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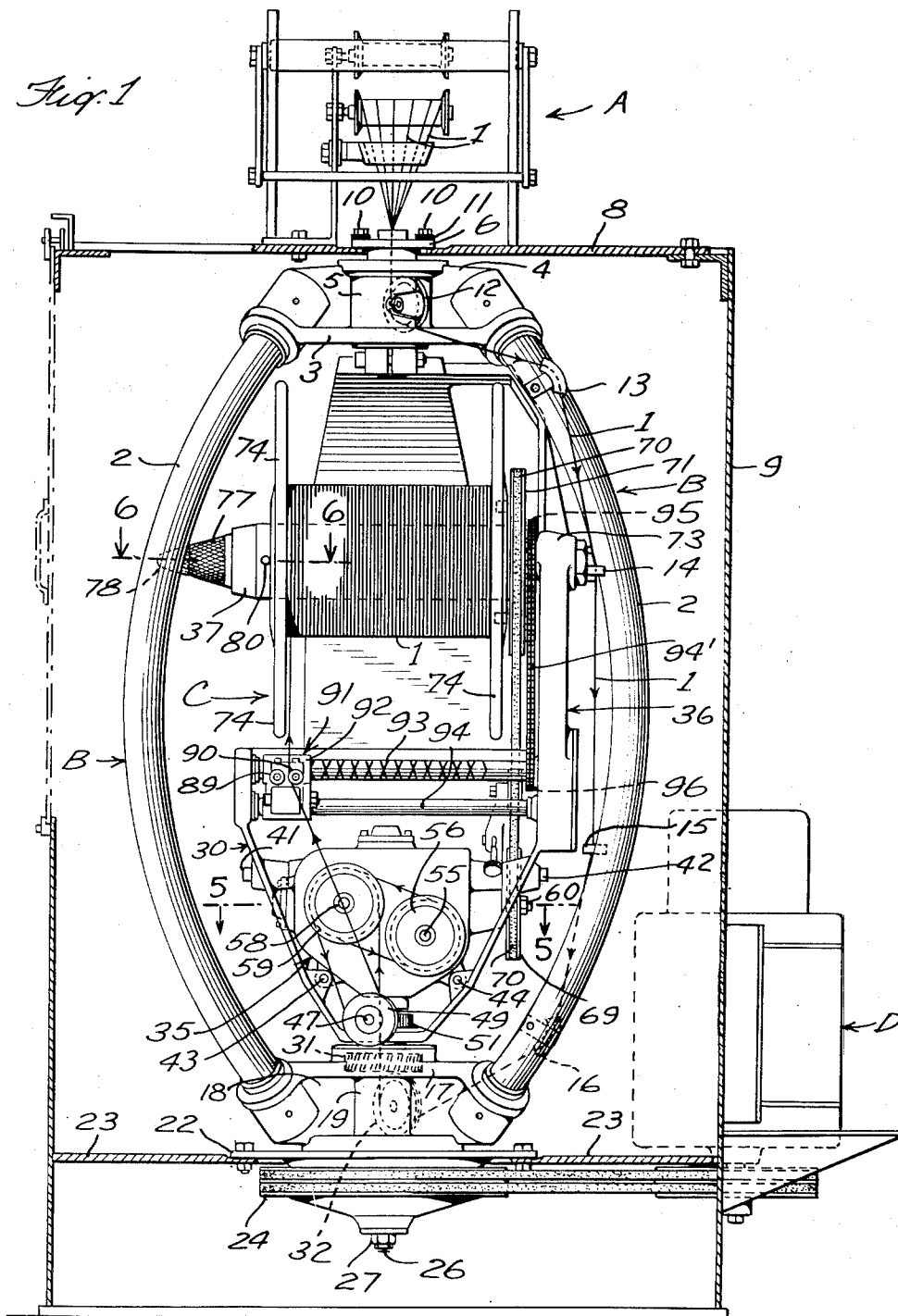
C. F. VAN HOOK

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VERTICAL TWISTING MACHINE

Filed April 12, 1951

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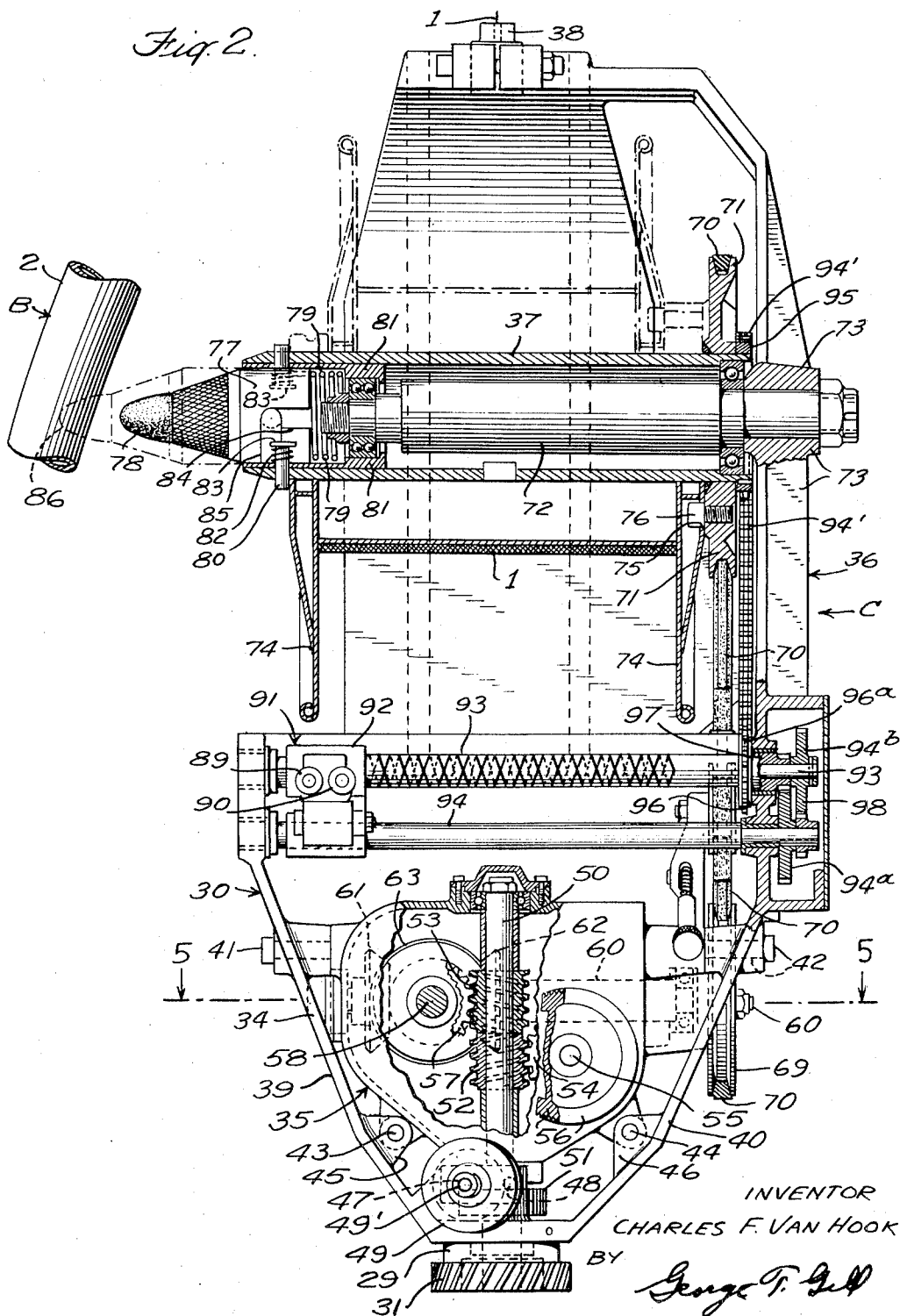
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Fig. 2.



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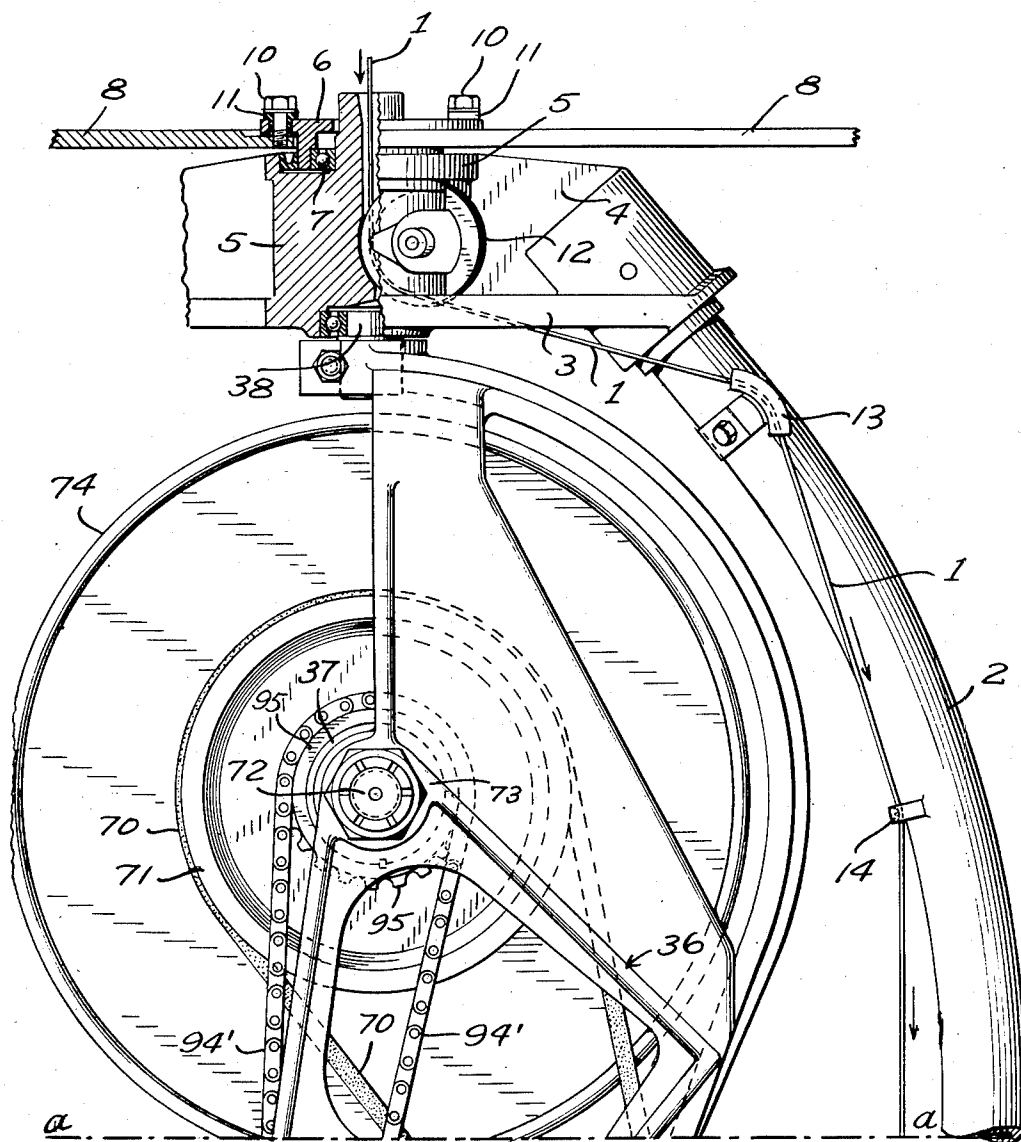
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Fig. 3.



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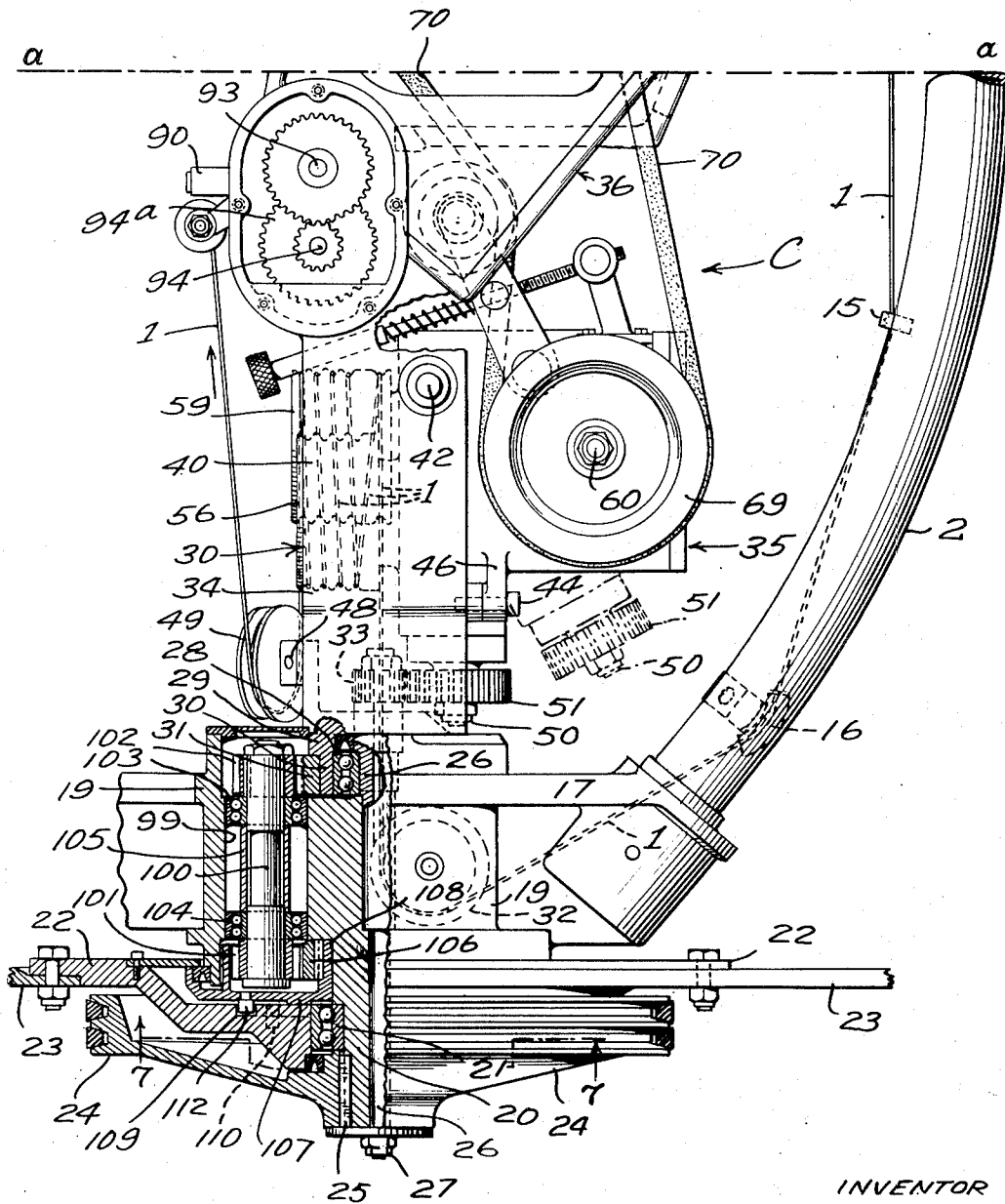
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Fig. 4



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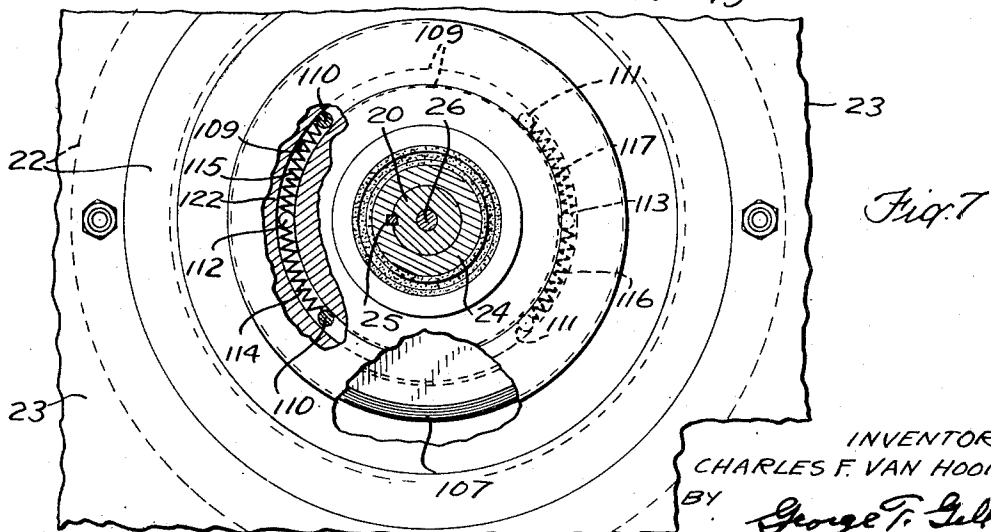
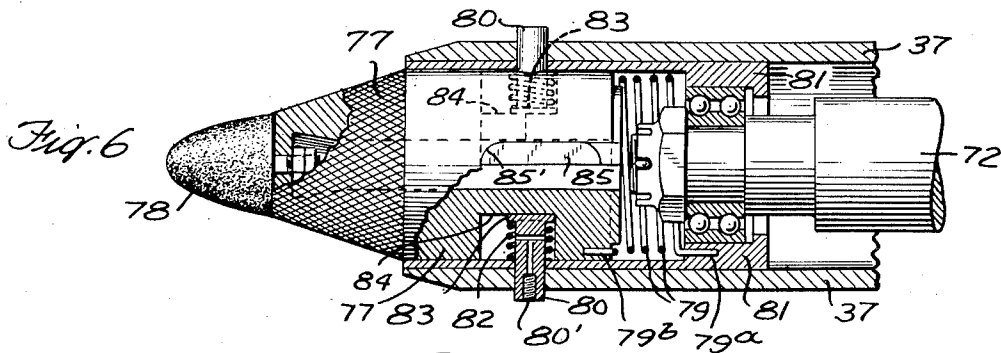
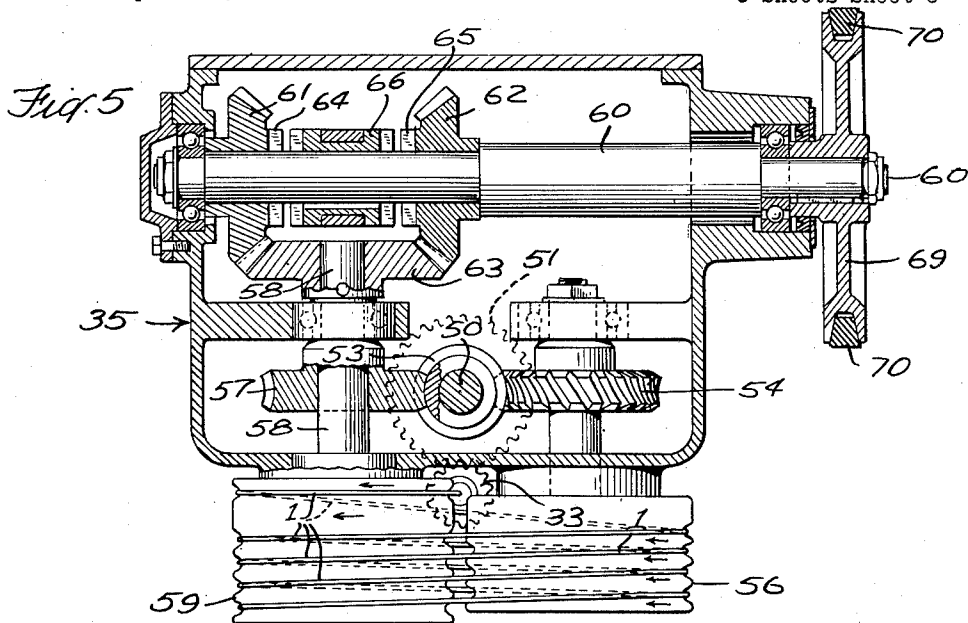
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VERTICAL TWISTING MACHINE

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VERTICAL TWISTING MACHINE

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Application April 12, 1951, Serial No. 220,560

9 Claims. (Cl. 57—58.52)

The invention herein disclosed relates to a vertical twisting machine for twisting flexible threads of various material into strands.

Commonly a machine of the kind to which this invention relates includes a rotatable flyer and a normally stationary cradle within the flyer. The cradle carries a capstan box and a take-up spool or reel on which the twisted strand is reeled. Both the capstan and the reel are rotated as well as the traverse screw for actuating the guide which guides the twisted strand to the take-up spool.

The primary object of this invention is to provide a comparatively high production machine of the kind mentioned, and which incorporates features that permit greater speed in operation, greater speed in making change overs, and less breakage.

The features which are effective in attaining the foregoing objects of the invention are illustrated in the machine disclosed in the accompanying drawing and described in detail below, which machine constitutes one specific embodiment of the invention.

The drawings include:

Fig. 1 which is an elevation, partly in section, of a machine embodying the invention;

Fig. 2 which is an enlarged elevation, partly in section of the cradle,

Fig. 3 which is an enlarged elevation, partly in section, of the upper portion of the flyer, the cradle being positioned ninety degrees from the position shown in Fig. 2;

Fig. 4 which is an enlarged elevation, partly in section, of the lower portion of the flyer;

Fig. 5 which is a section taken on the line 5—5 of Fig. 1 and Fig. 2;

Fig. 6 which is an enlarged, fragmentary section of the spindle taken on the line 6—6 of Fig. 1; and Fig. 7 which is a fragmentary section taken on the line 7—7 of Fig. 4.

In general a vertical twisting machine includes a guide arrangement, such as that designated generally by the character A (Fig. 1) for guiding a plurality of threads 1 thereto at the top thereof, a flyer designated generally by the character B, a cradle, designated generally by the character C, and a power unit, in this instance an electric motor designated generally by the character D. The invention herein disclosed is concerned with the flyer and cradle construction and the drive connections between the various units or parts thereof.

The flyer essentially consists (Figs. 1 and 4) of three arms 2, each in the shape of a portion of an ellipse and spaced one hundred and twenty degrees apart about a vertical axis. At the upper end, each flyer arm is connected as by an arm 3 and bracket 4 to a rotatably mounted center piece, or upper flyer head 5. This center piece 5 is mounted in a bearing block 6, through ball bearings 7. The bearing block 6 is secured to the top plate 8 of the casing 9 by a plurality of bolts 10. Between the heads of the bolts 10 and the top plate 8, there are shock-cushioning, resilient washers 11.

The center piece 5 is bored axially to receive the bunched threads or wires 1 that are to be twisted into a strand. In addition, a rotatable sheave 12 is mounted in the center piece for rotation about a horizontal axis. The sheave 12 extends into the bore of the center piece, and the wires 1, bunched together, pass partially around the sheave to a guide 13 mounted on one (Fig. 3) of the arms 2 of the flyer. The bunched threads pass successively through guides 14, 15 and 16 mounted on the arm 2. It is to be noted, however, that the guide 16 is on the opposite side of the arm 2 relative to the position of the guide 13.

At their lower ends, each arm 2 is connected by integral arms 17 and 18 to a rotatably mounted, bottom flyer head 19. The flyer head 19 has a reduced lower end section 20 that extends through and is journaled, through ball bearings 21, in a bracket 22 secured to the bottom plate 23. A pulley 24 is keyed, as at 25 to the reduced section 20 of the flyer head 19. This pulley is driven by the motor D. It is extremely essential for smooth operation at high speeds that no unbalanced bending moment exist in the flyer. To avoid any such condition, the pulley 24 is mounted so that the horizontal center line thereof coincides with the horizontal center line of the bearing 21, and consequently only torque passes to the flyer above this center line.

The flyer head 19 is bored axially thereof and a central shaft 26 extends through the reduced lower end section 20 and is connected to the pulley 24, by a pressed fit, ensured by pulling upon a nut 27, to rotate therewith. On the upper end of the shaft 26 (Figs. 2 and 3), there is journaled, through ball bearings 28, the extended end 29 of the frame of the cradle, designated generally by the numeral 30. To this extended end 29 of the frame of the cradle, there is fixed a gear 31.

The shaft 26 has an enlarged upper end that is bored axially thereof. The flyer head 19 carries a sheave 32, rotatable on a horizontal axis, that extends through a slot provided therefor, into the bore in the enlarged upper end of the shaft 26. From the guide 16, on the arm 2, the bunched wires 1 pass partially around the sheave 32 and upwardly through the axial bore in the shaft 26. On the upper end of the shaft 26, there is fixed thereto a pinion 33.

The cradle frame 30 includes a lower portion 34 in which the capstan unit 35 is mounted, and an upper portion 36 in which the reel shaft 37 is rotatably mounted. At its upper end, the cradle frame is secured on a stub shaft 38 that is journaled in the center piece, or upper flyer head 5. The lower portion 34 of the cradle frame includes diverging arms 39 and 40. Between the arms 39 and 40, the capstan unit 35 is mounted. It is mounted on pivots 41 and 42, and during operations secured in place by bolts 43 and 44 threaded into brackets 45 and 46 extending respectively from the arms 39 and 40. At the lower end of the portion 34 of the cradle frame 30, a sheave 49 is rotatably mounted. The sheave 49 is mounted on a shouldered, threaded stud 49' which may be secured in either of two positions represented by tapped holes 47 and 48 in accordance with the twist being incorporated in the fed product 1, as will herein-after more fully appear.

The capstan unit 35 is a box-like housing or structure (Figs. 2 and 5) in which a vertical shaft 50 is rotatably mounted. At the lower end of the shaft, there is fixed a gear 51, which in the operative position of the capstan unit, meshes with the gear 33 fixed on the shaft 26. Intermediate the ends of the shaft 50, there is fixed thereto two worms 52 and 53 of opposite pitch. The lower worm meshes with a worm gear 54 secured on a shaft 55 which extends through and is rotatably mounted in the wall of the housing. The shaft 55 has fixed thereon a capstan 56.

In like manner, the upper worm 53 meshes with a worm gear 57 fixed on a shaft 58 that has fixed thereto a capstan 59 (Figs. 2 and 5). Through the aforementioned train of gears, the capstans are rotated by the shaft 26.

Within the capstan housing, there is rotatably mounted a horizontal shaft 60 which extends through one side thereof. Rotatably mounted on the shaft 60 there are two bevel gears 61 and 62 which mesh with a bevel gear 63 fixed on the capstan shaft 58. Each of the gears 61 and 62 (Figs. 2 and 5) has projections 64 and 65 respectively. A clutch 66, having teeth 67 and 68 in opposite faces thereof is keyed to the shaft 60 between the gears 61 and 62. The clutch 66 is movable longitudinally of the shaft to engage the projections on one or the other of the gears 61 and 62. On the extended end of the shaft 60, there is fixed thereto a pulley 69.

Through a belt 70, the pulley 69 drives a pulley 71 fixed on the reel shaft 37. The reel shaft 37 is hollow and rotatably mounted on a cantilever shaft 72 fixed, at one end, in a bracket 73 integral with the cradle frame 30. On the reel shaft 37 a spool 74 may be mounted. The spool 74 has an opening 75 in the side thereof into which a pin 76, threaded into the pulley 71, extends. At the outer end of the reel shaft 37, there is slidably mounted a projection 77, the outer end 78 of which may be of rubber or other resilient material. The projection 77 is resiliently urged or biased outwardly by a spring 79.

Pins, such as the pin 80, are slidably mounted in the projection 77, radially thereof, and in the operative position extend through aligned openings in a liner 81 and the reel shaft 37. These pins serve to engage the side of a spool or reel, such as the reel 74 and hold the reel on the reel shaft. A spring 82 acts between the inner surface of the liner 81 and a head 83 on the inner end of the pin 80, and resiliently urges the pin radially inwardly of the projection 77. The head 83, in the operative position of the pin 80, abuts against a cam surface 84 within the projection 77. By pressing the projection 77 inwardly and turning it, the pins are brought into coincidence with longitudinal slots, such as the slot 85, in the projection 77 and are retracted. When the pins are retracted, the projection 77 is moved outwardly, into the path of the flyer arms, as shown by the broken lines 86. A shoulder 85' is provided adjacent the end of the slot 85 which engages the head 83 of the pin, in its fully retracted position, i. e. when the flange abuts against the base of the slot and when the end of the pin is flush with the outer surface of the reel shaft 37. Engagement of the head 83 with this shoulder, prevents the projection from being pushed out of the shaft by the spring 79. By pushing the projections inwardly and turning in the opposite direction, the pins will again extend through the openings in the reel shaft and the projection 77 will be held in the retracted position. The projection 77 extending into the path of the flyer arms prevents operation of the machine while the pins 80 are retracted. Thus, the arrangement prevents operation unless the reel is locked on the reel shaft.

When the pins are in the retracted position, the projection 77 may be removed by pulling the pins outwardly so that the head 83 does not engage the shoulder 85'. For this purpose each pin is provided with a tapped hole 80' in the end thereof. A screw is threaded in the hole to pull the pins outwardly to a position in which the flanges 83 do not engage the shoulder 85'.

The spring 79 is provided with tangs or projections 79^a and 79^b at each end thereof. The tang 79^a extends into an opening in the end portions of the liner 81 and the tang 79^b extends into an opening in the projection 77. When assembled, the spring is arranged to produce, through the tangs 79^a and 79^b, a torsional effect which will always tend to turn the projection 77 to a so-called locked position (causing the pins 80 to protrude and prevent the spool 74 from sliding off) unless the pins are engaged securely in the slot 85 and against the shoulder

85'. This feature guards against the pins being in any intermediate position without a human force being applied and thus while the machine is running they cannot accidentally become engaged in the slot 85, causing interference of the rubber end 78 with the flyer arms as shown by the broken lines 86 on Fig. 2.

On leaving the shaft 26, the bunched wires 1 (Figs. 1, 4 and 5) pass partially around the inner groove of the capstan 59. This capstan has five grooves and the capstan 56 has four grooves. The wires pass back and forth from one capstan to the other, each time in a different groove. From the outermost groove of the capstan 59 the bunched wires pass around the sheave 49 that is rotatably mounted on the stub shaft 47 at the lowermost extremity of the cradle, resulting in a loop that greatly increases the lead length to the reel. The product passes from the sheave 49 between rollers 89 and 90 of a traverse guide 91 and thence to the reel.

The traverse guide 91 is of a construction well known in the art. It includes a bracket or slide block 92 on which the guide rollers 89 and 90 are mounted. The bracket is moved back and forth across the cradle by a rotatable traverse shaft 93 provided with a continuous left and right hand thread. It is also slidably mounted on a rotatable shaft 94, the rotation of which prevents binding of the slide blocks. The traverse shaft 93 is driven from the reel shaft 37 by a chain 94' which engages a sprocket 95 fixed on the reel shaft and a sprocket 96 having a hub 97 rotatable on a reduced end of the shaft 93 and in the frame of the cradle. The shaft 93 is driven by a back gear 94a keyed to the shaft 94 and by means of reduction back gears 98 is driven by fixed gear 94b. This arrangement results in an even pitch of the strand from reel barrel wind to full reel.

While the flyer rotates, the cradle is maintained stationary through a planetary cradle gear train. For this purpose, the bottom flyer head 19 (Fig. 4) has several openings therethrough, such as the opening 99, extending parallel to and symmetrically disposed about the axis of the flyer head. Within each opening, there is rotatably mounted a shaft 100 on each end of which there are fixed pinions 101 and 102. The shaft 100 is mounted in spaced ball bearings 103 and 104, between the inner races of which there extends a tubular, spacer member 105.

The pinion 101 meshes with a fixed or stationary gear 106 and the pinion 102 meshes with the gear 31 fixed to the cradle. The gear 106 is fixed to a dish-shaped float plate 107 on a hollow central extension 108 thereof that is journaled on the reduced section 20 of the head 19.

In the plate 22, there is a circular groove 109. Within the groove 109, there rides two pins 112 and 113 which are fixed to a float plate 107.

In the plate 22, two pair of pins 110 and 111 are fixed and spaced apart one hundred and eighteen degrees. The pin 112 extends into the groove 109 between the pins 110, and the pin 113 extends into the groove 109 between the pins 111 (Fig. 7). A spring 114, in the groove 109 and under slight compression, abuts at one end against one of the pins 110 and at the other end against the float-plate pin 112. Another spring 115, also under slight compression abuts at one end against the other of the pins 110 and at the other end against the float-plate pin 112. Like springs 116 and 117 act between the pins 113 and the pins 111.

This arrangement cushions the shock on the fed product on starting. Fine wires of extremely low strength are fed into the machine for twisting. The shock effect of accelerating the loaded feed spools each of which often carries twenty-five pounds of wire, to the velocity over the capstans, which on a long twist may be two hundred and fifty feet per minute, in a matter of approximately ten seconds would seriously affect the successful operation of the machine unless the shock is cushioned. With the arrangement above described the float plate is able

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to sway rotationally under the impetus of the shock on starting. This cushioned effect of the cradle backing up slightly and then swinging back as the accelerating torque falls when the motor and flyer reach operating speed, permits the running of very fine, low-strength wires from relatively heavily loaded spools.

There are several features in the mechanism disclosed and described above that are of especial interest to those skilled in the art. These include the triple arm elliptical flyer which results in equal strength resistance and deflection to horizontal loading in any direction radial to the flyer axis; the planetary cradle train for holding the cradle stationary with the incorporation therein of the helical spring assembly for cushioning the shock of starting on the fed product; the pivoted capstan box which avoids the necessity of removing the box to change the lay, or twist length, of the product. The lay of the product is effected by changing the gears 33 and 51. Heretofore, in machines of this kind, it has been necessary to remove the capstan box in order to effect this change.

In order to reverse the direction, or hand, of twist of the product, it has been necessary in machines heretofore constructed to change the worms and worm gears 52, 54 and 53, 57 to worm and worm gears of opposite hand. This involved considerable time and labor. The same is accomplished in the present machine by transposing the capstans 56 and 59 on their shafts, shifting the clutch 66, reversing the motor, and relocating the transfer sheave 49, (see Figs. 5 and 6).

The grooving of the capstans is designed to have the product 1 leave the first or inner groove of the first capstan 59 outward in its path to the first groove of capstan 56, so as to avoid the product passing onto the capstan on the vertical axis of the flyer. With the change of the capstans, the sheave 49 is changed to the stub shaft 48 mounted on the cradle. This change of the sheave keeps the point from which the product leaves the sheave as near the center line of the sheave as possible with the result that the transverse angles of the product, as it is moved by the traverse guide, are as nearly equal as possible.

It is to be noted that the bunched strand receives two twists for each revolution of the flyer. The first twist is effected as it passes over the top sheave 12 and the second twist as it loops over the flyer sheave 32.

From the foregoing it will be obvious to those skilled in the art that by this invention there is provided a relative high speed vertical twisting machine and a machine with which considerable time and labor is saved in making changes of lay and twist.

It will be obvious that various changes may be made by those skilled in the art in the details of the embodiment of the invention illustrated in the drawing and described above within the principle and scope of the invention as expressed in the appended claims.

I claim:

1. In a vertical twisting machine of the kind described, the combination comprising a flyer mounted for rotation about a vertical axis, a cradle within said flyer, means for maintaining the cradle stationary during rotation of the flyer, a capstan box assembly including a box-like housing pivoted to the cradle, a shaft extending vertically thereof and rotatably mounted therein, a gear on the lower end of the shaft, capstans rotatably mounted in the housing, and gears connecting said shaft and said capstans.

2. In a vertical twisting machine of the kind described, the combination comprising a flyer mounted for rotation about a vertical axis, a cradle within said flyer, means for maintaining the cradle stationary during rotation of the flyer, and a capstan unit pivoted to the cradle adjacent the upper end of the unit.

3. In a vertical twisting machine of the kind described, the combination comprising a flyer mounted for rotation about a vertical axis, a cradle within the flyer, means for maintaining the cradle stationary during rotation of the flyer, a capstan unit mounted in the cradle and including

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a rotatably mounted shaft extending through the lower end thereof, a gear on the lower end of the shaft, and capstans rotatably mounted on the unit and driven from said shaft, the unit being pivoted at its upper end to the cradle, whereby it may be swung about the pivots for changing the gear on the end of the shaft.

4. In a vertical twisting machine of the kind described, the combination comprising a flyer mounted for rotation about a vertical axis, a shaft having a gear thereon rotatable with said flyer, a cradle within the flyer, means for maintaining the cradle stationary during rotation of the flyer, a capstan unit mounted in the cradle, a rotatably mounted shaft extending through the lower end of the capstan unit, and a gear on the shaft normally meshing with said first mentioned gear, the capstan unit being pivoted at its upper end to the cradle, whereby it may be swung about the pivotal axis for changing said gears to vary the lay of the product.

5. In a vertical twisting machine of the kind described, the combination comprising a flyer mounted for rotation about a vertical axis, a cradle within the flyer, means for maintaining the cradle stationary during rotation of the flyer, a capstan unit mounted in the cradle, spaced capstan shafts rotatably mounted in the unit, interchangeable capstans mounted on the shafts, means for driving the capstan shafts, a transverse shaft rotatably mounted in said capstan unit and extending through one end thereof, reversible driving connections between said transverse shaft and a capstan shaft, a reel shaft rotatably mounted in the cradle, and a drive connection between said transverse shaft and said reel shaft.

6. In a vertical twisting machine of the kind described, the combination comprising a three arm flyer mounted for rotation about a vertical axis, a cradle within the flyer, means for maintaining the cradle stationary during rotation of the flyer, a capstan unit mounted in the cradle, spaced capstan shafts rotatably mounted in the unit, interchangeable capstans mounted on the shafts, means for driving the capstan shafts, a transverse shaft rotatably mounted in said capstan unit and extending through one end thereof, a bevel gear fixed on one of said capstan shafts, a pair of bevel gears rotatably mounted on said transverse shaft and meshing with the bevel gear on said capstan shaft on diametrically opposite sides thereof, a clutch slidably mounted on said shaft and rotatable therewith between the bevel gears rotatable thereon for connecting one or the other of said gears to rotate the shaft, a reel shaft rotatably mounted in the cradle, and a drive connection between said transverse shaft and said reel shaft.

7. In a vertical twisting machine of the kind described, the combination comprising a flyer mounted for rotation about a vertical axis, a cradle within the flyer, means for maintaining the cradle stationary during rotation of the flyer, a capstan unit mounted in the cradle, transposable capstans on the capstan unit for effecting a change of twist of the product, a looping sheave located below the capstan for delivering the product from the capstans to a reel, and a pair of sheave shafts mounted on the capstan unit for transposing the position of said sheave upon transportation of the capstans.

8. In a vertical twisting machine having a flyer mounted for rotation about a vertical axis and including angularly spaced flyer arms, a cradle within the flyer, and means for maintaining the cradle stationary during rotation of the flyer, the combination comprising a reel shaft mounted in the cradle, and a projection slidable longitudinally of the reel shaft from a position in the path of the flyer arms to a position out of the path of the flyer arms.

9. In a vertical twisting machine having a flyer mounted for rotation about a vertical axis and including angularly spaced flyer arms, a cradle within the flyer, and means for maintaining the cradle stationary during rotation of the flyer, the combination comprising a reel shaft

mounted in the cradle, a projection slidable longitudinally of the reel shaft from a position in the path of the flyer arms to a position out of the path of the flyer arms, radially movable pins for engaging a reel mounted on the reel shaft, and interengaging means on said projection and said pins whereby when the pins are retracted the projection extends into the path of the flyer arms.

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