction disk having internal gear teeth and receiving motion from said flier.

16. The combination with a rotary flier, of a drum supported within the same; a cradle likewise supported within said flier; a worm shaft supported by said cradle; a reciprocating carriage mounted on said shaft; means for imparting motion to said drum and to said carriage, and embodying friction disks one having external teeth meshing with a gear connected with said shaft, said friction disk and gear having an approximate multiple of teeth whereby the cord or rope is laid on the drum in crossed helices.

17. The combination with a rotary flier carrying a drum or spool, of means for rotating said drum and embodying a friction disk having teeth on its exterior; a stationary cradle; means for maintaining said cradle stationary; a reciprocating carriage carried by said cradle for laying the rope on said drum; a worm shaft on which said carriage is mounted; and a gear fixed to said shaft and meshing with the teeth of said friction disk for rotating said shaft.

18. The combination with a rotary flier carrying a spool or drum, of means for rotating said spool or drum and comprising a positively driven driving friction member and a second driven friction member; a cradle located within said flier; means for holding said cradle stationary; a worm shaft carried by said cradle and having a member in engagement with said second driven friction member and by means of which motion is imparted to said shaft; and a rope or cord carriage mounted on said shaft and provided with a movable rope or cord guide.

19. The combination with a flier, of means for rotating the same; a drum or spool carried by the flier; means for rotating the same and comprising a positively driven friction member and a second driven friction member having gear teeth on its periphery; a worm shaft supported interiorly of the flier and carrying a gear in engagement with the teeth of said second driven friction member and by means of which said shaft is rotated; a carriage mounted on said shaft and provided with a swinging guide for the cord or rope; said driven friction member and shaft gear having an approximate multiple of teeth relatively to each other.

20. A combined twisting and balling mechanism effective to twist and to wind in crossed helices, comprising in combination in one single structure a single rotary take-up flier, a drum or spool located therein, and mechanism, including a laying on means for the drum, coöperating with said flier and drum whereby the cord or rope is twisted and as fast as it is twisted is wound up on the drum in crossed helices, means for driving the laying on means comprising a pair of gears in which the number of teeth on the larger gear is slightly less than a multiple of the number of teeth on the smaller gear.

21. A pull-down comprising a pair of

driven capstans spaced apart, and only one of which is positively driven; and a loosely mounted intermediate roll at least one diametrical half of which is included between a plane embracing the axes of the two capstans and a plane tangential to the peripheries of both of the latter, whereby a rope passing between each capstan and the loose roll and straddling the latter, will under draft be wedged between the peripheries of the capstans and roll, the latter being free to move bodily in and out.

22. A pull-down comprising a pair of capstans spaced apart, and encircled by grooves of greater width than the depth of their seats, and one only of which capstans is positively driven; and a loosely mounted intermediate roll, the rope passing between each capstan and the loose roll and straddling the latter while engaged with the grooves of the capstans, whereby under draft it will be gripped between the latter and the loose roll.

23. A pull-down comprising a rotary twisting head or frame and driving means therefor; a pair of driven capstans mounted transversely in said frame and spaced apart and one only of which is positively driven; and a loosely placed roll between the two capstans, lightened to reduce force of centrifugal action, the rope or cord passing between each capstan and the loose roll and straddling the latter.

24. A pull-down comprising a pair of rotary capstans or rolls spaced apart, and an intermediate roll mounted for bodily movement in or out between the two capstans or rolls and having rope grooves, the rope or strand passing between each capstan and the bodily movable roll and straddling the latter.

25. A pull-down comprising a pair of rotary capstans or rolls spaced apart, and an intermediate roll mounted for bodily movement in or out between the two capstans or rolls and having guiding flanges, the rope or strand passing between each capstan and the bodily movable roll and straddling the latter.

26. A pull-down comprising a pair of rotary capstans or rolls spaced apart, and an intermediate roll mounted for bodily movement in or out between the two capstans or rolls and having rope grooves and guiding flanges, the rope or strand passing between the capstans and the bodily movable roll and straddling the latter.

27. A pull-down comprising a pair of rotary capstans or rolls spaced apart and having rope grooves, and an intermediate roll mounted for bodily movement in and out between the two capstans or rolls and also having rope grooves, the rope or strand passing between each capstan and the bodily movable roll and straddling the latter.

28. A pull-down comprising a pair of rotary capstans or rolls spaced apart and having rope grooves of greater width than the depth of their seats, and an intermediate roll mounted for bodily movement in or out between the two capstans or rolls and also having grooves and provided with guide flanges, the rope or strand passing between each capstan and the bodily movable roll and straddling the latter.

29. A pull-down comprising a pair of rotary capstans or rolls, spaced apart, one only carrying a gear, an intermediate roll mounted for bodily movement in and out between the two capstans or rolls, and driving gearing in mesh with said capstan gear, the rope or strand passing between each capstan and the bodily movable roll and straddling the latter.

30. A pull-down comprising a pair of rotary capstans or rolls spaced apart, gearing for driving one of said rolls, the other being driven by friction, and an intermediate roll mounted for bodily movement in and out between the two capstans or rolls, the rope or strand passing between each capstan and the bodily movable roll and straddling the latter.

31. A pull-down structure for rope or strand making machines, the same comprising a plurality of capstans or rolls spaced apart, a part only being positively driven and an intermediate roll mounted for bodily movement in or out between the two capstans or rolls, the rope or strand passing between each capstan and the bodily movable roll and straddling the latter.

32. A pull-down structure for rope or strand making machines, the same comprising a pair of capstans or rolls spaced apart and one only of which is positively driven, and an intermediate roll mounted for bodily movement in or out between the two capstans or rolls the rope or strand passing between each capstan and the bodily movable roll and straddling the latter.

33. A combined twisting and balling mechanism effective to twist and to wind in crossed helices, comprising in combination in one single structure a single rotary take-up flier, a drum or spool located therein, and mechanism, including laying on means for the drum, stationary with relation to said drum and located within the flier and cooperating with said flier and drum whereby the cord or rope is twisted and as fast as it is twisted is wound up on the drum in crossed helices, means for driving the laying on means comprising a pair of gears in which the number of teeth on the larger gear is slightly less than a multiple of the number of teeth on the smaller gear.

34. A combined twisting and balling mechanism effective to twist and to wind in crossed helices, comprising in combination

in one single structure a rotary take-up flier, a drum or spool located therein, a cradle also located within said flier and below said drum, means for positively preventing the rotation of said cradle, and mechanism, including laying on means, carried by said cradle, coöperating with said flier and drum whereby during each revolution of the flier the rope or cord is twisted and as fast as it is twisted is wound on the drum in crossed helices, means for driving the laying on means comprising a pair of gears in which the number of teeth on the larger gear is slightly less than a multiple of the number of teeth on the smaller gear.

35. A combined twisting and balling mechanism effective to twist and to wind in crossed helices, comprising in combination in one single structure a single rotary take-up flier, means for rotating the same, a spool or drum located within said flier, and mechanism, including a cradle and laying on means for the drum, coöperating with said flier and drum and effective to wind the cord or rope upon such drum in crossed helices, means for driving the laying on means comprising a pair of gears in which the number of teeth on the larger gear is slightly less than a multiple of the number of teeth on the smaller gear.

36. A combined twisting and balling mechanism effective to twist and to wind in crossed helices, comprising in combination in one single structure a single rotary take-up flier, means for rotating the same, a spool or drum located within said flier, and mechanism also located within said flier, and including a cradle and laying on means, cooperating with said flier and drum and effective to wind the cord or rope upon such drum in crossed helices, means for driving the laying on means comprising a pair of gears in which the number of teeth on the larger gear is slightly less than a multiple of the number of teeth on the smaller gear.

37. The combination of a rotary flier carrying a spool or drum, of means for rotating said spool or drum, of a reciprocating carriage embodying a hinged and swinging cord guide, said drum rotating means comprised of a positively driven friction member and a second driven friction member, a cradle located within said flier, means for holding said cradle stationary, and actuating means in engagement with said second friction member whereby a reciprocating motion is imparted to said carriage.

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