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APPARATUS FOR TYING ELASTIC THREADS

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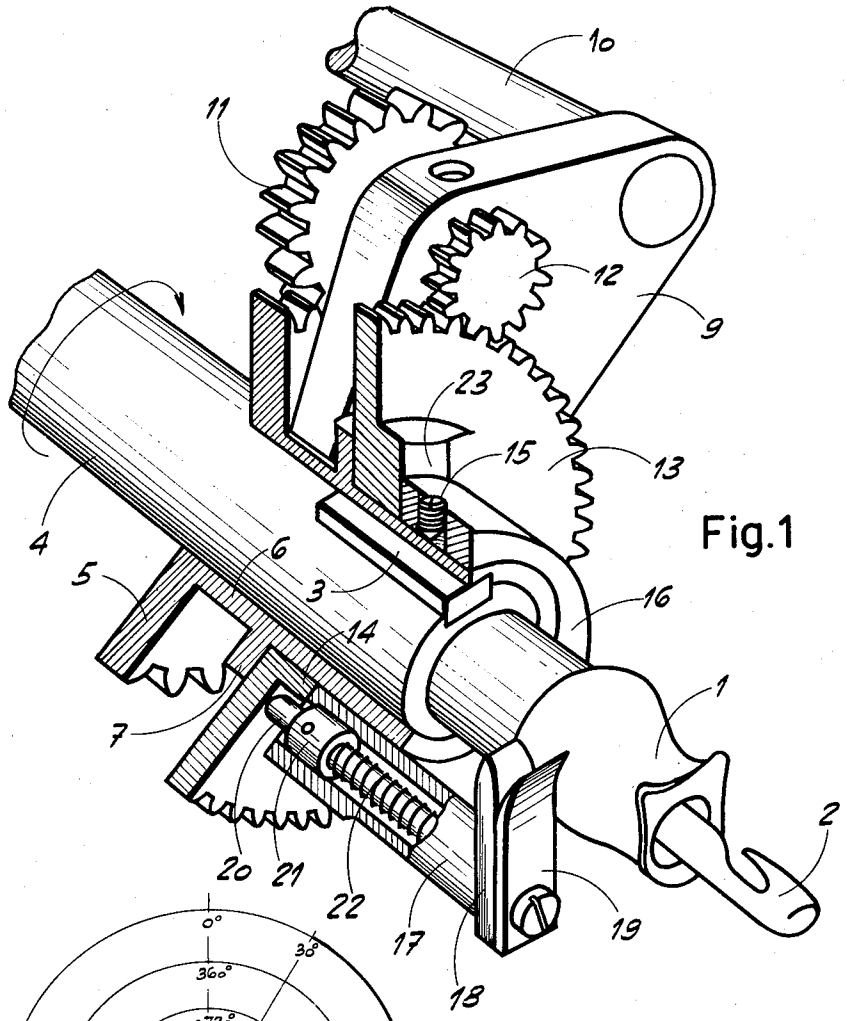

Fig.1

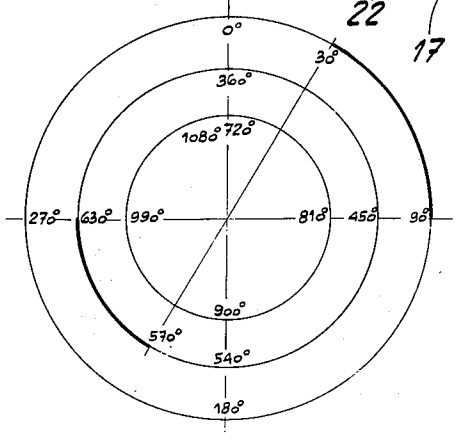

Fig.2

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APPARATUS FOR TYING ELASTIC THREADS

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2 Claims. (Cl. 289—12)

It is well known that innumerable mechanical devices have been utilized for the tying of threads and filaments. One of the major classes of thread tying devices relies for its action upon a sleeve arrangement, which may also comprise a plurality of sleeves, around which the thread loops are formed and which also contains a retractable, reciprocating hook. After the loop formation, the retractable hook draws the ends of the threads into the interior of the sleeve or sleeves so that on stripping the loops over the free end of the hook the desired knot is formed. For the desired loop formation, the sleeves and the clamps holding the ends of the threads must rotate relative to each other and this may be accomplished either by the rotation of the sleeve itself, which is provided with a hook operatively connected to the sleeve, or by the rotation of the clamp holding the thread ends about the stationary sleeve. For the formation of loops, the length of thread required is provided in each case by permitting the thread ends frictionally engaged by the thread clamp to slide therein. The thread clamp is so designed that it is held in closed position, for example, by means of a spring. It may be opened either by the action of the thread itself or it may be so designed as to be held in closed position by the action of a spring and opened by suitable means of the tying machine. The latter design and arrangement of the thread clamp has usually served heretofore only to enable the threads to be inserted more easily since the threads, in each instance, after the completion of the knot-tying step are caused to slide free of the thread clamp.

When tying threads of a highly elastic material such as a cellulose-based yarn or the like spun around a rubber thread or monofilament, the above devices are quite impractical. Since the thread, in each instance, must be withdrawn from the thread clamp at the completion of the knot-tying operation, the pressure exerted by the thread clamp should not be excessive. In such a situation, however, if the elastic yarns are drawn from the thread clamp against the tension which the elastic yarns exert and before the retractable hook has drawn the yarn ends into the sleeve, it is apparent that in the ordinary situation a knot will not be formed since once the ends of the elastic thread are drawn out of and leave the thread clamp they will, because of the tension they are under, immediately snap away from the sleeve.

It is, therefore, an important object of this invention to provide a device for the knotting of highly elastic threads utilizing a sleeve about which the desired loops are formed but which will not be subject to the disadvantages of the devices hitherto available.

Another object of this invention is the provision of a knot-tying device for the knotting of elastic threads in which the threads are gripped firmly during the operation to prevent slippage but are then released in a suitably timed sequence of operations in order to enable the thread ends to be drawn into the actual knot-tying operation.

Other objects of this invention will appear from the following detailed description.

In the drawing:

Fig. 1 is a perspective view, partly in section, of the knot-tying device of this invention showing the sleeve about which the threads are wound to form the loops, the retractable hook which effects the actual knotting of the threads as well as the thread clamp in which the threads are gripped as the operation is effected, and

Fig. 2 is a diagram of the rotational timing sequence of the device shown in Fig. 1.

Like numerals indicate like parts throughout the several views of the drawing.

Referring now to the drawing, and more particularly to Fig. 1, reference numeral **1** identifies a fixed sleeve of the type commonly employed for the tying of threads the interior of which is provided with a hook **2** which is reciprocatably mounted within sleeve **1** for extended lateral movement axially thereof and is actuated in said movement by a suitable mechanism (not shown). A key **3** is mounted in a suitable keyway provided in a hollow shaft **4** which in operation rotates in the direction of the arrow and which is so timed that it makes three complete revolutions over the course of each knot-tying operation. Keyed to shaft **4** and rotating therewith by reason of key **3** is a pinion gear **5** whose boss **6** carries a radial flange **7** which, together with pinion gear **5** encloses the arm of a bracket **9**, the arrangement of the several parts being such that together with bracket **9** pinion gear **5** and flange **7** can be shifted or displaced laterally in a direction along the axis of hollow shaft **4**. This lateral movement is effected by means of the action of rod **10** which is operatively connected to bracket **9**, the desired movement of rod **10** in the direction indicated being produced by suitable actuating means (not shown).

Mounted on bracket **9** are a pair of rotatably mounted gears **11** and **12** which are fixed to the same shaft (not shown), the relationship being such that gear **11** meshes with gear **5** and gear **12** meshes with a gear **13** which is mounted on boss **6** and which is freely rotatable relative thereto. The respective gear ratios of the several gears **5**, **11**, **12** and **13** are such that three full revolutions of gear **5** cause gear **13** to rotate once about its axis. Gear **13** is fixed or aligned in the desired relative axial position on boss **6** by means of its boss **14** which abuts against an annular collar **16** held in position on boss **6** by means of an adjustable set screw **15**. Fixed to the circumference of annular collar **16** is a tube **17** which is thus rotatably mounted relative to the sleeve **1**. The end **18** of the tube **17** forms a fixed or stationary arm or jaw of a thread clamp mechanism. The opposing jaw of the thread clamping mechanism is the movable clamping arm or jaw **19** which is held in position on the end of a shaft **20** by a screw, as shown. Shaft **20** carries a collar **21** at the opposite end thereof against which is pressed a coil pressure spring **22** which acts not only to force but to maintain the clamping arm or jaw **19** in spring-loaded contact with the fixed or stationary clamping arm or jaw **18**.

During the rotation of gear **13** the offset lug **23**, which is integrally formed with said gear **13**, comes into contact with the end of shaft **20** and by reason of its shape exerts a camming action due to the increasing pressure of said offset lug **23** thereon thus causing shaft **20** to be moved in a direction against the pressure of the spring **22** thus causing movable clamping jaw **19** to move away from contact with fixed clamping jaw **18**. As brought out in greater detail below, this action takes place twice during each knot-tying operation.

Furthermore, as indicated by the above gear ratios, gear **13** rotates only once for every three revolutions of

gear **5**. Accordingly, since the thread clamping mechanism is mounted on collar **16** which rotates at the same radial speed as gear **5**, being fixedly mounted on boss **6** by means of set screw **15**, the thread clamping mechanism will likewise rotate three times for each rotation of gear **13**. The lug or cam **23** is so designed that over 40° of revolution of gear **13** it is able to maintain the thread clamping mechanism in open position, but the actual contact of cam **23** with the end of shaft **20** occurs over only 30° of revolution because of relative displacement of the respective parts. During this movement the thread clamping mechanism itself rotates from its initial position at 30° to a position at 90° of revolution so that the net movement of the cam **23** on gear **13** is actually over only 20° of revolution, even though the thread clamp is at the 90° position.

The net effect of the relative movements involved is that the jaws of the thread clamping mechanism remain open while it rotates from the 30° to the 90° position and the jaws then close. As the thread clamping mechanism moves from the 90° position to the 360° position and on the second revolution around to 570°, the cam **23** radially advances meanwhile over a net of 160° so that its position is at 250°, its action thus beginning at 210° or at 570° as the case may be. In this position the filament clamping mechanism is opened and remains open, as previously indicated, for 60° of revolution. Thereafter, the thread clamping mechanism advances relative to the cam **23** so that during the third revolution it remains closed. After the mechanism has rotated through 1080° the knot-tying operation has been completed and a new cycle commences. The relationship of the relative rotational movements are graphically illustrated in Fig. 2 wherein the three revolutions of the thread clamp are represented by three concentric circles on which are indicated the respective degrees of revolution of the elements involved. The heavy line represents the period during which the thread clamping mechanism remains open.

It is readily understood that by a suitable choice or proportion of cam length and by a suitable variation of its position relative to the rotating thread clamp at the commencement of the knotting operation, one can vary within limits the duration of the period during which the thread clamp remains open and the period during which it is closed, so that the knotting operation can be very accurately adjusted. The particular relationships of the several elements given above with respect to their relative rotational movement are merely given by way of illustration and in no way are to be considered as limiting the claims.

As an example of the manner in which the device of the present invention operates the following detailed example and description is given:

By suitable means (not shown) the pair of threads to be knotted are brought into the path of the thread clamp which, as described above, is maintained in open position when rotating from 30° to 90° and then closes as it reaches 90° of rotation. The force exerted by the coil spring **22**, when the clamping mechanism is in closed position, is sufficient so that the elastic threads are unable to be withdrawn from the thread clamp at any time. The firm grip of the clamp on the elastic threads can be ensured by roughening the faces of the clamping elements or jaws or by providing the clamping elements with conventional serrations or teeth which will mesh and will thereby exert a maximum holding force on the threads. The initial revolution of gear **13** causes the

thread clamp assembly which is carried on collar **16** to place a loop of the paired threads about the stationary sleeve **1**. During the second complete revolution the free ends of the threads forming the loop, by virtue of the timed axial displacement of the thread clamp assembly by suitable movement of the rod **10** is carried over the free end of sleeve **1** and is placed in the hook **2**. Just as soon as the threads have been placed in hook **2** it is caused to be retracted by means of the actuating mechanism provided in the sleeve and the movable thread clamping arm or jaw **19** is moved out of contact with the stationary clamping arm or jaw **18** thus freeing the thread ends gripped by said jaws immediately. The above operation is, of course, continuously repeated.

The present invention is not limited to the particular embodiment disclosed above in which the thread or filament clamp rotates about a stationary sleeve.

What is claimed is:

1. In a device for knotting together the ends of a pair of threads including a sleeve around which said thread ends are looped and a reciprocating, retractable hook within said sleeve for drawing the thread ends through the loop and forming said knot, the combination of thread gripping means mouted on and integral with a circumferential collar rotatably mounted on said sleeve, said collar being provided with circumferential coaxial drive means producing rotation of said collar about said sleeve whereby thread ends gripped thereby are looped about said sleeve, said thread gripping means on said collar comprising a fixed jaw and a movable jaw carried on a laterally displaceable spring-pressed shaft, and means including a rotating cam in contact with said shaft operating in timed relationship to the reciprocating movement of said hook for permitting said thread gripping means to remain in spring-pressed closed thread gripping position during said knotting operation and for opening said thread gripping means at the completion of said knotting operation.

2. In a device for knotting together the ends of a pair of threads including a sleeve around which said thread ends are looped and a reciprocating, retractable hook within said sleeve for drawing the thread ends through the loop and forming said knot, the combination of thread gripping means mounted on and integral with a circumferential collar rotatably mounted on said sleeve, said collar being provided with circumferential coaxial drive means producing rotation of said collar about said sleeve whereby thread ends gripped thereby are looped about said sleeve, said thread gripping means on said collar comprising a fixed jaw and a movable jaw, a shaft carrying said movable jaw mounted thereon and a spring on said shaft normally maintaining said jaws in spring-pressed contact, and timing means including a face cam in contact with said shaft rotatably driven at a predetermined speed of rotation relative to the rotation of said thread gripping means so as to permit said thread gripping means to remain in spring-pressed closed thread gripping position during said knotting operation and to cause said thread gripping means to open at the completion of said knotting operation.

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