April 3, 1962 D. MESSA 3,028,185

DEVICE FOR TYING TWO ENDS OF THREAD BY THE SO-CALLED BARREL KNOT

Filed May 18, 1960 7 Sheets-Sheet 1

Fig.1

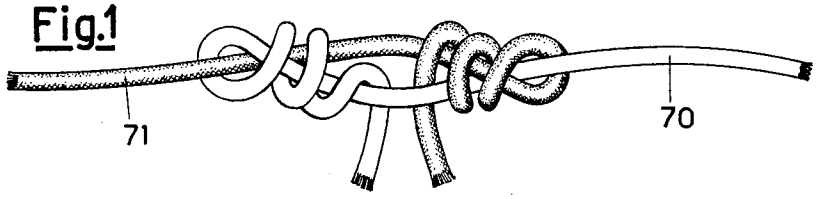


Fig.2

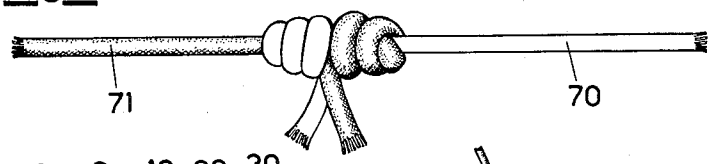


Fig.8

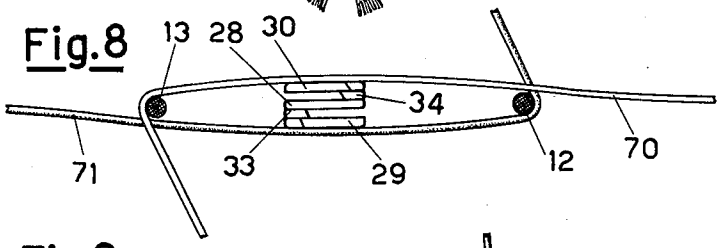


Fig.9

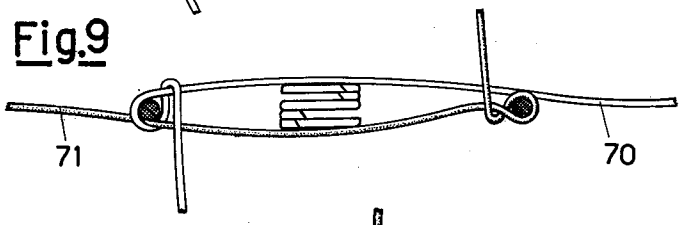


Fig.10

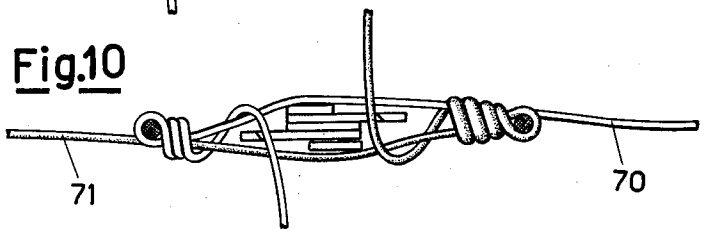
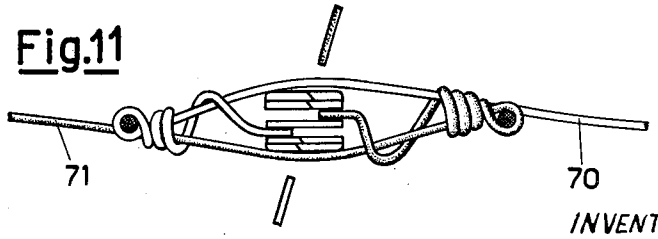


Fig.11



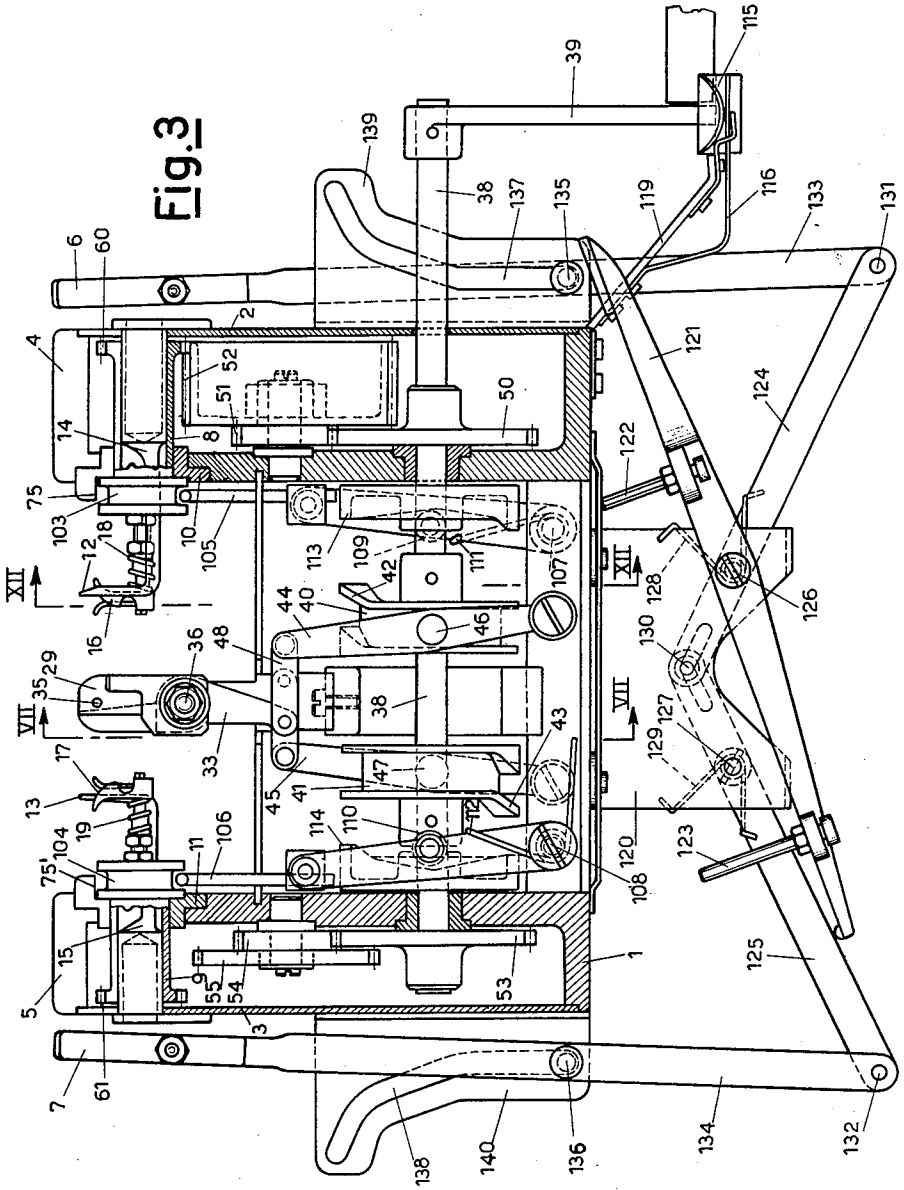
INVENTOR
DANIELE MESSA
BY Dean, Fairbank & Hirsch
ATTORNEYS

April 3, 1962 D. MESSA 3,028,185

DEVICE FOR TYING TWO ENDS OF THREAD
BY THE SO-CALLED BARREL KNOT

Filed May 18, 1960 7 Sheets-Sheet 2

Fig. 3



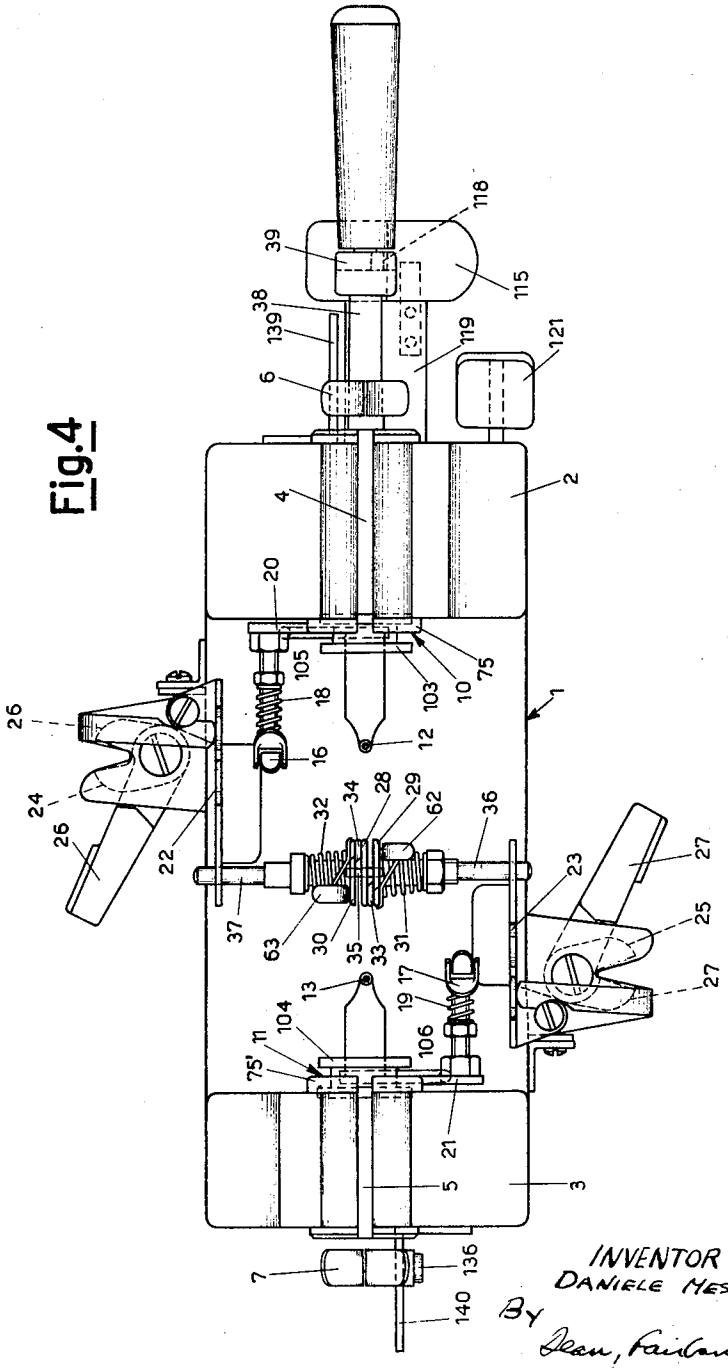
INVENTOR
DANIELE MESSA
By Dean, Fairbank & Hirsch
ATTORNEYS

April 3, 1962 D. MESSA 3,028,185

DEVICE FOR TYING TWO ENDS OF THREAD BY THE SO-CALLED BARREL KNOT

Filed May 18, 1960 7 Sheets-Sheet 3

Fig.4



INVENTOR
DANIELE MESSA
BY
Dean, Fairbank & Hersch
ATTORNEYS

April 3, 1962 D. MESSA 3,028,185

DEVICE FOR TYING TWO ENDS OF THREAD BY THE SO-CALLED BARREL KNOT

Filed May 18, 1960 7 Sheets-Sheet 4

Fig.6

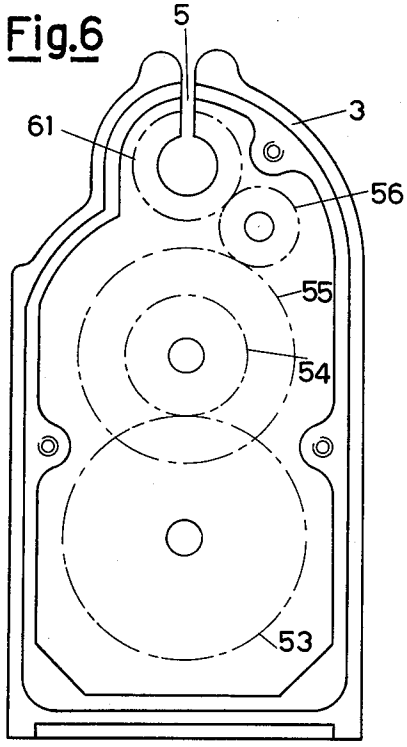
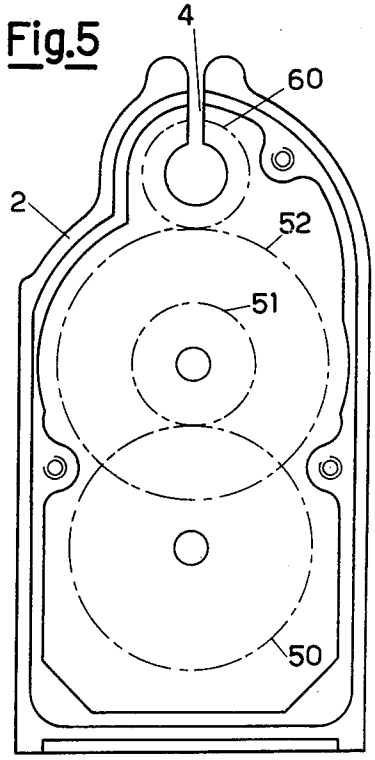


Fig.5



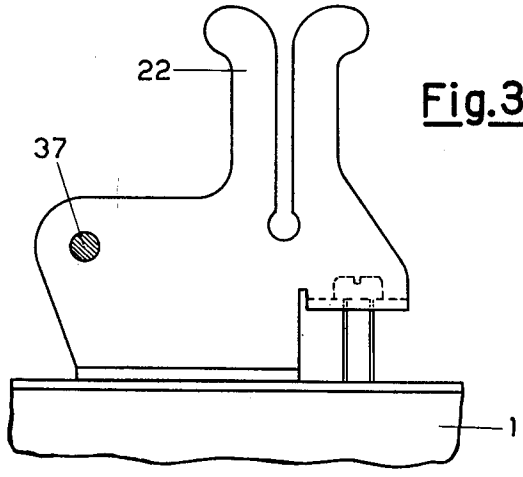


Fig.3a

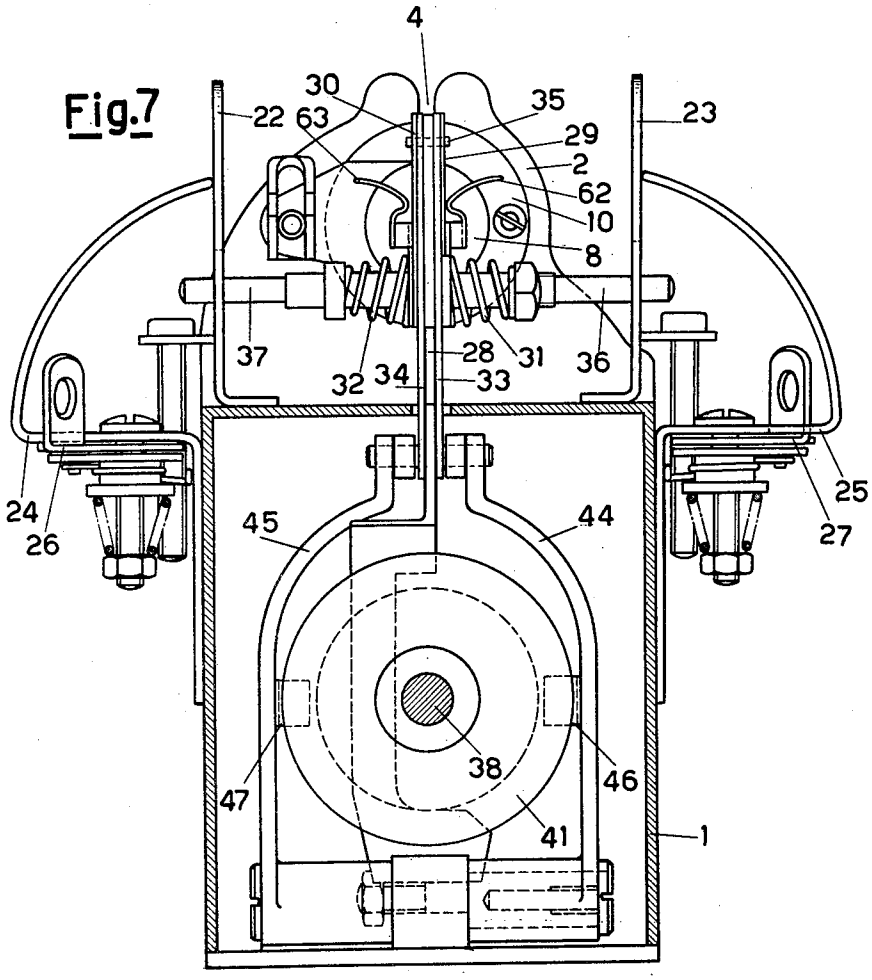
INVENTOR
DANIELE MESSA
By
Dean, Fairbank & Husch
ATTORNEYS

April 3, 1962 D. MESSA 3,028,185

DEVICE FOR TYING TWO ENDS OF THREAD
BY THE SO-CALLED BARREL KNOT

Filed May 18, 1960 7 Sheets-Sheet 5

Fig.7



INVENTOR
DANIELE MESSA
By Dean, Fairbank & Hauch
ATTORNEYS

April 3, 1962 D. MESSA 3,028,185

DEVICE FOR TYING TWO ENDS OF THREAD
BY THE SO-CALLED BARREL KNOT

Filed May 18, 1960 7 Sheets-Sheet 6

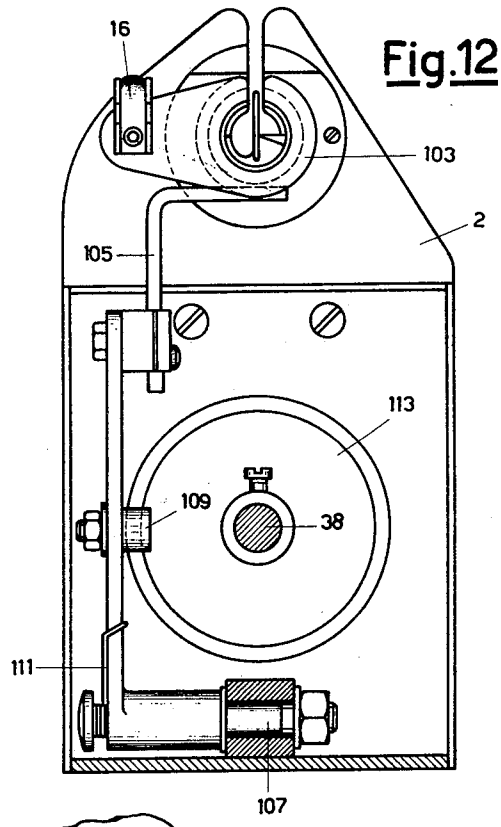


Fig.12

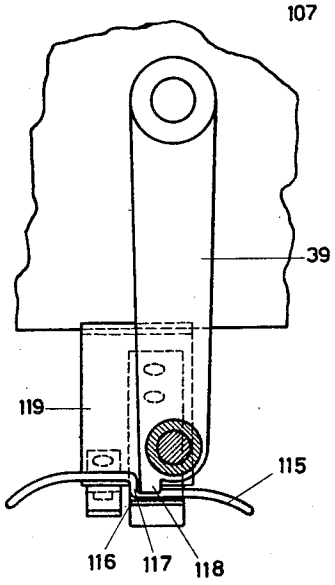


Fig.14

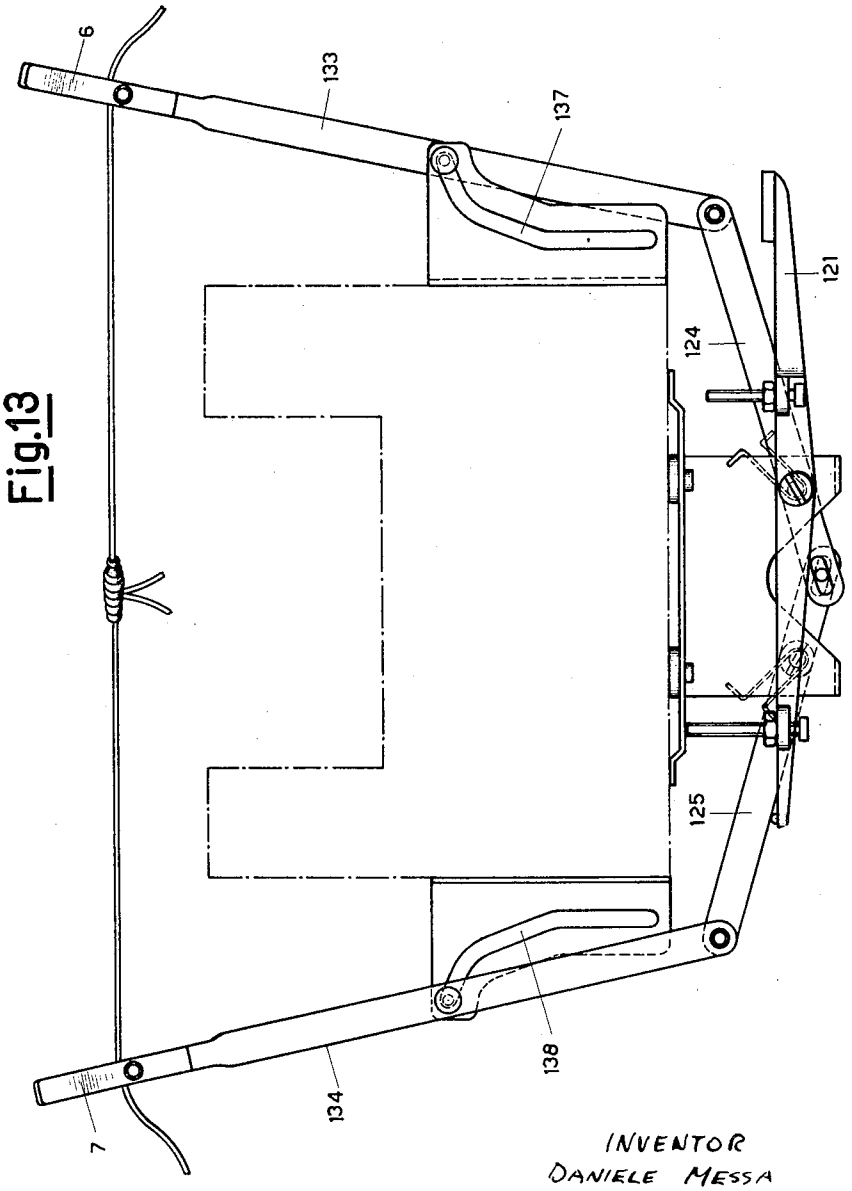
INVENTOR
DANIELE MESSA
BY Dean, Fairbank & Hensch
ATTORNEYS

April 3, 1962 D. MESSA 3,028,185

DEVICE FOR TYING TWO ENDS OF THREAD BY THE SO-CALLED BARREL KNOT

Filed May 18, 1960 7 Sheets-Sheet 7

Fig.13



INVENTOR
DANIELE MESSA
BY Dean, Fairbank & Hirsch
ATTORNEYS

United States Patent Office 3,028,185 Patented Apr. 3, 1962

3,028,185

DEVICE FOR TYING TWO ENDS OF THREAD BY THE SO-CALLED BARREL KNOT

Daniele Messa, Via S. Pietro 17, Roe-Volciano, Brescia, Italy

Filed May 18, 1960, Ser. No. 29,873
Claims priority, application Italy May 25, 1959
9 Claims. (Cl. 289—2)

The present invention relates to a device for the forming of the so-called "barrel" type knot between two ends of threads to be knotted. Said kind of barrel-knotting, as distinguished over other types, is particularly suited for yarns having high strength but scarce malleability and for yarns which have slippy character and pronounced facility to slide such as nylon yarns and the like. The so-called barrel-knotting finds special applications with industrial yarns destined for the manufacture of tyres, of transporting belts, of cloths for washing machines, of sails, of impermeable overalls, of elastic cords, of fish-nets and the like, especially thanks to its marked resistance against traction and owing to its reduced size and space requirement.

The barrel-knot is formed by winding the terminal portion of the first thread to be knotted, by right-hand reverse spiral contouring the second thread towards the centre of the knot, and the terminal portion of the second thread by left-hand reverse spiral contouring the first thread towards the centre of the knot, and then by tightening the windings with each other, after having threaded the two terminal tails between one thread and the other in the central part of the knot. By increasing the overall number of windings one increases proportionally the tightness and safety of the junctions in relationship with the various qualities and characteristics of the yarns to be knotted.

The device according to the invention comprises: two opposed heads fixed to the framing and provided with grooves (one each head) lying in one and the same vertical plane, which are adapted to permit the respective passage of the two threads to be knotted; pressure pincers arranged outside each of said heads to retain the yarn introduced into the groove of the respective head; two coaxial hollow bushes housed in the aforesaid heads slidable axially and rotatable in cylindrical seats of the respective heads, in such a way that they can be approached to the central part of the device or taken away therefrom, each of said bushes being equipped with a longitudinal through slit adapted to come to coincide with the fixed slit of the corresponding head when the device finds itself in one or the other extreme positions, initial and final; to allow the lateral introduction or the lateral extraction of the threads to be knotted; two opposed fixed vertical guide pins each projecting at right angle from a fixed hollow bar, which passes coaxially and internally through the corresponding bush, also said bar being provided with a longitudinal slit aligned with the slit of the head for the lateral passage of the thread; two elastic pincers for retaining the ends of the threads to be knotted, each one fixed eccentrically at the end of the corresponding bush, turned towards the central portion, said pincers being arranged in such a way as to find themselves, when the device is in the starting position of knot-tying, substantially arranged at opposed sides with respect to the axial plane passing through the two fixed pins and through the slits of the heads and respectively arranged in two transversal and parallel planes passing through said pins and substantially normal to said axial plane; a knot-tying member placed centrally between the two heads and said fixed guide pins, constituted by a vertical fixed plaque and by two cutting members, one at one side and the other one at the other side of the plaque, each cutting

member comprising a first blade cooperating with elastic means which hold it pressed against the plaque and a second blade oscillating around a pivot perpendicular to the said plaque and inserted between said plaque and said first blade, said cutting members being adapted to exert in succession a cutting action upon the ends of the threads which take part in the tying of the knot; means for rotating around their own axis the two bushes with the respective pincers in reversed senses with respect to each other and in such a manner that to n revolutions of one bush there correspond $n+1$ revolutions of the other one; means for displacing axially the bushes during the rotation in such a way as to approach them or to take them away contemporaneously with respect to the central member; stopping means for defining the initial and final positions of the bushes and of the respective pincers; thread-guide means and cutting means, adjustable in distance, for cutting the ends of the threads at the predetermined length when said ends are arranged in the starting position of the formation of the knot; a rotatable shaft supported by said heads whereon are fitted two symmetrical cams which control each in succession by means of an oscillating arm the opening and closing movement of the second blades of the cutting members of said central member, and two cams which control by means of levers the axial displacements of said bushes.

Other characteristics will appear from the description of a preferred embodiment illustrated in the accompanying drawing wherein:

FIG. 1 represents a barrel-knot already tied, prior to the tightening of the windings;

FIG. 2 represents a finished barrel knot, after tightening the windings;

FIG. 3 represents an elevational view partly in section of the device;

FIG. 3*a* represents a detail view on an enlarged scale of the thread guide,

FIG. 4 represents a top plan view of the device,

FIGS. 5 and 6 represents the position of the gears in respective heads of the device on an enlarged scale,

FIG. 7 represents a cross section on an enlarged scale taken along line VII—VII of FIG. 3, without the extracting device,

FIGS. 8 to 11 represent on an enlarged scale the various stages of formation of the knot during the revolution of the crank,

FIG. 12 represents a section on an enlarged scale taken along the line XII—XII in FIG. 3 without the extracting device,

FIG. 13 represents the extracting device on an enlarged scale in lifted position, and

FIG. 14 represents a detail view on an enlarged scale of the end-of-stroke stop for the crank.

The device illustrated comprises essentially a casing or frame **1** with two opposed heads **2—3** provided with slits **4** and **5** lying in the same vertical middle plane, two elastic pincers **6—7** for retaining the threads introduced into the respective grooves **4** and **5**, two bushings **8—9** internally hollow and rotatable and slidable axially in the respective seats **10—11** of the heads, two shaped vertical guide pins **12—13**, fixed, formed by the thinned ends bent at right angles of two hollow bars **14—15** which pass through the inside of bushings **8—9** coaxially and are fixed at the heads the bushings **8—9** and the hollow bars **14—15** being provided with longitudinal slits which find themselves aligned in the same plane with the slits **4—5** when the bushes find themselves in the starting position and in the final position of the formation of the knot; two jawed pincers **16—17** with pressure springs **18—19** carried at the ends by two square arms **20—21** fixed to the respective bushings **8—9** and rotatable therewith (FIGURE 4) there being provided for said arms

the abutments 75—75′ solid with the head guides 10—11 in such a way that in the initial and final positions of the knot-formation the two pincers 16—17 find themselves in the position illustrated in FIG. 4.

At the opposed sides of the frame there are mounted two thread-guides 22—23 and two shears 24—25 with the movable blades 26—27 operable by hand. Said shears are adjustable in height in order to effect the cutting of the thread-ends at the length necessary and sufficient to form the knot in relationship with the diameter of said threads.

Centrally there is arranged the member for the formation of the knot (FIG. 7) constituted by a central fixed vertical plate 28 and by two shears arranged one at one side and the other one at the other side of said plate, each shear being constituted by a first blade 29—30 displaceable on the cylindrical guide 36—37 pushed by the spring 31—32 towards the plate 28 prevented from rotating by the small dowel 35; and by a second shear 33—34 interposed between the first blade and the plate 28, oscillating around the axis 36—37 normal to the plate. Also the second blades 33—34 are subject to the pressure of the springs 31—32. Against the first blade 29—30 are pressed by said springs 31—32 the shaped lamellae 62—63 which serve to retain in position the heads of the threads during the formation of the knot.

At the interior of the framing there is supported a rotatable central shaft 38 actuated by the crank 39; on said shaft are fitted two symmetrical grooved cams 40—41 the salients 42—43 of which are out of phase by about 180°; said cams control the second blades 33—34 by means of the oscillating arms 44—45 provided with rolls 46—47 engaging in the grooves 40—41, and the link rods 48.

The same shaft 38 transmits—by means of the gears 50—51—52 contained in the head 2, and by means of the gears 53—54—55—56 contained in the head 3—the movement of rotation respectively to the toothed wheels 60—61 which are rigid with the two bushes 8—9, which turn in reversed senses with different speeds, the number of teeth being calculated in such a way that the bush 9 effects n revolutions while the bush 8 effects $n+1$, if $2n$ is the number of windings forming the thread.

The two bushings 8—9 are rigid with the rings 103—104 each of which has an annular groove in its periphery with which cooperate the ends of the arms 105—106 oscillating around the fulcra 107—108 provided with contact rolls 109—110 which are kept adherent to the tumbler-cams 113—114 by action of the springs 111—112. Said cams 113—114 are fitted on the central shaft 38, which already carries the other cams 40—41 and they oscillate during their rotation the arms 105—106 thereby causing the axial displacements of the rings 103—104 and, therefore, of the bushings 8—9 and of the pincers 16—17 which so can approach or go away with respect to the central member while they rotate by effect of the pairs of meshing toothed wheels 52—60 and 56—61.

By 115 is indicated a plate solid with the end of the springing arm 116, and provided with an abutting step 117 against which stops the crank 39 hitting it with its projection 118. The plate 115 is held in position of stopping by the springed arm 116 which keeps said plate pressed against the rigid arm 119. If lowering with a finger the plate 115, the crank 39 disengages from the abutment 117 and can perform another revolution.

The device for the mechanical extraction of the yarn already knotted, is constituted by a support 120 fixed on the bottom of the frame 1 whereon there are pivoted: the push-button control lever 121 with applied thereto two adjusting screws 122—123; two counter-levers 124—125 fulcrumed respectively at 126—127 provided with return springs 128—129 and operated by the lever 121 acting below the counter-lever 125. Said counter-levers are articulated with one another at one end 130 and articulated at the other end 131—132 with the rods 133—134 which are terminated by the pressure pincers 6 and 7 in the plane of the slits 4—5. Said rods 133—134 are provided with rolls 135—136 pivoted thereon and constrained to slide in the slits 137—138 of the plates 139—140, said slits having each a vertical initial portion and a subsequent portion diverging towards the outside.

Operation of the device is as follows:

Starting from the initial position illustrated in FIG. 4, one of the threads 71 to be knotted is introduced at the side into the slit 5 of the head 3 until bringing it along the axis of the bushing 9 and introducing it contemporaneously into the external pincer 7 and into the central pincer 62; then said thread is made to deviate by about 90° around the fixed guide pin 12, it is introduced into the rotary pincer 16 and into the thread-guide 22 finally reaching the mouth of the shears 24. At this time the movable blade 26 is depressed thereby cutting the excess of thread (FIG. 8).

Then the other thread 70 is taken and, placing it in sense opposed to the former, it is made to pass into the external pincer 6 into the slit 4 and into the central slit 63, then it is deviated by 90° around the pin 13 and made to pass into the thread-guide 23 to cut it to measured length by the shears 25 (FIG. 8).

Then the crank 39 is rotated in clockwise sense until making it perform a complete revolution and forming the windings of the knot with the predetermined number starting from the outside and proceeding inward, to the central portion of the knot. From the FIGURES 8 to 11 it is possible to understand the various stages of the formation of the windings during the complete revolution of the crank, of the figures corresponding to the following angular positions of the crank —0° —90° —180° —270° —360°.

During the rotation of the crank, in addition to the rotation and forwarding of the pincers 16—17 for the formation of the windings, there occurs also the rotation of the cams 40—41 whence the mobile blades 33—34 open and close in succession. Said mobile blades open to permit the introduction of the thread and in closing again there are of assistance above all the extraction of the threads from the respective pincers 16—17 and subsequently they cause the insertion of the threads between the fixed plate 28 and the mobile blades 33—34; in such a way that when the blade, continuing its stroke, cuts the thread, its ends (or tails) remain clamped, by effect of the pressure exerted by the springs 31—32, between the plate 28 and the blades 31—34.

At this time, to extract the knot, it suffices to lower the push-button lever 121, which with the rotation of the counter-levers 124—125 causes the rotation and translation of the rods 133—134 with the respective pincers 6—7 in such a way that the two pincers at a first time draw near to the frame, to get them away from it and to lift itself decidedly thereby causing the pulling of the two ends of the yarn whence the various spirals which form the knot become tightened and approach and the knot leaves the group of central pincers (FIG. 14). At that time the knot is made, the pressure upon the push-button of the lever 121 is released and the pincers 6—7 return to their initial position, while one extracts by hand by the thread knotted by the pincers 6—7.

I claim:

1. A device for the tying of two threads by the system called barrel knot, comprising a frame having two opposed heads, each having a groove lying in the same vertical plane, adapted to allow the respective passage of the two threads to be knotted, pressure pincers arranged at the outside of each of said heads to retain the thread introduced into the groove of the respective head, each of said heads having a cylindrical seat, two coaxial hollow bushings rotatable and slidable axially in an associated cylindrical seat, said bushings being mov-

able toward and away from the central part of the device, each of said bushings having a longitudinal through slit adapted to be moved into alignment with the groove of the corresponding head to permit the lateral introduction and the lateral extraction of the threads to be knotted, a pair of fixed hollow bars exending coaxially respectively through an associated bushing, each of said bars having a longitudinal slit aligned with the slit of the head for the passage of a thread, two opposed vertical guide pins, each projecting at right angles from an associated bar, two resiliently urged pressure pincers each having adjustable pressure means for retaining the ends of the threads to be knotted, each of said resiliently urged pressure pincers being secured eccentrically to the end of the corresponding bushing, a knot forming member positioned centrally between the two heads and said fixed guide pins, said knot forming member comprising a vertical fixed plate and two cutting members, one on each side of said plate, each cutting member comprising a first blade, resilient means retaining said first blade pressed against the plate and a second blade, a pivot mount for said second blade perpendicular to the plate, said second blade being positioned between said plate and said first blade, said cutting members being adapted to exert in succession a cutting action upon the ends of the threads which take part in the formation of the thread, means to rotate the two bushings with the respective pincers around their own axes, in reverse senses with respect to each other in such a manner that to n revolutions of one of said bushings there correspond $n+1$ revolutions of the other one of said bushings, means for displacing axially the bushings during such rotation to move them simultaneously toward and away from the knot forming member, means for defining the initial and final position of the bushings and of the respective pincers, thread guiding means and cutting means adjustable in distance to cut the ends of the threads at predetermined length when said ends are arranged in the initial position of the knot formation, a rotary shaft supported by said heads, two cams mounted on said shaft, an oscillatory arm coacting with said cams successively to control the opening and closing movements of the second blades of the retaining and cutting members of said knot forming member for control of the axial displacement of said bushings and cams for controlling said levers.

2. The combination set forth in claim 1 in which the rotary control shaft is supported by the lower part of the heads, each of said cams is grooved and mounted symmetrically on said shaft with respect to the central knot forming member, the salients of said cams being out of phase by 180 degrees with respect to an axial plane, said oscillatory arm is controlled successively by said cams, said arm carrying a roll for engagement with the groove of the cam, a link rod connected to said arm and controlling the opening and closing movement of the second blades of the retaining and cutting members of said central knot forming member.

3. The combination set forth in claim 2 in which a pair of toothed wheels is mounted on said rotary shaft associated respectively with said heads and positioned internally thereof, and a gear train engaging said wheels and operatively connected to an associated bushing to rotate the latter.

4. The combination set forth in claim 2 in which a pair of toothed wheels is mounted on said rotary shaft associated respectively with said heads and positioned internally thereof, a gear train engaging said wheels and operatively connected to an associated bushing to rotate the latter, the transmission ratios of the gear trains of each of the fixed heads being selected in such a way that to n revolutions of one of the bushings there corresponds $n+1$ revolutions of the other bushing in reverse sense.

5. The combination set forth in claim 1 in which two coaxial rings are provided each having an annular groove in its periphery, said rings being secured to an associated bushing, two arms are provided pivotally mounted in a horizontal plane, one end of each arm extending into an associated groove, shaped cams mounted on the rotary shaft, said arms having spring urged rollers engaging said cams.

6. The combination set forth in claim 1 in which means are provided to extract the yarn after knotting, said means comprising a push button control lever having adjustable end of stroke stops, two spring return counter levers controlled by the movement of said control lever, a pair of rods each carrying one of the pressure pincers at one end which retain the ends of the yarn to be knotted, means connecting the free ends of said rods to said counter levers respectively, said two rods being provided with rolls, fixed grooves guiding said rolls respectively, said grooves being shaped as to cause the rods and the pincers to be lifted and to spread apart in such a way as to pull the yarn and tighten the spirals of the knot and extract the knot from the knot forming member.

7. The combination set forth in claim 1 in which abutting means are fixed to said heads to define the initial position of the bushings and the pincers rigid therewith.

8. The combination set forth in claim 1 in which thread guiding means are provided to arrange the threads to be knotted on the machine, aligned with said fixed pins and fixed at opposed sides and in staggered position with respect to the line joining said fixed pins.

9. The combination set forth in claim 8 in which adjustable thread cutting means are provided associated with said guide means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,518,687	Harvey	Aug. 15, 1950
2,781,213	Tarbox	Feb. 12, 1957
2,807,487	Tarbox et al.	Sept. 24, 1957
2,947,558	Bethune	Aug. 2, 1960