June 6, 1939. M. J. DEMPSEY ET AL 2,161,023

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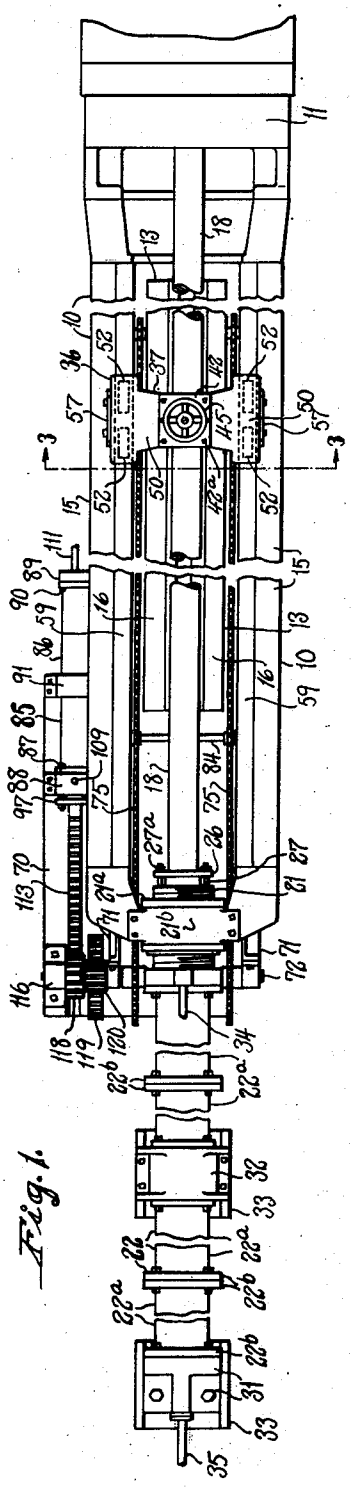


Fig. 1.

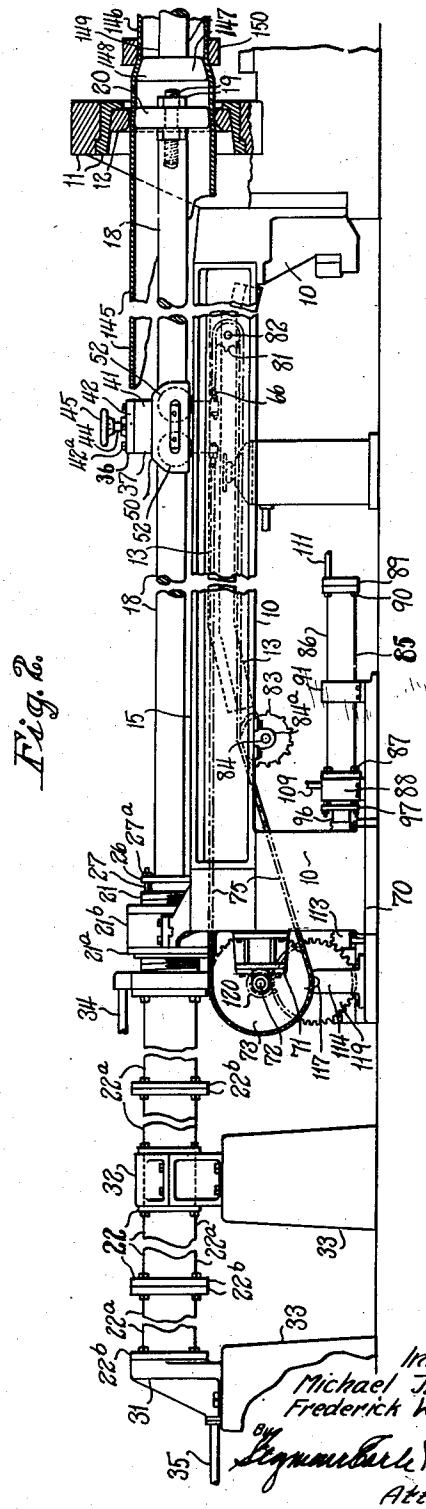


Fig. 2.

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Fig. 3.

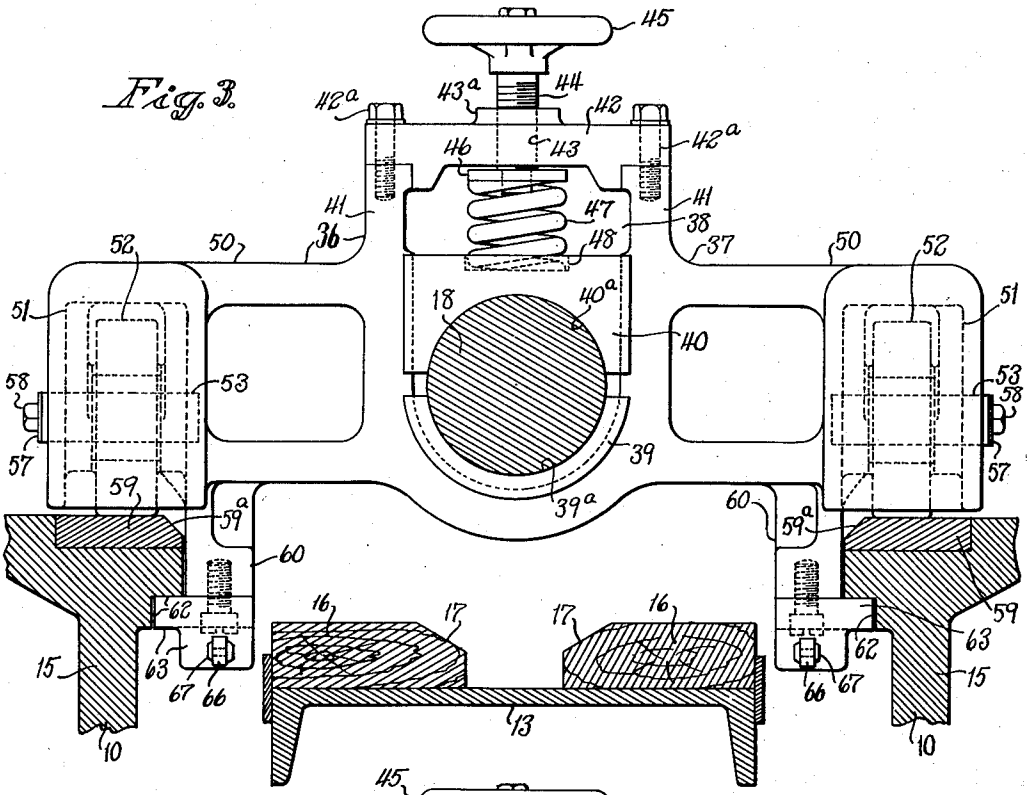
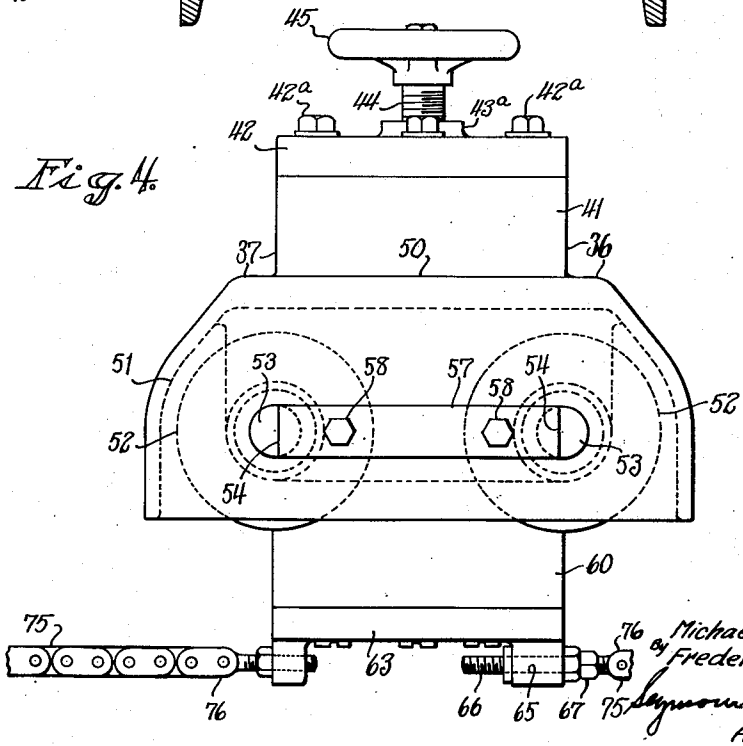


Fig. 4.



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Fig. 5.

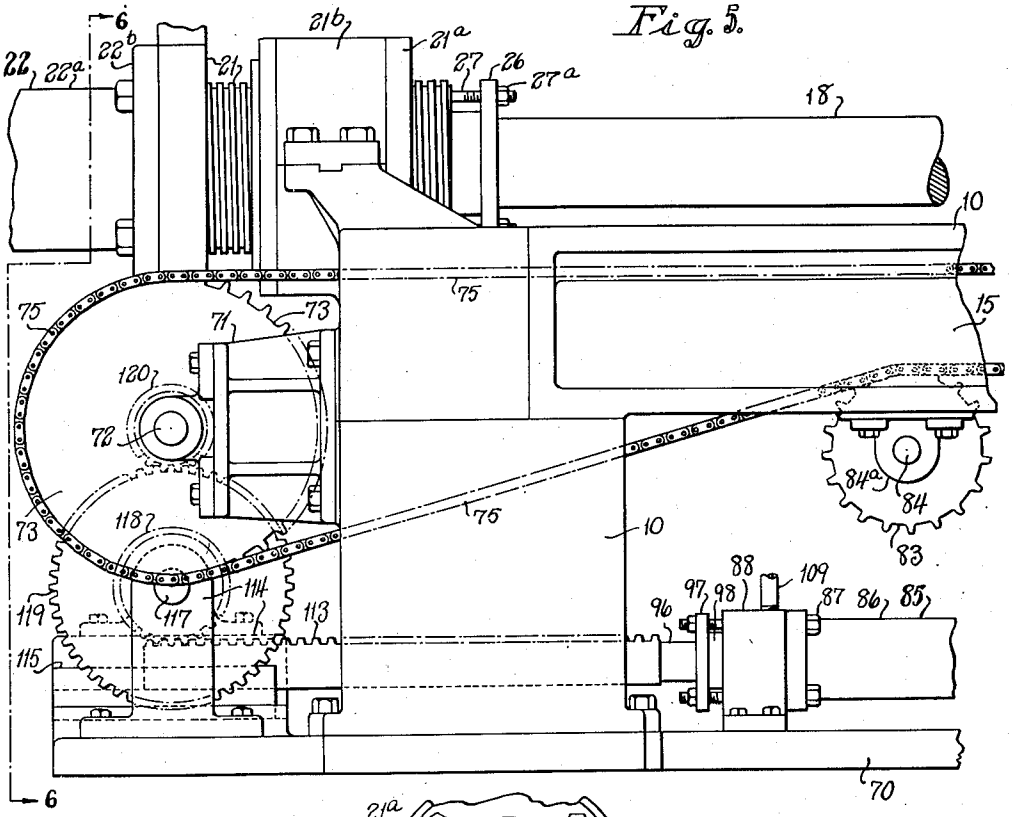
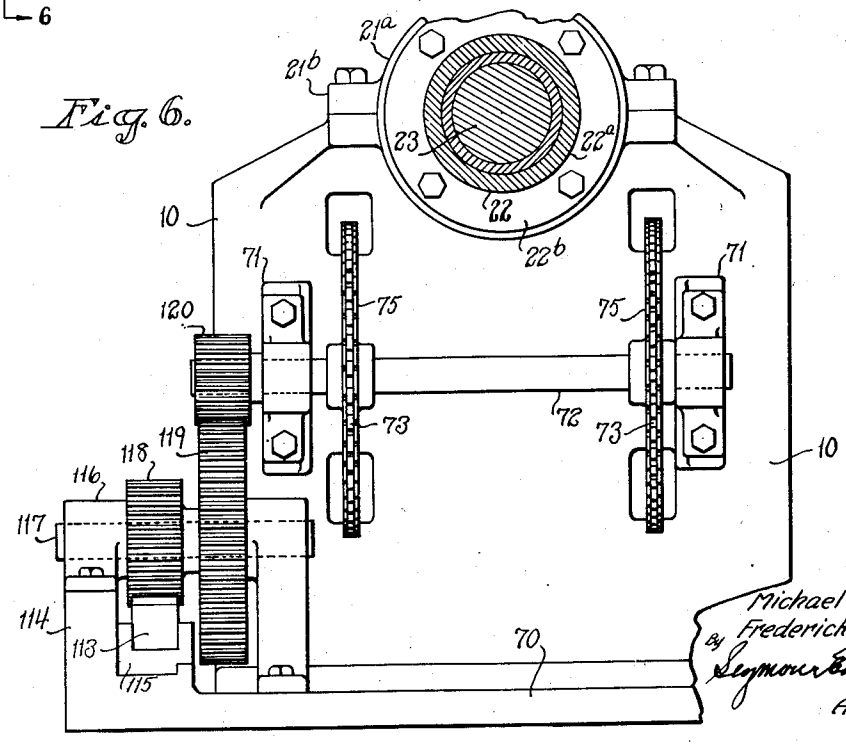


Fig. 6.



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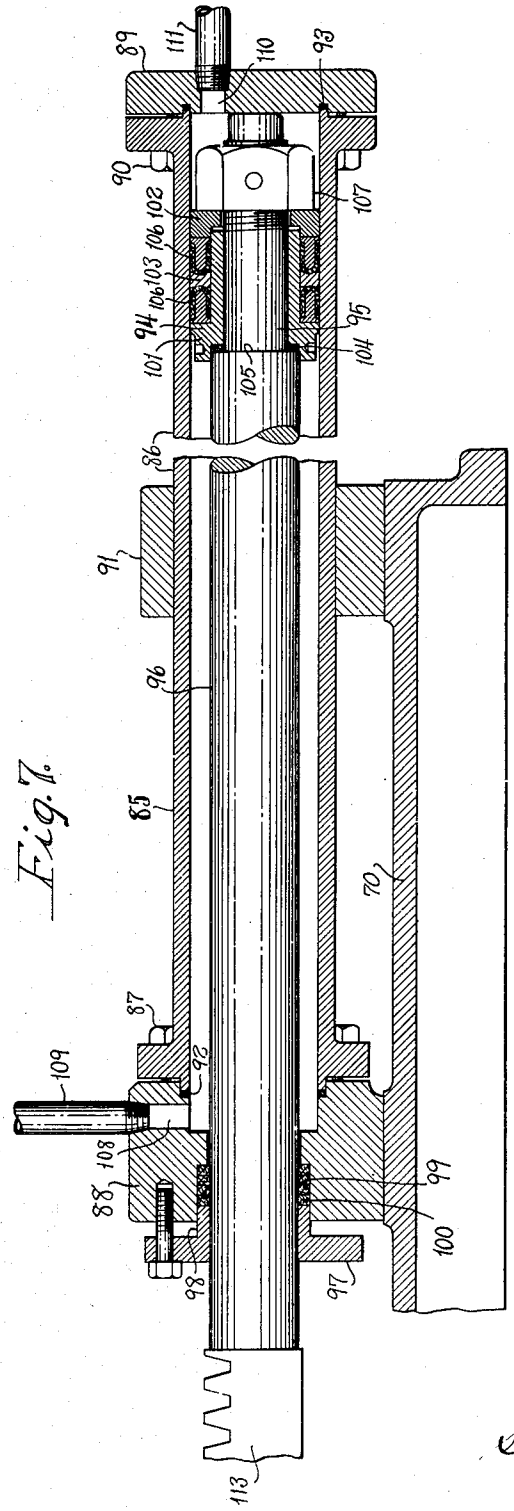


Fig. 7.

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Fig. 8.

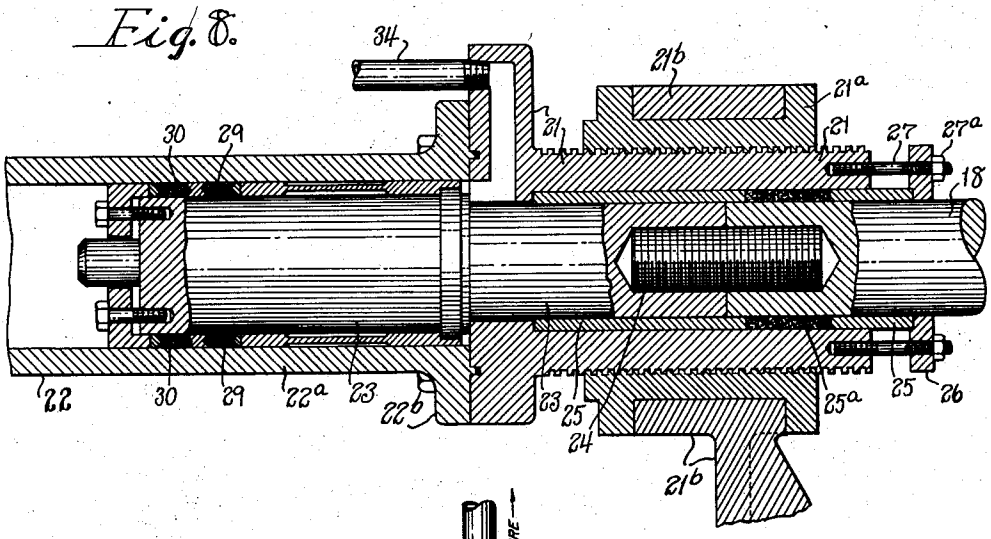
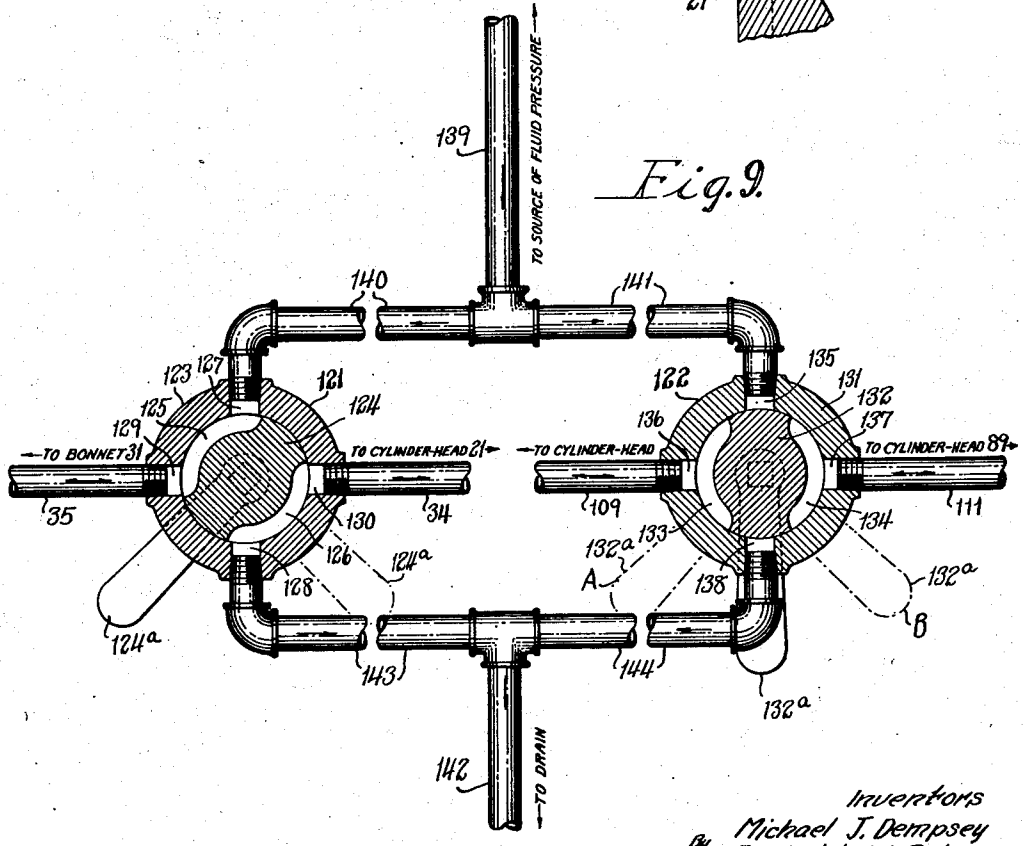


Fig. 9.



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UNITED STATES PATENT OFFICE

2,161,023

DRAWBENCH

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Application May 17, 1938, Serial No. 208,340

15 Claims. (Cl. 205—7)

This invention relates to draw-benches for drawing tubes and especially to draw-benches of the type which includes a power-operated rod carrying a plug at its front end, which rod can be retracted to enable a tube to be positioned on the bench, and which can be advanced into the tube to position the plug of the rod in the die-head of the bench, to cooperate with the die in the drawing of the tubes. More particularly, the invention concerns improved arrangements of a traveling carriage for a draw-bench of the type indicated, which carriage, as one of its principal functions, provides support for the movable plug-rod of the draw-bench.

One of the objects of the invention is to provide for the power-operated plug-rod of a draw-bench, a supporting-carriage of novel construction and arrangement, which is caused to ride smoothly and evenly along a feed-table of the draw-bench; is guided and restrained to avoid lateral movement, side-sway and rocking movements; and is arranged to take up jars, shocks, or vibrations.

Another object of the invention is to provide a supporting-carriage for the purposes described, with separate operating-means, which, when a tube is placed on the feed-table of the draw-bench, and the plug-rod is advanced into the tube, are operable to cause the carriage to move forwardly along the rod to any place intermediate its rear-end portion and a point on the rod determined by the length of the tube to be drawn, selected by the operator, to provide at the place selected, support for the rod, whereby sagging, drooping, or lateral deflection of the plug-rod are avoided.

Another object of the present invention is the provision for a draw-bench, as described, of a carriage, which, by the operation of operating-mechanism individual to the carriage, can be moved to an initial selected position of support for the plug-rod of the bench, and which, as the tube is carried forwardly in the drawing operation, is caused, by its individual operating-mechanism, to follow the tube along the plug-rod, whereby, as the tube is drawn, and stress is transmitted to the plug at the front end of the rod, the support for the plug-rod is progressively moved forwardly toward the plug-end, to support the rod against sagging and other deflection, and whereby the carriage in its following movement is made available for the performance of other functions.

A further object of the invention is to provide operating-means individually associated with a traveling supporting-carriage, operable to cause the carriage to move forwardly along and in supporting relation to the plug-rod of a draw-bench as a tube is drawn, to limit the forward movement of the carriage when the carriage reaches a predetermined supporting position for the plug-rod, whereby the carriage is constrained from following the tube along the rod into a zone adjacent the plug, where the carriage would not effectively serve to guard against sag or other deflection occurring in the section of the rod extending rearwardly of the carriage.

Still another object of the invention is to provide reversible operating-means individually associated with a carriage, as described, operable to cause the carriage to be moved in opposite directions, longitudinally along the feed-table of the bench, and to limit the travel of the carriage in each direction, the greater portion of the travel of the carriage taking place along the rear-half of the feed-table, whereby the carriage in its forward movement, supporting the plug-rod, is stopped at a point along the rod which is predetermined, to secure a full range of supporting positions for the carriage with respect to the plug-rod, and whereby, the carriage in its return movement is retired to a position adjacent the rear end of the feed-table, allowing the plug-rod to be returned to a position with its plug closely adjacent the carriage, at the rear end of the feed-table, and make available substantially the entire length of the feed-table, to receive a tube length.

A still further object of the present invention is to provide a traveling-carriage for supporting the plug-rod of a draw-bench, with reversible operating-mechanism, and to so arrange the operating-mechanism that the rate of movement of a drive-member is less than 1 to 1 with relation to the movement of the carriage, and that connections between the drive-member and the carriage comprise motion-multiplying means, whereby the carriage is caused to travel, in opposite directions, along the major portion of the length of a feed-table of the draw-bench.

Another object of the invention is to provide an improved arrangement of hydraulically-controlled operating-means for the plug-rod of the draw-bench and for the supporting-carriage for the plug-rod, each of the operating-means comprising a cylinder having a piston, the piston of one cylinder being secured to the plug-rod, and the piston of the second cylinder being connected with the carriage for supporting the plug-rod, and means separately operable for each cyl-

inder, to control the admission, from a single source, of water under pressure to each cylinder, and to control the discharge of water from each cylinder, alternately, at opposite ends of the cylinders, whereby a simplified arrangement and control of the separate operating-mechanism is secured.

The invention also contemplates in an arrangement as last described, connections between the piston of one of the cylinders and the carriage for supporting the plug-rod, comprising multiplying mechanism, whereby the dimensions of the cylinder are substantially smaller, and the stroke of its piston is substantially less, than the dimensions of the cylinder and the stroke of the piston comprising part of the operating-means for the plug-rod, whereby a further simplification and a compact arrangement of the apparatus, is secured, and costs are substantially reduced.

With the above and other objects in view, as will appear to those skilled in the art from the present disclosure, this invention includes all features in the said disclosure which are novel over the prior art.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a plan view of a general assembly of the rear end of a draw-bench;

Fig. 2 is a side view of the apparatus illustrated in Fig. 1, and showing in section a portion of a tube which is being drawn, and the carriage for supporting the plug-rod arranged adjacent the rear end of the tube;

Fig. 3 is a transverse sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a side view of the carriage showing the same connected to opposite ends of a driving sprocket-chain;

Fig. 5 is a broken view in side elevation showing the preferred operating-mechanism for separately operating the carriage which supports the plug-rod;

Fig. 6 is a cross-sectional view taken on line 6—6 of Fig. 5;

Fig. 7 is a vertical, longitudinal, sectional view of the hydraulically-operated piston, showing it connected to a rack-bar for driving gearing to separately operate the carriage;

Fig. 8 is a vertical, longitudinal, sectional view through the head and forward end of the cylinder of the plug-rod, showing a piston secured to the rear end of the plug-rod; and

Fig. 9 is a schematic view, showing the separately-operable valve-means for controlling the admission of water under pressure, from a single source to each cylinder, and for discharging water from each cylinder, alternately, at the opposite ends of the cylinders.

Before describing the arrangements shown in the drawings, it may be observed, that draw-benches requiring a power-operated rod, carrying a plug at its front end for cooperating with the die of the draw-bench, are comparatively long.

The power-operated rod must be advanced from a position at the rear end of a feed-table of the bench, into a tube, and take up a position with its plug in the die-head. The plug must be initially centered in the die-head and it must remain centered in the die-head throughout the drawing operation.

When the plug is being moved to its forward position, it is a cantilever rod, and as it advances, unless it is supported intermediate its ends, the weight of the rod and its plug is likely to cause the rod to undesirably droop or sag.

Again, when the rod is in place, with its plug in the die-head, unless other means are provided, it is supported only at its piston and plug ends. Under such conditions, the rod may sag intermediate its ends, and the position of the plug in the die-head, or the operation of its piston in the cylinder, or both may be affected.

With demand for seamless tubing of longer length, draw-benches and plug-rods for the benches have been lengthened, and there has been a corresponding increase in the difficulties attending the necessity of providing adequate support for the plug-rods.

While it is intended to be in no way restrictive with regard to any and all of the novel features of the arrangements here shown and hereinafter to be described, it may be, that the supplementing of the description, from time to time, with approximate dimensions of draw-benches, in which the novel features of the disclosure are particularly useful, will assist those skilled in the art in their appreciation of the difficulties found in prior practice and of the manner in which such difficulties are substantially eliminated by the arrangements now about to be described.

In the embodiment of the invention illustrated, there is shown in Figs. 1 and 2, the rear end extension of a draw-bench, which, in a number of its particulars, is of conventional structural arrangement.

Generally, the bench comprises supporting-structure 10, a die-head 11 secured to the supporting-structure 10 and provided with a removable ring-like draw-die 12, and a vertically-adjustable feed-table 13 between side-frames 15 of the supporting-structure 10 of the bench.

Secured to and forming part of the feed-table 13, are parallel pads 16—16 which extend longitudinally throughout a substantial portion of the table. The pads are preferably formed of wood and are provided with sloping converging surfaces at 17 (Fig. 3) on which a tube to be drawn, may rest.

In the arrangement shown, the draw-bench is provided with a power-operated plug-rod 18, which at its front end has removably secured to it, as by bolt and nut 19, a draw-plug 20.

The outer periphery of the draw-plug 20 cooperates with the inner periphery of the draw-die 12 in the drawing of tubes in accordance with usual practice. As shown in Fig. 2, when a tube is being drawn, the draw-plug 20 is centered in the draw-die 12. The draw-plug 20 determines the inner diameter of the tube, the draw-die 12 determines the outer diameter of the tube, and the distance between the said draw-plug and the said draw-die establishes the wall thickness of the tube.

In the embodiment of the present invention herein illustrated, the power-operated plug-rod 18 is hydraulically movable axially in opposite directions. As shown particularly well in Fig. 8, the rear end of the plug-rod 18 is received in a cylinder-head 21 which throughout the major portion of its length is externally-threaded and which is rigidly secured to the front end of a cylinder-structure, generally designated by the reference character 22. The threaded portion of the said cylinder-head has threaded engagement with a rotary adjusting-nut 21*a* which in turn is supported with capacity for rotary movement in a bracket 21*b*. The said bracket 21*b* is rigidly

attached to the supporting-structure 10 as shown and while it permits the rotation of the said adjusting-nut 21a, it holds the same firmly against axial movement.

The rear end of the plug-rod 18 is secured to a piston 23 by means of a nipple 24 threaded into the respective adjacent end-faces of the plug-rod 18 and the piston 23. Fitted between the cylinder-head 21 and the plug-rod 18 are complemental sleeves 25—25 between which is located a plurality of packing-rings 25a. The sleeves 25—25 are subjected to compressive force to similarly compress the packing-rings 25a by means of a cap 26 through which studs 27 pass from the cylinder-head 21. Suitable nuts 27a are threaded onto the studs 27, as shown in the drawings.

As shown, the inside diameter of the cylinder-head 21 is less than the inside diameter of the cylinder-structure 22 and the rear face provides a stop to limit the forward movement of the piston and hence also limit the forward movement of the plug-rod 18 and its draw-plug 20. The piston 23 carries oppositely-arranged U-shaped packing-rings 29 and 30, which, when subjected to the pressure of water admitted to the cylinder-structure 22, serve to guard against leakage of such water past the piston in either direction.

The cylinder-structure 22 comprises a number of tubes or cylinder-sections 22a, suitably secured together in end-to-end relationship and having end-flanges 22b. The end-flange 22b at the front end of the front tube 22a, is secured to the rear end of the cylinder-head 21, as shown, and the end-flange 22b at the rear end of the rear tube 22a is communicably connected with a bonnet or hood 31. One or more of the intermediate tubes 22a of cylinder-structure 22 extend through and are supported in split bearing-blocks, such as the split bearing-block 32 shown in Figs. 1 and 2.

The cylinder-head 21 is mounted on the supporting-structure 0, and the bonnet 31 and the bearing-block 32 are carried on pillars 33—33, respectively, to support the cylinder-structure 22 above the floor.

As shown in Fig. 2, piping 34 leads into the cylinder-head 21 and piping 35 leads into the bonnet 31 of the cylinder-structure 22. The piping 34 and 35 are arranged to alternately serve, as will be described, to admit water under pressure to the cylinder-structure 22, and to discharge water from the cylinder. During one operation, water under pressure admitted to the forward end of the cylinder-structure 22 acts on the front face of piston 23 to force the piston rearwardly and cause the plug-rod 18 to be retracted, and during the alternate operation, water under pressure admitted to the rear end of the cylinder-structure 22, acts on the rear end face of piston 23 to move the piston forward and cause the plug-rod 18 to be advanced. When the water under pressure is supplied through piping 34, or alternately through piping 35, the water is discharged from cylinder-structure 22, by way of the pipe 35, or the pipe 34, respectively.

It is common in the art to provide draw-benches in which the feed-table, such as the feed-table 13, extends well over 25 feet. The cylinder-structure for a draw-bench of this character extends rearwardly of the feed-table, approximately the same distance. And for this apparatus there is provided a plug-rod, such as the plug-rod 18, which in its advanced position has its rear end positioned in the cylinder-head at the front end of the cylinder-structure, and extending from the head of the cylinder-structure over the entire length of the feed-table and into the die-head at the front of the feed-table. Accordingly, the plug-rod, in the example given, is some several feet longer than the 25 feet or more length of the feed-table of the draw-bench.

Again, on a draw-bench such as that used for purposes of illustration, tubes are often drawn which are 12 inches or more in diameter. In such operations, the plug, such as the plug 20, secured to the tip of the plug-rod 18, is of a diameter corresponding to the desired internal diameter of the tube and the plug-rod is much smaller in diameter than either.

When it is considered that the plug-rod, for instance a plug-rod some 5 or 6 inches in diameter and carrying at its tip a heavy plug, which may be a foot or more in diameter, must be moved and extend over a distance of some 25 feet, before its draw-plug is positioned to cooperate with the draw-die in drawing a tube engaged therebetween; and that the plug-rod must remain in its extended position throughout the drawing operation, during which time it is submitted to severe stresses, the likelihood of sagging or other deflections accuring along the length of the rod become at once apparent. And it will be realized that in preventing undesired behavior of the plug-rod of the nature referred to, and the objectionable effects of such behavior, there is involved a unique problem of support for the plug-rod.

In accordance with the invention, there is provided a separately-driven traveling carriage for the draw-bench, the particular function of the carriage being to cooperate with and provide support for the plug-rod of a draw-bench as a tube is being drawn on the bench, and also to discharge other functions as will hereinafter appear.

The carriage designated as a whole by the numeral 36, comprises a frame 37. The said frame 37 is hollow at places where resistance to substantial stresses is not required. In this manner there is provided a carriage which is of light weight for easy movement along the feed-table, and which is of sufficient strength to provide proper support for the plug-rod 18.

The central portion of the frame 37 is formed to define at 38, a U-shape passage therethrough. The arcuate lower portion of the frame is positioned above the space between the parallel pads 16 and above the converging surfaces 17 of the said pads.

At the bottom of the U-shape passage at 38, there is provided an arcuate liner 39 having an arcuate bearing-surface 39a on which the plug-rod 18 rests. Within the passage 38 and above the liner 39 is located a vertically-adjustable bearing-block 40 formed with a semi-circular inner bearing-surface 40a.

The power-operated plug-rod 18 passes through the U-shape passage at 38, between the arcuate liner 39, and the inner surface 40a of bearing-block 40, and is circumferentially engaged and axially movable therebetween.

As shown, bearing-block 40 is yieldingly mounted in the U-shape passage at 38, in the frame 37. The upper side-wall portions of the said passage are defined by a neck 41, which extends upwardly from the body of the frame 37, and a cap 42 is secured to the said neck, as by bolts 42a, the shanks of which pass through the cap 42 and are threaded into the necks 41 of the frame. The cap 42 is provided with a central threaded passage 43 surrounded by a threaded boss 43a on the upper face of the cap 42. An adjusting-screw 44

is threaded through the threaded passage 43 in the cap 42 and into the U-shape passage 38. At its upper end, adjusting-screw 44 carries an operating hand-wheel 45, and the unthreaded lower end of the said adjusting-screw 44 is fitted in a socket in a circular spring-seat 46. The said spring-seat 46 is seated against the upper end of a compression-spring 47, the lower end of which is seated in a recess 48 provided in the upper face of the bearing-block 40.

The adjusting-screw 44 may be raised or lowered to raise or lower spring-seat 46 to vary the tension of spring 47, as desired.

As thus constructed and arranged, a supporting-carriage is provided which is capable of movement axially along the plug-rod 18. The carriage 36, as described carries means in the form of bearing-block 40 and the arcuate liner 39 for holding the plug-rod against lateral deflection, and the yielding mounting referred to for the said bearing-block, and comprising the said compression-spring, serves to absorb jars, shocks and vibrations incident to the operation of apparatus of the character shown.

As is shown particularly well in Fig. 3, the frame 37 is provided at each side with laterally-projecting arms 50—50, each of which is formed with an inverted U-shaped recess or notch 51. In the U-shaped recess 51 of each of the arms 50, there are arranged two wheels 52—52 respectively located at the front and rear of the carriage 36. Each wheel 52 is mounted for rotation upon one of four stationary axles 53, each of which passes through the hubbed center of a given wheel 52 and into the respective opposite walls of the particular inverted U-shaped recess 51 in which the particular wheel 52 is located. In the form illustrated, the outer end of each axle 53 is cut away about half of its diameter to provide a stabilizing-notch 54. Mounted on each of the respective opposite sides of the arms 50 of the frame 37 is a retaining-bar 57—57, each of which extends between the stabilizing-notches of the two axles 53 on the side of the said frame on which the particular retaining-bar is located. The said retaining-bars are retained in place by screws 58 and by virtue of fitting into the stabilizing-notches 54, as above described, each of the said bars serves not only to hold the axles 53 against rotation, but serves to retain the same in place against axial displacement.

Mounted upon each of the side-frames 15 of the supporting-structure 10 are rails 59—59 preferably formed of tough steel or other wear-resisting material and upon which roll the wheels 52—52, before referred to. Preferably and as shown, the inner upper corner of each of the said rails 59 is formed with a bevel 59a.

As shown in the drawings, the frame 37 is formed on each of its respective opposite sides with guide-flanges 60—60, which are spaced from each other a distance sufficient to project downwardly between the respective side-frames 15—15, as is shown particularly well in Fig. 3. In this manner, the guide-flanges 60—60 serve to guide the carriage 36 for movement longitudinally of the draw-bench structure and serve to prevent the lateral displacement of the said carriage and the horizontal twisting thereof with respect to the said side-frames.

Each of the side-frames 15 is formed with a longitudinally-extending and downwardly-facing notch 62, as is shown particularly well in Fig. 3. Adapated to ride longitudinally in the said notches 62—62 are retaining-plates 63—63 respectively bolted or otherwise secured to the underface of the guide-flanges 60—60 depending from the carriage-frame 37. The cooperation of the retaining-plates 63—63 with the longitudinal notches 62—62 in the said frames 15—15 serves to hold the carriage 36 against upward displacement such, for instance, as that which might be caused by the upward whip or flexure of the plug-rod 18.

At each of its respective opposite ends, each of the retaining-plates 63 is formed with a threaded bore 65, each of which has threaded into it a stud 66 locked in place by means of a lock-nut 67, as is shown in Fig. 4. The said stud 66 provides means, as will be later described, for the attachment of suitable sprocket-chains whereby the carriage 36 may be caused to travel longitudinally with respect to the feed-table 13 and the plug-rod 18.

In the preferred arrangement, a sprocket and chain drive is provided for shifting the carriage 36, as will presently be described. As shown (Fig. 2), the rear end of supporting-structure 10 has a base-plate 70 and rearwardly-extending bearing-supports 71—71, one at each side of supporting-structure 10 (see Fig. 6). Extending between and journaled in bearing-supports 71, is a rotatable shaft 72 to which are rigidly secured two corresponding sprocket-wheels 73—73. The sprocket-wheels 73 are mounted on the said shaft between bearing-supports 71, one sprocket-wheel 73 being arranged adjacent each of the said bearing-supports.

Passing about and engaged by the teeth of each sprocket-wheel 73—73 respectively is a sprocket-chain 75—75. The end link 76—76 of each end of each chain 75 is pinned or otherwise secured to one of the aforesaid studs 66, one of which is threaded onto each of the respective opposite ends of each retaining-plate 63 of the carriage 36. The upper reach of each chain 75 extends from its connection to carriage 36 rearwardly alongside of the feed-table 13, and between the same and the side-frames 15 of the supporting-structure 10 through openings provided in the rear supporting-structure 10, and onto and about the particular sprocket-wheel 73 with which the chain is associated.

The opposite end of the upper reach of each chain 75 extends from its connection to carriage 36, forward to and about the adjacent one of two sprocket-wheels 81—81 located near the forward end of the side-frames 15. The sprocket-wheels 81—81 are mounted on and at opposite ends of a shaft 82, which extends transversely under feed-table 13, and turns in bearings provided in the side-frames 15. From the sprocket-wheels 81, the lower reach of each chain 75 passes rearwardly at opposite sides of the said table and between the side-frames 15 of the supporting-structure 10. Adjacent the rear end of the feed-table 13, the lower reach of each chain passes over idler sprocket-wheels 83. The idler sprocket-wheels 83—83 are mounted on opposite ends of a shaft 84 which is arranged transversely of the structure below the feed-table 13 and turning in bearing-brackets 84a depending from the side-frames 15—15. The lower reaches of the chains 75—75 continue rearwardly from the said idler-sprockets 83—83 through suitable openings in the rear of the supporting-structure 10 and thence onto and about the sprocket-wheels 73—73 respectively.

As will be later described, while a tube is being drawn and the plug-rod 18 and its plug 20 remain stationary, the sprocket-wheels 73—73 may

be driven in either direction. When the said sprocket-wheels 73—73 are turned in a clockwise direction, as viewed in Fig. 2, the lower reaches of the chains 75—75 are drawn rearwardly and the forward ends of their upper reaches are pulled forwardly, to thus cause the carriage 36 to move forwardly while the latter still maintains its supporting relationship to the plug-rod 18.

The means for turning the sprocket-wheels 73—73 in opposite directions to effect the similar movement of the carriage 36 will now be described.

Mounted upon the said plate 70, before referred to, is a hydraulic operating-structure, generally designated by the reference character 85, and comprising a cylinder 86, flanged at each of its respective opposite ends and secured by bolts 87 or the like to a cylinder-head 88 which is rigidly attached to the bed-plate 70 in any suitable manner.

Secured to the cylinder 86 at the end thereof opposite the cylinder-head 88 is a second cylinder-head 89 secured to the adjacent flange of the said cylinder by bolts 90, as is illustrated in Fig. 7. Intermediate its cylinderhead 88 and its cylinder-head 89, the cylinder 86 is supported in a rigid block-like support 91.

The cylinder 86 has interposed between it and the cylinder-head 88 suitable packing material 92 to guard against the leakage of fluid between the said parts, in a similar manner, there is interposed between the opposite ends of the cylinder 86 and the cylinder-head 89 a packing-ring 93 which also serves to guard against the leakage of fluid. Arranged for reciprocal movement in the cylinder 86 is a piston, generally designated by the reference character 94, which is rigidly attached to the reduced forward end 95 of a piston-rod 96 which extends through the cylinder-head 88 and is supported in the latter by an apertured cap 97 having a flange 98 projecting into an annular packing-recess 99 in the said cylinder-head 88, so as to compress suitable packing-rings 100 therein, to guard against the leakage of fluid from the hydraulic operating-structure 85.

The piston 94, before referred to, which is mounted upon the reduced forward end of the piston-rod 96 includes a ring-like body-member 101, a clamping-ring 102, and a spacing-ring 103. To guard against leakage between the body-member 94 and the reduced end 95 of the piston 96, a packing-ring 104 is interposed between the forwardly-facing shoulder 105, formed at the junction of the piston-rod 96 proper and its reduced portion 95, and a rearwardly-facing shoulder formed on the body-member 101. Located on each of the respective opposite sides of the spacing-ring 103 of the piston 94 are packing-rings 106—106 which are formed of suitable flexible packing material of U-shaped form in cross-section. As shown in Fig. 8, the packing-rings 106—106 are faced in opposite directions, so that the leakage of fluid past the piston 94 in either direction is effectively guarded against. The body-member 101, clamping-ring 102 and the parts carried by the said body-member are retained in place by a retaining-nut 107 which is threaded onto the externally-threaded forward end of the reduced portion 95 of the piston-rod 96, before referred to.

For the purpose of alternately admitting water or other fluid into the rear end of the cylinder-structure 85 and permitting the outflow of such fluid therefrom, the cylinder-head 88 is provided with a fluid-passage 108 with which piping 109 is in communication. For the same purpose, with respect to the opposite end of the hydraulic operating-structure 85, the cylinder-head 89 is formed with a fluid-passage 110 with which the adjacent end of a pipe-line 111 is in communication. The said pipe-lines 109 and 111 are connected to suitable control-valves, as will hereinafter appear.

As above described, the pipe-lines 109 and 111 are in communication with the respective opposite ends of the hydraulic operating-structure 85, to serve alternately as inlet- and outlet-pipes. By this arrangement (Fig. 7), water under pressure may be admitted to the forward end of the cylinder 86 to act on the front face of the piston 94 and force the piston rearwardly. Alternately, water under pressure admitted to the rear end of the cylinder will act on the rear face of the piston 94 to move the same forwardly. When water under pressure is supplied through the piping 109, or, alternately, through piping 111, the water is discharged from the hydraulic operating-structure 85, by way of the pipe 111, or the pipe 109, respectively.

In accordance with the present invention, means are provided for transmitting the movements of the piston or drive-member 94 to cause the shaft 72 and sprocket-wheels 73 to rotate in opposite directions, as may be desired, and it is a feature of the invention, that the transmitting-means include motion-multiplying mechanism.

In the embodiment of the invention illustrated, there is welded or otherwise permanently secured to the rear end of piston-rod 96 a rack-bar 113, which is arranged for guided travel in opposite directions over the base-plate 70. Between bearing-standards 114—114 (Fig. 6) carried on the base-plate 70 at one side thereof, there is arranged a channeled guide-block 115 and the rack-bar 113 reciprocates in the channel of the said block 115. Each bearing-standard 114 at its upper end is formed to provide a bearing-collar 116 for the adjacent end of a stub-shaft 117.

Mounted fast on the stub-shaft 117, between the bearing-standards 114, is a pinion 118 and a gear 119. The pinion is mounted on the shaft 117 above the channel in the guide-block 115, in which the rack-bar 113 moves, at a distance providing for the proper meshing of the teeth of rack-bar 113 with the teeth of pinion 118.

The shaft 72, carrying the sprocket-wheels 73—73, is arranged above the stub-shaft 117. One end of shaft 72, extends beyond one of its bearing-supports 71 and mounted fast on this end of the shaft, directly above the gear 119, is a pinion 120 meshing into the said gear 119.

As will be clear, the movements transmitted by the gear 119 will be multiplied at the pinion 120, causing the pinion to rotate the shaft 72 and the sprocket-wheels 73 at a faster rate than the rate of rotation of the shaft 117. At the sprocket-wheels 73—73 another multiplication of movement occurs and is delivered to the chains 75, which, in turn, reciprocate the carriage 36 along the rails 59—59.

There are several advantages associated with the above-described arrangements. The rectilinear movement of the drive-member or piston 94 is translated into rotative movement, the rotative movement is multiplied and is again translated into multiplied rectilinear movement of the carriage 36. This makes for simplification of the

apparatus and economy of operation. Applied to the hydraulically-controlled embodiment shown, the arrangements described allow of the use of a small cylinder and a piston having a comparatively short stroke. For operating a carriage a distance of some 18 feet or more, as required for a draw-bench of the type here taken as an example, the stroke need be no more than a few feet, and the cylinder need be of but slightly-greater length. A simple and compact arrangement is thus secured which is economical in cost and operation, and which economizes space.

It will also be noted, that, in the arrangement shown, the train of gearing-mechanism is completely assembled at the rear of feed-table 13 and between the floor and the cylinder 22 for plug-rod 18, thus utilizing space which, ordinarily, would be wasted.

When plug-rod 18 has been advanced to position, its plug 20 in a tube and in the draw-die 12 and the carriage 36 has been separately driven forward into position to support the said plug-rod intermediate its respective opposite ends, it is desirable under some circumstances, as the tube is being drawn and plug-rod 18 is subjected to strain at its plug-end, that the supporting-carriage 36 be caused to progressively move to support the plug-rod 18 at any desired point. It is also desirable that the forward supporting movement of carriage 36 be stopped at a place with reference to the plug-rod 18 at a predetermined distance rearwardly of plug 20 where it will provide adequate support for the said plug-rod. In this manner, as the drawing of a tube proceeds, advantage is taken of the forward movement of the tube, to advance the support for plug-rod 18 closer to the plug end of the said plug-rod, and to arrest the forward movement at a place where proper support will continue to be provided for the portion of plug-rod 18 extending behind carriage 36.

The arrangement also provides that normally the major portion of the travel of carriage 36 occurs along the rear half of feed-table 13. The carriage 36 in its return movement is caused to travel along substantially all of the rear half of feed-table 13 and is brought to rest closely adjacent the forward face of the cylinder-head 21, where it will not interfere with plug 20 upon the return movement of plug-rod 18 which then can be returned to a position with its plug 20 closely adjacent the front face of the carriage 36. In this manner, substantially the full length of feed-table 13 is made available to receive a tube.

Another desirable feature of the arrangements here shown and described, is to provide hydraulically-operating driving-mechanism for the plug-rod 18; hydraulically-operated driving-mechanism for separately operating carriage 36 to support the said plug-rod; and a simple unitary control for the operation of the respective drive-mechanisms.

In Fig. 9 is shown schematically valve-control means, generally designated by the reference characters 121 and 122, respectively designed for controlling the flow of fluid into and out of the cylinder-structure and the operating-structure 22 and 85 respectively. The control-valve 121 comprises a body 123 housing a rotary disk 124, which latter is formed in its periphery with two diametrically-opposite arcuate port-connecting channels 125 and 126. At diametrically-opposite points, the body 123 is formed with a fluid-inlet port 127 and a fluid-outlet port or drain-port 128. The body 123 of the control-valve means 121 is also formed with two diametrically-opposite fluid-ports 129 and 130 arranged at a right angle to the ports 127 and 128, before referred to. When the rotary disk 124 is turned into the position in which it is shown in Fig. 9, its port-connecting channel 125 serves to interconnect the inlet-port 127 with the port 129, and the port-connecting channel 126 serves to interconnect the port 130 with the outlet- or drain-port 128.

When the operating-handle 124*a* of the rotary disk 124 of the control-valve means 121 is turned into the position in which it is shown by broken lines in Fig. 9, its port-connecting channel 125 will be moved into position to connect the port 129 with the drain-port 128 and the port-connecting channel 126 will be moved into position to connect the inlet-port 127 with the port 130. When the operating-handle 124*a* is moved into a position intermediate the two positions respectively indicated by the full and broken lines, its port-connecting channels 125 and 126 will be in such position as not to interconnect any two of the ports of the control-valve means 121.

The control-valve means 122 also includes a body 131 housing a rotary disk 132 which has rigidly secured to it an operating-handle 132*a* by means of which the said disk may be turned within the housing 131. The disk 132 is formed in its periphery with two diametrically-opposite arcuate port-connecting channels 133 and 134, as is clearly shown in Fig. 9. When the handle 132*a* of the disk 132 is in the position in which it is indicated by full lines in Fig. 9, it may be considered to be in its inoperative or non-functioning position. When, however, the operating-handle 132*a* is moved into the position in which it is indicated by the broken lines A in Fig. 9, the port-connecting channel 133 of the disk 132 will be brought into position to interconnect an inlet-port 135 and a lateral port 136 to which the pipe 109, before referred to, is connected. When the parts are in this position, the port-connecting channel 134 will be in position to interconnect a lateral port 137 with a drain-port 138. When, however, the operating-handle 132*a* of the rotary disk 132 is turned into the position indicated by broken lines B, the said disk 132 will be moved into such position that its port-connecting channel 133 will interconnect the ports 136 and 138 and the port-connecting channel 134 will interconnect the ports 135 and 137.

Leading from a source of hydraulic pressure, such, for instance, as a hydraulic accumulator (not shown), is a supply-pipe 139 having two branches 140 and 141 respectively leading to the ports 127 and 135 in the control-valve means 121 and 122 respectively. A drain-pipe 142 is also employed which has two branches 143 and 144 respectively leading from the drain-ports 128 and 138 of the control-valve means 121 and 122 respectively.

The piping system 34 which is connected to the cylinder-head 21 of the hydraulic cylinder-structure 22 is also connected to the port 130 of the control-valve means 121. Similarly, the piping-system 35 which is connected to the bonnet 31 of the hydraulic cylinder-structure 22 is also connected to the port 129 of the control-valve structure 121.

The piping-system 109 which is connected to the cylinder-head 88 of the hydraulic cylinder-structure 85 is also connected to the lateral port 136 of the control-valve means 122. Similarly, the piping-system 111 which is connected to the cylinder-head 89 of the hydraulic cylinder-struc-

ture 85 is also connected to the lateral port 137 of the said control-valve means 122, so that the entry of fluid under pressure into either end of the cylinder-structure 85 and the drainage of fluid therefrom is placed under the control of the said control-valve means 122.

When it is desired to draw a tube, such, for instance, as the tube 145, shown in Fig. 2, the carriage 36 and the plug-rod 18, if not already in such position, are fully retired to the rear of the apparatus which, as viewed in Figs. 1 and 2, would be to the left, until the carriage 36 stands immediately in front of the cylinder-head 21 and the draw-plug 20 is immediately in front of or to the right of the said carriage 36.

The retiring movement of the plug-rod 18 and the parts carried thereby may be effected by turning the handle 124a of the control-valve means 121 into the position indicated by broken lines in Fig. 9 to thus cause the port-connecting channel 126 to interconnect the inlet-port 127 with the lateral port 130 and simultaneously cause the port-connecting channel 125 to interconnect the lateral port 129 with the drain-port 128. Under such conditions, water or other fluid under pressure will pass from the supply-pipe 139 through the piping-system 34 and into the cylinder-structure 22 at a point forwardly of the piston 23, which latter will be moved rearwardly and such fluid as may be located in the cylinders to the rear of the said piston 23 will be forced outwardly through the piping-system 35, thence through the channel 125 of the control-valve means 121, to the drain-pipe 142.

To effect the rearward movement of the carriage 36, the operating-handle 132a will be moved into the position B indicated in Fig. 9, to thereby cause the port-connecting channel 134 of the control-valve means 122 to interconnect the inlet-port 135 with the lateral port 137, and simultaneously cause the port-connecting channel 133 to interconnect the lateral port 136 with the outlet-port 138.

Under the conditions just described, fluid under pressure will pass from the supply-pipe 139 through the features 135, 134 and 137 of the control-valve means 122, to the piping-system 111 and thence into the forward end of the hydraulic cylinder-structure 85 at a point forwardly of the piston 94 therein. Said piston, together with the piston-rod 96 and rack 113, will be moved rearwardly by the fluid pressure referred to and such water as may be located in the cylinder 86 to the rear of the piston 94, will be ejected through the port 108 and piping-system 109, thence through the features 136, 133 and 138 of the control-valve means 122, to the drain-pipe 142.

With the carriage 36 and the plug-rod 18 fully retired in the manner above described, a tube to be drawn such as 145 may be placed upon the parallel pads 16—16 after having first been provided with a reduced portion 146 which is commonly referred to as the "point" of the tube and which is a common expedient in the art.

Into the point 146 of the tube there is introduced from the rear end thereof the so-called "draw-head" or "draw-hook" generally designated by the reference character 147 and comprising a ring-like rear terminal 148 and a forwardly-extending shank 149 which is adapted to be connected in any suitable manner to very powerful means which will draw the same forwardly and effect the drawing of the tube 145. As shown, a retaining-ring 150 is installed over the exterior of the point 146 of the tube 145 to prevent the pulling out of the draw-head or draw-hook 147.

After the tube 145 is placed upon the longitudinal pads 16—16 and forwardly of the carriage 36, the said tube may be pushed forwardly to project its point 146 through the draw-die 12 by manipulating the handle 124a of the control-valve means 121 to admit water to the rear end of the cylinder-structure 22 and to permit the escape of water from the forward portion thereof, to thus move the plug-rod 18 forwardly, and the plug 20 thereof may frictionally engage the interior of the tube adjacent the point 146 thereof and cause the tube to be moved forwardly. After the forward end of the tube 145 has been projected into the draw-die 12, the forward movement of the plug-rod 18 will be continued until the plug 20 is properly positioned within the said draw-die. The carriage 36 may be also utilized to thrust the tube 145 forwardly by manipulating the handle 132a of the control-valve means 122 so as to admit water under pressure into the rear end of the hydraulic cylinder-structure 85 and permit the escape of water from the forward end thereof.

As before indicated, the draw-head or draw-hook 147 is connected with suitable power-means (not shown) which will pull forwardly on the said tube 145 to draw the same between the outer periphery of the draw-plug 20 and the inner periphery of the draw-die 12.

Under some conditions and prior to reaching its fully forward position within the draw-die 12, the draw-plug 20 will be required to force its way into the rear end and longitudinally through the tube 145 to expand the tube before the same is drawn as before described. Under these conditions, great deflecting strains are imposed upon the plug-rod 18 which, however, are effectively resisted by the carriage 36 which may be shifted back and forth with reference to the said plug-rod to the most advantageous position for resisting the deflections referred to.

Thus, by providing the power-operative carriage 36 not only may the plug-rod 18 or its equivalent be held against harmful deflection, but the said carriage may be utilized to assist in the drawing of a tube by thrusting against the rear end thereof at the same time that the draw-hook 147 is being pulled forwardly.

The movement of the plug-rod 18 in either direction may be halted at any desired position by swinging the operating-handle 124a of the control-valve means 121 so that the same stands vertically, in which case the disk 124 will be so turned that neither one of its port-connecting channels 125 or 126 will interconnect any two of the ports 127, 128, 129 or 130. In a similar manner, the movement of the piston 94 within the cylinder-structure 85 may be halted at any desired position of adjustment to similarly halt the carriage 36 by moving the disk 132 of the control-valve means 122 into the position in which it is indicated in Fig. 9.

After the tube has been drawn completely through the draw-die 12, the draw-plug 20 may be retired by turning the operating-handle 124a of the control-valve means 121 into the position in which it is shown in broken lines in Fig. 9, to thereby admit fluid under pressure to the forward end of the cylinder-structure 22 and to provide a free path for the egress of fluid located to the rear of the piston 23 therein. The carriage 36 must, of course, be retired rearwardly either as or prior to the rearward movement

of the draw-plug 20, as just described. The rearward movement of the carriage 36 may be effected by shifting the operating-handle 132a of the control-valve means 122 into the position B as shown in Fig. 9. The shifting of the handle 132a, as just described, will move the disk 132, so that the channel 134 thereof will interconnect the ports 135 and 137 and similarly the channel 133 will interconnect the ports 136 and 138. This will result in the supplying of fluid under pressure to the forward end of the cylinder-structure 85 and the drainage of such water as may be located to the rear of the piston 94 therein, outwardly through the drain-pipe 142. The parts will now have been restored to a condition in readiness for the beginning of another cycle of operation, to effect the drawing of another tube.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

We claim:

1. A draw-bench structure including in combination: a frame-structure carrying a die-head at one end thereof and provided with a carriage guide-way extending substantially throughout the length of the frame-structure; a reciprocating plug-rod movable axially in a direction parallel with the guide-way of the said frame-structure; means for axially moving the said plug-rod in opposite directions over substantially the entire length of the said guide-way; a plug-rod-supporting carriage supported on and movable along the major portion of the length of the guide-way of the said frame-structure, the said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and being provided with guide-means through which the said plug-rod extends and which engage with the said plug-rod for supporting the same against transverse deflections; and reversible power-driven operating-means connected to the said carriage and operable to move the same along the said major portion of the guide-way of the said frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guide-way traveled by the carriage.

2. A draw-bench structure including in combination: a frame-structure carrying a die-head at one end thereof and provided with a carriage guide-way extending substantially throughout the frame-structure a reciprocable plug-rod movable axially and parallel to the guide-way of the said frame-structure; means for axially moving the said plug-rod in opposite directions over substantially the entire length of the said guide-way; a plug-rod-supporting carriage supported on and movable along the major portion of the length of the guide-way of the said frame-structure, said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and also being formed to provide a passage for the plug-rod; a bearing-member arranged in the passage over the plug-rod, the inner surface of the bearing-member and the lower wall-section of the passage being of arcuate shape, for engaging and supporting the plug-rod against transverse deflections; and reversible power-driven operating means connected to the said carriage and operable to move the same along the said major portion of the guide-way of the said frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guide-way traveled by the carriage.

3. A draw-bench structure including in combination: a frame-structure carrying a die-head at one end thereof and provided with a carriage guide-way extending substantially throughout the length of the frame-structure; a reciprocable plug-rod movable axially and parallel to the guide-way of the said frame structure; means for axially moving the said plug-rod in opposite directions over substantially the entire length of the said guide-way; a plug-rod-supporting carriage supported on and movable along the major portion of the length of the guide-way of the said frame-structure, said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and also being formed to provide a passage for the plug-rod; a bearing-member arranged in the passage over the plug-rod, the inner surface of the bearing-member and the lower wall-section of the passage being of arcuate shape, for engaging and supporting the plug-rod against transverse deflections; shock-absorbing means connecting the bearing-member to the carriage; and reversible power-driven operating-means connected to said carriage and operable to move the same along the said major portion of the guide-way of the said frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guide-way traveled by the carriage.

4. A draw-bench structure including in combination: a frame-structure carrying a die-head at one end thereof and provided with a carriage guide-way extending substantially throughout the length of the frame-structure; a reciprocable plug-rod movable axially and parallel to the guide-way of said frame-structure; means for axially moving the said plug-rod in opposite directions over substantially the entire length of the guide-way; a plug-rod-supporting carriage supported on and movable along the guide-way of said frame-structure, said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and also being formed to provide a passage for the plug-rod; a bearing-member arranged in the passage over the plug-rod, said bearing-member and the lower wall-section of said passage supporting the plug-rod against transverse deflections; connections between the carriage and the bearing-member comprising a shock-absorbing spring; and reversible power-driven operating-means connected to the said carriage and operable to move the same along the said major portion of the guide-way of the said frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guide-way traveled by the carriage.

5. A draw-bench structure including in combination: a frame-structure carrying a die-head

at one end thereof and provided with a carriage guide-way extending substantially throughout the length of the frame-structure; a reciprocable plug-rod movable axially and parallel to the guide-way of the frame-structure; means for axially moving the said plug-rod in opposite directions over substantially the entire length of said guide-way; a plug-rod-supporting carriage supported on and movable along the major portion of the length of the guide-way of said frame-structure, the said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and also being formed to provide a passage for the plug-rod, a bearing-member arranged in the passage, over the plug-rod, said bearing-member and the lower wall-section of said passage supporting the plug-rod against transverse deflections; connections between the carriage and the bearing-member comprising a screw-shaft adjustable in the carriage, a spring-seat carried at one end of said screw-shaft, and a compression-spring seated at one end against the spring-seat carried by the screw-shaft, and seated at its opposite end on said bearing-member; and reversible power-driven operating-means connected to said carriage and operable to move the same along the said major portion of the guide-way of said frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guideway traveled by the carriage.

6. A draw-bench structure including in combination: a frame-structure carrying a die-head at one end thereof and provided with a carriage guide-way extending substantially throughout the length of the frame-structure; a reciprocable plug-rod movable axially and parallel to the guide-way of said frame-structure; means for axially moving the plug-rod in opposite directions over substantially the entire length of the said guide-way; a plug-rod-supporting carriage supported on and movable along the major portion of the length of said guide-way; said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and also being formed to provide a passage for the plug-rod; a bearing-member arranged in the passage over the plug-rod, said bearing-member and the lower wall-section of said passage supporting the plug-rod against transverse deflections; connections between the carriage and the bearing-member comprising a shock-absorbing compression-spring and means for adjusting said spring; wheels mounted on the carriage for travel on the carriage guide-way; and reversible power-driven operating-means connected to the said carriage and operable to cause the carriage to be rolled along the said major portion of the guide-way of said frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guide-way traveled by the carriage.

7. A draw-bench structure including in combination: a frame-structure carrying a die-head at one end thereof and provided with a carriage guide-way extending substantially throughout the length of the frame-structure; a reciprocable plug-rod movable axially and parallel to the guide-way of said frame-structure; means for axially moving the plug-rod in opposite directions over substantially the entire length of the said guide-way; a plug-rod-supporting carriage supported on and movable along the major portion of the length of the guide-way of said frame-structure, the said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and being provided with guide-means through which the said plug-rod extends and which engage with said plug-rod for supporting the same against transverse deflections; wheels mounted on and at opposite sides of said carriage and supported on longitudinally-extending portions of the guide-way for travel on the carriage guide-way; reversible operating-means connected to said carriage, and operable to cause the carriage to be rolled along the said portion of the guide-way of said frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guide-way traveled by the carriage; and cooperating limit-means for guiding the carriage, said limit-means comprising a side-surface of the wheel-supporting portion of the guide-way at each side of said frame-structure, and a guide-portion provided at each side of the carriage for engagement with said surfaces of the guide-way to prevent transverse movements of the carriage.

8. A draw-bench structure including in combination: a frame-structure carrying a die-head at one end thereof and provided with a carriage guide-way extending substantially throughout the length of the frame-structure; a reciprocable plug-rod movable axially and parallel to the guide-way of said frame-structure; means for axially moving said plug-rod in opposite directions over substantially the entire length of said guide-way; a plug-rod-supporting carriage supported on and movable along the major portion of the length of the guide-way of said frame-structure, the said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and being provided with guide-means through which said plug-rod extends and which engage with said plug-rod for supporting the same against transverse deflections; wheels mounted on and at opposite sides of the carriage and supported on longitudinally-extending portions of the guide-way for travel on the carriage guide-way; reversible operating-means connected to said carriage and operable to cause the carriage to be rolled along the said major portion of the guide-way of said frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guide-way traveled by the carriage and cooperating limit-means for guiding the carriage, said cooperating limit-means comprising an undercut formed in and extending longitudinally in the wheel-supporting portion of the guide-way at each side of the frame-structure, and a foot-piece provided at each side of the carriage for engaging the undercut of the guide-way to prevent rocking movements of the carriage in the axial direction of said plug-rod.

9. A draw-bench structure including in combination: a frame-structure carrying a die-head at one end thereof and provided with a carriage guide-way extending substantially throughout the length of the frame-structure; a reciprocal plug-rod movable axially and parallel to the guide-way of the frame-structure; means for axially moving said plug-rod in opposite direc-

tions over substantially the entire length of the said guide-way; a plug-rod-supporting carriage supported on and movable along the major portion of the length of the guide-way of said frame-structure, the said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and being provided with guide-means through which said plug-rod extends and which engage with said plug-rod for supporting the same against transverse deflections; wheels mounted on and at opposite sides of the carriage and supported on opposite longitudinally-extending portions of the guide-way for travel on the carriage guide-way; reversible operating-means connected to said carriage and operable to cause the carriage to be rolled along the said major portion of the guide-way of said frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guide-way traveled by the carriage; and cooperating limit-means for guiding the carriage, comprising a laterally-facing surface and a downwardly-facing surface formed in and extending longitudinally of the wheel-supporting portion of the guide-way at each side of the said frame-structure, a guide-bar and a foot-piece provided at each side of the carriage for engaging the said laterally-facing surface and the said downwardly-facing surface respectively of the wheel-supporting portion of the said guide-way at each side of the frame-structure, whereby lateral displacement and rocking movements of the carriage are avoided.

10. A draw-bench structure including in combination: a frame-structure carrying a die-head at one end thereof and provided with a carriage guide-way extending substantially throughout the length of the frame-structure; a reciprocable plug-rod movable axially and parallel to the guide-way of said frame-structure; means for axially moving the plug-rod in opposite directions over substantially the entire length of the said guide-way; a plug-rod-supporting carriage supported on and movable along the major portion of the length of the guide-way of said frame-structure, said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and also being formed to provide a passage for said plug-rod; a bearing-member arranged in the passage over the said plug-rod, said bearing-member and the lower wall-section of said passage supporting the plug-rod against transverse deflections; connections between the carriage and said bearing-member, said connections including a shock-absorbing spring; wheels mounted on the said carriage and supported on opposite longitudinally-extending portions of the guide-way for travel on the carriage guide-way; reversible power-driven operating-means connected to said carriage and operable to cause the carriage to be rolled along the said major portion of the guide-way of said frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guide-way traveled by the carriage; and cooperating limit-means for guiding the carriage, comprising a pair of opposed side-surfaces, and an under-cut formed in and extending longitudinally in the wheel-supporting portion of the guide-way at each side of said frame-structure, a guide-bar and a foot-piece provided at each side of the carriage for engaging one of said side-surfaces and one of said under-cuts respectively of the wheel-supporting portion of the guide-way at each side of the frame-structure, whereby lateral movements and rocking movements in the axial direction of the said plug-rod, are avoided.

11. A draw-bench structure including in combination: A frame-structure carrying a die-head at one end thereof provided with a carriage guide-way extending substantially throughout the length of the frame-structure; a reciprocable plug-rod movable axially and parallel to the guide-way of said frame-structure; means for axially moving said plug-rod in opposite directions over substantially the entire length of the said guide-way; a plug-rod-supporting carriage supported on and movable along the major portion of the length of the guide-way of said frame-structure, the said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and being provided with guide-means through which said plug-rod extends and which engage with the said plug-rod for supporting the same against transverse deflections; reversible power-driven operating-means connected to the said carriage and operable to move the same along the said major portion of the guide-way of the said frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guide-way traveled by the carriage; and the said operating means being operable in moving the said carriage to shift it along substantially the entire rear half of the guide-way and to limit forward movement of the carriage along the front half of the guide-way at an intermediate point thereof at a predetermined distance rearward of the plug end of said plug-rod.

12. A draw-bench structure including in combination: a frame-structure carrying a die-head at one end thereof and provided with a carriage guide-way extending substantially throughout the length of the frame-structure; a reciprocable plug-rod movable axially and parallel to the guide-way of the said frame-structure; means for axially moving the said plug-rod in opposite directions over substantially the entire length of the said guide-way; a plug-rod-supporting carriage supported on and movable along the major portion of the length of the guide-way of the said frame-structure, the said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and being provided with guide-means through which the said plug-rod extends and which engage with the said plug-rod for supporting the same against transverse deflections; and reversible operating-means for the said carriage comprising a power-responsive member, and connections between said member and the carriage comprising motion-multiplying mechanism for causing the carriage to move along the major portion of the length of said guide-way of the frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guide-way traveled by the carriage.

13. A draw-bench structure including in combination: a frame-structure carrying a die-head at one end thereof and provided with a carriage guide-way extending substantially throughout the length of the frame-structure; a reciprocable

plug-rod movable axially and parallel to the guide-way of the said frame-structure; means for axially moving the said plug-rod in opposite directions over substantially the entire length of the said guide-way; a plug-rod supporting carriage supported on and movable along the major portion of the length of the guide-way of the said frame-structure, the said carriage being dimensioned to extend along a relatively-short portion of the said plug-rod and being provided with guide-means through which the said plug-rod extends and which engage with the said plug-rod for supporting the same against transverse deflections; and reversible operating-means for the carriage comprising an hydraulic cylinder, means for admitting water under pressure to, and discharging water from, the cylinder alternately at opposite ends thereof, a double-acting piston in the cylinder, a piston-rod connected to said cylinder, and connections between said piston-rod and said carriage including a speed-multiplying gear-train, a sprocket-wheel, and a chain passing about and engaged by teeth of the sprocket-wheel, the opposite ends of the chain being connected to the said carriage for moving the same along the said major portion of the said guide-way of the frame-structure to support the plug-rod by the engagement in the said carriage of any of several relatively-short portions thereof aggregating the length of the plug-rod extending over the said major portion of the guide-way traveled by the carriage.

14. A draw-bench structure including in combination: a frame-structure provided with a carriage guide-way; a reciprocable plug-rod; reversible operating-means for reciprocating the said plug-rod including an axially-movable hydraulic cylinder, a double-acting piston located in the said cylinder and operatively connected to the said plug-rod, and adjusting-means for adjusting the said cylinder lengthwise of itself to vary the extended position of the said plug-rod; a plug-rod supporting-carriage movable along the guide-way of the said frame-structure and provided with guide-means supporting the said plug-rod against transverse deflections; and reversible operating-means for the said carriage for moving the same along the guide-way of the said frame-structure into various positions of adjustment axially along the length of the said plug-rod.

15. A draw-bench structure including in combination: a frame-structure provided with a carriage guide-way; a reciprocable plug-rod; a reversible operating-means for reciprocating the plug-rod; a plug-rod-supporting carriage movable along the guide-way of the said frame-structure and provided with guide-means through which the said plug-rod extends and which engage with the said plug-rod for supporting the same against transverse deflections; and reversible operating-means for the carriage; the reversible operating-means for the plug-rod, and the reversible operating-means for the carriage each comprising an hydraulic cylinder, means individual to each cylinder for admitting water under pressure to, and discharging water from the cylinders alternately at opposite ends of each of said cylinders; a double-acting piston in each of said cylinders, means connecting the piston in one of said cylinders with the plug-rod for causing reciprocable, axial movements of the plug-rod, parallel to said guide-way, said first-named cylinder being bodily adjustable in axial direction to adjust the position of said plug-rod; a piston-rod connected to the piston in the second cylinder, and connections between said piston-rod and said carriage for causing the carriage to move along the guide-way of said frame-structure into various positions of adjustment axially along the length of the said plug-rod.

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