

July 12, 1966

L. D. MERSEK

3,260,085

WIRE DRAWING APPARATUS

Filed Aug. 2, 1962

5 Sheets-Sheet 1

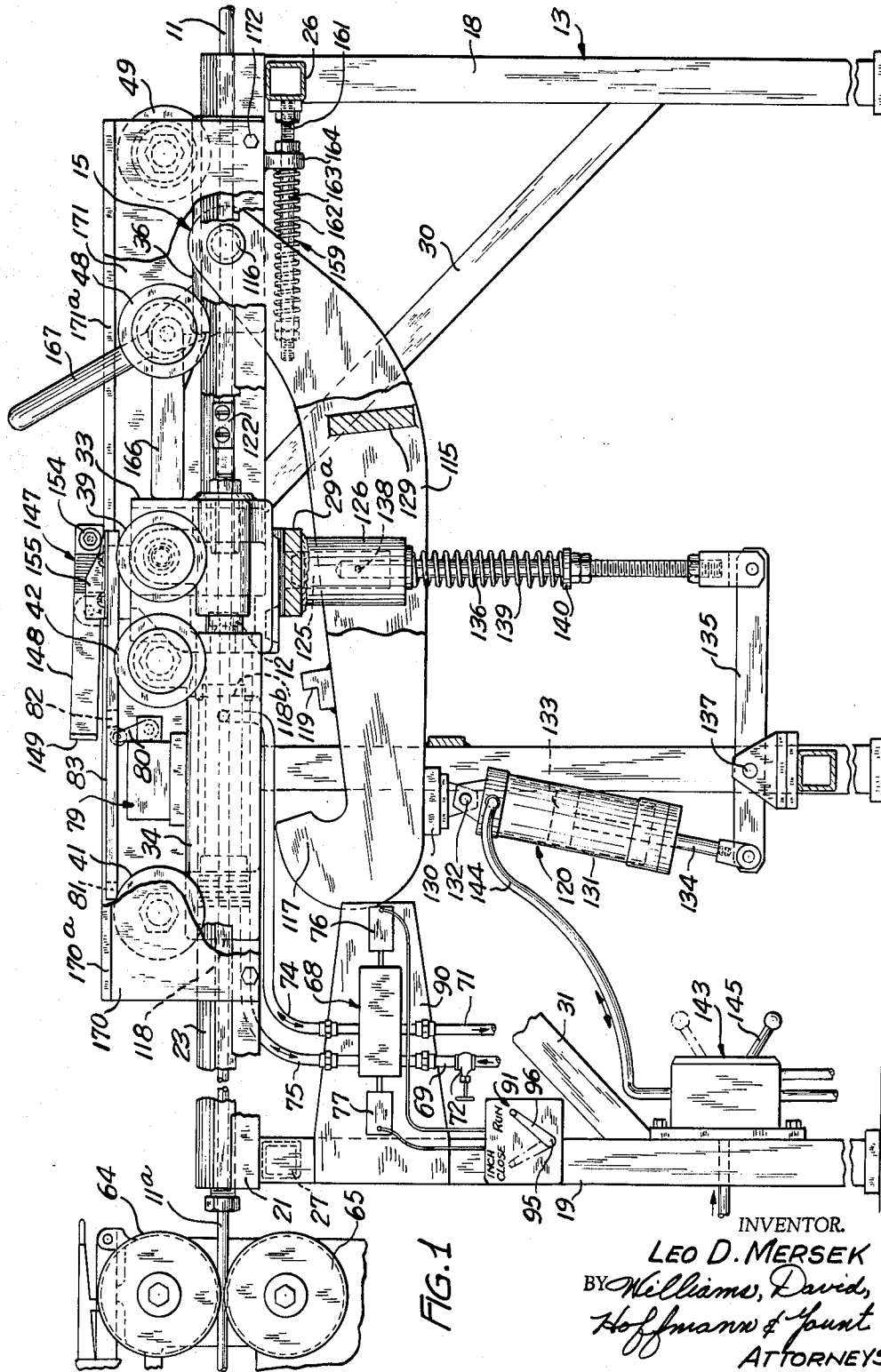


FIG. 1

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5 Sheets-Sheet 2

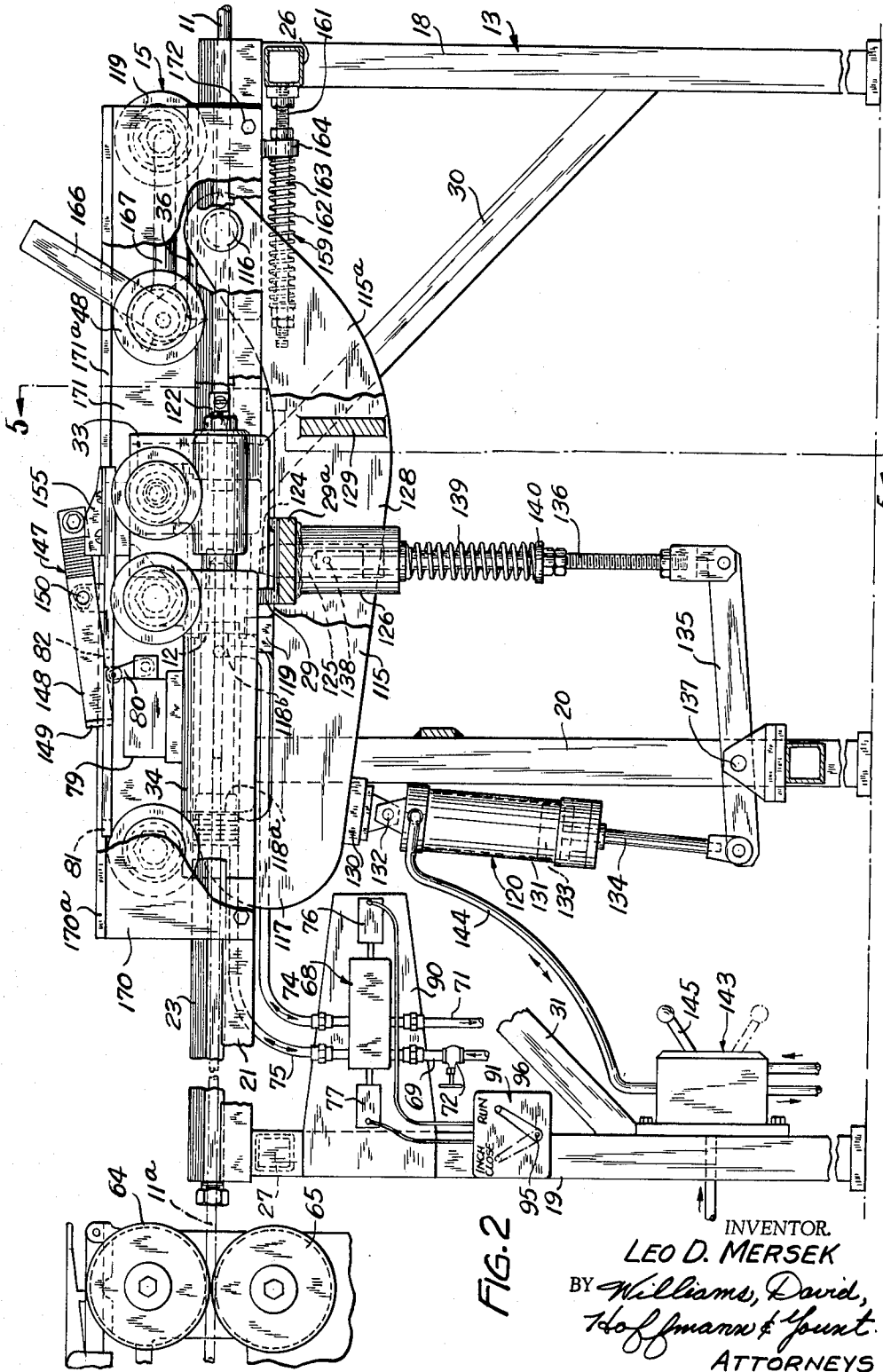


FIG. 2

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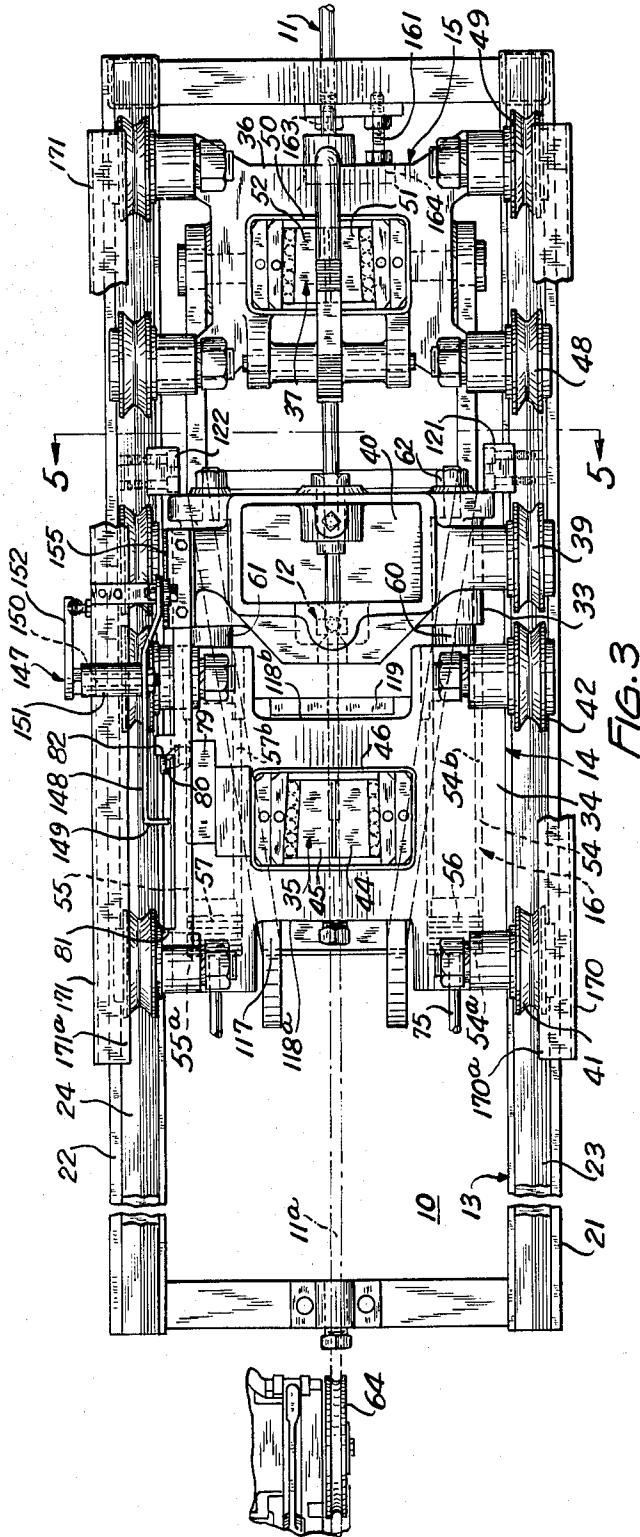
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WIRE DRAWING APPARATUS

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5 Sheets-Sheet 3



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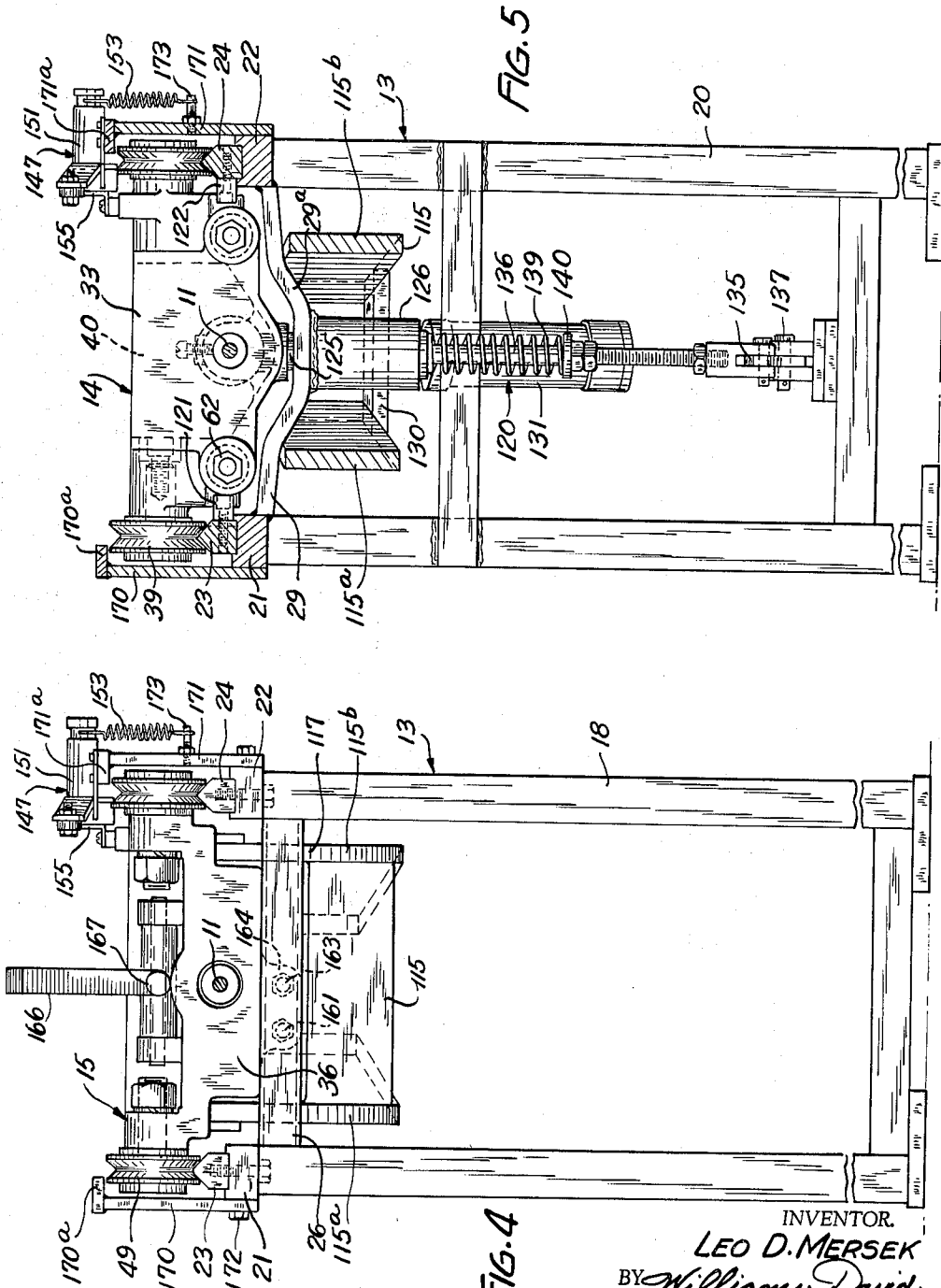
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WIRE DRAWING APPARATUS

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5 Sheets-Sheet 4



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WIRE DRAWING APPARATUS

Filed Aug. 2, 1962

5 Sheets-Sheet 5

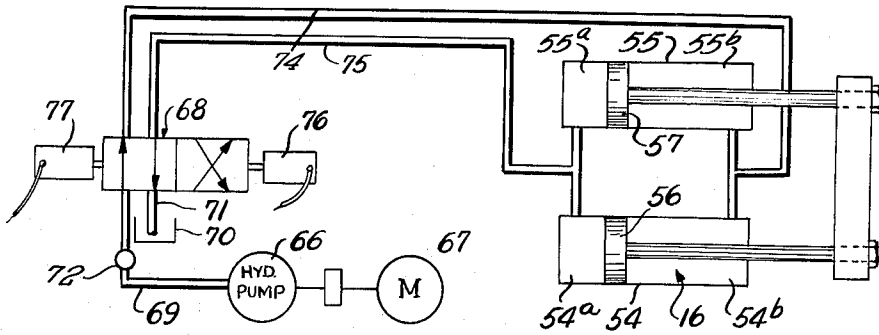


FIG. 6

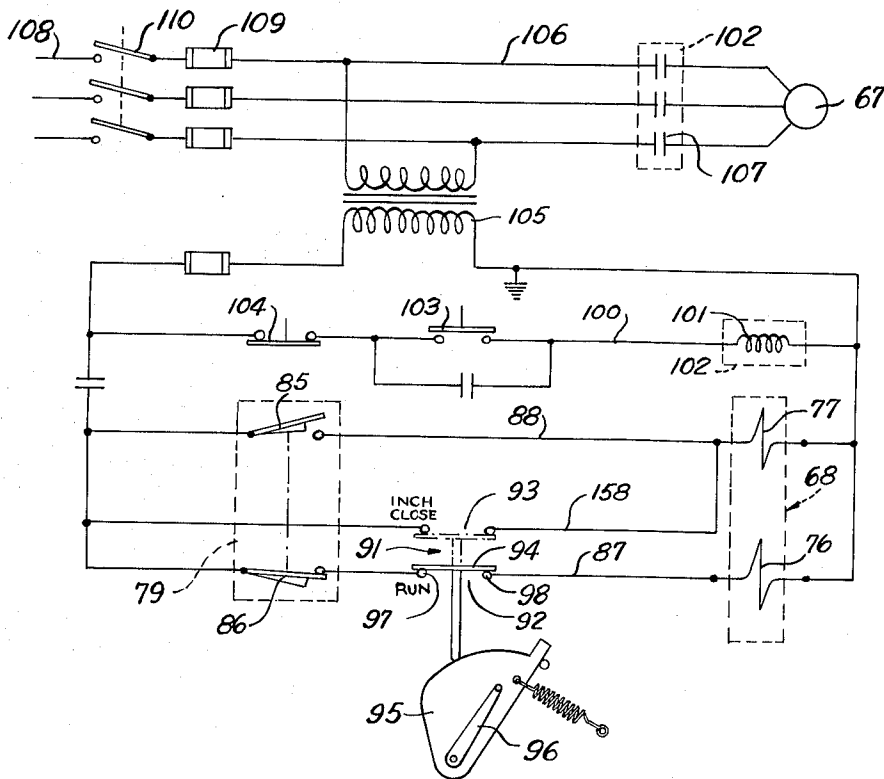


FIG. 7

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3,260,085

WIRE DRAWING APPARATUS

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Filed Aug. 2, 1962, Ser. No. 214,292
29 Claims. (Cl. 72-20)

This invention relates to apparatus for drawing linear stock, such as bar, rod and wire stock, which are all referred to herein merely as wire, and more particularly to drawing apparatus of the reciprocating type and embodying inching means for starting the stock through the drawing die.

My earlier application Serial No. 191,770 filed May 2, 1962 discloses wire drawing apparatus of the reciprocating type in which a power means for producing a succession of drawing strokes is embodied directly in the drawing unit. The drawing apparatus of the earlier application is described therein as being usable in conjunction with an associated mechanism or fabricating machine to which the drawn wire is supplied directly and at substantially the rate of production thereof. The apparatus of the present application is intended for a similar use but is more versatile and more capable of substantially continuous operation, because of the inching means embodied therein.

An object of the present invention is to provide novel wire drawing apparatus of the reciprocating type comprising such a drawing unit embodying a power means, and an inching means for starting the wire through the drawing die and actuatable by the power means of the drawing unit.

Another object is to provide novel wire drawing apparatus of the kind above referred to wherein the drawing unit comprises a drawing die and a drawing grip device as relatively axially movable components, and wherein the power means embodied in the drawing unit for actuating the same is usable to actuate an associated inching means upon operative connection of the latter with an appropriate one of the components of the drawing unit.

Still another object is to provide novel wire drawing apparatus comprising a drawing unit having a fluid pressure responsive reciprocable power means embodied therein for supplying the power for the drawing, and an inching means associated with the drawing unit in a manner to be detachably connected with the drawing grip component for actuation by the power means of the drawing unit.

Additionally, this invention provides novel wire drawing apparatus comprising a drawing unit, an inching means for starting the wire through the die of the drawing unit, a fluid pressure responsive power means embodied directly in the apparatus and common to the drawing unit and the inching means, and means for relating the functioning and control of the power means appropriately to the drawing unit or the inching means as may be desired.

Other objects, novel characteristics and advantages of this invention will be apparent in the following detailed description and in the accompanying drawings forming a part of this specification and in which,

FIG. 1 is a side elevation of the novel wire drawing apparatus of this invention showing the same with por-

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tions broken away and with the apparatus in a condition for a normal performance of the drawing operation, the inching means being shown disconnected from the drawing unit;

FIG. 2 is a side elevation similar to that of FIG. 1 but showing the inching means connected with the drawing unit and in readiness for the inching operation;

FIG. 3 is a top plan view of the apparatus in the condition shown in FIG. 2;

FIG. 4 is an end elevation of the apparatus as viewed from the wire-entry end of FIG. 2 thereof;

FIG. 5 is a transverse vertical section through the apparatus taken on section line 5-5 of FIGS. 2 and 3;

FIG. 6 is a diagram of the hydraulic fluid supply system for the power means of the drawing unit; and

FIG. 7 is a schematic diagram of the electrical system of the apparatus.

As one practical embodiment of this invention, the accompanying drawings show wire drawing apparatus 10 in which wire stock 11 is reduced by a drawing die 12 and in which an inching operation is also accomplished for starting the wire through the die. The drawing apparatus 10 comprises, in general, a support structure in the form of frame means 13, a drawing unit 14 supported by the frame means for movement thereon during the drawing operation, and an inching means 15 for carrying out the inching operation for starting the wire 11 through the die 12. The apparatus 10 also includes power means 16 common to the drawing unit 14 and the inching means 15 and which is here shown as being located on the drawing unit and comprising a hydraulic pressure responsive power means.

The frame means 13 is shown as having support legs 18 at the wire-entry end of the apparatus and support legs 19 at the wire-exit end of the apparatus. Intermediate support legs 20 are provided at a point between the end legs 18 and 19. The frame means 13 includes a top portion supported by the legs 18, 19 and 20 and comprising laterally spaced longitudinal side members 21 and 22 (see FIGS. 4 and 5) supporting a pair of longitudinal rails 23 and 24.

The end legs 18 and 19 includes cross members 26 and 27 adjacent the top thereof and, for a purpose to be explained hereinafter, the frame means 13 is provided with a transverse plate member 29 whose ends are secured to the side members 21 and 22 at an intermediate point of the length of the latter as shown in FIG. 4. The frame 13 also includes suitable bracing for the legs such as the inclined brace members 30 and 31 connected with the end legs 18 and 19. When the power means 16 is embodied in the drawing unit 14 as referred to above, the frame means 13 can be of the relatively light construction shown in the drawings because very little, if any, of the operating thrust of the power means is transmitted to the frame means.

The drawing unit 14 comprises, as a pair of relatively movable drawing components, a first mount 33 having the drawing die 12 located thereon, and a second mount 34 having a drawing grip device 35 located thereon. The inching means 15 comprises a third mount 36 movable along the frame means 13 and an inching grip device 37 on such third mount.

The first mount 33, which is at times referred to herein as the die mount, is provided with grooved wheels 39 on laterally opposite sides thereof which are supported

by, and operate on, the rails 23 and 24. The die mount is constructed of a shape so as to have a lubricant chamber 40 therein for holding a supply of lubricant adjacent the drawing die 12.

The second mount 34, which is sometimes referred to herein as the drawing grip mount, is provided at opposite sides thereof with pairs of grooved wheels 41 and 42 which likewise are supported by, and operate on, the rails 23 and 24. The drawing grip device 35 is of a conventional form comprising a pair of grip blocks 44 and 45 (see FIG. 3) located in a grip box 46 provided on the second mount. The grip blocks 44 and 45 are suitably tapered on the remote sides thereof and are disposed in the grip box 46 so as to be subject to wedging actuation thereof for automatically gripping the wire 11. The gripping of the wire 11 prevents backward movement thereof, that is, movement toward the right in FIG. 3, during the drawing operation to be described hereinafter. The grip blocks 44 and 45 automatically release the wire 11 for a forward movement thereof between the blocks and in a direction toward the left of FIG. 3. Movement of the drawing grip mount 34 toward the right while the wire 11 is stationary will likewise automatically release the gripping action of the blocks 44 and 45 on the wire.

The third mount 36, which is sometimes referred to herein as the inching mount, is provided on laterally opposite sides thereof with pairs of grooved wheels 48 and 49 which are supported by, and operate on, the rails 23 and 24. The inching mount 36 is constructed to embody a grip box 50 in which the inching grip device 37 is located. This grip device is of a conventional form comprising a pair of grip blocks 51 and 52 between which the wire 11 passes.

The grip blocks 51 and 52 are suitably tapered on the remote sides thereof and are disposed in the grip box 50 so as to be automatically effective to grip the wire 11 upon movement of the mount 36 toward the left along the frame means 13 through an inching stroke, as will be explained in detail hereinafter. The gripping action of the blocks 51 and 52 is automatically released during return movement of the mount 36 toward the right along the frame means 13, and also during advance movement of the wire 11 through the grip box 50 while the mount 36 is stationary.

The power means 16 comprises a pair of laterally spaced cylinders 54 and 55, provided on the drawing grip mount 34 on laterally opposite sides of the grip box 46, and pistons 56 and 57 reciprocally operable in such cylinders. The cylinders 54 and 55 are double-acting cylinders having pressure chambers 54^a and 55^a therein on one side of the pistons 56 and 57 and pressure chambers 54^b and 55^b therein on the opposite side of the pistons.

A pair of piston rods 60 and 61 are connected with the pistons 56 and 57 and project from the cylinders 54 and 55 toward the inching means 15. The outer ends of the piston rods 60 and 61 are secured to the die mount 33 as by means of clamping nuts 62 applied to threaded extensions of such piston rods. Although the die mount 33 has only one pair of support rollers 39, it will be effectively held against rocking or tilting movements by the piston rods 60 and 61.

During the drawing operation performed by the drawing unit 14 the die mount 33 is moved toward the right by supplying pressure fluid to the cylinder chambers 54^a and 55^a whereby the drawing die 12 is pushed over and along the wire 11 to reduce the same while the wire is being held against backward movement by the drawing grip device 35. The drawing traverse of the die 12 along the wire 11 in the direction and manner just described is therefore produced by a relative opening movement between the mounts 33 and 34. A subsequent relative closing movement between the mounts 33 and 34 is produced by supplying pressure fluid to the cylinder chambers 54^b and 55^b and exhausting the previously supplied fluid from the chambers 54^a and 55^a, whereby the draw-

ing grip mount 34 is moved toward the right toward the die mount 33. This closing or return movement of the mount 34 relative to the mount 33 is permitted by the drawing grip device 35 inasmuch as this movement of the mount 34 is accompanied by an automatic release by the blocks 44 and 45 of their gripping engagement with the wire.

From what has been described above as to the opening and closing relative movements between the mounts 33 and 34 of the drawing unit 14, it will be recognized that these mounts move alternately during the drawing operation and in a direction along the wire 11 toward the right so as to have an action which is akin to a crawling movement. It should also be explained, however, that the drawn wire 11^a is supplied to a fabricating machine or the like by a pair of driven feed rolls 64 and 65 of a conventional form which grip the drawn wire and advance the same into die mechanism of such an associated fabricating machine. The fabricating machine is here represented only by the feed rolls 64 and 65 although, if desired, these feed rolls can be a part of the drawing apparatus 10.

While the opening and closing movements just described above for the mounts 33 and 34 of the drawing unit 14 are taking place the drawn wire being produced is, at the same time, being advanced by the feed rolls 64 and 65. Therefore, although the drawing unit 14 exhibits a tendency during the drawing operation to crawl along the wire 11 toward the right, the wire and the drawing unit are at the same time being advanced toward the left by the feed rolls 64, 65. The resultant action of the apparatus 10 is that the drawing unit 14 operates along a limited portion of the length of the frame means 13, and any tendency for the drawing unit to move in one direction or the other out of such limited operating location, will be the result of either a too-rapid or too-slow rate of operation of the drawing unit in producing the drawn wire 11^a in relation to the rate of feeding thereof by the feed rolls 64, 65. Any such tendency for the drawing unit 14 to move out of its proper range of operation on the frame means 13 can accordingly be counteracted by suitably reducing or increasing the supply of pressure fluid to the cylinders 54 and 55.

The drawing apparatus 10 includes hydraulic pressure fluid supply and control means for the cylinder 54 and 55 by which the desired operation of the power means 16 is achieved. The hydraulic fluid supply means includes a suitable pump 66 (see FIG. 6) driven by an electric motor 67 and which delivers pressure fluid to the cylinders 54 and 55 in properly timed relation through a solenoid valve device 68. The pump 66 is connected with the solenoid valve device 68 by a discharge conduit 69 and has its intake connected with, or located in, a reservoir 70 into which fluid returning from the cylinders 54 and 55 is discharged by the solenoid valve device through an exhaust conduit 71. A suitable control valve 72 is provided in the conduit 69 for varying the amount of hydraulic fluid being supplied to the power means 16 for controlling the rate of production of the drawn wire 11^a, as referred to above.

The solenoid valve device 68 is connected with the pressure chambers of the cylinders 54 and 55 by combined delivery and return conduits 74 and 75 and operates as a reversing valve device for the flow of fluid to and from the pressure chambers. The solenoid valve device 68 includes actuating solenoids 76 and 77 which are selectively energizable for producing the flow-reversing functioning of this device.

The relative opening and closing movements of the mounts 33 and 34 of the drawing unit 14 are produced automatically during the drawing operation by controlling the selective energization of the solenoids 76 and 77 of the solenoid valve device 68. This energization control is accomplished by a limit switch device 79 located on the drawing grip mount 34 for movement with the latter.

The switch device 79 includes a swingable actuating arm 80 which projects into the path of movement of a pair of stops 81 and 82 formed on a control plate 83 which is connected with the die mount 33 and movable therewith. The control plate 83 extends longitudinally of the frame means 13 so as to be movable above and across the limit switch device 79.

The limit switch device 79 contains two electric switches 85 and 86 (see FIG. 7) and is what can be conveniently called a neutral position switch device inasmuch as the two electric switches 85 and 86 normally tend to assume an open-switch position. The switches 85 and 86 are actuable by the actuating arm 80 so that swinging of this arm in one direction by engagement with one of the stops 81, 82 will cause closing of one of these switches and swinging of the arm in the opposite direction will cause closing of the other switch. When one of the switches 85, 86 is closed by such swinging of the arm 80, the other of the two switches is simultaneously opened. The switches 85 and 86 are located in energizing circuits 87 and 88 which are the circuits respectively of the solenoids 76 and 77 of the solenoid valve device 68.

The solenoid valve device 68 is located at a suitable point of the apparatus 10, such as on a bracket plate 90 projecting from one leg of the end legs 19, and is in a position clear of all other moving parts of the apparatus.

The control means of the apparatus 10 also includes a manually operable selector switch device 91 suitably located on the frame means 13 adjacent the solenoid valve device 68. The selector switch device 91 embodies a pair of switches 92 and 93 (see FIG. 7), which have a common movable switch member 94 movable relative to these two switches to either of two circuit-closing positions, as by actuator means 95 which includes a swingable handle 96. The switch member 94 is normally in switch-closed engagement with a pair of contacts 97 and 98 of the switch 92 by reason of the handle 96 being spring biased toward a setting designated by the word "Run" as shown in FIGS. 1 and 7. When the handle 96 is in this "Run" position, the switch 92 is closed to enable the solenoid valve device 68 to perform its normal functioning in controlling the drawing operation of the apparatus 10 but, when this switch member is moved to open the switch 92 and close the switch 93, it alters the condition of the solenoid switch device 68 to suit the needs of the apparatus for carrying out the inching operation to be described hereinafter.

The control mechanism of the drawing apparatus 10 includes, in addition to the control circuits of the solenoid valve device 68, a control circuit 100 for controlling the electric motor 67 which drives the hydraulic pump 66. The circuit 100 contains the magnet coil 101 of a starting relay 102 for the motor 67, and also contains manually operable starting and stopping switches 103 and 104 for starting and stopping the motor. Electric current for energizing the circuits 87 and 88 of the solenoid switch device 68 and the circuit 100 of the motor control relay 102 is supplied as by a suitable transformer 105. A main energizing circuit 106 is provided for the motor 67 and contains the contacts 107 of the motor control relay 102. The main energizing circuit 106 is connected with a power supply line 108 through fuses 109 and a suitable disconnect switch 110.

During the wire drawing operation of the apparatus 10, as described above, the apparatus is in the condition shown in FIG. 1 and the manually operable selector switch device 91 has the handle 96 thereof at the "Run" setting corresponding with the closed condition of the switch 92 of this device. It can be assumed that the wire 11 has already been started through the drawing die 12 and that a drawn portion 11^a of the wire extends through the drawing grip device 35 and is being gripped by the feed rolls 64 and 65 and that the down wire is being fed, or is about to be fed, to the associated fabricating machine. Under these conditions the apparatus 10

is ready to perform its normal drawing operation and will do so upon manual closing of the starting switch 103 for the electric motor 67.

During the normal wire drawing operation performed by the apparatus 10 the co-operation of the swingable arm 80 of the limit switch device 79 with the two control stops 81 and 82 will cause the desired functioning of the solenoid valve device 68 for supplying hydraulic fluid to the pressure chambers 54^a, 55^a and 54^b, 55^b in the properly timed relation to produce the above-described opening and closing relative movements between the mounts 33 and 34 of the drawing unit 14. The drawn wire 11 will be fed by the feed rolls to the associated fabricating machine at the rate required by the latter and which will be substantially the rate of production of the drawn wire by the drawing apparatus 10.

To prepare apparatus 10 for the normal wire drawing operation explained above, it is necessary to start the wire 11 through the drawing die 12 by a short-stroke inching procedure and to advance the drawn portion 11^a of the wire beyond the drawing die far enough to be gripped by the drawing grip device 35. The inching means 15, which will now be further described, permits this to be readily accomplished by the use of the power means 16 whose functioning has already been described in connection with the drawing operation performed by the drawing unit 14.

The drawing apparatus 10 includes thrust transmitting means for connecting the inching mount 36 with the power means 16 of the drawing unit 14 and which transmitting means is here shown as comprising a swingable link 115. The link 115 has one end thereof connected with the inching mount 36 by pivot means 116 and, at the other end, is provided with a hook-shaped portion 117 for engagement with a thrust portion 118^a of the drawing grip mount 34. The link 115 is shown in FIG. 1 in its ineffective position, which is a lowered position that it occupies during the normal wire drawing operation of the apparatus 10. The link 115 is shown in FIG. 2 in its effective position for the inching procedure and which is a lifted position.

When the hook portion 117 is in engagement with the thrust portion 118^a, a movement of the mount 34 toward the left will cause a pulling force to be transmitted by the link 115 to the inching mount 36 for an inching stroke of the latter, as is further explained hereinafter. An abutment bar 119 provided on the link 115 engages another thrust portion 118^b on the mount 34 when the link is in its effective position of FIG. 2 for causing a pushing force to be transmitted by the link to the inching mount 36 for the return stroke movement of the latter.

The link 115 is vertically swingable from its ineffective lowered position of FIG. 1 to its effective elevated position of FIG. 2 by a cylinder device 120 which is here shown as being a single-acting pneumatic cylinder device. The cylinder device 120 is a dual-purpose device and is also used for locking the die mount 33 in a stationary position on the frame means 13 for the inching procedure. The proper position of the die mount 33 on the frame means 13 for the inching procedure is with this mount in engagement with a pair of stops 121 and 122 secured on the rails 23 and 24.

When the die mount 33 is in engagement with the stops 121 and 122, as shown in FIGS. 2 and 3, a portion of this mount containing a locking recess 124 will be located immediately above a portion of the transverse plate member 29 of the frame means 13. A locking plunger 125 is engageable in the recess 124 for maintaining the die mount 33 in the inching position in engagement with the stops 121 and 122. The locking plunger 125 is actuable by the cylinder device 120 and is slidable in a guide member 126 which is secured on the plate member 29 in a depending relation thereto as shown in FIGS. 1 and 2.

The link member 115 is of a forked shape comprising a

pair of laterally spaced side members 115^a and 115^b so as to provide an opening 128 between such side members to accommodate the guide member 126. As shown in FIG. 5, the plate member 29 includes a downwardly deflected intermediate portion 29^a which dips partway into the opening 128 of the link 115. The side members 115^a and 115^b of the link 115 are connected by suitable cross bars 129 and 130 located on opposite sides of the guide member 126.

The cylinder device 120 comprises a cylinder member 131 whose upper end is connected with the crossbar 130 of the link 115 by a pivot member 132. A piston 133 operable in the cylinder member 131 is carried by a piston rod 134 which projects from the lower end of the cylinder member and is operably connected with the locking plunger 125 through a pivot lever 135 and a thrust rod 136. The lever 135 is fulcrumed on the intermediate leg 20 of the frame means 13 by a pivot pin 137.

The upper end of the thrust rod 136 extends into the guide member 126 and is connected with the locking plunger 125 as by means of a transverse pin 138. A compression spring 139 is disposed around the thrust rod 136 and has its upper end seated against the guide member 126 and its lower end engaged with a seat 140 which is adjustable on the thrust rod 136 for varying the compression of the spring. The spring 139 normally urges the locking plunger 125 in a downward direction to an unlocking position for the die mount 33 and, at the same time, normally urges the piston 133 in an upward direction in the cylinder member 131 toward a retracted position therein corresponding with the lowered or ineffective position of the link 115 as shown in FIG. 1.

The operation of the cylinder device 120 is controlled by a manually operable selector valve device 143 which is suitably mounted on the frame structure 13 such as on the end leg 19. The selector valve device 143 is connected with the upper end of the cylinder member 131 by a flexible conduit 144 through which air pressure is supplied to, and exhausted from, the cylinder device 120.

The selector valve device 143 includes a handle 145 by which this device can be actuated to cause air pressure to be supplied to, or exhausted from, the cylinder device 120. When the handle member 145 is swung to its full-line upper position, as shown in FIG. 2, pressure is supplied to the cylinder member 131 to cause lifting of the link 115 to its effective position for the inching operation and to simultaneously cause the locking plunger 125 to engage in the locking recess 124 of the die mount 33. The handle member 145 is left in its full-line upper position throughout the inching operation but, when it is swung to its full-line downward position shown in FIG. 1, the exhausting of air pressure from the cylinder member 131 permits the spring 139 to retract the locking plunger 125 from the recess 124. The spring 139 simultaneously causes an upward return relative movement of the piston 133 in the cylinder member 131 which permits lowering of the link 115 to its ineffective position by the action of gravity thereon.

The movement of the drawing unit 14 toward the right on the frame means 13 by which the die mount 33 is brought into engagement with the stops 121 and 122 can be achieved by manually shoving the drawing unit along the rails 23 and 24 or, if desired, the rails can be sloped downward to cause or facilitate this movement of the drawing unit. Before the link 115 can be lifted to its effective position of FIG. 2 for the desired co-operative thrust engagement of the hook portion 117 thereof with the mount 34, it is necessary that the drawing grip mount 34 be moved to a position in a relatively closed relation to the die mount 33. This is accomplished by manual actuation of the above-described selector switch device 91 to close the switch 93 and simultaneously open the switch 92. This is accomplished by swinging the handle 96 to the position designated "inch close" in FIGS. 1 and 2.

The movement of the handle 96 to this position results in actuation of the solenoid valve device 68 in a manner to supply hydraulic fluid to the pressure chambers 54^b and 55^b and to exhaust the fluid from the chambers 54^a and 55^a. The delivery of hydraulic fluid to the pressure chambers 54^b and 55^b, while the die mount 33 is locked in a stationary position in engagement with the stops 121 and 122, causes movement of the drawing grip mount 34 toward the right to its fully-closed position relative to the die mount. The mount 34 is shown in FIGS. 2 and 3 in this fully closed position which then permits the link 115 to be elevated to its effective position.

For the control of the inching movement of the inching means 15 the drawing apparatus 10 is provided with an inching control 147 by which the power means 16 of the drawing unit 14 can be operated with a relatively shortened reciprocating stroke. Such a shortened stroke is needed for the inching procedure so as to prevent buckling of the wire 11 while it is being forced into and through the drawing die 12 by the inching grip device 37 of the inching mount 36. The inching control means 147 comprises a swingable lever 148 having a stop 149 on the free end thereof and which stop is movable, by a swinging of this lever, to an effective position intermediate the two previously described stops 81 and 82.

The lever 148 is rockable on a pivot 150 which is mounted in a sleeve bearing 151 of a suitable bracket secured on the frame means 13. The lever 148 is normally urged toward an upwardly swung position, as shown in FIG. 1, for lifting the stop 149 to an elevated ineffective position. This is accomplished by providing the pivot 150 with a lever arm 152 with which a tension spring 153 is connected as shown in FIGS. 4 and 5. The downward swinging of the lever 148, by which the stop 149 is moved to its effective lowered position, is accomplished by the engagement of a roller 154 with a cam member 155.

The cam member 155 is secured on the die mount 33 and the roller 154 is mounted on the lever 148 on the side of the pivot 150 remote from the stop 149. The location of the mounting pivot 150 for the lever 148 is such that, when the die mount 33 has been moved to its inching position in engagement with the stops 121 and 122, the cam member 155 will be located under and engage the roller 154. Lifting of the roller 154 by the cam member 155 will swing the lever 148 in a counter-clockwise direction to thereby lower the stop 149 to its effective position between the stops 81 and 82. When the stop 149 has been thus lowered to its effective position it will be engageable by the arm 80 of the limit switch device 79 instead of the stop 81 and this will result in the achievement of the shortened operating stroke of the power means 16.

From the construction of the wire drawing apparatus 10 as above described it will now be understood that the preparation of the apparatus for the inching procedure involves steps to be performed in sequence. The lead end of the wire 11 is first advanced into the inching grip device 37 and the drawing unit 14 is shifted along the frame means 13 to engage the die mount 33 with the stops 121 and 122. The movement of the die mount 33 to this position causes lowering of the intermediate stop 149 to its effective position by the engagement of the cam 155 with the roller 154. The operator then shifts the handle 96 of the selector switch device 91 to the "inch close" position which results in energization of the solenoid 77 of the solenoid valve device 68 and de-energization of the solenoid 76. Hydraulic fluid is thereupon supplied to the pressure chambers 54^b and 55^b for causing the drawing grip mount 34 to be moved to its closed position relative to the die mount 33.

While the handle 96 of the selector switch device 91 is being maintained in the "inch close" position, the operator shifts the handle 145 of the selector valve device

143 to its upper position shown in FIG. 2 whereupon air pressure is supplied to the cylinder device 120 to simultaneously actuate the locking plunger into holding engagement with the die mount 33 and to lift the link 115 to connect the inching mount 36 for actuation by the power means 16 of the drawing unit 14. As soon as the link 115 has been thus fully engaged in its effective position, the operator returns the handle 96 of the selector switch device 91, or permits the same to return, to the "Run" position.

Thereupon the power device 16 is placed in reciprocating operation by hydraulic fluid supplied alternately to the pressure chambers 54^a, 55^a and 54^b, 55^b by the functioning of the solenoid valve device 68 under the control of the limit switch device 79. At this time the arm 80 of this limit switch device engages alternately with the stops 82 and 149 with the result that the inching mount 36 will be actuated with the above-mentioned relatively short inching strokes desired for pushing the wire 11 through the die 12 without buckling of such wire.

With respect to the selector switch device 91 it should be pointed out that, as shown in FIG. 7, the switch 93 thereof is located in a parallel circuit portion 158 which is in a shunt relation to the switch 85. Whenever the switch 93 is closed, a simultaneous opening of the switch 92 takes place as previously mentioned herein. The closed condition of the switch 93 causes energization of the solenoid 77 of the solenoid valve device 68 which is desirable for moving the drawing grip mount 34 to its closed position relative to the die mount 33, and this will then occur even though the switch 85 is in its open position. The opening of the switch 92 disables the solenoid 76 so that, when the drawing grip mount 34 is moved to its closed position relative to the die mount 33, it will remain in such closed position until the apparatus 10 has been fully prepared for the inching procedure.

When the handle 96 of the selector switch device 91 has been returned or has been permitted to return to the "Run" position, the switch 93 is opened and the switch 92 is simultaneously reclosed. The solenoid valve device 68 is thereby restored to its normal condition for reversing control operation and causes hydraulic fluid to be supplied to the power means 16 in a manner to produce reciprocation of the drawing grip mount 34. Inasmuch as the die mount 33 is being held stationary by the locking plunger 124, the only movement produced in the drawing unit 14 at this time will be a reciprocation of the mount 34 with which the inching mount 36 is then connected by the link 115. Each power stroke movement of the mount 34 toward the left as seen in FIG. 2, will produce an inching stroke of the mount 36 during which the inching grip 37 will push the lead end of the wire 11 a corresponding distance toward or through the drawing die 12.

During the power stroke movement of the mount 34 in the opposite direction, that is toward the right as seen in FIG. 2, the inching mount 36 will be moved through a corresponding return stroke by the above-mentioned pushing force imparted to the link 115 by the action of the mount 34 against the abutment bar 119. During this return stroke movement of the inching mount 36 the inching grip device 37 releases the wire 11 automatically and is moved therealong to a position at which it will again grip the wire during the next succeeding power stroke movement of the mount 34 toward the left. A spring means 159 is provided to normally hold the inching mount 36 in a parked position adjacent the end legs 18 of the frame means 13 when the inching means 15 is not being used. In its parked position the inching mount 36 is in engagement with a stop screw 161 of the frame means 13 as shown in FIG. 3.

The spring means 159 comprises a compression spring 162 supported by a rod 163 which is suitably anchored on the frame means 13 and along which a depending lug

164 of the inching mount 36 is freely movable. The spring 162 is effective against the lug 164 for urging the inching mount 36 toward its parked position in engagement with the stop screw 161.

When the inching operation has been completed and the drawing apparatus 10 is restored to its normal operating condition for drawing the wire 11, the operating location of the die mount 33 will then be in a spaced relation to the stops 121 and 122 and the cam 155 of the inching control means 147 will be disengaged from the roller 154. It is important that the cam 155 should not again engage the roller 154 until another inching procedure is to be carried out. In order to keep the cam 155 from engaging the roller 154 during the normal wire drawing operation of the apparatus 10, an abutment member 166 is provided on the inching mount 36 and is swingable to an effective lowered position shown in FIG. 1 by means of a handle 167.

The abutment member 166 is swung to its elevated position shown in FIG. 2 when the apparatus 10 is being prepared for the inching operation but, after the inching procedure has been completed, this member is swung to its effective lowered position shown in FIG. 1. The abutment member 166 is of a length so that its free end will be engaged by the die mount 33 before the cam 155 of the inching control 147 can engage the roller 154. Ordinarily the apparatus 10 operates in the drawing of wire without having the die mount 33 come into engagement with the abutment member 166, but the provision of this member on the inching means 15 insures a proper lifting of the stop 149 of the inching control 147 after the inching operation has been completed and prevents any unintentional lowering of the stop during the normal drawing operation of the apparatus.

Reverting to the description of the frame means 13 it is pointed out that upright longitudinal guard members 170 and 171 are provided in a covering and protective relation to the support wheels 39, 41, 42, 48 and 49 on the outer sides thereof. The guard members 170 and 171 are secured to the longitudinal top members 21 and 22 of the frame means 13 as by screws 172. Along the tops thereof the guard members 170 and 171 are provided with inwardly extending flanges 170^a and 171^a which serve as retainer members for preventing the wheels 39, 41, 42, 48 and 49 from lifting or jumping off of the rails 23 and 24. The guard member 171 also provides a mount for the bearing 151 of the inching control 147 and a mount for the anchor pin 173 of the tension spring 153.

From the accompanying drawings and the foregoing detailed description it will now be readily understood that this invention provides novel wire drawing apparatus of the reciprocating type having power means located directly in the drawing unit thereof and in which inching means, forming a part of the apparatus, is actuatable by the same power means for starting the wire through the drawing die. It will now also be understood that this novel wire drawing apparatus embodies control means for relating the functioning and control of the power means appropriately to the drawing unit or to the inching means, as may be desired for a proper and efficient functioning of the apparatus.

Although the wire drawing apparatus of this invention has been illustrated and described herein to a somewhat detailed extent it will be understood, of course, that the invention is not to be regarded as being limited correspondingly in scope but includes all changes and modifications coming within the terms of the claims hereof.

Having described my invention, I claim:

1. In apparatus for drawing linear stock; a support means; a drawing unit comprising a pair of drawing components carried by said support for movement relative to one another for causing a succession of drawing strokes; said pair of components comprising a first mount having a drawing die thereon and a second mount located on the drawn stock or die-exit side of the drawing mount and

having a drawing grip device thereon adapted to grip the stock during the drawing strokes; fluid pressure responsive power means operably connected between said first and second mounts for causing the drawing strokes; inching means at the side of said first mount opposite to said second mount movable along said support and including an inching grip device adapted to grip the stock upon relative movement between said first mount and said inching means toward one another; and means movable to an effective position for connecting said inching means with said power means for effecting relative movement between said first mount and said inching means.

2. Drawing apparatus according to claim 1 wherein said power means comprises reciprocally co-operable cylinder and piston members connected with said first and second mounts; and pressure fluid supply means connected with said power means.

3. Drawing apparatus according to claim 1 wherein said first mount is movable away from said second mount during said drawing strokes for pushing the die along said stock, and said second mount has a return stroke movement toward said first mount following each drawing stroke; and means co-operable with said first mount for holding the same relatively stationary on said support means during said inching strokes.

4. Drawing apparatus according to claim 2 wherein the connecting means for actuating said inching means comprises link means, and means for moving said link means to said effective position.

5. Drawing apparatus according to claim 3 wherein the connecting means for actuating said inching means comprises link means and means for moving said link means to said effective position; said link means comprising a lever having one end thereof pivotally connected with said inching means; and thrust means on said lever adjacent the other end thereof and engageable with said second mount.

6. In apparatus for drawing linear stock; a support means; first, second and third mounts movable relative to each other and along said support means; a drawing die on said first mount for reducing the stock; a drawing grip device on said second mount; said second mount being located on the drawn stock or die-exit side of said first mount; said first and second mounts having opening and closing relative movements for causing drawing and return strokes; said drawing grip device being effective to grip the stock during the drawing strokes; power means carried by and connected between said first and second mounts operable to cause said opening and closing relative movements between said first and second mounts; said third mount being located at the undrawn stock or die-entrance side of said first mount and being reciprocally movable relative to said first mount for producing inching strokes; an inching grip device on said third mount for gripping the stock and pushing the same through said die during said inching strokes; and motion transmitting means for connecting said third mount with said second mount for causing the inching reciprocation of said third mount in response to operation of said power means.

7. Drawing apparatus according to claim 6 and comprising means effective to hold said first mount in a substantially stationary position on said support means during said inching strokes and to release said first mount for movement along said support means during said drawing strokes.

8. Drawing apparatus according to claim 6 and comprising means providing an initial parked position for said third mount on said support means, and spring means effective to urge said third mount toward said parked position.

9. Drawing apparatus according to claim 6 wherein said motion transmitting means comprises lever means movable to an effective position for connecting said third mount with said second mount.

10. Drawing apparatus according to claim 9 and com-

prising auxiliary power means operable to move said lever means to said effective position.

11. Drawing apparatus according to claim 9 wherein said lever means comprises a lever having pivotal connection with one of the two mounts comprising said second and third mounts; and thrust means on said lever at a location spaced from said pivotal connection and engageable with the other of said two mounts.

12. In apparatus for drawing linear stock; a support means; first, second and third mounts movable on said support means; a drawing die on said first mount for reducing the stock during a drawing stroke; said second mount being located on the die-exit side of said first mount, and said third mount being located on the die-entry side of said first mount; a drawing grip device on said second mount for gripping the stock during said drawing stroke; power means connected between said first and second mounts comprising co-operating cylinder and piston members; said power means being operable to cause opening and closing relative movements between said first and second mounts for producing a succession of the drawing strokes; said third mount being reciprocally movable relative to said first mount for producing a succession of inching strokes; an inching grip device on said third mount for gripping the stock during said inching strokes; and motion transmitting means for connecting said third mount with said second mount for causing reciprocation of said third mount in response to operation of said power means.

13. In apparatus for drawing linear stock; a support means; first and second mounts movable relative to each other and along said support means; a drawing die on said first mount for reducing the stock; said second mount being on the die-exit side of said first mount and having a drawing grip device thereon; said first and second mounts having opening and closing relative movements for causing drawing and return strokes; said drawing grip device being effective to grip the stock during the drawing strokes; power means carried by and connected between said first and second mounts comprising co-operating cylinder and piston members; said power means being operable to cause said opening and closing relative movements between said first and second mounts; inching means on said support means and reciprocally movable relative to said first mount for producing a succession of inching strokes including an inching grip device for gripping the stock and during said inching strokes; motion transmitting means movable to an effective position for connecting said inching means with said power means for causing reciprocation of said inching means in response to operation of the power means; supply means connected with said power means for supplying motive fluid thereto including control means having a first operating condition for controlling said power means so as to produce said drawing and return strokes and a second operating condition for controlling said power means so as to produce said inching strokes; and selector means associated with said control means and operable to selectively establish said first and second operating conditions.

14. Drawing apparatus according to claim 13 wherein said motion transmitting means comprises a lever having one end thereof pivotally connected with said inching means; and thrust means on the other end of said lever and co-operable with said second mount when the lever is in the effective position.

15. Drawing apparatus according to claim 13 wherein said first mount is movable to a stationary inching position on said support means; locking means movable to a locking position relative to said first mount for holding the latter in said stationary position during said inching strokes; said transmitting means comprising link means movable to an effective position for transmitting motion between said second mount and said inching means for causing said inching strokes; and auxiliary power means operable to move said locking means to said locking position and said link means to said effective position.

16. Drawing apparatus according to claim 15 wherein said selector means comprises means responsive to the placing of said first mount in said stationary position for establishing said second operating condition of the control means.

17. In apparatus for drawing linear stock; a support means; a first carrier having a drawing die thereon; a second carrier on the die-exit side of said first carrier and having a drawing grip device thereon; a third carrier on the die-entry side of said first carrier and having an inching grip device thereon; said first and second carriers being movable along said support means and relative to each other for causing a drawing stroke of the die along the stock and a return stroke of said drawing grip device along said stock; said drawing grip device being operable to grip the stock during the drawing stroke and to release the stock during said return stroke; power means connected between said first and second carriers comprising cooperating cylinder and piston members; said power means being operable to cause the relative movement between said first and second carriers for producing a drawing operation comprising a succession of said drawing and return strokes; holding means co-operable with the first carrier for holding said carrier and die substantially stationary on said support means; said third carrier being reciprocally movable relative to said first carrier for producing a succession of inching strokes; an inching grip device on said third carrier for gripping the stock and pushing the same through said die during said inching strokes; motion transmitting means for connecting said third carrier with said second carrier for causing reciprocation of said third carrier in response to operation of said power means; means operable to render said holding means and said motion transmitting means effective; supply means connected with said power means for supplying motive fluid thereto including control means having a first operating condition for controlling said power means so as to produce said drawing and return strokes and a second operating condition for controlling said power means so as to produce said inching strokes; and selector means associated with said control means and operable to establish said first and second operating conditions.

18. Drawing apparatus according to claim 17 wherein said selector means comprises means responsive to the movement of said first carrier to its stationary holding position; and preventer means for preventing movement of said first carrier to said holding position during said drawing operation.

19. Drawing apparatus according to claim 18 wherein said preventer means is located on said third carrier and comprises stop means shiftable to an effective position for preventing movement of said first carrier to said holding position during said drawing operation; said stop means being movable to occupy an ineffective position during the inching stroke movement of said third carrier.

20. In apparatus for drawing linear stock; a drawing die and an associated drawing grip device adapted to grip the drawn stock; a support means including a first mount having said die thereon and a second mount having said drawing grip device thereon; said second mount being on the die-exit side of said first mount; means providing for reciprocating relative movement between said first and second mounts for drawing of the stock by a succession of drawing strokes; said first mount being effective to hold said die stationary for starting of the stock through the die by a succession of inching movements of the stock relative to the die; a third mount on said support means at the die-entrance side of said first mount; said third mount being reciprocally movable relative to said first mount and die; an inching grip device on said third mount for gripping the stock during said inching movements; and power cylinder means connected with said third mount and operable to cause reciprocation thereof for producing said inching movements of the stock.

21. Drawing apparatus according to claim 20 and comprising means effective to disable the connection of said power cylinder means with said third mount for discontinuance of the inching operation.

22. Drawing apparatus according to claim 21 wherein said power cylinder means comprises co-operating cylinder and piston members connected with said first and second mounts for producing the reciprocating relative movement therebetween for the drawing of said stock.

23. Drawing apparatus according to claim 20 and comprising spring means effective to urge said third mount toward an initial position on said support means; said power cylinder means being operable to repeatedly move said third mount from said initial position toward said first mount in opposition to said spring means for producing said inching movements of the stock.

24. In apparatus for drawing linear stock; a drawing die and an associated drawing grip device adapted to grip the drawn stock; a support means including a first mount having said die thereon and a second mount having said drawing grip device thereon; means providing for movement of said first and second mounts along said support means including reciprocating relative movement between said first and second mounts for drawing of the stock by a succession of drawing strokes; holding means co-operable with said first mount to maintain said die stationary for starting of the stock through the latter by a succession of inching movements of the stock relative thereto; a third mount on said support; said third mount being reciprocally movable relative to said first mount and die while the latter is being held stationary; an inching grip device on said third mount for gripping the stock during said inching movements; and power cylinder means connected with said third mount and operable to cause reciprocation thereof for producing said inching movements of the stock.

25. Drawing apparatus according to claim 24 and comprising stop means on said support means and engaged by said first mount while the latter is being held by said holding means.

26. Drawing apparatus according to claim 24 wherein said support means includes rails and said first, second and third mounts have rollers operable on said rails.

27. Drawing apparatus according to claim 24 and comprising stop means on said support means and engaged by said first mount while the latter is being held by said holding means; said support means comprising rails and said first, second and third mounts having rollers operable on said rails; said rails being longitudinally inclined in a descending relation toward said stop means for facilitating movement of said first mount into engagement with said stop means.

28. In apparatus for drawing linear stock; a support means; a drawing unit comprising a pair of drawing components relatively movable along said support means for causing a succession of drawing strokes; said pair of components comprising a first mount having a drawing die thereon and a second mount having a drawing grip device thereon adapted to grip the stock during the drawing strokes; inching means movable along said support means toward said drawing unit through successive inching strokes including an inching grip device adapted to grip the stock for pushing the same through said die during said inching strokes; holding means co-operable with said first mount for maintaining the same in a stationary position during said inching strokes; hydraulic pressure responsive reciprocating power means common to said drawing unit and said inching means for selective actuation thereof including cylinder and piston members connected with said first and second mounts, and motion transmitting means for releasably connecting said inching means with said power means; and means for supplying hydraulic pressure fluid to said power means including control means operable to vary the operation of said power means from a predetermined length of stroke needed for the drawing

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operation to a predetermined shorter length of stroke needed for the inching operation.

29. Drawing apparatus according to claim 28 wherein said control means comprises limit switch means on one of said mounts and trip means on the other of said mounts 5 and co-operable with said switch means to actuate the same for causing operation of the power means at the drawing stroke length; and other trip means positionable in response to movement of said first mount to its stationary position for co-operation of said other trip means with 10 said switch means for causing operation of said power means at the inching stroke length.

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