April 29, 1924. 1,491,805

C. D. KNOWLTON

WINDING MACHINE

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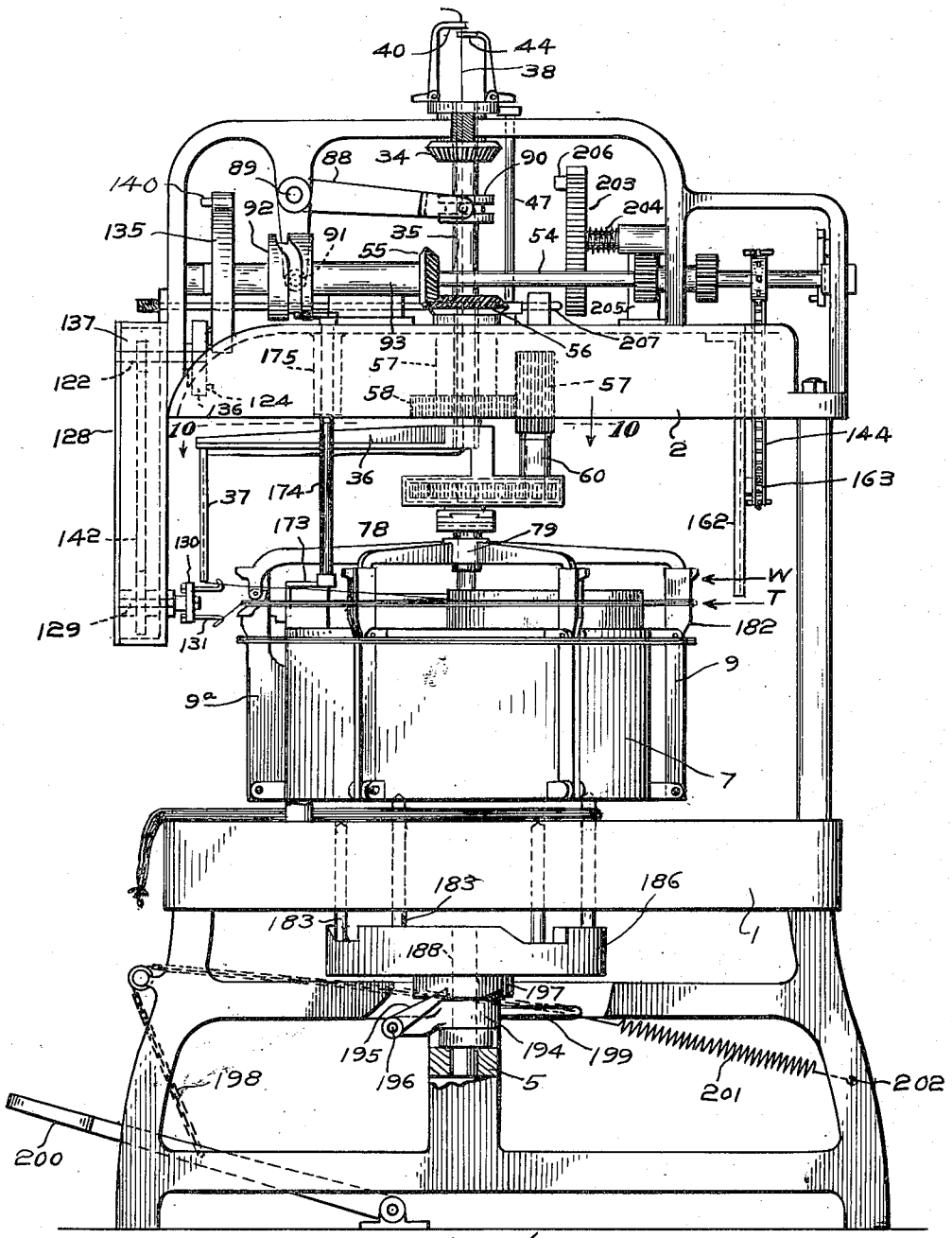


Fig. 1.

Inventor

Calvin D. Knowlton

By his Attorney

Nelson M. Howard

April 29, 1924.

1,491,805

C. D. KNOWLTON

WINDING MACHINE

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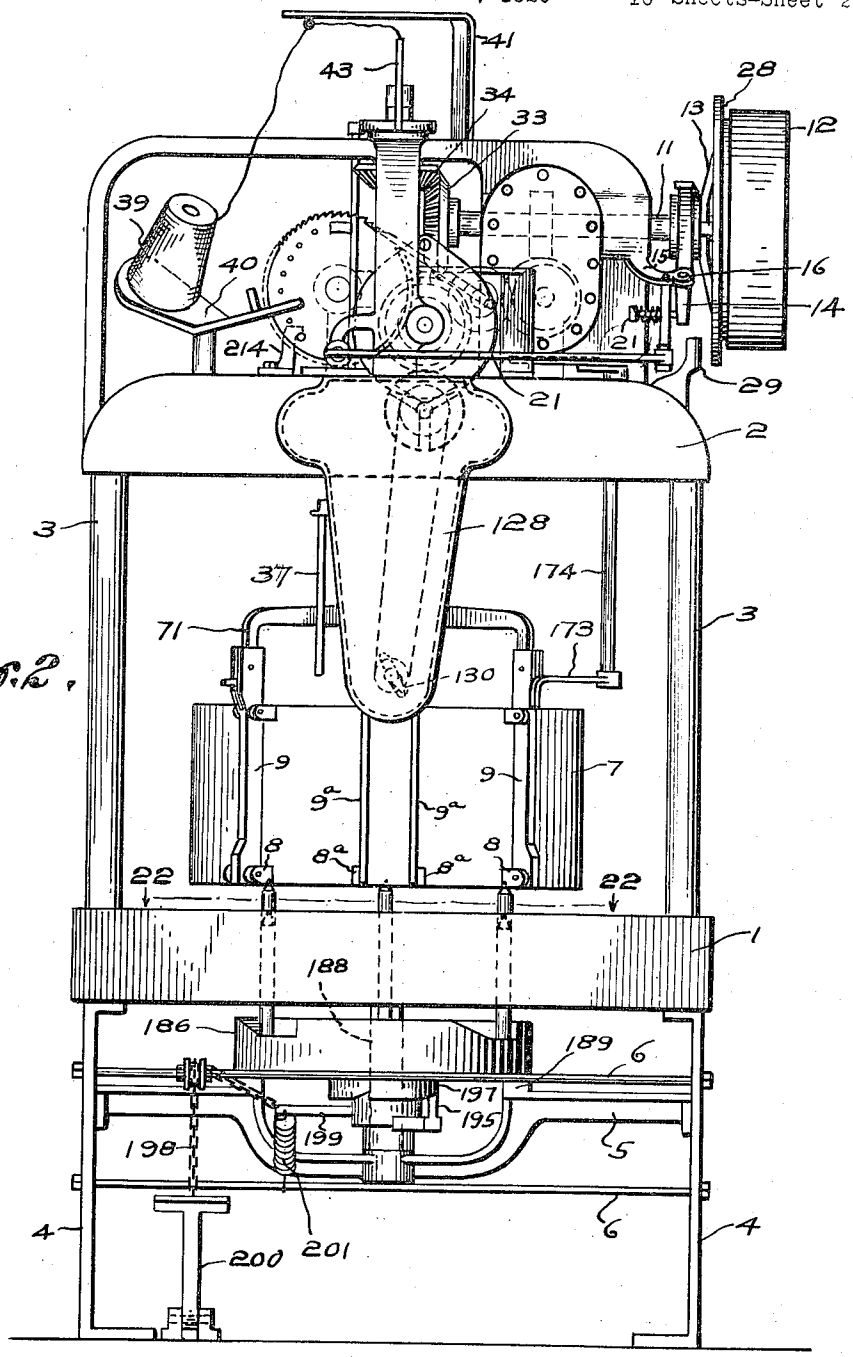


Fig. 2.

Inventor

Castler D. Knowlton

By his Attorney

Nelson W. Howard

April 29, 1924. 1,491,805

C. D. KNOWLTON

WINDING MACHINE

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Fig. 3.

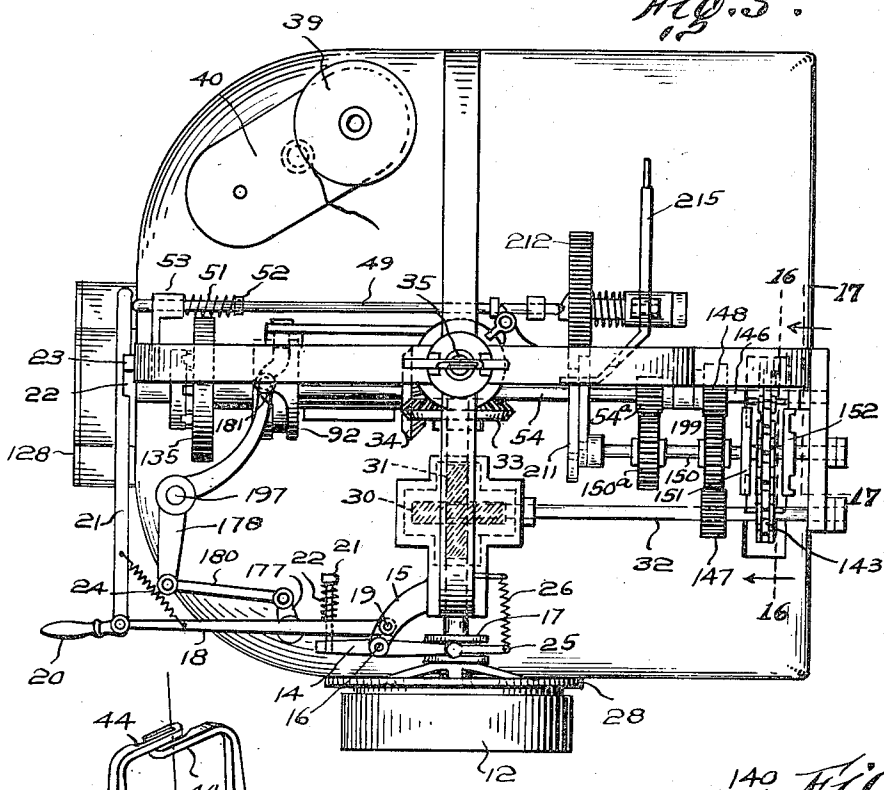


Fig. 4.

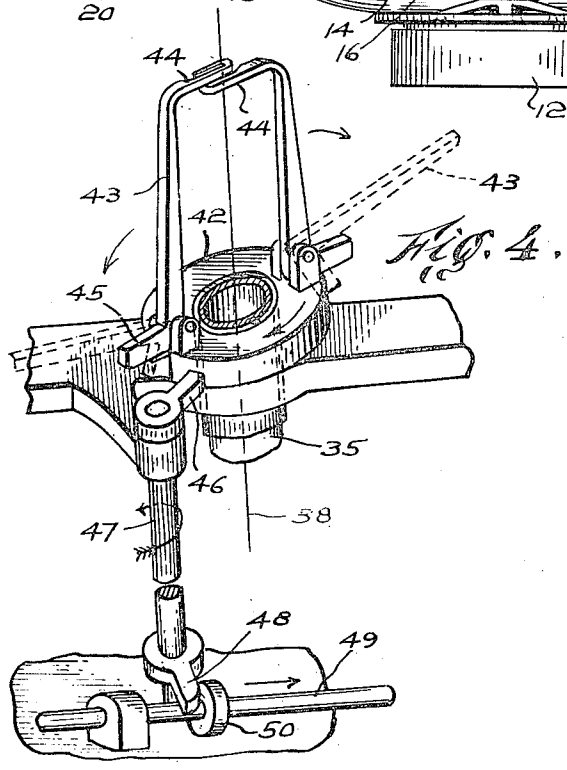
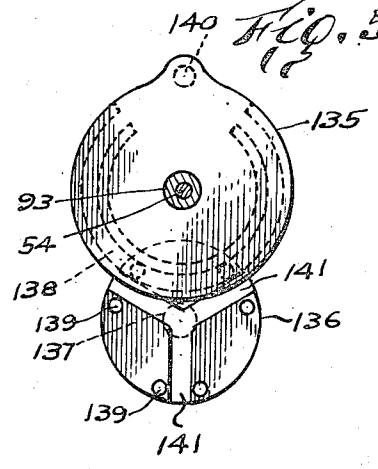


Fig. 5.



Inventor

Carlton D. Knowlton

By his Attorney

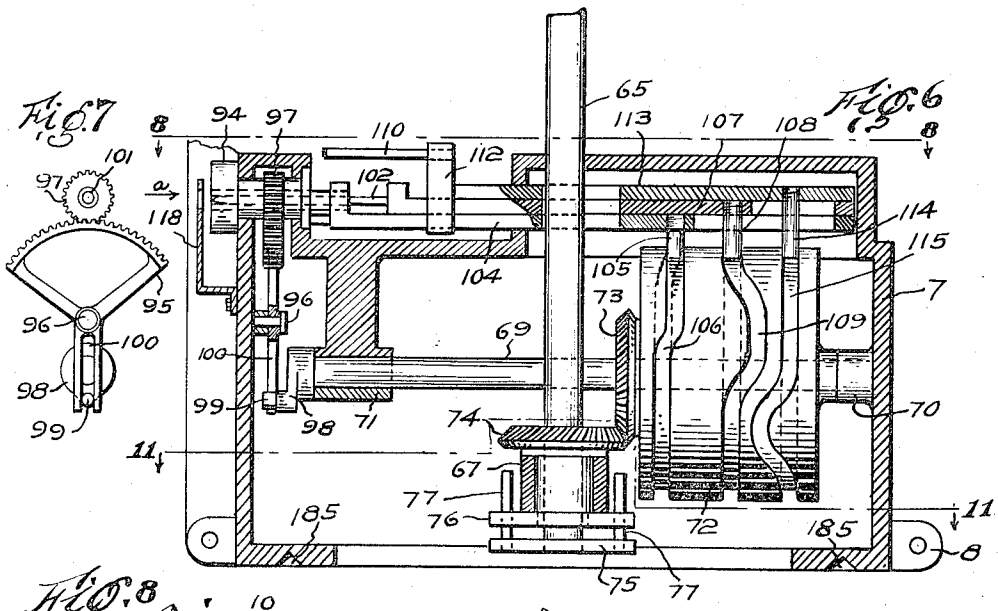
Nelson W. Howard

April 29, 1924. 1,491,805

C. D. KNOWLTON

WINDING MACHINE

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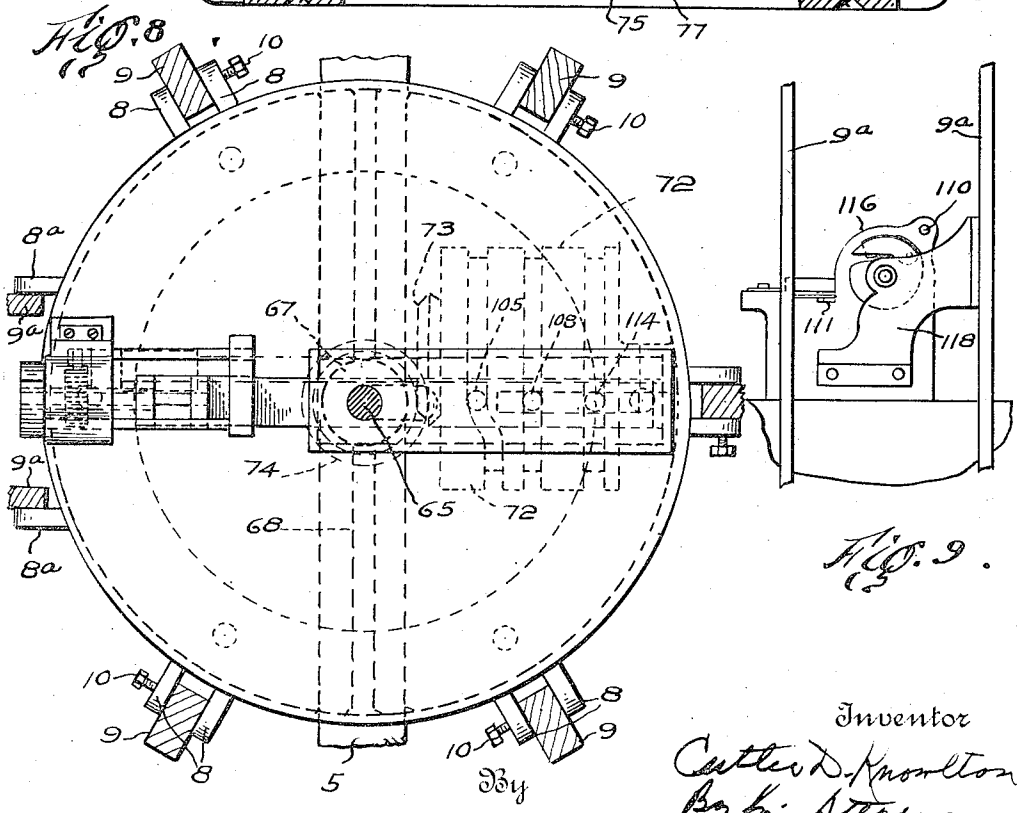


Fig. 9.

Inventor
Castles D. Knowlton
By his Attorney
Robert M. Thomas

April 29, 1924. 1,491,805

C. D. KNOWLTON

WINDING MACHINE

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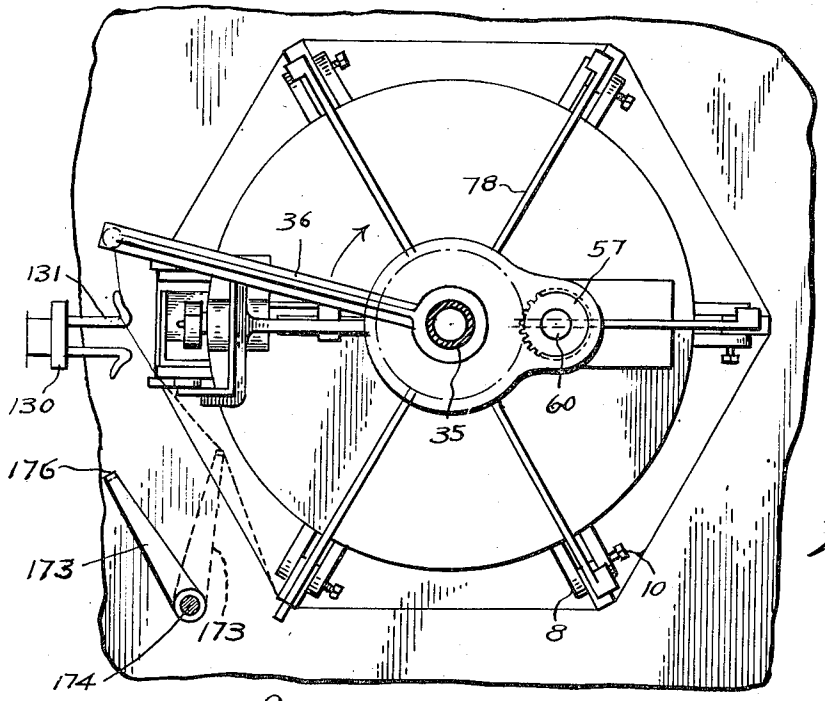


Fig. 10.

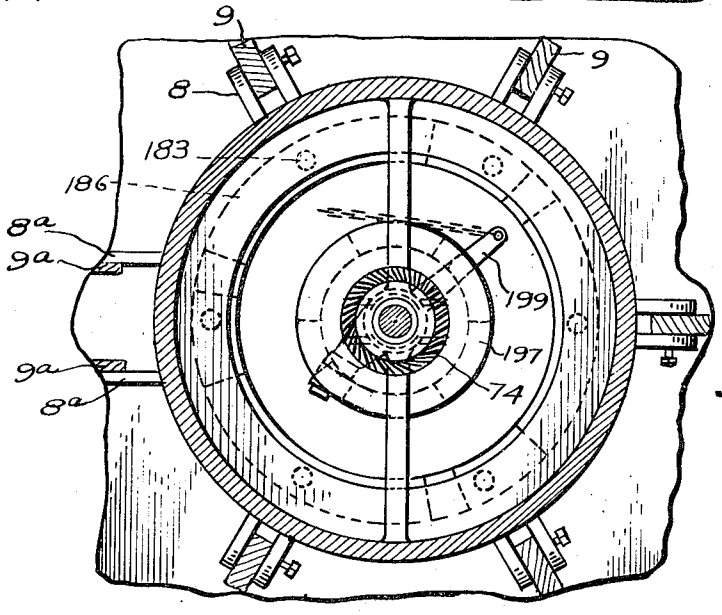


Fig. 11.

Inventor

Cutler D. Knowlton

By his Attorney,

Nelson W. Howard

April 29, 1924. 1,491,805

C. D. KNOWLTON

WINDING MACHINE

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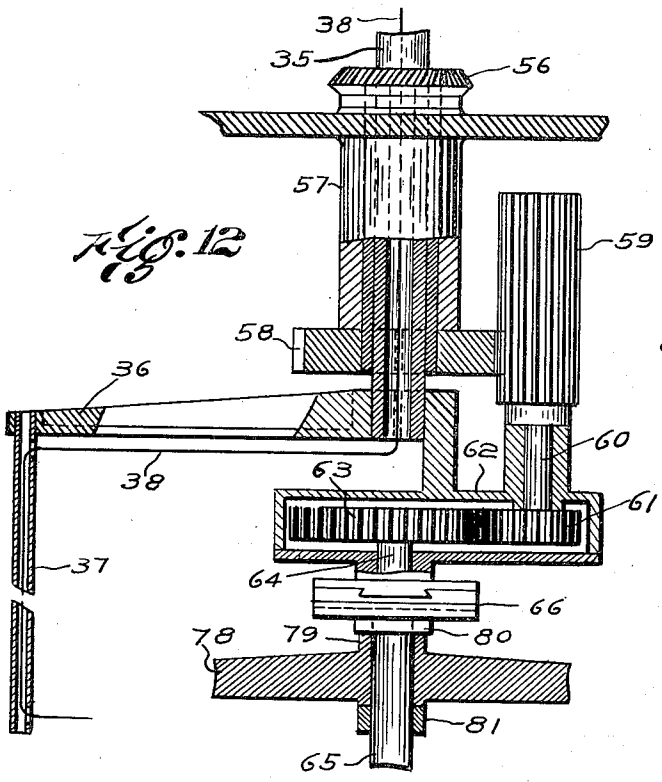


Fig. 12.

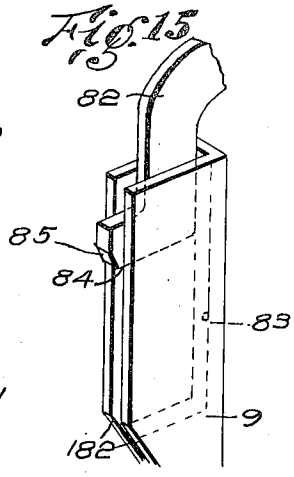


Fig. 15

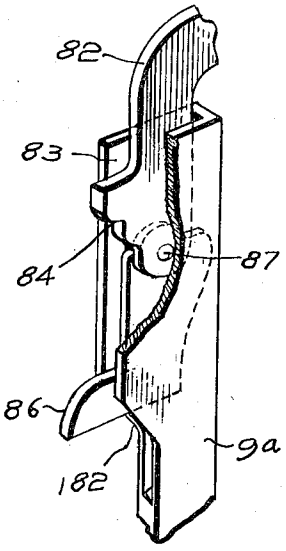


Fig. 14.

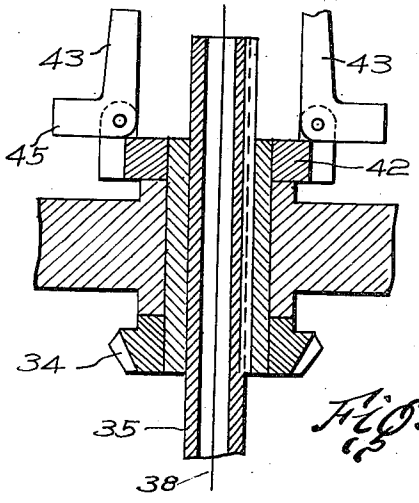


Fig. 13.

Inventor

Carter D. Knowlton

By his Attorney

Nelson M. Howard

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C. D. KNOWLTON

WINDING MACHINE

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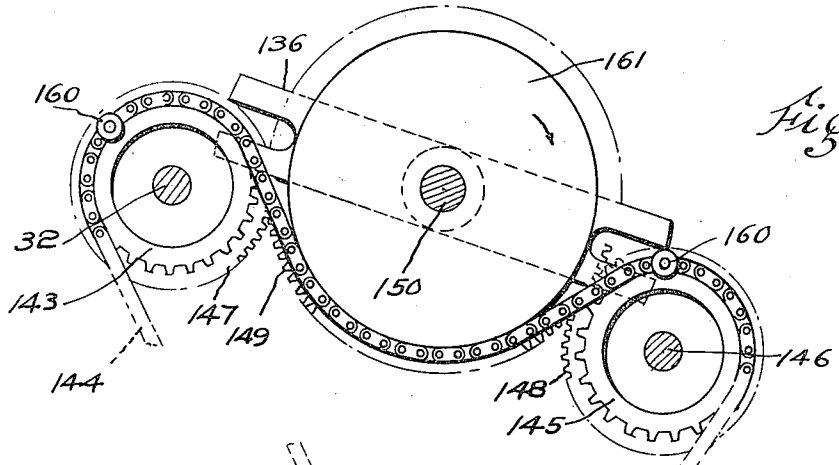


Fig. 16

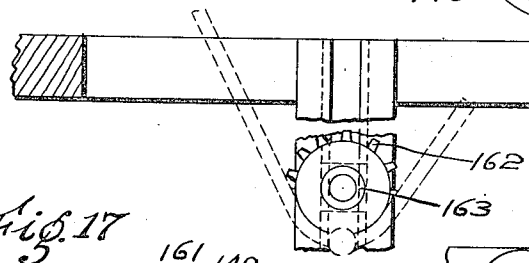
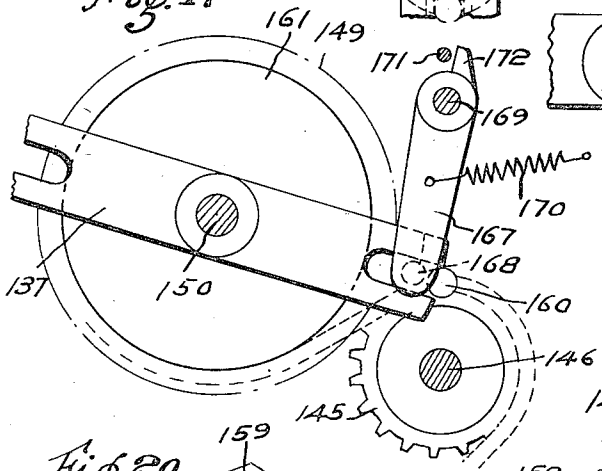


Fig. 17



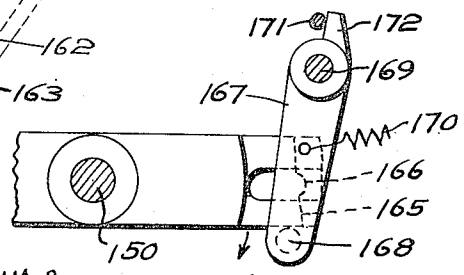


Fig. 18

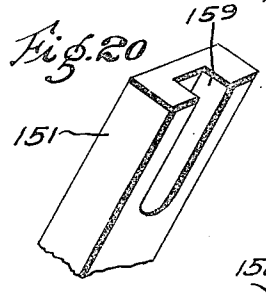


Fig. 20

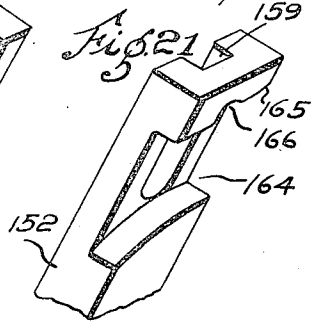


Fig. 21

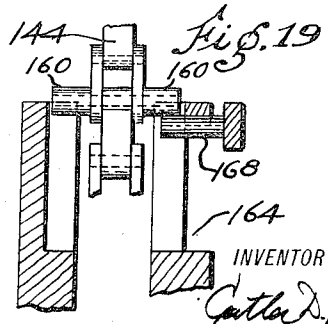


Fig. 19

INVENTOR

Cattle D. Knowlton

BY his Attorney

Nelson W. Howard

April 29, 1924. 1,491,805

C. D. KNOWLTON

WINDING MACHINE

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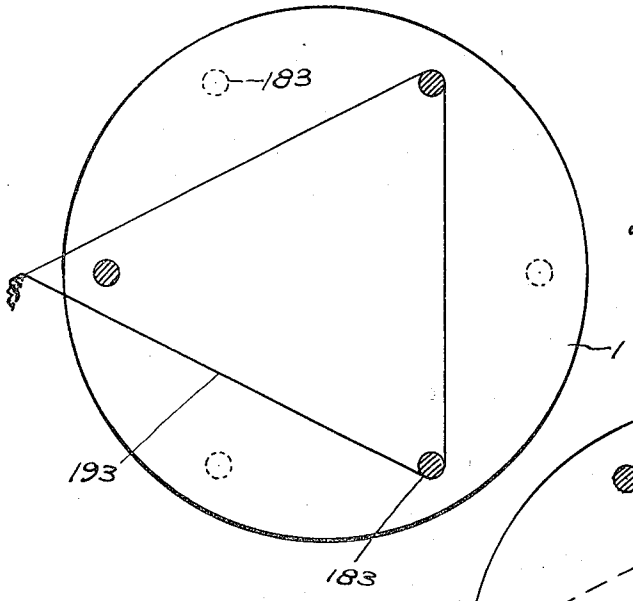


Fig. 22.

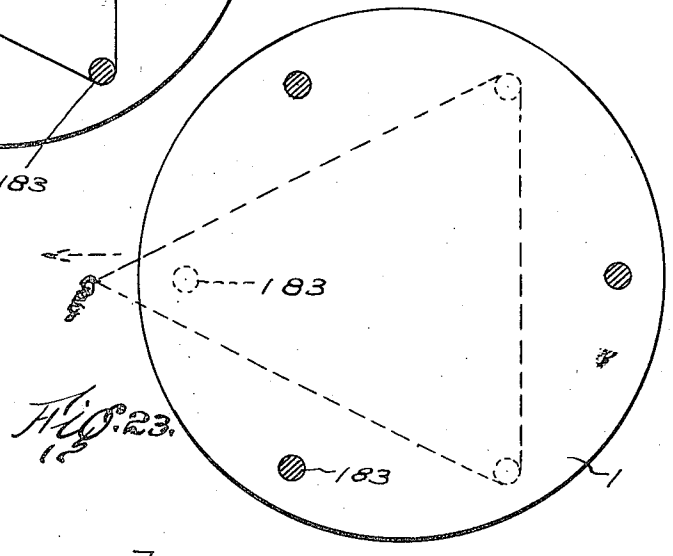


Fig. 23.

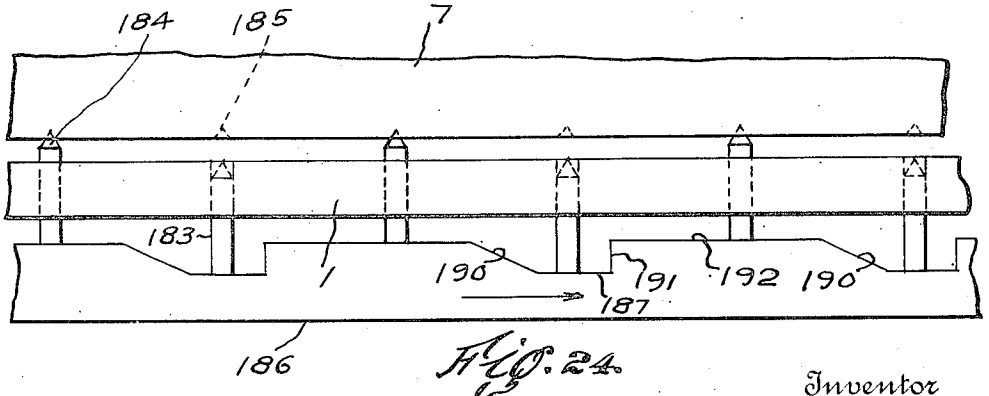


Fig. 24.

Inventor

Cutler D. Knowlton

By his Attorney,

Nelson M. Howard

April 29, 1924. 1,491,805

C. D. KNOWLTON

WINDING MACHINE

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Fig. 25

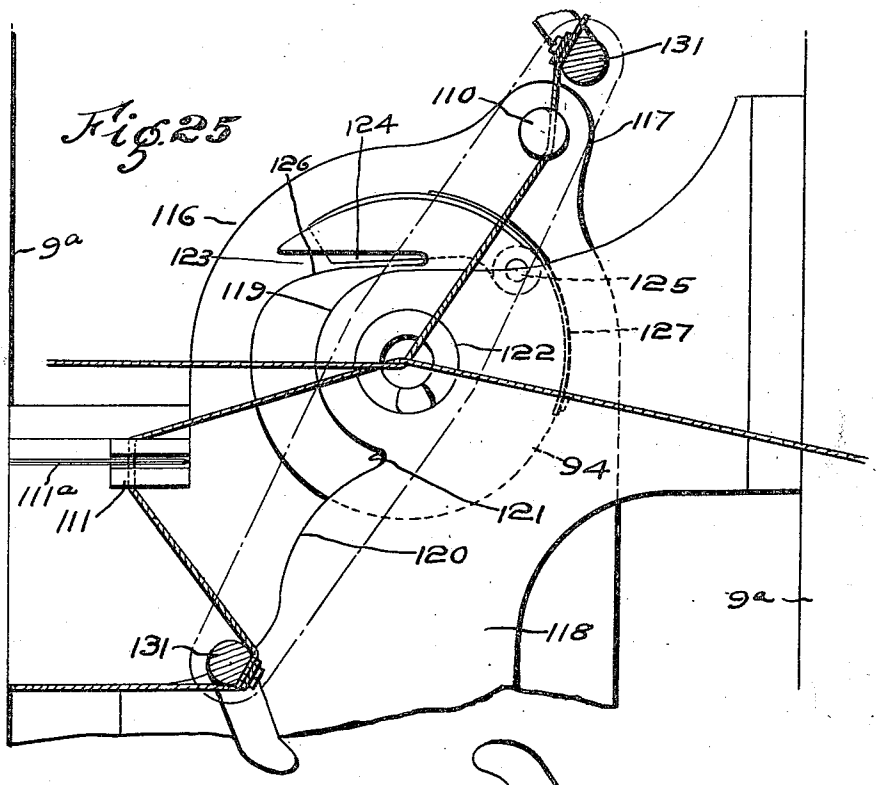
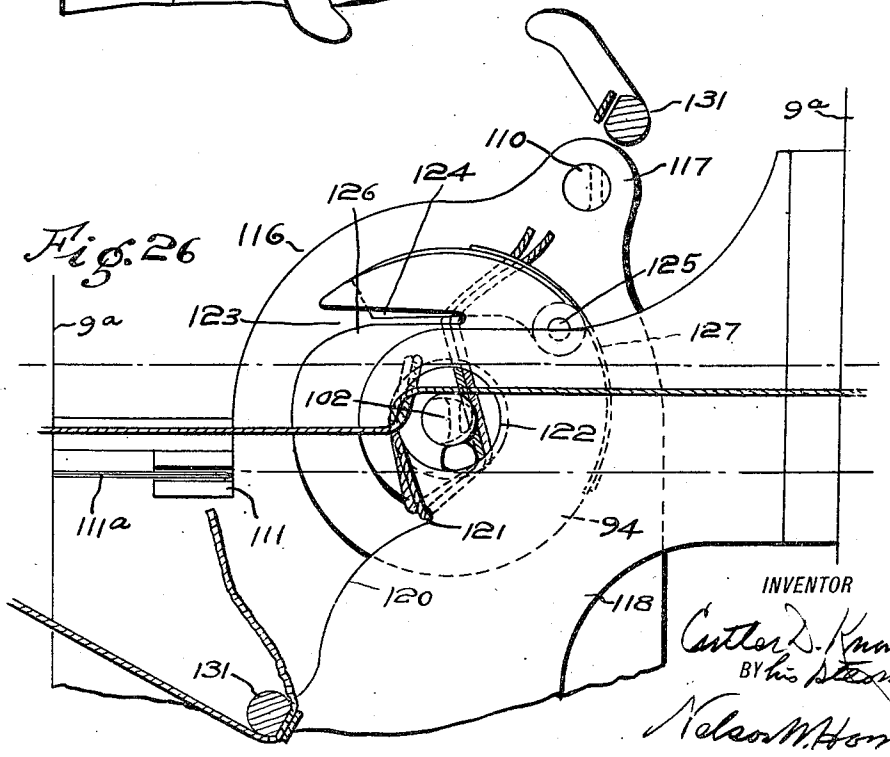


Fig. 26



INVENTOR

Cutler D. Knowlton

BY his Attorney

Nelson M. Horrack

April 29, 1924. 1,491,805

C. D. KNOWLTON

WINDING MACHINE

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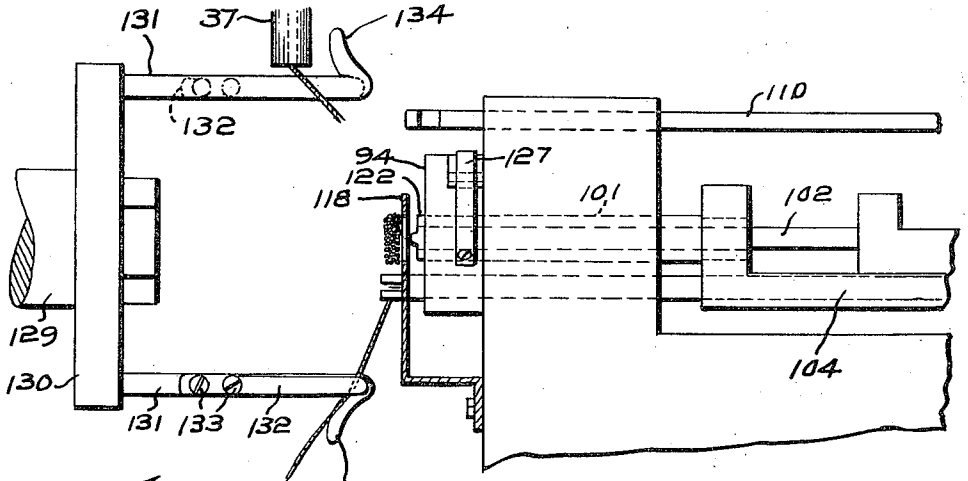


Fig. 27

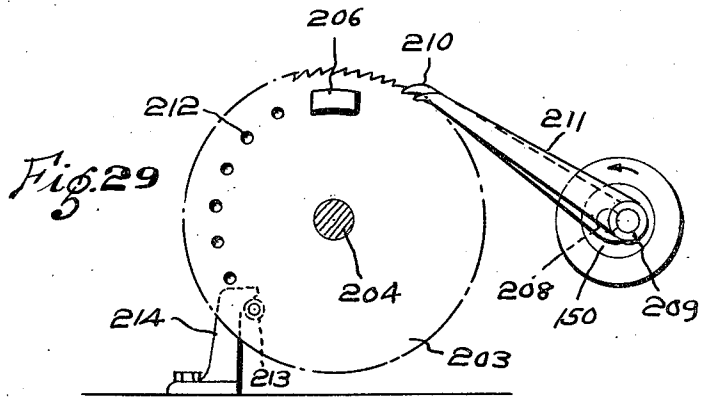


Fig. 29

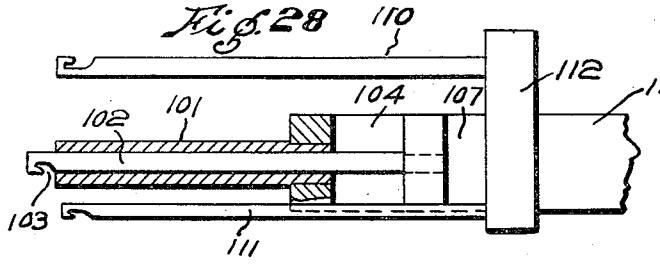


Fig. 28

INVENTOR
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BY his Attorney,
Nelson W. Howard

Patented Apr. 29, 1924. 1,491,805

UNITED STATES PATENT OFFICE.

CUTLER D. KNOWLTON, OF BEVERLY, MASSACHUSETTS, ASSIGNOR TO BARBOUR FLAX SPINNING COMPANY, OF PATERSON, NEW JERSEY, A CORPORATION OF NEW JERSEY.

WINDING MACHINE.

Application filed June 1, 1920. Serial No. 385,606.

To all whom it may concern:

Be it known that I, CUTLER D. KNOWLTON, a citizen of the United States, and residing at Beverly, in the county of Essex and State of Massachusetts, have invented certain Improvements in Winding Machines, of which the following description, in connection with the accompanying drawings, is a specification, like reference characters on the drawings indicating like parts in the several figures.

This invention relates to winding machines, and more particularly to machines for reeling silk, linen, and other character of filaments into skeins.

Heretofore it has been the practice to form skeins of filaments by winding the filament upon a reel, and tying the filaments together when the predetermined number to be contained in the skein has been wound. In machines of this general class, it has been the common practice to wind the filament upon the reel by rotating the reel and drawing the filament from a source of supply. This manner of forming the skein has been satisfactory so far as the skein formation is concerned, but it required that the reel be stopped whenever the skein was to be tied, and consequently, the output of the machine was restricted and loss occurred incident to the repeated stopping of the machine or the winding operation.

An important feature of the present invention consists of winding the filament upon a reel and tying each skein as it is formed or completed, without stopping the winding operation. The effect is that the output of the machine is greatly increased, and economy of product results.

In carrying this feature of the invention into practical effect, it has been found expedient to rotate a flyer about a stationary or fixed reel, so that the knotting or tying mechanism which is utilized to tie each completed skein, may be properly related to the reel and skein at all times, and ready to perform the tying operation.

Heretofore it has been the practice to tie the skein, or bind it up in the position in which the skein was wound upon the reel, and after the reel had been brought to rest. In the present invention, however, where each succeeding skein is being wound during the tying of a previously-wound skein, the skein to be tied is moved from the position in which it was wound to a second or tying position; and an important feature of the present invention, therefore, consists in winding the skein in one position and transferring it to another position for the tying operation. In carrying this feature of the invention into effect, it has been found expedient to move the skein from the winding to the tying position just prior to laying the final coil of the skein in position, and to utilize the movement of the flier at such times to place the final run of the skein under control of the knot-tying mechanism. An important feature of the invention in this respect, therefore, consists of means for placing the filament in control of the knotter or tying mechanism while the winding operation continues.

The knotter or tying mechanism acts upon both ends of the skein to pass these ends about the skein after having been crossed, and forming the knot. Where the flyer is utilized to lay the filament upon the reel, either by rotating movement of the reel or rotating movement of the flier, the tension of the filament as it is drawn from the source of supply keeps it taut; and to provide sufficient slack for the tying operation, another feature of the invention consists of means for producing sufficient slack in the filament during the skein-winding operation, to tie the knot.

During the operation of the machine of the present invention, one skein after another is formed upon the reel and tied without interrupting the winding operation, and it becomes necessary from time to time to remove the skeins from the reel while the machine still continues to operate. An important feature of the invention in this respect consists in a reel support which may be moved to and from supporting position at will, to permit the tied skeins to be re-

moved from the end of the reel. Where the reel is mounted with its axis in a vertical position, as in the present form of the invention, the removable reel-supporting means may be conveniently associated with the lower end of the reel and formed of two or more reel-supporting elements which may be alternately moved into and out of reel-supporting position.

In the present invention, the knotter is normally at rest and when a knot is to be tied, it is brought into active operation. Inasmuch as some kind of filaments may be unduly strained or even ruptured by a sudden jerk or pull thereon, the present invention provides means for obviating this defective operation. An important feature of the present invention in this respect consists of means for starting the knotter or tying mechanism with a relatively slow movement, progressively increasing the speed of the knotter to a maximum, and then gradually bringing it to rest.

Heretofore, it has been the usual practice to stop the winding operation of a skein winding machine upon the completion of each skein. This has been rendered necessary on account of the relation of the reel and knotter or tying mechanism. In the present invention, however, the winding operation continues until a predetermined number of skeins have been wound, and then the machine is automatically stopped. A further important feature of the present invention, therefore, consists of means for stopping the machine when a predetermined number of completed skeins have been wound and tied.

The above features of the invention and other novel elements and combinations of parts will be hereinafter described in connection with the accompanying drawings which form one good, practical form of the invention.

In the drawings:—

Figure 1 is a side view, partly in section and partly in elevation, of a machine embodying the invention, the parts being shown in the position they occupy at the instant the filament is placed over a hook of the tying mechanism;

Fig. 2 is a front elevation of the machine shown in Fig. 1;

Fig. 3 is a top plan view of the machine;

Fig. 4 is an enlarged perspective view of details of the stopping mechanism;

Fig. 5 is a view of the operating mechanism for the filament crossing head;

Fig. 6 is an enlarged vertical sectional view through the drum about which the filament is wound;

Fig. 7 is a detail face view of a portion of the knotter-operating mechanism;

Fig. 8 is a horizontal sectional view on the line 8—8 of Fig. 6;

Fig. 9 is a front view of the tying mechanism, looking in the direction of the arrow *a*, Fig. 6;

Fig. 10 is a sectional view taken on the line 10—10 of Fig. 1;

Fig. 11 is a sectional view taken on the line 11—11 of Fig. 6, looking in the direction of the arrows;

Fig. 12 is an enlarged vertical sectional view of the flyer and associated mechanism;

Fig. 13 is a vertical sectional view of parts shown in Fig. 4;

Figs. 14 and 15 are perspective views of details of the pusher;

Fig. 16 is a vertical sectional view taken on the line 16—16 of Fig. 3;

Fig. 17 is a similar view taken on the line 17—17 of Fig. 3;

Figs. 18, 19, 20 and 21 show details of the knotter timing mechanism;

Fig. 22 is a sectional view taken on the line 22—22 of Fig. 2, showing one set of reel supports raised, the table being indicated diagrammatically;

Fig. 23 is a view similar to that of Fig. 22, but showing a different set of reel supports raised;

Fig. 24 is a development showing the drum and reel supports;

Fig. 25 is an enlarged front view of the tying mechanism carried by the drum, the parts being shown in the position they occupy directly after the filaments have been crossed;

Fig. 26 is a similar view showing the knot partly completed;

Fig. 27 is an enlarged side view of the tying mechanism, the parts being shown in the position they occupy at the instant the filament is placed over a hook of the crossing mechanism;

Fig. 28 is an enlarged view, partly in plan and partly in section, showing elements of the tying mechanism; and

Fig. 29 is an enlarged face view of a ratchet wheel and the coopering pawls for stopping the machine after a predetermined number of skeins have been wound.

The machine frame may be of suitable form and character for supporting the operating parts, and in the present instance, comprises a lower frame or table 1 having an upper frame or head 2 supported in spaced relation thereto by posts 3. The table 1 may be supported by spaced brackets 4 having a bridge member 5 and connecting rods 6 extending between them.

Above the table 1 is supported a drum 7 preferably in the form of a hollow cylinder, as clearly shown in Fig. 6. The drum 7 is provided with an upper and lower row of lugs 8 positioned in vertical alignment, and arranged in pairs, which serve to adjustably support the vertical rails 9 which constitute what will hereinafter be termed the reel.

One of the lugs 8 of each pair is provided with a set screw 10 for securing the rails 9 in place after the rails have been adjusted toward or from the drum, the construction being such that the rails may be adjusted to vary the size of the reel. Two single lugs 8^a are provided at one side of the drum, and support rails 9^a which are rigidly and not adjustably secured to the lugs, for a purpose to be described.

Mounted in suitable bearings on the upper frame or head 2 is a driving shaft 11 provided with a pulley adapted to be driven by a belt from a suitable source of power. This pulley is mounted loosely on the shaft 11, and is operatively connected thereto at times by clutch mechanism of any suitable construction. The clutch member 13 is splined on the shaft and is moved into and out of gripping engagement with the companion clutch member or pulley 12 by the lever 14 pivotally mounted on the arm 15 at 16. The lever is operatively connected to the clutch member 13 by pins extending into the annular groove formed in the collar 17 of the clutch member 13. A lever 18 is pivotally connected to the bracket 15 at 19 and has a handle 20. The lever 14 is yieldingly connected to the lever 18 by a pin 21 secured to the lever 14 and having a spring 22 confined between the head of this pin and a face of the lever 18. The lever 18 may be actuated to engage the clutch members and may be held in this position by a rod 21^a pivotally connected to the lever 18 and having a notch 22 engageable over a fixed pin 23. A spring 24 is provided to hold the rod 21 in engagement with the pin.

It is desirable to bring the machine to rest promptly when the clutch members are disengaged, and to this end the clutch member 13 has a flange 28 which is forced into engagement with a brake shoe 29 under the impulse of a spring 26 which acts upon the extension 25 of the lever 14.

Secured on the shaft 11, Fig. 3, is a spiral gear 30 which meshes with a similar gear 31 secured upon a second shaft 32. The inner end of the shaft 11 has a bevel gear 33, Figs. 2 and 3, secured thereto, and meshing with a bevel gear 34 mounted on the hollow vertical shaft 35, Figs. 1 and 3, which extends below the lower face of the head 2. The flyer 36 is secured to and rotated by the shaft 35 and has a downwardly-projecting portion 37 for laying the filament upon the reel, as will more fully appear. The filament to be formed into skeins may be led from any suitable source, such as a spool or cheese 39 upon the stand 40, to a bracket 41 supported above the shaft 35, and down through the hollow shaft to the flyer, as shown in Figs. 1, 2 and 12.

A disc or bracket 42 is secured to the upper portion of the shaft 35, Figs. 1 and 4, and has pivotally secured thereto a pair of centrifugally operated arms 43 upon the upper ends of which are hooks 44, and upon the lower ends are the lateral extensions 45. As long as the filament is supplied to the flyer under the desired tension, the hooks 44 will hold the arms 43 from swinging outwardly by centrifugal force, but if the filament breaks or becomes too slack, the arms will fly outwardly sufficient to bring the extensions 45 into position to engage the finger 46 secured to the vertical rod 47 and rock the rod, Fig. 4. Projecting from the rod 47 is the finger 48 bearing against a shoulder 50 upon the rod 49 which is normally held in its retracted position by a spring 51 positioned between a shoulder 52 upon the rod and a fixed bracket 53, the construction being such that longitudinal movement of the rod 49 will disengage the rod 21^a from the lug 23 and stop the machine.

When the flyer 36 has laid or wound upon the reel the desired number of coils to constitute a skein, the present invention contemplates that the coils or windings be tied or bound together without the necessity of stopping the winding of successive coils or skeins, and a good form of means to this end will now be explained.

The shaft 32, which is driven from the main shaft 11 in the manner above described, operates a train of mechanism so that when a predetermined number of coils have been placed upon the reel, the shaft 54 (Figs. 1 and 3) will be actuated to tie or bind the coils together as a skein. The shaft 54 extends past the vertical shaft 35, and is provided with a skew bevel gear 55 which meshes with a similar gear 56 secured to a sleeve 57 rotatably mounted about the shaft 35. The lower end of the sleeve 57 has a gear 58 secured thereto and this gear meshes with an elongated pinion 59 mounted on a shaft 60, to the lower end of which is secured a pinion 61. The shaft 60 is rotatably mounted in a frame 62 rigidly secured to the flyer arm 36 so that the shaft 60 swings about the gear 58 when the flyer is rotated and the elongated pinion 59 rolls about the gear 58 without rotating the latter. A gear 63 of the same size as the gear 58 is mounted to mesh with the pinion 61 and these two gears are preferably enclosed in a casing as shown best in Fig. 12. The gear 63 is secured to a stub shaft 64 which is connected to rotate with the shaft 65 in alignment therewith. In the present instance, the connection consists of a coupling such as 66, the construction being such that one shaft is permitted to move laterally slightly relative to the other shaft. The shaft 65 extends into the drum 7, Fig. 6, to operate the tying mechanism, and the lower end of the shaft 65 preferably rotates in the bearing 67 formed in the cross-brace 68, Fig. 8.

Mounted within the drum 7 is a transversely-extending shaft 69 which rotates in bearings 70, 71. A cam drum 72 is secured upon the shaft 69 to rotate therewith. Motion is imparted to the shaft 69 from the shaft 65 by the cooperating skew gears 73, 74. The shaft 65 is capable of a limited longitudinal movement while the gear 74 is held against such movement and in operative connection with the gear 73. The gear 74 is driven by the shaft 65 by means of a head 75 secured to the shaft, and a similar head 76 secured to the gear 74, and the two heads are connected by the pins 77.

The construction of the mechanism for operating the shaft 65 is such that the shaft 65 will be rotated when the shaft 54 is rotated, but will not be rotated by the rotation of the flyer. This is due to the fact that since the gears 58 and 63 are of the same size, the pinions 59, 61 will roll about their respective gears when the flyer is rotated, but if the gear 58 is rotated, a corresponding rotation will be imparted to the gear 63 irrespective of whether the flyer is being rotated or not. This mechanism permits the tying mechanism to be operated without interfering with the operation of the flyer.

When a skein has been wound to or approximately to the predetermined number of coils desired in each skein, it is removed from the winding position to a second position for the action of the knotter, the effect being that one skein after another may be wound upon the reel and tied or bound together without stopping the winding operation incident to the formation of the next succeeding skein. In Fig. 1 the winding position is indicated at W and the tying position at T. In the present instance of the invention this is accomplished by arms, which may constitute a spider and which at proper times are moved to transfer the skein from the winding to the tying position. The spider which may be indicated as a whole by 78, has a central hub portion 79 loosely mounted on the shaft 65 and provided with arms 82, and collars 80 and 81, Fig. 12, cause longitudinal movement of the shaft 65 to be imparted to the spider. The outer ends of the spider arms extend downward and have heads formed thereupon, as best shown in Figs. 14 and 15. These heads may be mounted to slide within slots 83 formed in the rails 9, 9a. The lower horizontal surface 84 of the heads are positioned to engage the coils of filament wound upon the reel, and move them downward, when a downward movement is imparted to the spider. To insure that the strand will be positioned upon the reel below the surface 84, an inclined face 85 is preferably formed upon the heads to direct the coils downward to the proper position. The downwardly-directed ends 82 of the spider slidably mounted within the rails 9a, differ from the ends mounted in the rails 9 in that the former have pusher members 86 pivotally secured thereto by a pin 87, for a purpose to be described.

The spider is supported by the shaft 65 which in turn, is supported by the flyer 36, so that the spider may be lowered to move the coils down by lowering the hollow shaft 35. This, of course, will lower the flyer 36 and connected parts, but this is desirable since in moving the spider and flyer up and down simultaneously, the coils are always laid just below the surface 84 of the spider arms. The shaft 35 is held at the desired height and raised and lowered as desired, by a bell crank lever 88 pivoted upon the frame at 89, one arm of the lever being connected to a collar 90 secured to the shaft 35. The other arm of the lever 88 has a pin 91 extending into a cam groove formed in the collar 92 secured to a sleeve 93 mounted upon and rotated by the shaft 54. The arrangement of parts is such that when the shaft 54 is rotated, the spider and flyer will be lowered for an interval and then raised and held in raised position.

The tying mechanism for tying the leading and trailing end of a skein may be generally described as consisting of a knot-tying head, and a filament-crossing head opposite the knot-tying head. The tying head 94, Figs. 6 and 26, is rotatably mounted within a wall of the drum 7 and extends laterally a short distance from the drum, and is so positioned that it will lie directly back of the skein to be tied when the latter has been moved out of the normal winding position to the tying position. In performing the tying operation, it is necessary that the tying head be rotated, preferably about two complete revolutions; and this may be effected by a segmental rack 95, Fig. 7, pivotally mounted at 96 to a wall of the drum. The rack meshes with a gear 97 mounted about the head. Motion is imparted to the rack by a crank arm 98 mounted upon the shaft 69, Fig. 6, and provided with a pin 99 entering a slot 100 in the segmental rack. When the shaft 69 is rotated a complete revolution, the knotting head will be rotated in one direction the desired extent, and then rotated in the opposite direction to original position. The head 94 has a relatively large aperture formed therethrough, in which a tubular member 101 is slidably mounted, Fig. 28, and within which is a rod 102 having a hook 103. The tubular member 101 is secured to a sliding bar 104 having a pin 105, Fig. 6, projecting into the cam slot 106 of the cam drum 72. The rod 102 is secured to a similar bar 107 having a pin 108, Fig. 6, projecting into the cam slot 109 of the drum, the construction being such that when the shaft 69 is rotated, the tubular member and rod will be moved through the

knotter head by the cam slots 106, 109, and will cooperate with the head in forming the knot. A pair of spaced hook members 110 and 111 at opposite sides of the knotter head 94 operate to pull the strands to be tied toward the knotter head, and are rigidly secured to a crosshead 112 mounted upon a third slide bar 113 provided with a pin 114 projecting into a cam slot 115 of the drum, Fig. 6. As the hook member 111 moves inward, it draws the filament carried thereby across the blade of a knife 111ª and cuts the same, as will be apparent from Figs. 25 and 26. The knotting mechanism is preferably enclosed in a casing 116 (see Fig. 9) and the casing has an ear 117 through which the hook member 110 reciprocates.

In front of the tying head 94 is mounted a guide plate 118 positioned to support the parallel strands of the skein out of engagement with the head. This plate is provided with the curved edges 119, 120, Figs. 25 and 26, which serve to guide the strands into a notch 121 in the plate 118 as they are pulled inward by the reciprocating hooks 110, 111. The plate may be conveniently supported by having one portion thereof secured to the casing 116 and a second portion secured to a rail 9ª, as will be apparent from Figs. 9 and 25. An aperture 122 is formed through the plate 118 directly in front of the reciprocating rod 102 to receive the end of the rod when it is moved outwardly.

The knotter head 94 is provided with an engaging notch 123, Figs. 25 and 26, positioned to engage the filaments as the head is rotated. The filaments may be frictionally held in the notch by a finger 124 mounted upon a pin 125 and yieldingly held in engagement with the edge 126 of the notch by a spring 127.

Depending from the head frame 2, Fig. 1, is a casing 128 in the lower portion of which is rotatably mounted a shaft 129 carrying a crosshead 130, which is positioned opposite the knot-tying head 94. Mounted on the crosshead 130, Fig. 27, are the two crossing fingers 131, the outer extremities of which are formed as hooks 134. Adjacent the hooks 134 the crossing fingers are provided with filament-engaging springs 132 between which and the body of the fingers a filament may be held. The springs may be secured to the fingers by screws 133. The shaft 129 is normally held against rotation, and in such a position that the crosshead normally lies in the position shown in Fig. 2, so that one of the fingers 131 lies above the shaft 129 to one side of the vertical plane passing through the shaft. During the tying operation, the filament-crossing head is rotated through an angle of 180° so that the fingers 131 exchange places.

Mounted upon the sleeve 93 surrounding the shaft 54, is a disc 135, Figs. 1 and 5, which operates a second disc 136 secured to the shaft 137, these discs constituting what may be termed a modified Geneva gear. The disc 135 in the present embodiment of the invention, is provided with spaced annular ribs extending around the greater portion thereof to form the annular slot 138, and which receives a pair of pins 139 projecting laterally from the disc 136. The disc 135 is also provided with a laterally-projecting pin 140 positioned to enter any one of three slots 141 formed in the face of the disc 136, the construction being such that the disc 136 is held against rotation until the disc 135 is rotated sufficiently to disengage the slot 138 from the pins 139, whereupon the pin 140 will enter one of the slots 141 and rotate the disc 136 through an angle of 120°, in a well known manner. The shaft 137 is operatively connected to the shaft 129 by a sprocket chain 142 passing about a suitable gear upon each of these shafts.

The shaft 54 is to be periodically operated for the purpose of actuating the knotter when a skein is to be tied, and a suitable means for effecting the periodical actuation of the shaft 54 consists of a chain mechanism constructed and arranged to start the knotter slowly, progressively increase its speed of operation, and then slowly bring the knotter to rest. The shaft 32 has secured thereto a sprocket wheel 143, and in separated relation thereto is a shaft 146, Fig. 16, on which is secured a similar sprocket 145. A chain 144 passes partly around each of the sprocket wheels 143 and 145.

It is desirable to positively drive both the sprockets 143 and 145, and to this end, a pinion 147 is secured to the shaft 32, Fig. 3, and a similar pinion 148 is secured to the shaft 146. The pinion 148 is driven by the pinion 147 through the gear 149 loosely mounted on the shaft 150. The shaft 150, Fig. 16, is equally spaced between the shafts 32 and 146, and has rigidly secured thereto the spaced heads or bars 151, 152. Each of these bars has notches 159 formed in the opposite ends thereof, and which are positioned to receive the opposite end of any one of the operating lugs or pins 160 carried by the chain 144. A drum 161 is mounted upon the shaft 150 and serves to hold the chain 144 away from the shaft a distance equal to the distance that the lug 160 is held away from the shaft 150 by the notches 159, the operation of the parts being such that since the sprockets 143, 145 are driven at the same rate of speed by the pinions 147, 148, the chain 144 will be fed smoothly about the same; and when a portion of the chain carrying a pin 160 passes about the sprocket 145, the pin will enter the notches 159 and rotate the spaced heads 151, 152 and the shaft 150, to which they

are secured. In the particular construction shown, the shaft will be rotated through 180°, as the pin will be retained in the notches 159 until it passes about the second sprocket 143. The mechanism just described provides a satisfactory intermittent feed, since, as will be apparent from Fig. 16, the pin enters the notch 159 when this notch lies substantially tangential to the sprocket 145, so that the starting motion is gradually and smoothly applied to the heads 151 and 152, while the pin is moved within the notches, after which the heads will be rotated more rapidly. In a similar manner, the rotation of the head is slowed down as the pin passes about the other sprocket-wheel 143 and out of the notches. The chain 144 may be given any desired length, and the pins 160 are positioned at such intervals that they will actuate the knotter when a predetermined number of coils have been wound to form the skein. If desired, the machine frame may have secured thereto a guide rail 162, Figs. 1 and 16, in which a floating roller 163 is slidably supported, the roller being positioned to lie in the loop formed in the lower portion of the chain 144.

The shaft 150 may be operatively connected to the shaft 54 by providing the former with a gear 150^a meshing with a gear 54^a secured to the shaft 54. To prevent the shaft 150 from being accidentally rotated, one of the heads 152 has a notch 164, Figs. 18, 19 and 21, formed in the outer face thereof, constructed to form the inclined surface 165 in which a recess 166 is formed; and a swinging arm 167 is provided with a pin 168 to normally engage the recess 166. The arm 167 is mounted on a fixed pin 169, and may be normally held in engagement with the recess 166 by a spring 170. The movement of the arm by the spring may be limited by providing a fixed pin 171 against which a portion 172 of the arm bears. The pin 168 is so constructed that as the lug 160 upon the chain moves into the notches 159, it will force the pin 168 out of its recess 166 and thus release the heads so that they may be rotated.

As will be later explained, when enough coils have been placed about the reel to form a skein of the desired number of coils, the portion of the filament which is being wound at that instant is used to bind up the skein just completed, and to provide slack for this purpose, means is provided for drawing forward through the flyer a sufficient amount of the filament being wound. In the present instance, an arm 173, Figs. 1 and 10, is secured to the lower end of the downwardly-extending shaft 174 rotatably mounted in a bearing 175 in the machine head 2. The arm 173 is provided with a finger 176 which is swung from the position shown in full lines in Fig. 10 to that indicated by dotted lines, to produce the desired slack in the filament. Rocking motion is imparted to the shaft 174 from the cam slot in the collar 92, previously described. The upper end of the shaft 174 is provided with a crank arm 177 connected to a bell crank lever 178 pivotally mounted at 179. One end of the bell crank lever is connected to the crank arm 177 by a link 180, while the other end is provided with a pin 181 operatively engaging the cam slot in the collar 92.

As above pointed out, the coils wound about the reel are to be moved from the normal winding position indicated by the arrow W in Fig. 1, to the position indicated by the arrow T when the knot is to be tied, and this is accomplished by lowering the spider 79. After the coils have been moved to the tying position indicated by the arrow T and the skein has been tied, the tied skein is to be moved further along the reel toward the point of delivery. The pushers 86 above mentioned as being pivotally secured to the spider arms and mounted within the fixed rails 9^a, Fig. 14, are constructed so that the lower end normally projects beyond the edge of the rail 9^a, Figs. 1 and 14, but are free to swing inwardly to pass by a skein as the pusher is carried upwardly by an upward movement of the spider. The rails 9, 9^a are cut away below the shoulder 182 so that the diameter of the reel below the shoulder is less than above it, and the pushers 86 are preferably so positioned that they will push the skein below the shoulder. After the skein is moved below this shoulder it will either fall by gravity upon the table 1, or may be easily moved down by hand.

The drum 7 and reel are supported in a manner so that the completed skeins may be removed from the machine during and without interrupting the winding operation. In the present instance, two sets of pins support the drum and reel, and are so arranged that they may be alternately moved into and out of supporting position to permit the skeins to pass. In the present embodiment, six pins 183 are slidably mounted within the table 1, and are arranged below the drum 7. The pins are preferably provided with pointed ends 184 adapted to be received in sockets 185 in the lower face of the drum and are held in engagement with the drum to support the same, by the cam 186 having cam notches 187, Figs. 1, 2 and 24. The cam may be mounted upon a vertical shaft 188 supported by the bridge 5, which is provided with lugs 189 which engage the under face of the cam to support and steady it. The notches 187 are so positioned that after one set of pins has been forced into supporting engagement with the

drum, the other set of pins will be permitted to drop from their supporting position. To this end the notches 187 are provided with a sloping wall 190 and a vertical wall 191, the construction being such that when the cam is rotated, one set of pins will be moved into and the other set of pins will be moved out of supporting position to permit the skeins 193, Figs. 22 and 23, to be removed.

Connected to the cam 186 is the hub portion 197 provided with ratchet teeth adapted to be engaged by a pawl 195 carried at 196 on a swinging member or pawl carrier 194 mounted loosely on the shaft 188. The pawl may be actuated from time to time by any suitable means, as, for instance, the chain 198 which may be connected to an arm 199 extending from the pawl carrier and actuated in one direction by a treadle 200 and in the opposite direction by a spring 201 connected to the machine frame at 202.

The present invention contemplates that the winding and tying of one skein after another may continue uninterruptedly until a predetermined number of wound and tied skeins have been produced, and that then the machine will be automatically stopped. To this end a ratchet wheel 203, Figs. 1, 3 and 29, is provided with a stub shaft 204 supported by a bracket 205 upon the head 2 of the machine. One face of this ratchet wheel is provided with a cam lug 206 positioned to be moved into operating engagement with a sliding pin 207 having an end engaging the clutch-releasing rod 49. When the ratchet wheel is rotated sufficiently to bring the lug 206 into operating engagement with the pin 207, the rod 49 will be moved to the left of Fig. 3 sufficiently to release the rod 21 from its catch 23. The ratchet wheel is rotated toward the machine stopping position a desired increment each time the shaft 150 is rotated to operate the tying mechanism, and in the present instance of the invention, the shaft 150 is provided with two eccentrics 208, 209, having pawls 210, 211 operated thereby, the ends of these pawls being positioned to operatively engage the notches in the ratchet wheel 203, Fig. 29. Two pawls are provided because the shaft 150 which operates them, rotates only 180° each time the tying mechanism is actuated to tie a completed skein. The ratchet wheel 203 may be set in any one of a number of positions depending upon the number of skeins to be formed before the machine is stopped, and the positions may be conveniently determined by forming a number of pin-receiving apertures 212 in a face of the ratchet wheel, adapted to have a pin 213 inserted in any one of them, the pins being positioned to strike against a stop 214 when the wheel has been rotated backward the desired amount. After the ratchet wheel has been operated by the pawls to stop the machine, it may be returned to its starting position by a spring about the shaft 204 which will rotate the ratchet wheel to the position shown in Fig. 29, or starting position, as soon as the pawls have been disengaged from the ratchet by the hand-operated lever 215.

In operating the machine, before it is started, the filament is led from the flyer to the lower finger of the filament-crossing head, and is secured thereto by the filament-gripping spring upon the finger. The machine is then started and the flyer rotates about the fixed reel to lay the filament upon the reel in the normal winding position. As the flyer travels about the reel to lay the last coil of a skein, the flyer and spider are lowered to move the practically completed skein from the normal winding position to the tying position, and as the flyer completes the laying of the last coil, it is raised sufficiently to clear the upper finger of the crossing head, but not enough to cause the filament to clear the hook upon this finger, with the result that the filament is placed in engagement with the finger. Thereupon, the crossing head is rotated to cross the leading and trailing ends of the skein over the skein and in front of the tying head, while the flyer operates to wind a new skein. As the crossing head is rotated, the filament placed about the upper finger is pulled under the spring upon the finger and is frictionally held thereby. The rotation of the crossing head carries the ends of the skein into engagement with the reciprocating hook upon the opposite sides of the knot-tying head, and these hooks operate to pull the ends into position to be engaged by the knot-tying head, whereupon the head is rotated to form a loop in the ends to be tied and a reciprocating hook within the knot-tying head pulls the ends through this loop and forms the knot. After the knot is tied, the parts of the knot-tying head are restored to their normal position, ready to tie the next knot when again operated.

What is claimed is:—

1. In a machine of the class described, the combination of skein winding and skein tying means, a support on which the skeins are wound, and means for continuously operating the skein winding means to form another skein on the support while a previously wound skein is being tied by the co-operating tying means.

2. In a machine for winding filaments into skeins and tying the coils of a skein together as successive skeins are completed, the combination of skein winding mechanism for winding a filament into skeins, means for automatically tying the coils of a skein together when a skein is completed, and means for continuously operating the skein winding mechanism to form another skein

while a previously formed skein is being tied by the cooperating tying means.

3. In a machine of the class described, the combination of means for continuously winding a filament into successive skeins, skein tying means, and means for causing the skein tying means to tie a skein as it is completed and during the continued operation of the skein winding means in the formation of another skein.

4. In a skein winding and tying machine, the combination of a reel, means for winding a strand upon the reel to form skeins, and means for automatically tying a binder about each skein upon its completion while the winding means continues in operation in the formation of another skein.

5. In a skein winding and tying machine, the combination of a reel, means for winding a filament upon said reel to form skeins, and means for tying the end of a skein about the body thereof while the winding means continues in operation.

6. In a skein winding and tying machine, the combination of a reel, means for winding a filament upon the reel to form skeins, and means operable in timed relation with the winding means for automatically binding up each skein as it is completed and while the winding means operates continuously to form another skein.

7. In a skein winding and tying machine, the combination of a reel, means for winding a filament upon the reel, to form skeins, means for automatically moving each skein out of winding position to the binding position, and means for automatically binding up a skein while in the binding position during the continued operation of the winding means.

8. In a skein winding and tying machine, the combination of a reel, means for winding a filament upon the reel to form skeins, and means operated during the operation of the winding means and in timed relation thereto to tie the ends of a skein about the body of the skein while the winding means continues in operation to form another skein.

9. In a skein winding machine, the combination of a fixed reel, a flyer for winding a filament upon the reel to form skeins, and automatic means operated during the winding operation of the flyer to tie the ends of the skein about the body thereof while the flyer continues in operation to form another skein.

10. In a skein winding and tying machine, the combination of a fixed reel, a flyer for winding a filament upon the fixed reel to form skeins, and means for automatically tying up the skeins as completed while the flyer continues in operation in the winding of another skein.

11. In a skein winding machine, the combination of a reel, means for winding a filament thereupon to form skeins, a knotter for tying an end of the filament about a completed skein, the winding means being constructed and arranged to place the filament in engagement with the knotter upon completion of a skein without interrupting the winding operation.

12. In a machine of the class described, the combination of a fixed reel, a flyer for winding a filament into coils upon the fixed reel to form a plurality of skeins, a knotter for tying a portion of the filament about one completed skein, and means for changing the relative positions of the knotter and flyer when a knot is to be tied to place the filament under control of the knotter.

13. In a machine of the class described, the combination of a fixed reel, a flyer for winding a filament into coils upon the fixed reel to form a plurality of skeins, a knotter for tying a portion of the filament about one completed skein, during the winding of the filament in the formation of another skein, and means for changing the relative positions of the knotter and flyer when a knot is to be tied to place the filament under control of the knotter.

14. In a skein winding machine, the combination of a reel, means for winding a filament upon the reel to form skeins, means for moving a partially-formed skein out of the normal winding position during the winding operation to permit the commencement of another skein on the reel, and means for completing the winding of the partially-formed skein in the second position.

15. In a skein winding machine, the combination of a reel, means for winding a filament upon the reel to form skeins, means for moving a skein relatively to the reel out of the normal winding position as it approaches completion, and means for completing the skein after it has been moved relatively to the reel out of its normal winding position.

16. In a machine of the class described, the combination of a reel, means for causing a filament to be wound upon the reel to form a partly completed skein, means for moving the partly completed skein to another position to permit the winding of another skein in the position previously occupied by the partially-wound skein and completing the partially-wound skein in the second position.

17. In a machine of the class described, the combination of means for winding a filament into skeins, a knotter for tying the individual skeins, and means for relatively changing the position of the winding means and knotter to place the filament in control of the knotter when a knot is to be tied.

18. In a skein winding machine, the combination of a reel, means for winding a filament upon the reel to form skeins, means

for moving a skein out of the normal winding position as it approaches completion to permit winding of another skein in the position formerly occupied by the partially-wound skein, mean for completing the winding of the partially-wound skein in the second position, and a knotter for tying the completed skeins.

19. In a machine of the class described, the combination of a skein winding means for winding a filament into a partly formed skein in one position and completing the skein in another position, and a knotter for tying the completed skein during the continued operation of the machine in the formation of another skein.

20. In a machine of the class described, the combination of skein winding means including a reel and a flyer, a knotter for tying the skein, and means for moving the skein winding means into a position to place the filament under control of the knotter when a knot is to be tied and while the machine continues in operation.

21. In a machine of the class described, the combination of a skein winding mechanism, means for producing sufficient slack in the filament during the skein forming operation to tie the skein, and skein tying mechanism for tying the slack about the skein.

22. In a machine of the class described, the combination of a reel and a flyer for winding skeins of filaments upon the reel, means for drawing sufficient length of filament from the source of supply during the skein winding operation to form a loop about the skein, and knot tying mechanism.

23. In a machine of the class described, the combination of a reel and a flyer for winding skeins of filaments upon the reel, means adapted to act upon the filament between the reel and flyer for drawing sufficient length of filament from the source of supply during the skein winding operation to form a loop about the skein, and knot tying mechanism.

24. In a machine of the class described, the combination of a reel and a flyer for winding skeins of filaments upon the reel, means operative upon the final coil of the skein for drawing sufficient length of filament from the source of supply during the skein winding operation to form a loop about the skein, and knot tying mechanism.

25. In a machine of the class described, the combination of a skein winding mechanism for winding one skein after another, means for producing slack in the filament being wound during the winding operation and as a skein approaches completion, and skein tying mechanism for tying the slack portion of the filament about the skein during the winding of another skein.

26. In a skein winding machine, a reel, means for winding a filament on the reel to form one skein after another without stopping the winding operation, means for drawing forward a sufficient amount of the filament during the winding operation to form a loop about a complete skein, and means for tying each skein with the drawn strand without interrupting the winding of the skeins.

27. In a machine of the class described, the combination of skein winding mechanism, a knotter including a knot tying head and a filament crossing head, means for moving a skein to be tied into position between the knot-tying and filament-crossing heads, and means for operating the knotter.

28. In a machine of the class described, the combination of skein winding mechanism, a knotter for tying a skein, means for moving a skein from its winding position to another position while it is being wound that it may be tied by the knotter, and means for operating the knotter.

29. In a machine of the class described, the combination of skein winding mechanism, a knotter including a knot-tying head and a filament-crossing head, means for moving a skein to be tied into position between the knot-tying and filament-crossing heads, means for moving a part of the winding mechanism to place the filament in control of the crossing head, and means for operating the knotter.

30. In a skein winding machine, in combination, a reel, a flyer for winding a filament upon the reel to form skeins, a knotter including a knot-tying head and a filament-crossing head mounted in spaced relation to each other, means for moving a skein from the normal winding position to a position between said heads, and means for operating said knotter to tie the skein.

31. In a skein winding machine, in combination, a reel, a flyer for winding a filament upon the reel to form skeins, a knotter including a knot-tying head and a filament-crossing head mounted in spaced relation to each other, means to operate said flyer during the winding operation to place the filament in engagement with the crossing head, and means to operate said knotter to tie the filament about the skein.

32. In a skein winding machine, in combination, a fixed reel, a flyer for winding a filament upon the reel to form a skein, a knotter including a knot-tying head mounted within the reel and a filament-crossing head mounted outside the reel, and means for operating the knotter to tie the skein.

33. In a skein winding machine, the combination of a reel, means for winding a filament on the reel to form skeins, a knotter for tying each skein as completed, including filament-crossing means comprising a single rotatable head having two similar filament-engaging fingers constructed and

arranged alternately to hold the cut end of the filament between tying operations, and means for rotating the head to cross the filaments.

34. In a skein winding machine, the combination of a reel, means for winding a filament on the reel to form skeins, a knotter for tying each skein while upon the reel, including filament-crossing means comprising a single rotatable head having two filament-engaging fingers adapted alternately to hold the cut end of the filament between tying operations, and means for rotating the head step by step for a partial revolution in the same direction to cross the filaments.

35. In a skein winding machine, the combination of a reel, means for winding a filament on the reel to form skeins, a knotter for tying each skein while upon the reel, including filament-crossing means comprising a rotatable head having two fingers arranged symmetrically on opposite sides of the axis of rotation of the head and each finger constructed and arranged alternately to hold the cut end of the filament between tying operations, and means for rotating the head to cross the filaments and to interchange the position of the fingers.

36. In a skein winding machine, a fixed reel, a rotating flyer for winding a filament upon the reel to form skeins, a knotter for tying the skeins when completed, mechanism within the reel for operating the knotter, and means for operating said mechanism within the reel including a train of gears movable with the flyer.

37. In a winding machine, a fixed reel, a rotating flyer for winding a filament upon said reel into coils, and means operable to tie said coils together, including knot-tying mechanism operating within the reel, and means for operating said mechanism within the fixed reel.

38. In a winding machine, a fixed reel, a rotating flyer for winding a filament upon said reel into coils, and means operable to tie said coils together, including a cam drum within the fixed reel and means for operating said drum within the fixed reel, including a train of mechanism for transmitting the movement of the operating means at one side of the axis of the flyer.

39. In a skein winding machine, in combination, a reel, means for winding a filament into a skein upon said reel, a knotter including a knot-tying head and a filament-crossing head, a fixed guide plate positioned between said heads for directing the crossed filaments toward the knot-tying head, and means for operating said knotter to bind up said skeins.

40. In a skein winding machine, in combination, a reel, means for winding a filament upon said reel to form skeins, skein binding means, means to effect the binding up of a predetermined number of coils into a skein while the winding operation continues, and means for automatically stopping the machine when a predetermined number of skeins has been completed.

41. In a machine of the class described, the combination of skein winding mechanism, knot-tying means for tying the skeins as they are completed and during the continued operation of the winding mechanism, and means for automatically stopping the winding operation on the completion of a predetermined number of skeins.

42. In a skein winding machine, the combination of a reel and a flyer for winding coils of a filament upon the reel to form skeins, means for moving a skein axially of the reel, and means for simultaneously effecting movement of the skein moving means and flyer axially of the reel to cause the flyer to complete the skein in its new position.

43. In a skein winding machine, the combination of a reel and a flyer for forming skeins of filament upon the reel, means for moving a partially-formed skein from its winding position to skein tying position, and means for causing the flyer to move with the skein moving means to complete the skein in the skein tying position, and means for tying the completed skein.

44. In a skein winding machine, the combination of a fixed reel, a rotatable flyer for winding a filament upon the fixed reel to form skeins, a pusher for moving a partially-formed skein from normal winding position, and means for causing the flyer to move with the skein pusher to complete the skein in its new position.

45. In a skein winding machine, in combination, a fixed reel, a flyer for winding a filament upon the reel to form skeins, means for moving the flyer bodily out of the normal winding position during the winding operation, and a pusher movable bodily with the flyer to push the skein which is being wound out of the normal winding position.

46. In a skein winding machine, in combination, a fixed reel, a flyer rotatable to wind a filament thereupon, a skein pusher connected to said flyer, and means for moving the flyer and pusher axially of said reel upon the completion of a predetermined number of revolutions of the flyer to move the coils formed thereby out of the normal winding position and to complete the skein in the new position.

47. In a machine of the class described, the combination of skein winding means for forming skeins of filaments, knot-tying mechanism for tying the completed skeins successively as they are formed during the winding operation, and means for effecting the removal of the tied skeins while the machine continues in operation.

48. In a machine of the class described, the combination of skein winding means for forming skeins of filaments, knot-tying mechanism for tying the skeins while on the reel as they are completed, and means operable at will for effecting the removal of the tied skeins from the machine upon which they are wound and while the machine continues the winding operation.

49. In a machine of the class described, the combination of skein winding mechanism including a reel, means for supporting the reel with its axis in a substantially vertical position, and means for alternately withdrawing parts of the supporting means from supporting position to permit completed skeins to be removed from the end of the reel.

50. In a machine of the class described, the combination of skein winding mechanism including a reel, means for supporting the reel, and means for successively removing parts of the supporting means from supporting position to permit the finished skeins to be removed.

51. In a machine of the class described, the combination of skein winding mechanism including a reel and a flyer, plural means for supporting one end of the reel, and means for moving at will some of the plural means into and others out of supporting position to permit finished skeins to be removed.

52. In a skein winding machine, a reel, a flyer mounted to rotate about the reel to wind a filament into skeins, means opposite one end of the reel for supporting the reel comprising a plurality of members, and means for causing movement of some of said members into supporting position and others out of supporting position to permit removal of the skeins.

53. In a skein winding machine, a reel, a flyer mounted to rotate about the reel to wind a filament into skeins, means for moving the skeins toward one end of the reel, and means for supporting the reel comprising a plurality of members, and means for successively moving said members into and out of supporting engagement with the reel.

54. In a winding machine, a reel, a flyer mounted to rotate about one end of said reel to wind a filament thereupon, and means for supporting the reel at the end opposite the flyer, comprising a plurality of members movable alternately into supporting engagement.

55. In a winding machine, a vertical reel, a flyer mounted to rotate about the reel to wind a filament upon the reel, and means for supporting the reel, comprising a plurality of spaced supports movable alternately into engagement with the reel.

56. In a machine for winding skeins of filaments, the combination of a reel, a plurality of means for supporting the reel in fixed position, a flyer for winding a filament upon the reel, and means for moving some of the supporting means into and others out of supporting position to permit finished skeins to be removed from the reel.

57. In a machine for winding skeins of filaments, a fixed reel, a flyer for winding a filament upon the fixed reel, a plurality of supports for supporting the reel, and means for alternately moving some of the supports into and others out of supporting position to permit removal of completed skeins.

58. In combination, a vertical fixed reel, means positioned to engage the lower face of the reel to support the same, said means comprising two separate sets of supports movable into and out of supporting engagement with the lower face of the reel, and means for lowering one set after the other set has been moved into supporting engagement with the reel.

59. In a machine for winding skeins of filaments, a fixed reel, a flyer for winding a filament upon the fixed reel, a plurality of supports for supporting the reel, and cam actuated means for alternately moving some of the supports into and others out of supporting position to permit removal of completed skeins.

60. In a skein winding machine, the combination of skein winding mechanism, a knotter for tying each skein, and means for starting the knotter slowly and increasing the speed of operation to prevent breaking the tying filament, including a rotatable head, and operating means for the head that moves into engagement with the head and then rotates with the head about the axis of the latter.

61. In a skein winding machine, the combination of skein winding mechanism, a knotter for tying the skeins as they are completed, and mechanism for starting the knotter slowly, increasing its speed of operation and then gradually bringing the knotter to rest, including a rotatable head, and operating means for the head that moves into engagement with the head, then rotates with the head about the axis of the latter, and then moves out of engagement with the head.

62. In a skein winding machine, the combination of skein winding mechanism, a knotter, means for moving a skein from winding position a second position to be operated upon by the knotter, and means for actuating the knotter by starting slowly and increasing the speed of operation, including a rotatable head, and actuating means for the head movable toward the latter into engagement therewith and then rotatable with the head about the axis of the latter.

63. In a skein winding machine, the com-

bination of a reel and a flyer for winding a filament upon the reel into skeins, a knotter for tying each skein during the winding of other skeins, and means for gradually starting and stopping the operation of the knotter to prevent breaking the tying filament, including a rotatable head, and actuating means for the head rotatable with the head about the axis of the latter, and then disengaged from the head.

In testimony whereof I have signed my name to this specification.

CUTLER D. KNOWLTON.