United States Patent

[11] **3,614,019**

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[21] Appl. No. **36,780**
[22] Filed **May 13, 1970**
[45] Patented **Oct. 19, 1971**
[73] Assignee **Bowen Tools, Inc.**

[54] **APPARATUS FOR CONTROLLING THE WRAPPING OF TUBING ONTO A REEL**
10 Claims, 7 Drawing Figs.

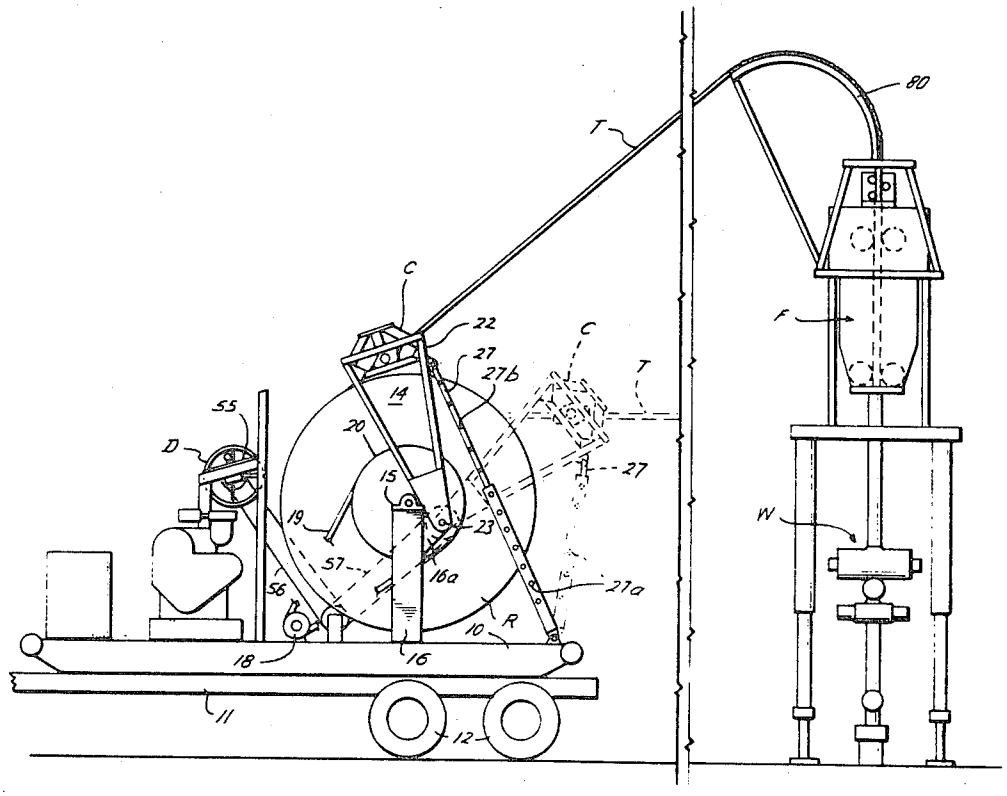
[52] **U.S. Cl.** ..... **242/157.1,** 242/158 R, 254/190 R
[51] **Int. Cl.** **B65h 57/28**
[50] **Field of Search** ..... 242/78.1, 82, 83, 158 R, 158 B, 158 F, 158.4, 157.1; 254/190 R

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Primary Examiner—Stanley N. Gilreath
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ABSTRACT: Apparatus for controlling the wrapping of tubing onto a reel to obtain substantially uniform- and level-wrapped layers on the reel, wherein the wrapping is normally accomplished by a free-wheeling or substantially unrestrained feeding of the tubing, but wherein control means is provided to force the tubing to feed in a desired manner to avoid improper wrapping of the tubing onto the reel.



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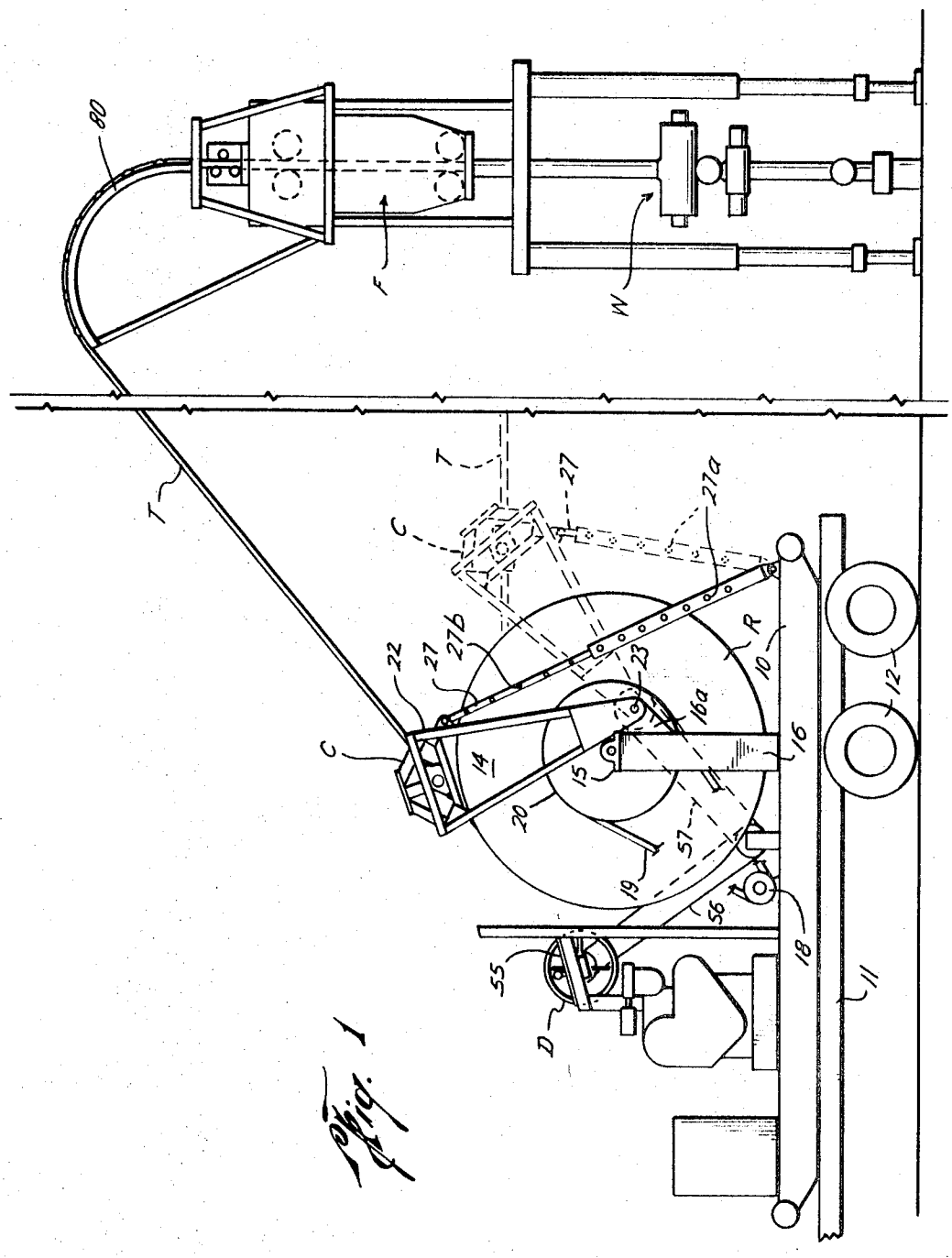


Fig. 1

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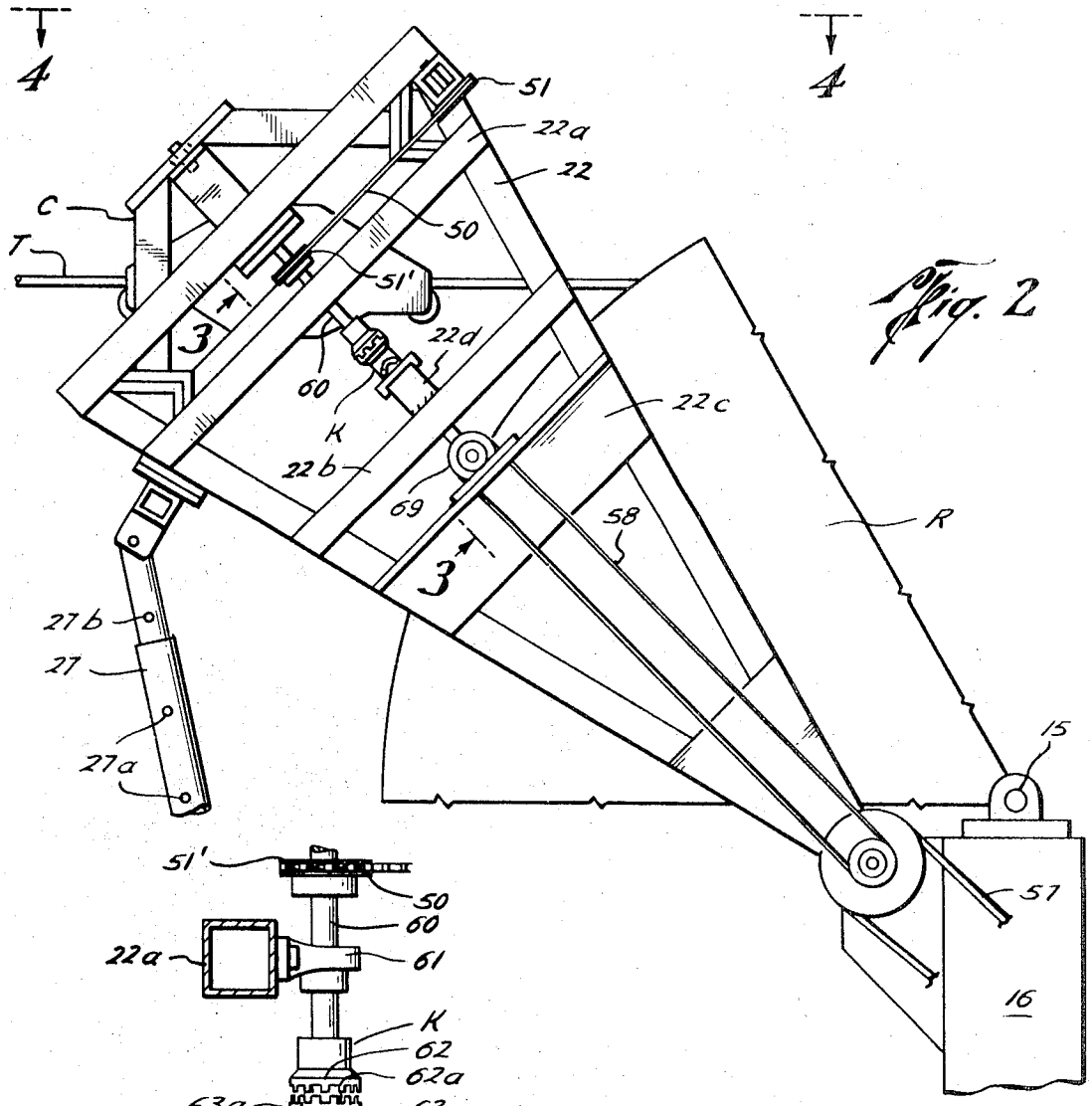


Fig. 2

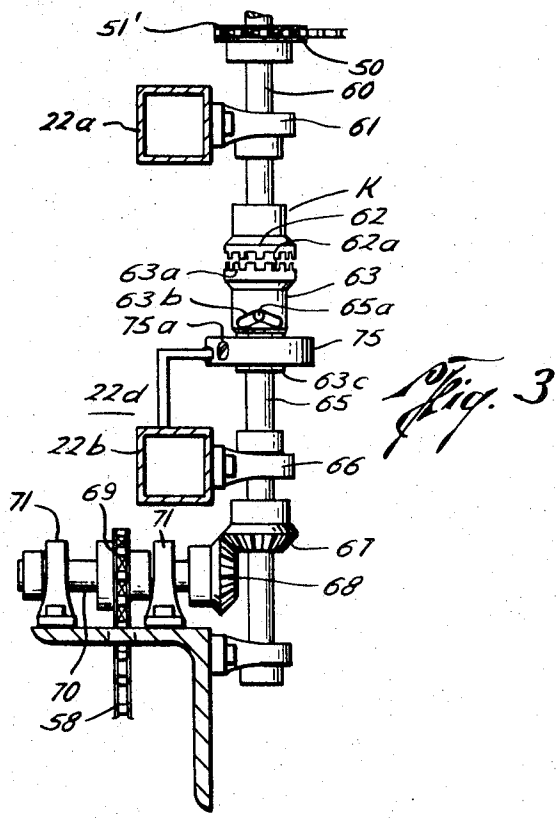


Fig. 3

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Fig. 4

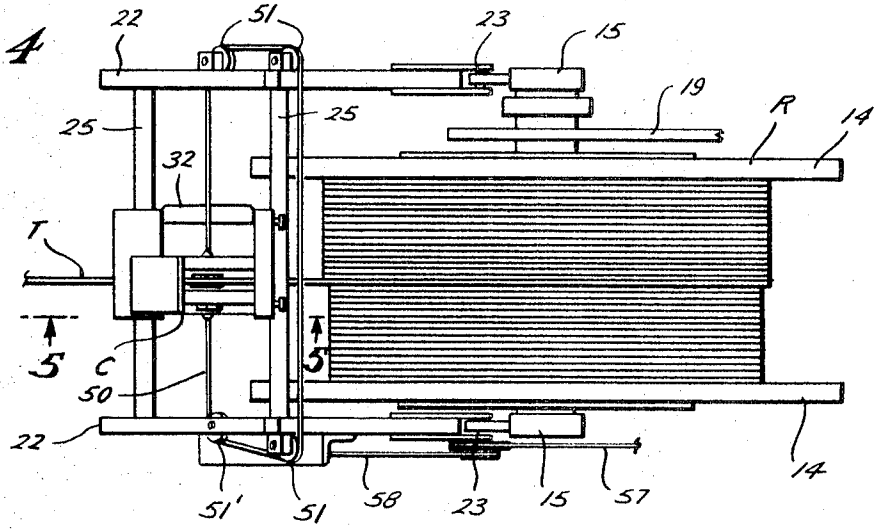
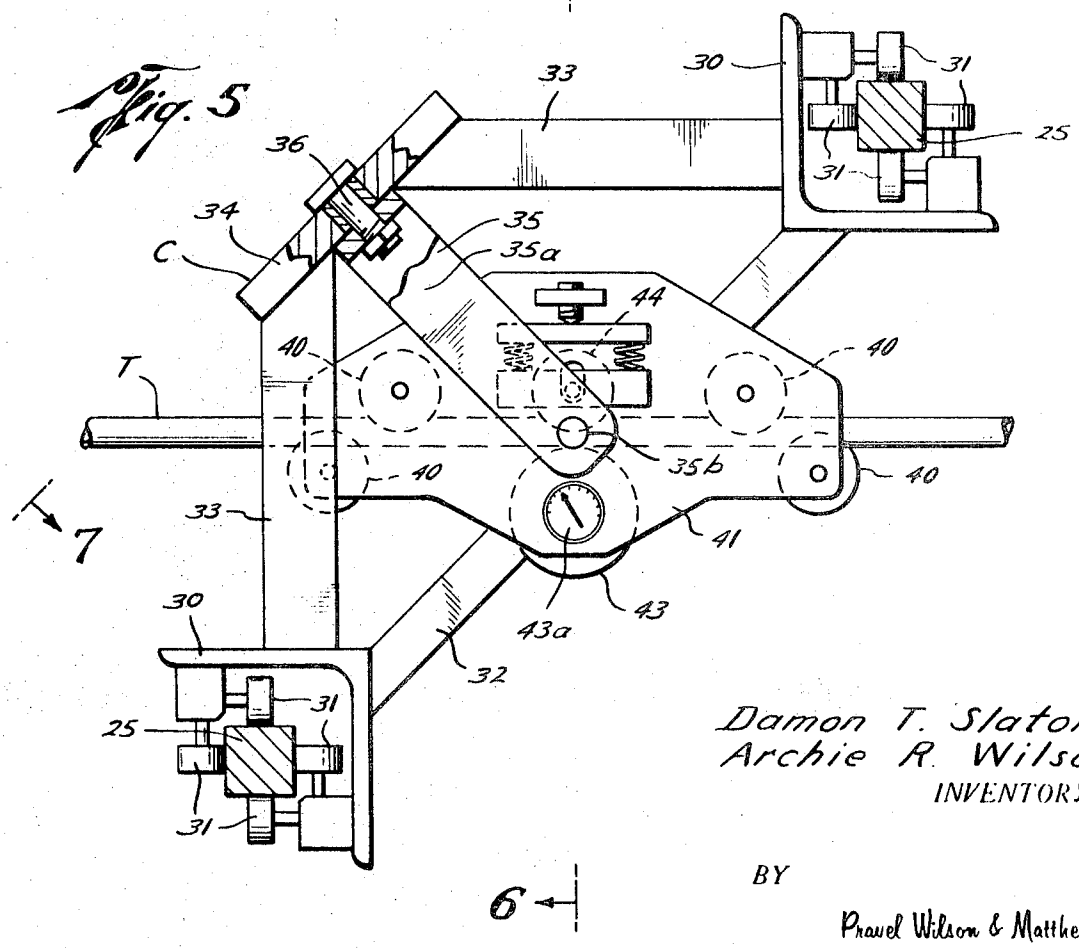


Fig. 5



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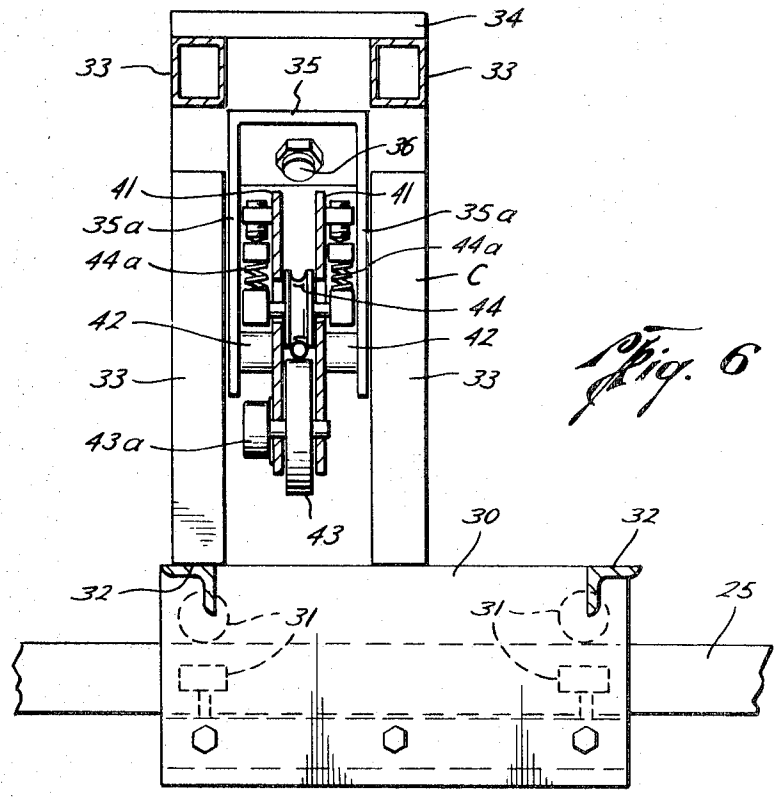


Fig. 6

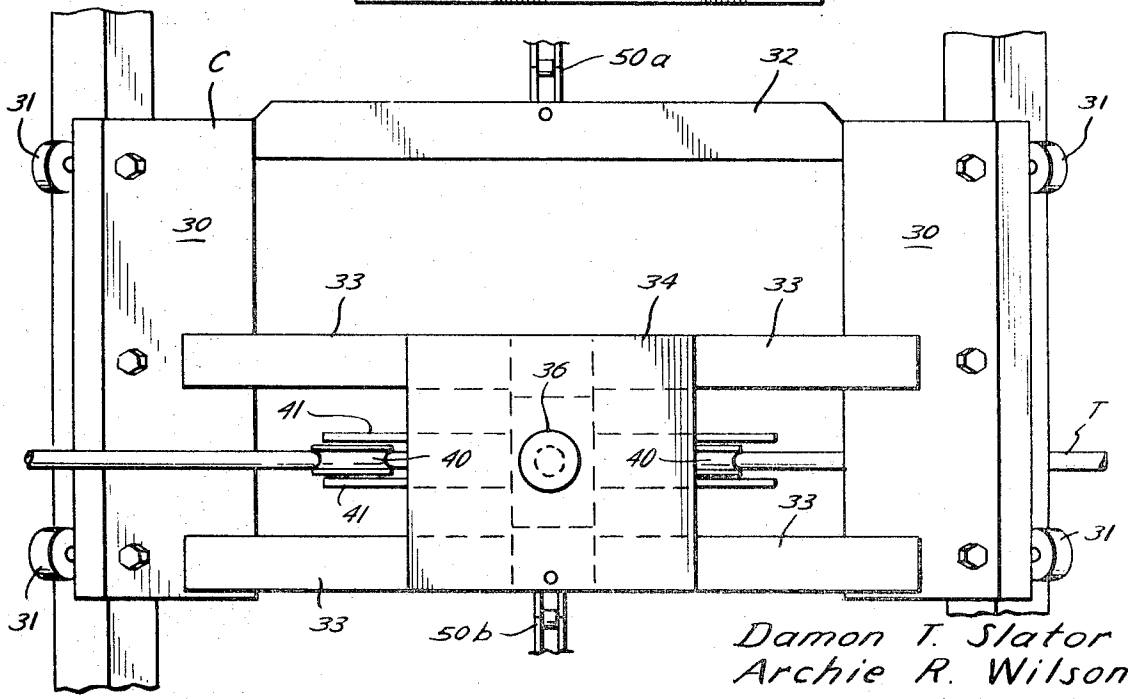


Fig. 7

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APPARATUS FOR CONTROLLING THE WRAPPING OF TUBING ONTO A REEL

BACKGROUND OF THE INVENTION

The field of this invention is apparatus for controlling the wrapping of tubing onto a reel.

Various tubing injection devices for feeding into a well have been invented in recent years, examples of which are shown in U.S. Pat. Nos. 3,182,877; 3,258,110; 3,285,485; and 3,330,531. With such apparatus, relatively stiff tubing such as metal tubing of about one-half inch in diameter, can be injected or forced down into a well for introducing gas such as nitrogen into the well to remove sand fill from wells and to perform various other operations in the well.

Because of the depth of the wells being so treated, and the desirability of feeding a continuous length of tubing into the well, it is advantageous to use a reel for the tubing. Due to the stiffness of tubing, the variations in its diameter due to flattened portions and other cause, and the variations in the distances between the flanges on a reel, it has been found that known automatic level winding apparatus such as shown in U.S. Pat. No. 3,379,393 is not practical for controlling the wrapping of such tubing. On the other hand, if the wrapping of the tubing is not controlled, when the tubing is wrapped on a reel, gaps will be left between adjacent wraps into which a subsequent wrap partially or fully drops, or wraps will accumulate at the side flanges of the reel and double up or slip off resulting in looseness and completely confused wrapping which not only is an inefficient use of the reel space, but is apt to result in a bending or distortion of the tubing itself, or in a malfunctioning when feeding the tubing off the reel to the tubing injector apparatus or other equipment. One effort to solve these problems is shown in U.S. Pat. No. 3,313,346, but the structure, and operation thereof, have not been satisfactory, largely due to the rigid guidance system and the difficulties in effecting an overpowering of the carriage feeding movements.

SUMMARY OF THE INVENTION

The invention relates to an apparatus for controlling the wrapping of tubing or the like onto a reel. With the present invention, the tubing is allowed to wind itself on the reel without substantial external restraint so as to obtain adjacent wraps in successive layers on the reel as the reel is rotated, but when it becomes necessary to shift the tubing so as to properly position a wrap, means are engaged to provide for overpowering the freewheeling wrapping to positively position the tubing in the proper location as it is being wound onto the reel.

The tubing is fed onto the reel through a guide assembly which is free to move to properly align the tubing as it is wrapped on the reel.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an elevation of the apparatus of this invention shown in position for use at a well head with a tubing injector apparatus;

FIG. 2 is a elevation of a portion of the tubing alignment apparatus used with the reel, viewed from the opposite side presented in FIG. 1;

FIG. 3 is a detailed view of the clutch means preferably utilized in the apparatus of this invention for the engagement and disengagement of the manual overpowering drive means of the apparatus, such view being taken on line of 3—3 of FIG. 2;

FIG. 4 is a plan view of the apparatus of this invention taken on line 4—4 of FIG. 2;

FIG. 5 is an enlarged view of the carriage means of this invention, taken on line 5—5 of FIG. 4;

FIG. 6 is a vertical sectional view taken on line 6—6 of FIG. 5 to further illustrate the line-measuring device and the rest of the carriage means of FIG. 5; and

FIG. 7 is view taken on line 7—7 of FIG. 5 to further illustrate the carriage means of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the drawings, the letter A designates generally the apparatus of the invention which is adapted to be used in conjunction with tubing injector apparatus F, an example of which is shown in U.S. Pat. No. 3,182,877 for the feeding or injecting of tubing T formed of steel, aluminum or other metal alloys, into a well through well head equipment W of conventional construction. As will be explained more in detail, the apparatus A provides for the wrapping or winding of the metal tubing T onto a reel R, utilizing a laterally movable carriage C in proximity to the reel R for supporting and engaging the tubing during the wrapping or winding of the tubing T in a plurality of adjacent wraps to form a plurality of layers thereof on the reel R. The carriage C is so mounted that it is free wheeling, i.e., it is substantially unrestrained in its lateral movement with respect to the reel R during the winding and unwinding of the tubing T with respect to the reel R, but means, including a manually operated drive wheel D (FIG. 1), are provided for overpowering the free wheeling of the carriage C so as to control the winding of the tubing T onto the reel R to be certain that the wraps are properly positioned thereon during such winding. The drive wheel D is completely disengaged except when manually operated by an operator. The carriage C is mounted for movement in multiple directions to prevent any twisting or bending of the tubing T as it is wound and unwound with respect to the reel R.

Considering the invention more in detail, the reel R is preferably mounted on a skid **10** which in turn may be mounted on a bed **11** of a truck or other transportation device having wheels **12** therewith. The skid **10** may be removed from the bed **11** and mounted on a suitable fixed base or on the ground as desired for use, or the skid **10** may be left upon the bed **11** of the truck or other transportation device during the use of the tubing T in connection with the well.

The reel R is preferably of a conventional construction with a typical drum having side flanges **14** (FIGS. **1** and **4**) mounted therewith, and with the reel R mounted upon suitable bearings **15** supported on vertical posts **16** on the skid **10**. For rotating provided, reel R to wind the tubing T thereon, any suitable drive means such as a hydraulic motor **18** is provided, with suitable belt or drive connectors **19** extending to a pulley or sprocket **20** connected to the shaft of the reel R.

A carriage support means for the carriage C includes a pair of side frame members **22**, each of which is pivoted at **23** (FIGS. **1** and **4**) to a bracket **16***a* on each post or vertical support **16**. The frame members **22** are joined together by a pair of guide rails **25**, which are preferably square in cross section (FIG. **5**) and which serve as the rails upon which the carriage C moves laterally relative to the reel R, as will be more evident hereinafter. Suitable means for such as the telescoping legs **27** are provided for supporting the carriage support means at a desired position with respect to the reel R. For example, the carriage C may be supported in the solid line position of FIG. **1** by the legs **27**, or the carriage C may be positioned at some other position such as indicated by the dotted lines in FIG. **1**, at which position the legs **27** also support the carriage C and its carriage support means, including the frame members **22**. A plurality of holes **27***a* (FIG. **2**) are provided in the outer tube of the support member **27** while similar holes **27***b* are provided in the inner member of the support member **27**, which holes are adapted to be aligned and receive a locking bolt or pin in the selected position. The particular location of the carriage C determines the angle at which the tubing T is fed to or from the reel R, which angle depends upon the relative position of the reel R with respect to the tubing injector apparatus F.

Reference is now made to FIGS. **5–7** in particular wherein the details of the carriage C are illustrated. The carriage C includes a pair of laterally extending angle iron guide members **30**, each of which is adapted to carry four rollers **31** which are disposed at 90° with respect to each other for the engagement

of each of the four surfaces of each of the guide tracks or rails 25. Such rollers 31 are mounted on suitable antifriction bearings so that there is relatively unrestrained freedom on movement of the entire carriage C on the two rails 25, and at the same time, the rollers 31 confine the position of the carriage C so that it can only move laterally along the guide rails 25.

The channels 30 are joined together by angle iron members 32 (FIGS. 5–7), and also by angularly disposed frame members 33 which are welded together through a connecting plate 34. A U-shaped bracket 35 having depending arms 35*a* is connected to the plate 34 by a pivot bolt 36 which permits the carriage support bracket 35 to rotate or pivot about the axis thereof.

For engaging and supporting the tubing T, the carriage C has a plurality of spaced guide rollers 40, which are mounted on roller support plates 41 so that the tubing is supported in a substantially straight line between the two pairs of the guide rollers 40. The plates 41 are pivotally mounted on pivot pins 42 to the side arms 35*a* of the bracket 35 (FIG. 6). Such pivotal mounting of the plates 41 permits the rollers 40 and the tubing T therewith to pivot about a substantially horizontal axis so that together with the rotational movement permitted about the axis of the pivot pin 36, there is substantially universal freedom of movement of the tubing T as it is being guided to or from the reel R as will be more evident hereinafter.

In some instances, it is desirable to measure the amounts of the tubing T which is being fed to and from the reel R, particularly when the tubing T is being injected into a well. For this purpose, the plates 41 preferably include a line-measuring wheel 43 of conventional construction which is mounted between the plates 41 opposite a pressure-loaded wheel 44 which maintains the tubing T constantly in engagement with the measuring wheel 43. The wheel 44 may be urged towards the wheel 43 to thus maintain contact with the tubing T by springs 44*a* or other suitable adjustable resilient means. Any standard indicator such as the gauge 43*a* shown in FIG. 5 may be provided for indicating the amount of the tubing T which has been fed to or from the reel R. Such indicator or gauge 43*a* is of course calibrated and is provided with a means for setting same to "0" for any desired use of such indicator.

With the mechanism thus described for the carriage C the carriage C is adapted to move without any substantial restraint in the lateral direction, and such movement is normally caused by the wrapping of the tubing T in the adjacent wraps on the reel R during the winding up of the tubing T on the reel R. However, in some instances, the tubing T will not wrap properly unless an external force is applied thereto, with the result that gaps are left between adjacent wraps, or an accumulation of wraps occurs of several layers at the side flanges 14 or at other points. To prevent such improper wrapping or winding of the tubing T on the reel R, the carriage C has connection with a carriage drive means which includes a drive chain 50 which is formed in an endless loop with its ends 50*a* and 50*b* (FIG. 7) secured to the frame members 32 of the carriage C. Thus, any movement of the chain 50 in its path produces a lateral movement of the carriage C. So long as the carriage C is free wheeling, that is, so long as no external force is applied to the chain 50 to impart movement to the carriage C, the chain 50 simply moves with the carriage C as the tubing T is wound upon or is unwound from the reel R.

The loop provided by the chain 50 is formed by a plurality of sprockets 51, preferably four in number, which are mounted on the pivoted side frame members 22 (FIGS. 2 and 4). It will be appreciated that instead of a chain 50, a belt may be provided, in which case, the sprockets 51 may be replaced by pulleys or similar rollers.

One of the sprockets or pulleys 51 is designated 51′ because it is connected in driving relationship with the drive wheel D (FIG. 1) through a clutch K.

The drive wheel D is located at any suitable point for ready access thereto by an operator, which as illustrated in FIG. 1, is preferably adjacent the control panel 55 for the apparatus A. Since the drive wheel D is thus located at a point remote from the sprocket 51′ it is connected through a plurality of drive chains 56, 57, and 58 (FIGS. 1, 2, and 3) to the clutch K. The clutch K is preferably of the type illustrated and described in detail in our copending U.S. Pat. application Ser. No. 25,216 filed Apr. 2, 1970, Automatic Mechanical Clutch, but the invention is not limited to the use of that specific clutch disclosed therein. The clutch K disclosed in said application is, however, particularly suitable for use in the combination of the present invention since it enables an operator to simply rotate the wheel D when he desires to control the wrapping of the tubing T, and the rotation of the drive wheel D automatically engages the clutch K. Also, upon a release of the drive wheel D by the operator, further rotation of the wheel D is discontinued and the carriage C returns to its normal freewheeling operation for the normal wrapping of the tubing T upon the reel R.

In view of the particular value of the clutch K illustrated in the drawings with the combination of the present invention, such clutch is shown in detail in FIG. 3 hereof. Thus, the sprocket 51′ is secured to an upper shaft 60 which is mounted in a suitable bearing 61 supported on a frame member 22*a* which is a part of the frame member 22 illustrated in FIG. 2. The shaft 60 has an upper clutch element 62 with clutch-engaging teeth 62*a* formed therewith.

A second clutch element 63 is disposed below the clutch element 62 and is has clutch teeth 63*a* which are spaced from the clutch teeth 62*a* when the clutch K is in the disengaged position (FIG. 3). However, the clutch teeth 62*a* and 63*a* are adapted to be engaged with each other in the engaged or connected position shown in FIG. 2 so as to transmit driving rotational movement of the drive wheel D through the clutch K to the sprockets 51′ and thus to the chain 50 and the carriage C. The clutch element 62 is mounted on a shaft 65 for limited rotational movement, as will be more fully explained, and the shaft 65 is supported in a bearing 66 which is secured to a frame member 22*b* of the frame member 22 shown in FIG. 2. A bevel gear 67 is mounted on the shaft 65 for engagement with a bevel gear 68 on a substantially horizontal shaft having a sprocket 69 therewith for driving engagement with the chain 58. The sprocket 69 is carried on a stub shaft 70 which is supported in suitable bearings 71 mounted on an angle iron frame member 22*c* which is also welded or otherwise secured to the frame member 22 shown in FIG. 2.

The clutch element 63 is normally held in the position shown in FIG. 3 out of engagement with the clutch element 62 by any suitable resilient means (not shown) disposed internally between the clutch element 63 and the shaft 65. The clutch element 63 is prevented from turning with the shaft 65 until the shaft 65 has moved a pin 65*a* to one end or the other of a slot 63*b* formed in the body of the clutch member 63. When that occurs, the movement of the shaft 65 is transmitted to the clutch element 63, and it also causes a longitudinal or vertical shifting as viewed in FIG. 3 of the clutch element 63 with respect to the clutch element 62 so as to cause an interengagement between the clutch teeth 62*a* and 63*a* as shown in FIG. 2. The restraint which is provided for limiting the rotation of the element 63 with respect to the shaft 65 until the engagement of the clutch element 62 and 63 is preferably provided by a plurality of spring-pressed detents or balls which engage flat surfaces 63*a* on the lower end of the clutch element 63. The balls are carried in a ring 75 and are removably held therein by screws 75*a*, with one ball being provided for each flat surface 63*a* in the normal instance. After the pin 65*a* has engaged in one end or the other of doubly inclined slot 63*b*, the resistance provided by the detents or balls on the flat surfaces 63*a* is overcome. It is to be noted that the ring 75 is secured to the frame member 22*b* by any suitable connecting member 22*d* so that the ring 75 does not rotate at any time. When the drive means D is released so that torque is no longer applied thereto, the resilient spring (not shown) internally of the clutch element 63 acts to move the clutch element 63 away from the clutch element 62 and to return the pin 65*a* to

its intermediate position shown in FIG. 3, wherein the clutch element 62 and 63 are disengaged. Thus, when an operator desires to control the movement of the tubing T, he simply rotates the wheel D in the direction desired and the clutch elements 62 and 63 are automatically engaged in the proper direction and they transmit the rotation of the wheel D to the carriage C so that is moves laterally for shifting the tubing T laterally to the desired position as it is being wrapped on the reel R. When the operator releases the drive means D, the drive wheel D no longer rotates and the drive to the carriage C is no longer connected because the clutch K is automatically disconnected and therefore, the carriage C is again free to move in accordance with the forces exerted by the tubing T as it follows its normal wrapping onto the reel R.

In the operation or use of the apparatus A of this invention, the tubing T is unwound from the reel R with the feeding or tubing-injecting means F so as to introduce the tubing T into the well through the well head equipment W. The particular angle at which the carriage support means, including the frames 22 are located is determined by the position of the adjustable support members 27. These are set so as to direct the tubing T in a substantially straight line from the carriage C to the curved guide means 80 to the upper end of the tubing-injection means E.

When it is desired to wind the tubing T onto the reel R, the motor 18 drives the reel R for pulling the tubing T thereon through the carriage C. The carriage C functions as a level-wind mechanism by guiding the tubing T in accordance with the forces exerted as the tubing T moves to the successive wraps on the reel R. Normally, the carriage C is free wheeling since it is unrestrained in its lateral movement back and forth on the rails 25. However, should the tubing T become misaligned or out of position, which would cause an improper positioning or wrapping of the tubing T on the reel R, the operator can immediately overpower the movement of the carriage C due to the tubing T by engaging the drive wheel D so as to automatically engage the clutch K and shift the tubing, or otherwise control the movement of the tubing, as it is being wound or wrapped on the reel R. As soon as the tubing has assumed the proper fleet angle position, the drive wheel D is released by the operator so that the carriage C then resumes its normal freewheeling movement during the further wrapping of the tubing T. Thus, loose wrapping, gaps between the adjacent wraps, an accumulation of several layers of wraps at the end flanges of the reel R, and other malfunctions in the wrapping of the tubing T may be prevented by the use of the apparatus of this invention so that the tubing T is wrapped uniformly and properly on the reel R in a plurality of adjacent wraps and in a plurality of layers of such wraps.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, and materials as well as in the details of the illustrated construction may be made without departing from the spirit of the invention.

We claim:

1. Apparatus for controlling the wrapping of tubing onto a reel, comprising:

a reel adapted to be rotated for the winding of tubing thereon in a plurality of layers with a plurality of wraps in each layer;

tubing carriage means disposed in proximity to said reel for supporting and engaging the tubing in proximity to said reel;

carriage support means for mounting said carriage for substantially unrestrained lateral movement relative to said reel in response to lateral movements of the tubing as it is being wound onto said reel; and

carriage drive means adapted to be selectively connected in driving relationship with said carriage for moving said carriage laterally relative to said reel to control the location of the tubing on the reel as it is being wound thereon.

2. The structure set forth in claim 1, wherein said carriage drive means includes:

a drive member; and

a clutch for the selective driving connection of said drive member with said carriage for laterally moving same.

3. The structure set forth in claim 1, wherein said carriage drive means includes:

a drive chain formed in a loop with its ends connected to said carriage;

sprockets for engagement with said drive chain to maintain it in said loop; and

a drive member for imparting rotation to one of said sprockets for thereby causing said chain to travel in a path defined by said loop for thereby moving said carriage with said chain relative to said reel.

4. The structure as set forth in claim 3, including:

a clutch for the selective driving connection of said drive member with said one of said sprockets.

5. The structure set forth in claim 2, wherein said clutch means includes:

means for automatically engaging same upon a rotation of said drive member and for automatically disengaging same upon a discontinuance of the rotation of said drive member.

6. The structure set forth in claim 1, including:

measuring means mounted on said tubing carriage means for measuring the length of tubing either wound onto or fed from said reel.

7. The structure set forth in claim 1, wherein said tubing carriage means includes:

a carriage; and

a plurality of rollers on said carriage in engagement with the tubing as it is fed to and from said reel.

8. The structure set forth in claim 7, including:

universal mounting means for mounting said rollers on said carriage to permit alignment of said rollers at the fleet angle at which the tubing is fed relative to said reel.

9. The structure set forth in claim 1, wherein said carriage support means includes:

a support frame; and

a guide track on said frame for the lateral movement of said carriage relative to said reel.

10. The structure set forth in claim 9, including:

pivotal mounting means mounting said support frame for pivotal movement relative to said reel for pivoting said frame to different angular positions for controlling the general direction of feed of the tubing relative to said reel.