# United States Patent

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## [54] RECEIVING TRAY FOR STRAND MATERIAL

**14 Claims, 13 Drawing Figs.**


[52] U.S. Cl. ..... 242/83
[51] Int. Cl. ..... B21c 47/00
[50] Field of Search ..... 242/83, 82



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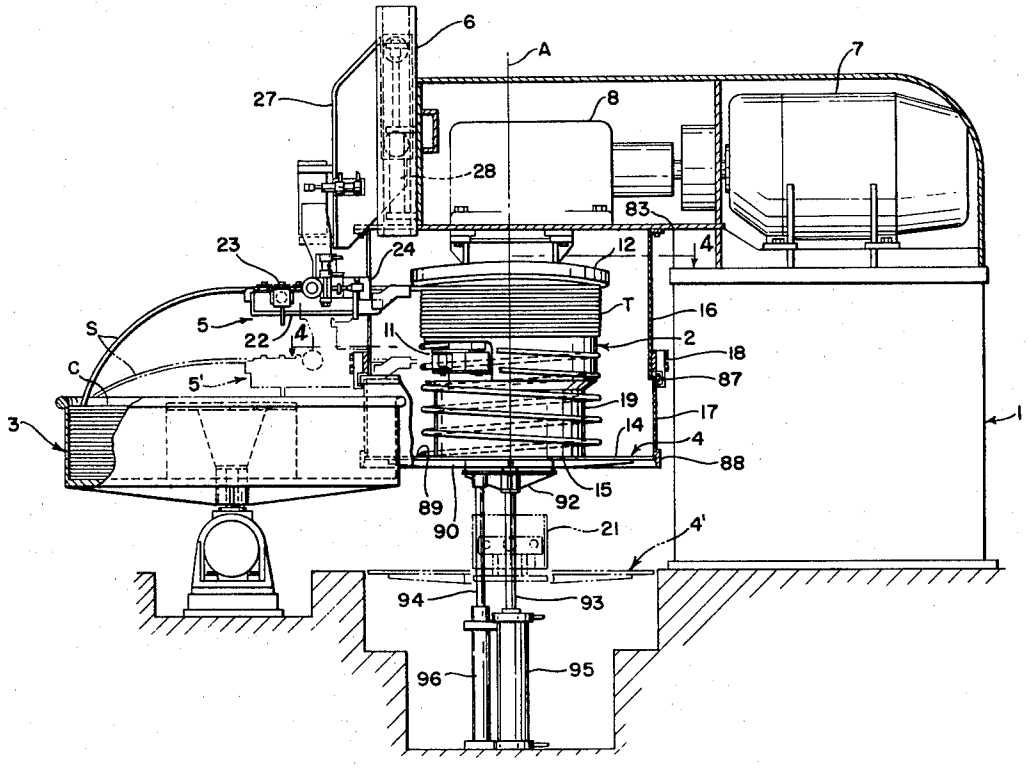
**ABSTRACT:** Apparatus for drawing strands such as tubing or rods in which the strand is drawn from a source, such as a coil, through a die onto a capstan rotatable about a generally vertical axis, after which turns of the strand drop onto a receiving tray that during the drawing operation is in an elevated position where it rotates with the lower portion of the capstan so that it receives in a coil the turns of strand dropped from the capstan. A guard encircles the lower portion of the capstan and the coil of discharged strand, and preferably rotates with the receiving tray and capstan. After the desired amount of strand has been drawn and deposited on the tray, the receiving tray is lowered and the coil of drawn strand is removed.

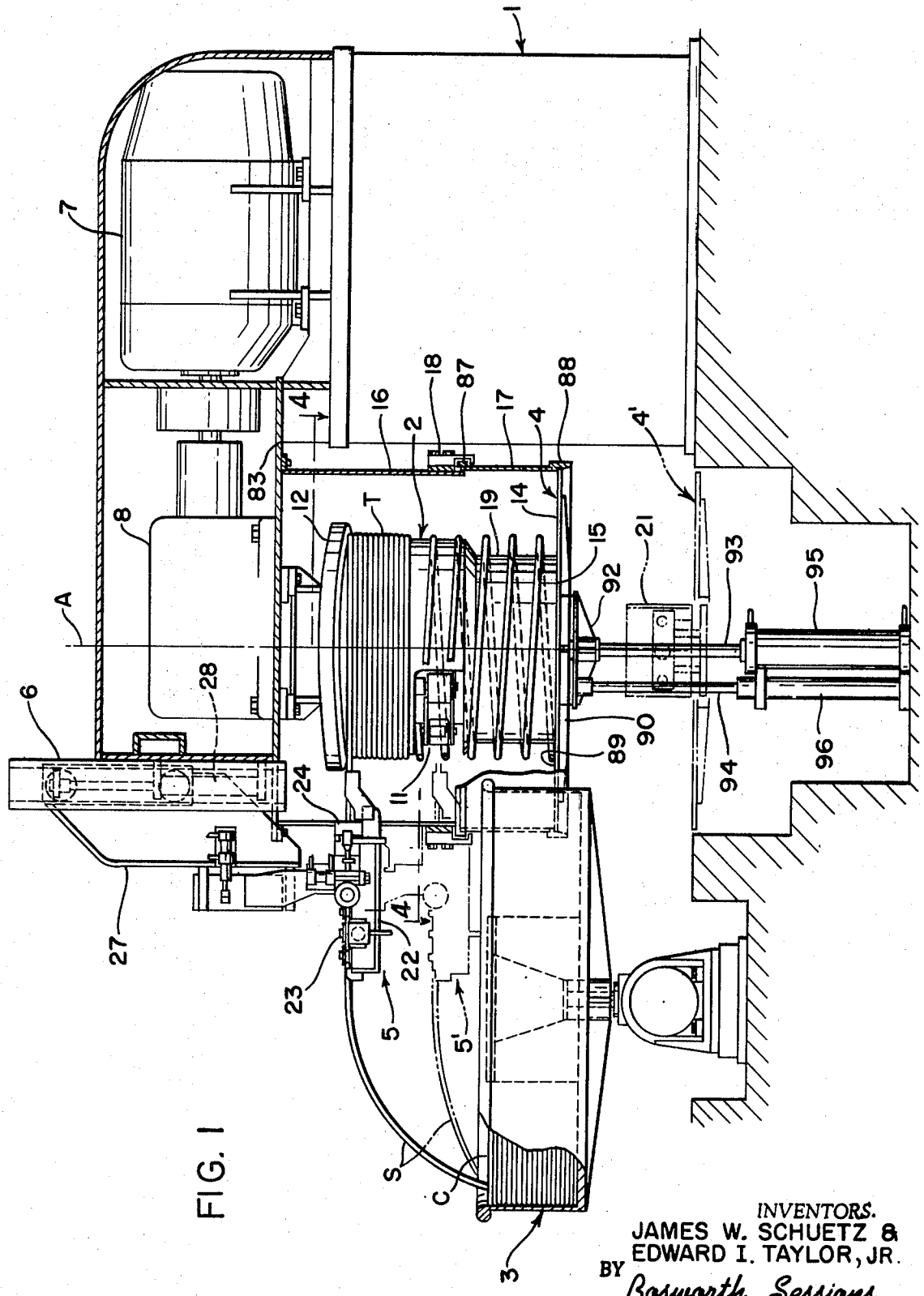



FIG. 1

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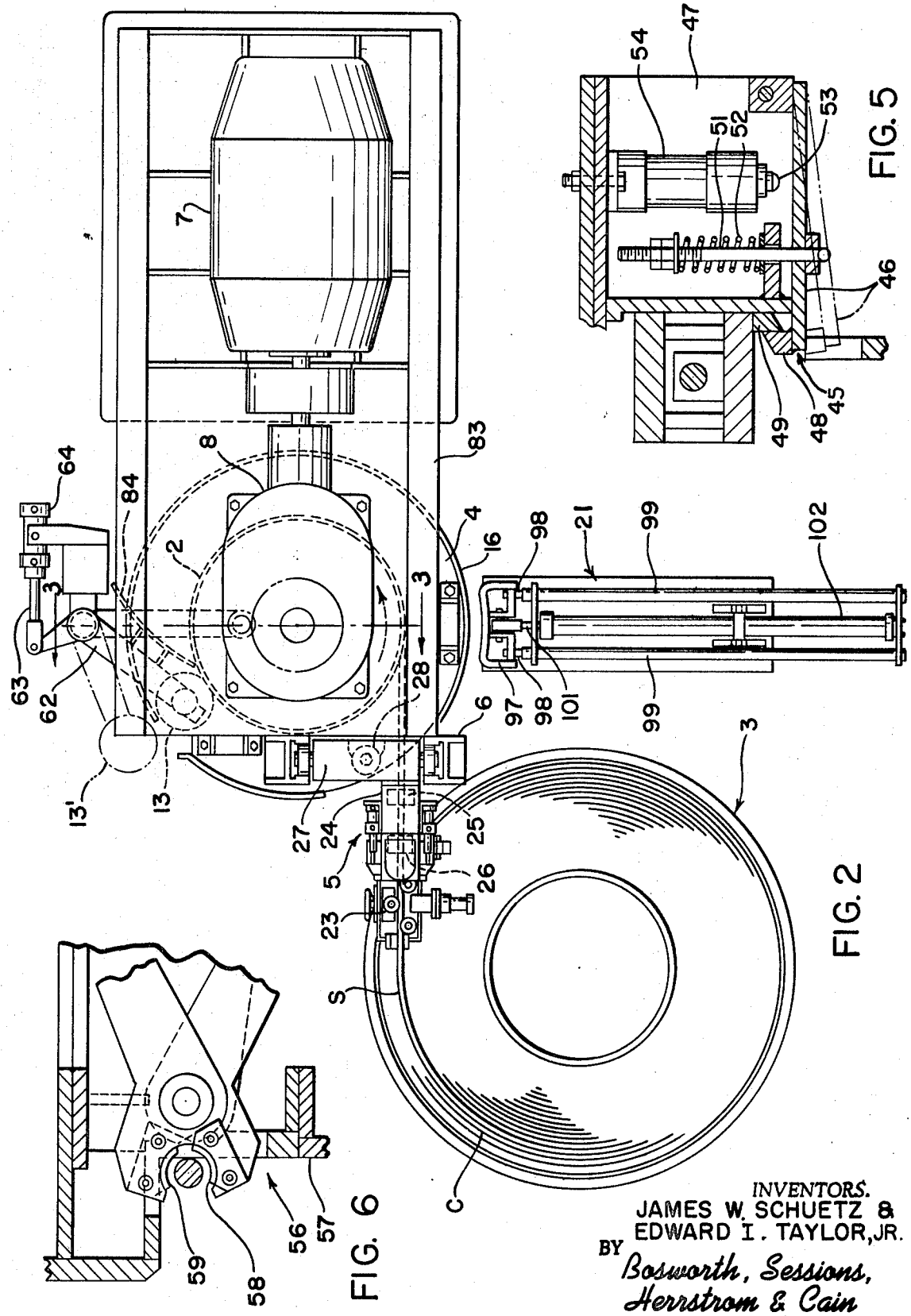


FIG. 2

FIG. 5

FIG. 6

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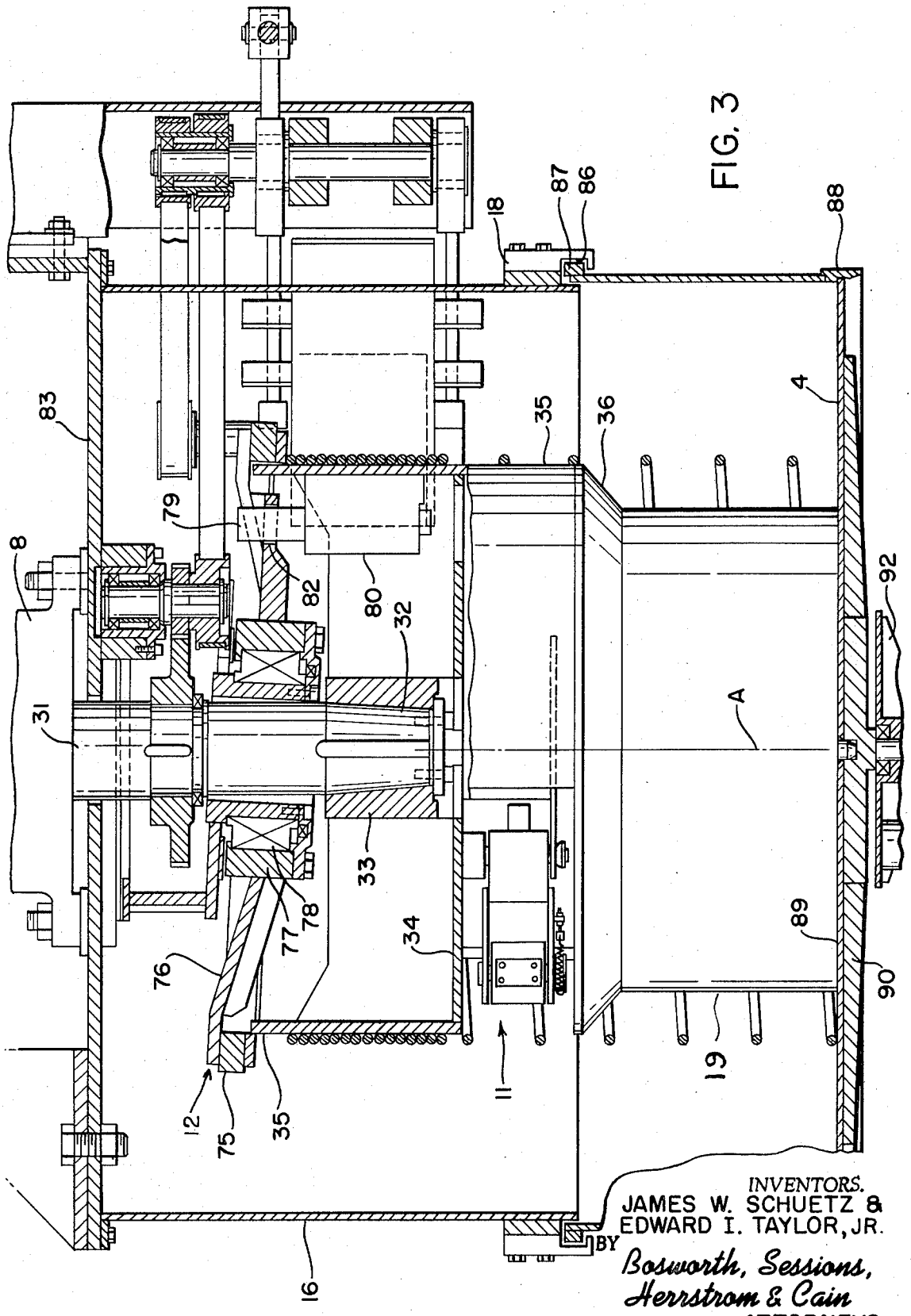


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FIG. 4

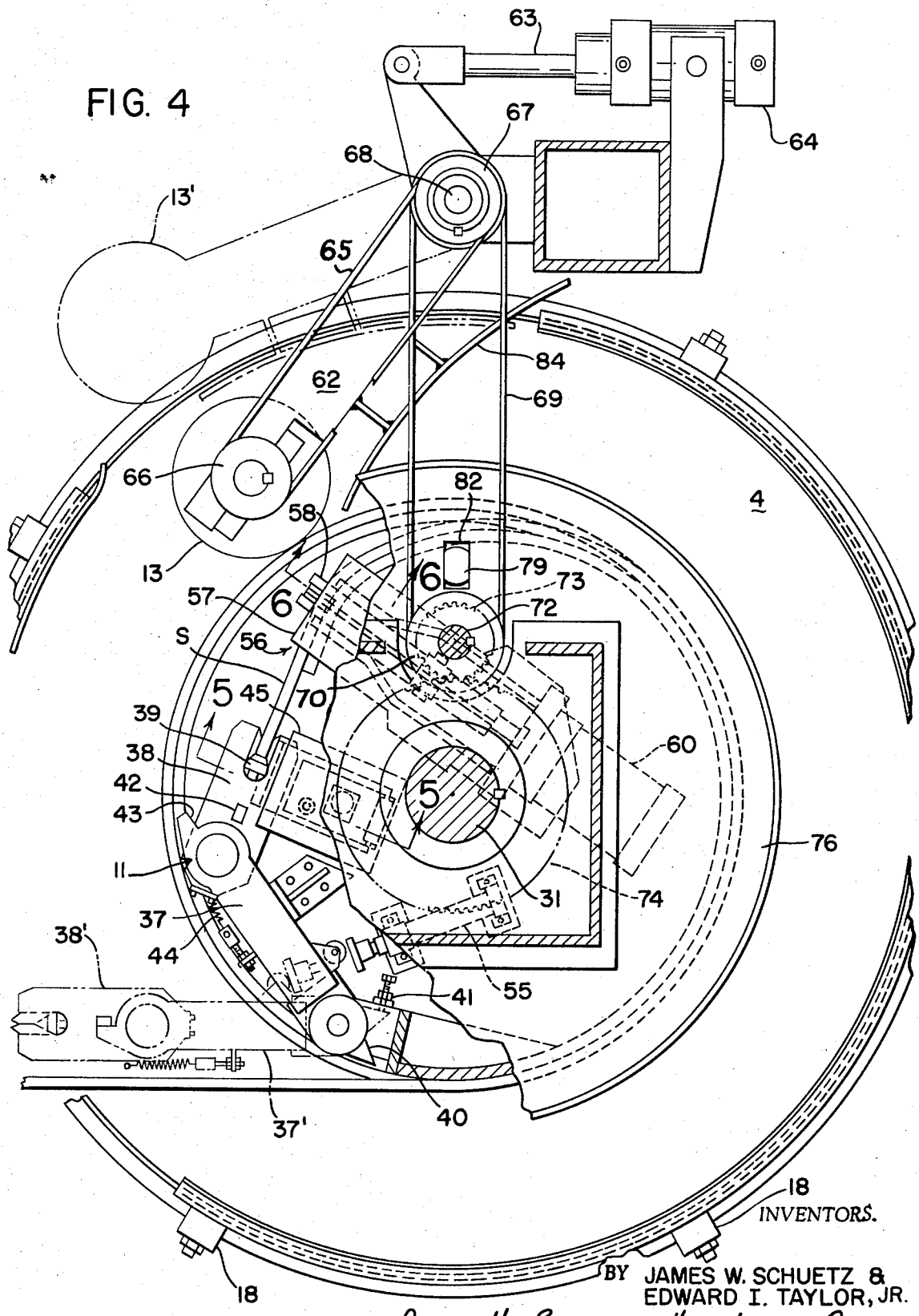


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FIG. 7

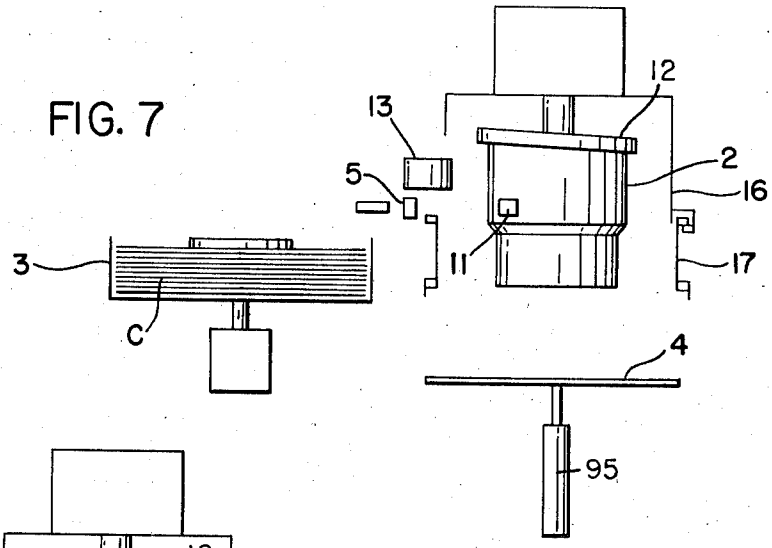



FIG. 8

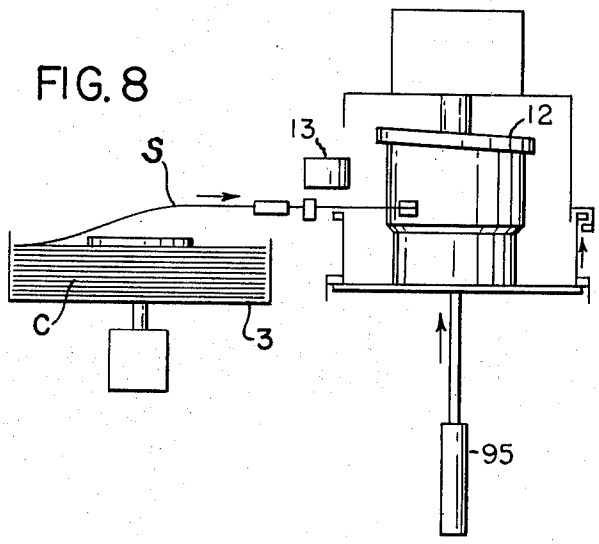



FIG. 9

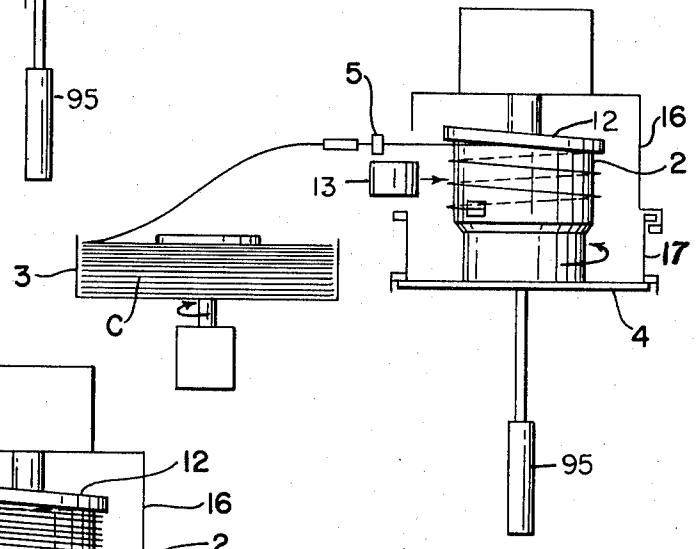
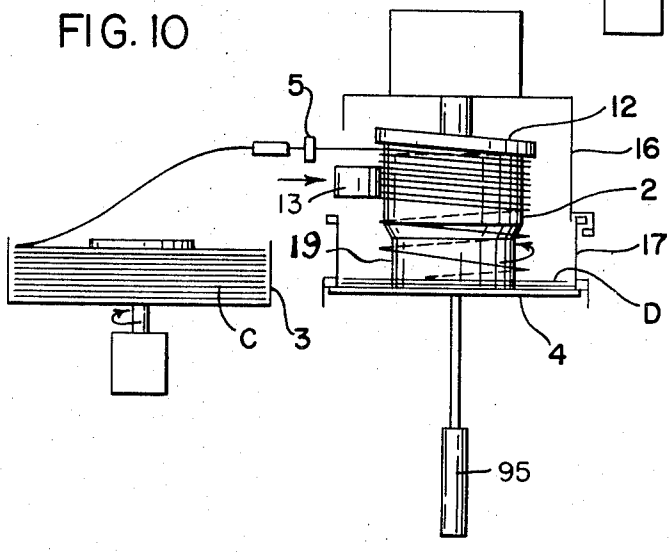



FIG. 10

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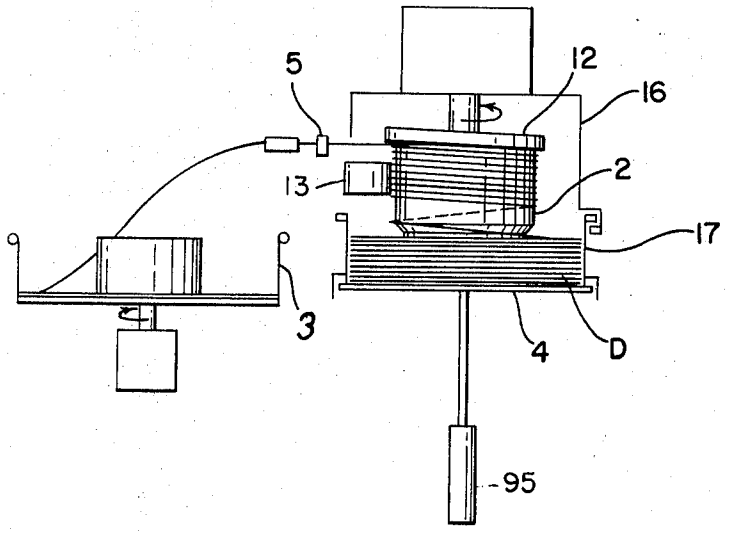


FIG. 11

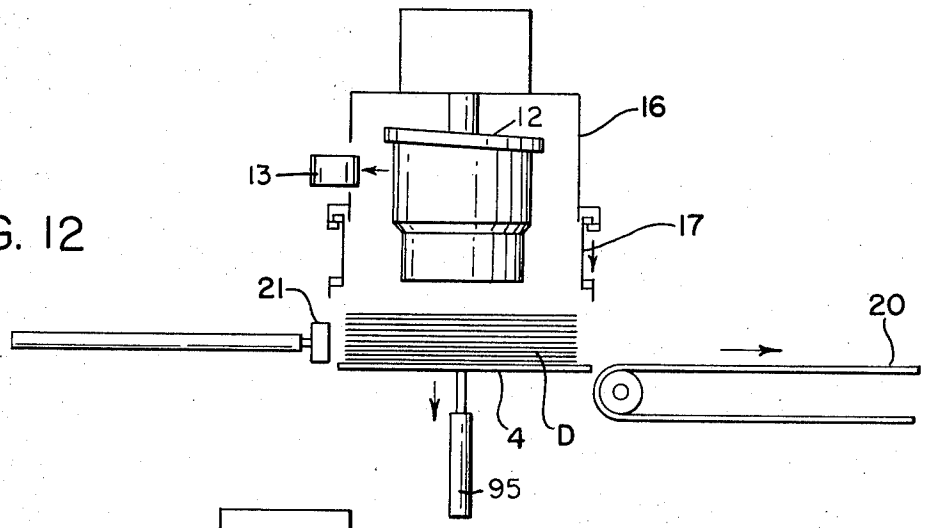


FIG. 12

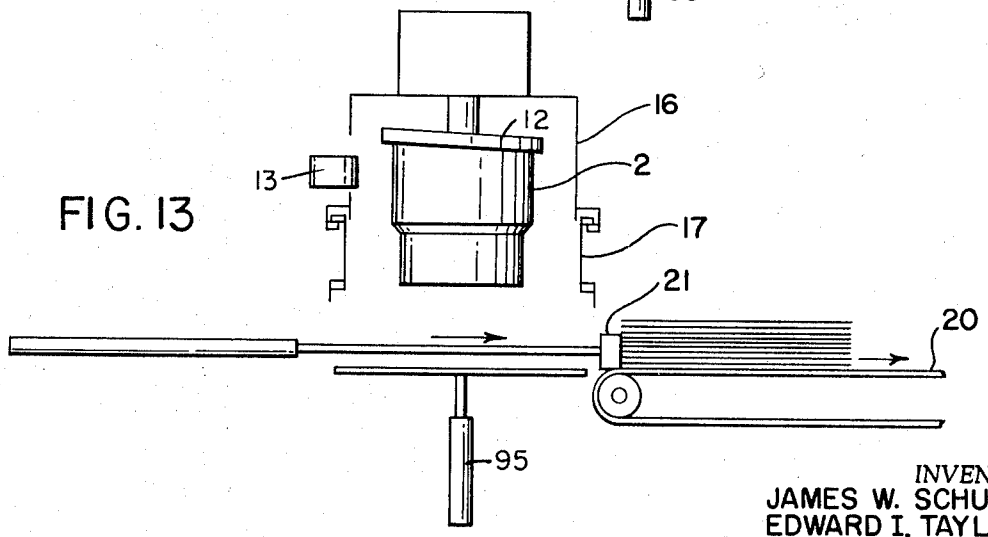


FIG. 13

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# RECEIVING TRAY FOR STRAND MATERIAL

## FIELD OF THE INVENTION

This invention relates to a continuous strand drawing apparatus and more particularly to an apparatus in which relatively stiff strands such as long lengths of metal tubing, rod or wire are drawn through a die by a capstan large enough to prevent damage to the product as it is bent around the capstan, after which the strand is discharged from the capstan onto a receiving tray.

## DESCRIPTION OF PRIOR ART

One type of widely used prior apparatus comprises a capstan that is mounted from one end for rotation about a vertical axis and has its other and lower end free. As the capstan rotates, the strand passes from a suitable source such as a payoff coil or reel through a drawing die to a location on the capstan near its upper supported end, on which the strand is wound for several turns for traction; the turns of strand move axially of the capstan and discharge over its free end until all of the strand has passed over the capstan. Since the capstan usually rotates at high speed, means must be provided to catch the turns of drawn strand that discharge from the free end of the capstan, collect them in a coil, and permit removal of the coil.

One such commonly used means comprises an annular basket positioned below the capstan, which basket is rotated at approximately the capstan speed. After the basket is filled with a coil of drawn strand, it is then moved laterally to the payoff position of the apparatus to locate the coil for subsequent redrawing passes. This type of apparatus has disadvantages because a large number of these baskets must be used in the drawing process at any given time, with resulting considerable investment in baskets, handling equipment, and considerable plant space.

Another means that has been used to collect drawn strands is a receiving tray, having a circumferential wall, that performs the same general function as the basket mentioned above, except that the central portion of the receiving tray is retractable into its bottom and a door is provided in the outer wall of the basket to permit withdrawal of the coil laterally from the basket. This apparatus is quite complex and expensive and subject to the possibility that the door might accidentally open when the receiving tray is rotating at high speed, causing danger to employees and damage to the strand or equipment.

## SUMMARY OF THE INVENTION

The invention overcomes these and other disadvantages of prior apparatus, and makes it possible for strand turns discharged over the free end of the capstan to be readily, safely, and rapidly collected in a coil that can be readily and rapidly removed, all with safety to employees and no damage to the strand or equipment.

Apparatus embodying the invention preferably comprises stationary supporting means; a drum mounted on the supporting means so the drum is rotatable about a generally upright axis and has a lower free end, the drum having a periphery on which turns of strand are wound, the drum being adapted to discharge turns of strand from its free end; and means for collecting the discharged turns of strand in the form of a coil comprising a strand-collecting member having a strand-collecting upper surface extending generally radially of such axis of rotation, movable supporting means for raising the collecting member to an upper position where its upper surface is in proximity to the free end of the drum and to lower it to a position in which a coil on the upper surface of the collecting member will clear the free end of said drum, the collecting member being rotatable on the movable supporting means essentially about the axis of rotation of the drum at substantially the same speed as the drum when the collecting member is in its upper position, and guard means surrounding and radially spaced from the drum, the guard means extending upwardly from the collecting member when it is in its upper position and



substantially overlapping the free-end portion of the drum, the guard means being rotatable essentially about the axis of the drum at a rotational speed essentially the same as that of the drum, so that turns of strand can discharge from the drum onto the collecting member within the guard means and form a coil of strand on the collecting member.

An object of the invention is the provision of apparatus for receiving strand turns discharged over the end of a drawing capstan and readily, safely and rapidly collecting them in a coil which may be readily and rapidly removed without damage to the strand or equipment and with safety to employees.

## BRIEF DESCRIPTION OF THE DRAWINGS

Further objects and advantages of the invention will become apparent from the following description of a preferred form of the invention in connection with the accompanying drawings, in which:

FIG. 1 is a side elevation of apparatus embodying the invention for drawing a strand and collecting the drawn strand in the form of a coil, parts of the apparatus being shown in section for the purpose of clearness, the receiving tray being shown in full lines in its elevated position where it can receive the coil and in broken lines in its lower position from which the coil can be removed, and means for pushing the coil off the tray shown in broken lines;

FIG. 2 is a plan of the apparatus of FIG. 1 to the same scale;

FIG. 3 is a section, to larger scale, generally along line 3–3 of FIG. 2, showing in particular the capstan structure and its supporting means, the inclined rotating plow that moves turns of strand axially along the capstan, the gripper, and the receiving tray and movable guard;

FIG. 4 is a plan generally along line 4–4 of FIG. 1 but to larger scale, showing the capstan, the roller for holding strand turns on the capstan, the gripper, its latch means, strand severing means, and the stationary guard;

FIG. 5 is a detail along line 5–5 of FIG. 4 but to larger scale, of the latch means for holding the gripper;

FIG. 6 is a detail along line 6–6 of FIG. 4 but to larger scale, of the strand severing means;

FIG. 7 diagrammatically illustrates the relationship of parts of the apparatus before start-up;

FIG. 8 diagrammatically shows the beginning of start-up in which the lead end of the strand is passed through the die and grasped by the capstan gripper, the receiving tray being in its uppermost position and the die being in its lowermost position;

FIG. 9 diagrammatically illustrates completion of the initial winding of the strand on the capstan;

FIG. 10 diagrammatically shows the drawing operation in which the strand level winds on the capstan and strand turns discharge from the free end of the capstan onto the receiving tray;

FIG. 11 diagrammatically illustrates another step in the drawing operation when the strand on the payoff tray is becoming exhausted;

FIG. 12 diagrammatically shows conditions at the completion of the drawing operation, after the receiving tray carrying the coil of drawn strand has moved downwardly; and

FIG. 13 diagrammatically illustrates the removal of the coil of drawn strand off the payoff tray onto a conveyor.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

The illustrated apparatus (FIGS. 1, 2, 3 and 4) comprises a base 1 supporting a power rotated drum or capstan 2 for rotation about a vertical axis A at automatically controlled speeds and cycles of starting and stopping. A strand S to be drawn passes to the capstan from a suitable source, such as a coil C on a conventional payoff tray 3 that is supported for rotation about a generally vertical axis to permit the strand to unwind from coil C. Strand collecting means, extending generally radially of and rotatable about axis A is provided below the

capstan; in this embodiment it is a receiving tray 4 rotatable about the axis A and adapted to be raised to the position shown in full lines 4 and lowered to a position shown in broken lines 4' in FIG. 1. The apparatus also includes die means 5 for reducing the cross section of the strand, movable vertically between an uppermost position shown in full lines and a lowermost position shown in broken lines in FIG. 1. Base 1 also carries guide means 6 that carries the die means for vertical movement. The capstan is positively rotated as required by an electric motor 7 that drives the capstan through a suitable gear box 8.

Turns T of strand are wound on the capstan in number sufficient to cause the strand to engage the capstan with enough friction to prevent slippage as the strand is drawn through the die means 5. To aid in initially winding the required number of turns on the capstan a gripper 11 is mounted on the capstan. The gripper is adapted to grasp firmly the leading end of the strand S after it is passed through the die means, and hold it on the capstan as it is rotated a predetermined number of times by conventional means to wind the desired number of helical turns of strand in a single layer on the capstan.

The die means 5, the position of which is shown in broken lines 5' in FIG. 1 when the gripper first grasps the leading end of the strand, is caused to move upwardly in a path parallel to the axis of the capstan at a rapid rate, to cause a number of widely spaced turns of strand to wind initially in a single layer on the capstan (FIG. 9). The die means 5 is then in the position shown in full lines in FIG. 1 in which the strand leaving die means 5 travels in a straight path to the capstan in a path lying essentially in a plane normal to the axis A of the capstan.

In order to move turns of strand winding on the capstan toward the free end of the capstan as they are thereafter wound on the capstan, a rotating plow 12 is mounted to rotate with and about the capstan in a plane at an angle other than normal to the axis of rotation of the capstan. This plow forces the turns away from the location on which they first contact the capstan, so that each increment of strand winding onto the capstan directly engages the surface of the plow, and so abutting turns are level wound on the capstan and pushed toward the free end of the capstan by the action of the plow acting through all turns on the capstan.

A snubber roller 13 (FIG. 2) is provided to be moved toward and engage the turns of strand on the capstan so that after the gripper has released the strand the turns of the strand will be maintained properly on the capstan.

Meanwhile, the receiving tray 4 has been raised until its upper surface 14 contacts and frictionally engages the lowermost surface 15 at the free end of the capstan so tray 4 rotates with the capstan.

The capstan is surrounded by a stationary guard 16 that is appropriately apertured to clear the die means 5, the snubber roller 13, and other parts. The lower end of the stationary guard carries a movable guard 17 that is capable of rotating with the receiving tray 4 relative to the stationary guard 16 when the bottom of the movable guard frictionally engages the top of the raised receiving tray and is lifted by this tray from its supporting means 18 on the stationary guard 16 so movable guard 17 can rotate freely. The strand is then released from gripper 11, preferably by severing the strand adjacent the gripper.

Thereafter, as the capstan is rotated the drawn strand leaving die means 5 is level wound on the rotating capstan in a single layer of turns which abut and are forced axially of the capstan toward its free end by plow 12; the turns discharge over the free end of the capstan, the capstan portion 19 adjacent its free end preferably being smaller in cross section to facilitate this. The discharged turns of strand drop onto the receiving tray where they are caused to form a coil D (FIGS. 11—13) in the space between the smaller end portion 19 of the capstan and the rotating guard 17. After a coil of desired size has been built up on the receiving tray, usually by using the entire length of strand on the payoff tray, the capstan is then halted, thus halting rotation of the receiving tray and the guard 17. The receiving tray carrying the coil D of drawn strand is then lowered to its lowermost position 4. While in this position, the coil is pushed off the receiving tray onto a suitable conveyor 20 (FIGS. 12, 13) by pusher means 21.

## DIE MEANS AND ITS GUIDE MEANS

As shown in FIGS. 1 and 2, the die means 5 comprises a conventional holder 22 that carries adjustable straightening rolls 23 and a die box 24 holding a manually changeable draw die 25 and guide 26 (FIG. 2). Holder 22 is mounted in a known manner for limited movements on a member 27 that can travel in guide means in path parallel to the axis of rotation A OF the capstan. In initial winding of the strand on the capstan, the member 27 is moved upwardly by cylinder 28 at the proper rapid speed as the capstan rotates to level wind the strand on the capstan in the desired number of widely spaced turns. Cylinder 28 is controlled by suitable conventional control means.

## CAPSTAN AND ASSOCIATED MECHANISM

FIGS. 1, 2, 3 and 4 illustrate the capstan 2 and its supporting and driving means. The capstan is supported by a shaft 31 that is journaled in the base 1 and has a tapered outboard end 32. Shaft 31 is driven by suitable conventional gear means, not shown, in gear box 8 from motor 7. Capstan 2 comprises a hub 33 rigidly mounted on outboard end 32 of the shaft and a radial wall 34 rigidly fixed to the hub and a generally cylindrical outer wall 35 of largest diameter connected through intermediate tapered or frustoconical portion 36 to the generally cylindrical lower portion 19 of substantially smaller diameter. Portions 35, 36 and 19 are rigidly connected.

The gripper 11 is of known construction and comprises a member 37 pivotally mounted on the capstan within its larger portion 35, and a member 38 pivotally mounted on member 37. Member 38 carries movable gripper jaws 39 that are suitably actuated by know means to grip the leading end of the strand as required. As shown in broken lines in FIG. 4, member 37 can swing to position 37' where it projects beyond the periphery of wall 35, stop means 40, 41 limiting such swing, and member 38 can swing to position 38' relative to member 37, stop means 42, 43 limiting such swing relative to member 37; a tension spring 44 biases the member 38 to its straight position relative to member 37.

Latch means 45 (FIGS. 4 and 5) operating between the gripper member 38 and capstan 2 normally holds the member 38 and its supporting member 37 in their innermost positions. It comprises a latch member 46 (FIGS. 4 and 5) pivotally mounted on a bracket 47 fixed inside capstan 2 and having a latch 48 that normally engages a keeper 49 on gripper member 38. The latch member is normally held engaged by member 51 biased by compression spring 52, but can be pushed into unlocked position shown in broken lines in FIG. 5 by piston rod 53 of fluid cylinder 54. Once released by the latch means, gripper members 37 and 38 may be pushed to their extended positions 37', 38' by fluid cylinder 55 controlled by conventional means.

Strand severing means 56 (FIGS. 4 and 6) is provided in the capstan to sever the end of the strand in the gripper from the remainder of the strand when the strand is to be released from the gripper. This means includes a bracket 57 mounted in the capstan and having a portion through which the strand passes to the gripper between two normally open pivotally mounted cutting blades 58 and 59 (FIG. 6). At the appropriate time, these blades are brought together to cut the strand, as by a suitable linkage actuated by fluid cylinder 60 controlled by suitable known means.

The elongated snubber roller 13 is surfaced with rubber or other resilient material. It is located at the rear side of the capstan as viewed in FIGS. 2 and 4. The roller 13 is long enough to extend substantially over the entire length of the portion of the larger diametered surface of the capstan that carries the wound strand turns. The roller is mounted for rotation about

an axis parallel to the capstan, on an arm structure 62 that is pivotally supported by the base of the apparatus and can be moved at appropriate times so the snubber roller engages the strand turns on the capstan and so the snubber roller is positioned at 13' away from the capstan, by a piston rod 63 of a fluid cylinder 64 (FIGS. 2 and 4); cylinder 64 is actuated and controlled by suitable conventional means. Snubber roller 13 is positively rotated by a belt 65 traveling over a pulley 66 fixed to a shaft rigidly carrying the roller, and a pulley 67 mounted on an auxiliary shaft 68 at the pivot of the arm structure supporting the snubber roller; shaft 68 is positively rotated by another belt 69 passing over a pulley on such shaft and another pulley 70 on a shaft 72 that is positively rotated by a small gear 73 engaging a larger gear 74 mounted on drive shaft 31 of the capstan. The sizes of the gears and the pulleys are selected to provide the proper circumferential speed of the snubber roll relative to the circumferential speed of the strand turns on the larger portion of the capstan.

## ROTATING PLOW

The rotating plow 12 (FIGS. 1, 3, and 7—13), comprises an annular continuous plow ring 75 located outside of and around the large portion 35 of the capstan near its supported end. This ring is supported by a generally radial member 76 mounted on a hub 77 that is supported by suitable bearing means 78 so that member 76 and the ring 75 rotate about an axis that is inclined to the axis A of the capstan shaft. Ring 75 and member 76 are caused to rotate with the capstan by a pin 79 mounted in a bracket 80 in the capstan and projecting through an opening 82 in member 76. The plow ring, therefore, always rotates in a fixed plane that is inclined to the axis of rotation of the capstan, the position, direction, and degree of inclination being such that when the strand S is passing to the capstan in a plane normal to the axis of rotation A of the capstan, the first turn of strand winding on the capstan clears the plow ring 75 at the location where the strand first contacts the capstan but thereafter is engaged by the plow ring and pushed axially of the capstan toward its free end. Each turn also pushes the next adjacent previously applied turn and so on, so that all turns are moved axially of the capstan as it rotates and additional strand turns are wound on it, until the turns are discharged from over the free end of the capstan.

## GUARD MEANS

The stationary guard 16 (FIGS. 1, 2 and 3) has a generally cylindrical inside surface and is fixed to a support 83 supported by base 1 above the capstan. This guard is suitably apertured to clear the die means and its supporting means, and the snubber roller. As shown in FIGS. 2 and 4 the arm 62 for the snubber roller also carries a guard 84 that cooperates with the stationary guard to close the opening for the snubber roller and its supporting means when the snubber roller is in its retracted position for safety during winding of the initial strand turns on the capstan. Guard 16 carries, circumferentially spaced around its lower portion, brackets 18 each having an inwardly facing groove 86.

Members 18 support and guide the lower movable guard 17, which has a generally cylindrical inner surface, by an outwardly facing annular ring member 87 fixed to the top of guard 17 and slidably fitting in grooves 86. Members 18 and 87 are formed of materials, preferably metals, that are wear resistant and have low friction. The lower edge of guard 17 also rigidly carries a ring member 88 formed of wear-resistant material providing high friction on engagement with the top of the receiving tray 4, and which fits over the outer edge of the receiving tray to prevent any gap through which a strand turn might escape or become jammed.

## RECEIVING TRAY AND PUSHER MEANS

As shown in FIGS. 1 and 3, the receiving tray 4 has a top table portion 89 with flat outer edges, which is reinforced by frame members 90 and supported for rotation on a member 92 that in turn is mounted on the piston rods 93 and 94 of two associated fluid cylinders 95 and 96 that cooperate to raise and lower the receiving tray while preventing rotation of supporting member 92. Fluid cylinder 95 is supplied with fluid to cause the desired raising and lowering at the appropriate times by suitable conventional means not shown.

The pusher means 21 shown in figs. 1, 2, 12 and 13, comprises a head 97, adapted to engage a coil of strand, that is mounted on two parallel guide rods 98 slidably mounted in two parallel horizontal tubular guide members 99 so that the head 97 can move in a straight path in a horizontal plane. The pusher head 97 is moved in such horizontal path between the position (FIGS. 2 and 12) in which it clears the receiving tray, to a position (FIG. 13) in which it extends across the receiving tray to push a coil of strand off the receiving tray, by a piston rod 101 of a fluid cylinder 102 that is supplied with fluid and controlled by suitable conventional means.

## OPERATION

It is assumed that the apparatus is properly set up adjusted for the particular size of strand to be handled by provision of the proper die 25, the proper size of gripper jaws 39, and proper size and adjustments of rolls 23. The receiving tray 4 is in its lowermost position and a coil C of strand material to be drawn is on the payoff tray 3 (FIG. 7). Die means 5 is in its lowermost position, and gripper 11 is in its extended position as shown in broken lines in FIG. 4.

In initiating operation, the leading end of the strand S from the coil C on the payoff tray 3 is suitably prepared drawing by being pointed, and then passed through the straightening rolls. The pointed leading end of the strand is then passed manually or by suitable conventional mechanical means through the die 25 of the die means, after which it is inserted between the jaws 39 of gripper 11, which are then actuated to grasp firmly the leading end of the strand (FIG. 8).

The capstan is then rotated counterclockwise as shown by arrows in FIGS. 2 and 4 while the die means is rapidly raised by fluid cylinder 28 to cause the strand to wind on the capstan in a predetermined number of widely spaced turns until the last turn of the strand contacts the plow and the strand passes from the die means to the capstan in a plane normal to the axis of rotation of the capstan. Upward movement of the die means is then halted, and the die means is maintained in this upper position.

Meanwhile, as soon as the first turn of strand starts to wind on the capstan, it moves the gripper inwardly to its innermost position, shown in full lines in FIG. 4, in which it is locked by sliding of latch 48 over and in back of keeper 49, the initially engaging surfaces of the latch and the keeper being inclined as shown in FIG. 5 for the purpose.

The receiving tray 4 is raised to its uppermost position so that ring member 88 at the bottom of movable guard 17 fits over the outer edge of the receiving tray as shown in FIGS. 1 and 3, and guard 17 is lifted by tray 4 so its upper ring is lifted from bottoms of the grooves of brackets 18 of the stationary guard.

The receiving tray 4 then frictionally engages the bottom end of the capstan and rotates with it, and the movable guard 17 frictionally engages the tray and rotates with it, so that the capstan, receiving tray, and movable guard are all rotating at essentially the same rotational speed (FIG. 9).

Rotation of the capstan and winding of the strand on the capstan are continued until the strand turns starting on the capstan are pushed downwardly by the plow 12 until they form a single layer of abutting turns extending from the plow to the gripper. The snubber roll 13 is then brought into contact with the layer of abutting turns, after which the severing means 56 is actuated to sever the strand and release it from the gripper. The speed of rotation of the capstan is then increased. The strand is thereafter drawn from coil C through the die means 5 while it is in its uppermost position, passes to the capstan in a straight path lying essentially in a plane nor-

mal to the axis of rotation of the capstan, is level wound on the capstan in a single layer of turns that are advanced axially of the capstan downwardly toward its free end, and that drop in sequence from the capstan and into the channel defined by the smaller lower portion **19** of the capstan **2**, the inside of the movable guard **17** and the top of receiving tray **4**, to form a coil D (FIG. **10**).

The capstan is rotated and the strand is thus drawn until all of the strand in the payoff tray has been drawn, wound onto the capstan, and discharged from the capstan into coil D (FIG. **11**).

Rotation of the capstan is then halted, the snubber roll is moved to its retracted position, and tray **4** which no longer is rotating, is then lowered to its lowermost position (FIG. **12**). In this position the coil D on the tray clears the underside of the the movable guard and can be pushed by the pusher means **21** onto a suitable conveyor **20** or other receiving means (FIG. **13**). The coil of drawn strand can then be put in payoff tray **3** and the process can be repeated to redraw the strand to a smaller size after the die and other parts required for the smaller size, have been installed or adjusted.

Although the illustrated embodiment has been described in connection with the drawing and handling of a strand such as a tube, it is obvious that such apparatus may be used for handling other types of strand material such as rods or even wire.

Those skilled in the art will appreciate that various changes and modifications can be made in the apparatus and process described herein by way of example, all without departing from the spirit or scope of the invention. The essential characteristics of the invention are defined in the appended claims.

We claim:

**1**. Apparatus for handling relatively stiff strand and collecting it in coil form, comprising stationary supporting means; a drum mounted on said supporting means so said drum is rotatable about a generally upright axis and has a lower free end, said drum having a periphery on which turns of strand are wound and being adapted to discharge turns of strand from its free end; and means for collecting said discharged turns of strand in the form of a coil comprising a strand-collecting member having a strand-collecting upper surface extending generally radially of said axis, movable supporting means for raising said collecting member to an upper position where its upper surface is in proximity to the free end of said drum and to lower it to a position in which a coil on said upper surface of said collecting member will clear said free end of said drum, said collecting member being rotatable on said movable supporting means about essentially the same axis as said drum at substantially the same speed as said drum when said collecting member is in its upper position, and guard means surrounding and radially spaced from said drum, said guard means extending upwardly from said collecting member when it is in its said upper position and substantially overlapping the free end portion of said drum, said guard means being rotatable essentially about the axis of said drum at a rotational speed essentially the same as that of the drum, whereby turns of strand can discharge from said drum onto said collecting member within said guard means and form a coil of strand therein.

**2**. The apparatus of claim **1** in which said guard means is at all times rotatably supported in said spaced overlapping relation to the lower free-end portion of said drum, and so it can be engaged and rotated by said collecting member when it is in its said upper position, and can clear a coil of strand on said collecting member to permit lateral removal of the coil from said collecting member when it is in its said lower position.

**3**. The apparatus of claim **1** comprising a second guard means disposed above said first-mentioned guard means and radially spaced from and substantially surrounding said drum, and defining with said first-mentioned guard means a guard that extends along substantially the entire length of said drum encircled by said strand turns.

**4**. The apparatus of claim **3** in which said second guard means is stationary and supports said first-mentioned guard means to permit its rotation about said drum.

**5**. The apparatus of claim **1** comprising drawing die means adjacent said drum, means for supporting said drawing die means for movement generally axially of said drum between a lower position in which a strand may pass from said die means to said drum, and an upper position in which said strand travels in a path lying essentially in a plane normal to the axis of rotation of said drum, and gripper means mounted on said drum to receive said strand traveling from said die means when it is in its lower position.

**6**. The apparatus of claim **5** comprising means for rotating said drum, means for moving said die means axially of said drum from its lower position to its upper position to cause a strand the end of which is gripped by said gripper means initially to wind on said drum in a plurality of single turns, means for releasing said strand from gripper means after said turns are initially wound, and means associated with said drum for forcing turns of strand wound on said drum axially thereof from the position in which the strand travels in said path until the endmost strand on said drum reaches a position at which it is discharged axially over the free end of said drum onto said strand collecting member.

**7**. The apparatus of claim **1** in which said drum has its lower free-end portion of smaller diameter than the upper portion of said drum to permit strand to be readily discharged therefrom.

**8**. Apparatus for drawing a relatively stiff strand and collecting it in coil form comprising a drum rotatable about a generally upright axis; means for supporting said drum from its upper end for rotation about said axis, so said drum has a lower free end; means for rotating said drum; strand drawing die means mounted adjacent to but spaced from said drum for movement in a guided path generally parallel to said drum axis, between a lower position and an upper position in which said strand passes to said drum in a path lying in a plane essentially normal to said upright axis; means for gripping the end of the strand, said gripper means being adapted initially to grip said strand when said strand is in its lower position and to retain its grip on said strand until the strand is released when said die means is in its upper position; means for moving said die means from its lower to its upper position initially to wind strand on said drum in a single layer while the end of said strand is gripped; guard means surrounding in radially spaced relation and overlapping the lower free-end portion of said drum; means for rotatably supporting said guard means in said relationship to said drum; a strand-collecting member located below the free end of said drum and having a portion with a generally radially extending upper surface that projects radially beyond the free end of said drum; and means for supporting said collecting member for guided movement between an upper position where it engages said guard means and a lower position where it clears said guard means sufficiently to permit a coil of strand on said collecting member to be moved laterally off said member, said means supporting said collecting member so it is rotatable when in its upper position and as it rotates can rotate said guard means.

**9**. The apparatus of claim **8** in which said drum has its lower free-end portion of smaller diameter than the upper portion of said drum on which the strand is wound, which smaller portion facilitates discharge of strand turns over the free end of said drum.

**10**. The apparatus of claim **9** in which the outer surface of said free-end portion of smaller diameter, the inner surface of said guard means, and the upper surface of said collecting member when it is in its upper position define an annular channel in which the strand turns discharged from said drum form a coil.

**11**. The apparatus of claim **8** comprising means for moving turns of strand, formed by strand passing to said drum as it rotates from said die means while it is in its upper position, said strand moving means acting to arrange strand turns wound on said drum in a single layer of turns and to move said turns axially on the drum toward its free end.

**12**. The apparatus of claim **10** comprising means for engaging said layer of turns wound on said drum to hold said turns on the drum.

13. The apparatus of claim **10** in which said rotatable guard means is rotatably supported by stationary guard means located above said rotatable guide means and substantially surrounding the portion of said drum on which said strand turns are wound.



14. The apparatus of claim **8** in which said collector member when in its upper position is adapted to engage said drum and be rotated by it, and to engage and rotate said rotatable guard means.