No. 693,887. Patented Feb. 25, 1902.

T. W. NORMAN.

CORD OR ROPE MACHINE.

(Application filed Nov. 4, 1895. Renewed June 8, 1901.)

(No Model.) 2 Sheets—Sheet 1.

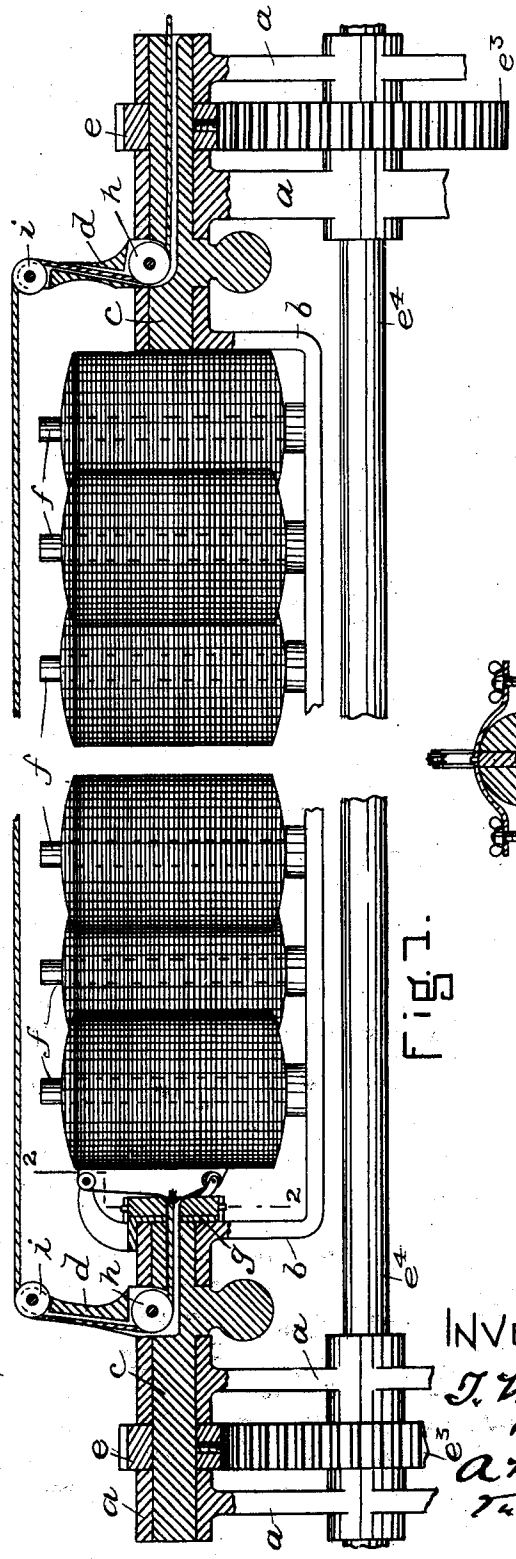

Fig. 1.

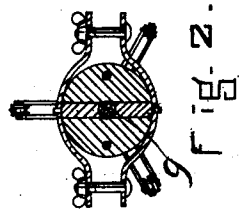

Fig. 2.

WITNESSES.

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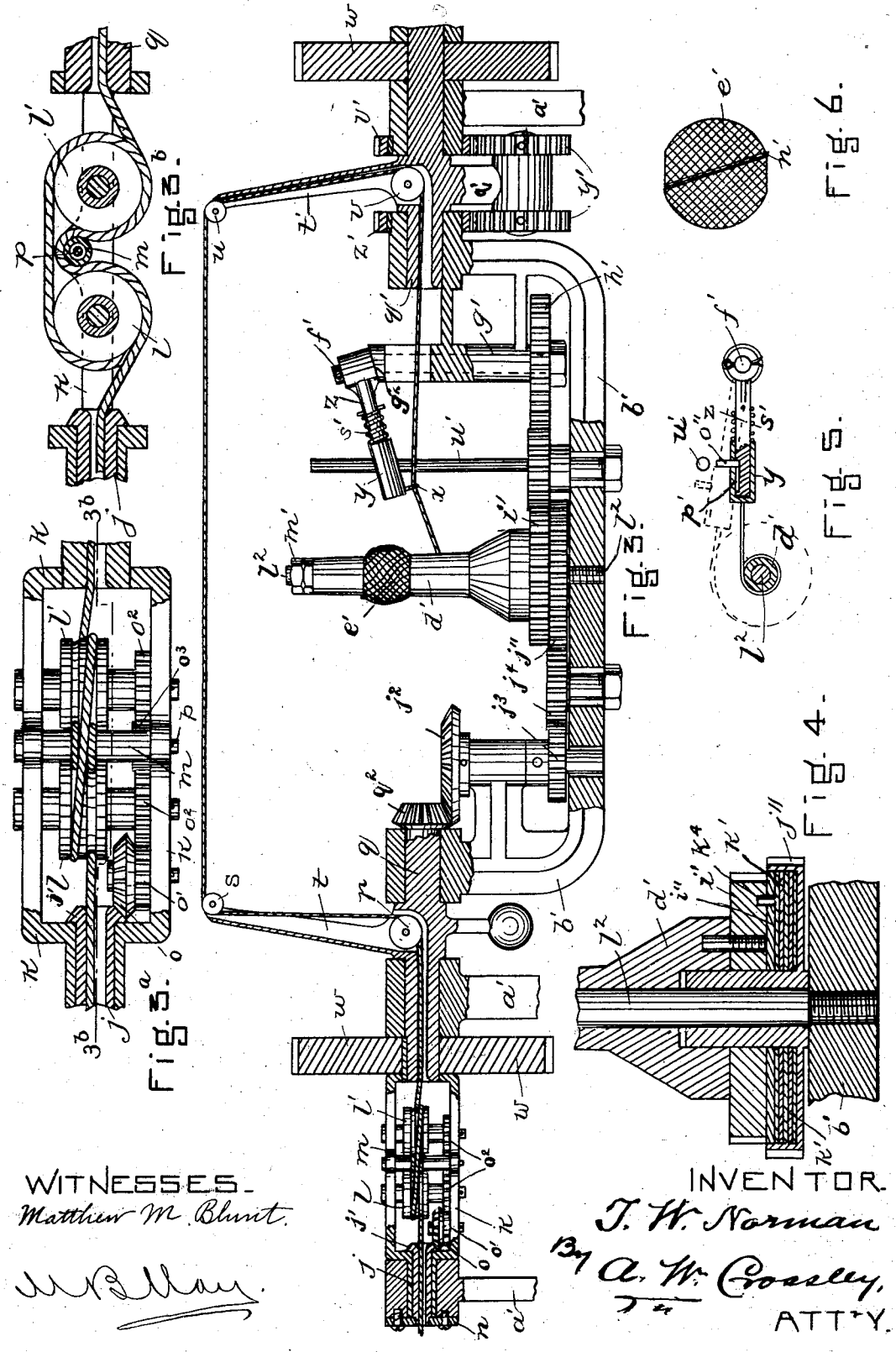

Fig. 3.

Fig. 3a.

Fig. 6.

Fig. 5.

Fig. 4.

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UNITED STATES PATENT OFFICE.

THOMAS W. NORMAN, OF BOSTON, MASSACHUSETTS.

CORD OR ROPE MACHINE.

SPECIFICATION forming part of Letters Patent No. 693,887, dated February 25, 1902.

Application filed November 4, 1895. Renewed June 8, 1901. Serial No. 63,799. (No model.)

To all whom it may concern:

Be it known that I, THOMAS W. NORMAN, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Cord or Rope Machines, of which the following is a specification.

This invention has relation to machines for manufacturing cords, lines, twines, ropes, and similar articles; and it is the purpose of the invention, generally stated, to provide improvements in several parts or groups of parts of the machines mentioned with a view to rendering them completely practicable and more efficient than heretofore.

Specific objects of the invention may be set forth as follows: first, to provide such improvements in machines employed in the art before specified as will simplify the means for carrying the strand, cord, or rope through flier mechanism to effect the twist in the material, eliminating flier structure extending from end to end of the mechanism, thereby also facilitating access to the holders of the material under treatment and their appurtenances and, furthermore, removing an element of danger; second, to provide improved means whereby accuracy may be secured in the operation of the means for feeding forward or pulling down the material or product being twisted or otherwise acted upon, so as to insure equality in twist foot for foot in any given length of product, as also equality in length of the strands laid up foot for foot in any given length of cord, line, or rope; third, to provide improved means for balling or bundling the product of the machine, so that it shall be in convenient condition to be dealt with in ordinary commercial or business transactions, and, fourth, to provide improved means for frictionally controlling the winding or spooling devices, so as to automatically differentiate the speed of rotation of the spindle as the ball or spool grows in diameter, thereby insuring uniformity in the winding.

Of the drawings which accompany and form part of this specification, Figure 1 is a sectional side elevation of that part of a machine for making cords, lines, or ropes which effects the preliminary work—*i. e.*, that of forming the yarn into strands—and between which part of the machine and the part for effecting the final operations my improved pull-down operates. Fig. 2 is a sectional detail view taken on the line 2 2 of Fig. 1. Fig. 3 is a sectional side elevation of that part of the machine which effects the final operations. Fig. 3^a is a sectional detail view, drawn to an enlarged scale, showing my improved "capstan" or "pull-down" mechanism for drawing off and feeding forward the product, said mechanism being also shown at the extreme left of Fig. 3. Fig. 3^b is a sectional view taken on the line 3^b 3^b of Fig. 3^a and drawn to the same scale. Fig. 4 is a sectional detail view, drawn to an enlarged scale, illustrating one form of my improved frictional means for controlling the winding on or spooling of the completed article. Fig. 5 is a sectional detail view in plan, illustrating my improved method and means for balling or bundling the product of the machine. Fig 6 is a side elevation of a ball of cord or rope, showing my improved method of winding on the binding courses.

In practice I have applied my invention herein described to different forms of machines used in the art recited at the outset of this specification, and in adapting certain of the improvements to different forms of machines I have found it desirable to change the arrangement and relationship of some of the parts, without, however, departing from the nature or spirit of the invention embodied therein. A clear understanding may be had of the invention, however, by a description of it as applied to one form of a cord, twine, or line making machine, in which the product is wound into a ball, and to this the description hereinafter given will be for the most part confined.

In the drawings the reference-letter *a*, Fig. 1, designates so much of a suitable supporting-frame as it is deemed necessary to show; *b*, a cradle hung upon the ends of rotary twisting-shafts *c c*, supported in suitable bearings on the frame *a* at opposite ends of the cradle *b*, and *d d* arms suitably counterbalanced and connected with and extending out from the twisting-shafts *c c*. The outer ends of the said arms are made entirely free of any connecting device or mechanism, so that in "making ready," as well as in the operation of the machine, entire freedom of access may

be had to the parts. *e e* are gears fixed to said shafts *c c* and rotated in unison by driving-gears e^3 e^3 on a shaft e^4.

The cradle *b* is provided with a number of upright spindles *f* for the reception of spools of thread, yarn, strands, or other material to be twisted into a line, cord, or rope and may be maintained in position to hold the spindles upright by gravity. The yarns or strands are led from the spools and suitably guided to a laying-head, tension device, and forming-tube *g*, attached to cradle *b* and shown in cross-section in Fig. 2, where by the rotation of the arms *d* the yarns are laid up and twisted into a cord, line, or rope, which passes into a guiding-hole formed in the inner end of the shaft *c* at the left in Fig. 1 and extending longitudinally of said shaft to a guide pulley or sheave *h*, said cord passing about the said pulley and to a similar pulley *i* on the outer end of an arm *d* and thence forward to similar guide pulleys or sheaves *i h*, similarly positioned in the arm at the opposite end of the cradle. From the last-mentioned pulleys the line extends through a longitudinal guide-hole in the twisting-shaft *c* at this end of the cradle and is led from the outer end of the latter to a tube *j*, (see Fig. 3,) where the strands are laid into a rope. Said tube is fastened in a frame *a'* by means of a washer *n* and is embraced by one trunnion or bearing of the pull-down frame *k*, the rope passing through the tube and thence over and around the capstans and roller of the pull-down. The latter may be revolved through any suitable connections with an active element of the machine, such as the adjacent shaft *c* or the main driving-shaft, (not shown;) but I have found it desirable to connect the pull-down frame *k* to the twisting-shaft *q*, having gear *w*, whereby rotation is given to the same. A pair of circumferentially-grooved capstans *l* and *l'* are journaled in the frame *k* transversely thereof and spaced apart, and the rope engages the grooves in passing over and around these capstans; but it is to be noted that the depth of the seats of the grooves is less than their width, so that the rope will project beyond the peripheries of the capstans. By means of a bevel-gear *j'* on the inner end of tube *j*, an intermeshing bevel-gear *o* on a stud in frame *k*, a spur-gear *o'*, compounded with bevel-gear *o*, spur-gears o^2 o^2 on the capstan-journals, and an intermediate gear o^3 the capstans *l l'* are rotated on their own axes to give any desired speed or pull-down force to the said capstans as the line or rope is being twisted by shafts *c c*, Fig. 1, and shafts *q q*, Fig. 3, thereby regulating the number of twists per foot in the finished product. To secure an accurate bearing or "grip" of the rope on capstans *l* and *l'*, I place between them a loose roller *m*, and the rope or line by straddling this loose roller is carried nearly around the capstans *l l'*, causing a greater grip on the same. The roller *m* is mounted loosely on a shaft *p*, extending across the frame *k*, (see Figs. 3^a and 3^b,) or, if preferred, said shaft could be loosely mounted in its bearings, thereby allowing the roller to have a gripping effect on the cord as it is drawn around the capstans *l l'* and also allowing the said roller to be pushed away from the capstans when a lump or knot in the rope passes. The hollow form of the roller, furthermore, lightens the same, reducing force of centrifugal action, which might otherwise impair the binding effect of the loose roller. The roller *m* is preferably sufficiently small relatively to the capstans to bring its utmost outward-projecting surface when viewed from the end within the utmost similarly-projecting surfaces of the capstans when viewed from the same point, so that the cord or rope may after engaging one capstan, straddling the loose roller, and engaging the other capstan pass back to the first capstan without touching the roller in its passage thereover. Again, it is desirable that the roller should be small in order that the cord or rope passed partially about the capstans and over the roller may under draft cause the roller to become wedged in between the capstans and bear hard upon the cord or rope. In order to secure this wedging effect, at least one-half of the roller 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 or arranging the capstans and roller as to secure this relation a wedging effect is produced which resists a draft upon the rope, such wedging effect being obviously superior to a simple pinching of the rope. This form of pull-down is believed to accomplish what has never before been accomplished in rope-making by machinery—viz., the absolutely accurate registering of the twisted strand or rope—*i. e.*, 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 revolutions. 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 measurement governed by known time and dimensions of machine elements, and as to character and weight. Obviously a pull-down operating with such accuracy as does mine insures unvarying effects in the treatment of the strands preparatory to their reception at the pull-down structure 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 my pull-down device does not at all depend upon a forward draft on the rope—*i. e.*, 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 mech-

anism employed in conjunction with my form of pull-down is merely required to perform the simple functions that its name implies—viz., caring for the finished rope as it arrives—the additional function heretofore required of the take-up mechanism—viz., the exertion of a force to maintain a powerful forward draft on the rope as it emerges from the pull-down—being entirely eliminated.

The grooves which receive the rope that passes around the 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 projection of the rope for the engagement therewith of the loose roller. The rope is preferably doubled in the pull-down, or, in other words, brought back to pass a second time through the same, and then it enters a guide-hole formed longitudinally in the twisting-shaft q and is fed forward to the completing and take-up or balling part of the machine, the said shaft being supported in suitable bearings on the frame a'. From a guide-pulley r in a recess of the shaft q at the end of the said guide-hole the rope passes to a pulley s at the outer end of an arm t, projecting laterally from said shaft. Thence the rope extends across to a guide-pulley u on the outer end of a similar arm t', projecting radially from a shaft q', companion to shaft q, and thence to a pulley v in a recess of the shaft q'. Thence the cord or rope is guided inward through this shaft to a balling device arranged and operated on a cradle b', supported between the twisting-shafts $q\,q'$, journaling on the inner ends thereof. The twisting-shafts $q\,q'$ are rotated by gears $w\,w$, which may be driven similarly to gears $e^3\,e^3$ on the shaft e^4, Fig. 1.

The product in process of balling being suspended in cradle b', the rope passes or is revolved entirely around the balling means and a double twist is given the rope in each revolution around the cradle.

The rope proceeding from the inner end of the twisting-shaft q', as shown in Fig. 3, passes through a guide-eye x on the end of the extensible part y of a telescopic guide and laying finger z to a revoluble spool of cop d', where it is laid up or wound into a ball e'. The finger z is journaled on an inclined pin or pintle f', the same being an angular projection of a vertical shaft (represented by dotted lines) and the latter being revoluble in suitable bearings g' on the cradle b' and compounded with a gear-wheel h' at its base. The boss of the finger seats upon an inclined shoulder g^2 of the shaft, and it will be seen that as the shaft and its angular pintle f' are revolved the finger z will be raised and lowered in unison therewith. The gear h' is connected by an "idler-gear" to gear-wheel i' on the base of cop d', and said gear h' may have, say, one tooth less than gear i', so that the pintle will be rotated and the guide-finger operated to lay each round of the cord or rope on the ball alongside of the preceding round and not one round on top of the other, as might be the tendency if the gears i' and h' had the same number of teeth and were operated in the same time. It will be understood that the guide-finger is reciprocated up and down at each revolution of the cop d', and each traverse exceeds in extent that necessary to carry the rope from one end of the ball to the other. This operation is necessary to effect balling of the product. By varying the size of or number of the teeth on the gears h' and i' the balling means can be suited for work upon varying sizes of rope.

By the means described a perfect ball can be formed on the spindle d', which ball can be stripped or taken off and be in most acceptable condition for commercial use, transportation, and storage.

When the winding or formation of a ball has been so far completed as to prepare it for the outer or binding courses, the finger z will be lengthened, so as to increase its throw and lay the binding courses (shown at n' in Fig. 6) on the ball, such binding courses extending over the ends from top to bottom and at a different angle to the regular courses, (represented by the lines e',) crossing each other substantially at right angles. This lengthening of the guiding and laying finger may be accomplished automatically or by hand, the finger being made extensible for that purpose.

Various forms of means may be provided for rendering the guiding and laying finger extensible, that herein shown consisting of a tube or sleeve y, arranged to move, turn, as well as slide on the guide-finger z, the guiding-eye x on the finger being located on the extensible part. The sleeve y is held normally back or in retracted position by a bayonet lock or joint, a pin o'', secured in the sleeve y, extending at its inner end into a slot p', formed on the body of the finger z, said slot having an angular part (not shown) into which the pin is turned or forced to hold the sleeve back against the tension of the spring s', bearing thereon. When the binding courses are to be laid on the ball, the pin o'' will be moved out of the angular part of the slot by the turning of the sleeve and the latter will be pressed forward by the spring s' to the position shown by dotted lines in Fig. 5, when the result described will be effected by reason of the increased throw of the finger.

As a means of rendering the finger automatically extensible I may provide a standard or rod u' on the cradle b', extending upward to a position where when the ball is made sufficiently large (see Fig. 5) the outer end of the pin o'' will strike the top of the standard or rod u' and be thrown out of the angular part of the slot, the extension of the finger being then effected by the spring.

The cop d' is pinned to or otherwise rotatively connected at its base with the gear-wheel i', the latter being rotatively connected with a friction-disk i'' just below it, as is best

seen in Fig. 4. The gear-wheel and its disk are frictionally connected with a gear-wheel j'', which is made cup-shaped, so that it may hold oil or any other suitable lubricating substance. In the cup-shaped part of the gear-wheel j'' and around its hub I place a plurality of metallic or other friction-disks or saw-plates k', superposed one upon another and surrounded by the friction-disk i'' of the gear-wheel i'. A bevel-gear q^2 on the inner end of the twisting-shaft q meshes with a bevel-gear j^2 on the upper end of a shaft supported in a bearing on the cradle b' and carrying at its lower end a spur-gear j^3, connected through an idler j^4 with the friction-gear j'', the gears being so timed that cop d' through its frictional gear i' is operated with a tendency to wind up the rope at a speed slightly ahead of the quantity fed forward by the capstans l l'. The gearing is so proportioned also as to greatly reduce the speed of rotation of the cop as compared with the speed of rotation of the flier-arms.

The cop d' and adjuncts at its base are shown as turning on a spindle l^2, the upper end of which is screw-threaded and provided with a nut or thumb-screw m', adapted to be turned down on the top of the cop d', and so cause the latter to be adjusted to the necessary resistance upon its frictional base k'.

It will be seen that as the rope or cord is fed to cop d' at a slower speed than the cop is geared to take it up the friction-disks k' between gears i' and j'' will be slightly operated upon; but as the cop becomes filled and its circumference increases the speed of the rope passing around capstans l l' does not increase. Hence cop d' and gear i' must slow down in speed. This I provide for in the frictional mechanism contrived by me between the gears i' and j'', it being understood from an inspection of Fig. 4 of the drawings that the former gear is driven from the latter solely through the frictional medium. It will be understood that the increased leverage of the cord attendant upon the increase in diameter of the ball increases the resistance to turning of the bobbin, and not only does this result in a slowing down of speed of the bobbin, but the cord is more tightly wound as the ball enlarges, which is desirable in order that a marketable product may be insured.

The resistance to the turning of the gear i' from the gear j'' offered by the superposed disks k' between the said gears (which disks are independent of any positive connection with the said gears) arises not only from friction between the disks, but apparently from suction due to the presence of a copious supply of liquid lubricating substance in the dish-shaped gear j'' as well. The function or mode of operation of the friction mechanism mentioned has in actual practice and experiment been found to be such that an adjustment of the nut m' on the spindle l^2 to secure the desired friction or resistance to movement between the disks at the start in winding a ball, bobbin, cop, or spool will answer the purpose throughout the performance of said work. Furthermore, a friction means of the kind described for all the work that is required of it will not generate heat to an objectionable degree, it being understood that a suitable liquid lubricant will, as before stated, be introduced freely to the surface of the disks. In actual practice with the means and under the circumstances mentioned there is in effect an increase of frictional and suctional resistance between the superposed plates in a ratio corresponding with the slowing down of the speed of the cop d'. This is an important feature of the invention. This friction device has been found by me from practical experience to be highly serviceable and efficient in spooling or bundling rope as well as in balling and spooling twine and other lines, and I do not therefore confine this part of my invention to the particular use herein shown as made of it, but may employ it wherever and in whatever connections and forms I may find it desirable.

The cradle b' may, as before stated with reference to cradle b, be maintained in proper position by gravity, or means may be employed, such as shown in Fig. 3, wherein a gear v' is shown as mounted upon the frame or other stationary part of the machine concentric with shaft q, and a gear z' of the same size and concentricity is mounted upon the cradle, and the shaft has an arm q'' with a bearing at the end for a counter-shaft carrying gears y' in mesh with gears v' and z', respectively, the said gears being uniform in size. This construction and arrangement of parts will obviously secure the maintenance of the cradle b' in a stationary position.

By my invention I do away entirely with flier structure extending from end to end of the twisting mechanism and secure the greatest degree of simplicity in the construction and mode of operation of the twisting means. I secure a maximum degree of twisting, a double twist being put into each revolution of the arms d d, and, the same result ensuing in each revolution of the arms t t', I economize space. The balling and binding of the ball is effected in a novel, simple, and most efficient manner. The tension on the product as it is being wound is secured by highly serviceable means, which do not become heated in use and are automatically regulated, and in general the entire machine is enhanced in points of simplicity, durability, and efficiency.

I claim—

1. A cord and rope making machine embodying in its construction a hanging cradle and means therein for taking up and supporting the product of the machine, revoluble arms free of connecting means between their ends, the cradle being provided with hollow journals at its ends upon which journals it is supported, the said cord and rope being adapted to be passed through the said hollow journals in opposite directions to the take-up

means, means for revolving the arms in unison, and means carried by said arms for guiding the material acted upon, whereby the latter is carried around the cradle and given a double twist at each revolution of the arms, while the cradle is held in fixed position.

2. A means for balling the product in a cord or rope making machine, embodying in its construction a rotary cop or bobbin, a rotary shaft provided with an inclined pin or pintle, a yarn-guiding finger pivoted at one end upon the inclined pin or pintle, and having its other end free of support or guiding means and provided with a guide-eye, and moreover extended into proximity to the revoluble cop or bobbin, whereby the material led to the cop may be guided thereon in the form of a ball and the lateral movements of the free end of the finger be controlled in accordance with the size or diameter of the ball, substantially as hereinafter set forth.

3. A means for balling the product in a cord or rope making machine, embodying in its construction a rotary cop or bobbin, a rotary shaft provided with an inclined pin or pintle, a yarn-guiding finger pivoted at one end upon the inclined pin or pintle, and having its other end free of support or guiding means and provided with a guide-eye, and moreover extended into proximity to the revoluble cop or bobbin, combined with means for rotating the said cop and shaft, the one slightly out of time with the other to effect the laying of the different layers of cord or rope on different lines on the ball formed on the cop.

4. A cord or rope making machine embodying in its construction a revoluble cop or bobbin and a pivoted vibratory extensible spring-pressed reciprocating finger for guiding the product to be wound or balled upon the cop.

5. A friction device for controlling the tension of winding on, in cord or rope making machines, consisting of a cup-shaped driving means, a plurality of superposed disks or plates arranged in the same, a driven device positively connected with the top or covering plate, and through the latter and the said plurality of superposed disks or plates frictionally connected with the said driving means.

6. A friction device for cord and rope making machines consisting of the driving member and the driven member, combined with a plurality of disks or plates superposed between said members and means for maintaining a lubricant in connection with said members or disks.

7. A pull-down for cord and rope making machines comprising in its construction two rotary capstans *l l'* of relatively large diameter, and a roller *m* of relatively small diameter, having bodily movement, said small roller being arranged between the capstans, and with the utmost line of its projecting periphery below or within the plane of the utmost lines of the projecting peripheries of the capstans, whereby a cord or rope may be passed about the capstans, and from one to the other without coming into contact with the periphery of the roller, and the rope or cord be also passed about the capstans and roller, may draw the latter down and wedge it between the capstans.

8. A pull-down for cord and rope making machines comprising in its construction two rotary capstans *l l'* of relatively large diameter provided with circumferential grooves in their faces for receiving and guiding the rope or cord, and a roller *m* of relatively small diameter, having bodily movement, said small roller being arranged between the capstans, and with the utmost line of its projecting periphery below or within the plane of the utmost lines of the projecting peripheries of the capstans, whereby a cord or rope may be passed about the capstans, and from one to the other without coming into contact with the periphery of the roller, and the rope or cord be also passed about the capstans and roller may draw the latter down and wedge it between the capstans.

9. The combination, in a cord and rope making machine, of mechanism for effecting preliminary work on the material being operated upon and means for completing the said work, of a pull-down arranged between the said mechanism and means to pull down the work from the former and feed it forward to the latter, the said pull-down comprising in its construction two rotary capstans *l l'* of relatively large diameter, and a roller *m* of relatively small diameter, having bodily movement, said small roller being arranged between the capstans, and with the utmost line of its projecting periphery below or within the plane of the utmost lines of the projecting peripheries of the capstans, whereby a cord or rope may be passed about the capstans, and from one to the other without coming into contact with the periphery of the roller, and the rope or cord be also passed about the capstans and roller, may draw the latter down and wedge it between the capstans.

10. A pull-down structure for rope-making machines, the same comprising a pair of positively-driven capstans spaced apart, and a loosely-mounted intermediate roller 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 roller and straddling the latter will under draft be wedged between the peripheries of the capstans and roller the latter being free to move bodily in and out, substantially as described.

11. A pull-down structure for rope-making machines, the same comprising a pair of positively-driven capstans spaced apart and en-

circled by grooves of greater width than the depth of their seats, and a loosely-mounted intermediate roller, the rope passing between each capstan and the loose roller 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 roller, substantially as described.

12. A pull-down structure for rope-making machines, the same comprising a rotary twisting head or frame and driving means therefor, a pair of positively-driven capstans mounted transversely in said frame and spaced apart, and a loosely-placed roller between the two capstans lightened to reduce force of centrifugal action, the rope or strand passing between each capstan and the loose roller and straddling the latter, substantially as and for the purpose described.

13. In a machine of the character described the combination of alining twisting-shafts having central cord-passages and laterally-projecting arms equipped with cord-guides at their extremities, between which the cord extends without other supports; means for rotating the shafts and arms in unison; and a cradle hung from the twisting-shafts and equipped with cord-holding means, substantially as described.

14. In a machine for balling cord the combination of a rotary spindle on which the ball is made, a vibratory cord-guide located at one side of said spindle to work longitudinally thereof, means for rotating the spindle, and means for vibrating the cord-guide timed to cause the latter to traverse back and forth during one rotation of the spindle, substantially as and for the purpose described.

15. In a machine for balling cord the combination of a rotary spindle on which the ball is made, a vibratory cord-guide located at one side of said spindle to work longitudinally thereof, means for rotating the spindle, means for vibrating the cord-guide timed to cause the latter to traverse back and forth during one rotation of the spindle, and means for increasing the traverse of the cord-guide when the ball reaches its full size, substantially as and for the purpose described.

16. In a machine for balling cord the combination of a rotary spindle on which the ball is made, a vibratory cord-guide located at one side of said spindle to work longitudinally thereof, means for rotating the spindle, means for vibrating the cord-guide timed to cause the latter to traverse back and forth during one rotation of the spindle, and means for automatically increasing the traverse of the cord-guide when the ball reaches its full size, substantially as and for the purpose described.

17. In a machine for balling cord the combination of a rotary spindle on which the ball is made, a swinging arm alongside said spindle and having a cord-guide at its free end, means for rotating the spindle and means for swinging the arm timed to produce a to-and-fro movement thereof during one rotation of the spindle, substantially as and for the purpose described.

18. In a machine for balling cord the combination of a rotary spindle on which the ball is made, an extensible swinging arm alongside said spindle and having a cord-guide at its free end, means for rotating the spindle; and means for swinging the arm timed to produce a to-and-fro movement thereof during one rotation of the spindle, substantially as and for the purpose described.

19. In a machine for balling cord the combination of a rotary spindle on which the ball is made, an extensible swinging arm alongside said spindle and having a cord-guide at its free end, means for rotating the spindle, means for swinging the arm timed to produce a to-and-fro movement thereof during one rotation of the spindle, and means for automatically extending said arm when the ball attains a predetermined size, substantially as and for the purpose described.

20. In a machine for balling cord, the combination of a rotary spindle on which the ball is made, an extensible cord-guiding arm alongside said spindle adapted to move longitudinally thereof and also laterally with respect thereto, means normally maintaining the cord-guiding arm contracted in length, and an abutment arranged to be encountered by said means upon lateral movement of the arm produced by growth of the ball, substantially as and for the purpose described.

21. In a machine for balling cord, the combination of a rotary spindle on which the ball is made, a telescopic spring-distended cord-guiding arm having means normally restraining the spring and including a laterally-projecting member, said arm being mounted to swing longitudinally of the spindle and also laterally with relation thereto; means for rotating the spindle; means for vibrating the arm longitudinally of the spindle; and an abutment for the projecting member of the arm, spring restraining means to encounter when the arm is moved laterally a predetermined extent by the increase in size of the ball.

22. In a machine of the character described, the combination of means for pulling down and supplying or feeding a rope, cord or strand to a take-up mechanism at a fixed rate of speed; a rotary spindle around which the cord is wound; a flier structure receiving the cord axially of itself from the pull-down and delivering the cord axially of itself to the spindle; a spindle-driving gear timed to turn the spindle faster than required to take up the cord; and frictional connecting means between said gear and the spindle whereby the speed of rotation of the latter will automatically comport with changing relations be-

tween the diameter of the ball and the rate of cord-supply thereto, substantially as described.

23. In a machine of the character described, the combination of means for pulling down and supplying or feeding a rope, cord or strand to a take-up mechanism at a fixed rate of speed; a rotary spindle around which the cord is wound; a flier structure receiving the cord axially of itself from the pull-down and delivering the cord axially of itself to the spindle; means for revolving the flier structure; a spindle-driving gear; speed-reducing gearing between the flier-driving means and said spindle-driving gear whereby the latter is rotated at a considerably-reduced rate of speed as compared with the speed of rotation of the flier structure; and frictional connecting means between said gear and the spindle whereby the speed of rotation of the latter will automatically comport with changing relations between the diameter of the ball and the rate of cord-supply thereto, substantially as described.

24. In a machine of the character described, the combination of means for pulling down and supplying or feeding a rope, cord or strand to a take-up mechanism at a fixed rate of speed; a rotary spindle around which the cord is wound; a flier structure receiving the cord axially of itself from the pull-down and delivering the cord axially of itself to the spindle; a spindle-driving gear timed to turn the spindle faster than required to take up the cord; frictional connecting means between said gear and the spindle whereby the speed of rotation of the latter will automatically comport with changing relations between the diameter of the ball and the rate of cord-supply thereto; and a rotary cord-guide alongside the spindle and movable longitudinally thereof, said guide being geared to the spindle directly so as to take its motion therefrom with differentiations effected through the frictional connections, substantially as described.

25. In a machine of the character described, the combination of means for pulling down and supplying or feeding a rope, cord or strand to a take-up mechanism at a fixed rate of speed; a rotary spindle around which the cord is wound; a flier structure receiving the cord axially of itself from the pull-down and delivering the cord axially of itself to the spindle; a spindle-driving gear timed to turn the spindle faster than required to take up the cord; frictional connecting means between said gear and the spindle whereby the speed of rotation of the latter will automatically comport with changing relations between the diameter of the ball and the rate of cord-supply thereto; and a rotary cord-guide alongside the spindle and movable longitudinally thereof, said guide being geared to the spindle directly so as to take its motion therefrom with differentiations effected through the frictional connections and the gearing being timed to produce to-and-fro motion of the guide during one rotation of the spindle.

26. A pull-down structure for rope or strand making machines, the same comprising a pair of positively-driven capstans or rolls, spaced apart, 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.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 21st day of October, A. D. 1895.

THOMAS W. NORMAN.

Witnesses:
ARTHUR W. CROSSLEY,
C. C. STECHER.