Sept. 2, 1947. D. MAPES 2,426,631

WIRE TENSIONING DEVICE

Original Filed Jan. 8, 1942 3 Sheets-Sheet 1

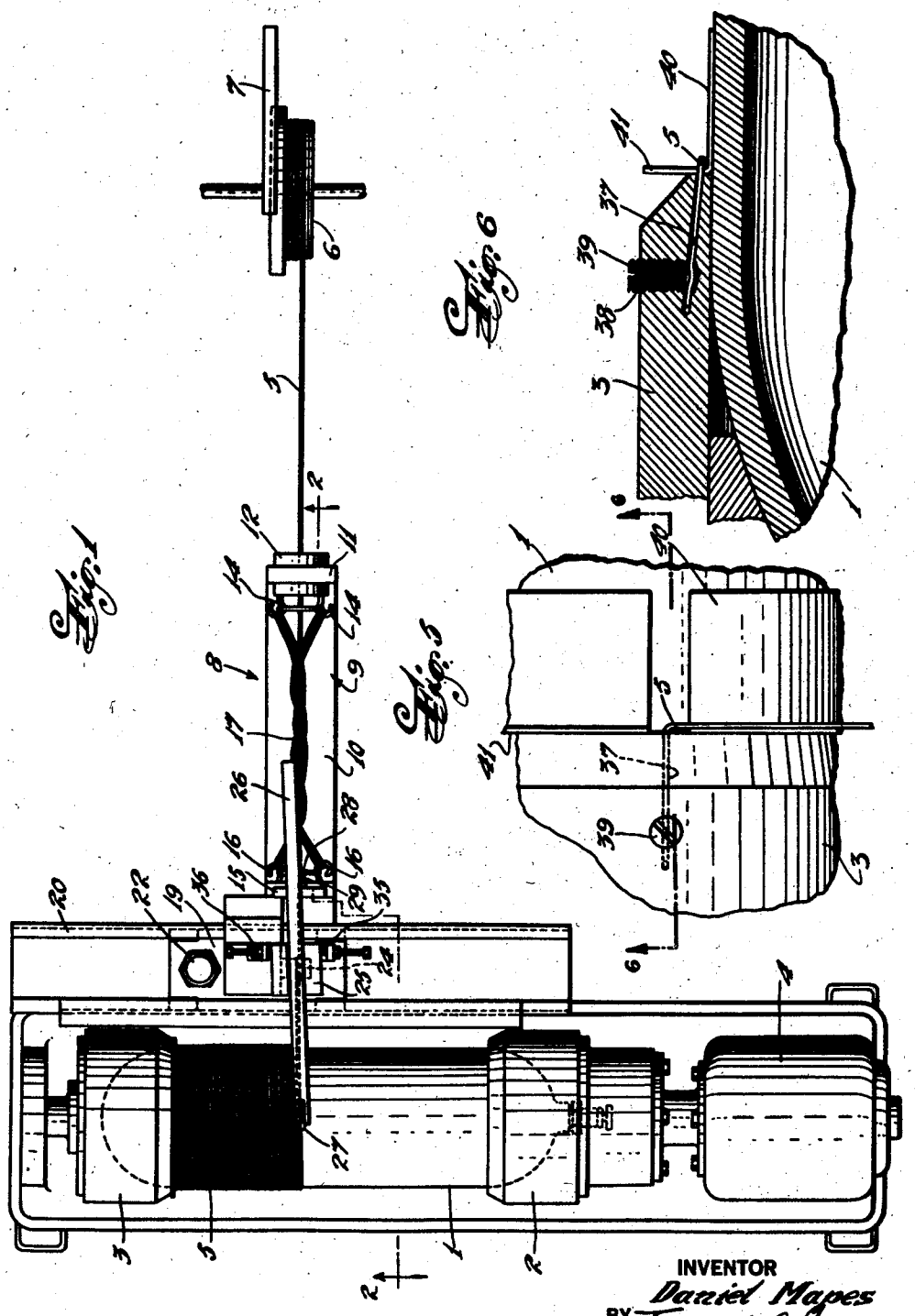


Fig. 1

Fig. 5

Fig. 6

INVENTOR
Daniel Mapes
BY Ernest A. Jensen
ATTORNEY

Sept. 2, 1947. D. MAPES 2,426,631

WIRE TENSIONING DEVICE

Original Filed Jan. 8, 1942 3 Sheets-Sheet 2

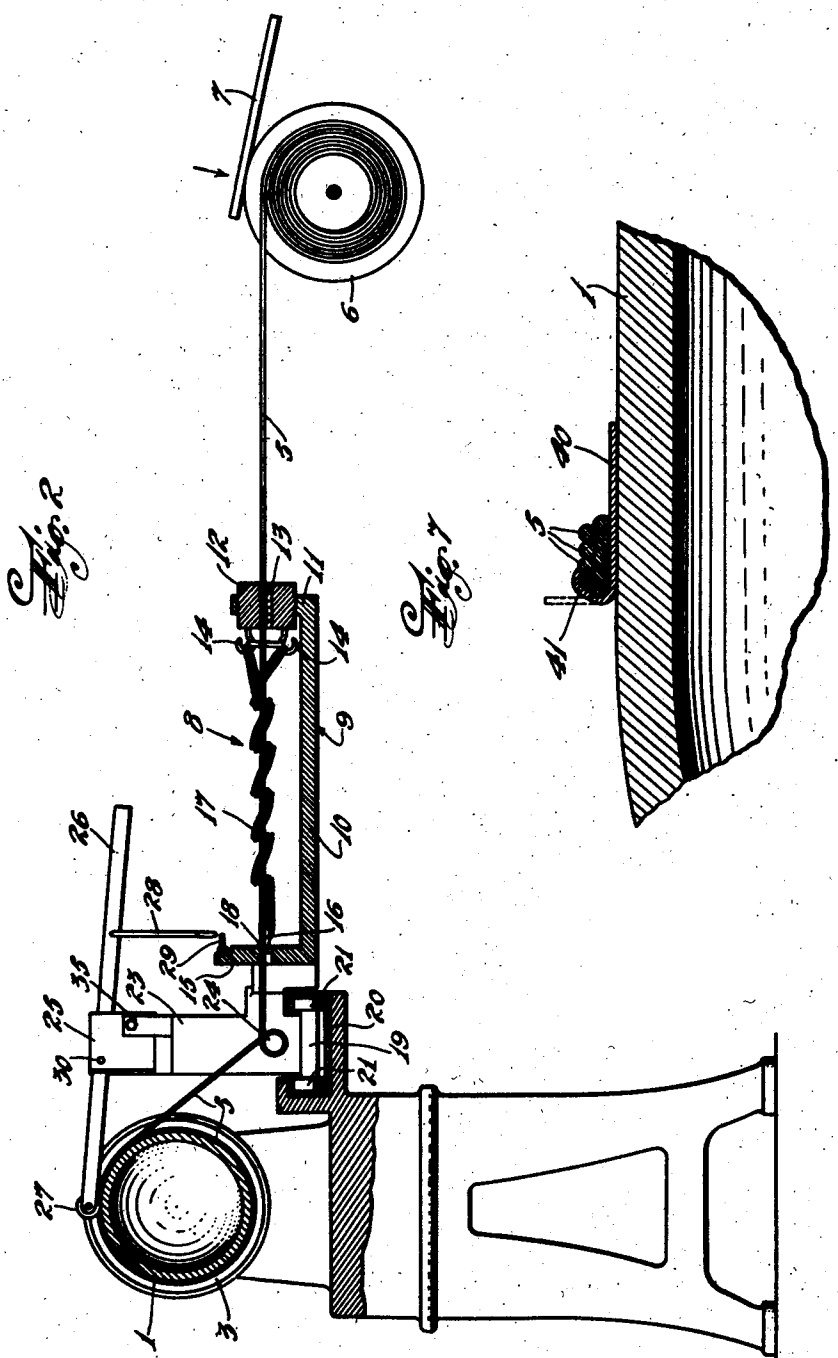


Fig. 2



Fig. 4

INVENTOR
Daniel Mapes
BY Ernest A. Jensen
ATTORNEY

Sept. 2, 1947. D. MAPES 2,426,631

WIRE TENSIONING DEVICE

Original Filed Jan. 8, 1942 3 Sheets-Sheet 3

Fig. 3

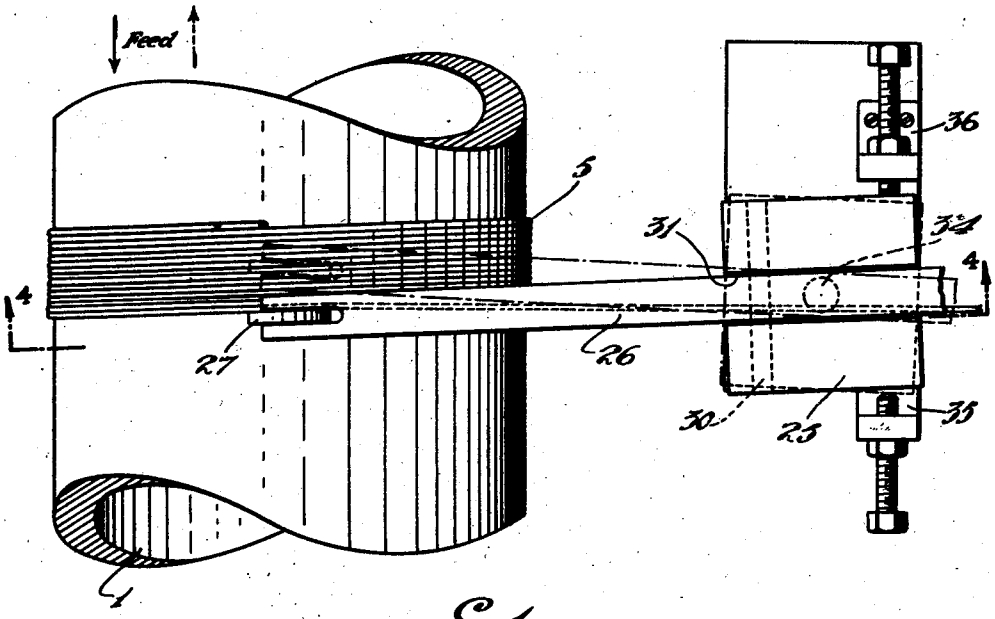
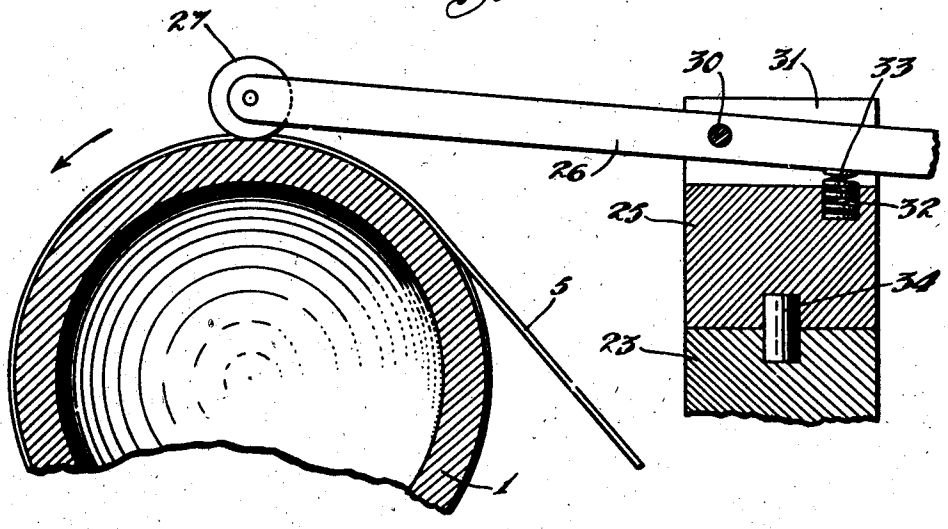



Fig. 4




INVENTOR
Daniel Mapes
BY Ernest A. Joerren
ATTORNEY

Patented Sept. 2, 1947

2,426,631

# UNITED STATES PATENT OFFICE

2,426,631

## WIRE TENSIONING DEVICE

Daniel Mapes, West Caldwell, N. J., assignor to Specialties Development Corporation, Bloomfield, N. J., a corporation of New Jersey

Original application January 8, 1942, Serial No. 426,019, now Patent No. 2,371,107, dated March 6, 1945. Divided and this application January 30, 1945, Serial No. 575,215

8 Claims. (Cl. 242—147)

1

The present application is a division of applicant's co-pending application Serial No. 426,019, filed January 8, 1942, now Letters Patent No. 2,371,107, dated March 6, 1945, which relates to new and useful improvements in methods of and apparatus for winding wire, with particular reference to winding wire on bodies, of revolution, as, for example, containers of a general cylindrical shape, pipe or tubing, and the like, while this divisional application relates to a wire tensioning device embodied in the aforementioned apparatus.

The invention is especially adapted to be utilized in connection with winding high tensile strength steel wire, such as that usually known as "piano" wire, on containers or cylinders designed for the storage of high pressure fluid media, to provide a protective jacket for such containers.

The use of protective jackets of high tensile strength steel wire for containers which are otherwise sufficiently strong to withstand the highest operating pressures to which they may be subjected in normal service, is an outgrowth of the widespread use of powerful 0.50 caliber machine guns on modern fighter planes in place of previous less powerful 0.30 caliber machine guns; it having been found that 0.50 caliber machine gun bullets striking a high pressure gas container squarely, will completely pierce the container, leaving entrance and exit openings, and that the container wall is so weakened at the exit opening that under the influence of the high pressure fluid medium issuing from the opening, the container literally tears asunder with explosive force with great danger to the plane and its crew. It has also been discovered that this danger of "explosion" of the container can be overcome by providing the container with a suitable jacket of high tensile strength steel wire, which has no function normally, but which serves to take up the unusual stresses occurring when the container is pierced by a bullet or other high velocity projectile, and to localize the damage to the area immediately adjacent the opening in the container wall.

Such a jacket consists of a series of turns or coils of wire which are arranged to form a substantially continuous winding on a wall of the container. Of course, when the container wall is pierced by a bullet, a number of turns of the wire are severed; and in order to overcome the tendency of the remaining portion of the coils to unwind or become dislocated, it has been found desirable to wind the wire on the container

2

under a predetermined degree of tension, and to so preset the wire as to create a tendency for it to cling to the contour of the container. In order to further aid in holding the winding in place, an adherent coating, such as one of solder, is usually applied to the jacket; and as the wire itself should preferably have a coating resistant to rust and conducive to the adhesion of the solder, so-called "tinned" wire may be advantageously employed.

Ordinary methods of winding wire and machines for this purpose known heretofore, have not been satisfactory for providing wire-wound jackets of the foregoing character. One of the difficulties of such previously known machines is that the wire tensioning means mechanically damages the wire coating. Another difficulty is that the tensioning means, by the application of friction, heats the wire to such an extent as to cause melting or deterioration of the coating and also to affect the tensile properties of the wire.

Accordingly, it is to object of the invention to provide an improved wire tensioning device adapted to be used in connection with apparatus for winding wire on bodies of revolution, such as cylindrical containers, and the like.

Another object is to provide a simple, practical and economical wire tensioning device.

A further object is to provide a wire tensioning device adapted to be used in connection with apparatus for winding wire, wherein the wire may be suitably tensioned without damage to the coating of the wire, either mechanically or due to heat caused by friction.

Other and further objects of the invention will become apparent upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

In the drawings:

Figure 1 is a plan view of an apparatus for winding one or more layers of wire upon a body of revolution;

Figure 2 is a sectional view, partly in elevation, taken on the line 2—2 of Figure 1;

Figure 3 is an enlarged plan view of a portion of the apparatus shown in Figure 1 and illustrating means for guiding the wire in place as it is being coiled about a cylinder;

Figure 4 is a transverse sectional view taken on the line 4—4 of Figure 3;

Figure 5 is an enlarged fragmentary plan view,

illustrating means of attaching the starting end of the wire to one of the chucks;

Figure 6 is a fragmentary sectional view taken along line 6—6 of Figure 5; and

Figure 7 is an enlarged fragmentary sectional view, illustrating means for securing the end coils or turns together.

Referring now to the drawings, there is shown, in Figure 1, a cylinder 1 rotatably secured between a head chuck 2 and a tail chuck 3 of a conventional lathe powered by motor means 4. The cylinder is seen to be partly wound with wire 5, which is being supplied from a stock reel 6, the reel being retarded by a friction brake 7. On its way from the stock reel 6 to the cylinder 1, the wire 5 passes through tensioning means 8, in accordance with the invention, arranged to move as a whole, parallel to the main axis of the cylinder 1, as will be hereinafter made apparent. The tensioning means 8 comprises a supporting member 9 having a longitudinal portion 10 provided with a pair of outer and inner uprights 11 and 15, respectively. The upright 15 is centrally apertured as at 18, while the upright 11 has rotatively adjustably mounted therein a bushing 12 formed with a central aperture 13. The bushing 12 and upright 15 are provided with a pair of hooks 14 and 16, respectively, and which are disposed in confronting relation. The wire 5 passes through the apertures, 13 and 18 longitudinally of the portion 10 and between the backs of each pair during the feed of the wire from the reels to the cylinder.

The ends of a pair of rope lengths 17 are fastened to the hooks 14 and 16, respectively, and with said lengths being twisted about each other and the wire. By adjustment of the bushing 12 within the upright 11, the tension of the rope lengths is regulated about the wire, thus permitting the wire to be fed to the cylinder under a desired tension for a purpose hereinafter made apparent.

The tensioning means 8 is made a part of a carriage means 19, which is designed to be supported by a carriage bed 20 suitably secured to the side of the lathe where, ordinarily, the tool would be. A minimum amount of friction between carriage and bed is obtained by the interposition of rollers 21.

If desired, an adjustable friction brake for the carriage 19 may be provided as at 22.

The carriage 19 is formed with a block 23 or the like, which is adapted to carry on one side a roller or pulley-like member 24 having a relatively small diameter, and on its top a secondary block 25. The block 25 is seen to support a wire guide, which may take the form of an arm 26 normally adapted to make contact through its end 27 with the cylinder 1, as will be shown and explained with respect to Figures 3 and 4. The guidearm 26 may be held, if desired, in an "out-of-contact" position with respect to the cylinder 1 by means of a "hook and eye" arrangement, which is shown to comprise an eyed member 28 suspended from the arm 26, and a pin-like member 29 projecting horizontally from the upright 15, and adapted to cooperate with the eye of the member 28. The wire 5, after passing through the upright 15, is looped once around the roller 24, and is then coiled about the cylinder 1. Initially, the free or starting end of the wire is secured to the tail chuck 3 by means of a set-screw 39, as will be explained in detail.

Referring now to Figures 3 and 4, the guide arm 26 is shown pivotally supported at 30 on the



secondary block 25. The block 25 is formed with a slot 31 across its top which accommodates the arm 26 and permits it to rotate vertically through a small angle. The block 25 is also formed with a vertical recess 32 communicating with the slot 31 and wherein is positioned an expansion spring 33, serving to exert an upward thrust on the arm 26, and thereby maintaining the end 27 thereof in close contact with the cylinder 1. The end 27 is provided with a rotatably mounted wheel, or other suitable means adapted to move over the cylinder surface with a minimum amount of friction. The block 25 on which the arm 26 is mounted is arranged to rotate about a pin member 34 secured to the top of the block 23. The rotation of the block 25 is limited to a small arc, the size of which is determined by adjustable screw stops 35 and 36 disposed on top of the block 23. The wheel on the end 27 of the arm 26 is intended to bear on the cylinder just ahead of the respective coil being wound so that the wire, as it is being coiled about the cylinder, exerts a lateral thrust on the end 27 of the arm 26. The action of the wire coils, in thus dragging along the carriage 19, causes the block 25 to bear on one stop when the feed is in one direction, and against the other when feeding in the reverse direction. The relation between the direction of feed (shown by arrows) and the position of the arm 26 and the block 25 is indicated in full and in broken lines, respectively. The adjustment of the stops 35 and 36 makes it possible to determine the best position of the carriage 19 with respect to the arm 26 so that the ultimate in close winding is attained. The foregoing described form of wire guide 26 is an illustration of a preferred embodiment, and alternative possibilities will suggest themselves to one skilled in the art.

Figures 5 and 6 illustrate how the wire 5, before the winding operation proper is begun, is threaded into a passage 37 in the wall of the chuck 3. The passage 37 terminates in a threaded recess 38 for the accommodation of a set-screw 39 which secures in place the free end of the wire 5. At 40 is indicated a split end-ring preferably constructed of sheet metal for instance, brass which is postioned on the cylinder 1 before the wire is applied thereto, serving as an anchor for the wire when the winding is completed. A flange 41 on the ring 40 is bent inwardly and over the end coils to securely hold the coils, as is evident from Figure 7. Another similar end-ring (not shown) is employed for the other end of the winding.

The foregoing description makes it evident that when a new cylinder is to be wound, the tail chuck 3 is retracted sufficiently for the cylinder to be fitted between the tail chuck 3 and the head chuck 2, whereupon the tail chuck is brought up again to a snug fit over the bottom of the cylinder, shown in broken lines in Figure 1, and is locked in position by conventional chuck locking means, not shown. One of the end-rings 40 is then fitted over the cylinder adjacent the chuck 3 as illustrated in Figures 5 and 6. The wire 5, having been threaded through the apertures 13 and 18 and between the rope lengths 17, is looped once around the preset roller 24, and finally the free end thereof is inserted into the passage 37 of the chuck 3 and there secured by means of the set-screw 39. The lathe may now be started up on slow speed until enough coils of wire have been put on to cover the brass end-ring entirely. After the wire has begun to wind on the cylindrical surface of the cylinder itself, the speed of winding

may be increased to between 200 to 300 feet per minute. At this high speed, the lateral inertia of the carriage **19** and the arm **26** is used to force each wire coil into close contact with the previous one, the vertical pressure exerted by the arm on the cylinder being determined by the strength of the spring **33**.

The effect of the wire coils on the arm **26** is to drag along the carriage **19**, and the reason for the presence on the latter of both the rollers **21** and of the friction brake **22** now becomes evident because of the necessity for the carriage to move smoothly but not too freely.

During the high speed winding, the tension means **8** is adjusted as tightly as possible by the rotating bushing **12** without causing enough friction to result in heating of the wire. It is to be noted that the nature of the twisted rope lengths permits of adequate tensioning of the wire without in any way injuring it. Alternative tensioning means having similar properties are, of course, within the scope of the invention.

The preset roller **24** functions to impart to the wire, when the latter is fed thereabout, a set or established tendency to coil in a manner that each coil or convolution of the winding, will have a diameter which is less than that of the cylinder. Thus, any coils cut, for instance, by bullets, would tend to cling to the cylinder instead of straightening out and loosening the whole winding.

The friction brake **7** on the rotating stock reel **6** is necessary to prevent over-ride and consequent tangling of the wire. Preferably, the wire should be supplied in large diameter coils, since, obviously, the rotative speed of the coil support will be lower and the wire feed smoother than with a supply coil of smaller diameter.

When the cylinder has been wound to within ½'' of the head chuck, the machine is stopped and a second brass end piece fitted over the cylinder against the head chuck. Before the machine is again started up, the pressure guide arm **26** is hooked back off the cylinder **1** by means of the hook and eye members **28** and **29**, in order to eliminate interference with the head chuck **2**. The wire may then be wound at slow speed close up to the vertical edge of the end piece.

A second wire layer, if desired, may be wound immediately over the first by merely continuing the feed in a reverse direction as soon as the first layer has been filled in entirely. When one or several coils of the second layer have been wound the arm is released again, and the speed brought up to the 200 or 300 feet per minute mark. At the end of the winding of the second layer, the wire is cut off, and temporarily fastened to prevent loosening. Both the head and tail chucks are now retracted, and some form of spinning tool applied to the vertical section of each of the end-pieces **40** to turn them snugly over the end coils as shown in Figure 7.

As a final step, the wire winding is subjected to a so-called solder-lick by dipping a cylinder into a solder bath and rotating the same until the wire jacket is completely coated. Other adherent coatings, not necessarily metallic, will suggest themselves to those skilled in the art. The primary purpose of a coating of this type over the wire jacket is to render it proof against loosening, in case some of the coils should become broken.

It will be apparent from the above that upon being injured locally, as by a bullet, the winding as a whole will tend to cling to the contour of the cylinder even if a considerable portion of the coils are broken.



From the foregoing description it will be seen that the present invention provides apparatus for winding wire on bodies of revolution, which, in spite of the high speeds of application and close winding, will not injure the wire, and which will precoil the wire in such a manner that it will tend to cling to the body on which it is being wound.

It is to be understood that while a container has been chosen as a specific example for purposes of illustration, the method and apparatus herein disclosed for the production of wire-wound cylindrical containers of the character described, are usable in connection with the winding of wire on any so-called "body of revolution" as commonly understood in geometrical terminology.

As various changes may be made in the form, construction, arrangement and operation of parts disclosed herein, without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter contained in the above description or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention, as a matter of language, which might be said to fall therebetween.

I claim:

1. In apparatus of the class described, wire tensioning means comprising fibrous strands for receiving the wire, and supporting means for said strands having means for twisting said strands about the wire.

2. In apparatus of the class described, the combination of a movable carriage, wire tensioning means comprising strands of rope for receiving the wire, and supporting means for said rope having a member for twisting the strands about the wire, said tensioning means and said supporting means being supported by said carriage.

3. In apparatus of the class described, wire tensioning means comprising a plurality of strands of predetermined length for receiving the wire, and supporting means for the two ends of said strands, at least one end of said supporting means being rotatable in a plane perpendicular to the axis of said strands for twisting the strands about the wire.

4. In apparatus of the class described, wire tensioning means comprising an elongated member, a support on each end of said member, rotatable adjusting means on one of said supports, and a plurality of soft strands secured between said adjusting means and the other of said supports for receiving the wire, whereby rotation of said adjusting means is adapted to produce a twist in said strands about the wire.

5. In apparatus of the class described wire tensioning means comprising fibrous strands for receiving the wire, and supporting means at the respective ends of said strands, one of said supporting means including a member for twisting said strands about the wire.

6. In a wire tensioning device, the combination of an elongated supporting member having an upright portion provided with a wire guiding aperture and having a second upright portion spaced from said first portion and provided with a screw threaded bore, a bushing adjustably screw

threaded into said bore to vary the distance between said first upright portion and said bushing and having a wire guiding aperture therein substantially in alignment with said first aperture, and a plurality of fibrous strands having their respective ends secured to said first upright portion and to said bushing, said strands being adapted to be twisted about a wire passing through said apertures to tension the wire and being adjustable to vary the tension by adjustment of said bushing in said bore.

7. In apparatus of the class described, wire tensioning means comprising flexible means for receiving the wire, and supporting means for said flexible means including means for twisting said flexible means about the wire.



8. In apparatus of the class described, wire tensioning means comprising flexible strands for receiving the wire and extending longitudinally therewith, and supporting means for said strands including means affecting said strands longitudinally to exert force laterally against the wire.

DANIEL MAPES.


REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 2,124,001 | Lawson et al. | July 19, 1938 |