April 18, 1933. E. W. LARSEN 1,904,147

WIRE DRAWING MACHINE

Filed Dec. 31, 1929 4 Sheets-Sheet 1

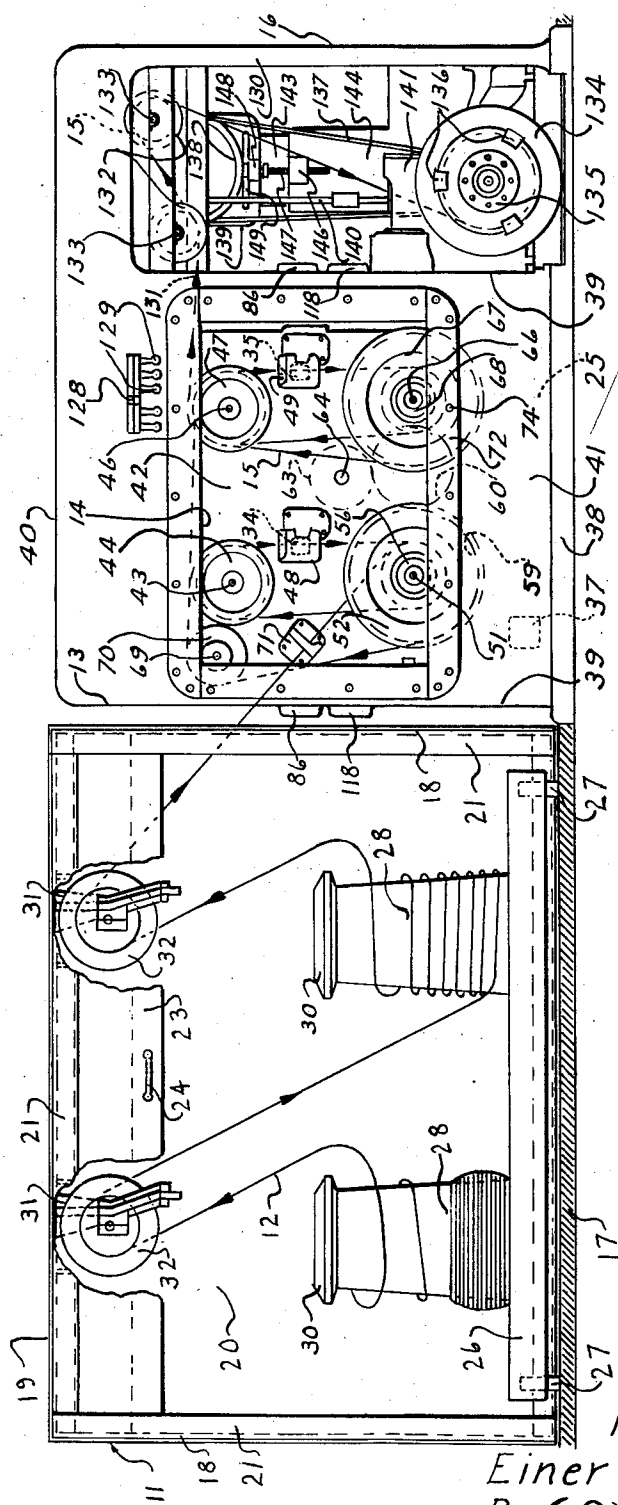


Fig. 1.

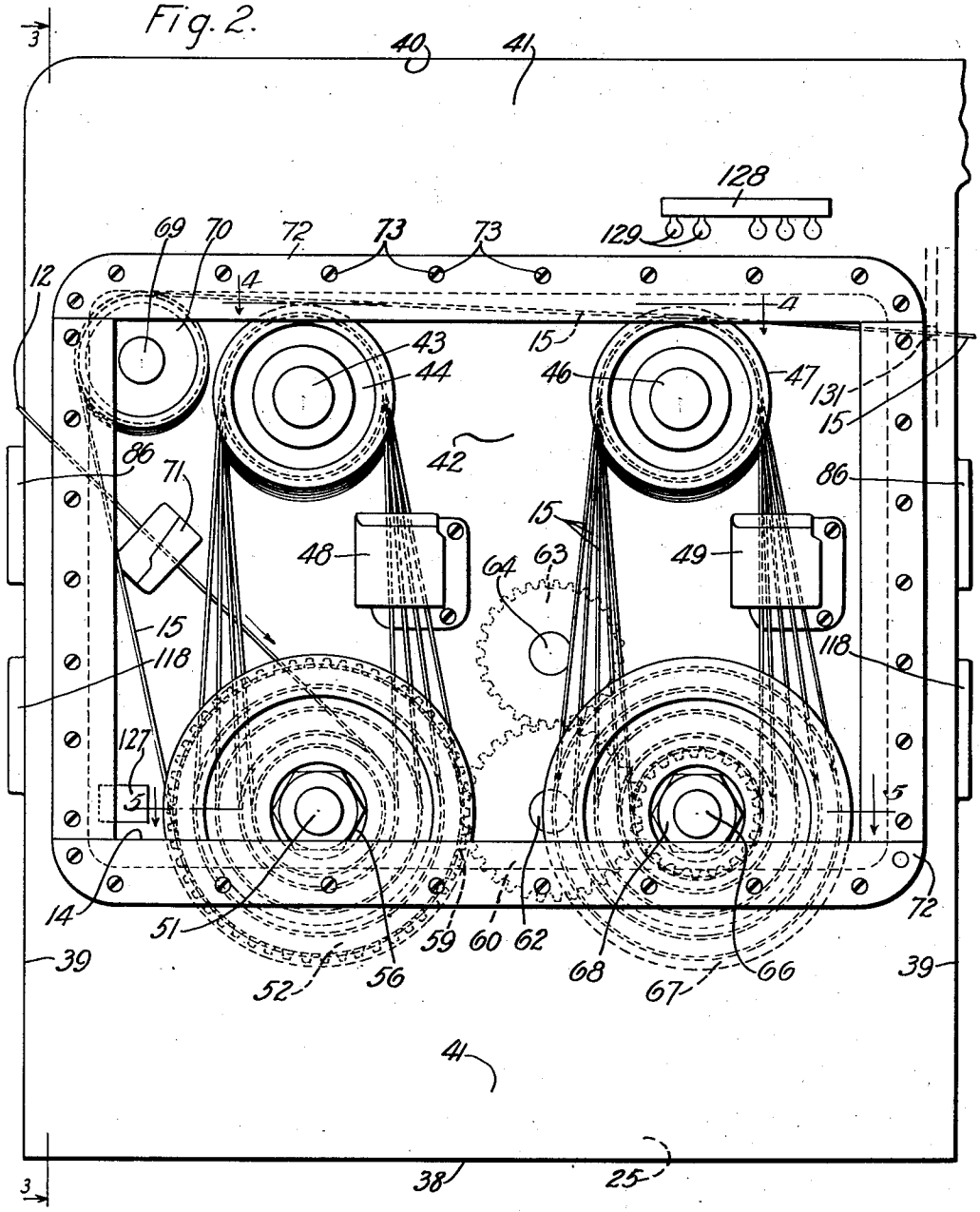
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WIRE DRAWING MACHINE

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Fig. 2.



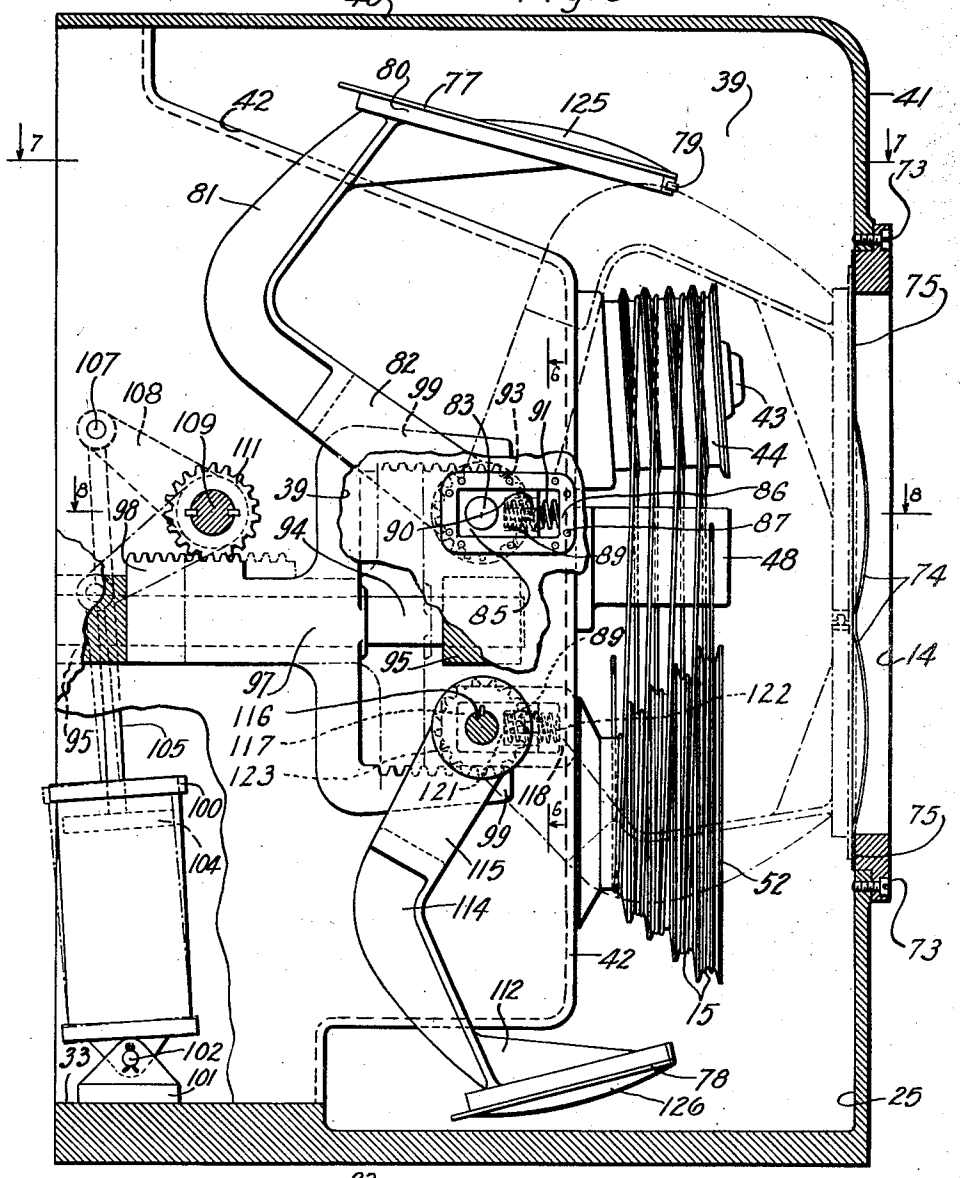
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WIRE DRAWING MACHINE

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Fig. 3.



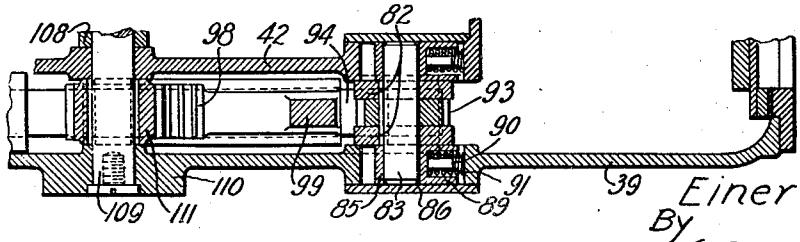


Fig. 8.

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WIRE DRAWING MACHINE

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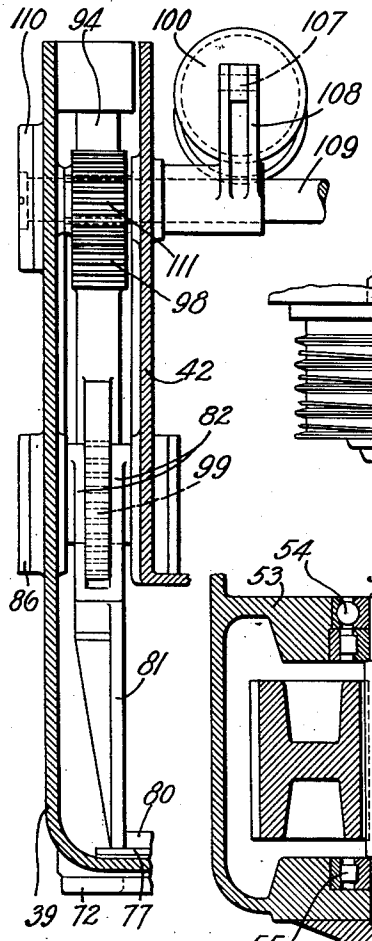


Fig. 7.

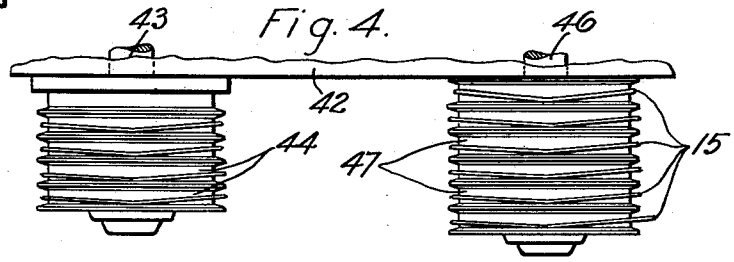


Fig. 4.

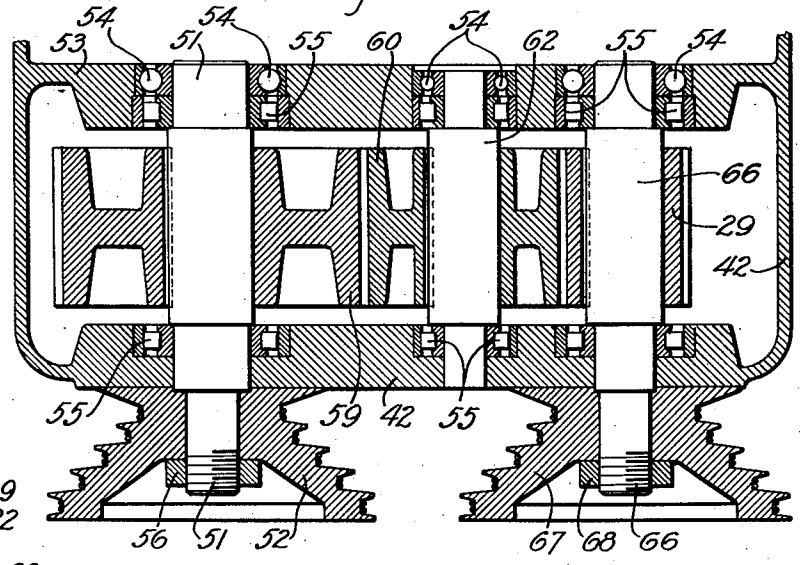


Fig. 5.

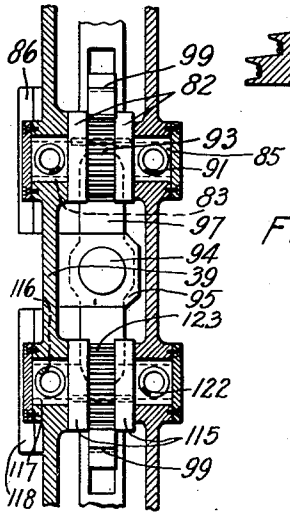


Fig. 6.

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UNITED STATES PATENT OFFICE

EINER W. LARSEN, OF CHICAGO, ILLINOIS, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

WIRE DRAWING MACHINE

Application filed December 31, 1929. Serial No. 417,623.

This invention relates to an apparatus for treating material, and more particularly to an apparatus for treating strand material at high speeds.

An object of the invention is to provide an apparatus for working strand material at high speed which will be compact, easy of access and efficient in operation. Further objects of the invention are to provide suitable housing for the strand working apparatus as will cause it to be safe and efficient in operation, and closure means for the housing which will be facile of operation, permit a tight seal of the housing, and afford a high economy of the materials used in working the strand.

In accordance with these and other objects, an embodiment of the invention contemplates the provision, in a wire drawing chamber, of four shafts arranged in a rectangular formation, two being driven by gearing from a suitable source of power to rotate stepped capstans mounted thereon, and others being stationary and inclined slightly, and carrying idler sheaves over which pass the wire being drawn by the capstans. The chamber is provided with quick closing doors which, being mounted upon pivoted L-shaped members, are movable to close the chamber after stringing, with a liquid-tight seal by means of bifurcated racks which, moving in one direction rotate the L-shaped members to bring them together, and then carry them bodily forward in closed position to tightly seal the aperture while the machine is in operation. To string the machine, the doors are opened by reversing the action of the bifurcated members, the path followed by the doors during both operations lying wholly within the chamber.

A thorough understanding of the structure and operation of the invention is afforded by the following detailed description, taken in conjunction with the accompanying drawings forming a part thereof, in which

Fig. 1 is a front elevation of a high speed wire drawing machine constituting an embodiment of the invention, showing the routing of the wire schematically;

Fig. 2 is an enlarged fragmentary elevation of the drawing compartment shown in Fig. 1;

Fig. 3 is a section taken on the line 3—3 of Fig. 2, showing the doors in open position;

Fig. 4 is a section taken on the line 4—4 of Fig. 2 showing the idler sheaves in plan;

Fig. 5 is a section taken on the line 5—5 of Fig. 2 showing the capstans and capstan drive in section;

Fig. 6 is a fragmentary section taken on the line 6—6 of Fig. 3;

Fig. 7 is a fragmentary section taken on the line 7—7 of Fig. 3, showing the doors closed, and

Fig. 8 is a section taken on the line 8—8 of Fig. 3 showing the doors closed.

Referring now to the drawings in which similar elements are designated by identical reference numerals, a wire drawing apparatus consists of a supply compartment 11 (Fig. 1) for handling rod stock 12, a drawing compartment 13 wherein the rod stock 12 is reduced to wire 15, and a take-up compartment 16 all mounted upon a common foundation or floor 17. The supply compartment 11 consists of oppositely disposed side walls 18—18, a roof 19 and a rear wall 20 which are braced and secured together by angle beams 21. For closing the supply compartment during operation of the apparatus there is provided a folding door 23 having a handle 24 by means of which the door may be manually raised to roll against the inner surface of the roof 19 by any suitable mechanism (not shown) or may be lowered to close the compartment. A portable platform 26, having wheels 27, is provided upon its upper surface with a pair of truncated cone-shaped posts 28—28, having suitable guard flanges 30—30 superposed thereon. Suspended from the roof 19 of the supply compartment are a pair of brackets 31—31, each arranged to support therein an idler pulley 32.

The drawing compartment 13 consists of a bed plate 38, which is sunken into the foundation 17, sides 39—39, roof 40 and a front portion 41, having an aperture 14 to permit access to the drawing compartment 13. Extending from the rear portion of the roof 40

to the bed plate 38 and from the right to the left wall 39, and welded to such portions of the drawing compartment as to divide it into front and rear sections 25 and 33, respectively, is a partition or housing 42. The housing 42 extends forward at the center in the manner shown in Fig. 3 to form a support for a stationary shaft 43 (Figs. 2, 3 and 4) upon which are mounted four low speed idler sheaves 44, 44 in any suitable manner to permit their free rotation with a minimum of friction. To the right of the shaft 43 is a similar shaft 46 upon which are mounted six high speed idler sheaves 47, 47 which are also mounted to permit their free rotation about the shaft 46 with a minimum of friction. It will be understood that the shafts 43 and 46 are inclined slightly from the horizontal (Fig. 3) in order to distribute wear of the wire 15 as it passes over the apparatus. Below and to the right of the shaft 43 and suitably secured to the face of the housing 42 as to be maintained rigidly in position is a die box 48; and a similar die box 49 is similarly mounted upon the face of the housing below and to the right of the shaft 46. The die boxes 48 and 49, are disposed somewhat to the right of the shafts 43 and 46, respectively, their centers being directly under the peripheries of the idler sheaves 44 and 47 in order that the wire carried over the respective sheaves may pass perpendicularly through suitable reducing dies (not shown) which are customarily mounted in the die boxes 48 and 49 in the conventional manner.

For drawing the wire through the reducing dies there is keyed upon a horizontal rotatable shaft 51 (Figs. 2, 3 and 5) a stepped capstan 52. The shaft 51 is mounted in a rear portion 53 of the housing 42, substantially perpendicular to the path of the wire as it passes through the die boxes 48 and 49, by suitable ball bearings 54 (Fig. 5) and by roller bearings 55—55, and in the housing 42 by other roller bearings 55. A nut 56 cooperates with a threaded extremity of the shaft 51 to maintain the stepped capstan 52 in proper position upon the shaft during its revolution to draw the wire without slipping. The structure just described constitutes a low speed capstan, the shaft 51 of which is rotated by the co-action with a gear 59 keyed thereto of an intermediate gear 60 having a smaller diameter and a lesser number of teeth than the gear 59. The intermediate gear 60 is mounted upon a shaft 62 extending parallel with the shaft 51 and actuated from a drive gear 63 (Fig. 2) mounted upon a parallel shaft 64, the shaft 64 being rotated by any suitable source of power (not shown). To the right of the shaft 62 and parallel thereto, there is provided a similar rotatable shaft 66 carrying a stepped capstan 67 secured thereon by a nut 68. The shaft 66 carries a gear 29 which is keyed thereto and which has a smaller diameter and a lesser number of teeth than the intermediate gear 60, with which it meshes, thus constituting a high speed drawing capstan for handling the finer wire delivered from the low speed capstan 52. Like the shaft 51, the shafts 62 and 66 are horizontal and mounted in the rear portion 53 of the housing 42 by ball bearings 54 and roller bearings 55, and in the housing 42 by roller bearings 55. A horizontal shaft 69 (Figs. 1 and 2) is mounted in the housing to the left of the idler shaft 43 and carries a grooved idler pulley 70. Secured to the sides of the housing 42, beneath the idler pulley 70 is a die box 71 for containing a single reducing die, through which is threaded, and by means of which the rod stock 12 is reduced as the latter is drawn from the cone-shaped loading posts 28—28 in the supply compartment.

Behind each of the die boxes 48 and 49, respectively, the housing 42 is provided with outlets 34 and 35 (Fig. 1) through which flows, when the machine is in operation, from any suitable source continuous streams of suitable lubricating fluid (not shown) to facilitate the wire drawing and to diminish the formation of copper dust in the compartment. The fluid flows through the die boxes 48 and 49, pours upon the capstans 52 and 67 and accumulates in a pool at the bottom of the front section 25 of the drawing compartment, until it rises to a level sufficient to permit the rotating capstans 52 and 67 to become half submerged therein. To maintain this level while the wire drawing is proceeding, the fluid entering the compartment after this level is reached is drawn off through a drain 37 near the bottom of the front section of the compartment and returned to the source.

A special mechanism is provided, in order to prevent waste and splashing of the lubricating fluid outwardly into the aisle, as when the various elements within the chamber are in rapid rotation and to further the safety of the operator. Surrounding the aperture 14 of the drawing compartment 13 is a reinforcing frame 72 which is secured to the outer surface of the compartment by means of screws 73. The rear surface of each of the vertically disposed end members of the frame 72, which members are flush with the rear face of the compartment 13, is provided with a pair of vertically aligned curved recesses 74. Fixed in a suitable manner to the rear surface of the frame 72 is a gasket 75 composed of cork, rubber or other suitable material, the gasket being continuous around the aperture in the frame 72 and following the contour of the curved recesses 74. The purpose of the recesses 74 and the gasket 75 will be made apparent presently.

The mechanism for quickly closing and opening the aperture 14 consists of an upper door 77 (Fig. 3) and a lower door 78, each of which are of a width somewhat greater than that of the aperture 14. The upper door 77 is provided along one edge thereof with a projecting lip 79, composed of rubber or similar substance, which assists in forming a liquid tight seal between the doors 77 and 78 when they are together. The door 77 is also provided with a back brace 80 to which is welded and which forms a part of a pair of L-shaped arms 81—81. The L-shaped arms 81—81, which are located on either side of the housing 42, are each provided with a forked extension 82 (Figs. 6, 7 and 8), each portion thereof being perforated to receive the ends of shafts 83—83. Shafts 83—83 are rotatably mounted in individual bearings 85—85 which are mounted upon the side walls of the drawing compartment in boxes 86—86 which are secured thereto by bolts or other suitable affixing means 87—87. The bearings 85 are each provided with a recess 89, from the base of which projects a centered spring post 90. A relatively stiff compression spring 91 is mounted upon the spring post and seated against the front end of the boxes 86—86. The shafts 83—83 are each provided, between the forked extensions of the L-shaped members, with a gear 93, which is keyed to the shaft 83 so as to be rotatable therewith and with the L-shaped members. A pair of stationary horizontal beams 94—94, placed at opposite sides of the housing 42 at the inside thereof by suitable brackets 95—95, each carry a bifurcated member 97 comprising a rear toothed shank portion 98 and oppositely extending rack portions 99—99, the upper of which meshes with the gear 93.

Secured to the floor of the drawing compartment in the rear section 33 thereof is a cylinder 100 (Figs. 3 and 7) supplied with air or other fluid pressure by any conventional means (not shown). The cylinder 100 is pivotally mounted in a base 101 by a suitable shaft 102, and contains a piston 104 which is movable from one to the other end of the cylinder 100 by the fluid pressure to open or close the doors of the drawing compartment. The piston 104 of the cylinder 100 is provided with a shaft 105 which is apertured at an extremity to receive a pin 107 by means of which the shaft is connected with one end of a lever 108. The lever 108 is perforated at the opposite end to receive a shaft 109 which is keyed thereto, and which extends from side to side of the drawing compartment and rotates in suitable journal boxes 110 of the side walls 39—39. Upon the shaft 109 there are keyed at either end, gears 111—111, which respectively mesh with the toothed shank portions 98—98 of the bifurcated members 97—97.

The operation of the lower door 78 is effected from the bifurcated members 97—97 by means of a mechanism similar to that used in controlling the upper door 77. The lower door 78 is provided with a back brace 112 which is integral with a pair of L-shaped arms 114—114. The L-shaped arms 114—114 are each provided with a forked extension 115, each portion thereof being perforated to receive the ends of shafts 116—116. Shafts 116—116 are rotatable in individual bearings 117—117 mounted upon the side walls of the drawing compartments in boxes 118—118 which are secured thereto directly under the boxes 86—86, by bolts or other suitable affixing means (not shown). The bearings 117—117 are recessed at 89 from which recess projects a centered spring post 121. A relatively stiff compression spring 122 is mounted thereon and seated against the front end of the boxes 118—118. The shafts 116—116 are each provided, between the forked extensions of the L-shaped members with a gear 123, which is keyed to the shaft 116, so as to be rotatable therewith and with the L-shaped members. The lower rack portion 99 meshes with the gear 123 and causes it to rotate in an opposite direction from that of the gear 93. The front portion 41 of the drawing compartment is provided at either side of the aperture 14 with curved recesses 74—74, to accommodate the edges of the doors 77 and 78 as they are moved to opened and closed positions. The upper door 77 at each end is provided with curved projections 125—125 and the lower door 78 with similar projections 126—126, which when the doors are closed fit into and closely engage the curved recesses 74—74 of the frame 72, which surfaces, as well as the inner surface of the frame have the continuous gasket 75 fixed thereto.

A switch rack 128 is secured to the front 41 of the drawing compartment above the door guard 72 and accommodates switches 129—129, which are connected by any suitable arrangement (not shown) to regulate the functioning of the various portions of the apparatus.

The take-up compartment 16 which is immediately adjacent the drawing compartment, consists of a right wall 130 (Fig. 1) and a left wall consisting of the right wall 39 of the drawing compartment, which is provided with an aperture 131 (Fig. 2) to permit passage of the wire 15 from the drawing to the take-up compartment. The take-up unit housed therein consists of a pair of idler pulleys 132—132, mounted so as to be freely rotatable on shafts 133—133, secured in the frame of the machine for the purpose of conducting the finished wire 15 from the drawing compartment to a take-up reel 134. The take-up reel 134 is mounted upon a supporting arbor 135, which is provided with fingers

136—136, which engage the reel. The reel supporting arbor is engaged by a tex-rope or other suitable belting 137, which passes over a grooved pulley 138 mounted in the frame 139, and which is driven by suitable gearing (not shown) from a shaft 140. The shaft 140 is rotated, at any desired speed to correspond with the speed at which the wire is drawn, by an air or electric motor 141 of any conventional type. The frame 139 is secured to a block 143, which is slidably mounted with reference to a base 144 to which is secured the reel supporting arbor 135 and the motor 141. Mounted upon the front of the base 144 is a collar 146 in which is journaled an end of a threaded member 147 which extends upwardly through a collar 148, which is internally threaded to cooperate with the threaded member 147. The other end of the threaded member is apertured to receive a cross bar 149 by means of which the threaded member is rotated to raise or lower the frame supporting block 143 with respect to the base 144 for the purpose of varying the tension in the tex-rope 137 to prevent slipping.

In preparing the machine for operation a supply consisting of a coiled bundle of the copper rod stock 12 is placed over each of the truncated cone-shaped posts 30—30, and the end of the bundle on the right hand post is welded or otherwise connected to the beginning of the bundle on the left hand post, so as to form a single and continuous length of stock. The platform 26 is then rolled into the supply compartment 11 and a portion of the stock is drawn from the right hand post and passed over the right hand pulley 32. Another portion is withdrawn from the left hand post and passed over the left hand pulley 32. A greater length is then withdrawn from the right hand post and over the pulley 32 and is strung with the number of dies which it is desired to utilize in reducing the stock. In the embodiment illustrated in Fig. 2 a total of ten dies are used, each being of a different bore. After stringing the dies thereon, the stock is then passed through the die box 71 and drawn taut to engage the die having the largest bore therein. The stock is then passed around the step of the low speed capstan 56 which has the smallest diameter, is looped therearound in order to insure perfect gripping of the wire by the capstan, and is then passed over the first or innermost low speed idler sheave 44. It will be understood that the dies are strung on the stock in the order of their progressively reducing bore diameters, the die having the largest bore being strung first as pointed out above. The die having the second largest bore is then placed in the die box 48 and the stock looped around the next larger step of the low speed capstan 56. The stock is then carried over the second low speed sheave 44, as shown in Fig. 4, and passed through the die box 48, which engages the third largest die, after which the stock is looped about the next larger step of the low speed capstan 56, and the process carried out until the stock has been looped about the largest step of the low speed capstan 56, with the dies having from the second to the fifth largest bores engaged by the die box 48. The stock or wire 15 is then carried upwardly from the largest step of the low speed capstan and passed over the idler pulley 70 and across to the first or innermost high speed idler sheave 47. The wire is then passed through the die box 49, which engages the die having the largest bore remaining, and from the die box 49 is looped about the step of the high speed capstan 67 having the smallest diameter. Thence the wire is passed over a second sheave 47, through the die box 49 and the process carried forward until each of the remaining dies have been engaged by the die box 49 and the wire has been looped around each step of the high speed capstan from that of the lowest to that of the greatest diameter, after which it is passed over the sixth sheave 47, through the aperture 131 in the side wall 39 of the take-up compartment, under the idler pulley 133 and over the idler pulley 132, and thence downwardly to the take-up reel 134, to which it is secured in any suitable manner.

Having so prepared the machine for operation, the operator actuates one of the switches 129, which is suitably connected for that purpose with the fluid supply means, and pressure is thereby exerted on the top of the piston 104, causing it to descend in the cylinder 100. This causes a downward movement of the shaft 105 and lever 108 and the rotation of the shaft 109 and gear 111 keyed therein in a contra-clockwise direction. The toothed shank portions 98 of the bifurcated members 97 is thus moved to the front of the machine, along the horizontal beams 94—94, causing the rack portions 99—99 thereof to engage the gears 93 and 123 and rotate them simultaneously in opposite directions. The bifurcated members 82 and 115, being secured to the shafts 83 and 103 respectively, are rotated with the shafts, and the doors 77 and 78 are brought together between the wire drawing portions of the apparatus and the front portion 41, the rubber lip 79 of the door 77 forming a liquid tight seal with the corresponding edge of the door 78. At this stage the bifurcated members 97—97 are in a position intermediate of that shown in Fig. 2 respectively in full and dotted lines; the doors are closed tightly against each other, but the main aperture 14 of the drawing compartment is not yet fully sealed. This is accomplished by the continued descent of the piston 104 in the cylinder 100, which through the shaft 105, lever 108, and gear 111, causes the bifurcated members 97—97 to advance and occupy the position indicated in Fig. 3 by

dotted lines. It will be seen that since the doors 77 and 78 have already been completely brought together in a liquid tight seal, the continued advancement of the members 97—97 along the stationary beams 94—94 produces no further rotation of the gears 93 and 123 respectively, but instead, by engaging with these locked gears, the rack portions 99—99 of the bifurcated members 97—97 act to move the shafts 83 and 123 and their respective bearings 85 and 117 forward along a horizontal line in their respective boxes 86 and 118 against the force of the compression springs 91 and 122, and cause the closed doors 77 and 78 to be moved bodily forward and to closely engage the gasket 75 throughout its entire extent, thus creating a liquid tight seal for the aperture 14.

The apparatus being now in condition for operation, the operator actuates one of the switches 129 which is suitably connected for that purpose to establish the flow of lubricating fluid from the outlets 34 and 35 over the dies in the die boxes. The fluid flows downwardly from the die holder and over both high and low speed capstans 56 and 67 until the level of the fluid in the bottom front section 25 of the drawing compartment reaches the mouth of the drain 127 (Fig. 2), whence it returns to the source. This process is continuous during the wire drawing operation and enables the continuous lubrication of the drawing dies and, through the immersion of the capstans in the fluid, the gripping and rotation of the wire about the capstans with a minimum of friction and burning. After a sufficient elapse of time to permit the lubricating fluid in the front section of the drawing compartment to attain the level of the drain 127, the operator presses another switch 129 for the purpose of actuating the drive shaft 64 and associated drive gear 63, the intermediate gear 60 meshing with the drive gear 63 and being rotated thereby in a contra-clockwise direction. Simultaneously the capstan shafts 51 and 66 are set in action by the intermediate gear 60 to rotate the respective capstans 52 and 67 in a clockwise direction. The take-up reel 134 is simultaneously put in operation and the wire is drawn from left to right through the machine, over the low speed capstans and idlers, thence to the high speed capstan and idlers, passing through the various reducing dies in series until the wire 15, drawn from the drawing compartment, is of the finest diameter which the machine under the condition of a die setup of the character described is capable of producing. Any suitable mechanism (not shown) may be employed to govern the relative speeds of the take-up motor and the drawing apparatus. The machine may be permitted to operate until the supply of the rod stock 12 has been exhausted and the completely drawn wire 15 stored upon the take-up reel 134. Since the door of the supply compartment may be raised as desired during operation of the machine without danger to the operator, he will have no difficulty in determining when the operation of the machine may be halted. At that time the operator, by pressing another of the switches 129, which is suitably connected for that purpose, may apply any suitable braking effect to stop the revolutions of the take-up reel, and simultaneously therewith the driving motor operating switch 129 may be operated to stop the rotation of the driven shaft 64 and the gear 63. The lubricating fluid is then entirely drained off by any suitable means for example, by means of the valve controlled drain 37 (Fig. 1) at the bottom of the front compartment and the doors 77 and 78 opened by introducing fluid pressure to the lower portion of the cylinder 100. The piston 104 is thereby forced upwardly and carries with it the shaft 107 and lever 108. The toothed shank portion 97 is then moved backwardly somewhat, through its engagement with the gear 111. The pressure on the locked gears 93 and 123 being thus removed, the compression springs 91 and 122 become effective to thrust the bearings 85 and 117 respectively rearwardly until they come to rest up against the rear wall of the side boxes 86 and 118. The continued ascent of the piston 104 and the cylinder 100 continues the rotation of the lever 108 and the gear 111, with the result that the toothed shank portion is engaged thereby and carried rearwardly along the horizontal beams 94—94. The backward movement of the bifurcated members 97 causes the toothed rack portions 99—99 to cooperate with the gears 93 and 123, respectively, which rotate the shafts 83 and 116 to swing the doors 77 and 78 backwardly. The door operating mechanism described will be found, due to its unique design, which enables the doors 77 and 78 to first come together to form a liquid tight seal, after which they are subsequently forced against the gasket, a very efficient device for expeditiously opening and closing the aperture 14 of the front portion 42 with a liquid tight seal.

By arranging the capstan and inclined idler shafts in the rectangular formation described and drawing the wire from an idler to its associated capstan in a substantially vertical plane, a compactly arranged high speed wire drawing mechanism is provided, and through placing the capstans side by side on separate parallel shafts and correspondingly arranging the respective groups of idler sheaves, the depth of the drawing compartment is materially reduced so that all of the portions of the apparatus which are located in the front section thereof are within easy reach of an operator through the aperture 14. By maintaining the dies and capstans in the lubricat-

ing fluid it will be found that the wire may be drawn at higher speeds without slipping or burning on the capstans than would otherwise be possible. Since the doors are accommodated entirely within the drawing compartment in such a manner that they may be readily opened and closed without any portion of the door or door operating mechanism projecting beyond the compartment and into the aisle, an appreciable saving in floor space is obtained and a substantial increase in the safety factor is afforded.

Although the invention has been described in connection with the drawing of wire at high speeds from rod stock, it is obviously capable of many applications other than that shown and it should therefore be limited only by the scope of the appended claims.

What is claimed is:

1. In a wire drawing machine, a substantially completely enclosable working chamber having stock entrance and wire exit ports and a vertical doorway, a wire drawing unit housed in the chamber and comprising a horizontally disposed low speed capstan and a horizontally disposed high speed capstan positioned horizontally side by side and laterally spaced from the walls of the chamber, means to form and maintain a bath of lubricant within the chamber and extending above the threshold of the doorway and above the bottoms of the capstans, a pair of pivoted and slidable doors for the doorway, and means to slide the doors linearly and unitedly away from the doorway and then arcuately and oppositely into the lateral spaces between the capstans and the chamber walls to open the doors and to reverse the action to close the doors.

2. In a wire drawing machine, a substantially completely enclosable working chamber having stock entrance and wire exit ports and a vertical doorway, a wire drawing unit housed in the chamber and comprising a horizontally disposed low speed capstan and a horizontally disposed high speed capstan positioned horizontally side by side and laterally spaced from the walls of the chamber, means to form and maintain a bath of lubricant within the chamber and extending above the threshold of the doorway and above the bottoms of the capstans, a pair of pivoted and slidable doors for the doorway, and means to slide the doors linearly and unitedly away from the doorway and then arcuately and oppositely into the lateral spaces between the capstans and the chamber walls to open the doors and to reverse the action to close the doors, said last mentioned means comprising oppositely disposed pivoted arms for carrying the doors, a toothed member for carrying the arms, and means for actuating the toothed member to move the arms in opposite directions and then in the same direction by single continuous movement to open or close the aperture.

In witness whereof, I hereunto subscribe my name this 14th day of December, A. D., 1929.

EINER W. LARSEN.