

June 9, 1925.

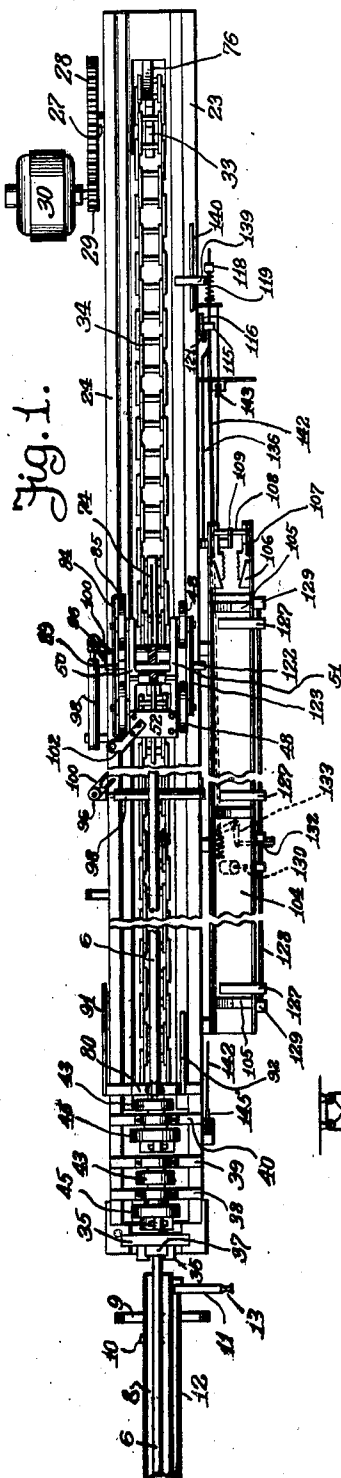
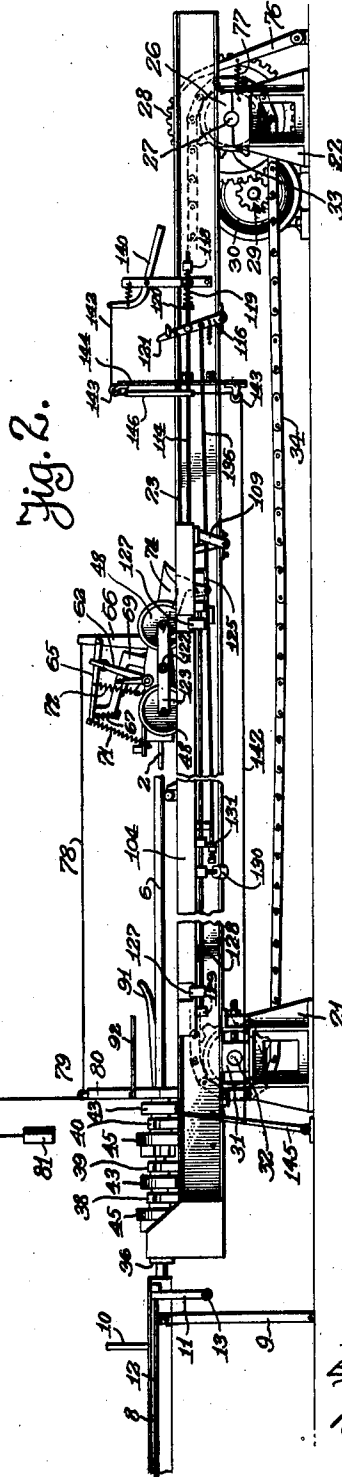
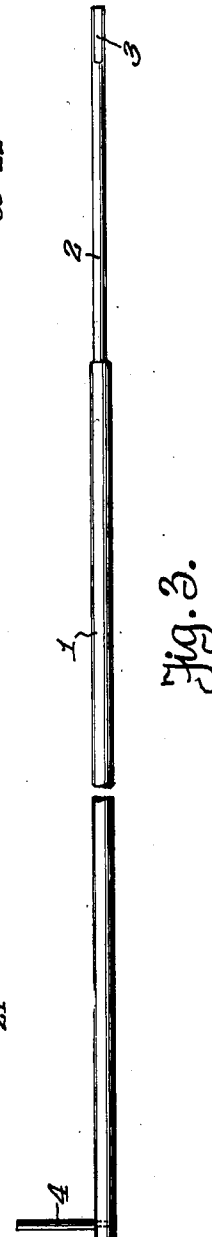
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E. LINDERME

TUBE DRAWING MACHINE

Filed Dec. 10, 1920

6 Sheets-Sheet 1



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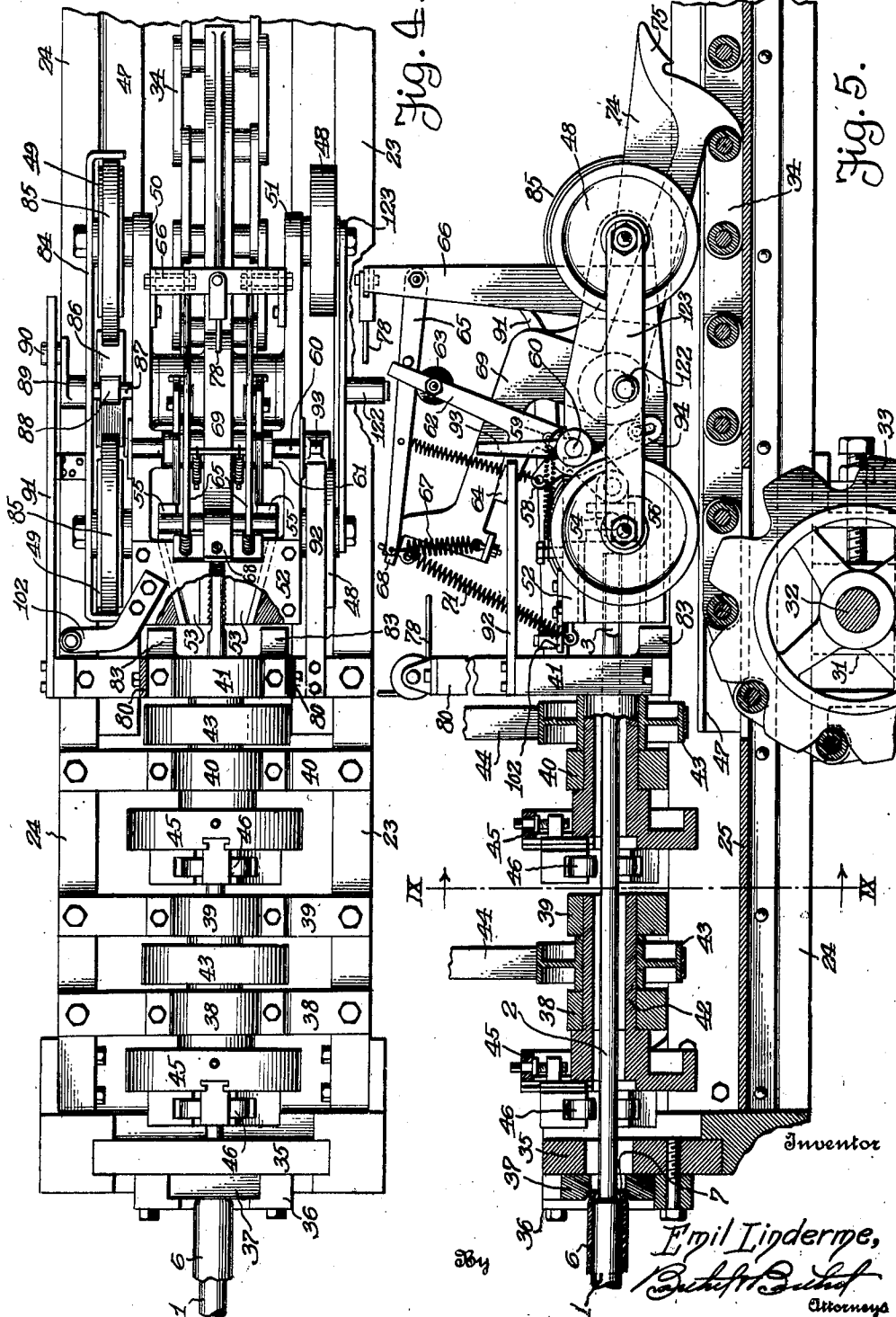
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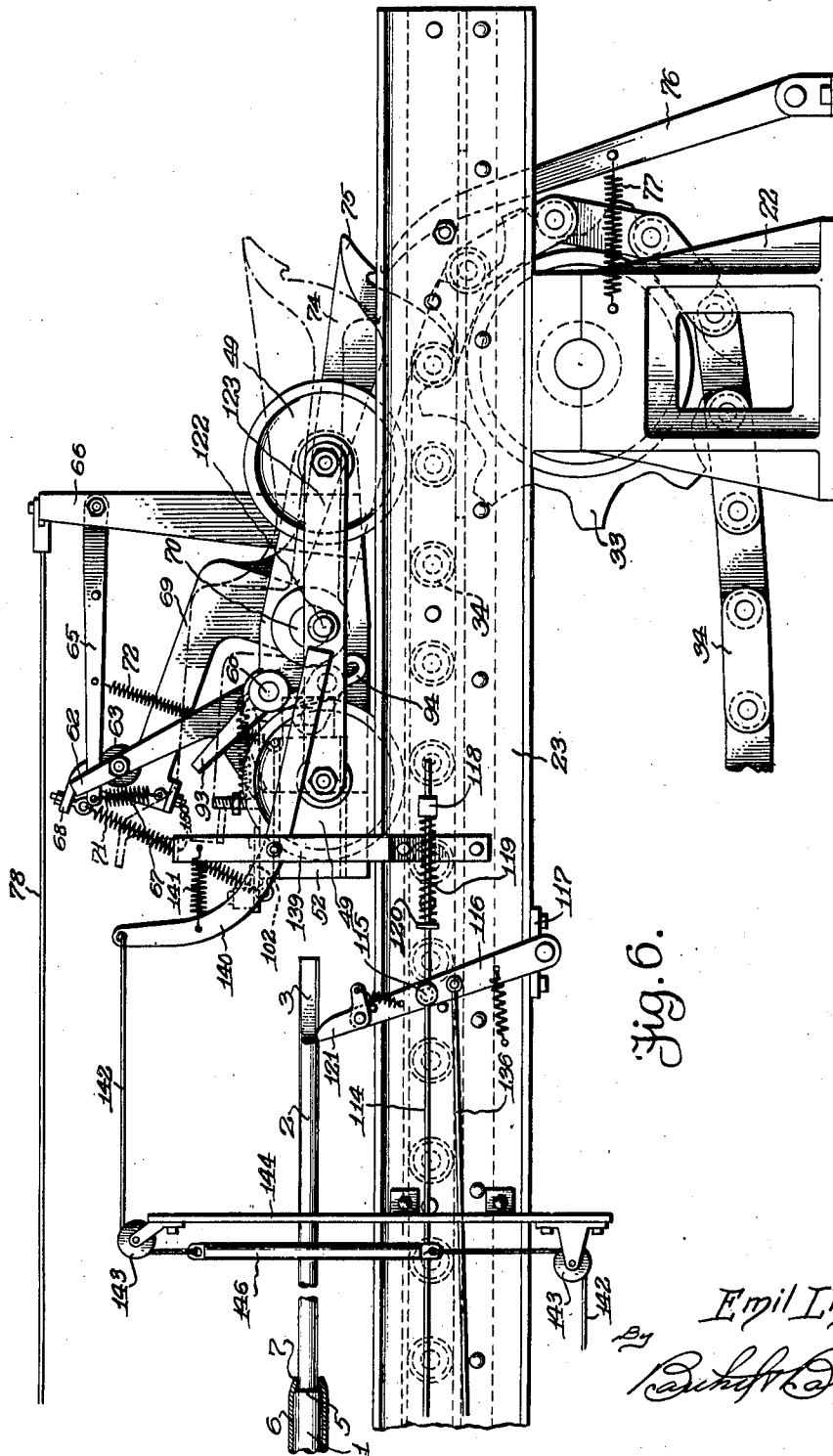


Fig. 6.

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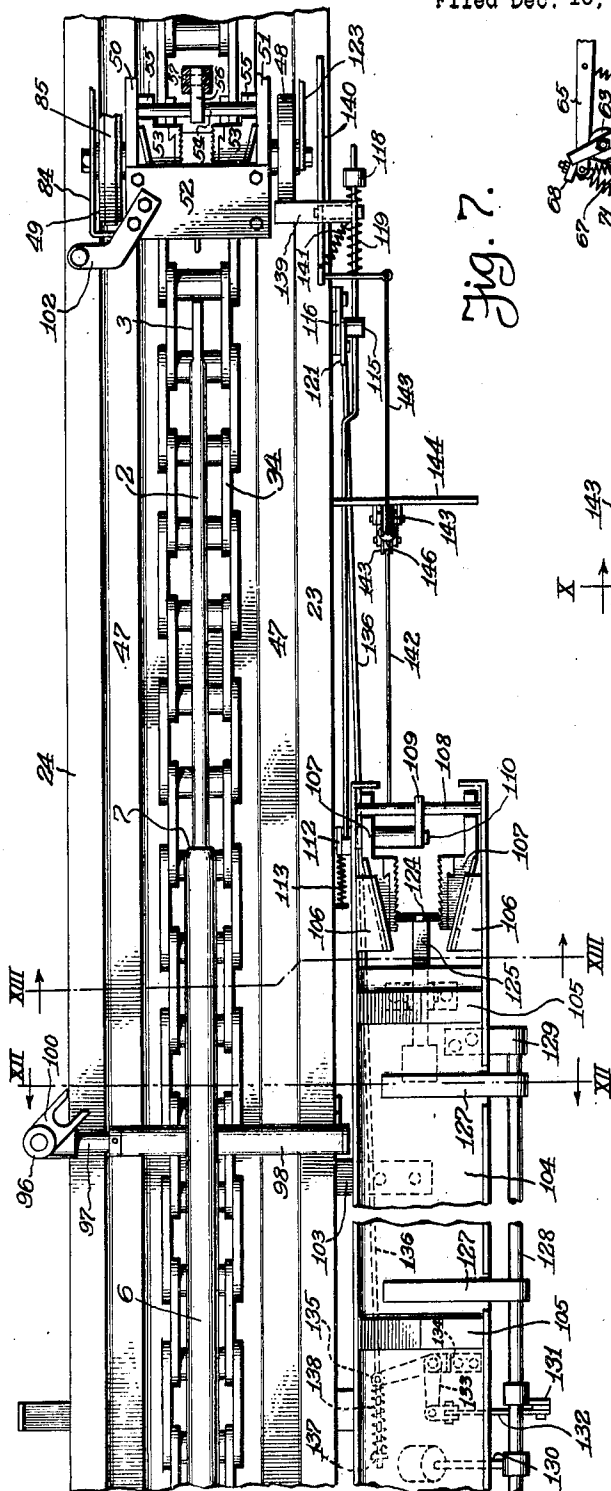


Fig. 7.

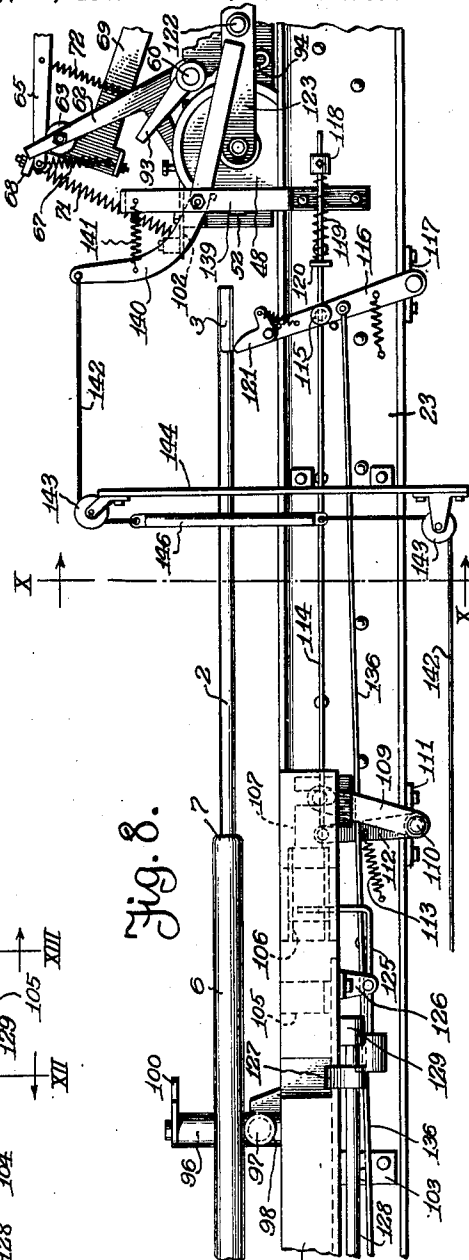


Fig. 8.

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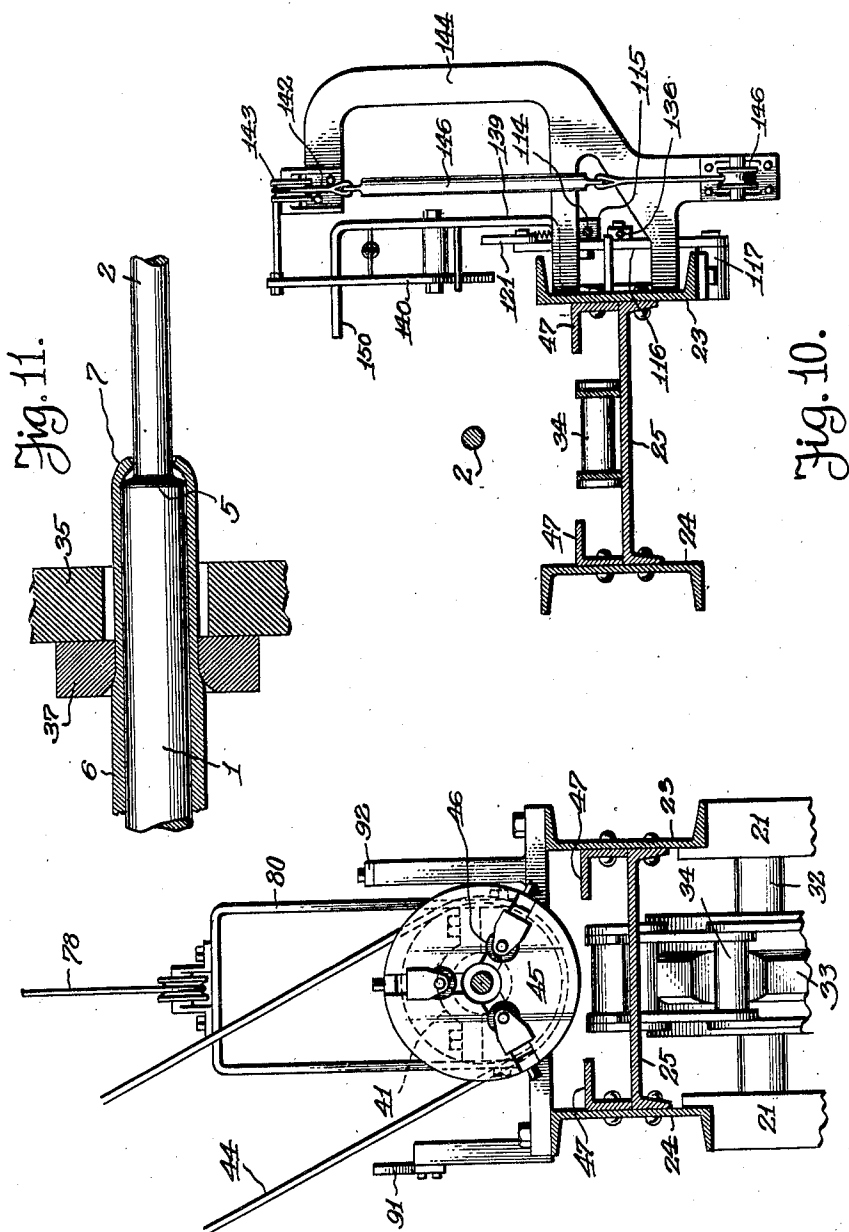
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TUBE DRAWING MACHINE

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6 Sheets-Sheet 5



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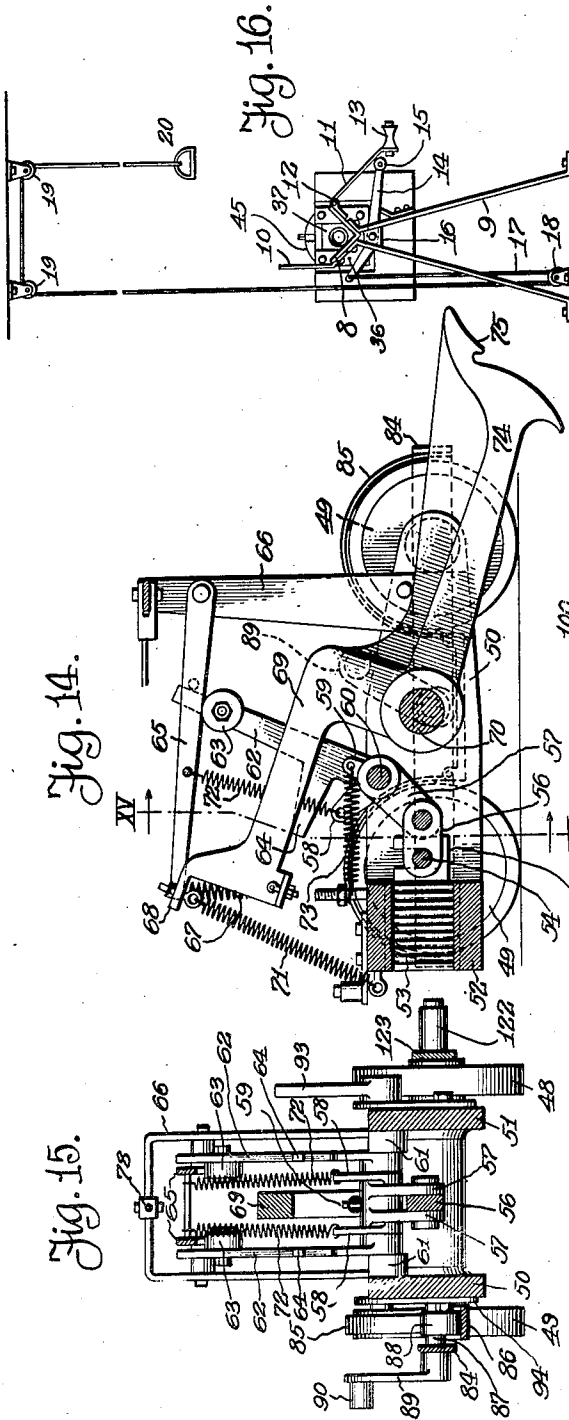
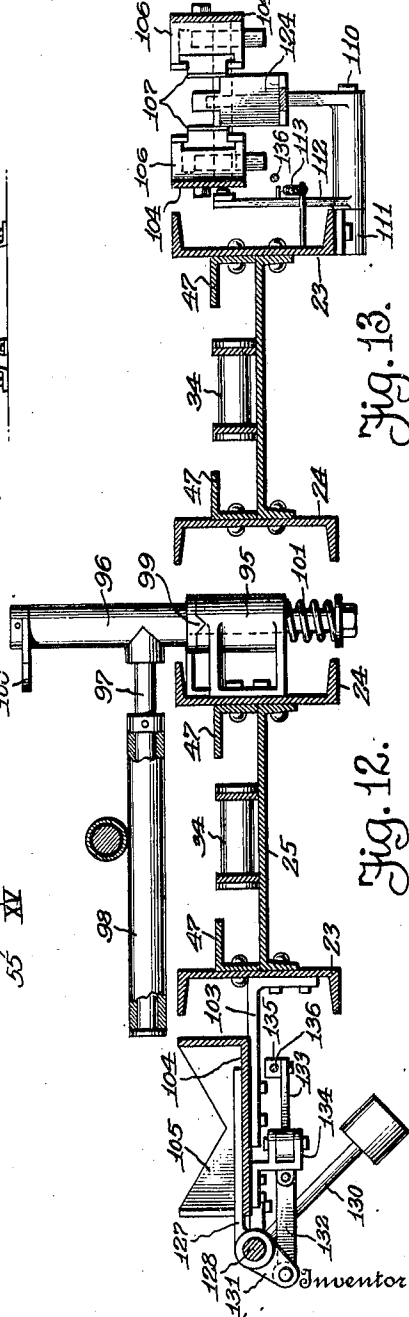
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TUBE DRAWING MACHINE

Filed Dec. 10, 1920

6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE.

EMIL LINDERME, OF CLEVELAND, OHIO.

TUBE-DRAWING MACHINE.

Application filed December 10, 1920. Serial No. 429,638.

To all whom it may concern:

Be it known that I, EMIL LINDERME, a citizen of the United States of America, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Tube-Drawing Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to the art of drawing tubes by a cold process wherein tubes are drawn or reshaped by a mandrel and suitable dies, the mandrel preventing the tubes from being crushed or collapsed while being elongated by dies between which the tubes are drawn.

My invention aims to provide a drawing bench or machine by which tubes may be expeditiously and economically manipulated and drawn, the drawing bench having novel accessories which permit of mandrels and tubes being readily handled so that the production of tubes by such a process may be at a maximum.

My invention further aims to provide a drawing bench or tube reducing machine embodying tube and mandrel handling instrumentalities, some of which are automatic in their action and perform duties heretofore requiring time and labor on the part of workmen.

My invention is characterized by a mandrel and tube; a work assembling bench; a drawing bench and the endless conveyor thereof; dies and tube loosening devices; a drawing carriage and a work disassembling bench, together with devices and appliances organized to permit of the aforementioned instrumentalities cooperating in safely and expeditiously drawing tubes.

In order that my invention may be readily understood, portions thereof will be separately considered for the construction of the drawing bench as now in use, and then all the constructions will be jointly considered in the general operation of the machine.

Reference will now be had to the drawings, wherein—

Figure 1 is a plan of a portion of the drawing bench or machine;

Fig. 2 is a side elevation of the same;

Fig. 3 is a side elevation of a portion of a mandrel;

Fig. 4 is a plan of the forward end of the drawing bench, showing the die, tube loosening devices and the drawing carriage;

Fig. 5 is a longitudinal sectional view of the same, showing the drawing carriage in elevation;

Fig. 6 is an enlarged side elevation of the rear end of the drawing bench or machine showing a carriage thereon;

Fig. 7 is an enlarged plan of a portion of the drawing bench showing a portion of the work disassembling bench.

Fig. 8 is a side elevation of the same;

Fig. 9 is a cross sectional view taken on the line IX—IX of Fig. 5;

Fig. 10 is a similar view taken on the line X—X of Fig. 8;

Fig. 11 is an enlarged longitudinal sectional view of the dies showing the drawing of a tube in said dies;

Fig. 12 is a cross sectional view taken on the line XII—XII of Fig. 7;

Fig. 13 is a similar view taken on the line XIII—XIII of Fig. 7;

Fig. 14 is a longitudinal sectional view of the drawing carriage;

Fig. 15 is a cross sectional view taken on the line XV—XV of Fig. 14, and

Fig. 16 is an end view of the work assembling bench.

In describing my invention by aid of the views above referred to, I desire to point out that the same are merely illustrative of the machine now in use, and that I do not care to confine myself to the precise construction and arrangement of parts shown, other than defined by the appended claims.

Mandrel and tube.

(Figs. 3, 11, 7 and 8.)

As set forth in the beginning, the drawing of a tube, especially by a cold process, requires a mandrel patterned after the mandrel shown in Fig. 3 and designated 1 throughout the drawing. The mandrel has its forward end reduced to provide a shank

2 and the forward end of said shank has facets or flat surfaces 3 adapted to be gripped for moving the mandrel during a drawing operation, and the mandrel is made of such a length that the forward end of the shank 2 and the rear end of the mandrel will always protrude from the ends of the tube to be drawn, thus permitting of the shank 2 being gripped while the rear end of the mandrel is manipulated by a detachable handle or crank 4 which may be placed in engagement therewith, said handle or crank permitting of a workman shifting the mandrel with a tube thereon so that the shank 2 may be placed in position to be gripped and manipulated by the machine.

By reference to Fig. 11 it will be noted that the juncture of the shank 2 with the forward end of the mandrel 1 affords an annular shoulder 5 and it is by virtue of this shoulder that the tube 6 may be held on the mandrel during a drawing operation. The tube 6 has its forward end reduced or inturned, as at 7, to loosely fit the shank 2 and it is this reduced end of the tube which prevents the tube from slipping rearwardly on the mandrel as the tube on said mandrel is elongated. The tubes 6 may be suitably prepared with reduced ends prior to being brought to the drawing machine, and with the tubes convenient to a workman at the forward end of the machine, the tubes may be placed on mandrels or mandrels placed therein. To facilitate this operation I have devised a work assembling bench, but it is obvious that the mandrels may be carried to a suitable location and placed in the tubes so that the tubes will be all ready for drawing on reaching the machine.

Work assembling bench.

(Figs. 1, 2, and 16.)

The work assembling bench is approximately the same length as the mandrel and comprises a V shaped trough 8 supported at its ends and at suitable intervals by diverging legs 9. At one side of the trough are a plurality of uprights 10 serving as a wall extension for the trough, and at the opposite side of the trough are hinged arms 11. The arms 11 having a common hinge 12 throughout the length of the trough 8 so that said arms may move in synchronism, and on the outer ends of said arms are grooved rollers or spools 13 adapted to support a tube while a mandrel is placed therein. The spools 13 are held normally in a horizontal plane by a bell crank 14 having an anti-frictional roller 15 normally engaging under one of the arms 11, and said bell crank is pivotally supported by a bearing 16 at the forwardmost legs 9 of the

work assembling bench. The bell crank 14 is connected to a cable 17 extending under a sheave 18 and upwardly over sheaves 19, with the end of the cable provided with a suitable handle 20 which is at all times convenient to a workman standing at the forward end of the bench. The sheaves 18 and 19 may be conveniently supported by the floor and ceiling of the room or building in which the work assembling bench is located.

With one the tubes 6 on the spool 13, the mandrel 1 can be easily placed therein with its shoulder 5 engaging the reduced end 7 of the tube. The handle 20 can then be pulled upon to actuate the bell crank 14, which raises the arm 11 and causes the tube and mandrel to roll off of the spools 13, down the arms 11, into the trough 8 where the tube, with its mandrel therein, is held in longitudinal alinement with the drawing bench. The workman releases the handle 20 so that the arms 11 may assume normal position and permit of another tube being placed on the spools 13. The workman may then place the handle 4 in engagement with the mandrel so as to manually push the mandrel and its tube forward to the drawing bench.

Drawing bench and the endless conveyor thereof.

(Figs. 1, 2, 4, 5, 6, 7, and 9.)

The drawing bench comprises sets of supports 21 and 22 supporting longitudinal parallel channel frames 23 and 24 arranged back to back and connected by a horizontally disposed bed plate 25. The supports 22 have fixed bearings 26 for a transverse driven shaft 27 provided with a large gear wheel 28 meshing with a small gear wheel 29 on the armature shaft of an electric motor 30, said electric motor representing a suitable source of power for operating an endless conveyor forming part of the drawing bench.

The set of supports 21 have adjustable bearings 31 for a shaft 32 and mounted on the shafts 32 and 27 are sprocket wheels 33 for a longitudinally disposed endless sprocket chain 34 constituting an endless conveyor which passes over the bed plate 25, as best shown in Figs. 5 and 12, said bed plate having openings providing clearance for the sprocket wheels 33 and the sprocket chain 34.

The forward end of the drawing bench is in proximity to the rear end of the work assembling bench, as shown in Figs. 1 and 2, and the sprocket chain 34 is of such construction that links or portions thereof may be automatically gripped when it is desired to utilize the conveyor for moving the man-

drel and its tube relative to the drawing bench.

Dies and tube loosening devices.

(Figs. 4, 5 and 9.)

At the forward end of the drawing bench is a transverse head 35 provided with a detachable die holder or housing 36 containing an interchangeable die 37. The die 37 has an opening through which the mandrel and its tube are drawn and the diameter of the die opening determines the diameter of the tube after being drawn. By reference to Fig. 11, it will be noted that as the mandrel and its tube are drawn through the die 37 that the thickness of the tube wall is reduced so that the metal is evenly and slowly crowded towards the rear end of the tube, thus elongating the tube and drawing it out to a desired length. In so drawing the tube while on the mandrel 1 the walls of the tube receive a pressure which tends to contract the granular or fiber structure of the tube walls and produce a more intimate molecular composition resulting in a strong and tenacious tube.

The drawing of the mandrel and its tube through the die 37 causes the tube 6 to be compressed about the mandrel 1 and it is necessary to provide tube loosening devices so that the mandrel may be withdrawn from the drawn tube. For this purpose, I provide the forward end of the drawing bench with transverse bearings 38, 39, 40 and 41 and in the bearings 38 and 39 is journaled a sleeve 42 on which is mounted a pulley 43 adapted to be driven by a belt 44 from a suitable source of power. The sleeve 42 provides clearance for the mandrel and its tube and at the forward end of the sleeve is a chuck or clutch head 45 supporting a plurality of adjustable rolls 46 adapted to engage the tube 6 and loosen said tube relative to the mandrel 1.

The bearings 40 and 41 support an equipment similar to the bearings 38 and 39, but the equipment of the bearings 40 and 41 is operated the reverse of the equipment of the bearings 38 and 39. This causes the rolls 46 to have a kneading action on the tube 6 and sets up sufficient vibration to cause the tube to become loose on its mandrel, so that after the tube has been fully drawn and removed from the drawing bench to the work disassembling bench, the mandrel may be withdrawn from the tube. It is essential that one set of the rolls 46 be bodily revolved in the opposite direction from the other set of rolls 46, otherwise the tube cannot be conveniently released from its mandrel and it is necessary that the drawn tube be subjected to this vibratory action at the forward end of the drawing bench to per-

mit of the drawn tube being further manipulated beyond the tube loosening devices.

In order that the mandrel and its tube may be supported above the drawing bench as it is pulled through the dies and operated upon by the tube loosening device, swingable supports are employed as best shown in Figs. 7 and 12. The side frame 24 of the drawing bench has brackets 95 supporting turn posts 96 provided with lateral supports 97 having anti-frictional rollers 98 on which a tube containing a mandrel may move. The posts 96 have interengaging portions 99 for the brackets 95, so that the supports 97 will be temporarily held transversely of the drawing bench or in longitudinal alignment at the frame 24. In order that the swingable supports may be shifted to provide clearance for the drawing carriage, the upper ends of the posts have cranks 100 adapted to be automatically engaged to swing the supports in lateral planes. The lower ends of the posts 96 are provided with coiled expansion springs 101 which maintain the posts interlocked with the brackets 95 in positions which the posts may assume relative to the brackets.

Drawing carriage.

(Figs. 4, 5, 14 and 15.)

The inner walls of the drawing bench frames 23 and 24 are provided with angle rails 47, above the bed plate 25 and movable on said rails are the wheels 48 and 49 of a drawing carriage, which comprises suitably connected side frames 50 and 51 constituting a carriage body. The frames 50 and 51 have the forward ends thereof connected by a housing 52 affording guides for tapered reciprocable gripping jaws 53 which are in opposed relation and have the confronting faces thereof roughened or serrated, as shown in Figs. 4 and 14, so that the gripping jaws may cooperate in gripping the flat facets 3 on the shank 2 of the mandrel 1. The gripping jaws 53 have a tongue and groove connection with the housing 52 and the rear ends of said jaws are connected by a transverse pin 54 loose in sockets 55 of said gripping jaws. Intermediate the ends of the pin 54 is a link 56 pivotally connected to the long arms 57 of a bell crank which has short arms 58 and 59. The bell crank is fast on a transverse pin 60 set in bearings 61 of the frames 50 and 51, and on this same pin are fixed roller members 62 having rollers 63. The roller members 62, have stop extensions 64 adapted to impinge against the housing 52 and limit the forward movement of the upper ends of the roller members 62, as best shown in Fig. 6, and the rollers 63 of said members support levers 65 pivotally connected to a yoke 66,

carried by the rear ends of the frames 50 and 51. The yoke 66 bridges or spans the rear end of the carriage body, and permits of the levers 65 extending forwardly so that the forward ends thereof may be connected by a light coiled retractile spring 67 to the forward end 68 of a fulcrumed conveyor engaging member 69, said member being fulcrumed on a transverse pin 70 connecting the frames 50 and 51 of the drawing carriage. The forward end 68 of the conveyor engaging member 69 is also connected by a heavy coiled retractile spring 71 to the housing 52 and the levers 65 are connected by light coiled retractile springs 72 to the short arm 58 of the bell crank which controls the movement of the gripping jaws 53. The short arm 59 of this bell crank is connected by a heavy coiled retractile spring 73 to a stud on the housing 52, and the manner in which all these springs cooperate will appear in the general operation of the drawing machine.

The conveyor engaging member 69 has a central tail piece 74 adapted to engage links or connecting members of the endless conveyor 34, and the tail piece 74 has an extension 75 adapted to impinge against a pivoted elevating member 76 adjacent the support 22, said elevating member being connected to the support 22 by a coiled retractile spring 77 so that said elevating member will be normally held in position to engage the extension 75 of the tail piece 74 and, at a predetermined time, elevate the tail piece 74 and move it out of engagement with the endless conveyor 34. The yoke 66 of the drawing carriage is connected by a cable or flexible member 78 to a weight 81, and said cable is trained under a sheave 79 and over sheaves 82, the sheaves 82 being supported by the ceiling of a compartment in which the machine is operated, and the sheave 79 supported by a yoke 80 associated with the bearing 41 at the forward end of the machine. The weight 81 is elevated when the drawing carriage is moved by the endless conveyor 34 and when the drawing carriage is released the weight 81 moves the drawing carriage to the forward end of the drawing bench. Besides being limited in its forward movement by buffers 83 at the bearing 41 a brake mechanism is associated with the wheels 49 of the drawing carriage, said brake mechanism including the following elements.

The studs or axles which support the wheels 49 also support a longitudinal beam 84, best shown in Figs. 4 and 14, and connected to the ends of said beam are brake bands 85 extending over the wheels 49 and connected by a coupling member or cam plate 86. The beam 84 cooperates with the frame 50 of the drawing carriage in support-

ing a cam shaft 87 provided with a cam 88 and a crank 89 having an anti-frictional roller 90. The cam 88 is adapted to engage the coupling or cam plate 86 and lower said plate to apply the brake bands 85 to the wheels 49 and retard the forward movement of the drawing carriage as it approaches the forward end of the drawing bench. The cam 88 and its shaft 87 are actuated by the anti-frictional roller 90 of the crank 89 riding against and under a shoe 91 supported at the side of the bearing 41, as best shown in Figs. 2 and 4. The initial movement of the drawing carriage from the forward end of the machine may cause the wheels 49 to slide on one of the rails until the roller 90 is released by the shoe 91, when the brake bands 85 will automatically retract and release the wheels 49.

At the opposite side of the bearing 41 from the shoe 91 is a trip member 92 adapted to be engaged by a trip crank or arm 93 on the end of the bell crank pin or shaft 60, which is retained in the bearings 61 by adjustable members 94 carried by the frames 50 and 51 of the drawing carriage.

On the housing 52 is a laterally extending arm 102 provided with an anti-friction roller adapted to engage the cranks 100 of the posts 96, and turn said posts so that the supports 97 will be swung into active or inactive positions.

Work disassembling bench.

(Figs. 1, 2, 6, 7, 8, 10, 12 and 13.)

Suitably attached to the outer wall of the bench frame 23 are brackets 103 supporting a channel bench or trough 104 having spaced V-shaped supports 105 adapted to receive a tube with a mandrel therein, and while the tube and mandrel are on the supports 105, the mandrel may be removed from the tube and transferred to the forward end of the machine to again be used, while the tube from which the mandrel is withdrawn may be transferred to a stock room. In order that the mandrel may be withdrawn from the tube it is necessary that some means be employed for temporarily holding the forward reduced end 7 of the tube, and the means which I resort to is somewhat similar to the mandrel gripping means of the drawing carriage.

The rear end of the bench 104 has fixed tapering guides 106 for gripping jaws 107 and these jaws are connected by a pin 108, engaged by a crank 109 of a crank shaft 110, said crank shaft being supported by a bearing 111 from the drawing bench frame 23. The crank shaft 110 has another crank 112 attached by a coiled retractile spring 113 to the frame 23, and the retractile force of the spring 113 retains the gripping jaws 107

closed, when otherwise not held open. To open the gripping jaws 107, the crank 112 is connected to a rod 114 which extends rearwardly and loosely through a guide 115 on the side of a lever 116 pivotally supported by a bracket 117 connected to the bench frame 23. On the end of the rod 114 is an abutment 118 for a coiled spring 119 surrounding said rod and engaging another abutment 120 loose on said rod and adapted to be engaged by the guide 115 of the lever 116. The lever 116 extends upwardly at the side of the frame 23 and is provided with a pivoted spring held latch member 121 adapted to yield when the drawing carriage is moving forward but when the drawing carriage moves rearward the latch member 121 is engaged by an anti-frictional roller 122 supported by a beam 123 connecting the studs or shafts of the wheels 48 of the drawing carriage.

To hold the gripping jaws 107 normally open a block 124 is employed and temporarily held between the gripping jaws 107 by a weighted arm 125 pivotally supported in a bearing 126, carried by the bottom of the work disassembling bench 104.

The outer side wall of the bench 104 is slotted to provide clearance for tube discharge arms 127 mounted on a rock shaft 128 journaled in suitable bearings 129, carried by the bench 104. The rock shaft 128 has a weighted arm 130 which maintains the discharge arms 127 normally in the bench 104, and adjacent the weighted arm 130 is a crank 131 connected by a link 132 to a horizontally disposed bell crank 133 supported by a bearing 134 from the bottom of the bench 104. On the bell crank 133 is a guide 135 for a rod 136, said rod having its forward end provided with an abutment 137 for a spring 138 which surrounds the rod 136 between the abutment 137 and the guide 135. This construction affords a yieldable connection between the bell crank 133 and the rod 136, which has its forward end pivotally connected to the lever 116, adjacent the guide 115.

It is necessary that the drawing carriage be retained at the rear end of the drawing bench while a mandrel and its tube is transferred from the drawing bench to the work disassembling bench and for this purpose, I provide the frame 23 of the drawing bench with a bracket 139 to which is pivotally connected a tiltable arm 140, said arm being also connected to the bracket 139 by a coiled retractile spring 141 and the retractile force of the spring retains the lower end of the arm 140 normally in the path of the roller 122, so that the roller will impinge against the end of the arm and prevent the carriage from moving forward under the influence of weight 81. The upper end of the arm 140 is connected to a cable or flexible

member 142 and said cable is trained over and under sheaves 143 carried by the upper and lower ends of an offset bracket 144, carried by the bench frame 23. The cable 142 extends forwardly, as shown in Fig. 2, and is connected to a lever 145 adjacent the forward end of the drawing bench. Included in the cable 142, between the sheaves 143, is a strike bar 146, and when the cable 142 is not manually actuated by the lever 145, it may be actuated by the end of the mandrel striking the bar 146 sufficiently to tilt the arm 140 and raise the lower end thereof above the plane of the roller 122, so that the weight drawn carriage may move to the forward end of the drawing bench.

General operation.

To explain the operation of the drawing bench, I will assume that a tube rests on the rollers 13 of the work assembling bench and that a mandrel has been placed in the tube, so that the mandrel bears the same relation to the tube as brought out in Fig. 11. The operator at the work assembling bench now pulls on the handle 20 and the arms 11 are raised to bodily transfer the mandrel and its tube to the trough 8. While in this trough the handle 4 or a similar device is placed in engagement with the end of the mandrel to permit of it being manually pushed forward to the die 37 and the tube loosening devices. The handle 4 also permits of the mandrel being placed in proper position so that the facets 3 of the reduced ends 2 of the mandrel will be in position to be gripped by the drawing carriage.

When the mandrel and its tube are pushed forwardly into the die 37, the reduced end 7 of the tube 6 readily enters the die and permits of the reduced end 2 of the mandrel extending through the sleeves 42 of the tube loosening devices so that the end of the mandrel may be gripped by the drawing carriage.

As the drawing carriage is moved forward under the influence of the weight 81, it having been released by an operator pulling on the lever 145 to raise the yieldable arm 140 out of the path of the roller 122, the tail piece 74 of the conveyor engaging member 79 is held out of engagement with the driven endless conveyor 34 by the retractile force of a heavy spring 71 such position being shown by dot and dash lines in Fig. 6. This condition of the drawing carriage has been brought about as the drawing carriage moves rearwardly, the crank or arm 93 having struck the protruding end 150 of the bracket 139 and when the pin or shaft is rocked the fixed roller members 62 are swung forwardly permitting the forward ends of the levers 65 to be lowered thus reducing to a certain extent the tension on the heavy spring 71 connected to the forward

end 68 of the conveyor engaging member 69. The initial movement of the conveyor engaging member may not be sufficient to raise the tail piece 74 out of engagement with the endless conveyor, so the elevating member 76 is brought into action when the drawing carriage reaches its rearward position, as shown in Fig. 6.

Since the pin or shaft 60 has been rocked the gripping jaws 53 are open, and again considering the drawing carriage as moving forward under the influence of the weight 81, a number of operations are performed.

First, the brake mechanism of the drawing carriage is automatically actuated by the shoe 91 to apply the brake bands 85 to the wheels 49 and stop the drawing carriage, second, the arm or crank 93 impinges against the trip member 92 just before the carriage is stopped and the pin or shaft 60 is rocked to close the gripping jaws 53 against facets 3 of the mandrel. Rocking of the pin or shaft 60 swings the fixed roller members 62 rearwardly, elevates the levers 65, and causes the spring 67 to elevate the forward end 68 of the conveyor engaging member 69 and place the tail piece 74 thereof in engagement with the conveyor 34. This all takes place while the drawing carriage is at the forward end of the drawing bench and immediately upon the tail piece 74 engaging the endless conveyor 34 the drawing carriage starts rearwardly with the mandrel. As the mandrel and its tube 35 are drawn through the die 37, the wall thickness of the tube 6 is reduced, as shown in Fig. 11, and the reduced tube eventually carried into position to be acted upon by the loosening devices at the bearings 38 to 41 inclusive. As previously pointed out the tube is loosened on the mandrel, and the first operation performed by the retreating drawing bench is brought about as the drawing carriage passes by the posts 96. The arm 102 of the drawing carriage successively engages the cranks 100 of the posts 96 and places the supports 97 transversely of the drawing bench in order that said supports will sustain the drawn tube and the mandrel therein above the drawing bench.

As the drawing carriage continues to move rearward, the roller 122 engages the latch member 121 of the lever 116 and the initial movement of said lever causes the guide 115 thereof to slide on the rod 114 until it reaches the abutment 120, when the spring 119 is partially compressed and eventually causes the abutment 118 and the rod 114 to rock the shaft 110, place the spring 113 under tension, open the jaws 107 of the work disassembling bench 104, so that the gravity actuated block 124 may assume a position between the gripping jaws 107 to hold said jaws open.

Next, the retreating drawing bench brings

the crank or arm 93 in engagement with the protruding end 150 of the bracket 139, and the pin or shaft 60 is again rocked so that the conveyor engaging member 69 assumes a full line position shown in Fig. 6, and is eventually brought to the position shown by dot and dash lines, thereby loosening the drawing carriage relative to the endless conveyor. The lower end of the tiltable arm 140 is in position to be engaged by the roller 122, so that the drawing carriage cannot move forward, under the influence of the weight 81, until the tiltable arm 140 is manually actuated through the medium of the lever 145 or by the end of a mandrel striking the bar 146.

The drawn tube and its mandrel are now supported on the anti-friction rollers 98 of the supports 97, and the workman at the forward end of the drawing bench may reach over and grab the tube to shift it on to the work disassembling bench 104. As the reduced end 7 of the tube 6 strikes the block 124 the block is lowered to permit of the gripping jaws 107 closing in on the reduced end 7 of the tube, so that while the end of the tube is held the mandrel 1 may be withdrawn therefrom by the workman and carried rearwardly to be placed in the tube at the work disassembling bench. The jaws 107 are caused to close under the influence of the expansive force of the springs 119 and the retractile force of the spring 113. While this takes place the drawing carriage has moved forward, gripped another mandrel and is moving rearwardly to again actuate the lever 116. The initial actuation of this lever causes the rod 136 to be pulled upon placing the spring 138 under tension, and consequently when the lever 116 is released and restored to normal position the expansive force of the spring 138 causes the shaft 128 to rock and the discharge arms 127 remove the tube 6 from the bench 104. This is possible because the initial movement of the lever 116 has opened the gripping jaws 107, thereby loosening the reduced end of the tube 7 and permitting of the tube being flopped out of the work disassembling bench. The operation of the discharge arm 127 is practically in synchronism with the release of the gripping jaws 107, which are temporarily retained in an open position by the block 124, whereby the drawing tube and mandrel may be shifted from the drawing bench into the work disassembling bench.

What I claim is:—

1. In a tube drawing machine, a die adapted to have a mandrel with a tube thereon pulled through said die to reduce the tube, a drawing carriage adapted to grip the mandrel and pull it through the die, swingable means actuated by said drawing carriage to support the mandrel and its

tube while passing through the die, and tube loosening devices adjacent said die and adapted to loosen the tube on the mandrel as drawn from said die.

5 2. A tube drawing machine as in claim 1, characterized by said means being swung to inactive positions by a forward movement of said drawing carriage and swung to an active position by a rearward movement of
10 said drawing carriage.

3. In a tube drawing machine, a drawing bench, a die at one end thereof, a reciprocable drawing carriage on said bench adapted to draw a tube with a mandrel therein
15 through said die, a conveyor for moving said carriage in one direction, means for moving said carriage in the opposite direction, means on said carriage for gripping said conveyor and means also on the carriage
20 for gripping the mandrel in the tube and means whereby said conveyor gripping means and mandrel gripping means are operated in synchronism.

4. In a tube drawing machine, a die, a
25 drawing carriage adapted to grip a mandrel with a tube thereon and draw the mandrel and tube through the die, gripping means on the carriage adapted to automatically release the mandrel when the tube
30 thereof is drawn, and means adapted to support the mandrel and its drawn tube so that the mandrel may be withdrawn from the tube.

5. A tube drawing machine as in claim 4,
35 characterized by the last mentioned means including a bench having jaws at one end thereof to grip the mandrel while the tube is removed therefrom.

6. A tube drawing machine as in claim 3,
40 characterized by the conveyor gripping means including gripping jaws and a fulcrumed conveyor engaging member.

7. In a tube drawing machine, a die adapted to have a mandrel with the tube
45 thereon drawn through said die to reduce the tube, drawing means for the mandrel and tube, and sets of tube loosening rolls revolved in opposite directions and adapted to loosen the tube on the mandrel after passing
50 through said die.

8. The combination of a die, drawing means for drawing a mandrel with a tube
55 thereon through said die to elongate the tube, a bench adapted to receive the mandrel and its tube, and means on said bench under the control of said drawing means for gripping the tube so that the mandrel may be withdrawn therefrom.

9. The combination set forth in claim 8,
60 wherein the bench is provided with additional means for discharging the tube therefrom.

10. In a tube drawing machine, a drawing bench, a die at one end thereof, a draw-

ing carriage reciprocable on said bench to
65 grip a mandrel with a tube thereon and draw said mandrel and tube through said die, a work disassembling bench supported by said drawing bench, means on said work
70 disassembling bench under the control of said drawing carriage adapted to grip a drawn tube and permit of the mandrel being removed therefrom, and a work assembling
75 bench adjacent said drawing bench to facilitate assembling the mandrel relative to a tube to be drawn.

11. A method of drawing tubes, consisting in providing a tube with a reduced end, placing a mandrel in said tube with an end
80 of said mandrel protruding from the reduced end of said tube, gripping the protruding end of the mandrel at a point remote from the tube to pull it and the tube
85 thereon between dies, to reduce the thickness of said tube, and while a portion of the tube is being reduced subjecting the reduced portion of the tube to an action which will
90 loosen said tube relative to said mandrel.

12. The herein described method of redrawing tubing which consists in position-
95 ing the tubing on a mandrel of slightly less diameter than the interior of the tubing, drawing the mandrel and tubing longitudinally through a die to partially thin the
100 wall thereof, subjecting the tubing to a series of rollers passing circumferentially about the tubing under pressure to decrease the thickness of the wall and partially re-
105 lease the tubing from the mandrel, and then subjecting the tubing to a second rolling operation in which the rollers move in an opposite direction to the first named rollers and completely loosen the tubing from the
110 mandrel.

13. The method of redrawing tubing to
115 decrease the thickness of the wall thereof which consists in positioning the same on a mandrel of slightly less diameter than the interior of the tube and securing the end of the tube to the mandrel, passing the tube
120 and mandrel longitudinally through a die to partially thin the wall of the tube and cause the tube to seize upon the mandrel, rolling the tube while being moved from the die by a series of companion rollers to further thin
125 the wall of the tube, and then subjecting the tube while in motion to a second series of rollers to finally release the tube from the mandrel.

14. The method of redrawing tubing to
130 thin the wall thereof and consequently lengthen the tube which consists in positioning the tube on a mandrel and securing the end of the tube thereto, moving the tube and
135 mandrel longitudinally through a die to slightly thin the wall thereof and causing the tube to seize upon the mandrel, then, as the tube passes from the die subjecting it to

a rolling operation under pressure to further decrease the thickness of the wall and release the tubing from the mandrel.

15. The method of redrawing tubing to
5 thin the wall thereof and increase its length which consists in the positioning of the tubing on a mandrel slightly less in diameter than the interior of the diameter of the tube and with the end of the tube secured to the
10 mandrel, then moving the tube and mandrel first through a die and then through a series of rollers rotating about the moving tube,

and then through a series of rollers rotating in an opposite direction about the tube, both of said sets of rollers engaging the tubing 15 under pressure, the die and rollers acting to successively decrease the thickness of the wall and loosen the tube from the mandrel.

In testimony whereof I affix my signature in presence of two witnesses.

EMIL LINDERME

Witnesses:

G. C. KANEEN,
J. T. MAHONEY.