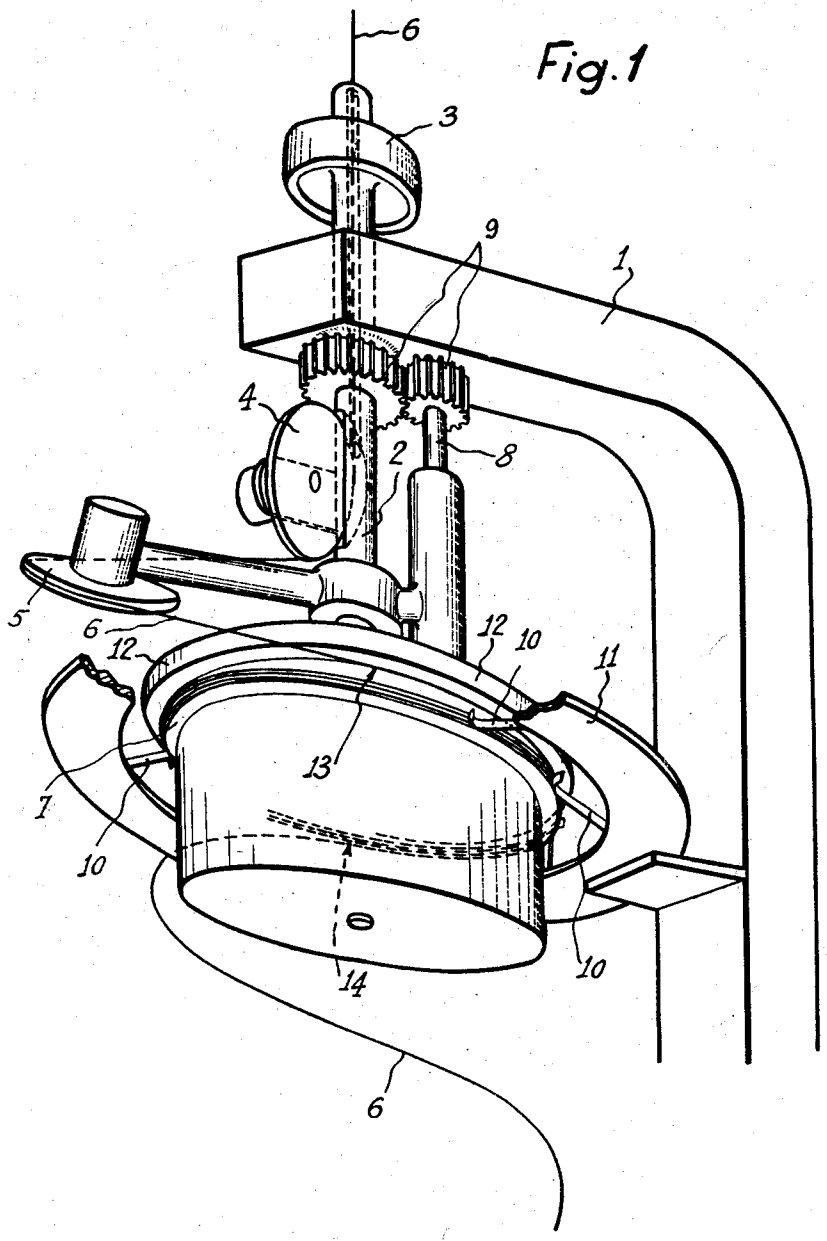
Sept. 8, 1964 J. GODDERIDGE 3,147,934

APPARATUS FOR WINDING WIRE

Original Filed June 15, 1960 3 Sheets-Sheet 1

Fig. 1



APPARATUS FOR WINDING WIRE

Original Filed June 15, 1960 3 Sheets-Sheet 2

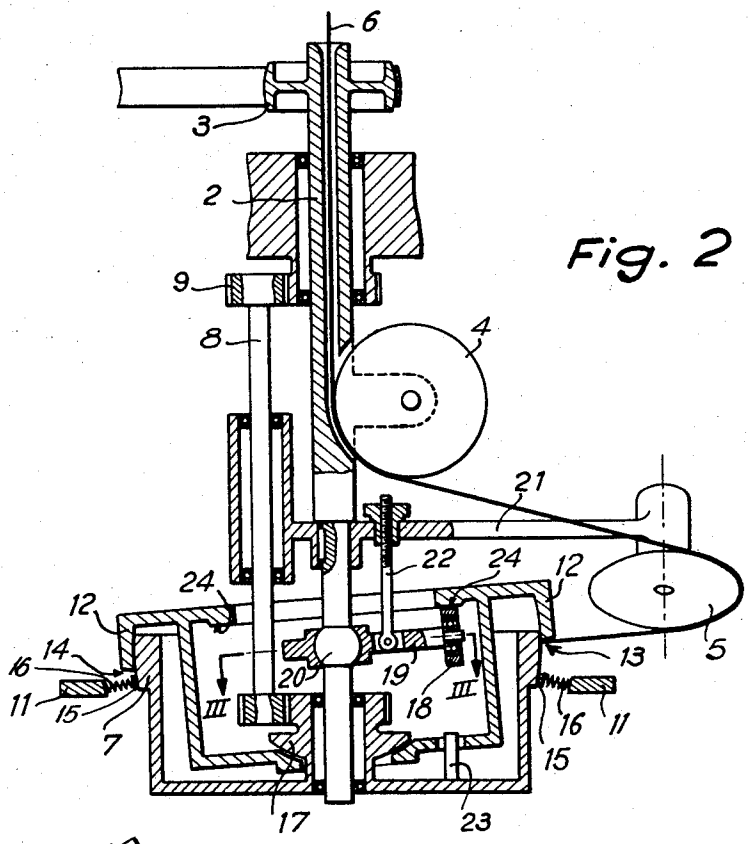


Fig. 2

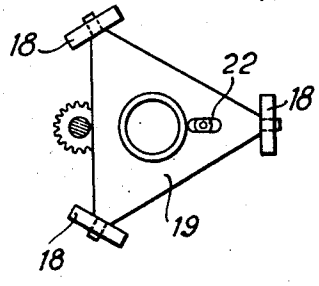


Fig. 3

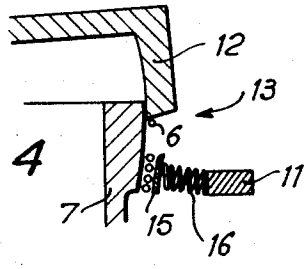


Fig. 4

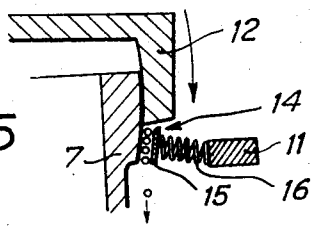


Fig. 5

APPARATUS FOR WINDING WIRE

Original Filed June 15, 1960 3 Sheets-Sheet 3

Fig. 6

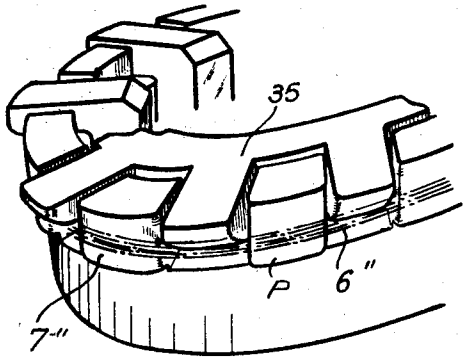


Fig. 7

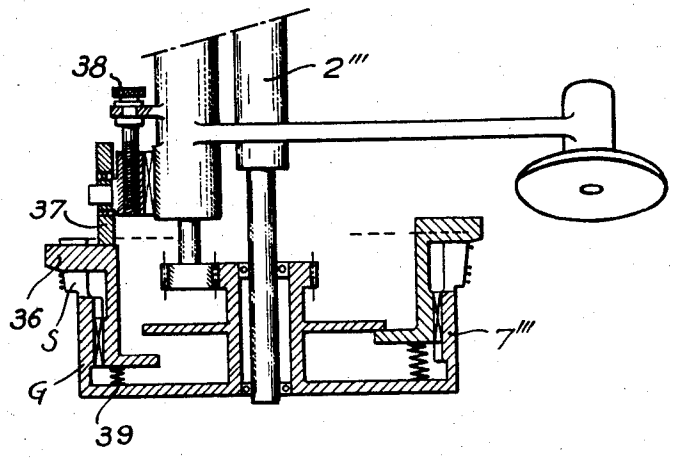
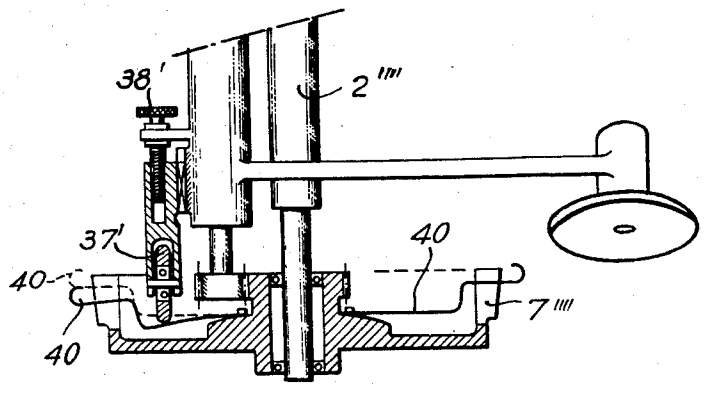


Fig. 8



United States Patent Office 3,147,934 Patented Sept. 8, 1964

3,147,934

APPARATUS FOR WINDING WIRE

Jean Godderidge, 11 Blvd. Henri Barbusse, Houilles, France

Original application June 15, 1960, Ser. No. 36,411, now Patent No. 3,093,339, dated June 11, 1963. Divided and this application Sept. 26, 1962, Ser. No. 226,340 11 Claims. (Cl. 242—82)

The present invention relates to arrangements for winding wire into circular turns at high speed.

This application is a divisional application based on copending application, Serial No. 36,411, filed June 15, 1960, now Patent No. 3,093,339 of June 11, 1963.

It is an object of the invention to provide improved apparatus for winding wire into circular turns as aforesaid.

The improvements of the invention relate particularly to arrangements in which wire is wound by a rotating head to form a plurality of turns around a conical, fixedly mounted capstan. In such arrangements, all the turns of wire are preferably maintained against the capstan by springs or similar flexible elements and must be displaced at each revolution of the rotating head towards the bottom of the capstan by a distance which is equal to the diameter of the wire such that the lowest turn, which is progressively freed as a new turn is being wound at the top of the capstan, drops freely onto a support disposed below the capstan.

In known arrangements of the kind referred to above, this downward thrust on the turns of wire is exerted by a pressure member comprising a roller or a rigid part, mounted on the rotating head in order to turn with it around and adjacent the capstan.

This type of pressure member, however, has drawbacks with respect to winding wire having a small diameter into circular turns at high speeds. Indeed, if the clearance between the pressure member and the capstan is very small, the pressure member may rub on the capstan and thus cause substantial wear of the latter, particularly when the rotating head carrying the pressure member is rotated at high speeds. On the other hand, when the clearance between the pressure member and the capstan is large, small-diameter wire may become wedged between these members and may thus break. In either case, the rotating pressure member rubs on the wire and causes the wire to wear.

A particular object of the invention is to provide a winding arrangement of the above-mentioned type that does not suffer from the drawbacks referred to above.

According to the invention, it becomes possible to avoid any clearance between the pressure members and the capstan since pressure members are used which are actuated only with an alternating longitudinally sliding movement of small amplitude relative to the capstan. The capstan is thus not subjected to wear due to friction of pressure members of the rotating type and the wire is no longer in danger of becoming wedged between the pressure members and the capstan. Moreover, wear of the wire is also avoided since the latter is no longer subjected to friction forces which are tangentially exerted as in hitherto known devices having a rotating pressure member.

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings which show some embodiments thereof by way of example and in which:

FIGURE 1 shows a perspective view of an arrangement for winding wire according to the invention,

FIGURE 2 is a longitudinal sectional view of a modification of the arrangement of FIGURE 1,

FIGURE 3 is a partial plan view along line III—III of FIGURE 2,

FIGURES 4 and 5 are partial sectional views on enlarged scale, showing in detail the relative positions of the pressure members and of the capstan, respectively, at the point where the wire is applied to the capstan, and at the diametrically opposite point,

FIGURE 6 shows a perspective view of a modification of the capstan and of the longitudinal pressure members associated with the capstan, and

FIGURES 7 and 8 show in longitudinal section other means of carrying out the invention.

Referring now to FIGURE 1, there is shown an arrangement comprising a support 1 supporting a hollow shaft 2 driven by a pulley 3. The shaft 2 is provided with two guide pulleys 4 and 5 which guide the wire 6, which is fed downwardly through the hollow shaft 2 towards and around a capstan 7, which is rotated by an auxiliary shaft 8 driven from the shaft 2 by differential pinions 9.

The turns, thus formed on the capstan 7 by the rotating head constituted by the shaft 2 and pulleys 4 and 5, are maintained on the capstan by flat springs 10, mounted around the capstan on an annular member 11. A ring 12 is located above the turns, the plane of said ring being inclined relatively to the axis of the capstan 7 in such a manner that its uppermost part is located at the point 13 where the wire 6 is applied to capstan 7.

When the rotating head turns, the inclination of the ring 12 is angularly altered in order to remain always the same relative to the point where the wire 6 is applied to the capstan 7. The ring 12, whose lower edge constitutes the above-mentioned pressure member, by this movement presses the whole stack of turns in a downward direction until it has reached its lowermost position at the point 14 diametrally opposite the point of arrival of the wire. The lower turn is consequently freed and comes out below the springs 10.

Since there is no rotation of the ring 12 relative to the capstan 7, but only a movement having a very small longitudinal oscillation whose amplitude is at least substantially equal to the diameter of the wire 6, the play between the capstan 7 and the ring 12 may be very small and substantially zero. The risk of the wire being wedged is thus avoided and the wire itself is also protected because there is no movement of the capstan relative thereto.

Reference will now be made to FIGURE 2 which is a sectional view of a modification of the device of FIGURE 1, this modification consisting in that the flap springs 10 are replaced by retaining plates 15 pushed back against the capstan 7 by spiral springs 16.

The movement of the ring 12 which corresponds in shape to the capstan 7 whose upper part is spherical, is guided by a cup joint 17 and three rollers 18 fixed on a triangular member 19, which may be seen in FIGURE 3, mounted on a ball joint 20 having the same center as the cup joint 17 which is situated in a medium plane of the spherical part of the capstan.

The member 19 is maintained in inclined position relative to the arm 21, which supports the pulley 5, by means of an adjustable screw 22.

A finger 23 prevents the ring 12 from rotating relatively to the capstan 7.

When the shaft 2 turns, the rollers 18 roll on a path 24 provided on the internal face of the ring 12 and impose on it an inclination which is always equal to that of the part 19 carrying the rollers 18. The inclination of the ring is thus modified cyclically relative to the capstan 7 as a function of the rotation of the shaft 2.

FIGURE 4 shows partially in section the upper position of the ring 12 on the capstan 7 at the point 13 where the wire 6 is applied to the capstan. Four turns are located under the plate 15. In the lower position 14 shown in FIGURE 5, the new turn takes the place of the upper turn of the stack and all the others are pushed

downwardly by a distance equal to the diameter of the wire. The last turn therefore exits from under the spring so that it is no longer held and falls freely.

FIGURE 6 shows another embodiment, in which the inclined ring having a smooth edge is replaced by a plate **35** the edge of which is castellated. It will be noted in FIGURE 6 that the capstan **7''''** includes a wire supporting section P. The upper part of the capstan **7''** is also castellated, and is interdigitated in the plate **35** in such a manner that the projecting parts of the one extend into the recesses of the other without mutual contact.

The wire **6''** is wound around the capstan under the projecting parts of the oscillating plate **35** which by their longitudinally alternating movement drive the turns of wire outwardly.

Instead of a castellated plate, it is possible to use individual elements **36** in association with capstan **7'''** as is shown in FIGURE 7. These elements have the shape of the projecting parts of the preceding plate **35** and are located in the same place, and they slide vertically in slot S and on guideways G, actuated by a roller **37** which is adjustable by means of a screw **38** and fixed to the shaft **2'''**. Return springs **39** insure that the parts **36** return to the upper positions thereof.

The parts **36** may also be replaced by flexible cantilever-type springs **40** associated with capstan **7''''** on shaft **2''''** as is shown in FIGURE 8. Springs **40** are sequentially displaced by roller **37'** adjustably supported by screw **38'**.

From what has been stated above, it will be appreciated that the embodiments of the invention illustrated in FIGURES 6–8 have various characteristic features in common. They differ essentially in that the displacing means of FIGURES 7 and 8 are as illustrated whereas the displacing means in association with the embodiment of FIGURE 6 are essentially the same as in FIGURE 2. As a matter of fact the ring **35** of FIGURE 6 replaces the element or ring **12** in FIGURE 2 and is cyclically and rockingly displaced by means including the elements **19**, **20**, **21** and **22** of FIGURE 2.

Generally speaking, the apparatus of FIGURES 6–8 comprises a capstan defining a plurality of radially disposed slots, a source of wire and rotatable means operatively disposed with respect to the source and capstan and adapted for receiving wire from the source and winding the wire around the capstan in the vicinity of the slots. A plurality of members is provided in each of the embodiments in FIGURES 6–8 which extend through the slots and are displaceable therein in an axial direction relative to the capstan. Furthermore, in FIGURES 6–8 there are means provided coupled to the rotatable means and engaging the members to displace the latter in axial direction and in sequence from a first position whereat winding of the wire on the capstan is unimpeded to a second position whereby wire wound on the capstan is urged in an axial direction along the latter.

There will now be obvious to those skilled in the art many modifications and variations of the structure set forth above. These modifications and variations will not however depart from the scope of the invention if defined by the following claims.

What is claimed is:

1. Apparatus for winding wire comprising a capstan defining a plurality of radially disposed slots, a source of wire, rotatable means operatively disposed with respect to said source and capstan and adapted for receiving wire from the source and winding the wire around said capstan in the vicintiy of said slots, a plurality of members extending through said slots and displaceable in the slots in an axial direction relative to said capstan, and means coupled to said rotatable means and engaging said members to displace the latter in said axial direction and in sequence from a first position whereat winding of the wire on the capstan is unimpeded to a second position whereby wire wound on the capstan is urged in axial direction along the latter.

2. Apparatus as claimed in claim 1, wherein said capstan is a castellated structure defining said slots, comprising a castellated ring including said members as radially extending, relatively fixed elements accommodated in said slots.

3. Apparatus as claimed in claim 2 wherein said capstan includes a wire supporting section of determinable axial extent, said slots extending axially along the capstan and said elements being axially displaceable in said slots at least to the extent of said section.

4. Apparatus as claimed in claim 1 wherein said members are displaceable independently of each other.

5. Apparatus as claimed in claim 4 wherein the latter said means includes a roller rotatable around said capstan and positioned to engage said members in sequence to displace the same.

6. Apparatus as claimed in claim 5 comprising guideways slidably mounting said members on said capstan and springs engaging and urging said members toward said first position.

7. Apparatus as claimed in claim 5 wherein said members are cantilever-type springs mounted on said capstan.

8. Apparatus as claimed in claim 5 where the latter said means further includes means adjustably supporting said roller with respect to said members.

9. Apparatus for winding wire comprising a capstan, a head adapted for winding turns of wire around said capstan upon relative movement between said capstan and head, pressure means for pressing said turns in a downward direction, said pressure means comprising a pressure member adjacent said capstan and coupled thereto such that relative rotation is prevented, said pressure member being located above the uppermost turn of wire, and means coupled to said pressure member for cyclically and rockingly displacing the same downwardly by a distance equal to the diameter of said wire whereby the lowermost turn of wire is continuously removed from said capstan by the pressure means, said capstan including a castellated upper portion, the pressure member including projecting parts intermeshed with the castellated capstan, the last said means including a vertically adjustable roller for driving said pressure member and resilient means coupled to said pressure member and opposing displacement by said roller.

10. Apparatus as claimed in claim 9, in which each said projecting part comprises a flexible blade, said blades assuming a normal position spaced from said turns of wire.

11. Apparatus for winding wire comprising a capstan, a rotatable head operatively disposed with respect to said capstan to wind a plurality of turns of wire therearound, a rotatable shaft, means for driving said rotatable head from said shaft, a member coupled to said shaft and inclined with respect thereto, said capstan including a spherical upper portion, a ball joint concentric with said spherical portion, said inclined member being coupled to said ball joint, a plurality of rollers on said inclined member, a pressure member including a track engaging said rollers, said pressure member being operatively associated with said capstan so that the rotation of said said rollers causes said pressure member to oscillate with respect to said capstan to cause said pressure member to urge one of the wires off the capstan.

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