

Dec. 25, 1945.

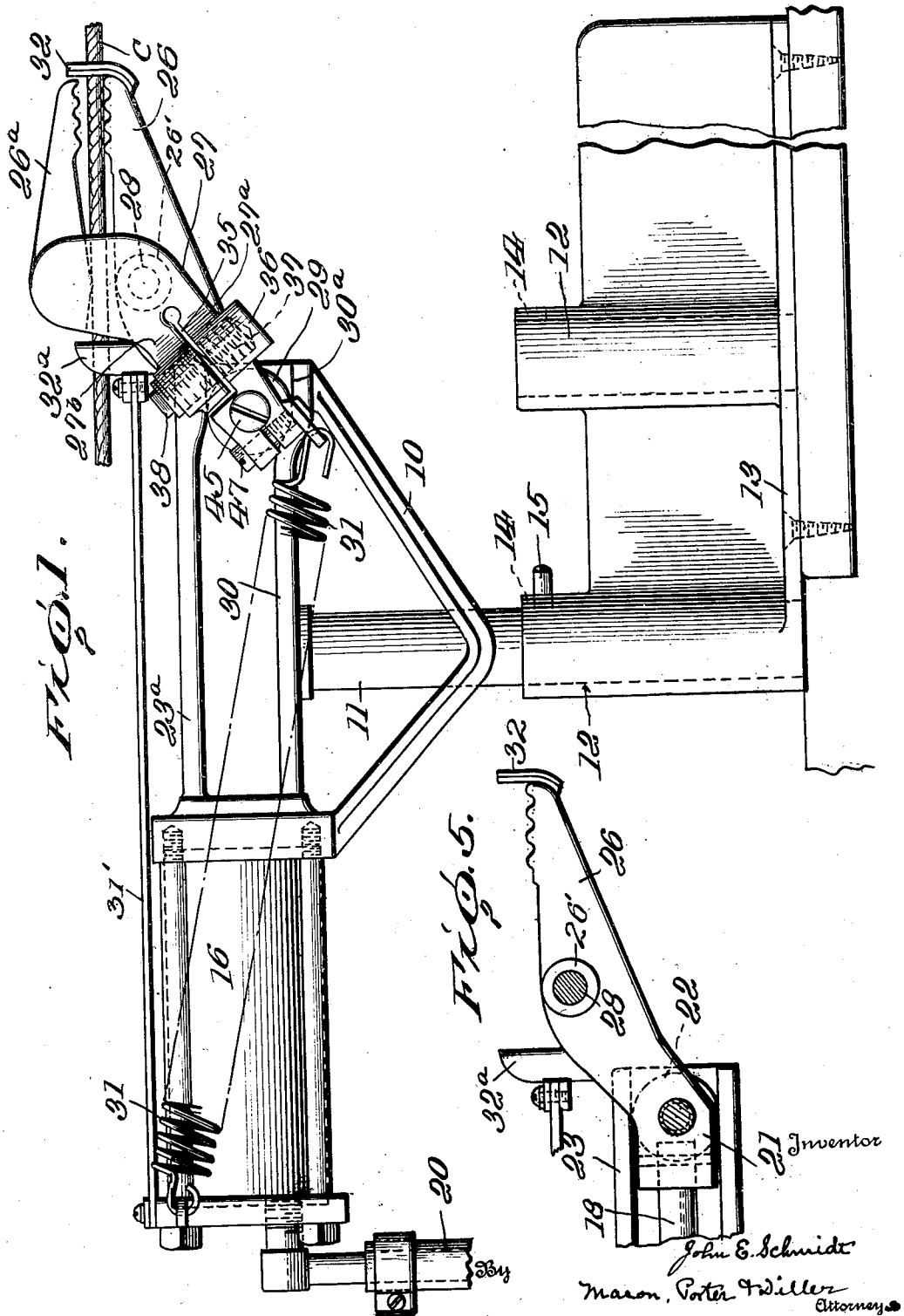
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2,391,644

KNOT TIGHTENING DEVICE

Filed April 19, 1944

2 Sheets-Sheet 1



UNITED STATES PATENT OFFICE

2,391,644

KNOT TIGHTENING DEVICE

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Application April 19, 1944, Serial No. 531,813

13 Claims. (Cl. 254—51)

This invention is a device for use in applying a pulling tension upon a cord or cable which has previously been tied in a knot.

In the manufacture of parachutes of the type commonly used for dropping supplies, ammunition, and certain types of incendiary bombs, the cords attached to the numerous corners of the fabric are all tied in a single knot. It is imperative, however, that this knot be made as tight as possible, and this is accomplished by separately pulling the free end of each of the cords with considerable force. Heretofore, prior to the final knot-tightening operation, all of the parachute cords are joined in a somewhat loosely tied single knot. Each cord is then placed in a suitable chuck which is manually moved to apply the necessary pulling tension to produce a relatively tight knot.

An important object of the invention is to provide a mechanical cord-pulling device by means of which the knot can be pulled tighter than it is possible to do it by hand. A further object is to produce a device of the character mentioned capable of performing the knot-tightening operations quicker and with less fatigue to the operator than can be accomplished by the methods previously employed.

The invention will be hereinafter fully set forth and particularly pointed out in the claims.

In the accompanying drawings:

Figure 1 is a side elevation illustrating a mechanical knot-pulling device constructed in accordance with the invention.

Figure 2 is a top plan view thereof.

Figure 3 is an end view.

Figure 4 is a vertical sectional view on the line A—A, Figure 2, through the cross head and bearing ways.

Figure 5 is a detail view, partly in section, illustrating the fixed jaw.

Referring to the drawings, 10 designates a frame provided with a vertical stud portion 11, which is adapted to be inserted into a socket 12, forming part of a table bracket 13. The socket 12 is provided with a slot 14 to receive a pin 15 on the stud 11, in order to prevent rotation of the frame 10 within the socket 12 while the apparatus is in use.

The pulling force is preferably provided by means of a pneumatic pressure cylinder 16 which is supported by the frame 10. The cylinder 16 has a conventional piston 17, and a piston rod 18, the latter having its outer end connected to the gripping mechanism for the parachute cord in a manner about to be described.

The piston 17 is caused to travel in either direction within the cylinder 16 by any suitable pressure medium. For instance, conduits 19 and 20, connected with a source of fluid pressure (not shown), are also connected with the cylinder 16 at the respective ends thereof. The flow of pressure fluid through said conduits is controlled by a suitable valve (not shown) in a manner well understood in the art of fluid pressure motors. A cross head 21 is connected to the outer end of the piston rod 18, said cross head being provided with rollers 22, arranged to travel in guide channels 23, and 23^a, suitably supported by the frame 10.

The gripping mechanism comprises a lower jaw 26 which is fixedly connected to the cross head 21, and an upper clamping jaw 26^a which is movably mounted with respect to said lower jaw. The top jaw 26^a is connected to a lever arm 27 by an intermediate portion 27'. The jaw, arm, and the intermediate portion form an integral unit. A stud 28 is rigidly attached to the arm 27 by having the inner end thereof butt-welded or brazed to the inside face of the arm 27. A bottom jaw 26 is provided with an integral projecting hub 26' which has an opening therethrough to receive the stud 28. This provides for the pivotal connection between the jaws and the mounting of the upper jaw on the lower jaw. The lower end of the arm 27 is free to move in an arcuate path with respect to its pivot, and carries a roller 29. Said roller travels in engagement with a fixed cam track 30, which extends parallel with the guiding channels 23 and 23^a, and is provided with a depression 30^a at the end thereof furthest from the cylinder 16. A spring 31 is connected to the lower end of the arm 27 so as to aid in lifting the roller 29 over the rise of the cam track 30, during the initial stage of the pulling operation.

In practice, the cord C to be tightened is initially placed between the jaws 26 and 26^a, as shown in Figure 1 of the drawings, the placing of the cord in proper position being aided by gauge stops 32, 32^a, connected to the lower jaw. The operator then operates the fluid pressure control valve to the position which will introduce fluid under pressure through the pipe 19, and to vent the cylinder through pipe 20, whereupon the piston 17 will be caused to move to the left, as viewed in the drawings. At the beginning of the pull-stroke of the piston rod 18, the initial rise in the cam track 30 causes the roller 29 to lift the lower end of the lever arm 27, so as to move the upper jaw 26^a toward the lower jaw 26 and to thereby

clamp the cord C between them. During the remainder of the pull-stroke the cord is tightly gripped between the jaws and pulled to produce a very tight knot. Upon completion of the knot-tightening stroke of the piston rod 18, the fluid pressure control valve is reversed, so that fluid pressure is introduced into the cylinder through pipe 20, and to vent the cylinder through pipe 19, whereupon the piston rod is caused to travel in the reverse direction. When the return stroke has been completed, the roller 29 drops into the depression of the cam track 30, so that the clamping jaws are separated and the tightened cord may be removed. It will be observed that the spring 31 assists in lifting the roller 29 over the rise in the cam track 30 during the initial stage of the pulling operation. It is preferred to place a flexible cover 31 over the top of the frame 10, one end of the cover being connected to and movable with the fixed jaw 26, the other end of said cover being anchored to the end of the frame which is remote from the jaw. The primary purpose of this flexible cover 31' is to protect the hands of the operator and prevent them from being caught between the cylinder head and the jaws during the pulling stroke of the jaws.

The parachute cords frequently vary in thickness and hardness as a result of having been made by different manufacturers, and in order to compensate for this lack of uniformity, the lever arm 27 is bifurcated, as indicated at 35, so that said arm is provided with relatively spaced fork portions 27^a and 27^b. In this manner a portion of the arm 27 between the jaws and the roller 24 is rendered more or less resilient, so as to yield slightly if the pressure upon said roller becomes too great. The fork portion 27^a is provided with an abutment well 36 for receiving a spring 37, and the fork portion 27^b is provided with a threaded adjusting screw 38 which bears against the spring 37. The degree of yieldable resistance to excess pressure upon said roller 29, may be varied by adjustments of screw 38.

To compensate for wear in the moving parts, as well as to provide for adjustment of the upper jaw 26^a relative to the lower jaw 26, the roller 29 is mounted on an eccentric shaft 45, which is supported between the members 27^a and 27^b of the lever arm 27. The shaft 45 is fixedly retained in any selected position by a clamping screw 47. When an adjustment is to be made the screw 47 is loosened and the operator turns the eccentric shaft 45, by placing a screw driver in the slotted head thereof. After the desired adjustment has been made, the screw 47 is again tightened for retaining the eccentric shaft 45 in the adjusted position.

The advantages of the invention will be readily understood by those skilled in the art to which it belongs. For instance, it will be particularly observed that a very simple mechanical knot-pulling device is provided, by the use of which it is possible to draw the knots very tightly. A further advantage is that better knots are produced than is possible by any manual method now commonly practiced, and at the same time the labor required to tighten the knots is materially reduced.

Having thus explained the nature of the invention and described an operative manner of constructing and using the same, although without attempting to set forth all of the forms in which it may be made, or all of the forms of its use, what is claimed is:

1. A knot-tightening device of the character

described comprising a supporting frame, a movable member reciprocally supported by said frame, a fixed jaw connected to and movable with said movable member, a lever pivotally connected with the fixed jaw and having at one end a jaw member complementary to said fixed jaw, the other end of the lever being free for arcuate movement with respect to its pivotal support, a roller mounted in the free end of said lever, means for imparting movements to the movable member in either direction, and a cam track engageable with said roller during travel of the movable member, said cam track having means for holding the lever and said movable jaw in rope-clamping position during said movements.

2. A knot-tightening device of the character described comprising a supporting frame, a movable member reciprocally mounted in said frame, a jaw fixedly connected with the movable member so as to be movable therewith, a pivotally supported lever having a jaw member at one end complementary to said fixedly supported jaw, a shaft carried by said lever, a roller carried by said shaft, means for imparting movements to said movable member in either direction, and a cam track positioned to engage said roller and having means for preventing pivotal movement of the lever during movements of said movable member.

3. A knot-tightening device of the character described comprising a supporting frame, a movable member reciprocally mounted in said frame, a jaw fixedly connected with the movable member so as to be movable therewith, a pivotally supported lever having a jaw member at one end complementary to said fixedly supported jaw, a shaft carried by said lever, a roller carried by said shaft, means for imparting movements to said movable member in either direction, a cam track having a portion engageable with said roller to prevent pivotal movement of the lever during reciprocative movements of the movable member, said cam track having a depression at one end to permit said roller to drop so as to open the movable jaw, and a spring connected with said lever for assisting movement of said roller out of said depression.

4. A knot-tightening device of the character described comprising a supporting frame, a movable member reciprocally supported by said frame, a fixed jaw connected to and movable with said movable member, a lever pivotally connected with said fixed jaw and having at one end a member complementary to the fixed jaw, the other end of the lever being free, a rotatively adjustable eccentric shaft carried by the free end of said lever, means for normally preventing rotative movement of said shaft, a roller rotatively supported by said shaft, and a cam track engageable with said roller for holding said lever and the movable jaw in rope-clamping position during travel of said movable member.

5. A knot-tightening device of the character described comprising a supporting frame, a cylinder supported by said frame, a piston located within said cylinder, means for controllably supplying fluid under pressure to said cylinder to move the piston in either direction, a piston rod connected with said piston, a lower jaw fixedly connected with said piston rod, a lever connected with said fixed jaw and having a jaw portion complementary thereto, and means rendered operative by the movement of the piston for shifting the movable jaw into and out of rope-clamping position and for holding the jaws in clamping position

during the greater portion of the movement of said piston.

6. A knot-tightening device of the character described comprising a supporting frame, a cylinder supported by said frame, a piston located within said cylinder, means for controllably supplying fluid under pressure to said cylinder to move the piston in either direction, a piston rod connected with said piston, a cross head connected to said piston rod, means for slidably supporting said cross head, a lower jaw fixedly connected with said cross head, a lever arm pivotally connected with said fixed jaw and having a jaw portion complementary thereto, and means rendered operative by the movement of the piston for shifting the movable jaw into and out of rope-clamping position and for holding the jaws in clamping position during the greater portion of the movement of said piston.

7. A knot-tightening device of the character described comprising a supporting frame provided with a depending stud, support means for said stud, a movable member reciprocally supported by said frame, a lower jaw fixedly connected with said movable member, a lever pivotally connected with said fixed jaw and having a jaw portion complementary thereto, said lever having a free end, a roller mounted in the free end of said lever, and a cam track carried by said frame and engageable with said roller during reciprocal travel of the movable member, said cam track having means for preventing movement of said lever during travel of said movable member.

8. A knot-tightening device of the character described comprising a supporting frame, a movable member reciprocally mounted within said frame, a lower jaw fixedly connected to said movable member, a lever pivotally connected with said fixed jaw and having a jaw portion at one end complementary to the fixed jaw, the other end of said lever being free and having a split portion therein, means for imparting reciprocal movements to said movable member, an eccentric shaft rotatively adjustable within the split portion of said lever, clamp means carried by said lever for normally holding said eccentric against rotative movement, a roller mounted on said eccentric shaft, and a cam track engageable with said roller for holding the lever and its movable jaw in rope-clamping position during travel of said movable member.

9. A knot-tightening device of the character described comprising a supporting frame, a movable member reciprocally supported by said frame, a fixed jaw connected to and movable with said movable member, a lever pivotally connected to said fixed jaw and having at one end a jaw member complementary to the fixed jaw, the other end of the lever being free, a roller carried by the free end of said lever, means for imparting reciprocal movements to said movable member, and a cam track engaging said roller for holding the lever and its movable jaw in rope-clamping position during movements of said movable member, the free end of said lever being split so that the jaws may adjust themselves to inequalities in the size of the cord being operated upon.

10. A knot-tightening device of the character described comprising a supporting frame, a movable member reciprocally supported by said

frame, a fixed jaw connected to and movable with said movable member, a lever pivotally connected to said fixed jaw and having at one end a jaw member complementary to the fixed jaw, the other end of the lever being free, a roller carried by the free end of said lever, means for imparting reciprocal movements to said movable member, a cam track engaging said roller for holding the lever and its movable jaw in rope-clamping position during movements of said movable member, the free end of said lever being split so that the jaws may adjust themselves to inequalities in the size of the cord being operated upon, and means for adjustably varying the yieldability of the split portion of said lever.

11. A knot-tightening device of the character described comprising a supporting frame, a movable member reciprocally supported by said frame, a fixed jaw connected to and movable with said movable member, a lever pivotally connected to said fixed jaw and having at one end a jaw member complementary to the fixed jaw, the other end of the lever being free, a roller carried by the free end of said lever, means for imparting reciprocal movements to said movable member, a cam track engaging said roller for holding the lever and its movable jaw in rope-clamping position during movements of said movable member, the free end of said lever being split so that the jaws may adjust themselves to inequalities in the size of the cord being operated upon, a fixed abutment secured to said lever on one side of the split portion thereof, an adjustable abutment secured to said lever on the opposite side of said split portion, and a spring interposed between said abutments.

12. A knot-tightening device comprising a supporting frame, a movable member reciprocally supported by said frame, a lower jaw fixedly connected to said movable member, a lever pivotally connected with said fixed jaw and having a jaw portion complementary to the latter, means for imparting movement to said movable member in either direction, means engageable with the lever for holding the movable jaw in rope-clamping position with respect to the fixed jaw during said movement, and a flexible cover supported by said frame above said movable member but below the horizontal plane of the clamping jaws, so as to prevent fouling of the cord being operated upon during travel of the movable member.

13. A knot-tightening device of the character described comprising a supporting frame, a fluid pressure motor supported by said frame and having a piston rod mounted for reciprocal movements with respect to said frame, a cross head secured to the outer end of the piston rod, guides for said cross head supported by said frame and arranged parallel with said piston, a lower jaw fixedly connected with said cross head, a lever pivotally connected with said fixed jaw and having at one end a jaw member complementary to the fixed jaw, the other end being free, a roller mounted in the free end of said lever, and a cam track engageable with said roller and having means for holding the lever and its movable jaw in rope-clamping position during travel of said cross head.

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