July 29, 1941. M. REVEL 2,251,205

APPARATUS FOR WINDING WIRE AROUND A BODY OF REVOLUTION

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Fig. 1

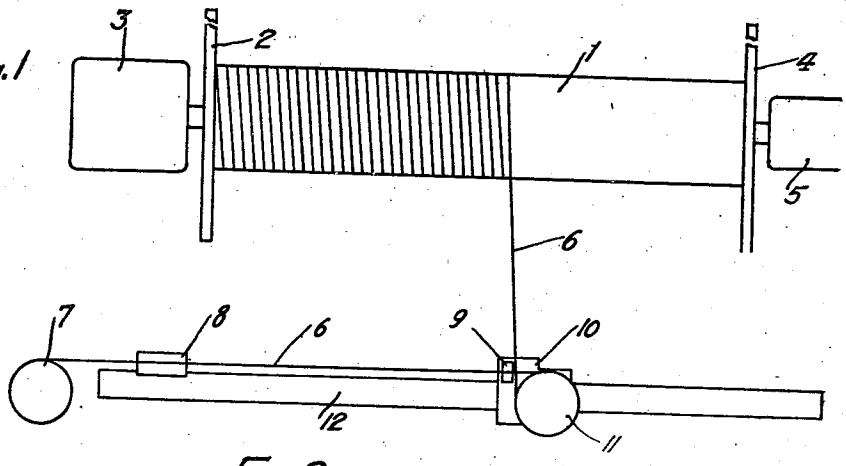


Fig. 2

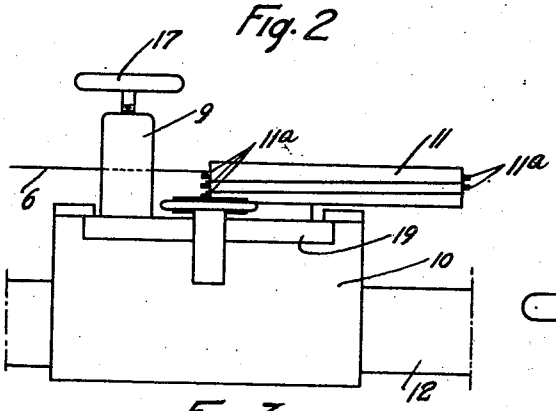


Fig. 3

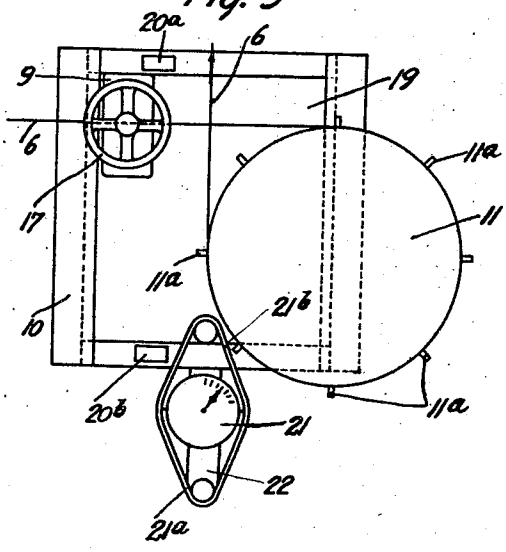
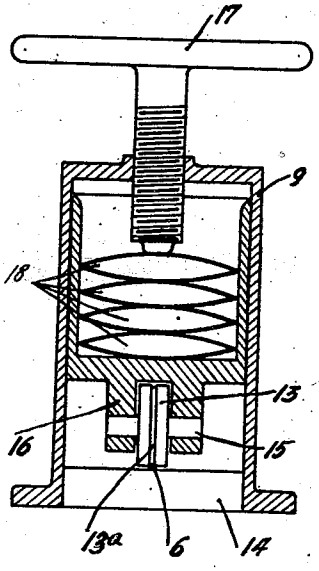


Fig. 4



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APPARATUS FOR WINDING WIRE AROUND A BODY OF REVOLUTION

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Fig 6

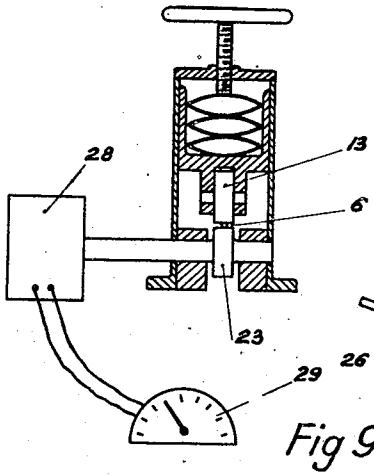


Fig 5

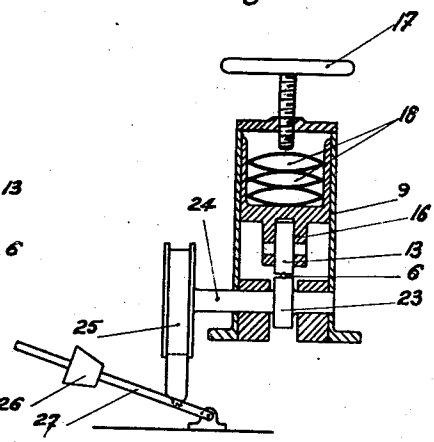


Fig 9

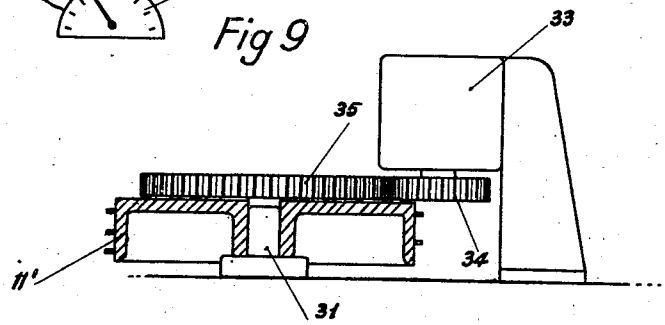


Fig 8

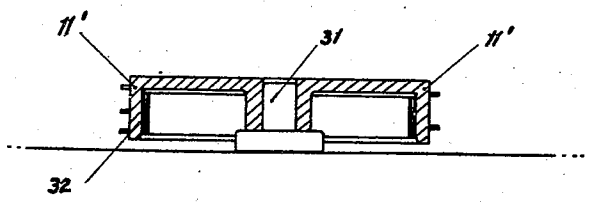
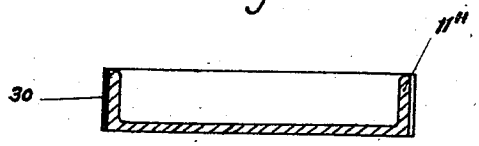


Fig 7



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Patented July 29, 1941

2,251,205

UNITED STATES PATENT OFFICE

2,251,205

APPARATUS FOR WINDING WIRE AROUND A BODY OF REVOLUTION

Maurice Revel, Paris, France, assignor to Societe des Tuyaux Bonna, Paris, France, a corporation of France

Application October 27, 1938, Serial No. 237,358
In France November 5, 1937

9 Claims. (Cl. 242—148)

This invention relates to the production of a predetermined winding tension on a wire or the like which is wound on a body of revolution and more particularly, to the hooping of concrete pipes, piles or posts through winding under tension, on the said pipes, piles or posts, of a steel wire adapted to put the concrete in a state of compression.

In such applications the tension which is desired is so high that it is not possible to obtain it by causing the wire to be hooped by a simple clamping operation between two surfaces. On the other hand, this invention enables such result to be easily attained.

According to the present invention I greatly increase and multiply the comparatively slight degree of tension which is obtained by clamping the wire between two surfaces by using this tension for insuring the adhesion of the said wire on a rubbing surface of suitable form on which this wire is forced to pass before it is wound on the body to be hooped.

For carrying out the invention, the winding device for the wire being formed, for instance, of a carriage which moves in a parallel direction to the axis of the body to be hooped and which the wire leaves perpendicularly to the axis of the said body itself which is rotated about its own axis. The device for first clamping the wire can be formed of a roller which is under the influence of a controllable yielding clamping device which presses the wire against a rubbing holder carried by the said carriage.

The rubbing surface on which the wire is forced to pass when leaving the clamping device can be advantageously formed of the side surface of a barrel which is also carried by the said carriage and on which the wire is helically wound with a number of turns corresponding to the desired final tension.

In order to permit the control of the said tension the wire clamping device and the barrel which forms the rubbing surface can be mounted on the carriage of the winding device through the medium of a second carriage which can move on the first carriage perpendicularly to the axis of the body to be hooped, both carriages being connected together through a tension dynamometer the resistance of which exerts its action in the direction opposite to the wire winding tension.

In these conditions the wire winding tension can be exactly known at every moment. On the other hand, the regularity of the wire which is wound is not likely to be affected by the irregularities which could occur on the surface of the body on which the winding operation is performed.

In order to avoid the wire winding tension undergoing changes when the wire shows an irregular surface (deposits of carbon or rust, for instance), the direct rubbing of the wire in the clamping device and/or on the barrel which serves to give the final tension can be substituted by the rubbing action or the braking action of a movable member driven by the wire and with respect to which the latter undergoes practically no relative displacement.

When the wire surface shows irregularities only in small regions which are localized and comparatively spaced, these irregularities do not substantially affect the mean coefficient of friction of the wire on the barrel, but, on the contrary, as soon as one of them appears in the clamping device in contact with the rubbing holder, the initial tension undergoes a change which is multiplied by the barrel and the final tension is thus changed. Then the rubbing barrel can remain without change, but it is expedient to modify the clamping device in the direction which is indicated above. For this purpose the rubbing holder of this device can be replaced by a roller which is tangent to the first roller of the said device and on which a brake is mounted which is either a mechanical or a magnetic brake and adjustable to determine the initial tension.

When the wire which is used has a surface which is irregular everywhere, it is also expedient to modify the barrel which gives the final tension so as to do away with the rubbing of the wire on the said barrel. To this end a sliding hoop wound on the barrel and slit along a generatrix can be inserted between the wire and the barrel, due to which the rubbing of the hoop on the barrel, which is independent of the condition of the wire surface, is substituted for the irregular rubbing of the wire, the hoop being applied on the barrel by the wire with a pressure which is the higher the greater is the number of turns of the wire which is wound on it. Or the barrel can be made movable about its axis and its movement of rotation can be braked either mechanically or magnetically, the desired winding tension being determined by this braking action. In this latter arrangement the clamping device can be eliminated and replaced by a couple of rollers suitably resting on another so as to insure a sufficient adhesion of the wire on the barrel.

In every case the double carriage device with the dynamometer indicating the tension of the

wire at every moment can remain so as it is indicated above.

Other features and advantages of the device according to the invention will appear from the complementary description which follows and which is given with reference to the appended drawings in which various forms of execution of the invention are shown by way of nonlimitative examples.

In the drawings:

Figure 1 is a diagrammatical plan view of the whole of a machine which is more particularly adapted for hooping concrete pipes and which comprises a tensioning device according to the invention.

Figures 2 and 3 are an elevational view and a plan view respectively, on a larger scale, of the wire tensioning device.

Figure 4 is an axial sectional view of the wire clamping device.

Figures 5 and 6 are axial sectional views of modifications of the clamping devices.

Figures 7 to 9 are also axial sectional views of modifications of the barrels.

In the diagrammatical view of Figure 1, 1 is the pipe to be hooped, this pipe being mounted, for instance, between the chuck 2 of a chuck lathe driven by an electric motor 3 and the plate 4 of a loose headstock 5 so that its axis is substantially horizontal.

The steel wire 6 for the hooping is supplied from a bundle threaded onto a reel 7 which rotates loosely on its axis and passes first through a straightening device 8 where it loses the curvature which is due to its winding as well as the irregularities which it may have. Then the wire 6 passes into a clamping box 9 carried by a carriage 10 and it is then wound onto a rubbing barrel 11 which is also secured on the carriage 10 and which it leaves perpendicularly to the axis of the pipe 1 on which it is wound. The carriage 10 is driven at a suitable velocity on a turning bed 12 which is parallel to the axis of the pipe 1 by means of a suitable transmission driven by the motor 3 so that the wire is helically wound on the pipe 1.

The clamping box 9 (see Figure 4) contains a roller 13 provided with a groove 13*a* insuring the guiding of the wire 6 and pressing the latter onto a rubbing holder 14 secured to the bottom of the box 9. The roller 13 is journaled by means of a pin or shaft 15 carried by a mounting 16 adapted vertically to slide in the box 9 and the desired pressure is transmitted to the same by means of a handwheel 17 screwed into the top of the box 9, through the medium of Belleville washers 18 adapted to insure all the desired softness to the said transmission. It is possible, moreover, to adjust this softness by modifying the number of the washers 18 or by overturning a certain number of them.

The so formed clamping box gives to the wire 6 a certain tension which is comparatively slight and which will be called "primary tension." In order to give the desired value to the final tension of the wire, the latter is wound on the rubbing barrel 11 with a suitable number of turns this number being increased by ¾ of a turn for insuring the change of direction which is necessary for the winding of the said wire on the pipe 1 to be hooped. The wire 6 is guided on the side surface or periphery of the barrel 11 (see Figures 2 and 3) by a certain number of guiding fingers 11*a* arranged at suitable intervals and along a helix on the said surface. The rubbing of the wire 6 on the barrel 11 will increase or multiply the primary tension by a coefficient which depends only on the number of rubbing turns of the wire, and which feature enables the desired winding tension to be attained.

The adjustment of this tension is effected in a very simply manner. If T is the winding tension and t the primary tension produced by the clamping box 9, it is well known that both these tensions are connected together through the relation: $T=te^{fx}$, f being the coefficient of friction of the wire on the surface of the barrel 11 and x being, in radians, the arc of contact of the wire and of the said surface. This formula shows that it is possible to vary the tension T either by varying the primary tension t, the arc of contact x remaining the same, or by varying the arc of contact x, the primary tension t remaining the same. In practice both means will be used simultaneously: The number of wire turns which gives a nearly suitable value to the angle x will be chosen with an approximation of one turn, in order not to modify the direction of the wire bits and then the adjustment is completed by varying the primary tension t through the adjustment of the handwheel 17.

The control of the winding tension T is effected by means of the following device:

The clamping box 9 and the barrel 11 are mounted on the carriage 10 through the medium of a second carriage 19 which can move on the first carriage perpendicularly to the turning bed 12 either through a rolling operation or, as shown, owing to a mounting on slide bars, this displacement being limited in both directions through two stops 20*a*, 20*b* secured on the carriage 10. A traction dynamometer provided with a dial 21 is secured by one of its ears 21*a* to a lug 22 fast or integral with the carriage 10 and by its other ear 21*b* to the carriage 19. This fastening can be advantageously rendered adjustable on one of both carriages through a device formed of a screw and a nut and actuated by means of a handwheel (not shown).

As it is easy to conceive from the foregoing explanations, under the action of the winding tension T the carriage 19 tends to move into engagement with the front stop 20*a* but it is prevented from doing so by the dynamometer 21 which balances the tension of the wire and retains the carriage 19 in an intermediary position between both stops 20*a*, 20*b*. Now, if all the forces which are applied to the wire 6 are projected onto a plane which is perpendicular to the axis of the pipe 1, the tension T and the resistance of the dynamometer are projected with their true length, the projection of all the other forces (tension due to the straightening device 8, primary tension t) being nought. Thus the dynamometer 21 exactly indicates the winding tension T.

The stroke of the carriage 19 between both stops 20*a*, 20*b* is preferably chosen equal to the expansion between the ears of the dynamometer 21 corresponding to the maximum stress which this apparatus can sustain, so that a sudden bound of tension due to an accidental cause can never exert on the dynamometer a stress which is higher than the stress for which it has been constructed.

Independently of the advantages which have already been mentioned above, it is to be noted that the device according to the invention insures, due to the self-braking action of the wire, a ready dissipation of the heat which is devel-

oped, the fresh wire being constantly renewed on arriving to the carriage and carrying with it the heat which has been developed. The barrel 11 can be made solid, of cast iron, for instance, and aid the cooling action through radiation. It is possible, moreover, if the machine must produce a considerable winding work under a strong tension, to make this barrel in the form of a vat which can be filled with water.

In the modification shown in Figure 5, 9 is still the box of the clamping device in which is mounted a sliding mounting 16 which carries a roller 13 and which is subjected to the pressure of a clamping handwheel 17 through the medium of Belleville washers 18. In this case the roller 13 is not provided with a groove and the rubbing holder is replaced by a second roller 23 on the shaft 24 of which is arranged, for instance, a band brake 25. In these conditions the handwheel 17 operates to insure the contact of the wire 6 with both rollers 13 and 23 and it is the brake 25 which permits the primary tension to be obtained. This tension can be varied by tightening the brake band 25 more or less by means of a counterweight 26 which can slide along a tilting lever 27 connected with the said brake band.

In the modification shown in Figure 6 the braking action of the lower roller 23 is insured by a magnetic brake 28. The adjustment of the tension is obtained by means of a rheostat 29 operable to vary the voltage of the current for energizing the brake 28 in a sufficiently progressive manner.

In Figure 7, 11 is a barrel which is fixedly mounted. On this barrel is arranged a friction or sliding hoop or barrel 30 which is slit on one of its generatrices. It is on this latter that the wire is wound with the number of turns corresponding to the desired final tension. The wire adheres to the split friction barrel 30 and causes the latter to slide on the fixed barrel, the rubbing force which is developed depending on the number of turns of the wire which are wound on the said hoop.

In Figure 8 the barrel 11' directly receives the wire, but this barrel is loosely mounted on a fixed axis 31 and its movement of rotation is braked by a fixed mechanical brake 32. In the modification shown in Figure 9 the braking of the barrel 11' is obtained by means of a magnetic brake 33 connected with the said barrel, for instance, through the medium of a pair of coupling elements 34, 35. In these two devices the adjustment of the tension of the wire is effectuated by acting on the brake in the manner which has been indicated in describing the clamping devices shown in the Figures 5 and 6.

What I claim is:

1. In apparatus for winding a wire under tension on a revolving body member as the latter and a carriage member slide one relatively to the other member; a carriage on the carriage member, means on the carriage operable to place the wire under a low primary tension, and frictioning means on the carriage arranged to receive the wire from the first mentioned means and to increase the tension thereof to the degree employed in winding, means mounting the carriage for movement on the carriage member through the movement of the wire in accordance with the degree of tensioning of the wire.

2. In apparatus of the class described, a carriage, means thereon operable to place wire under a low primary tension, frictioning means arranged on the carriage to receive the wire from the first mentioned means and to increase the tension thereof, means mounting the carriage for movement by movement of the wire in accordance with the degree of tensioning of the wire.

3. An apparatus according to claim 2, in which said last mentioned means includes a dynamometer balancing the tension of the wire and mounted for operation through movement of the carriage.

4. Apparatus according to claim 1 wherein said frictioning means is a relatively large drum movable on an axis perpendicular to the carriage and disposed so that tensioned wire will cross the wire of primary tension.

5. Apparatus according to claim 2 wherein the first mentioned means comprises a box, a rubbing holder mounted by the box and crossed by the wire, a slide in the box to clamp the wire against said rubbing holder, and variable resilient pressure means positioning said slide.

6. Apparatus according to claim 2 wherein the first mentioned means comprises a box, a rotatable member mounted by the box and crossed by the wire, a slide in the box operable to clamp the wire against said rotatable member, and tension-varying brake means for said rotatable member.

7. Apparatus of the class described according to claim 2 wherein the first mentioned means is in spaced relation to the frictioning means, said frictioning means comprising a rotatable drum, and a brake means for said drum.

8. Apparatus according to claim 2 wherein the frictioning means comprises a rotatable drum in the form of a split hoop, and a mounting barrel for said drum surrounded by the latter.

9. Apparatus according to claim 2 having a stop on the last mentioned means to limit movement of the carriage in one direction and a stop on the same means to limit movement of the carriage in the other direction, and a dynamometer included in the mounting means adjacent the second mentioned stop.

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