

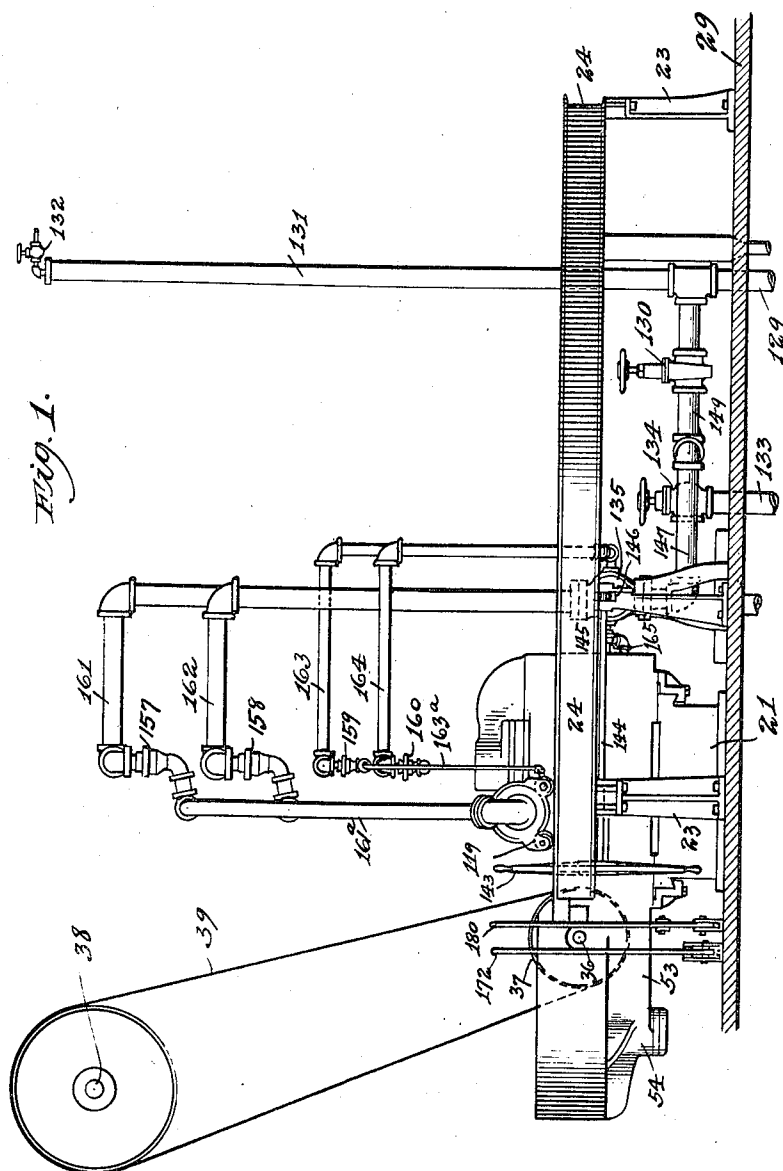
J. F. GAIL.
TUBE BENDING APPARATUS.

APPLICATION FILED DEC. 13, 1916. RENEWED NOV. 20, 1920.

1,379,858.

Patented May 31, 1921.

8 SHEETS—SHEET 1.



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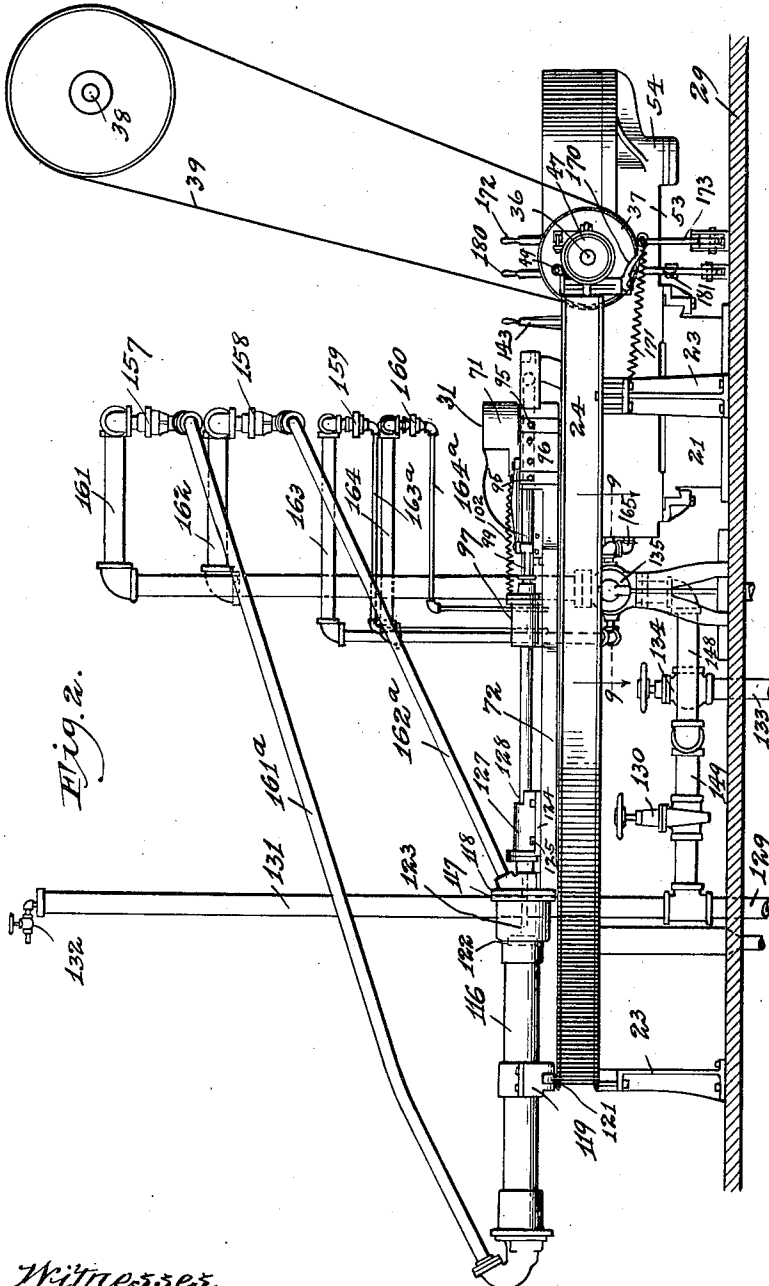


Fig. 2.

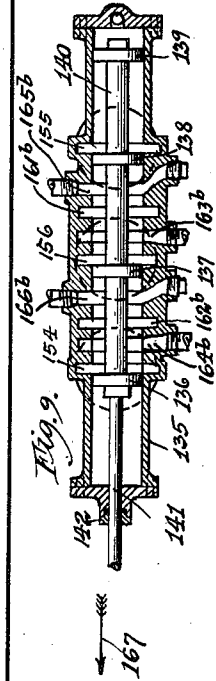


Fig. 9.

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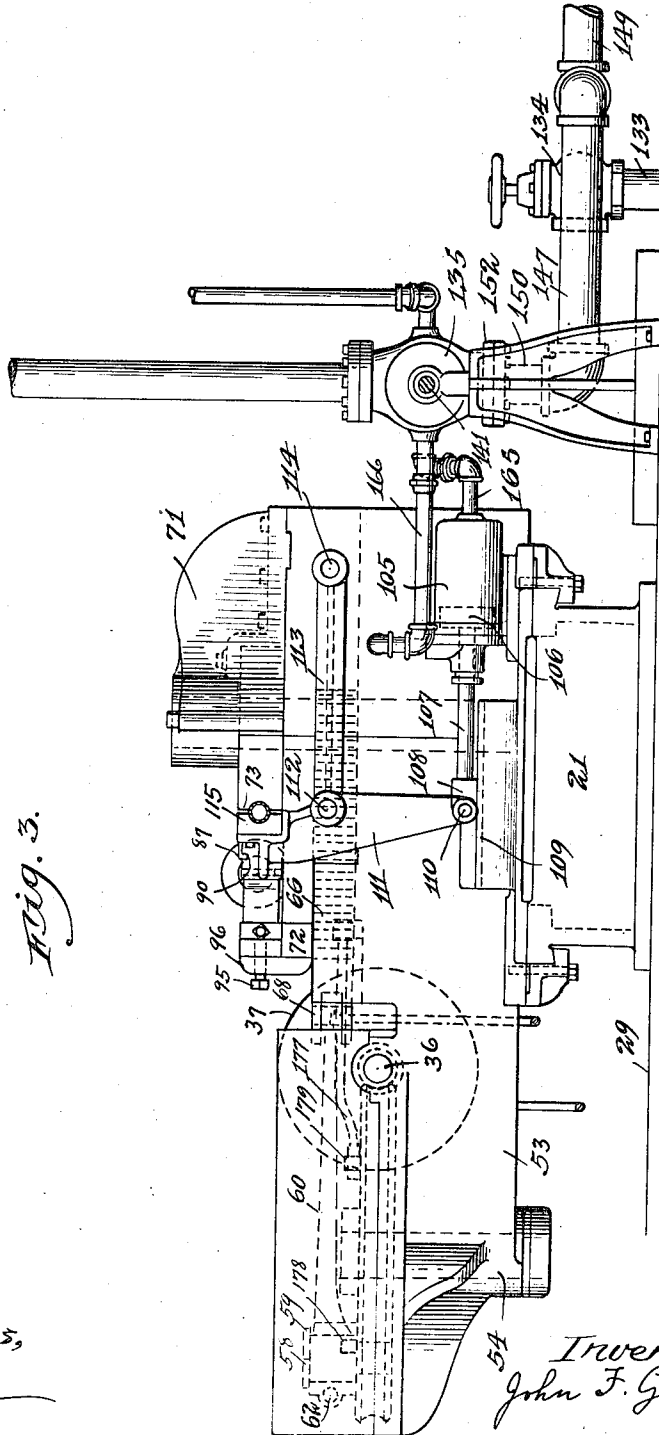


Fig. 3.

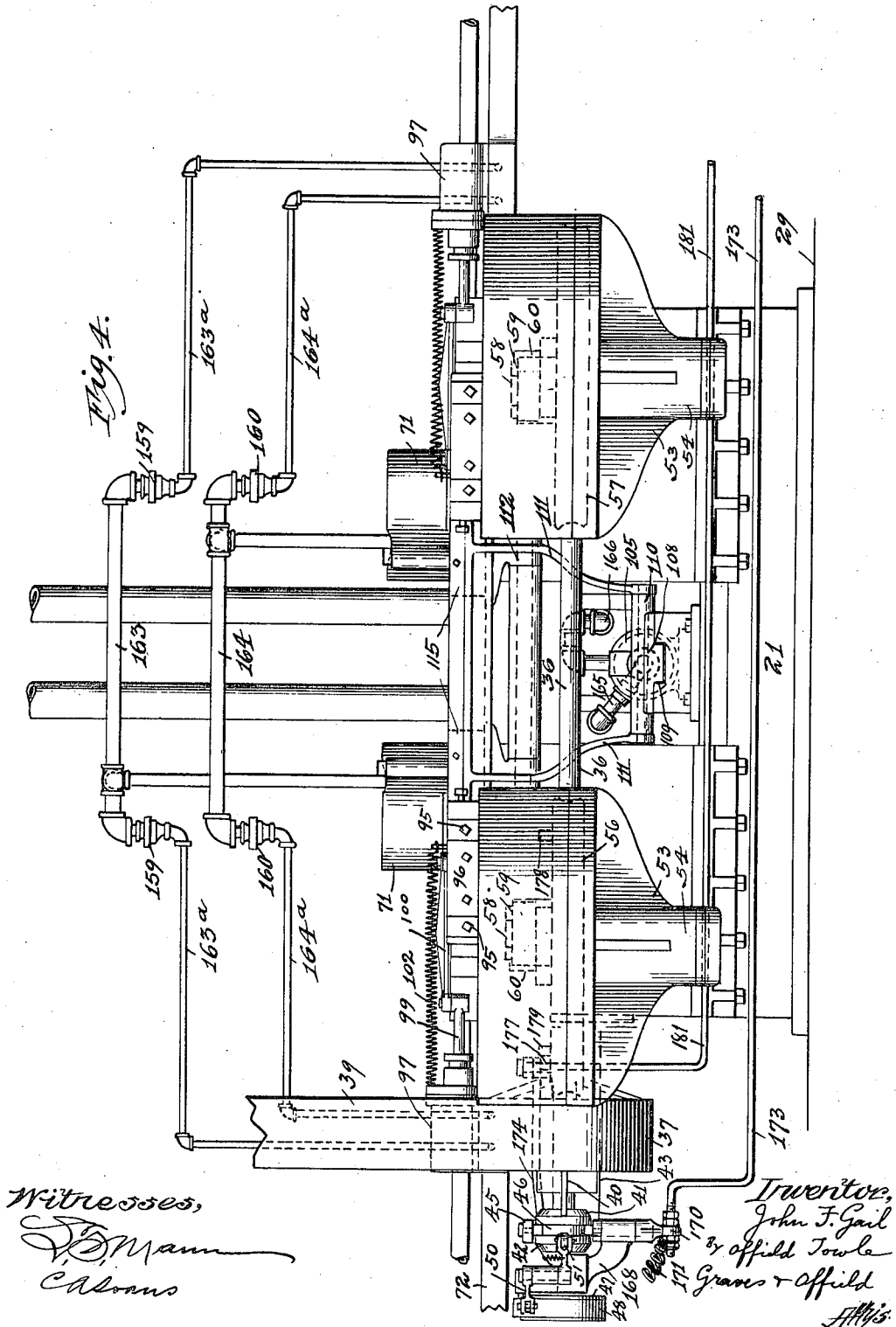
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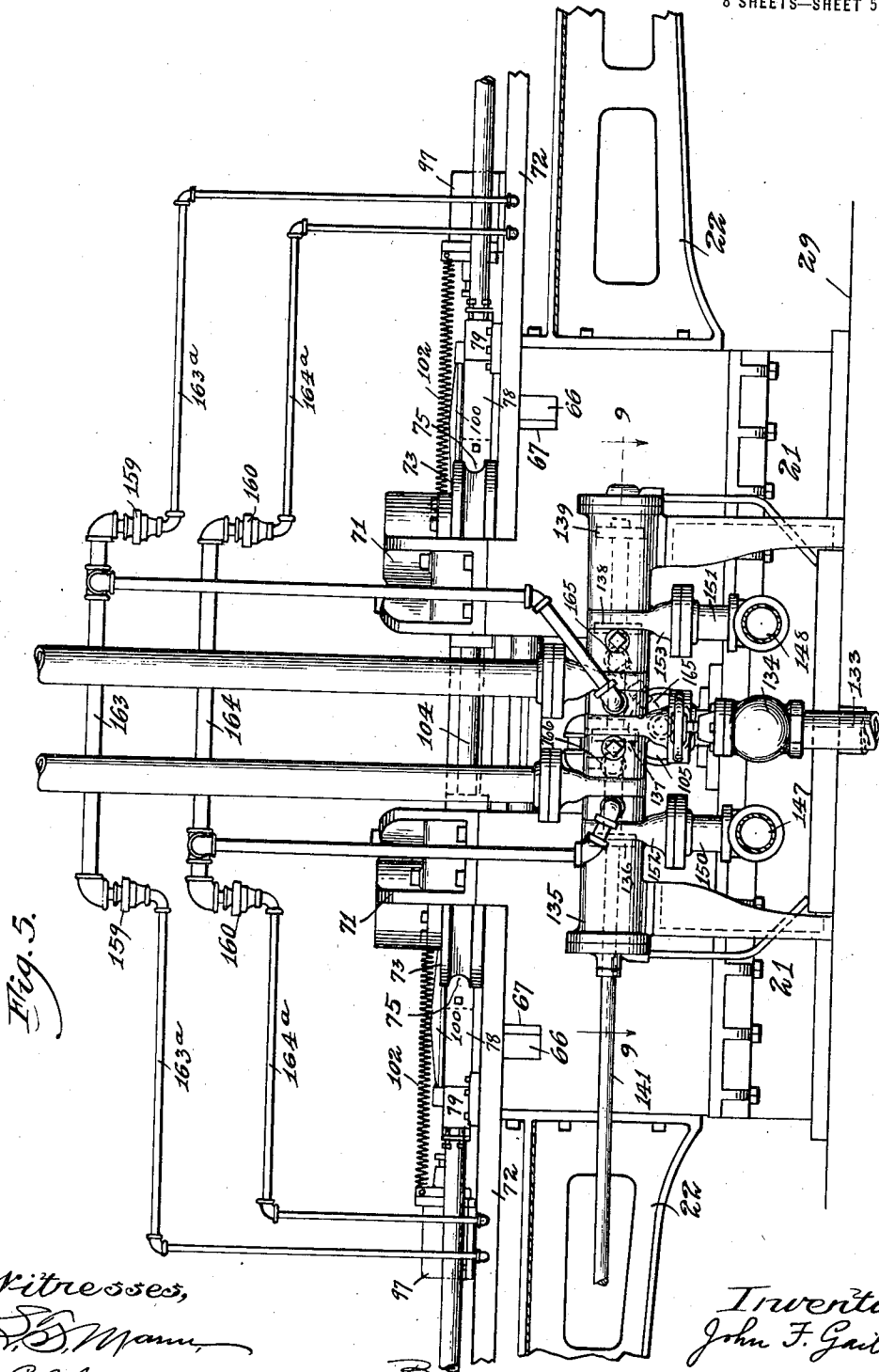


Fig. 5.

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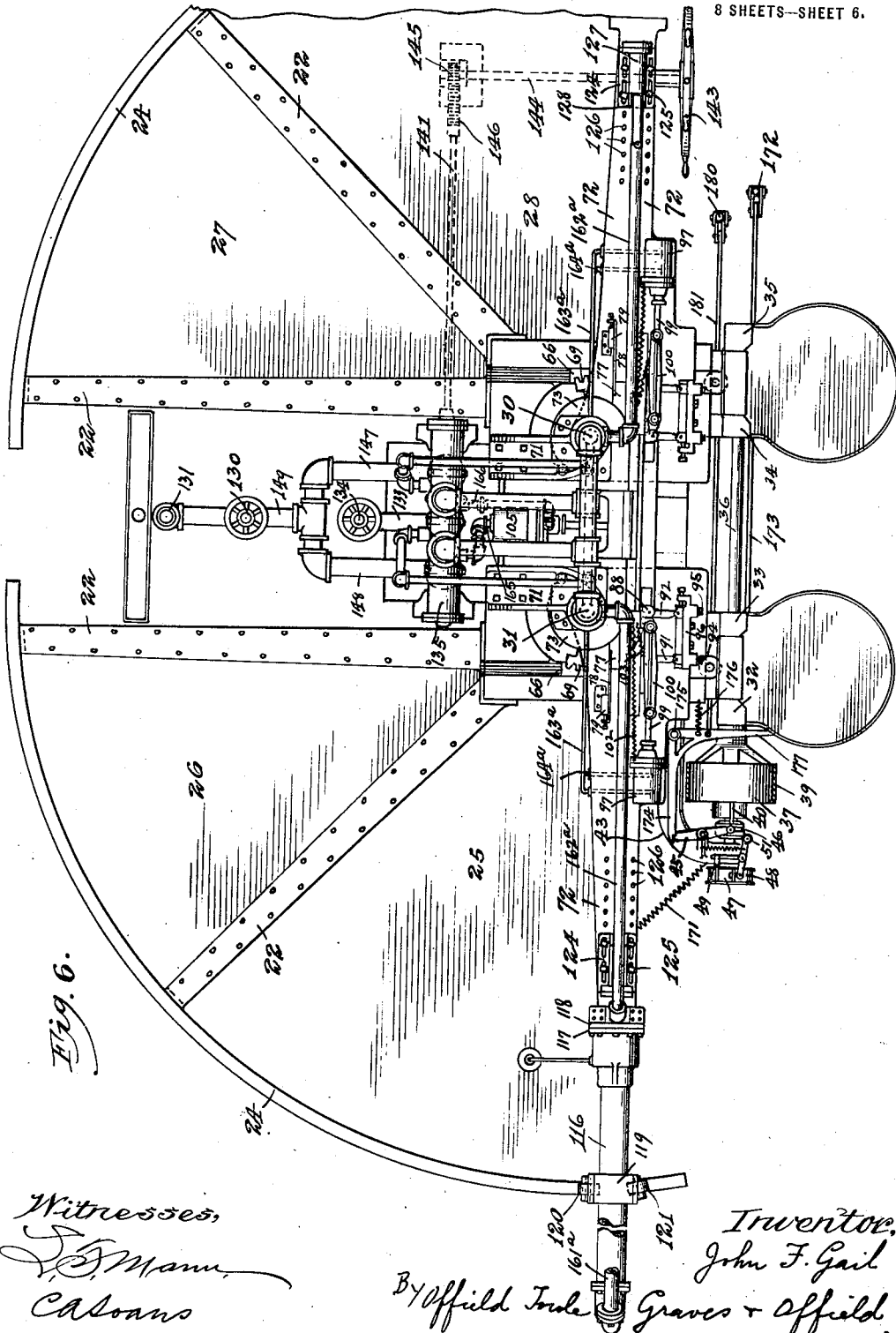
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8 SHEETS—SHEET 6.



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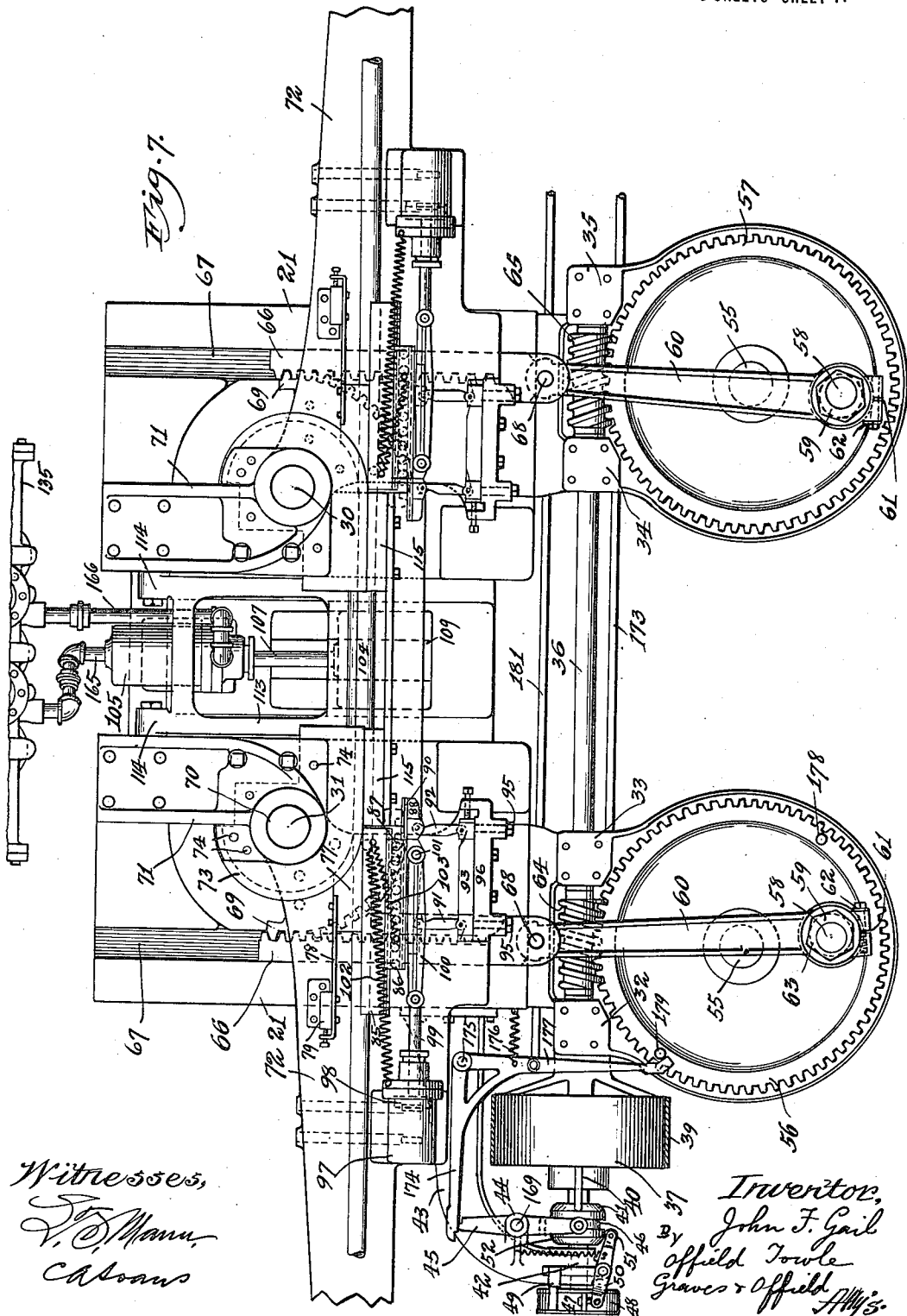
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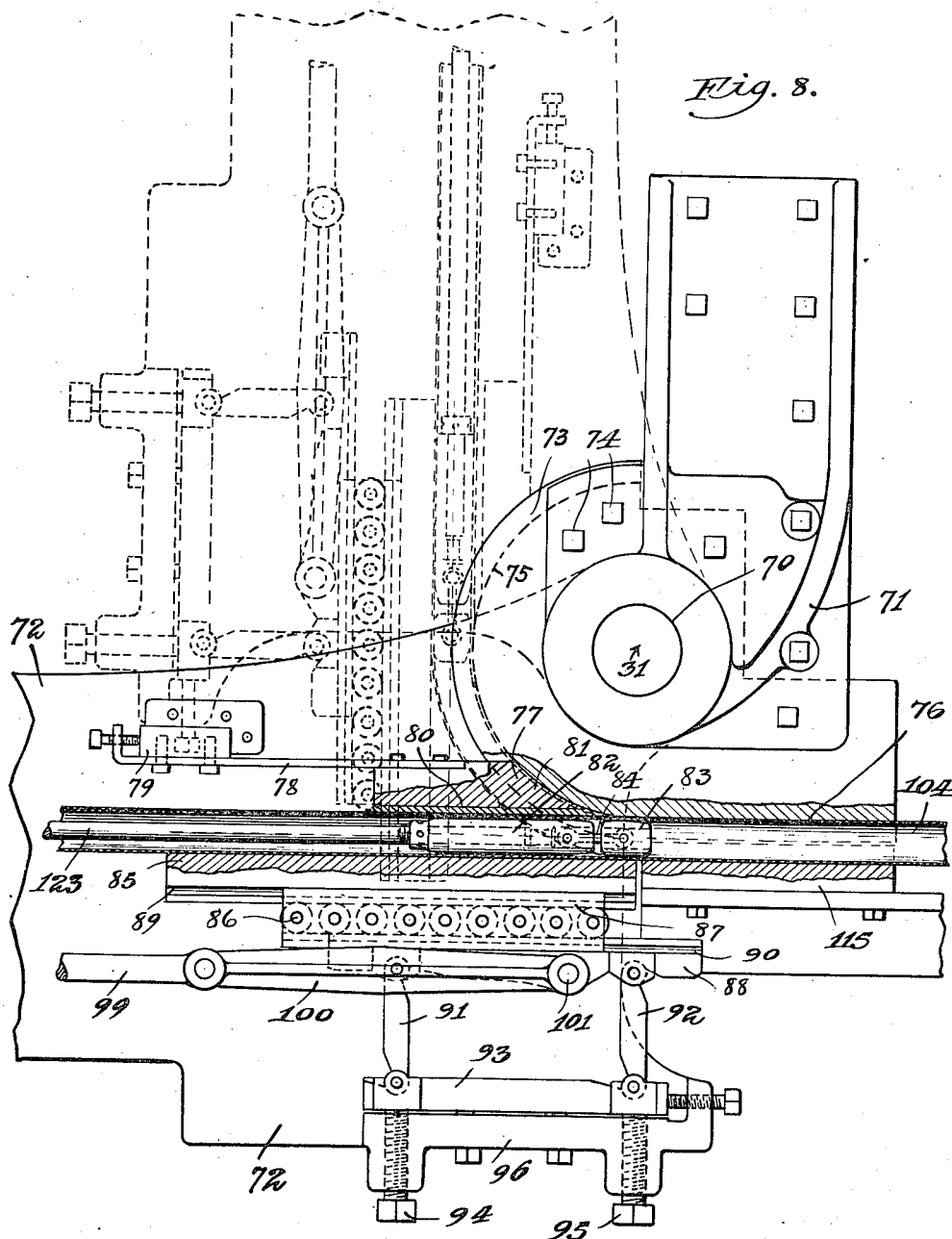
8 SHEETS—SHEET 7.



APPLICATION FILED DEC. 13, 1916. RENEWED NOV. 20, 1920.

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8 SHEETS—SHEET 8.



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UNITED STATES PATENT OFFICE.

JOHN F. GAIL, OF KENOSHA, WISCONSIN, ASSIGNOR TO SIMMONS COMPANY, OF KENOSHA, WISCONSIN, A CORPORATION OF DELAWARE.

TUBE-BENDING APPARATUS.

1,379,858.

Specification of Letters Patent.

Patented May 31, 1921.

Application filed December 13, 1916, Serial No. 136,599. Renewed November 20, 1920. Serial No. 425,561.

To all whom it may concern:

Be it known that I, JOHN F. GAIL, a citizen of the United States, residing at Kenosha, in the county of Kenosha and State of Wisconsin, have invented certain new and useful Improvements in Tube-Bending Apparatus, of which the following is a specification.

My invention relates to improvements in tube-bending apparatus and is of particular service when applied to a machine capable of effecting simultaneously a plurality of bends in a length of metal tubing, although certain features of my invention are available for use in tube-bending machines generally.

In certain classes of work, such as furniture constructions, and particularly in the end frames of what in the trade are known as "continuous post bedsteads," it is necessary to make a pair of bends in a length of metal tubing, the distance between the bends being previously determined and being required to be definite and accurate so that the various parts may be assembled together rapidly, accurately, and without the necessity of expending a large amount of time and labor in fitting the various parts together. In other words, the continuous tube, after having been provided with the two bends, must be of standard dimensions. Although it is possible to make such bends, one at a time, serially, the process is somewhat tedious and demands a fair degree of skill and care, and even then the resultant product may be slightly off size, causing delay and trouble in the assembly of the frames, if not the rejection of a certain percentage of the parts.

Among the salient objects of my invention are, to provide a tube-bending apparatus which is capable of bending a length of tubing in two places simultaneously; to provide a tube-bending apparatus in which the various movements of the machine may be performed in a substantially automatic manner without the necessity of employing manual power, except in the control of the apparatus; to provide an improved apparatus of the character described, so organized that the various movements are performed in proper order and correctly synchronized as to time; to provide an apparatus of the class described so constructed and arranged that the resultant product

shall be of standard dimensions and of uniformly high quality; to provide an apparatus of the class described so arranged that the necessity of trimming the product or making allowances for such trimming is obviated; to provide an apparatus which shall effect the bending of the tubes rapidly and economically; to provide a machine which shall be comparatively compact, considering the work performed, inexpensive to manufacture and maintain, simple in construction and operation, easy to manipulate, and, in general, to provide an improved apparatus of the class described.

As illustrating the application of my invention I shall now describe a machine for effecting twin bends in the main tubes of continuous post tubular frames, said machine being shown in the accompanying drawings, in which—

Figure 1 is a left-hand end elevation of the machine, showing the parts in normal position;

Fig. 2 is a right-hand elevation of the machine, showing the parts in the position assumed after the bends have been effected;

Fig. 3 is an enlargement of a portion of Fig. 1;

Fig. 4 is a front elevation of the central part of the machine;

Fig. 5 is a rear elevation of the central part of the machine;

Fig. 6 is a plan view of the machine, a portion of the right-hand end being broken away;

Fig. 7 is a plan view of the central portion of the machine with the gear covers removed;

Fig. 8 is an enlarged fragmentary plan view of the left-hand bending head and associated parts, partly in section; and

Fig. 9 is a section taken through the control valve on the line 9—9 of Figs. 2 and 5.

In the drawings, 21 represents the main frame or base casting which carries the principal parts of the tube-bending apparatus. Bolted to said frame, as shown best in Fig. 5, and radiating therefrom are a series of arms 22, the outer ends of which are supported by small cast-iron standards, as shown at 23 in Fig. 2. These arms 22 at their outer ends carry a pair of quadrant-shaped track members 24 for a purpose which will hereinafter appear. Sheet-iron plates 25, 26, 27, and 28, bolted to the arms,

fill up spaces between arms 22 and prevent material from dropping onto the floor 29.

The machine, which, as previously described, is for the purpose of making a double bend in continuous-post bed frame tubes, has two bending centers 30 and 31 which are disposed symmetrically on each side of the center line of the machine. Parallel with the front of the machine and journaled in a set of bearings 32, 33, 34, and 35, carried by the main casting 21, is a main power shaft 36 which is driven by a pulley 37 from a constantly running shaft 38 by means of a belt 39. Through the constantly running pulley 37 the shaft 36 is intermittently operated by means of a clutch 40 with which coöperates a clutch-engaging cone 41 slidably arranged upon the left-hand end of the shaft 36. The outer end of the shaft 36 is supported by means of an outboard bearing 42 on the end of a substantial bracket 43 bolted to the left-hand face of the main base casting 21. On said bracket 43 is an integral lug 44 on which is pivoted a lever 45, the front end of which is forked and provided with pins which engage in the groove 46 of the clutch-cone 41. The outer end of the shaft 36 beyond the outboard bearing 42 is equipped with a brake-drum 47 having associated therewith a brake-strap 48, one end of which is fixedly secured to the bracket 43, as at 49, and the other end is linked to the outer end of a bracket lever 50 pivotally mounted on the end of said bracket 43. On the inner end of said bracket lever 50 is mounted a roller 51 which coöperates with a conical portion 52 on the outer end of the clutch collar 41 in such a manner that when the clutch 40 is engaged by moving the member 41 inwardly, the roller 51 runs down the cone 52 and releases the brake, said brake being normally in engagement when the clutch 40 is disengaged, with the shaft 36 stationary.

Symmetrically disposed at the front of the machine are a pair of forwardly projecting brackets, as shown at 53 in Fig. 3, formed integrally with the main frame 21, and each having an axially vertical heavy bearing boss 54 in which is journaled a short vertical shaft 55. To the upper ends of the shafts 55 there are keyed a pair of large worm gears 56 and 57, each provided with a fixed crank pin 58. Journaled on each of the crank pins 58 is an eccentric collar or bushing 59 which fits within a hole bored in the outer end of a pitman 60. The ends of the pitmen are split, as shown at 61, and equipped with clamping screws 62, whereby the eccentric collars 59 may be adjusted in any position in the ends of the connecting rods 60, thereby in effect lengthening or shortening the pitmen 60. In order to facilitate the adjustment of the bushings 59 when necessary to adjust the length

of the pitmen 60, I preferably form a hexagon head 63 on each of said bushings 59. The worm gears 56 and 57 are rotated by means of a pair of worms 64 and 65 keyed to the shaft 36.

The bending heads are in duplicate, so I shall describe only one of said heads, viz., the one which is associated with the left-hand bending center 31. an enlarged view of certain portions of said bending head being shown in Fig. 8. Referring to Fig. 7, 66 represents a rack bar which is slidably mounted in a deep groove 67 cut in the upper face of the main casting 21, the front end of said rack bar being pivotally connected at 68 to the rear end of the pitman 60. The effect of reciprocating the rack bar 66 is to rotate the coöperating sector arm 69 which is keyed to a vertical shaft 70, the lower end of which is journaled in the main casting 21, and the upper end is journaled in the bracket 71 bolted to the main frame. To the top of the sector arm 69 I bolt the bending arm 72, which is also keyed to the vertical shaft 70, and therefore swings about the center 31 whenever the rack bar 66 slides in its groove. Immediately above the pivotal end of the bending arm 72 I mount a stationary bending form 73 which is secured to the upper bracket 71 by means of bolts, as at 74. Said bending form 73 is grooved, as shown at 75 in Fig. 5, a portion of the groove being straight, as shown at 76 in Fig. 8, in order to form an inner support for the central or unbent portion of the tube to be bent. That portion of the bending form 73 around which the tube is to be bent is made circular in shape, the center of the circle being of course coincident to the bending center 31.

The bending arm 72 is equipped with a swiping block 77 stationarily mounted upon the bending arm 72 and capable of being adjusted by means of a bar 78 to which the swiping block is secured, the outer end of said bar being slidably mounted upon and adapted to be clamped to the bracket 79 bolted to the top of the bending arm 72. The swiping block 77 has a straight curved grooved seat 80 for the tube and a curved surface 81 which slides around the circular grooved surface of the forming block 73. The swiping block 77 coöperates with the tube and the forming block 73 in a manner similar to that described in United States patent to Brinkman, No. 878,604. While the bending arm 72 is bending the pipe by swinging into the dotted line position shown in Fig. 8, the tube is supported internally by means of a mandrel 82 to which is pivotally connected a ball or short curved plug 83. The link 84, which pivotally connects the two parts of the mandrel, is preferably provided at each end with a ball-and-socket joint, thereby permitting the mandrel to be

inserted in the tube without reference to its angular position.

Describing the means for clamping or exerting pressure upon the tube while the same is being formed, 85 is a slide which engages the tube being bent, the contacting surface being curved or grooved out in the form of a semicircle in order to exert uniform pressure upon the outer surface of the tube. Said slide 85 is supported upon a set of anti-friction rolls 86 mounted in a rectangular cage 87, the support for said rolls while the tube is being bent being furnished by means of a casting 88. The sides of the parts 85 and 88 are grooved adjacent their edges, as shown at 89 and 90 to accommodate small loosely fitting tongues on the inner faces of the sides of the cage 87, thereby preventing lateral separation of the slide 85 from the casting 90. The casting 88 is supported by a pair of toggle-plates or arms 91 and 92, the inner ends of which are pivoted in the casting 88, and the outer ends of which are pivoted on a thrust block 93 capable of being adjusted toward or away from the tube by means of set screws 94 and 95 which are mounted in a bracket 96 projecting upwardly from and forming an integral abutment on the arm 72.

The pressure block or slide 85 is moved into or out of engagement with the tube by means of a hydraulic cylinder 97 securely mounted upon the arm 72 and provided with a piston 98, and piston rod 99, which is connected to the thrust casting 88 by means of a link 100, one end of which is pivoted to the piston rod 99, and the other end of which is pivotally connected to the thrust casting 88 at 101. It will be readily understood that an inward movement of the piston 98 in its cylinder 97 will result in a flattening out of the toggle links 91 and 92, thereby drawing the pressure slide 85 away from the tube, and an outward movement of said piston will straighten out the toggles and cause the slide 85 to move toward the tube and press the same against the swiping block 77.

While the tube is being bent, the slide 85 moves inwardly toward the middle portion of the tube, rolling upon the rolls 86, the position of said slide after the tube has been completely bent being shown in dotted lines in Fig. 8. The cage 87, carrying the rolls, of course moves just half the distance moved by the slide 85. In order to facilitate the return of the slide to its normal full line position, as shown in Fig. 8, after the tube has been bent and in readiness for the insertion of another tube, I connect a coiled tension spring 102 between the slide 85 and a fixed part of the bending arm, and also connect a second similar spring 103 between the cage 87 and the slide 85. After the tube has been bent and when the tube is re-

leased by flattening out the toggles 91 and 92, the springs bring the slide 85 and cage 87 back to their normal full line positions.

While the bending is taking place, the central portion of the tube 104 must be securely held in clamped position against all movement. To this end, I employ a central clamping hydraulic cylinder 105 provided with a piston 106, piston rod 107, and cross-head 108 which reciprocates upon a longitudinal slide 109 formed as a part of the main casting 21. To said cross-head 108 I pivotally connect at 110 a lever-like casting or frame 111 which fulcrums at 112 upon the end of a link 113, the other end of which is pivotally connected at 114 with the main frame casting 21 (see Fig. 3). The upper end of the swinging frame 111 extends laterally a sufficient distance in either direction to accommodate a pair of clamping blocks 115, the inner faces of which are grooved to fit the outer surface of the pipe 104 and force the latter against the straight portions 76 of the forming blocks 73.

It will be readily understood that an outward movement of the piston 106 in its cylinder will cause the upper end of the frame 111 to swing up and around the end of the link 112, thereby forcing the clamping blocks 115 into engagement with the pipe and holding the same in position while the tube is being formed. Similarly, a movement of the piston 106 inwardly in its cylinder will release the tube and cause the upper end of the frame 111 carrying the clamps to swing away from the tube downwardly so as not to interfere with the insertion of another tube.

The mandrels 82 are inserted in and removed from the tube 104 to be bent by means of a pair of hydraulic cylinders 116 carried by the outer ends of the bending arms 72. (See Figs. 2 and 6). The inner end of each of these cylinders 116 is flanged, as shown at 117, whereby it may be bolted to a similar flange 118 on the end of the bending arm 72, the cylinder 116 constituting in effect an integral extension of the bending arm 72. In order to support the considerable weight of the end of the arm 72 and cylinder 116, I clamp onto the barrel of the cylinder 116 a mounting 119 having a pair of trolley wheels 120 and 121 which roll upon the quadrant-shaped track 24 previously referred to. The cylinder 116 has a piston 122, and piston rod 123, the outer end of which is screwed into the mandrel 82.

When the tube is inserted in the apparatus preparatory to bending, the bending arms 72 are in line, as shown in Fig. 6. In order to facilitate the positioning of the tube preparatory to bending, each bending arm 72 carries a positioning device 124 in the form of a small bracket which may be adjusted along the top of the bending arm

72 by means of the bolts 125 and bolt holes, as shown at 126. On said bracket 124 is carried a sleeve or cylinder 127 (see Fig. 2 and right-hand end of Fig. 6) of sufficient diameter to readily accommodate the mandrel 82, a short distance of the inner end of which cylinder 127 being cut away, as shown at 128 in Fig. 2, in order to form a semi-circular positioning seat for each end of the tube to be bent. It will be manifest that before the tube can be inserted in the machine, it is necessary to draw in the piston 122 until the end of the mandrel disappears in the cylinder 127.

Describing the hydraulic controlling apparatus for the central clamping cylinder 105, the pair of toggle cylinders 97, and the pair of mandrel cylinders 116, 129 (see Fig. 2) is a pipe for supplying to the apparatus water under pressure. Said water is admitted to the apparatus by means of a main controlling valve or gate 130, and surges or water hammer in the piping or cylinders is prevented by a cushion of air under pressure contained in the vertical riser pipe 131 connected to the main supply pipe 129. The desired cushioning effect can be obtained by pumping a sufficient quantity of air into the riser 131 through the valve 132. The exhaust water is conducted away through a pipe 133, the flow being controlled by means of a valve 134. The valve apparatus comprises a single valve cylinder 135 having a set of four valves 136, 137, 138, and 139, all securely mounted upon an enlargement 140 of a valve-actuating rod 141 extending through the stuffing box 142. The longitudinal movement of said valve rod 141 is controlled by means of a hand-wheel 143 which is keyed to a shaft 144 mounted in stationary journal bearings and having at its inner end a spur gear 145 which coöperates with a rack 146 on the end of said valve rod 141. The pressure fluid is admitted to opposite ends of the cylinder 135 through a pair of pipes 147 and 148, both connected to the main supply pipe 149 and equipped with risers 150 and 151 bolted to flanged inlets 152 and 153 integral with the valve cylinder 135. The inlets 152 and 153 communicate with the interior of the cylinder 135 through ports 154 and 155. The exhaust fluid is conducted away from the valve cylinder through a port 156 leading to the exhaust valve 134.

Since the pairs of cylinders 97 and 116 are mounted upon and swing with the bending arms 72 during the bending of the tube, it is necessary to provide flexible connections for conducting the pressure fluid to and away from said cylinders. To this end, I associate with each of the arms 72 and above each of the bending centers a set of four rotary pipe joints or connections 157,

158, 159, and 160. There is, of course, a set of four of such joints for each bending head, the pipes feeding corresponding joints being connected through T's, and the various pairs of corresponding joints or connections being connected to common conduits 161, 162, 163, and 164, which also form the supports from which the rotary joints 157, 158, 159, and 160 are suspended over the centers of the bending heads. The outer ends of the mandrel cylinders are connected to the joints 157 through pipes 161^a, the inner ends of the mandrel cylinders are connected to the joints 158 through pipes 162^a, the outer ends of the toggle cylinders 97 are connected to the joints 159 by pipes 163^a, and the inner ends of the toggle cylinders are connected to the joints 160 through the pipes 164^a.

The pipe 161, which is connected to the outer ends of the mandrel cylinders, leads into the valve cylinder 135 through a port 161^b, and the pipe 162, connected to the inner ends of said mandrel cylinders, leads into the valve chamber 135 via a port 162^b. The pipe 163, which leads to the outer ends of the toggle cylinders, leads into the valve chamber through a port 163^b, and the pipe 164, which is connected to the inner ends of the toggle cylinders, leads into the valve chamber through a pipe 164^b.

The rear end of the central stationary cylinder 105 is connected by means of a pipe 165 with the valve chamber 135 through a port 165^b, and the inner end of said central cylinder leads into the valve chamber through a pipe 166 and port 166^b.

Describing the operation of the valve mechanism, in the position shown, that portion of the valve chamber between the pistons 136 and 137 is under pressure from water flowing into the cylinder through the pressure port 154, thereby communicating the pressure to the pipes 162, 164, and 166 which supply the inner ends of all of the cylinders, whereas, the outer ends of the cylinders are exhausted by reason of the fact that the exhaust port 156 is in free communication with the pipes 163, 161, and 165, which lead to the rear ends of said cylinders. Hence, in this position the pistons of the various actuating cylinders are withdrawn and it is possible to insert a pipe in the apparatus, it being understood that the arms 72 are in line with each other at that time. After a pipe has been inserted in the apparatus, the operator rotates the hand-wheel 143, thereby moving the valve rod 141 in the direction of the arrow 167 a sufficient distance to move the piston 138 to a position just to the right of the exhaust port 156. With the valve in this position, the outer ends of the cylinders are placed under pressure and the inner ends are exhausted, resulting in the clamping of the

tube by the central clamping plunger 105, setting up of the toggles by the cylinders 97, and insertion of the mandrels by the cylinders 116. During the clamping movement of the valve stem in the direction of the arrow the piston 138 first uncovers the port 165^b in order to clamp the central portion of the tube against the stationary forming blocks; it next uncovers the port 161^b, causing the insertion of the mandrels into the tube, and finally uncovers the port 163^b controlling the clamping movement of the toggle cylinders 97. The apparatus is then in condition for the application of power to swing the bending arms 72 and form the tube. (See Fig. 7).

When the apparatus is at rest, the clutch member 47 is pulled back out of engagement with the clutch 40. Immediately below the lug 44 and the bracket 43 is another lug or bracket 168 (see Fig. 4), and in said lugs is rotatably mounted a pivot shaft 169 to which is keyed the shifter forked lever 45. On the lower end of said pivot shaft 169 I key an arm 170, the end of said arm 170 being connected by means of a suitable spring 171 with a fixed part of the frame of the apparatus, thereby tending to turn said shaft and said shifter lever 45 in a direction to force the clutch member 41 out of engagement with the clutch 40.

To the starting lever 172 is suitably connected one end of a rod 173, the other end of which is pivotally connected to the end of the arm 170 (see Figs. 2 and 4), whereby movement of said lever 172 will have the effect of rotating the shaft 169, thereby moving the clutch fork 45 in a direction to engage the clutch. After the shaft 36 has commenced to rotate, the lever 45 is locked in clutched position by means of cooperating locking abutments on the end of said lever 45 and on the end of a bell crank lever 174 pivoted at 175 on the bracket 43. Said bell crank lever 174 is held in locking engagement with the end of the lever 45 by means of a spring 176 attached to the forwardly projecting arm 177 of said bell crank lever. After the worm gears 56 and 57 have made a half-revolution, thereby bending the tube, the shaft 36 is automatically unclutched from the constantly running pulley 37 by means of a trip-pin 178 which engages the front end of the bell crank arm 177 and rotates said bell crank slightly against the tension of the spring 176, thereby releasing the end of the clutch lever 45 and throwing the clutch out of engagement. At the same time that the clutch is thrown out of engagement, the brake is applied by reason of the roller 51 climbing up the cone surface 52 of the clutch member 41, thus instantly arresting the movement of the shaft 36. The worm gear 56 is also equipped with another tripping pin 179 which operates in the same

manner as the tripping pin 178 and causes the movement of the bending arms to be arrested upon the return of the bending arms 72 to the normal or idle position, shown in Fig. 7.

It will be understood that after the lever 172 has once been actuated to engage the clutch, the rotation of the worm gear 56 moves the trip pin 178 or 179 out of range of the bell crank lever arm 177 and thereafter during a half revolution of the worm gears, the lever 172 has no further control over the clutching or unclutching of the shaft 36. In some cases, however, it has proved to be of advantage to be able to stop the machine after the movement has been once commenced—for instance, in case of a mishap. I therefore prefer to utilize an emergency lever 180 which is connected to the bell crank lever arm 177 by means of a rod 181. It will be readily understood that said emergency lever 180 may at any time be actuated in order to untrip the lever 45 and release the clutch.

In manipulating the apparatus, the hand-wheel 143 is placed in such position that the pistons of the various hydraulic cylinders are retracted. The bending arms 72 having been brought into the position shown in Fig. 6, the straight tube to be bent is held in position and the hand-wheel 143 is actuated to admit pressure fluid to the rear ends of the various cylinders. The central part of the tube is thus clamped, the mandrels are inserted and the toggles are set up, thereby forcing the tube against the swiping blocks. The arrangement is such that the mandrels are inserted a sufficient distance to prevent the tube from collapsing while it is being bent around the formers.

The lever 172 is then operated to lock the clutch in engagement and the shaft 36 commences to revolve, thereby rotating the worm gears 56 and 57 and swinging the bending arms 72 toward the rear of the machine by virtue of the rack 66 and sector arms 69. The movement of the gears 56 and 57 continues until said gears have revolved through an angle of 180°, at the expiration of which time the tripper pin 178 releases the clutch and the bending arms 72 will then be found to have moved through an angle of approximately 90° into the position shown in dotted lines in Fig. 8, the bending of the tube thus having been accomplished. After the tube has been bent and before moving the bending arms back into normal position, the hand-wheel 143 is actuated to admit fluid to the inner ends of the various cylinders, thereby retracting the several pistons to withdraw the mandrels and unclamp the tube. The bent tube must of course be removed before the bending arms 72 are returned to normal position. The second movement of the lever 172 causes

another 180° movement of the worm gears 56 and 57 and brings the bending arms into alinement.

Any size or shape of tube may be bent by means of my improved apparatus, and it must also be borne in mind that certain important features of the machine are not necessarily confined to use in connection with a machine for forming a plurality of bends, such as I have described. In many respects the apparatus disclosed herein may be modified or changed without sacrifice of efficiency. Hence, it will be manifest that the scope of the invention must be determined by the claims and not by referring to the specific details of construction, which are merely illustrative of a single application of my invention.

I claim—

1. In tube-bending apparatus, the combination of a stationary former, a swiping block fitting the former and having a face fitting one side of the unbent tube, means for holding one end of the tube relative to the former, an outer support engageable with the other side of said tube, means operable by power for engaging the support with the tube, and means for moving said support and said swiping block to bend the tube around the former.

2. In tube-bending apparatus, the combination of a stationary former having a circular bending surface, means for clamping an unbent tube to said former, a bending arm mounted to swing on an axis coincident with the center of said former, means for moving said arm, a swiping block carried by said arm having a face fitting the circular face of the former and another face fitting one side of the unbent tube, an outer support also carried by said arm engageable with the other side of said tube, and means operable by power for engaging the support with the tube.

3. In tube-bending apparatus, the combination of a stationary former having a circular bending surface, means for clamping an unbent tube to said former, a bending arm mounted to swing on an axis coincident with the center of said former, means for moving said arm, a swiping block carried by said arm having a face fitting the circular face of the former and another face fitting one side of the unbent tube, an outer support also carried by said arm engageable with the other side of said tube, means operable by power for engaging the support with the tube, and a mandrel carried by said arm and insertible in said tube.

4. In tube-bending apparatus, the combination of a stationary former having a circular bending surface, means for clamping an unbent tube to said former, a bending arm mounted to swing on an axis coincident with the center of said former, means for

moving said arm, an outer support carried by said arm engageable with the other side of said tube, means operable by power for engaging the support with the tube, a mandrel carried by said arm and insertible in said tube, a source of power, means operable from said source of power for inserting a mandrel into the tube, and means for controlling the power means.

5. In tube-bending apparatus, the combination of two bending heads, each comprising a stationary former, a swiping block fitting the former and having a face fitting one side of the tube and an outer support engageable with the other side of said tube, power means for engaging the supports with the tube, and means for simultaneously moving said supports and said swiping blocks around their respective formers to bend the tube around each of said formers simultaneously.

6. In tube-bending apparatus, the combination of a pair of bending heads, each comprising a circular stationary former and a bending arm carrying a swiping block fitting the circular face of the former and also fitting one side of the unbent tube and an outer support engageable with the other side of said tube, means operable by power for engaging the supports with the tube, and means for simultaneously moving said arms around the respective formers to bend the tube in two places.

7. In tube-bending apparatus, the combination of a pair of bending heads, each comprising a circular stationary former and a bending arm carrying a swiping block fitting the circular surface of the former and also fitting one side of the unbent tube, an outer support engageable with the other side of said tube and means for pressing the support against the tube, and means for clamping an intermediate portion of said tube to both of said formers.

8. In tube-bending apparatus, the combination of a pair of bending heads, each comprising a circular stationary former and a bending arm carrying a swiping block fitting the circular surface of the former and also fitting one side of the unbent tube and an outer support engageable with and slidable along the other side of said tube, means for engaging said supports with the tube, means carried by said arms for inserting a mandrel in each end of said tube, means for clamping the intermediate portion of said tube into engagement with the formers, and clutch-controlled power mechanism for simultaneously revolving said arms around the formers to effect simultaneous bending of the tube in two places.

9. In a tube-bending apparatus, the combination of a pair of stationary formers around which a tube is to be bent, means for holding the tube against endwise move-

ment, means movable with reference to said
formers for bending the tube around said
formers, said bending means carrying man-
drels insertible within the tube for the pur-
5 pose of maintaining the form of the tube
at the bends, a source of power, means car-
ried by said bending means and operable
from a source of power for inserting and
withdrawing said mandrels, and stationary
10 mechanism for controlling said power-op-
erated means.

10. In tube-bending apparatus, the com-
bination of a stationary former, an arm ro-
tatable with reference to said former, an
abutment on said arm for engaging the tube, 15
a mandrel carried by said arm, a source of
fluid under pressure, a cylinder carried by
said arm, means carried by said arm oper-
ated by pressure of said fluid for inserting
said mandrel and means for moving said 20
arm to bend the tube.

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