

Aug. 30, 1955

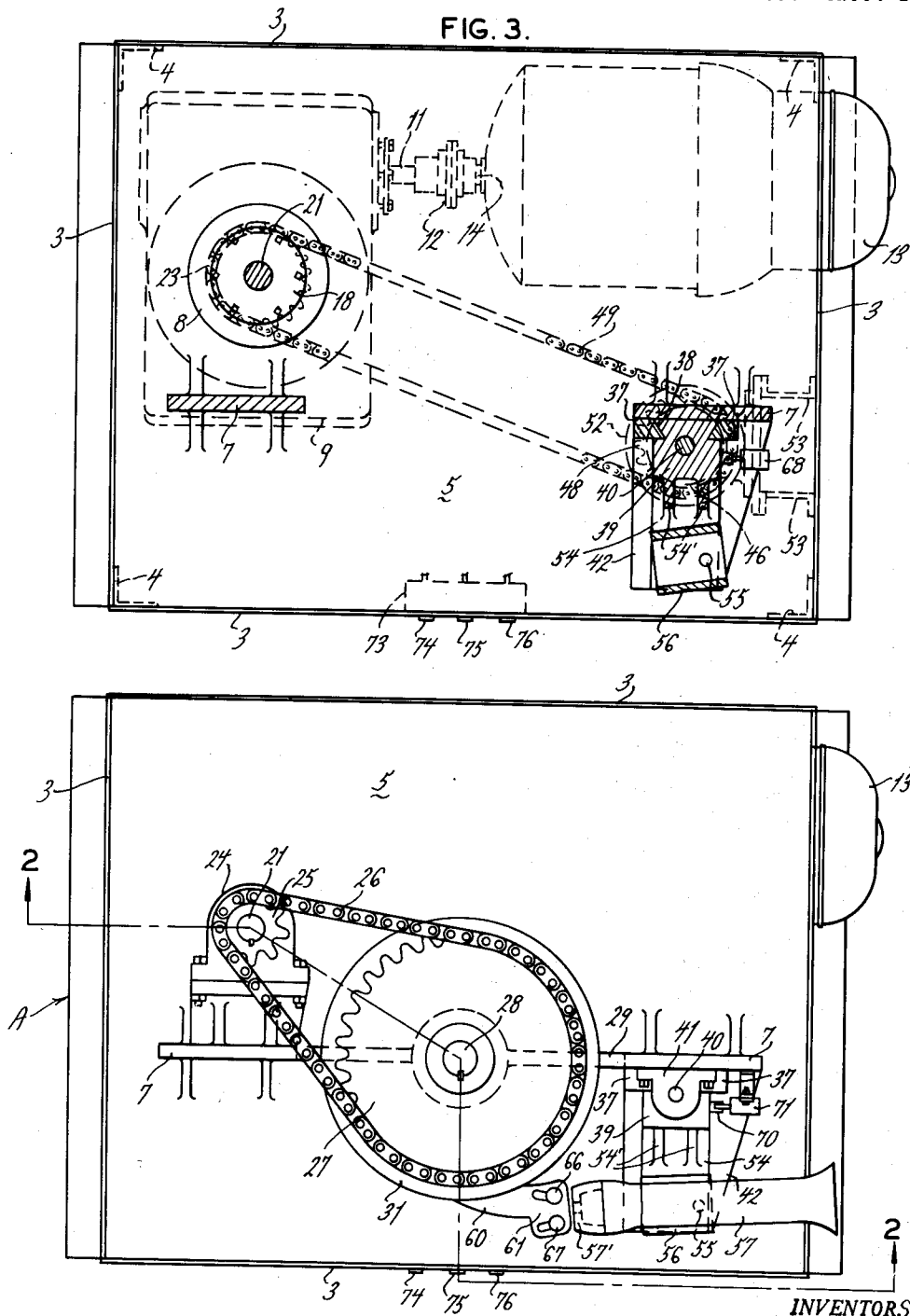
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2,716,482

BULL-BLOCKS

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3 Sheets-Sheet 1



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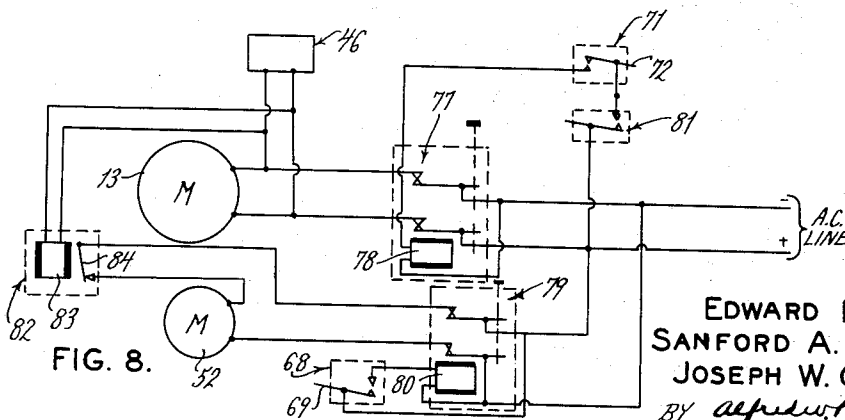
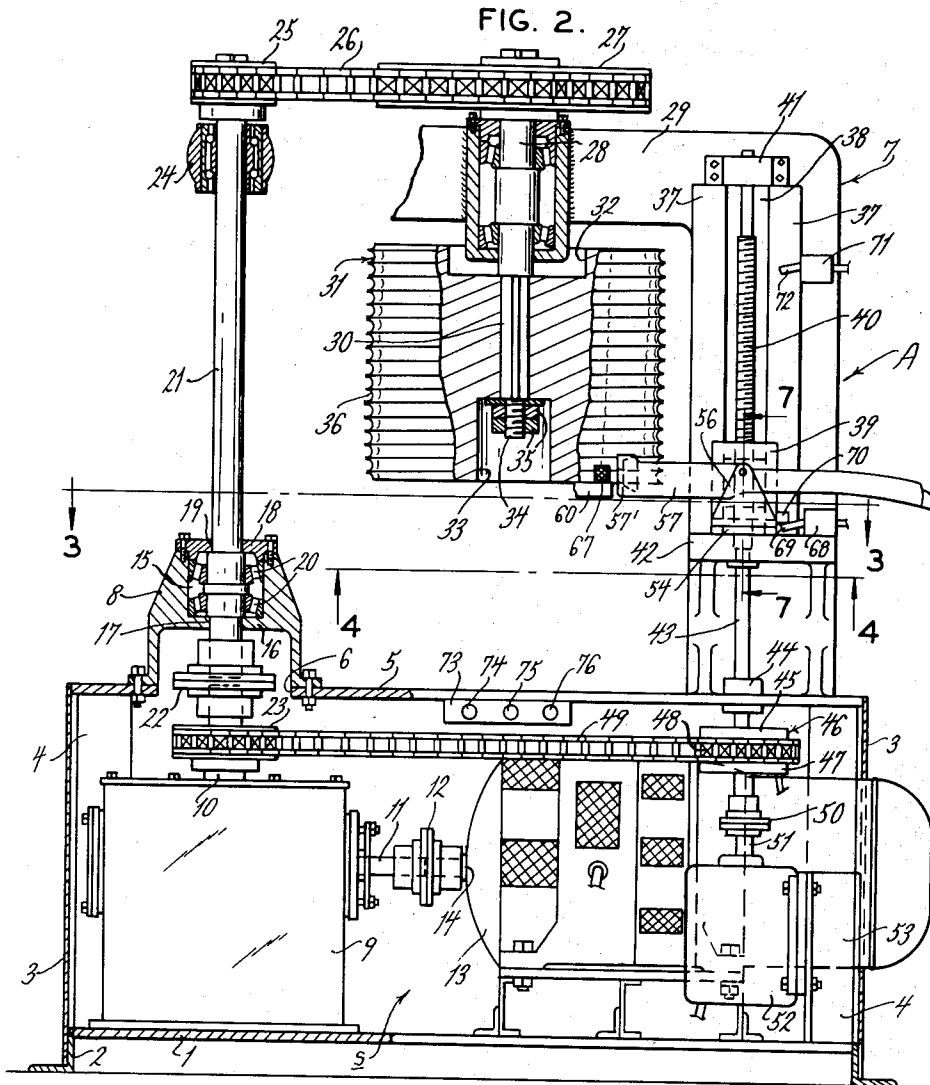
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

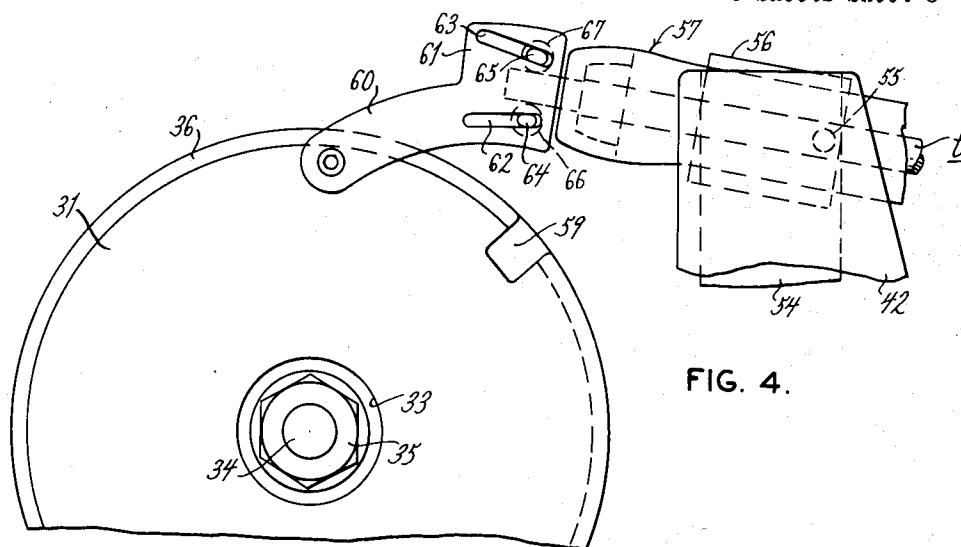


FIG. 4.

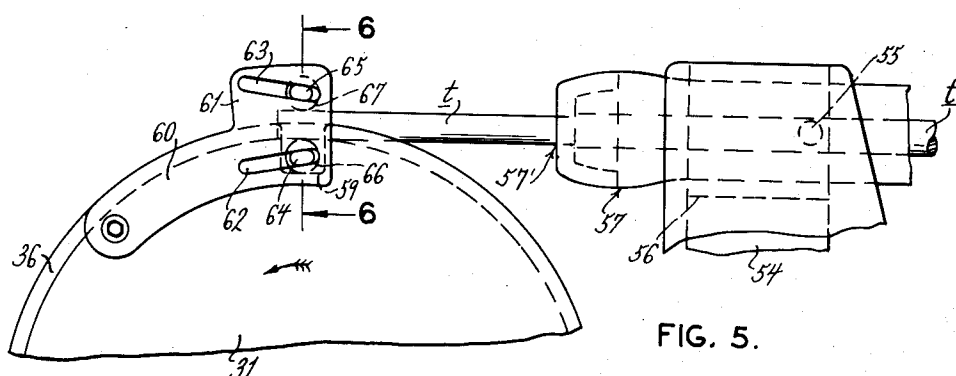


FIG. 5.

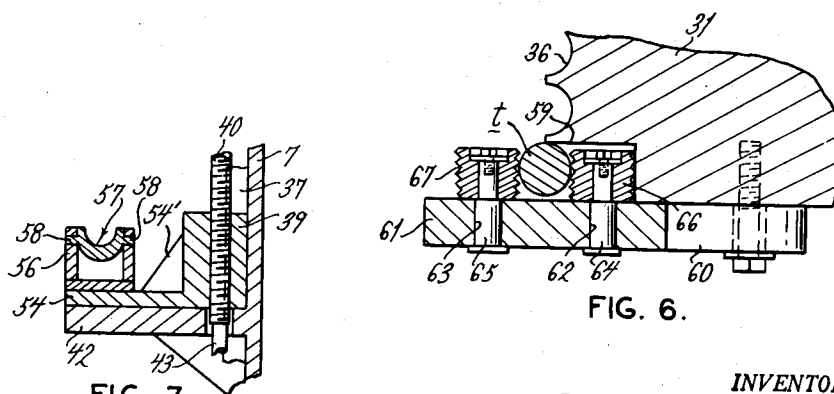


FIG. 6.

FIG. 7.

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BULL-BLOCKS

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Application January 14, 1952, Serial No. 266,364

5 Claims. (Cl. 205—3)

This invention relates in general to certain new and useful improvements in tube drawing machinery and, more particularly, to a type of tube drawing machinery sometimes referred to as a bull-block.

In the drawing of seamless tubing from pierced billets of a malleable metal, such as copper for instance, it is a common practice to pull the pierced billet through a large reducing die in a draw bench and pass the tubing through successive drawing dies of successively smaller diameters until the tube is reduced to the desired diametral size and wall-thickness. The drawing operation, of course, results in a progressive lengthening of the tube and consequently draw benches for producing such tubing are extremely long, requiring relatively large floor space. The straight-line draw bench also produces straight lengths of tubing which are somewhat cumbersome to handle and frequently the tubing is damaged in transference from one machine to another for successive drawing operations.

These space requirements and other difficulties have led to the utilization of a somewhat different type of drawing machine commonly referred to in the industry as a bull-block. In this latter type of machine a drawing die is juxtaposed to a large cylindrical drum or "block," as it is called, and the tubing to be drawn is swaged down so that a rather crude, much reduced, end or "point" can be manually threaded through the drawing die and engaged in a suitable jaw mounted upon the drum. The drum is then rotated by a powerful driving mechanism and thus serves to pull the tubing through the drawing die while causing it to wrap up around the outer peripheral surface of the drum. The gripping jaw is usually mounted for axial sliding movement along the drum as the tubing winds thereon so that successive turns of tubing will force the previously drawn turns of tubing upwardly along the surface of the drum until the draw is completed. In order to facilitate this winding and self-feeding action, the drums frequently are tapered slightly.

Bull-blocks, as these machines are called, have definite advantages in terms of space requirements and, furthermore, the tubing thus drawn is already coiled so that it can be very conveniently and simply handled. Nevertheless, the tubing thus produced is not entirely satisfactory because the cross-sectional shape is slightly oval. This ovality, which is highly undesirable in tubing, is not particularly serious in small diameter tubing and in tubing having relatively heavy wall size, particularly where the ratio of the drum diameter to the tubing diameter is relatively great. On the other hand, where large diameter tubing is being drawn or the wall thickness of the tubing is relatively small in relation to tubing diameter, the tendency toward ovality becomes quite pronounced.

Another difficulty which has been encountered with conventional types of bull-blocks is the difficulty of obtaining accurate measurements as to the length of tubing in the coil after it has been drawn. Superficially it

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would seem that in a bull-block or drum of given diameter it should be possible to ascertain within reasonably accurate limits the length of tubing in the coil by counting the number of turns on the block or drum.

Unfortunately, however, in the course of normal rotation, the coils ordinarily do not lie in closely adjacent relation but tend to angle away from each other and, therefore, it becomes difficult and inconvenient to determine the length of tubing which may happen to be in any particular coil. It has been found that variations in length amounting to several percent are routinely encountered in conventional bull-block drawing operations. Since seamless tubing and, particularly, seamlessly tubing formed from non-ferrous metal, is comparatively expensive, this degree of error in length measurement is highly unsatisfactory both to the manufacturer and the purchaser or user.

It is, therefore, the primary object of the present invention to provide a tube drawing machine of the bull-block type which is capable of drawing seamless tubing at a relatively high rate of speed without producing any ovality or other undesirable deviations from the true desired cross-sectional shape in the tubing being drawn.

It is another object of the present invention to provide a tube drawing machine of the type stated in which it is possible to determine, with a high degree of accuracy, the length of tubing in any particular coil on the basis of the number of turns in the coil as it is being drawn.

It is another object of the present invention to provide a tube drawing machine of the type stated which is rugged, durable, and can be operated continuously for long periods of time without requiring extensive maintenance or repairs.

It is a further object of the present invention to provide a tube drawing machine of the type stated which is simple in operation and can be readily manipulated and controlled by a single operator.

It is an additional object of the present invention to provide a tube drawing machine of the type stated which may readily and simply be converted for the accommodation of various different sizes of tubing to be drawn thereon without necessitating time-consuming and expensive mechanical set-up operations.

With the above and other objects in view, our invention resides in the novel features of form, construction, arrangement and combination of parts presently described and pointed out in the claims.

In the accompanying drawings—

Figure 1 is a top plan view of a bull-block constructed in accordance with and embodying the present invention;

Figure 2 is a front elevational view, partly broken away and in section, of the bull-block;

Figures 3 and 4 are transverse sectional views taken along lines 3—3 and 4—4, respectively, of Figure 2;

Figure 5 is a fragmentary sectional view similar to Figure 4, but showing the drum and tube-gripping jaw in an advanced position as the initial portion of the tubing is being drawn against the drum;

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

Figure 7 is a fragmentary sectional view taken along line 7—7 of Figure 2; and

Figure 8 is a schematic wiring diagram showing the electrical connections of the several component elements of the present invention.

Referring now in more detail and by reference characters to the drawings, which illustrate a preferred embodiment of the present invention, A designates a bull-block comprising a relatively heavy horizontal bed plate 1 provided around its peripheral margin with depending flanges 2 for engagement with the floor or other support-

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ing surface. Welded around the peripheral margins of the bed plate 1 and extending vertically upwardly therefrom are side walls 3 and corner posts 4 formed of heavy gauge angle iron. Supported upon and extending horizontally across the upper ends of the corner posts 4 is a base plate 5 having a relatively large aperture 6 opening downwardly into the enclosure or space *s* forming the interior of the machine base.

Formed integrally with or otherwise rigidly mounted upon the upper face of the base plate 5 is a large, heavy, extremely rigid head-frame 7 of substantially inverted U-shape and being provided with an enlarged housing 8 registering with and enclosing the aperture 6. Securely mounted within the base-enclosure *s* upon the bed plate 1 is a conventional speed reducer 9 having an output shaft 10 and an input shaft 11, the latter being connected through a conventional coupling 12 to a so-called clutch motor 13, which includes, in combination, a heavy-duty electric motor directly connected to a mechanical clutch and brake so arranged that immediately upon interruption of the electrical circuit to the motor the clutch will automatically disengage and the brake will automatically become operative to stop the motor drive shaft 14 practically instantaneously.

The housing 8 is provided with an upwardly presented recess 15 having a horizontal bottom wall 16 provided with a central aperture 17. The recess 15 is closed across its top by a cap plate 18 having a central aperture 19 vertically aligned with the aperture 17 and being adapted for retaining a pair of conventional roller thrust bearings 20 for operatively supporting a vertical shaft 21 which projects downwardly and is connected by means of a conventional shaft coupling 22 to the output shaft 10 of the speed reducer 9. Also rigidly but removably mounted upon the output shaft 10, just below the shaft coupling 20, is a split-hub sprocket 23.

At its upper end the shaft 21 passes through a conventional ball-bearing journal 24 and is provided with a removable sprocket 25 which is, in turn, connected by means of a sprocket chain 26 to a large drive-sprocket 27 removably secured upon the upper end of a drum shaft 28 journaled in and extending vertically through the central portion of the bight 29 of the head frame 7 and terminating at its lower end in a shaft-tail 30 of rectangular cross section for snug-fitting non-rotative engagement within a cylindrical drum 31, the latter being counter-bored upon its opposite horizontal end faces to provide clearance recesses 32, 33. The shaft-tail 30 projects downwardly into the clearance recess 33 and is threaded at its lower end, as at 34, for receiving a retention nut 35 by which the drum 31 is securely, but removably, mounted to the shaft 28. Upon its external or peripheral face the drum is precisely machined to provide a closely lying continuous helical groove 36 of substantially semi-circular cross-sectional shape and having a diametral size equal to the outside diametral size of the tubing to be drawn.

Mounted upon the forward face of one vertical leg of the U-shaped head frame 7, on the opposite side of the drum 31 with respect to the shaft 21, is a pair of spaced parallel way-bars 37 forming a dovetail slideway 38 for shiftably accommodating a slide-block 39 operatively mounted therein. Extending threadedly through the slide-block 39 and centrally along the slideway 38 is a feed screw 40 which is turned down and journaled at its upper end in a sleeve bearing 41. At its other end the feed screw 40 is turned down and similarly journaled in a horizontal bracket plate 42 formed integrally with and extending forwardly from the head frame 7. Below the bracket plate 42 the feed screw 40 is provided with an integral shaft portion 43 which extends through a suitable bearing 44 mounted in the base plate 5 and extends through the driven member 45 of a magnetic clutch 46 having a driving member 47 disposed concentrically around the driven member 45 and provided

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upon its peripheral face with a sprocket 48 which is, in turn, drivingly connected by means of a sprocket chain 49 to the sprocket 23. The shaft portion 43 of the feed screw 40 extends downwardly below the driven member 45 of the magnetic clutch 46 and is, at its lower end, connected by means of a conventional coupling 50 to the drive shaft 51 of a small high-speed die-return motor 52 which is, in turn, mounted upon an upstanding support-post 53 within the base enclosure *s*.

Formed integrally with the slide-block 39 and projecting horizontally forwardly therefrom is an arm 54 reinforced by an integral gusset 54'. Mounted upon the upper face of the arm 54 for swivelling movement about a vertical swivel pin 55 is a U-shaped die-carriage 56 and operatively mounted therein for rocking movement about a horizontal axis is a tubular drawing die 57 having oppositely presented axially aligned pins 58 rotatably engaged in the opposed parallel side walls of the U-shaped die-carriage 56, all as best seen in Figure 7. The drawing die 57, the slide-block 39 and the arm 54, are all so arranged and positioned that the mouth 57' of the drawing die 57 will be positioned at the level of the lowermost convolution of the helical groove 36 when the slide-block 39 is in its lowermost position resting upon the bracket plate 42, substantially as shown in Figure 2.

The drum 31 is provided adjacent its lower end with a radially inwardly extending somewhat rectangular recess 59 coinciding substantially with the entrant or lower end of the helical groove 36 and swingably mounted upon the under face of the drum 31 for rocking movement in a horizontal plane is a gripper arm 60 having a lateral extending horizontal enlargement 61 which is provided with a pair of converging slots 62, 63. Shiftably mounted in, and extending upwardly through, the slots 62, 63, are slide-blocks 64, 65, respectively, provided on their upwardly extending ends with deeply serrated gripper jaws 66, 67, respectively. The gripper jaws 66, 67, are somewhat shorter in height than the vertical height of the recess 59 so that the gripper jaw 66 will fit freely within the recess 59 when the gripper 60 is swung inwardly into the position shown in Figures 5 and 6.

Mounted upon the bracket plate 42 in laterally spaced relation to the slide-block 39 is a limit switch 68 having an actuating element 69 projecting outwardly therefrom into the path of a contact boss 70 formed on the slide-block 39 and adapted to be actuated as the slide-block 39 reaches the lower limit of its travel. Similarly mounted adjacent the upper end of the slideway 38 is a second limit switch 71 having a laterally projecting actuating arm 72 for similarly contacting the boss 70 of the slide-block 39 as the latter reaches the upper limit of its travel. It will be noted, in this connection, that the upper end of the feed screw 40 is turned down for a substantial distance and is free of threads so that in the event that the slide-block 39 should, for some accidental reason, move upwardly past the upper limit switch 71 or the latter should fail to function, the slide block 39 will, in effect, run off the threads and idle so that no serious damage will result to the machine or any of its component parts.

Similarly mounted upon the forwardly presented face panel 3 of the machine base is a main control switch 73 of substantially conventional design and including a main switch button 74, a die-return switch button 75, and a stop-switch button 76. The main switch button 74 controls a conventional double pole single throw relay 77 having a hold-in coil 78. The die-return switch button 75 actuates a double-pole single throw relay 79 having a hold-in coil 80, and the stop-switch button 76 is operatively associated with a single pole single throw switch 81, the switch blade of which is normally spring-biased to closed position. It will be noted that the limit switches 68, 71, are similarly single pole single throw switches with switch blades normally spring-biased to closed position and, like the switch 81, are opened re-

sponsive to mechanical actuation. It will also be noted by reference to the wiring diagram, Figure 8, that the limit switch 71 and the stop switch 81 are in series with each other and in series with the holding coil 78 of the relay 77. Similarly the lower limit switch 68 is in series with the holding coil 80 of the relay 79. The die-return motor 52 is, furthermore, connected to the A. C. line through the relay 79 and the main motor and magnetic clutch are connected in parallel to the A. C. line through the relay 77. Finally, the circuit includes a safety interlock relay 82 which consists of an actuating coil 83 and a single pole single throw switch 84, the switch blade of which is normally spring-biased to closed position. The holding coil 83 is parallel across the common lead to the main motor 13 and magnetic clutch 46 and the switch 84 is in series with the die-return motor 52.

In use, the operator manually inserts the swaged or pointed end of a length of tubing stock *t* through the drawing die 57 and engages it between the gripper jaws 66, 67, with the gripper arm 60 swung outwardly and the drum 31 rotated to the position shown in Figure 4. A slight tightening pull either on the gripper arm 60 or backwardly upon the tubing *t* will serve to pull the gripper jaws 66, 67, along the converging slots 62, 63, and tighten them upon the pointed end of the tubing *t*. Thereupon, the operator manually presses the main switch button 74 closing the main relay 77 and energizing both the main motor 13 and the magnetic clutch 46. Since the slide-block 39 is in its lowermost position and the boss 70 is in engagement against the actuating arm 69 of the lower limit switch 68, this latter switch is held open. Thus, the circuit to the die-return motor 52 is open and the die-return motor 52 is accordingly not energized. Immediately upon closing the main relay 77, however, the holding coil 83 of the safety interlock relay 82 is energized, opening the switch 84 and doubly assuring that the circuit to the die-return motor 52 will remain open so that the die-return motor 52 will not be energized while the relay 77 is closed. As the motor 13 takes up rotation, the shaft 21 is rotated simultaneously driving the drum 31 through the sprocket chain 26 and the driving member 47 of the magnetic clutch 46 through the sprocket chain 49. Since the magnetic clutch is also energized and hence coupled, the driven member 45 will also be rotated, thereby rotating the feed screw 40 and feeding the slide-block 39 upwardly in precisely timed relation to the rotation of the drum 31. As the drum 31 takes up rotation the gripper arm 60 will move from the position shown in Figure 4 to the position shown in Figure 5 in which the gripper jaw 66 lies within the recess 59 and the initial portion of the tubing *t* is thus laid precisely into the entrant portion of the groove 36.

The speed of rotation and pitch of the feed screw 40 is such that the drawing die 57 will ride upwardly in precise following relationship to the helical groove 36 so that as the drum 31 rotates and pulls the tubing *t* through the drawing disc 57 the oncoming portions of tubing will fall precisely in and follow the groove 36. Since the groove 36 is substantially semi-circular it will embrace the side walls of the tubing *t* as it bends around and conforms to the circularity of the drum 31, thereby preventing any distortion in the true circular cross-sectional shape of the tubing *t* and forcing the tubing *t* to lie in closely contiguous uniform turns or convolutions.

The vertical height of the drum 31 and the number of convolutions in the groove 36 are ordinarily selected so that the drum 31 will more than accommodate the usual lengths of tubing to be drawn. Thus, in the ordinary run of operations the entire length of the tubing *t* will be drawn through the drawing die 57 before the drum is entirely filled up. As soon as the final portion of the tubing *t* passes beyond the mouth 57' of the drawing die 57 the tension will immediately be released and the tubing will spring outwardly uncoiling itself somewhat, thereby releasing the drawing tension on the gripper jaws

66, 67. This release of tension will cause the gripper jaws 66, 67, to loosen their grip upon the tubing *t* and the entire coil will fall downwardly free of the drum 31 coming to rest upon the upper face of the base plate 5 from which it may be manually removed by the operator for further processing or handling. If the tubing *t* is to be drawn through a successive operation to further reduce its external diametral size it may be transferred to such further processing equipment or if the tubing is at its final and finished size it can be transferred to other parts of the plant and annealed, inspected, packaged or otherwise handled in such conveniently coiled form.

As soon as the tubing drops free the operator may press the stop-switch button 76, thereby opening the circuit to the hold-in coil 78 of the relay 77 and causing the relay 77 to drop out, breaking the circuit to the motor 13 and magnetic clutch 46. Thereupon, the operator may press the die-return switch button 75, closing the circuit to the die-return motor 52. The opening of the relay 77 will deenergize the hold-in coil 83 of the safety interlock relay 82, thereby allowing the switch 84 to close so that the circuit to the die-return motor 52 will be fully completed upon closure of the relay 79 and the die-return motor 52 will become energized and rapidly rotate the feed screw in the reverse direction. Since the magnetic clutch is de-energized, the driven member will be uncoupled from the driving member 47 and the feed screw 40 will be completely under the control of the motor 52, thereby shifting the slide-block 39 downwardly to initial or starting position. As soon the slide block 39 reaches its lowermost position the lower limit switch 68 will be actuated opening the circuit to the hold-in coil 80 of the die-return relay 79 causing this relay to drop out and break the circuit to the die-return motor 52. The opening of this circuit is closely timed so that the slide-block 39 will, at this moment, come to rest gently upon the upper face of the bracket plate 42 in substantially precise alignment with the lowermost or entrant portion of the groove 46 of the drum 31 and the machine A will be in position for the next drawing operation.

If, for any reason, an unusually long section of tubing is being drawn so that the entire length of the groove 36 is filled and the slide-block is still moving upwardly, then the boss 70 will engage the actuating lever 72 of the upper limit switch 71, thereby opening the circuit through the hold-in coil of the main relay 77 in the same manner as would have been accomplished if the operator had, himself, pressed the stop-switch button 76.

It will be understood that the machine A may be adapted for drawing any particular diameter of tubing by changing the drawing die 57 and the drum 31. Since the speed of upward travel of the slide-block 39 must be different from each different size of pipe being drawn the sprockets 23, 25, 27, must be changed appropriately so that the speed of rotation of the drum 31 and the upward rate of travel of the slide-block 39 will be properly related to each other. In other words, there will be a set of tools for each particular diametral size including a drum 31, drawing die 57, and companion sprockets 23, 25, 27.

It should be understood that changes and modifications in the form, construction, arrangement, and combination of the several parts of the bull-block may be made and substituted for those herein shown and described without departing from the nature and principle of our invention.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. A bull-block for drawing ductile tubing and the like comprising a base, a frame, driving means associated with the base, a drum operatively mounted for rotation upon the frame and drivingly connected to the driving means, said drum being provided on its peripheral face with a continuous helical groove, a slide-block shiftably mounted on the frame for movement along a path spaced outwardly from the drum and parallel to

the axis of rotation thereof, a drawing die carried by the slide-block, a feed-screw journaled at its ends in outwardly spaced parallel relation to the axis of the drum and being threadedly engaged in the slide-block, and driving means for rotating the screw whereby to cause the slide-block to travel along its path in timed relation to the rotation of the drum at a speed which is matched to the pitch of the helical groove.

2. A bull-block for drawing ductile tubing and the like comprising a base, a frame, driving means associated with the base, a drum operatively mounted for rotation upon the frame and drivingly connected to the driving means, said drum being provided on its peripheral face with a continuous helical groove of arcuate cross-sectional contour conforming in shape to a segment of the external cross-sectional shape of the tubing being drawn so as to fit snugly up around and substantially support said tubing during drawing operations whereby to prevent cross-sectional deformation of said tubing as it is being drawn, a slide-block shiftably mounted on the frame for movement along a path spaced outwardly from the drum and parallel to the axis of rotation thereof, a drawing die carried by the slide-block, a feed-screw journaled at its ends in outwardly spaced parallel relation to the axis of the drum and being threadedly engaged in the slide-block, and driving means for rotating the screw whereby to cause the slide-block to travel along its path in timed relation to the rotation of the drum at a speed which is matched to the pitch of the helical groove.

3. A bull-block for drawing ductile tubing and the like comprising a base, a frame, driving means associated with the base, a drum operatively mounted for rotation upon the frame and drivingly connected to the driving means, said drum being provided on its peripheral face with a continuous helical groove of semi-circular cross-sectional contour conforming in shape to a segment of the external cross-sectional shape of the tubing being drawn so as to fit snugly up around and substantially support said tubing during drawing operations whereby to prevent cross-sectional deformation of said tubing as it is being drawn, a slide-block shiftably mounted on the frame for movement along a path spaced outwardly from the drum and parallel to the axis of rotation thereof, a drawing die carried by the slide-block, a feed-screw journaled at its ends in outwardly spaced parallel relation to the axis of the drum and being threadedly engaged in the slide-block, and driving means for rotating the screw whereby to cause the slide-block to travel along its path in timed relation to the rotation of the drum at a speed which is matched to the pitch of the helical groove.

4. A bull-block for drawing ductile tubing and the like comprising a base, a frame, driving means associated with the base, a drum operatively mounted for rotation upon the frame and drivingly connected to the driving means, said drum being provided on its peripheral face with a continuous helical groove of semi-

circular cross-sectional contour conforming in shape to a segment of the external cross-sectional shape of the tubing being drawn so as to fit snugly up around and substantially support said tubing during drawing operations whereby to prevent cross-sectional deformation of said tubing as it is being drawn, a slide-block shiftably mounted on the frame for movement along a path spaced outwardly from the drum and parallel to the axis of rotation thereof, a drawing die carried by the slide-block, slide-block traversing means for sliding the slide-block along its path in timed relation to the rotation of the drum, first slide-block driving means for operating the slide-block traversing means outwardly along its path from an initial position during a drawing operation, second slide-block driving means for returning the slide-block to initial position after conclusion of a drawing operation, and means for alternatively connecting the first and second slide-block driving means to the slide-block traversing means.

5. A bull-block for drawing ductile tubing and the like comprising a base, a frame, driving means associated with the base, a drum operatively mounted for rotation upon the frame and drivingly connected to the driving means, said drum being provided on its peripheral face with a continuous helical groove conforming in shape to a segment of the external cross-sectional shape of the tubing being drawn so as to fit snugly up around and substantially support said tubing during drawing operations whereby to prevent cross-sectional deformation of said tubing as it is being drawn, the convolutions of said groove being closely contiguous, a slide-block shiftably mounted on the frame for movement along a path spaced outwardly from the drum and parallel to the axis of rotation thereof, a drawing die carried by the slide-block, a feed-screw journaled at its ends in outwardly spaced parallel relation to the axis of the drum and being threadedly engaged in the slide-block, and driving means for rotating the screw whereby to cause the slide-block to travel along its path in timed relation to the rotation of the drum at a speed such that, for each full revolution of the drum, the slide-block will advance along its path by a distance substantially equal to the axial distance between two adjacent convolutions of the groove.

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