May 20, 1941. E. H. TAYLOR ET AL 2,242,332

MACHINE FOR PRODUCING PIPE BENDS

Filed May 6, 1940 3 Sheets-Sheet 1

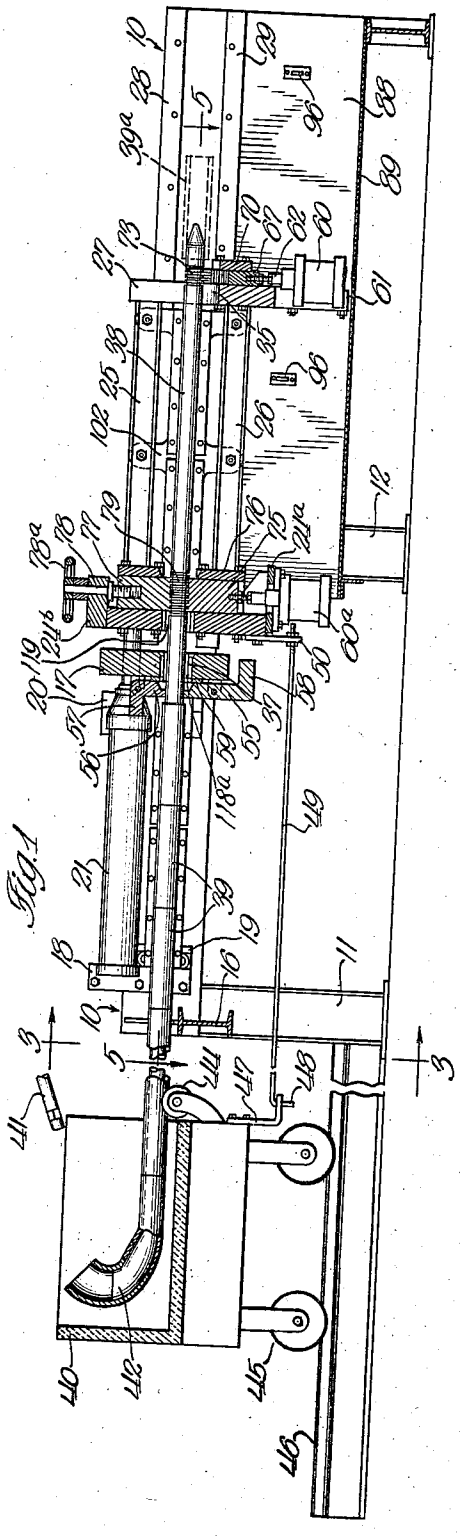


Fig. 1

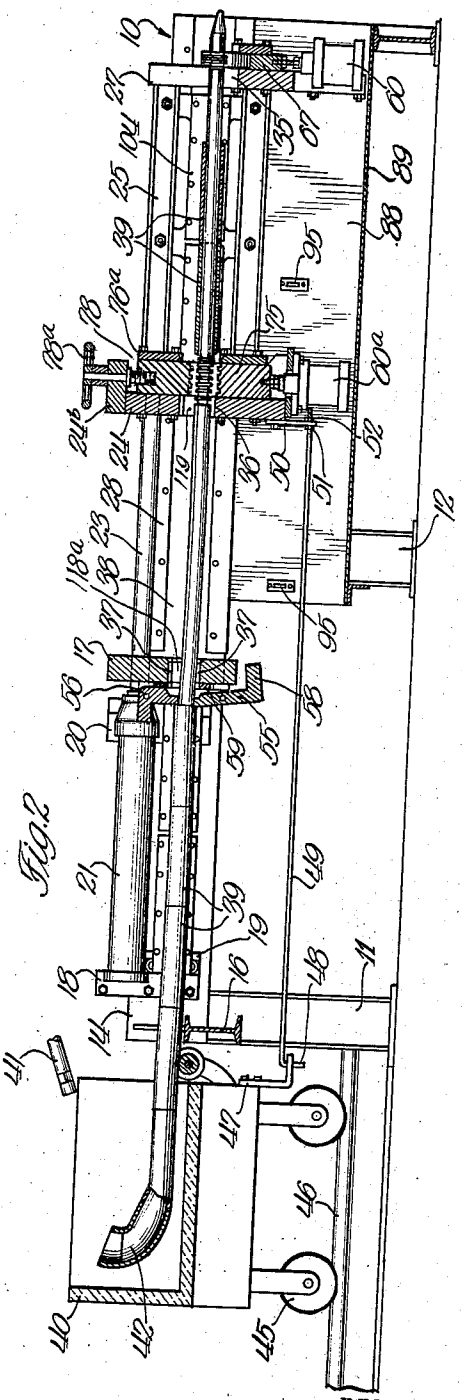


Fig. 2

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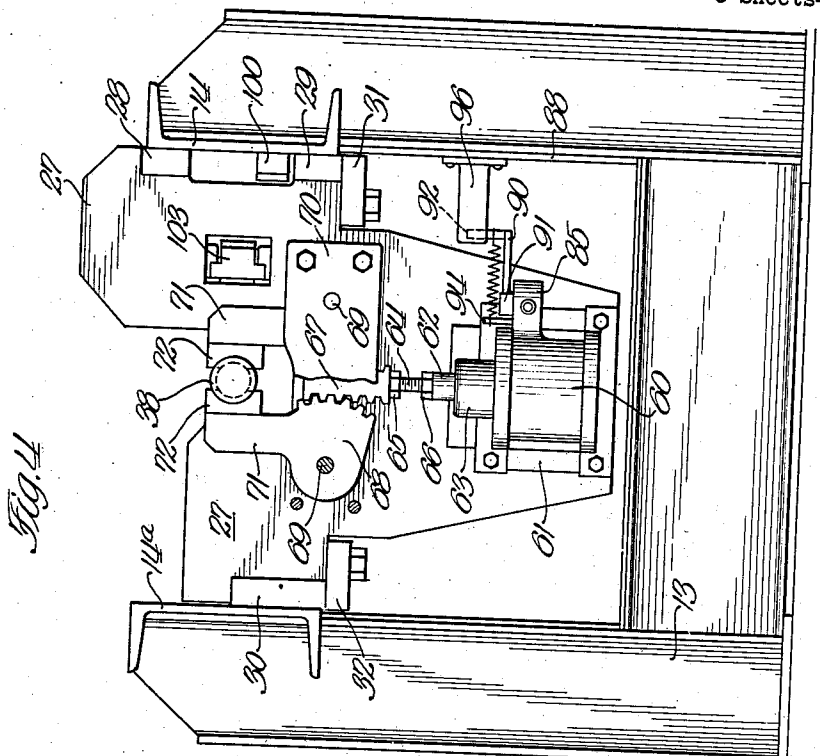


Fig. 4

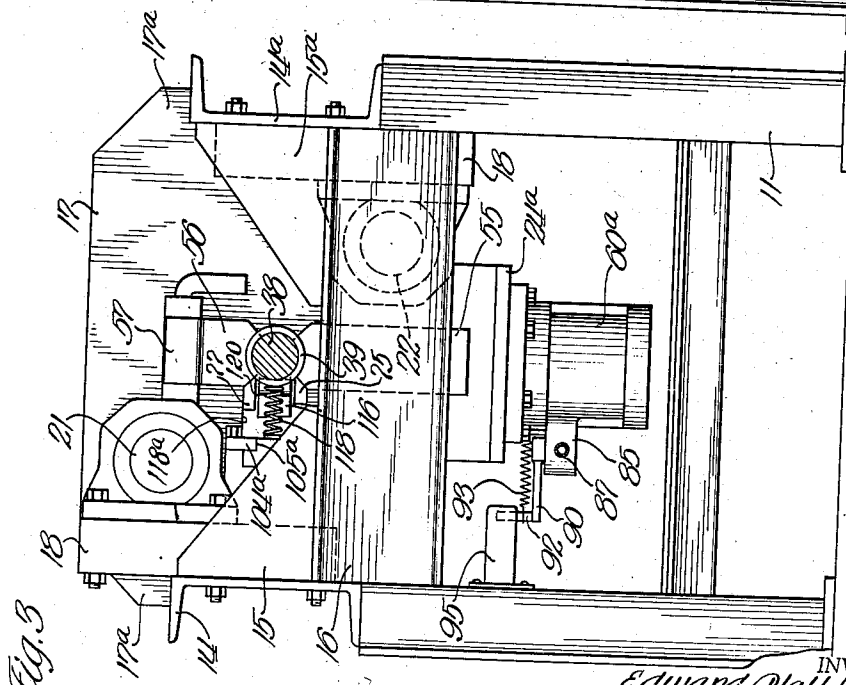


Fig. 3

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MACHINE FOR PRODUCING PIPE BENDS

Filed May 6, 1940 3 Sheets-Sheet 3

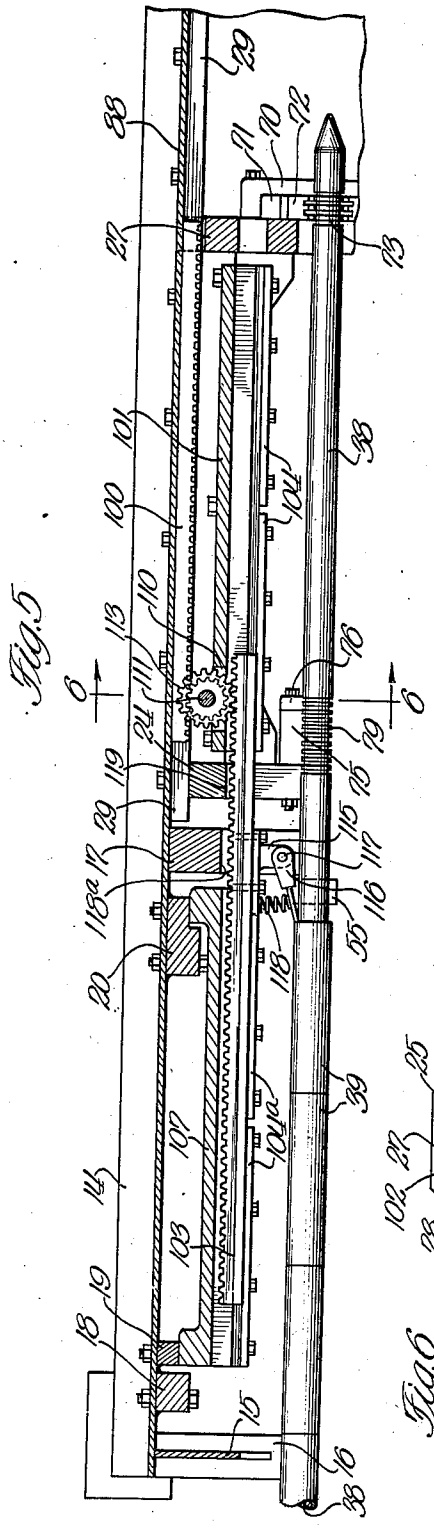


Fig. 5

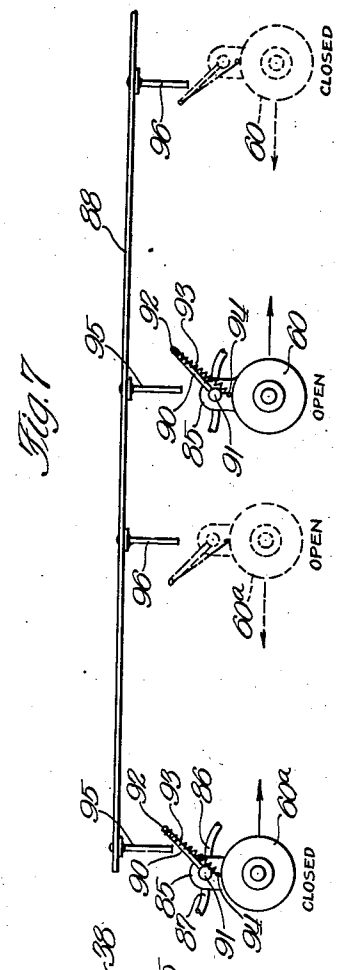


Fig. 7

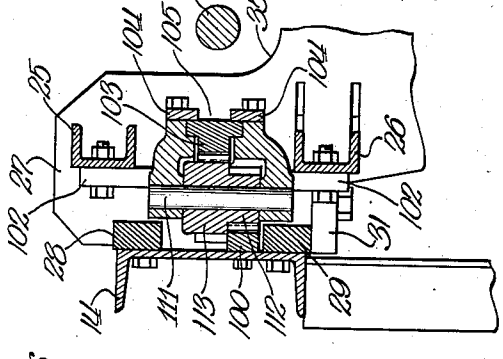


Fig. 6

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Patented May 20, 1941

2,242,332

UNITED STATES PATENT OFFICE

2,242,332

MACHINE FOR PRODUCING PIPE BENDS

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Application May 6, 1940, Serial No. 333,566

9 Claims. (Cl. 153—48)

This invention relates to pipe fittings, and has to do with production of elbows, U-bends and analogous articles by forcing straight tubular blanks over a suitably formed enlarging mandrel.

Our invention is directed to a machine comprising a mandrel rod having an associated mandrel, and means cooperating with said rod for in effect forcing tubular blanks over the mandrel by relative reciprocation of such means and the rod. In one form of our invention we provide a machine having means for reciprocating a mandrel rod and a mandrel carried thereby, such means comprising alternately acting holding devices spaced apart lengthwise of the mandrel rod for restraining it against lengthwise movement relative to the reciprocating means, while permitting placing of blanks upon the rod during the draw stroke thereof for forcing the blanks over the mandrel, to the end of increased speed in operation with resulting increase in production and consequent reduction in cost of producing the blanks. More specifically, we provide, in conjunction with the holding devices, feeder or pusher means for advancing blanks placed upon the mandrel rod forwardly along the latter, in such manner as to dispose the referred to blanks in front of blank abutment means extending about the rod, as the latter approaches the limit of its forward stroke, thus assuring that the rearmost of such blanks will be disposed for contact with the blank abutment means during the rearward or draw stroke of the rod. Further objects and advantages of our invention will appear from the detail description.

In the drawings:

Figure 1 is a central vertical lengthwise sectional view of a machine embodying our invention, certain parts being shown in elevation and certain other parts being shown broken away, the parts of the machine being shown in the positions which they occupy when the mandrel rod starts its rearward stroke;

Figure 2 is a view similar to Figure 1 but with the mandrel rod in the position which it occupies at the end of its rearward or draw stroke;

Figure 3 is a sectional view, on an enlarged scale, taken substantially on line 3—3 of Figure 1;

Figure 4 is an end view of the machine, as viewed from the rear thereof, on the same scale as in Figure 3, certain parts being broken away;

Figure 5 is a sectional view, on an enlarged scale, taken substantially on line 5—5 of Figure 1, certain parts being shown in plan;

Figure 6 is a sectional view taken substantially on line 6—6 of Figure 5, on an enlarged scale, certain parts being shown in elevation; and

Figure 7 is a diagrammatic view of the valve actuating means for controlling operation of the mandrel rod clamping devices.

The machine is provided with a main frame 10, suitably constructed and braced, comprising uprights 11, 12 and 13 spaced apart at each side thereof and suitably anchored to an appropriate foundation. These uprights support, at their upper ends, channel members 14 and 14a which extend lengthwise of the frame at the sides thereof and, at their forward ends, are connected by gusset plates 15 to a cross member 16 of I-beam construction, these parts of the frame structure being secured together in any suitable manner, conveniently by welding.

A relatively thick plate 17 extends across the main frame a short distance from the front thereof and is secured to the channel side members 14 and 14a in any suitable manner, conveniently by welding. Mounting blocks 18, 19 and 20 are welded to the inner face of channel member 14, between the cross member 16 and cross plate 17. Blocks 18 and 20 extend above member 14, as does plate 17, the latter being provided with side extensions 17a seating upon the top flanges of channel members 14 and 14a. Similar mounting blocks 18 and 20 are welded to the inner face of channel member 14a but are reversed relative to the blocks of member 14, in that the blocks 18 and 20 welded to member 14a extend downward beyond the latter member. Two hydraulic cylinders 21 and 22 are suitably mounted, as by bolting, on the mounting blocks of the channel members 14 and 14a, respectively, these cylinders extending lengthwise of the frame in parallelism with the channel members 14 and 14a. Each of the cylinders is provided with a piston (not shown) therein to which is secured a piston rod 23 slidable through appropriate stuffing box means in the rear cylinder head, the piston rod 23 passing through appropriate openings in the cross plate 17.

The rearward ends of piston rods 23 are secured to a cross head 24 in the form of a thick plate, which may be somewhat thinner than the stationary plate 17. Cross head 24 is connected, by upper and lower channel members 25 and 26, respectively, at each side thereof, to a yoke 27 disposed a considerable distance in rear of the cross head, to which the channel members 25 and 26 are suitably secured, conveniently by welding,

these channel members also being similarly secured to yoke 27. The cross head 24 and yoke 27, together with the connecting channel members 25 and 26 constitute a supplementary frame of substantially rectangular shape in plan. This supplementary frame is mounted for reciprocation lengthwise of the main frame, by means of slide rails 28 and 29 welded to the inner face of channel member 14, and a slide rail 30 welded to the inner face of channel member 14a. The yoke member 27 is provided with appropriate extensions seating upon the upper faces of rails 28 and 30 for sliding movement lengthwise thereof, and with retaining clips 31 and 32 suitably secured to the yoke member, conveniently by bolting, and disposed to contact the under faces of slide strips 29 and 30, respectively. It will be understood that cross head 24 is likewise provided with suitable extensions seating upon the upper faces of slide strips 28 and 30, and with retaining clips extending beneath the slide strips 29 and 30. In this manner the supplementary frame is supported in the main frame for reciprocation lengthwise thereof. It will be understood that, within the broader concepts of our invention, the supplementary frame may be of any other suitable construction and may be slidably supported in any other suitable manner.

The hydraulic cylinders 21 and 22 have associated therewith suitable means for admitting liquid under pressure thereto at either side of the pistons therein and for exhausting liquid from the other side of the pistons, for retracting and projecting the piston rods 23 and thus reciprocating the supplementary frame. Such means is well known and need not be illustrated nor described here in greater detail. While we preferably employ hydraulic means of the character referred to for reciprocating the supplementary frame, any other suitable means may be employed for that purpose.

Yoke 27 is provided with a central slot 35 extending downward from its top and disposed in alignment, lengthwise of the frame 10, with an opening 36 through cross head 24 and an opening 37 through the fixed stop plate 17. Slot 35 and openings 36 and 37 receive a mandrel rod 38 of a length to receive a plurality of straight tubular blanks 39 and to extend forwardly beyond frame 10 into a hood or furnace 40 of refractory construction. A suitably formed curved enlarging mandrel 42 is secured on the forward end of rod 38 within furnace 40. Suitable means, such as one or more gas burners 41, is provided for heating blanks on the mandrel 42 and rod 38. Preferably, a grooved roller 44 is supported by a bracket secured to the back wall of the furnace, in position to support the mandrel rod and the blanks thereon. Furnace 40 is suitably mounted on wheels 45 traveling upon rails, one of which is shown at 46, extending forwardly from frame 10 in alignment therewith. An apertured plate 47 is secured to the back of furnace 40 and receives a finger 48 extending downward from the forward end of a furnace draw bar 49, the rearward end of which extends through an arm 50 secured to and depending from cross head 24. Two nuts 51 and 52 are screwed upon the rearward end portion of draw bar 49 and contact the forward and rearward faces, respectively, of arm 50. The furnace is thus connected to cross head 24 for movement therewith effective to maintain constant the relation between the furnace and the mandrel rod and mandrel carried thereby.

Two blank abutment members or stops 55 and 56 are pivotally mounted at the front of plate 17 for swinging movement toward and away from the latter. The inner or free ends of these stops are of arcuate shape to fit snugly, but not tightly, about the mandrel rod 38. The upper stop 56 is provided, at its upper end, with a forwardly extending weight element 57 which urges this stop toward plate 17, and the lower stop 55 is provided, at its lower end, with a rearwardly extending weight element 58 which urges this stop toward plate 17. In this manner the stops 55 and 56 normally are held in contact with a spacing member 59 secured to the front of plate 17 around opening 37, plate 17 being effective for preventing rearward movement of the stops 55 and 56 from their normal position. During the rearward or draw stroke of mandrel rod 38, the rearward end of the most rearward or last blank 39 on this rod, in advance of the stops 55 and 56, is in contact with these stops so that, during the rearward travel of rod 38, the blanks are successively forced over the mandrel 42 as a continuous operation. During this rearward stroke of the mandrel rod further blanks are loaded thereon and, subsequently, are advanced forwardly along the mandrel rod and move into position in front of the blank stops, as will be described presently.

The reciprocating frame is provided with holding devices alternately operated in opposite relation, for securing the mandrel rod to the reciprocating frame for movement therewith and restraining the rod against movement relative to the reciprocating frame, to facilitate charging the mandrel rod with blanks. The holding means referred to preferably is in the form of two clamping devices, one associated with cross head 24 and the other associated with yoke 27. The latter clamping means will be described first, with particular reference to Figure 4. A hydraulic cylinder 60 is suitably mounted on the lower portion of yoke 27, at the rear thereof, as by means of an associated mounting frame structure 61 bolted to yoke 27. This cylinder has a piston (not shown) slidably mounted therein, to which is secured the lower end of a piston rod 62 slidable through a stuffing box structure 63 at the upper end of cylinder 60. Piston rod 62 is adjustably secured at its upper end, by means of a screw rod 64 and associated jam nuts 65 and 66, to the lower end of a double rack bar 67. Rack bar 67 meshes with two segments 68 pivoted on pins 69 mounted in yoke 27 and in a keeper plate 70 bolted to the yoke. An arm 71 extends upward from each of the segments 68 and carries, at its upper portion, a clamping jaw 72 appropriately recessed to fit about the mandrel rod 38 in clamping engagement therewith. The area of rod 38 corresponding to the jaws 72 is provided with a plurality of circumferential ribs 73, the rod engaging face of each jaw 72 also being provided with a plurality of ribs disposed for interengagement with the ribs 73. When the double rack bar 67 is moved downward into its position shown in Figure 4, the clamping blocks or jaws 72 are closed tightly about mandrel rod 38 and serve to support the rearward end of this rod while also securing it to yoke 27 for movement therewith. The ribs on the clamping blocks 72, being disposed in interengaging relation with the ribs 73 on the mandrel rod 38, positively restrain this rod against lengthwise movement relative to the reciprocating frame.

Cross head 24 also is provided with clamping means for supporting and gripping the mandrel rod 38. A hydraulic cylinder 60a is bolted to a

supporting bracket 24a suitably secured to and extending rearward from the lower portion of cross head 24. The piston rod of cylinder 60a is adjustably secured to a lower clamping block 75 slidably mounted between cross head 24 and a keeper plate 76 bolted to the back of cross head 24. Clamping block 75 cooperates with an upper clamping block 77 slidably mounted between cross head 24 and an upper keeper plate 76a. Block 77 is operated by means of a screw shaft 78, rotatably mounted through a bracket plate 24b secured to cross head 24, suitable means being provided for restraining shaft 78 against endwise movement. A hand wheel 78a is secured on the upper end of shaft 78 for rotating the latter. Each of the blocks 75 and 77 has a surface shaped to fit about rod 38 and is provided with spaced ribs disposed for interengagement with ribs 79 extending circumferentiallly of rod 38, at the area thereof corresponding to the associated clamping blocks. Block 77 is adjustment for engagement about the corresponding portion of rod 38, and thereafter remains in that position, the rear clamping jaws 72 then being slightly lower than block 77. When the lower block 75 is moved downward into releasing position, the rod 38, owing to its length between roller 44 and clamping jaws 72, sags downward sufficiently to clear block 77, into substantially the position shown in Figure 2. Upon raising of the block 75 the corresponding portion of rod 38 is raised by the latter block into engagement with block 77 and clamped between blocks 75 and 77. That causes slight upward bowing of the portion of rod 38 between the blocks 75 and 77 and the rear clamping jaws 72. Shortly thereafter the jaws 72 are opened and moved laterally away from the rod 38 sufficiently to clear the latter, the rearward end of which then rises slightly into the position shown in Figure 1. In the releasing position of block 75 the latter block and block 77 are spaced apart to provide clearance about mandrel rod 38, sufficient to accommodate a blank moved forward along this rod and, also, to permit movement therebetween of a pusher device; as will be explained later. It will be noted that the clamping blocks 75 and 77 are of greater thickness than the rearward clamping jaws or blocks 72. That is desirable since, as will appear more fully later, the forward clamping device is used for supporting and holding the mandrel rod 38 during the draw or rearward stroke thereof and, accordingly, is subjected to more severe stresses than the rearward clamping device.

Each of the cylinders 60 and 60a is provided with means for admitting thereto liquid under pressure, from a suitable source of supply, at either side of the piston and for exhausting liquid from the cylinder at the other side of the piston, for moving the piston in desired direction and opening and closing the clamping devices as required. Means of the character referred to is known and need not be illustrated nor described in detail. Such means may comprise a suitable valve within a valve housing 85 carried by the cylinder, the latter having appropriate ducts or passages cooperating with the valve within housing 85 for controlling desired flow of the liquid. Two lengths of flexible hose 86 and 87 may be connected to the valve housing 85 for admission and exhaust of liquid to and from the cylinder. Conveniently, sheet metal plates 88 and 89 are provided at the sides and adjacent the bottom of the main frame, defining a boxing in which the flexible hose lengths may lie, resting upon the bottom plate 89.

In order to assure operation of the clamping devices in suitable timed relation, means is provided for actuating the control valves of the cylinders 60 and 60a responsive to reciprocation of the mandrel rod and the reciprocating frame. To that end, an arm 90 is secured, at its inner end, to valve stem 91 extending through the top wall of housing 85. Arm 90 is provided, at its outer end, with a vertically extending pin 92 connected by an over center tension spring 93 to a pin 94 secured in the top wall of valve housing 85 in rear of valve stem 91. Each of the pins 92 cooperates with a pair of trip fingers 95 and 96 secured to and projecting inward from the adjacent side wall 88 of the boxing. The trip fingers are so disposed that, as the reciprocating carriage reaches its forward position shown in Figure 1, pin 92 of cylinder 60a contacts trip finger 95 associated therewith, causing turning of arm 90 in clockwise direction, as viewed in Figure 7, until the line of pull of tension spring 93 passes beyond the center of valve stem 91, after which spring 93 completes the throw of arm 90, effective for turning the valve within housing 85 into position to cause closing of the forward clamping device about mandrel rod 38 for supporting and gripping the latter. Immediately thereafter arm 90 associated with cylinder 60 is similarly operated, by contact of its pin 92 with the associated trip finger 95, and serves to cause opening of the rearward clamping device. In that respect, it will be noted that the valve means of the cylinders 60 and 60a operate in opposite relation, the turning of the valve of cylinder 60a serving to cause closing of the associated clamping device and turning of the valve associated with cylinder 60, in the same direction as the turning of the valve associated with cylinder 60a, serving to cause opening of the rearward clamping device, and vice versa. When the reciprocating frame is in its forward position shown in Figure 1, the most rearward blank 39 on mandrel rod 38, in front of the blank stop members 55 and 56, is spaced a short distance in advance of such members, as shown, and the mandrel rod 38 is secured to the reciprocating frame by means of the forward clamping device which, as stated, has been closed, and the rearward clamping device is then in open position, with the clamping jaws or blocks 72 thereof spaced away from mandrel rod 38. During the next stroke of the reciprocating frame, which is its rearward stroke, the rearward end of blank 39 on rod 38, in advance of and adjacent the stop members 55 and 56, is moved into contact with these stop members, and during the continued rearward movement of the mandrel rod with the reciprocating frame, which is its draw stroke, the blanks are forced over the mandrel in the manner previously described.

The distance between the forward clamping device and yoke 27 is somewhat greater than twice the length of one of the tubular blanks 39. During the draw stroke of the mandrel rod and the reciprocating frame, two blanks may be placed on the rearward portion of mandrel rod 38, over the rearward end thereof, as indicated at 39a, the blanks being placed upon the mandrel rod manually and moved therealong into position within the length of the reciprocating frame, with the forward end of the forward blank in proximity to the jaws of the forward clamping device. In that manner no time is lost in

charging the mandrel rod with the blanks, since such charging is done during the draw stroke of the rod. The machine illustrated is what might be termed a short stroke machine, having a draw stroke approximately equal to twice the length of one of the blank. For that reason, two blanks are placed upon the mandrel rod during the draw stroke, in the manner previously described. Obviously, if the machine were made to have a different length of stroke, the number of blanks placed upon the mandrel rod during its rearward stroke would be varied accordingly. As the reciprocating frame approaches the end of its rearward stroke, the valve of cylinder **60** is actuated, by the associated trip finger **96** and tension spring **93**, to close the rearward clamping device, after which the valve of cylinder **60***a* is actuated, by its associated trip finger **96** and tension spring **93**, to open the forward clamping device. At that time the cylinders **60***a* and **60** occupy the relative positions shown in dotted lines in Figure 7, the full line positions of these cylinders being those which they occupy when the reciprocating frame is in its forward position shown in Figure 1. With the reciprocating frame in its rearward position the forward clamping device is open, two blanks are disposed upon mandrel rod **38** between the forward clamping device and the rearward clamping device, and the rearward end of the mandrel rod is supported and secured by the latter clamping device. The reciprocating frame is then moved forward and carries with it the mandrel rod **38**. During such forward movement of the reciprocating frame the two blanks on the rearward portion of rod **38** are moved forward along the latter, by means to be described presently, into position in front of the forward clamping device, this movement of the blanks preferably being such that when the reciprocating frame reaches its forward position shown in Figure 1 the two blanks placed upon the rearward portion of the rod **38** will have been moved into position in front of the blank stop members **55** and **56**. The forward clamping device is then closed and the rearward clamping device is opened, in the manner above described, and the reciprocating frame is moved rearward moving with it the mandrel rod for performing the draw stroke of the latter.

A rack bar **100** is secured to channel member **14**, at the inner face thereof, by bolting or in any other suitable manner, this rack bar extending lengthwise of channel member **14** at the midportion thereof. A guide member **101** (Figures 5 and 6) provided with supporting arms **102**, as shown in Figure 1, is bolted to the channel members **25** and **26** of the reciprocating frame and slidably supports a reciprocating rack bar **103**. The latter is retained in guide member **101**, by retaining strips **104** bolted to the inner face of guide member **101** and defining between them a slot **105**, strips **104** overlying the upper and lower flanges of the head of rack bar **103** which, as shown in Figure 6, is of T-shape in cross section. Rack bar **103** also is slidable in a guide member **107**, similar to guide member **101**, bolted to mounting blocks **19** and **20** secured to the inner face of channel member **14**. Retaining strips **104***a*, bolted to the inner side of guide member **107**, overlie the head flanges of rack bar **103** and define between them a slot **105***a* aligned with slot **105**, defined by the retaining strips **104** associated with the guide member **101**. The latter guide member is provided, adjacent its forward end and through its outer side, with an opening **110** (Figure 5) through which extends a compound pinion mounted for rotation about a vertical axis by means of a stub shaft **111**, the end portions of which extend into the upper and the lower walls of guide member **101**. The compound pinion comprises a lower pinion **112** which meshes with rack bar **100**, and an upper pinion **113** of increased diameter which meshes with rack bar **103** and overlies rack bar **100**, out of mesh therewith, it being noted that rack bar **103** is disposed somewhat higher than rack bar **100**, as shown in Figure 6. Preferably pinion **113** has twice as many teeth as pinion **112** so that rack bar **103**, while it moves in the same direction as the reciprocating frame, travels twice as fast as the latter frame in the reciprocation thereof.

An angle bracket **115** is bolted to the inner side of rack bar **103** for movement therewith, this bracket operating in the slots **105** and **105***a* and extending therefrom inward toward the mandrel rod **38**, in the plane of which rack bar **103** is disposed. A pusher **116** is pivoted at its rearward end, at **117**, to the bracket **115**. This pusher is shaped at its forward end to fit about the side portion of mandrel rod **38** and is normally held in contact therewith by a coil compression spring **118** confined between the forward portion of the pusher and the face of bracket **115**. Suitable means, such as studs entering the end portions of the spring **118** may be provided for retaining the latter in position. In its normal position the pusher **116** is inclined inward and forward relative to the mandrel rod **38**, as shown in Figure 5.

It will be understood that the pusher **116** is reciprocated similarly to the reciprocating frame but at twice the speed thereof. In order to permit of this movement of the pusher **116** and bracket **115**, the stop plate **17** is provided with a slot **118***a* therein extending from opening **37** thereof, cross head **24** is provided with a slot **119** extending from opening **36** thereof and the upper and the lower jaws of the forward clamping device are spaced apart to define therebetween a slot **120**, these three slots being disposed in alignment and of appropriate size to accommodate the bracket **115** and the pusher **116**.

In the rearward position of the reciprocating frame, shown in Figure 2, the pusher **117** is disposed in rear of the second or rear blank **39** placed upon mandrel rod **38**, between the forward clamping device and yoke **27** of the reciprocating frame. In the forward movement of this frame the pusher also travels forward, but at twice the speed of the frame and the mandrel rod **38**. The pusher thus operates to move the two blanks **39** forward along rod **38**, through cross head **24** and stop cross plate **17**, into position in front of the blank stop members **55** and **56**, by the time the mandrel rod has been moved into its forward position shown in Figure 1. At that time the two blanks **39** have been moved from the rearward portion of rod **38** to a position in front of the stop members, shown in Figure 1, and the reciprocating frame is now ready to start on its rearward stroke. In the forward movement of the blanks along the mandrel rod **38**, the blank stop members are swung forward on their pivots to permit passage between them of the advancing blanks, after which the stop members are returned to their normal position by the associated weight elements, in the manner previously described. As the reciprocating frame reaches its forward position the forward clamping means is closed and the

rearward clamping means is opened, as above described, and in the succeeding rearward stroke of the reciprocating frame the mandrel rod 38 is moved rearward on its draw stroke, during which two blanks may be placed upon the rearward portion of the mandrel rod to be moved forward therealong in the manner described. In the rearward movement of the reciprocating frame the pusher also moves rearward, but at twice the speed of the frame, and is thus returned to its rearward position, for contacting the rearward end of the second blank placed on the mandrel rod 38, when the reciprocating frame reaches its rearward position.

It will be appreciated that the rate of travel of the pusher relative to that of the reciprocating frame may be varied somewhat, so long as the pusher operates at sufficient speed to move the blanks into position in front of the forward clamping means prior to closing of the latter. Preferably the blanks should be moved into position in advance of the blank stop members 55 and 56, as stated, though that is not essential to the broader concept of our invention, since, if the blanks be advanced into position in front of the forward clamping means prior to closing thereof, they may be moved manually further along the mandrel rod into desired position. It will be understood that changes in construction and arrangement of parts of our invention may be resorted to without departing from the field and scope thereof, and we intend to include all such variations, as fall within the scope of the appended claims, in this application in which the preferred form only of our invention has been disclosed.

We claim:

1. In a machine for producing pipe bends, a mandrel rod for receiving tubular blanks, blank abutment means movable toward and away from said rod normally held in position extending thereabout and restrained against movement rearward from normal position, a mandrel at the forward end of said rod, means for reciprocating said rod comprising two holding devices in rear of said abutment means spaced apart lengthwise of said rod and effective for holding it against endwise movement relative to said reciprocating means, means for first moving the rearward holding device into holding position and then moving the forward holding device into releasing position as said rod approaches the limit of its rearward stroke and for first moving the forward holding device into holding position and then moving the rearward holding device into releasing position as said rod approaches the limit of its forward stroke, and means for moving blanks placed on said rod between said holding devices forward along said rod into position in front of said forward holding device during and responsive to the forward stroke of said rod.

2. In a machine for producing pipe bends, a mandrel rod for receiving tubular blanks, blank abutment means movable toward and away from said rod normally yieldingly held in position extending thereabout and restrained against movement rearward from normal position, a mandrel at the forward end of said rod, means for reciprocating said rod comprising two clamping devices in rear of said abutment means spaced apart lengthwise of said rod and effective for holding it against endwise movement relative to said reciprocating means, means responsive to reciprocation of said rod for first closing the rearward clamping device and then opening the forward clamping device as said rod approaches the limit of its rearward stroke and for first closing the forward clamping device and then opening the rearward clamping device as said rod approaches the limit of its forward stroke, and means for moving blanks placed on said rod between said clamping devices forward along said rod into position in front of said abutment means during the forward stroke of said rod.

3. In a machine for producing pipe bends, a mandrel rod for receiving tubular blanks, blank abutment means movable toward and away from said rod normally yieldingly held in position extending thereabout and restrained against movement rearward from normal position, a mandrel at the forward end of said rod, means for reciprocating said rod comprising two clamping devices in rear of said abutment means spaced apart lengthwise of said rod and effective for holding it against endwise movement relative to said reciprocating means, means responsive to reciprocation of said rod for first closing the rearward clamping device and then opening the forward clamping device as said rod approaches the limit of its rearward stroke and for first closing the forward clamping device and then opening the rearward clamping device as said rod approaches the limit of its forward stroke, and means for moving blanks placed on said rod between said clamping devices forward along said rod into position in front of said abutment means during and responsive to the forward stroke of said rod.

4. In a machine for producing pipe bends, a main frame, a cross-member fixed in said frame, a reciprocating frame mounted in said main frame in rear of said member, a mandrel rod for receiving tubular blanks extending through said reciprocating frame and said cross-member and forward beyond the latter, blank abutment means carried by said cross-member movable toward and away from said rod normally held in position extending thereabout and restrained against movement rearward from normal position, a mandrel at the forward end of said rod, two clamping devices carried by said reciprocating frame spaced apart lengthwise of said rod and alternately clamping it, means responsive to reciprocation of said reciprocating frame for first closing the rearward clamping device and then opening the forward clamping device as said reciprocating frame approaches the limit of its rearward stroke and for first closing the forward clamping device and then opening the rearward clamping device as said reciprocating frame approaches the limit of its forward stroke, and means actuated by reciprocation of said reciprocating frame for moving blanks placed on said rod between said clamping devices forward along said rod during the forward stroke of the latter into position in front of said forward clamping means.

5. In a machine for producing pipe bends, a main frame, a cross-member fixed in said frame, a reciprocating frame mounted in said main frame in rear of said member, a mandrel rod for receiving tubular blanks extending through said reciprocating frame and said cross-member and forward beyond the latter, blank abutment means pivoted on said cross-member at the front thereof for swinging movement toward and away from the latter normally yieldingly held in position extending about said rod and restrained by said cross-member against movement rearward from

normal position, a mandrel at the forward end of said rod, two clamping devices carried by said reciprocating frame spaced apart lengthwise of said rod and alternately clamping it, means responsive to reciprocation of said reciprocating frame for first closing the rearward clamping device and then opening the forward clamping device as said reciprocating frame approaches the limit of its rearward stroke and for first closing the forward clamping device and then opening the rearward clamping device as said reciprocating frame approaches the limit of its forward stroke, and means actuated by reciprocation of said reciprocating frame for moving blanks placed on said rod between said clamping devices forward along said rod during the forward stroke of the latter into position in front of said forward clamping means.

6. In a machine for producing pipe bends, a main frame, a cross-member fixed in said frame, a reciprocating frame mounted in said main frame in rear of said member, a mandrel rod for receiving tubular blanks extending through said reciprocating frame and said cross-member and forward beyond the latter, blank abutment means carried by said cross-member movable toward and away from said rod normally held in position extending thereabout and restrained against movement rearward from normal position, a mandrel at the forward end of said rod, two clamping devices carried by said reciprocating frame spaced apart lengthwise of said rod and alternately clamping it, means responsive to reciprocation of said reciprocating frame for first closing the rearward clamping device and then opening the forward clamping device as said reciprocating frame approaches the limit of its rearward stroke and for first closing the forward clamping device and then opening the rearward clamping device as said reciprocating frame approaches the limit of its forward stroke, and rack and pinion means acutated by reciprocation of said reciprocating frame for moving blanks placed on said rod between said clamping devices forward along said rod during the forward stroke of the latter into position in front of said forward clamping means.

7. In a machine for producing pipe bends, a main frame, a cross-member fixed in said frame, a reciprocating frame mounted in said main frame in rear of said member, a mandrel rod for receiving tubular blanks extending through said reciprocating frame and said cross-member and forward beyond the latter, blank abutment means carried by said cross-member movable toward and away from said rod normally yieldingly held in position extending thereabout and restrained against movement rearward from normal position, a mandrel at the forward end of said rod, two clamping devices carried by said reciprocating frame spaced apart lengthwise of said rod and alternately clamping it, means responsive to reciprocation of said reciprocating frame for first closing the rearward clamping device and then opening the forward clamping device as said reciprocating frame approaches the limit of its rearward stroke and for first closing the forward clamping device and then opening the rearward clamping device as said reciprocating frame approaches the limit of its forward stroke, a rack bar fixed to said main frame, a reciprocating rack bar, differential drive means between said bars carried by said reciprocating frame for reciprocating said reciprocating bar similarly to but at greater speed than said reciprocating frame, and a pusher member carried by said reciprocating rack bar movable toward and away from said mandrel rod and disposed to engage the rearward end of a blank on said rod between said clamping devices when said reciprocating frame is at the limit of its rearward stroke.

8. In a machine for producing pipe bends, a main frame, a cross-member fixed in said frame, a reciprocating frame mounted in said main frame in rear of said member, a mandrel rod for receiving tubular blanks extending through said reciprocating frame and said cross-member and forward beyond the latter, blank abutment means carried by said cross-member movable toward and away from said rod normally yieldingly held in position extending thereabout and restrained against movement rearward from normal position, a mandrel at the forward end of said rod, two clamping devices carried by said reciprocating frame spaced apart lengthwise of said rod and alternately clamping it, means responsive to reciprocation of said reciprocating frame for first closing the rearward clamping device and then opening the forward clamping device as said reciprocating frame approaches the limit of its rearward stroke and for first closing the forward clamping device and then opening the rearward clamping device as said reciprocating frame approaches the limit of its forward stroke, a rack bar fixed to said main frame, a guide member carried by said reciprocating frame, a reciprocating rack bar mounted in said guide member, a compound pinion carried by said guide member comprising a first pinion meshing with said fixed rack bar and a second pinion of greater diameter than said first pinion meshing with said reciprocating rack bar, and a pusher member carried by said reciprocating rack bar movable toward and away from said mandrel rod and disposed to engage the rearward end of a blank on said rod between said clamping devices when said reciprocating frame is at the limit of its rearward stroke.

9. In a machine for producing pipe bends, means for forming tubular blanks by relative endwise movement between the blanks and an interior forming mandrel, said means comprising a first member in the form of a mandrel rod having a forming mandrel at its forward end and a second member having blank stops movable toward and away from said rod normally extending thereabout, one of said members being reciprocated relative to the other, the stroke of said one member in one direction constituting its draw stroke effective for causing relative endwise movement between said rod and blanks thereon in front of said stops, the stroke of said one member in the opposite direction constituting its return stroke, forward and rearward clamping devices engageable with said rod spaced apart lengthwise thereof in rear of said stops, means for closing said rearward clamping device and opening said forward clamping device and vice versa, as said one member approaches the limit of its draw stroke and its return stroke respectively, and means for advancing along said rod responsive to the return stroke of said one member blanks placed on said rod between said clamping devices.

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