H. D. COLMAN.

KNOT TYING MECHANISM.

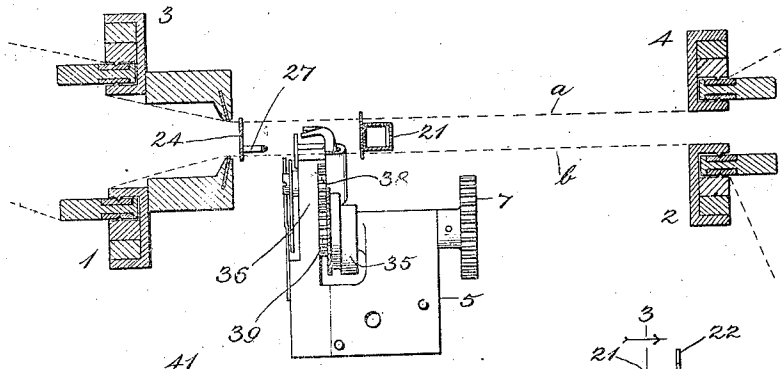
APPLICATION FILED DEC. 9, 1909.

1,029,853.

Patented June 18, 1912.

2 SHEETS—SHEET 1.

Fig. 1.



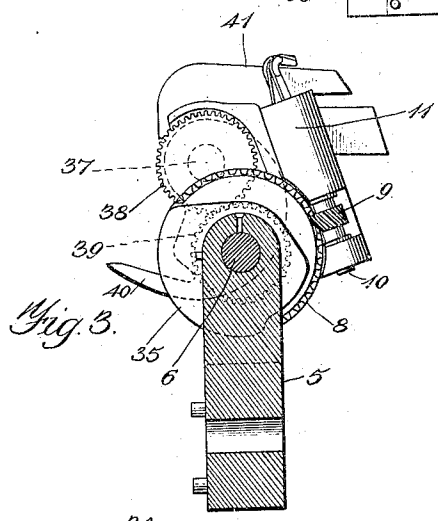




Fig. 3.

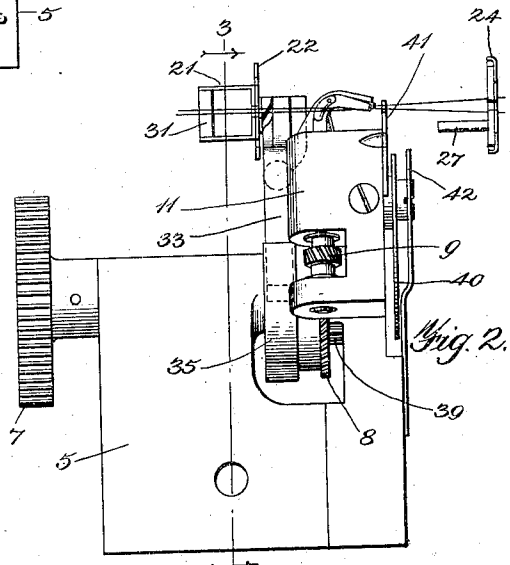



Fig. 2.

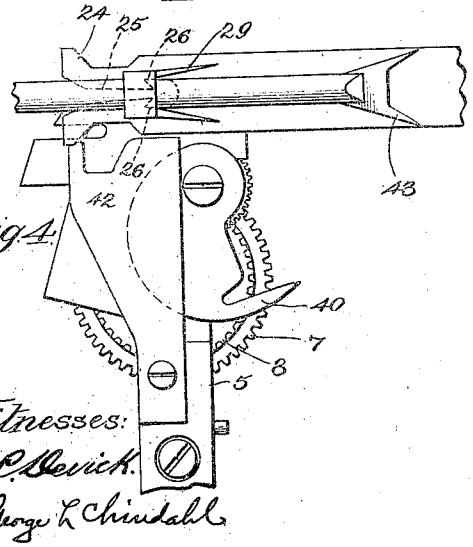



Fig. 4.

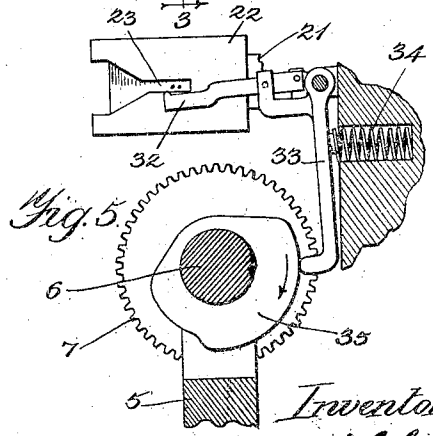



Fig. 5.

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2 SHEETS—SHEET 2.

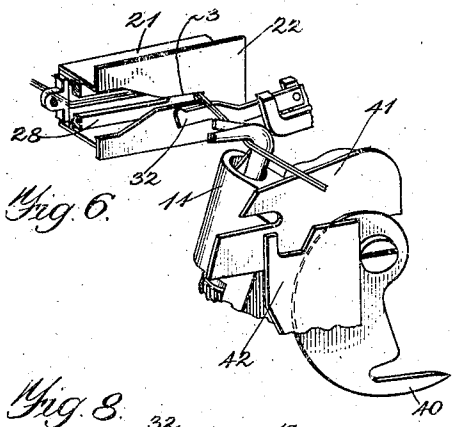


Fig. 6.

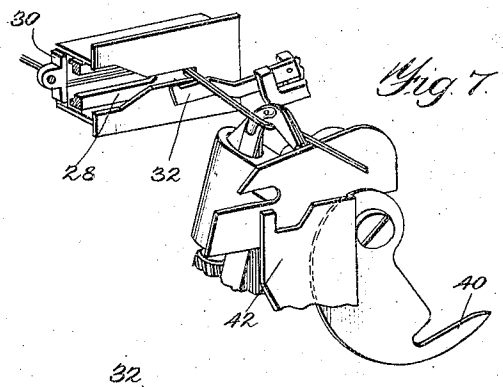


Fig. 7.

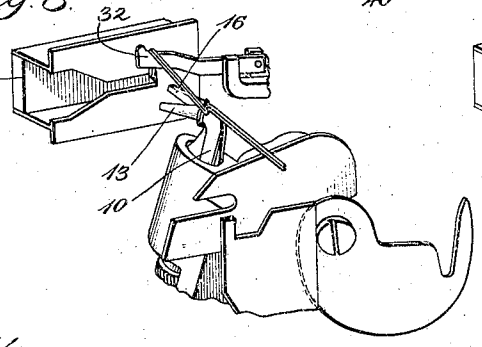


Fig. 8.

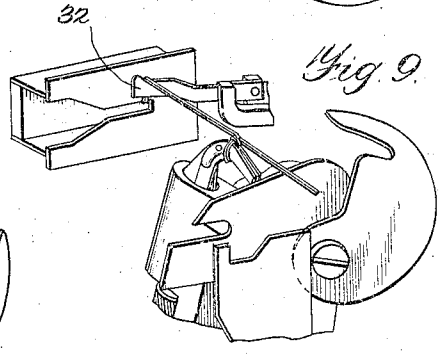


Fig. 9.

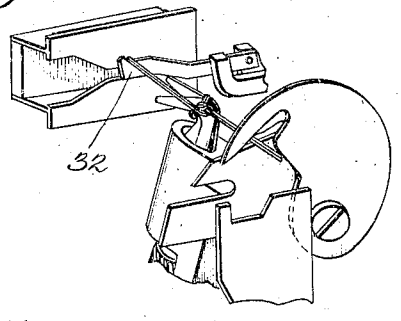


Fig. 10.

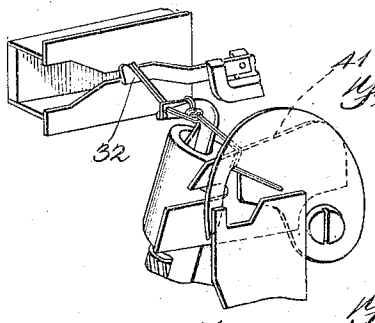


Fig. 11.

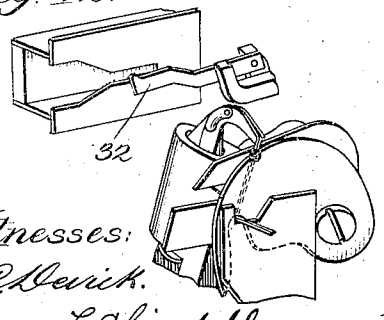


Fig. 12.

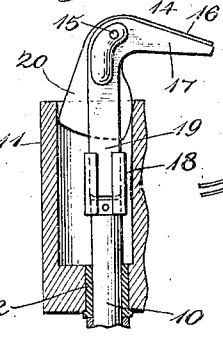


Fig. 13.


Fig. 14.

Fig. 15.

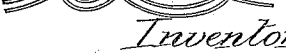

Fig. 16.

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# UNITED STATES PATENT OFFICE.

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## KNOT-TYING MECHANISM.

1,029,853. Specification of Letters Patent. Patented June 18, 1912.

Application filed December 9, 1909. Serial No. 532,226.

*To all whom it may concern:*

Be it known that I, HOWARD D. COLMAN, a citizen of the United States, residing at Rockford, in the county of Winnebago, in the State of Illinois, have invented certain new and useful Improvements in Knot-Tying Mechanisms, of which the following is a specification.

This invention relates to means for forming knots, and is herein shown as forming a part of a machine for uniting the ends of two warps.

The object of the invention is to produce a knot-tying mechanism arranged for use in a warp-tying machine and adapted to tie knots in worsted and other wiry yarns. When such yarns are coiled or looped by knot-tying mechanisms heretofore produced, to form a knot, the coils tend to spring open, and, owing to the limited amount of force that can be exerted by such mechanisms for tightening the knot, a loose knot is formed which is liable to work still looser and may fail altogether. This difficulty in tying wiry yarns I remedy by giving the tying bill of the knot-tying mechanism an additional revolution after the loop is formed, thereby coiling the looped threads upon themselves previous to the drawing of said threads through the loop upon the tying bill.

In the accompanying drawings, Figure 1 is a fragmental transverse vertical sectional view through a warp-tying machine embodying the features of my invention. Fig. 2 is an elevation of the knot-tying mechanism proper, together with one of the thread-clamping devices and a thread guide. Fig. 3 is a section taken substantially on line 3 3 of Fig. 2. Fig. 4 is an edge elevation of the knot-tying mechanism. Fig. 5 is a sectional view illustrating said thread-clamping device. Figs. 6, 7, 8, 9, 10, 11 and 12 are perspective views in a series illustrating successive steps in the operation of tying a knot. Fig. 13 is a fragmental sectional view illustrating the tying bill and the cam-barrel for operating the pivoted shearing and clamping jaw. Fig. 14 represents a section through the tying-bill and shows a sleeve for securing together the parts of said bill. Fig. 15 is an end view of the cam cylinder. Fig. 16 is a diagrammatic view of the knot formed by this mechanism.

The invention is herein illustrated as comprised in a warp-tying machine of the type disclosed in my British Patent No. 10,484 of 1905, to which patent reference may be had for a full understanding of the relation of the knot-tying mechanism to the other mechanisms of such a machine. Briefly described, the machine comprises a bed having thereon two stationary thread clamps 1 and 2 for one of the warps and a frame located above said bed, said frame comprising a pair of thread clamps 3 and 4 for the other warp. Upon the bed is mounted a carriage arranged to travel longitudinally of the warp frame and the bed from one side of the warps to the other, said carriage supporting the knot-tying mechanism, mechanism for selecting the warp threads in pairs, one thread from each warp, and mechanism for bringing each selected pair of threads into operative relation with the knot-tying mechanism.

The knot-tying mechanism comprises a frame 5 rigidly mounted upon the carriage. In said frame is rotatably mounted a shaft 6. Upon one end of said shaft is fixed a spur-gear wheel 7 by means of which power is communicated from a suitable source to said shaft for continuously rotating the latter. A spiral gear 8 rigidly mounted upon the shaft 6 is arranged to mesh with a pinion 9 fixed upon a knotter shaft 10, said shaft being rotatably supported in bearings in the knotter frame. A cam-barrel 11 is rigidly mounted in the knotter frame, said barrel being open at its upper end and having a bearing 12 in its lower end through which the knotter shaft 10 extends. As shown in Fig. 13, the bearing 12 is eccentric with relation to said cam-barrel. Within the cam-barrel and toward its upper end the knotter shaft 10 is flattened, and at its upper end said shaft is bent in a plane with its flattened surface at an angle somewhat greater than a right angle to form the portion 13 (Fig. 8) of the tying bill 14. At its bend, and upon its flattened side the knotter shaft is provided with a pivot pin 15 for a shearing and clamping jaw 16, said jaw lying between the knotter shaft and a bill spring 17 secured in place by means of a sleeve 18 (Figs. 13 and 14) fixed upon said knotter shaft and engaging the stem 19 of said bill spring. The point of the bill spring 17 is bent to correspond

with the shape of the tying bill, and said bill spring is perforated to receive the outer end of the pivot pin 15. The shearing and clamping jaw 16 lies between the bill portions 13 and 17, is pivoted on the pin 15, and has a cam-wing 20 lying within the cam-barrel 11. When the shaft 10 is rotated the shearing and clamping jaw 16 is moved upon its pivot 15 by reason of the cam conformation and the eccentricity of the cam-barrel 11. The edge of the shearing and clamping jaw adjacent to the bill spring 17 is sharpened to form a thread shear with said bill spring, while the other side of said jaw forms a thread clamp with the flattened side of the tying bill 10. At one side of said bill is located a suction air-tube 21 having fixed to its side adjacent the tying bill a plate 22 (Figs. 5 and 6) which has formed therein a throatway 23. At the opposite side of the tying bill is a thread guide 24 (Figs. 2 and 4) having therein a throatway 25, the rear end of said throatway being enlarged to form two notches 26, into which notches the threads spring after being pushed through the narrow part of the throatway 25 and wherein they are retained during the operation of tying the knot. On the side of the guide 24 adjacent the tying bill is fixed a guard 27.

The pair of threads to be tied together are moved laterally into operative relation with the tying bill by means substantially similar to that shown in my said British patent, namely, a reciprocatory fork 28 (Fig. 6) for inserting said threads into the throatway 23 and a reciprocatory fork 29 (Fig. 4) for passing said threads through the throatway 25 and into the notches 26. Moving with the fork 28 is a clamping jaw 30 adapted to clamp the threads between itself and the forward end 31 (Figs. 2 and 8) of the suction tube 21. At about the moment the jaw 30 clamps the threads, said threads are severed by mechanism not herein shown, in order to provide loose ends for the tying operation. Tension is placed upon the severed ends of the threads during the knot-forming operation by a spring clamping finger 32 which is attached to an arm 33 and the free end of which clamping finger presses against the side of the plate 22. The spring finger 32 is moved into and out of position to engage threads extending through the throatway 23 by means comprising a compression spring 34 (Fig. 5) and a cam 35, the latter being fixed upon the shaft 6. The finger 32 yieldingly clamps the threads, the latter slipping past the finger to provide slack as the tying bill forms loops in the threads. As will be seen in Figs. 7 to 12, inclusive, the finger 32 serves not only to clamp the threads, but also supports the threads at different heights during the cycle of operation. Immediately upon the beginning of the clamping operation said finger swings into the position shown in Fig. 8, thereby raising the threads so that the open tying bill can swing thereunder without catching the threads. The finger 32 then descends so as to place the threads in such position that the next time the open tying bill comes around said threads will be received in said open bill. During its continuing downward movement, the finger 32 releases the threads, which in the meantime have been severed by the tying bill, and the cut-off ends are withdrawn by the exhaust air current in the tube 21.

In the bracket 36 of the knotter frame is rotatably mounted a shaft 37 bearing at one end a gear wheel 38 adapted to mesh with a gear wheel 39 fixed upon the shaft 6. On the other end of the shaft 37 is fixed a stripper hook 40. The gearing for rotating the tying bill 14 and the stripper hook 40 is so proportioned as to cause three revolutions of the tying bill to one of the stripper hook. A blade 41 fixed to the bracket 36 is located between the tying bill and the stripper hook. At the outer side of the stripper hook is a thread guide 42 having a notch therein, said guide being rigidly secured to the bracket 36. The upper edge of the blade 41, the inner edges of the stripper hook, and the upper edge of the guide 42 are rounded at both sides to prevent wear or breakage of the threads extending thereover.

In the operation of the warp-tying machine, two threads, one from each of the warps *a* and *b*, are selected, separated from adjacent or adhering threads, advanced into operative relation with the tying bill by the forks 28 and 29, and severed. In the initial position of the tying mechanism the tying bill extends forwardly from the knotter shaft, as shown in Fig. 6, while the stripper hook 40 is at the point in its path substantially farthest from said bill. The first three-fourths of a revolution of the tying bill winds the threads about the knotter shaft. At this time the shearing and clamping jaw 16 is opened by reason of the eccentricity of the cam-barrel 11, but the finger 32 holds the threads elevated so that the threads will not be caught in the open tying bill. The continuing rotative movement of the tying bill causes the threads to be coiled upon themselves at one side of the loop upon the bill, as shown in Figs. 8 and 9. By the time the tying bill has reached the position shown in Fig. 10, said bill has been opened and the finger 32 has moved downward sufficiently to place the threads in the path of the open bill, wherein they are received, as shown in Figs. 10 and 11. The tying bill now closes, clamping the threads at one side of the jaw 16 and shearing them

at the other, the sheared-off ends being removed by the exhaust air current in the tube 21. About this time the stripper hook 40 engages the threads and draws a bight of the threads downward between the blade 41 and the guide 42, thereby pulling the loops of the knot off the tying bill and over the strands clamped in said tying bill, and finally pulling said strands out of the bill. In thus pulling the ends out of the tying bill, the loops of the knot are drawn tight. The knotted ends are drawn out through the enlarged rear end of the throatway 25 by a reciprocatory fork 43 (Fig. 4). The coiling of the threads upon themselves prior to their being drawn through the loop upon the tying bill prevents the coils of the knot from springing apart and from sliding when tension is placed upon the threads.

I claim as my invention:

1. In a warp-tying machine, the combination of a rotatory tying bill, a clamp for the threads to be operated upon by the bill, which clamp comprises a stationary member and a movable member, and means for moving said movable clamp member to place the threads out of the path of the tying bill and to subsequently place them in the path of the tying bill.

2. In a warp-tying machine, the combination of a rotatory tying bill, a clamp for the threads to be operated upon by said bill, which clamp comprises a stationary member and a movable member, means for opening and closing said bill in each revolution thereof, and means for moving the movable clamp member to permit the threads to enter the open bill after the bill has completed one revolution.

3. In a warp-tying machine, the combination of a rotatory tying bill, a clamp for the threads to be operated upon by said bill, which clamp comprises an air tube having a throatway therein to receive the threads, and a pivoted clamping finger arranged to bear against said tube and clamp threads extending through said throatway, means for opening and closing said bill in each revolution thereof, and means for swinging said finger to withdraw the threads from the path of the open bill until after said bill has completed one revolution.

4. In a warp-tying machine, the combination of a rotatory tying bill, a shaft, a driving connection between said shaft and said bill, a rotatory stripper device, a driving connection between said shaft and said stripper device, said driving connections being so proportioned that the tying bill makes three revolutions in each revolution of the stripper device, means for opening and closing said bill in each revolution thereof, and means for placing the threads in the open bill after the bill has completed one revolution.

5. In a warp-tying machine, the combination of a rotatory tying bill, a shaft, a driving connection between said bill and said shaft, a stripper device, a driving connection between said shaft and said stripper device, said driving connections being so proportioned that the tying bill makes three revolutions in each complete movement of the stripper device, means for opening and closing the bill in each revolution thereof, a clamp for the threads to be knotted, said clamp comprising a stationary member and a pivoted finger, and means for swinging said finger comprising a cam on said shaft, said swinging means being adapted to swing said finger to permit the threads to enter the open bill after the bill has completed one revolution.

6. In a warp-tying machine, the combination of a rotatory knotter shaft having a tying bill, a main shaft, a gear wheel on said main shaft, a pinion on said knotter shaft meshing with said gear wheel, a rotatory stripper device, a gear wheel fixed to said stripper device, a gear wheel fixed to said main shaft and meshing with the gear wheel that is fixed to the stripper device, the gear connection between the two shafts and the gear connection between the main shaft and the stripper device being so proportioned that the tying bill makes three revolutions in each revolution of the stripper device, means for opening and closing the bill in each revolution thereof, and means for placing the threads in the path of the open bill after the bill has completed one revolution.

HOWARD D. COLMAN.

Witnesses:
R. E. McCausland,
Louis A. Culver.

Corrections in Letters Patent No. 1,029,853.

It is hereby certified that in Letters Patent No. 1,029,853, granted June 18, 1912, upon the application of Howard D. Colman, of Rockford, Illinois, for an improvement in "Knot-Tying Mechanism," errors appear in the grant and in the heading to the printed specification requiring correction as follows: In the granting clause, line 3, strike out the words "their successors or assigns," and insert the words *copartners, doing business as Barber-Colman Company, of Rockford, Illinois, their heirs or assigns;* and in the heading of the printed specification, line 2, for the word "trading" read *doing business;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 18th day of March, A. D., 1913.

[SEAL.]

C. C. BILLINGS,

*Acting Commissioner of Patents.*