KNOT TYING MACHINE FOR TYING SPACED OVERHAND KNOTS

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Fig. 1

Fig. 2
KNOT TYING MACHINE FOR TYING SPACED OVERHAND KNOTS

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15 Claims. (Cl. 28—1)

1 This invention relates to a knot tying machine. More particularly, it relates to a knot tying machine adapted to tie overhand knots in series in cord, twine, yarn, thread or the like; for example for the purpose of producing textiles having a pinpoint effect.

It is an object of the present invention to provide an improved knot tying machine of the character described.

It is a further object of the invention to provide a knot tying machine capable of tying overhand knots in series in cord, twine, yarn or the like, at a rapid rate and with accuracy of performance.

It is a still further object of the invention to provide a knot tying machine of the character described which is capable of high speed, accurate operation and which is adjustable to adjust the spacing of the knots.

These and other objects of the invention will be apparent from the ensuing description and the appended claims.

One form which the invention may assume is exemplified by way of example in the accompanying drawings, in which:

Figs. 1 and 2 are plan views of the knot tying machine showing the loop forming hook and the loop in successive stages of operation;

Figs. 3 to 10 are more or less diagrammatic views, with parts omitted for purposes of simplification and clarity, showing the rotor and shuttle in top plan view and showing also the loop forming hook in successive stages of forming a loop and drawing the loop into a tight knot;

Fig. 11 is a front elevation of the machine;

Fig. 12 is a view in side elevation of the twine take-up mechanism as viewed along the line 12—12 of Fig. 1;

Fig. 13 is a view in side elevation of the knot releasing mechanism as viewed along the line 13—13 of Fig. 1;

Fig. 14 is a sectional plan view taken along the line 14—14 of Fig. 11, with certain parts omitted and illustrating the mechanism for actuating the loop forming hooks;

Figs. 15 and 16 are views similar to that of Fig. 14 but with the frame member shown in Fig. 14 omitted and showing the mechanism of Fig. 14 in different stages of operation.

Referring now to the drawings, and more particularly to Figs. 1, 2 and 11, the machine comprises a frame 8 in which a main spindle 10 is journaled at 11 and 12. A pulley 57 is fixed to the spindle 10 and it is intended that a counter-clockwise movement (as viewed in Fig. 1) be imparted to the pulley 57, hence to the spindle 10, from any suitable source of power (not shown). A rotor 13 is fixed to the upper end of the spindle 10, such rotor having a hollow or cup-like shape. A cam 21 and a loop-carrying hook 18 are fixed to and project radially from the rotor 13 as shown in Figs. 1 and 11, the hook 18 being disposed near the rim and the cam 21 at the bottom of the rotor and the hook 18 being disposed slightly in advance of the cam 21. A stud 22 is fixed to and depends from the bottom of the rotor 13, as shown in Fig. 11. The purpose and operation of the cam 21, the hook 18, and the stud 22 are explained hereinafter.

A shuttle 3 is also provided having a cup-shaped recess 32 which is intended to carry a spool of twine mounted on a shuttle spindle 14 which is fixed to the bottom of the cup and is disposed eccentrically with respect to the rotor, as will be seen from Fig. 11. The shuttle 3 is provided with a rim or flange 36 and a web 32, and the flange 36 rests upon the rim of the rotor. The rotor is also provided with a vertical flange 59 for centering the shuttle in the rotor. The flange 59 does not extend entirely around the shuttle and, as is best shown in Figs. 1 and 2, between the ends of the flange 59 the rim 36 is recessed at 70 and at 71 and is formed with a loop receiving point or hook 14 and a knot releasing point or hook 15. The shuttle 3 is intended to frictionally engage the rotor 13 only to a degree such that counter-clockwise rotation of the rotor will carry it to the position shown in Figs. 1 and 2; that is, with the knot releasing point 15 abutting a bracket 5a which is fixed to the frame of the machine, but such that the shuttle 3 is free to move in a clockwise direction when an appropriate force is applied to its web 32 in the manner and for the purpose described hereinafter.

A loop forming mechanism is also provided comprising a pair of converging hooks 29 mounted on a bracket or arm 29a which is non-rotatably mounted on one end of a shaft 42 which is journaled in arms 43a and 43b at one end of a bracket 43. Bracket 43 is non-rotatably mounted at its other end on a hollow shaft 46 which is journaled in the frame of the machine. The hooks 29 are intended to form loops in the twine and to this end they are actuated by the mechanism now to be described with particular reference to Figs. 14, 15 and 16.

Hollow shaft 46 is concentric to a solid shaft 47 which is also journaled in the frame of the ma-
chine. A sector gear 26 is fixed to the upper end of the shaft 41. Gear 26 meshes with a bevel pinion 27 which is fixed to one end of a shaft 42 a which is journaled in the bracket 43 at 43c and 43d. To the other end of shaft 42 a is fixed a bevel pinion 28 which meshes with a bevel pinion 22 c fixed to the shaft 42. The hollow shaft 45 and the solid shaft 47 are relatively rotatable, and the hollow shaft 46 is actuated through the medium of a lever 48 a which is fixed thereto while the solid shaft 47 is actuated through the medium of a lever 48 b which is fixed thereto. Lever 48 a is connected by a link 25 c to a lever 44 a which pivots on a stud 50 fixed to the frame of the machine. Lever 45 is similarly connected by a link 26 to a lever 44 which also pivots on the stud 50. As illustrated, either of the links 25 and 26 can be adjusted by attachment at selected holes 72 formed in the levers 44 and 44 a. Rollers 54 and 54 a are fixed to the levers 44 and 44 a respectively, and these rollers are held in contact by springs 51 and 51 a, respectively, with springs 24 and 23, respectively, the springs 51 and 51 a being fixed to the frame at 60. The cam 23 and 24 are fixed to the main spindle 10. The cam 23 is formed with a high dwell 73 comprising continuous sections m, q, and s, a low dwell k, a recede t and a rise l. The cam 24 is formed with high dwells m and s which are in registry with the similarly designated sections of the cam 23, a low dwell k which is in registry with the similarly designated low dwell of cam 23, another low dwell p, a recede t and a rise l in registry with the similarly designated portions of cam 23, and it is also formed with a recede n on opposite sides of the low dwell p. Motion is imparted to the hooks 29 as follows: At the commencement of a cycle, the hooks 29 and the cam 23 and 24 will be in the relative positions shown in Figs. 16 and 7. It will be seen that both rollers 54 and 54 a are riding the coinciding high dwells m of the cams 23 and 24. Consequently, no movement is imparted to the hooks 29. Soon thereafter, roller 54 rides down the recede n of cam 24, thus allowing lever 44 to pivot counter-clockwise as viewed in Figs. 15 and 16, under the tension of spring 51. Through link 25 and lever 45, solid shaft 47 is rotated counter-clockwise, and consequently sector gear 26 is also rotated counter-clockwise. Through the medium of pinion 21, shaft 43c, pinions 28 and 28 a and shaft 42, hooks 29 are rotated or twisted to the position shown in Figs. 3 and 14. A brief dwell occurs and then roller 54 rides up rise r to high dwell s, thus restoring hooks 29 to the position shown in Fig. 16. Meanwhile no motion has been imparted to bracket 43. Subsequently, both rollers 54 and 54 a ride down the recede t of cams 23 and 24, respectively. This imparts the same twisting motion to the hooks 29 as described above and it also, through the medium of lever 44 a, link 25 c, lever 45 a and hollow shaft 46, rotates bracket 43 counter-clockwise, thus resulting in dipping hooks 29 as well as twisting them. Thereafter a brief dwell occurs and then the rollers 54 and 54 a ride up the rise l to the high dwells m, thus completing a cycle of operation. The twisting and dipping movements of the hooks 29 thus described and illustrated, in cooperation with other elements of the machine, to take a bight in the twine, form a loop, and then form a knot and draw it tight. It is also necessary, of course, to provide a feeding movement for the twine, and this is accomplished by means of a twine take-up mechanism which is best shown in Figs. 11 and 12. The twine take-up mechanism comprises a take-up roller 8 fixed to one end of a shaft 55 and constructed of resilient material, and an idler roller 7. The shaft 55 is journaled in the frame of the machine, and fixed to its other end is a ratchet gear 31. The ratchet gear 31 is held in fixed position by a pawl 36, except as it is rotated in increments in a clockwise direction by means of a pawl 35. The pawl 35 is actuated by a lever 30 which is mounted on the hub of the ratchet gear 31, and a torsion spring 34 serves normally to hold the lever 30 and pawl 35 in a retracted position which is determined by a stop pin 53. The stop pin 53 may be located in any of a series of holes 31 a formed in the frame of the machine, thus governing the permissible effective strike, hence the degree of advancement of the ratchet gear 31. During each revolution of the rotor 13, the stud 22 strikes the lever 30, thus imparting an increment of clockwise movement to the ratchet gear 31, hence also to the roller 8. For a purpose that will appear hereinafter, means are provided for imparting a single oscillation to the shuttle 3 during each cycle of revolution of the rotor 13. Such means, best shown in Figs. 11, 13, and 15, comprises a pin or stud 50 mounted on a lever 37. The stud 58 projects radially and inwardly of the shuttle 3 adjacent the web 30 thereof. Lever 37 is fulcrummed on the frame of the machine at 37 a and it is urged in a clockwise direction as viewed in Fig. 13 by means of a spring 39 fixed at one end at 83 a to the machine frame and at its other end to a lug or ear 41 formed on the formed with a rise r and a recede n on opposite sides of the low dwell p. Motion is imparted to the hooks 29 as follows: At the commencement of a cycle, the hooks 29 and the cam 23 and 24 will be in the relative positions shown in Figs. 16 and 7. It will be seen that both rollers 54 and 54 a are riding the coinciding high dwells m of the cams 23 and 24. Consequently, no movement is imparted to the hooks 29. Soon thereafter, roller 54 rides down the recede n of cam 24, thus allowing lever 44 to pivot counter-clockwise as viewed in Figs. 15 and 16, under the tension of spring 51. Through link 25 and lever 45, solid shaft 47 is rotated counter-clockwise, and consequently sector gear 26 is also rotated counter-clockwise. Through the medium of pinion 21, shaft 43c, pinions 28 and 28 a and shaft 42, hooks 29 are rotated or twisted to the position shown in Figs. 3 and 14. A brief dwell occurs and then roller 54 rides up rise r to high dwell s, thus restoring hooks 29 to the position shown in Fig. 16. Meanwhile no motion has been imparted to bracket 43. Subsequently, both rollers 54 and 54 a ride down the recede t of cams 23 and 24, respectively. This imparts the same twisting motion to the hooks 29 as described above and it also, through the medium of lever 44 a, link 25 c, lever 45 a and hollow shaft 46, rotates bracket 43 counter-clockwise, thus resulting in dipping hooks 29 as well as twisting them. Thereafter a brief dwell occurs and then the rollers 54 and 54 a ride up the rise l to the high dwells m, thus completing a cycle of operation. The twisting and dipping movements of the hooks 29 thus described and illustrated, in cooperation with other elements of the machine, to take a bight in the twine, form a loop, and then form a knot and draw it tight. It is also necessary, of course, to provide a feeding movement for the twine, and this is accomplished by means of a twine take-up mechanism which is best shown in Figs. 11 and 12. The twine take-up mechanism comprises a take-up roller 8 fixed to one end of a shaft 55 and constructed of resilient material, and an idler roller 7. The shaft 55 is journaled in the frame of the machine, and fixed to its other end is a ratchet gear 31. The ratchet gear 31 is held in fixed position by a pawl 36, except as it is rotated in increments in a clockwise direction by means of a pawl 35. The pawl 35 is actuated by a lever 30 which is mounted on the hub of the ratchet gear 31, and a torsion spring 34 serves normally to hold the lever 30 and pawl 35 in a retracted position which is determined by a stop pin 53. The stop pin 53 may be located in any of a series of holes 31 a formed in the frame of the machine, thus governing the permissible effective strike, hence the degree of advancement of the ratchet gear 31. During each revolution of the rotor 13, the stud 22 strikes the lever 30, thus imparting an increment of clockwise movement to the ratchet gear 31, hence also to the roller 8. For a purpose that will appear hereinafter, means are provided for imparting a single oscillation to the shuttle 3 during each cycle of revolution of the rotor 13. Such means, best shown in Figs. 11, 13, and 15, comprises a pin or stud 50 mounted on a lever 37. The stud 58 projects radially and inwardly of the shuttle 3 adjacent the web 30 thereof. Lever 37 is fulcrummed on the frame of the machine at 37 a and it is urged in a clockwise direction as viewed in Fig. 13 by means of a spring 39 fixed at one end at 39 a to the machine frame and at its other end to a lug or ear 41 formed on the forms with a rise r and also to limit clock-wise movement of the lever 27 in an ear 39 provided, which projects inwardly and radially of the rotor 13 so as to contact the cam 21 once during each cycle or revolution. It will be apparent that each time such contact is established, the shuttle will be rotated clockwise as viewed in Figs. 1 and 2 so as to separate the knot forming point 15 momentarily from the bracket 5 a. However, after cam 21 has passed the lug 40, shuttle 3 will be carried by the rotor back to its normal position by butting the bracket 5 a. In operation, the machine functions as follows: A spool 1 of twine is placed on the shuttle spindle 1 a and the twine is threaded through an opening 4 in the shuttle. The pulley 57 is rotated manually until the loop forming hooks 29 are in the position shown in Fig. 1. The twine is looped over the hooks 29 and shuttle, to form a loop 32, as illustrated, care being taken that the twine is led over a spring guide wire 16 and between guide wires 17 and 18. The guide wire 16 is fixed at one end at 16 a to the shuttle and at its other end it extends through a guide slot 52 formed in a web member 3 e. The twine is also threaded through a hole 5 formed in bracket 5 a and through a knotting guide 6, thence between rollers 7 and 8. Of course, operation may be commenced at some other stage of the cycle if so desired, care being taken that the twine is led through the machine in a manner which is appropriate to the selected stage. As the machine commences and continues to operate, the following operations are performed on the twine, particular reference being made to Figs. 1, 2 and 3 to 10; Loop forming hooks 29 are raised (without being twisted) from the position shown in Fig. 1 to that shown in Fig. 2, thus taking a bight in the twine. Then hooks 29 are twisted (without
motion about the axis of shafts 46 and 47) through approximately 270° from the position shown in Fig. 2 to that shown in Fig. 3, thus forming a loop 33. A dwell occurs during which the loop carrying hook 13 on rotor 13 passes between the said said shaft forming hooks 29 and through the loop 33, lifts the loop clear of the hooks 19 (it will be seen from Figs. 3 to 5 that the loop follows a sloping path from e to f on hook 18 so as to clear the hooks 29), and deposits the loop 10 on the loop receiving point 14. The loop thus formed is carried by the hook 19 about the rim 2a of the shuttle as illustrated in Figs. 7 to 10. Meanwhile hooks 29 are twisted (Figs. 6 and 7) and are dipped to the position shown in Fig. 10, 15 in readiness for the next cycle of operation.

Meanwhile also, the preceding loop 32 is being drawn into a knot, released and withdrawn from the machine. This is accomplished by the take-up mechanism comprising take-up roller 8 and idler roller 7. These receive intermittent movement in the manner described hereinabove, and such movement is timed and adjusted to draw the loop into tight knot on the end of the loop releasing point 15, as is illustrated in Figs. 3 to 8. Bracket 5a prevents release of the knot until it has been drawn tight, and at the appropriate instant the knot is released by clockwise movement of the cam 3, which is accomplished by the said 56 in the manner described hereinabove.

It will be evident, of course, that clearance for the twine while the loop is being drawn into a knot is provided by the recesses 76 and 77 in the shuttle rim 3a, and that the loop is guided onto the point 15 by the guide wires 17 and 18. The guide wires 17 and 18 also retard the twine so as to prevent an overthrow of the loop when it has cleared the shuttle. To prevent overthrow when the loop has cleared the point 15, a guide wire 56 is also provided, as shawn in Fig. 1.

The guide wire 16, during travel of a loop about the shuttle, will be drawn inwardly along the slot 52 to about the position indicated as 16b in Fig. 2, and at about the instant of release of a knot from the point 15, the wire 16 will also be released and will spring back to its normal, outward position, thus assisting in clearing the twine for re-engagement with the loop forming hooks 29.

It will thus be apparent that a knot tying machine has been provided which effectively ties knots in twine. The machine is adjustable to space the knots as desired and it is capable of tying knots at high speed. The machine embodies numerous features which provide nicety of control, safety and dependability of operation, and ease and accuracy of adjustment.

While I have shown the preferred form of my invention, it is to be understood that various changes may be made in its construction by those skilled in the art without departing from the spirit of the invention as defined in the appended claims.

5. A machine for tying overhand knots comprising: a frame; a shuttle holder rotatably mounted on said frame; means for rotating said shuttle holder; a shaft mounted on said shuttle holder; a spool retainer formed in said shuttle; a cord take-up device mounted on said frame for periodically taking up a predetermined length of the cord passing through said second guide; opposed peripherally spaced, cord loop receiving and knot releasing hooks formed on the periphery of said shuttle; a loop sectioning hook arm on said frame and a looping hook journaled therein; means responsive to the rotation of said shuttle holder for periodically moving said arm and looping hook over said cord loop receiving hook and for periodically rotating said looping hook whereby said looping hook periodically takes a bite on that portion of said cord disposed between said first and second guides and forms it into a loop in alignment with said loop receiving hook; a cord loop clearing hook provided on the periphery of said shuttle holder and arranged to engage said cord loop and to carry it around said shuttle to said knot releasing hook, said knot releasing hook being normally in engagement with said second cord guide to restrain said cord passing therebetween; and means responsive to the rotation of said shuttle holder for periodically retracting said shuttle so as to disengage said knot releasing hook from said second cord guide.

6. A machine for tying overhand knots comprising: a frame; a shuttle holder rotatably mounted on said frame; means for rotating said shuttle holder; a shaft mounted on said shuttle holder; a spool retainer formed in said shuttle; a cord take-up device mounted on said frame for periodically taking up a predetermined length of the cord passing through said second guide; opposed peripherally spaced, cord loop receiving and knot releasing hooks formed on the periphery of said shuttle; a loop sectioning hook arm on said frame and a looping hook journaled therein; means responsive to the rotation of said shuttle holder for periodically moving said arm and looping hook over said cord loop receiving hook and for periodically rotating said looping hook whereby said looping hook periodically takes a bite on that portion of said cord disposed between said first and second guides and forms it into a loop in alignment with said loop receiving hook; a cord loop clearing hook provided on the periphery of said shuttle holder and arranged to engage said cord loop and to carry it around said shuttle to said knot releasing hook, said knot releasing hook being normally in engagement with said second cord guide to restrain said cord passing therebetween; and means responsive to the rotation of said shuttle holder for periodically retracting said shuttle so as to disengage said knot releasing hook from said second cord guide.

7. A machine for tying overhand knots comprising: a frame; a shuttle holder rotatably mounted on said frame; means for rotating said shuttle holder; a shaft mounted on said shuttle holder; a spool retainer formed in said shuttle; a cord take-up device mounted on said frame for periodically taking up a predetermined length of the cord passing through said second guide; opposed peripherally spaced, cord loop receiving and knot releasing hooks formed on the periphery of said shuttle; a loop sectioning hook arm on said frame and a looping hook journaled therein; means responsive to the rotation of said shuttle holder for periodically moving said arm and looping hook over said cord loop receiving hook and for periodically rotating said looping hook whereby said looping hook periodically takes a bite on that portion of said cord disposed between said first and second guides and forms it into a loop in alignment with said loop receiving hook; a cord loop clearing hook provided on the periphery of said shuttle holder and arranged to engage said cord loop and to carry it around said shuttle to said knot releasing hook, said knot releasing hook passing through the loop forming the knot.
4. A machine for tying overhand knots comprising: a frame; a shuttle holder rotatably mounted on said frame; means for rotating said shuttle holder; a shuttle mounted on said shuttle holder; a spool retainer formed in said shuttle; a cord spool mounted in said retainer; a first cord guide provided on the side of said retainer and a second cord guide mounted on said frame adjacent the periphery of said shuttle holder, cord from said spool being arranged to pass successively through said first and second guides; a cord take-up device mounted on said frame for periodically taking up a predetermined length of the cord passing through said second guide; opposed peripherally spaced, cord loops receiving and knot releasing hooks formed on the periphery of said shuttle; a looping hook arm mounted on said frame and a looping hook journaled therein; means including cams rotating in response to the rotation of said shuttle holder for periodically moving said looping hook over said cord loop receiving hook and for periodically rotating said looping hook whereby said looping hook periodically takes a sight on that portion of said cord disposed between said first and second guides and forms it into a loop in alignment with said loop receiving hook; a cord loop clearing hook provided on the periphery of said shuttle holder and arranged to engage said cord loop and to carry it around said shuttle to said knot releasing hook, said knot releasing hook being normally in engagement with said second cord guide to restrain said cord from passing there-through; and means responsive to the rotation of said shuttle holder for periodically retracting said shuttle so as to disengage said knot releasing hook from said second cord guide.

8. A machine for tying overhand knots comprising: a frame; a shuttle holder rotatably mounted on said frame; means for rotating said shuttle holder; a shuttle mounted on said shuttle holder; a spool retainer formed in said shuttle; a cord spool mounted in said retainer; a first cord guide provided on the side of said retainer and a second cord guide mounted on said frame adjacent the periphery of said shuttle holder, cord from said spool being arranged to pass successively through said first and second guides; a cord take-up device mounted on said frame for periodically taking up a predetermined length of the cord passing through said second guide; opposed peripherally spaced, cord loop receiving and knot releasing hooks formed on the periphery of said shuttle; a looping hook arm mounted on said frame and a looping hook journaled therein; means including cams rotating in response to the rotation of said shuttle holder for periodically moving said looping hook over said cord loop receiving hook and for periodically rotating said looping hook whereby said looping hook periodically takes a sight on that portion of said cord disposed between said first and second guides and forms it into a loop in alignment with said loop receiving hook; a cord loop clearing hook provided on the periphery of said shuttle holder and arranged to engage said cord loop and to carry it around said shuttle to said knot releasing hook, said knot releasing hook being normally in engagement with said second cord guide to restrain said cord from passing there-through; and means responsive to the rotation of said shuttle holder for periodically retracting said shuttle so as to disengage said knot releasing hook from said second cord guide.
take-up device mounted on said frame for periodically taking up a predetermined length of the cord passing through said second guide; opposed peripherally spaced, cord loop receiving and knot releasing hooks formed on the periphery of said shuttle; a looping hook arm mounted on said frame and a looping hook journaled therein; means responsive to the rotation of said shuttle holder for periodically moving said arm and looping hook over said cord loop receiving hook and for periodically retracting said looping hook thereby to strain said cord from passing therethrough; and means responsive to the rotation of said shuttle holder for periodically retracting said looping hook so as to disengage said knot releasing hook from said second cord guide.

6. A machine for tying overhand knots comprising: a frame; a shuttle holder rotatably mounted on said frame; means for rotating said shuttle holder; a shuttle mounted on said shuttle holder; a spool retainer formed in said shuttle; a cord spool mounted in said retainer; a first cord guide provided on the side of said retainer and a second cord guide mounted on said frame adjacent the periphery of said shuttle holder, cord from said spool being arranged to pass successively through said first and second guides; a cord take-up device including a pair of engaging rollers mounted on said frame for periodically taking up a predetermined length of the cord passing through said second guide; means for periodically rotating one of said rollers in response to the rotation of said spindles; opposed peripherally spaced, cord loop receiving and knot releasing hooks formed on the periphery of said shuttle; a looping hook arm mounted on said frame and a looping hook journaled therein; means responsive to the rotation of said shuttle holder for periodically moving said arm and looping hook over said cord loop receiving hook and for periodically retracting said looping hook whereby said looping hook periodically takes a bite on that portion of said cord disposed between said first and second guides and forms it into a loop in alignment with said loop receiving hook; a cord loop clearing hook provided on the periphery of said shuttle holder and arranged to engage said cord loop and to carry it around said shuttle to said knot releasing hook, said knot releasing hook being normally in engagement with said second cord guide to restrain said cord from passing therethrough; and means responsive to the rotation of said shuttle holder for periodically retracting said shuttle so as to disengage said knot releasing hook from said second cord guide.

9. A machine for tying overhand knots comprising: a frame; a shuttle holder rotatably mounted on said frame; means for rotating said shuttle holder; a spool mounted on said shuttle holder; a spool retainer formed in said shuttle; a cord spool mounted in said retainer; a first cord guide provided on the side of said retainer and a second cord guide mounted on said frame adjacent the periphery of said shuttle holder, cord from said spool being arranged to pass successively through said first and second guides; a cord take-up device mounted on said frame for periodically taking up a predetermined length of the cord passing through said second guide in response to the rotation of said shuttle holder; opposed peripherally spaced, cord loop receiving and knot releasing hooks formed on the periphery of said shuttle; a looping hook arm pivoted to said frame and a looping hook journaled therein; means responsive to the rotation of said shuttle holder for periodically swinging said arm and looping hook over said cord loop receiving hook and for periodically rotating said looping hook whereby said looping hook periodically takes a bite on that portion of said cord disposed between said first and second guides and forms it into a loop in alignment with said loop receiving hook; a cord loop clearing hook provided on the periphery of said shuttle holder and arranged to engage said cord loop and to carry it around said shuttle to said knot releasing hook, said knot releasing hook being normally in engagement with said second cord guide to restrain said cord from passing therethrough; and means responsive to the rotation of said shuttle holder for periodically retracting said shuttle so as to disengage said knot releasing hook from said second cord guide.

11. A machine for tying overhand knots comprising: a frame; a spindles journaled in said frame; a shuttle holder fixed at one end of said spindles for rotation therewith; means for rotating said spindles; a spool mounted on said shuttle holder; a spool retainer formed in said shuttle; a cord spool mounted in said retainer; a first cord guide provided on the side of said retainer and a second cord guide mounted on said frame adjacent the periphery of said shuttle holder, cord from said spool being arranged to pass successively through said first and second guides; a
being arranged to pass successively through said first and second guides; a cord take-up device, including a pair of engaging rollers mounted on said frame for periodically taking up a predetermined length of the cord passing through said second guide; means for periodically rotating one of said rollers in response to the rotation of said spindle; opposed peripherally spaced, cord loop receiving and knot releasing hooks formed on the periphery of said shuttle; a looping hook arm mounted on said frame and a looping hook journaled therein; means responsive to the rotation of said shuttle holder for periodically moving said arm and looping hook over said cord loop receiving hook and for periodically rotating said looping hook whereby said looping hook periodically takes a bite on that portion of said cord disposed between said first and second guides and forms it into a loop in alignment with said loop receiving hook; a cord loop clearing hook provided on the periphery of said shuttle holder and arranged to engage said cord loop and to carry it around said shuttle to said knot releasing hook, said knot releasing hook being normally in engagement with said second guide to restrain said cord from passing therethrough; and means responsive to the rotation of said shuttle holder for periodically retracting said shuttle so as to disengage said knot releasing hook from said second cord guide.

12. A machine for tying overhand knots comprising: a frame; a shuttle journaled in said frame; a shuttle holder fixed to one end of said spindle for rotation therewith; means for rotating said spindle; a shuttle mounted on said shuttle holder; a spool retainer formed in said shuttle; a cord spool mounted in said retainer; a first cord guide provided on the side of said retainer and a second cord guide mounted on said frame adjacent the periphery of said shuttle holder, cord from said spool being arranged to pass successively through said first and second guides; a cord loop take-up device mounted on said frame for periodically taking up a predetermined length of the cord passing through said second guide; opposed peripherally spaced, cord loop receiving and knot releasing hooks formed on the periphery of said shuttle; a looping hook arm pivoted to said frame and a looping hook journaled therein; means including cams rotating in response to the rotation of said shuttle holder for periodically swinging said arm and looping hook over said cord loop receiving hook and for periodically rotating said looping hook whereby said looping hook periodically takes a bite on that portion of said cord disposed between said first and second guides and forms it into a loop in alignment with said loop receiving hook; a cord loop clearing hook provided on the periphery of said shuttle holder and arranged to engage said cord loop and to carry it around said shuttle to said knot releasing hook, said knot releasing hook being normally in engagement with said second cord guide to restrain said cord from passing therethrough; and means responsive to the rotation of said shuttle holder for periodically retracting said shuttle so as to disengage said knot releasing hook from said second cord guide.

13. A machine for tying overhand knots comprising: a frame; a shuttle holder rotatably mounted on said frame and provided on its periphery with a cord loop clearing hook; means for rotating said shuttle holder; a spool mounted on said frame for movement to and away from said shuttle and over said cord loop receiving hook; a spool receiving cup mounted in said shuttle holder; a spool receiving cup formed in said shuttle holder; a spool being provided on one side thereof with a cord guide; a spool mounted in said cup; a looping hook arm mounted on said frame for movement to and away from said shuttle and over said cord loop receiving hook; a looping hook journaled in said frame; means responsive to the rotation of said shuttle holder for actuating said looping hook arm and for rotating said looping hook in a predetermined sequence; a cord take-up device mounted on said frame; and means responsive to the rotation of said shuttle holder for periodically actuating said cord take-up device.

14. A machine for tying overhand knots comprising: a frame; a shuttle holder rotatably mounted on said frame and provided on its periphery with a cord loop clearing hook; means for rotating said shuttle holder; a spool mounted on said frame for movement to and away from said shuttle; a looping hook journaled in said frame; means responsive to the rotation of said shuttle holder for actuating said looping hook arm and for rotating said looping hook in a predetermined sequence; a cord take-up device mounted on said frame; and means responsive to the rotation of said shuttle holder for periodically actuating said cord take-up device.

15. A machine for tying overhand knots comprising: a frame; a shuttle holder rotatably mounted on said frame and provided on its periphery with a cord loop clearing hook; means for rotating said shuttle holder; a spool mounted on said frame for movement to and away from said shuttle and over said cord loop receiving hook; a looping hook journaled in said frame; means responsive to the rotation of said shuttle holder for actuating said looping hook arm and for rotating said looping hook in a predetermined sequence; a cord take-up device mounted on said frame; and means responsive to the rotation of said shuttle holder for periodically actuating said cord take-up device.

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