Oct. 27, 1953

W. H. MANN ET AL

2,656,872

IRON BENDING MACHINE

Filed March 23, 1950

5 Sheets-Sheet 1

FIG. 1

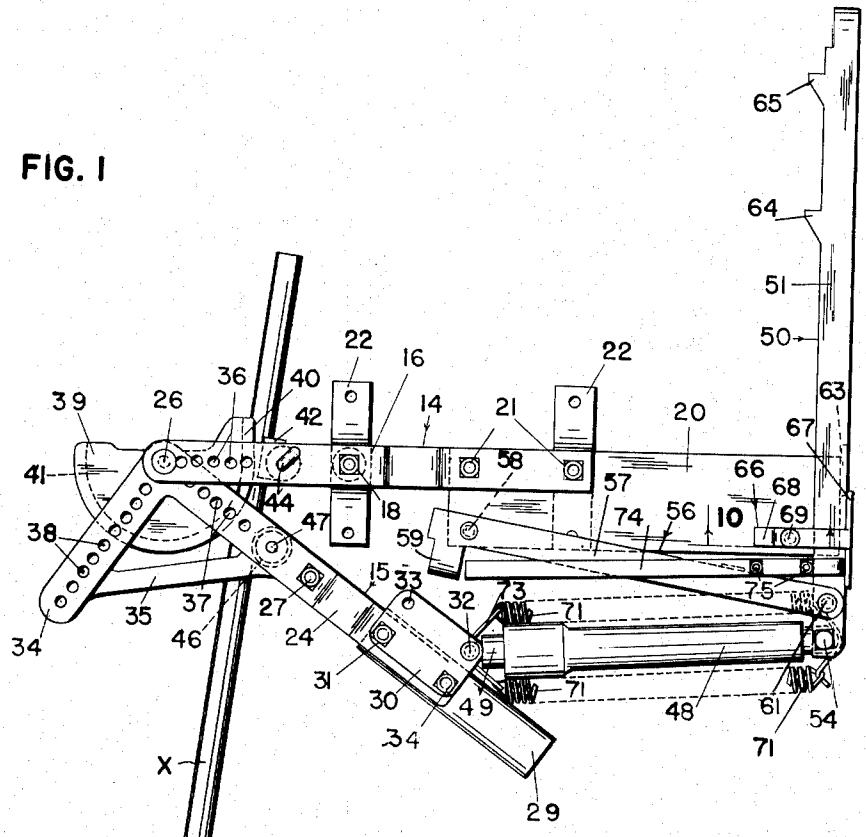
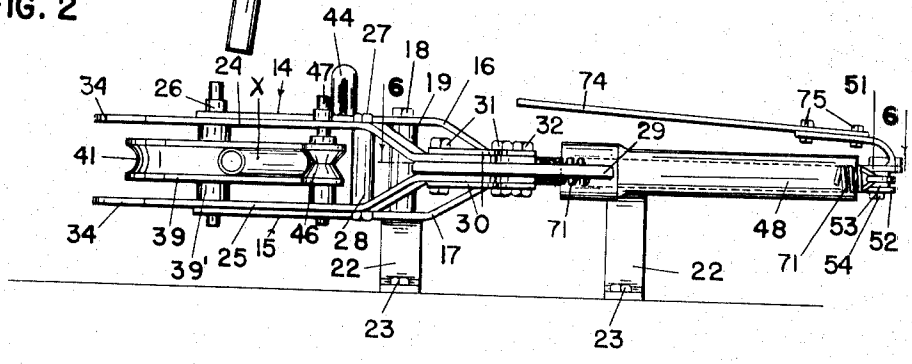



FIG. 2




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FIG. 3

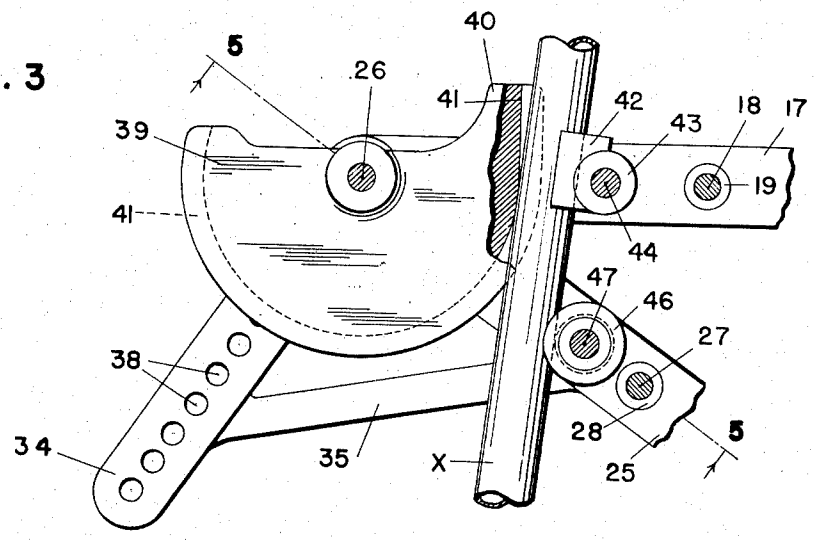



FIG. 4

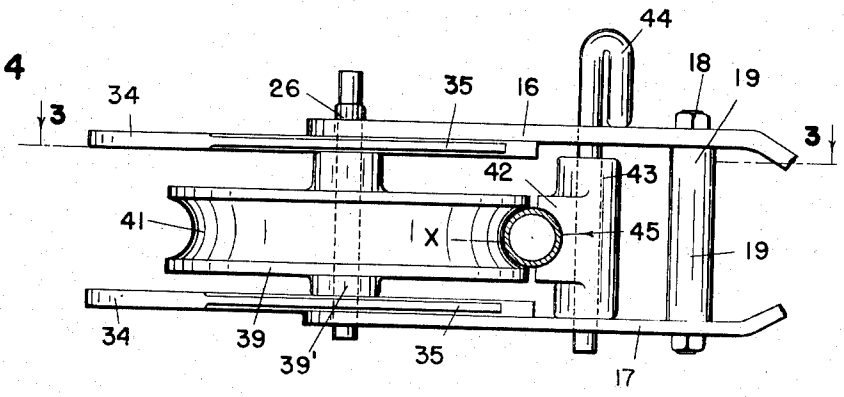
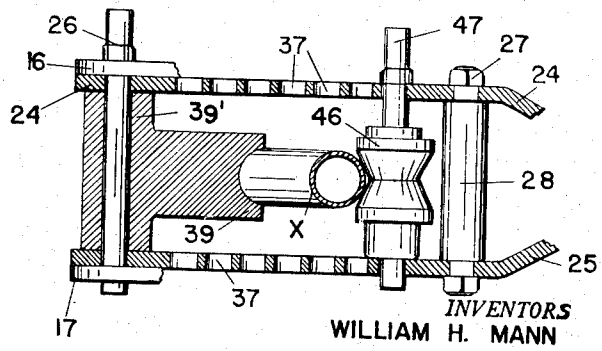



FIG. 5




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FIG. 6

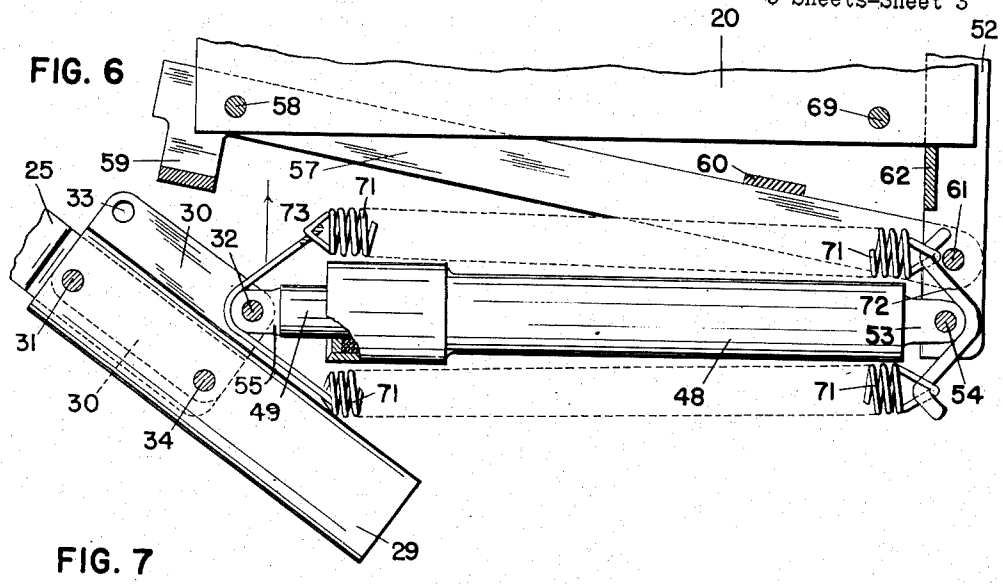



FIG. 7

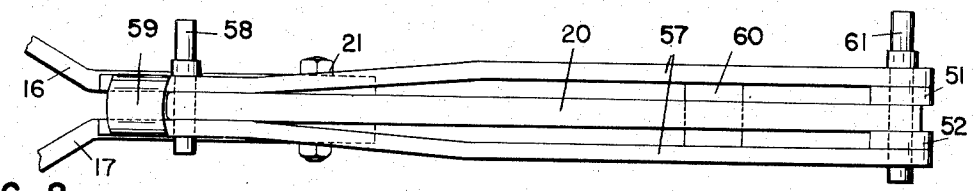



FIG. 8

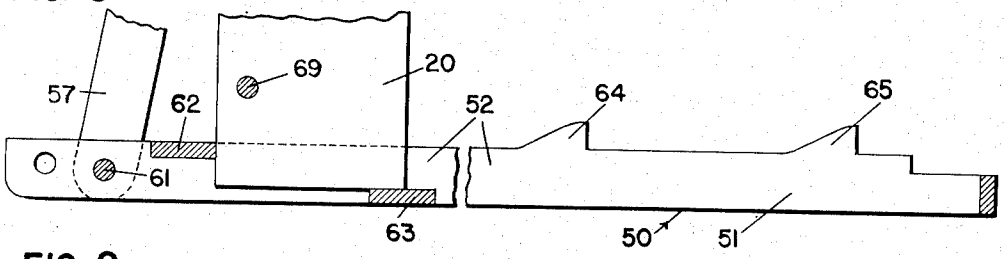



FIG. 9

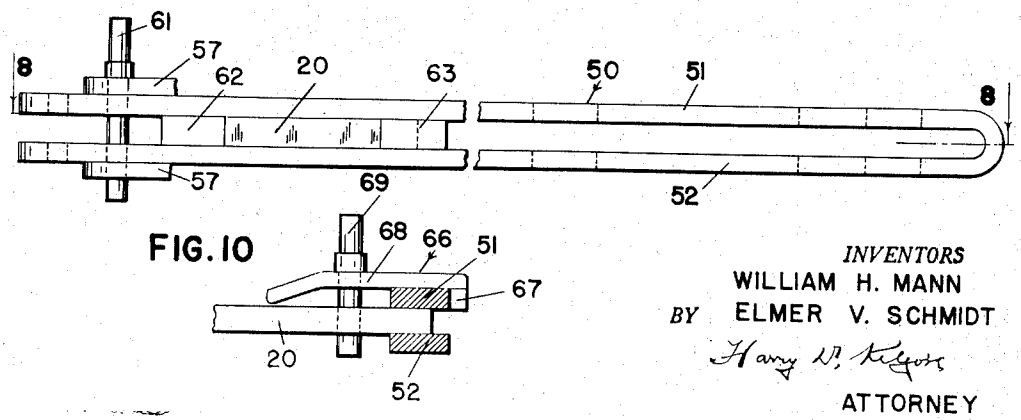



FIG. 10

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FIG. 11

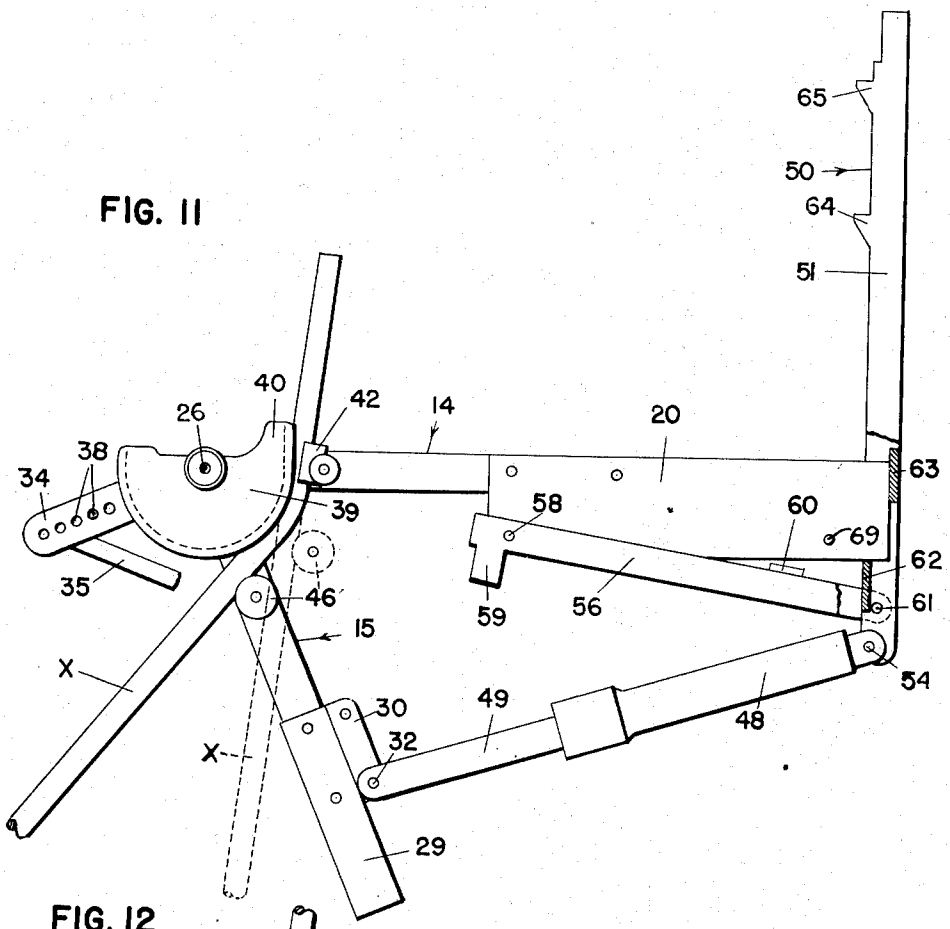
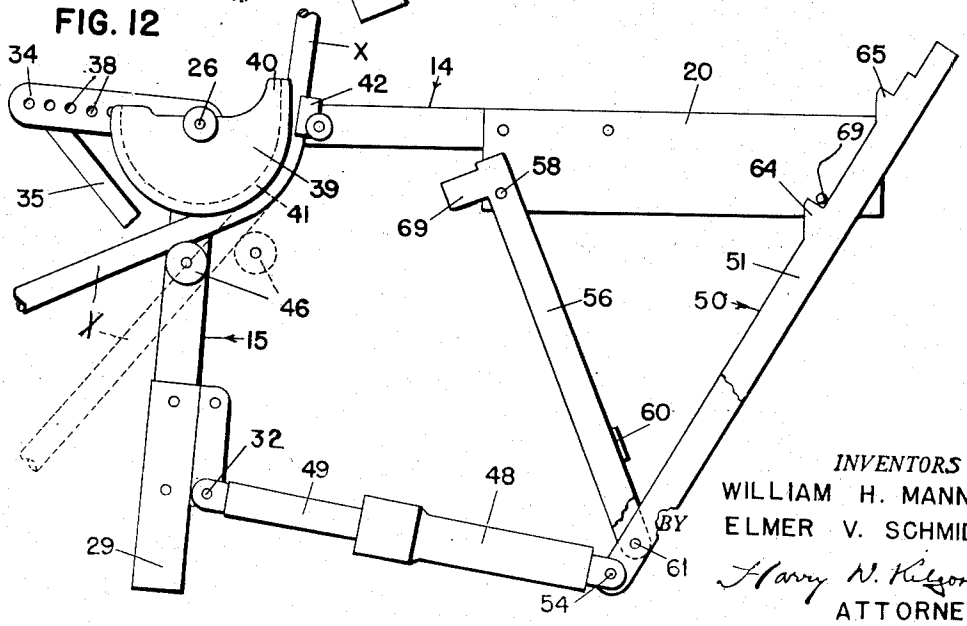



FIG. 12




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FIG. 13

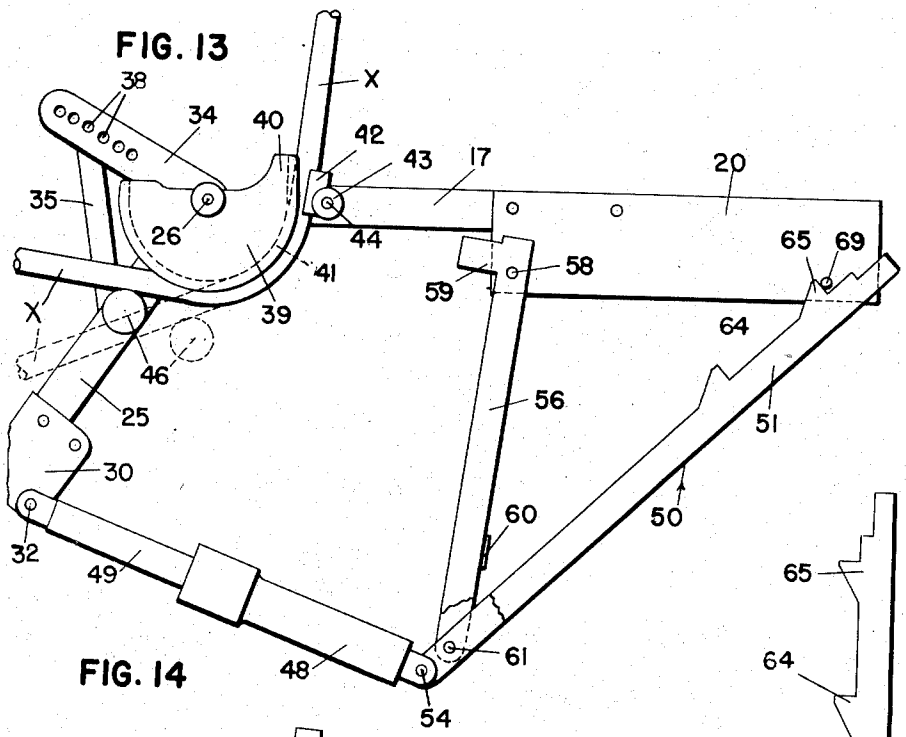
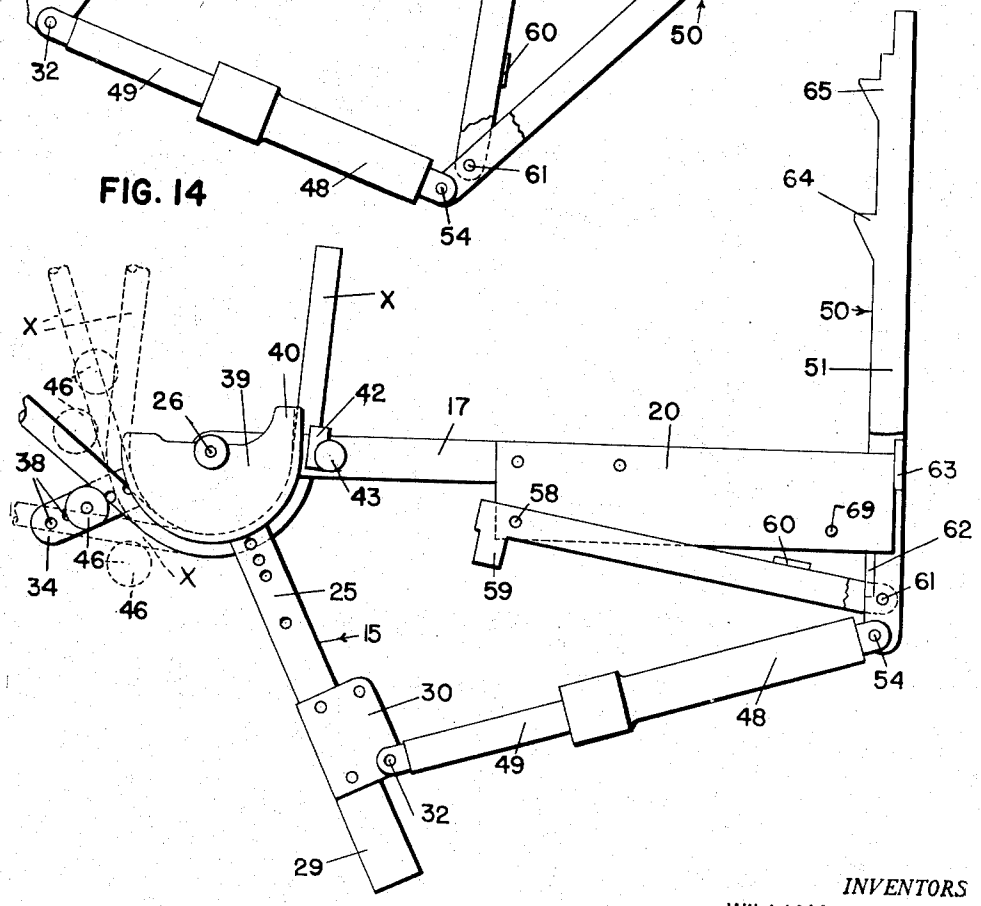



FIG. 14




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# UNITED STATES PATENT OFFICE

2,656,872

## IRON BENDING MACHINE

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Application March 23, 1950, Serial No. 151,494

10 Claims. (Cl. 153—46)

1

Our present invention relates to improvements in machines for bending elongated metal members such as pipes, bars, rods and the like.

The principal object of this invention is to provide a metal bending machine actuated by a fluid-operated cylinder and piston for bending a pipe, a bar, a rod and the like on the arc of a circle up to one hundred and eighty degrees (180°), whereby the end portions thereof are parallel, without changing the position of the work relative to a forming die.

Other objects of the invention will be apparent from the following description, reference being had to the drawings.

To the above end, the invention consists of the novel devices and combination of devices hereinafter described and defined in the claims.

In the accompanying drawings, which illustrate the invention, like characters indicate like parts throughout the several views.

Referring to the drawings:

Fig. 1 is a plan view of the improved iron bending machine adjusted to make the initial bend in a section of a pipe secured relative to a forming die;

Fig. 2 is a front elevational view of the machine shown in Fig. 1;

Fig. 3 is a fragmentary detail view partly in plan and partly in section taken substantially on the line 3—3 of Fig. 4, on an enlarged scale;

Fig. 4 is a front elevational view of the parts shown in Fig. 3;

Fig. 5 is a view partly in elevation and partly in section taken on the line 5—5 of Fig. 3;

Fig. 6 is a detail view partly in plan and partly in section taken on the line 6—6 of Fig. 2, on the same scale as Fig. 3;

Fig. 7 is a front elevational view looking at certain parts shown in Fig. 6, as indicated by an arrow;

Fig. 8 is a fragmentary detail view partly in plan and partly in section taken on the line 8—8 of Fig. 9;

Fig. 9 is a fragmentary detail view in front elevation of the ratchet bar and certain associated parts, as shown in Fig. 8;

Fig. 10 is a fragmentary detail view partly in elevation and partly in section taken on the line 10—10 of Fig. 1 on the same scale as Fig. 3; and

Figs. 11, 12, 13 and 14 are diagram views in plan showing progressive steps in the bending of the pipe, some parts being shown in different positions by means of broken lines, on the same scale as Fig. 1.

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The machine, as shown in the drawings, includes a stationary frame 14 and a swinging frame 15, the former including a pair of flat bars 16 and 17 spaced the former above the latter. Both frames 14—15 are horizontally disposed. The bars 16—17 are rigidly intermediately connected by a nut-equipped bolt 18 that extends through aligned holes in said bars and a spacing sleeve 19 interposed between the bars 16—17. These bars 16—17, outwardly of the bolt 18, are in converging relation to reduce the distance between their outer end portions which are parallel.

A horizontally disposed rectangular flat bed plate 20 is interposed, at its inner end portion, between the outer end portions of the bars 16—17. The back longitudinal edge of the bed plate 20 is aligned with the corresponding edges of the bars 16—17. The bars 16—17 and the bed plate 20 are rigidly connected by a pair of nut-equipped bolts 21 that extend through aligned holes in said bars and bed plate and are spaced apart longitudinally of the bars 16—17 at the transverse center thereof. A pair of leg brackets 22 extends transversely under the bar 17 and are rigidly secured relative to the stationary frame 14, the one by the bolt 18 and the other by the outermost bolt 21. The leg brackets 22 are secured to a table or other support by bolts or lag screws 23.

The swinging frame 15 is substantially like the stationary frame 14 and the upper and lower flat bars thereof are designated by the numerals 24 and 25, respectively. The end portions of the bars 24 and 25 that are spaced the greatest distance apart, extend between the bars 16—17 at their outer end portions with a working fit therebetween and are attached thereto by a pivot pin 26. This pivot pin 26 extends through aligned holes in the overlapping bars 16—17—24 and 25 and pivotally connects the swinging frame 15 to the stationary frame 14 for swinging movement in a horizontal plane.

The bars 24—25 are intermediately rigidly connected by a nut-equipped bolt 27 and a spacing sleeve 28 interposed between the bars 24 and 25. A short hollow handle 29 is interposed between the outer end portions of the bars 24—25 and forms an extension thereof. A rectangular flat plate 30 rests on the outer end portion of the bar 24 and a similar plate 30 extends under the bar 25. These plates 30 extend rearwardly and outwardly from the bars 24—25. A pair of nut-equipped bolts 31 ex-

tends through aligned holes in the plates 30, the bars 24—25 and the handle 29. The bolts 31 are spaced apart longitudinally of the bars 24—25, at their transverse centers, and rigidly connect said plates, the bars and the handle. A pivot pin 32 extends through aligned holes in the plates 30 at their rear outer corner portions and aligned holes 33 are formed in the inner rear corner portions of said plates, for a pupose that will presently appear.

A pair of upper and lower arms 34, integral with the pivoted end portions of the bars 24—25, extend outwardly thereof, at right angles thereto and in the planes thereof. A pair of cross-tie bars 35 rigidly connect the bars 24—25 to the arms 34. In each bar 16—17, at its transverse center, is a row of holes 36 that extend outwardly from the pivot pin 26. Similar rows of holes 37 and 38 are formed in the bars 25—25 and the arms 34, respectively. The holes 36—37 and 38 are arranged in vertically aligned pairs. Corresponding pairs of holes 36, 37 and 38 are spaced exactly the same distance from the axis of the pivot pin 26. In other words, the pairs of holes 36, 37 and 38 are on concentric arcs of circles having their centers at the axis of the pivot pin 26.

A semi-circular forming die 39 has at its axis a hub 39' interposed between the bars 24—25 and acts as a spacer therefor. The pivot pin 26 extends through the hub 39' and pivotally connects the die 39 to the frames 14—15 for turning movement in a horizontal plane. The die 39 on its right-hand side has an extension 40, the outer face of which is tangential to the periphery of said die. A groove 41 is formed in the periphery of the die 39 and its extension 40 and is semi-circular in cross-section.

A back holding block 42 having a hub 43 is interposed between the bars 16—17 and the hole in said hub can be brought into alignment with any one pair of the holes 36. A pivot pin 44 extends through one of the aligned pairs of holes 36 and the hub 43 and pivotally connects the block 42 to the stationary frame 14 for turning movement in the plane of the die 39. The block 42 has in its face a groove 45 that is in opposing relation to the grooves 41. The groove 45 is semi-circular in cross-section and said groove and the groove 41 form a complete circle with a working clearance between the die 39 and the block 42.

A section of a pipe $x$ is held in the groove 41 in the die 39 by the block 42 at a point where a bend is to start to be made in the pipe $x$. When the pipe $x$ in the groove 41 is to be bent on the die 39, it is held against endwise movement by the tangential extension 40 on the die 39, which presses the pipe $x$ in the groove 45 and against the block 42. There is a slight turning movement of the die 39, as said extension 40 presses on pipe $x$ and therefore serves as means for clamping the elongated member or pipe $x$ onto the holding means, or block 42.

The end portion of the pipe $x$ to be bent extends between the bars 24—25 of the swinging frame 15 to be engaged by a roller 46 on the opposite side of said pipe from the die 39. This roller 36 is interposed between the bars 24—25 and attached thereto by a pivot pin 47 that extends through the holes 37 of one of the aligned pair in the bars 24—25.

While the die 39, the block 42 and the roller 46 are designed to engage and hold a pipe to be bent, it will, of course, be understood that they could be designed to hold and bend any other longitudinal member such as an angle bar.



The swinging frame 15 is operated to press the roller 46 against the pipe $x$ and bend the same on the die 39, by a cylinder 48 and a piston 49. A ratchet bar 50 affords a base of resistance for the cylinder 48 and moves the same into different adjustments circumferentially about the axis of the die 39. This ratchet bar 50 is formed of a single flat bar intermediately folded upon itself to afford upper and lower members 51 and 52, respectively.

The bed plate 20, at its outer end portion extends between the ratchet bar members 52—52 with a working fit. In the adjustment of the machine, as shown in Figs. 1 and 2, the bed plate 20 at its outer end terminates short of the outer longitudinal edges of the ratchet bar members 51 and 52. On the outer end of the cylinder 40 is a lug 53 that extends between the ratchet bar members 51—52 at their front end portions. A nut-equipped bolt 54 extends through aligned holes in the ratchet bar members 51—52 and the lugs 53 pivotally connect the cylinder 48 and the ratchet bar 50 for relative swinging movements in a horizontal plane.

The piston 49 has on its outer end a lug 55 that extends between the plates 30 and is attached thereto by the pivot pin 32. Obviously, this pin 32 pivotally connects the piston 49 and the cylinder 48 to the swinging frame 15 for relatively swinging movements in a horizontal plane. A link 56 that swings in a horizontal plane connects the ratchet bar 50 to the bed plate 20. This link 56 comprises upper and lower flat bars 57 between which, at one of their end portions, the inner front corner portion of bed plate 20 extends and said link is attached thereto by a pivot pin 58 that extends through aligned holes in the link bars 57 and the bed plate 20.

The link bars 57, at their inner end portions, are rigidly connected by a U-shaped member 59 that extends forwardly of the link 56 and perpendicularly to the plane thereof. The link bars 57, at their outer end portions, are further rigidly connected at their opposite longitudinal edge portions from the U-shaped member 59 by a spacing plate 60. The U-shaped member 59 is free to swing past the respective corner of the bed plate 20. The ratchet bar 50 just rearwardly of the cylinder 48 extends between the outer end portions of the link bars 57 with a working fit and is attached thereto by a pivot pin 61 which extends through aligned holes in link bars 57 and the ratchet bars 51 and 52. The primary object of the U-shaped member 59 is to prevent the link 56 from sagging due to the weight of the cylinder 48 thereon.

A front stop plate 62 and a rear stop plate 63 are interposed between the ratchet bars 51 and 52 and rigidly secured thereto. These stop plates 62 and 63 extend longitudinally of the ratchet bar 50 and are located, respectively, at the inner and outer longitudinal edge portions of said ratchet bar. When the machine is adjusted, as shown in Fig. 1, the front stop plate 62 is in engagement with the front edge of the bed plate 20 and limits the rearward endwise movement of the ratchet bar 50. In the same adjustment of the machine, the rear stop plate 63 is in engagement with the outer end of the bed plate 20, limits the inward swinging movement of the ratchet bar 50, and positions said ratchet bar at a right angle to the bed plate 20.

A front pair of ratchet teeth 64 and a rear pair

of ratchet teeth 65 are integral with the inner longitudinal edges of the ratchet bar 50. These ratchet teeth 64 and 65 are located on the ratchet bar 50 near the free or rear end thereof.

A directional guard 66 is provided for holding the ratchet bar 50 positioned as shown in Fig. 1 and guiding said bar as the same is swung into its various positions, as shown in Figs. 11, 12, 13 and 14. This guard 66 is in the form of a T, the head and body of which are designated by the numerals 67 and 68, respectively. The head 67 is in the form of a long square rod that, as shown in Fig. 1, bears longitudinally against the outer longitudinal edge of the ratchet bar 51. The body 68 is in the form of a small flat bar that extends transversely over the ratchet bar 50 inwardly thereof. The free end portion of the body 68 is bent downwardly so that its outer end rests on the bed plate 20 and supports the body 68 above the ratchet bar 50. A pivot pin 69 extends through aligned holes in the body 68 and the bed plate 20 and connects the guard 66 to the bed plate 20 for swinging movement in a horizontal plane. The pivot pin 69 for the guard 66 performs another important function in that it affords a dog for the ratchet teeth 64—65.

On the under side of the cylinder 48 is a nipple, to which a hose may be attached that leads from a pump, not shown, for supplying fluid under pressure to the cylinder 48 for projecting the piston 49. In the connection from the pump to the cylinder will be a foot pedal control valve, not shown, for opening and closing the fluid supply.

A pair of coiled springs 71 are provided for retracting the piston 49 when the pressure on the fluid in the cylinder 48 is released. The two springs 71 are located, one on each side of the cylinder 48 and connected by a yoke 72 in the form of a round rod at their outer ends. This yoke 72 extends between the ratchet bars 51—52, straddles the lug 53 and bears on the outer end thereof as an anchor for the springs 71. The springs 71, at their inner ends are connected by a yoke 73 in the form of a flat strip of metal that extends between the plates 30, straddles the lug 55 and bears on the outer end thereof.

A handle 74 is provided for manipulating the ratchet bar 50. This handle 74 is in the form of a flat bar rigidly secured at one end to the ratchet bar 51. From the ratchet bar 51, the handle 74 is curved upwardly and inwardly therefrom and is then slightly inclined and extends transversely over the link 56. To facilitate the shipping and storing of the ratchet bar 50, the handle 74 is made in two sections in overlapping arrangement and detachably connected by a pair of nut-equipped bolts 75. When bending light material, the pin 32 that attaches the piston to the plates 30 may be shifted into the holes 33 to shorten the leverage from the axis of the die 39 to the piston 49.

As heretofore stated, the machine, as shown in Fig. 1, is adjusted to make the first bend in the pipe $x$. The adjustment of the machine shown in diagram in Fig. 11 is the same as that shown in Fig. 1 except that the piston 49 has been projected to move the swinging frame 15 and bend the pipe $x$ from its dotted line position to its full line position in Fig. 11.

To make the next or second bend in the pipe $x$, the ratchet bar 50 has been moved to engage its teeth 64 with the pin 69 and thereby advance the cylinder 48, the piston 49 and the swinging frame 15 in the direction in which the pipe $x$ is being bent. With the machine thus adjusted, the piston 49 has been projected to move the swinging frame in the direction in which the pipe $x$ is being bent to bend the pipe $x$ from its dotted line position to its full line position, see Fig. 12.



To make the next or third bend in the pipe $x$, the ratchet bar 50 is drawn forwardly to engage its teeth 65 with the pin 69 and thus again advance the cylinder 48, the piston 49 and the swinging frame 15 in the direction in which the pipe is being bent. With the machine in this adjustment, the piston 49 is projected to move the swinging frame 15 and thus bend the pipe from its dotted line position to its full line position, as shown in Fig. 13. This last operation has bent the respective end portion of the pipe $x$ substantially ninety degrees.

To make the next or fourth bend in the pipe $x$, the machine is adjusted to its original position as shown in Fig. 11 and the roller 46 shifted from the swinging frame 15 to the arms 34. With the machine thus adjusted, the piston 49 is projected to move the swinging frame 15 and bend the pipe $x$ from its dotted line position to its full line position as shown in Fig. 14.

The next two following operations will complete the bending of the pipe $x$ one hundred and eighty degrees (180°). The adjustment and bending of the pipe $x$ in these last operations are identical with the second and third operations previously described and shown in Figs. 12 and 13.

The roller 46 and the pipe $x$ is shown in Fig. 14 by means of broken lines.

While the strokes imparted to the piston 49 in bending of the pipe $x$ as shown in the drawings are all of equal length, it is, of course, understood that these strokes may be varied, at will.

When the machine is adjusted as shown in Fig. 1, the ratchet bar 50 affords a base of resistance for the cylinder 48. At this time, the link 56 and the stop plates 62—63 positively hold said ratchet bar 50 against relative movement to the bed plate 20.

When the machine is adjusted as shown in Figs. 12, 13 and 14, the ratchet bar 50 is held by the link 56 and the back pressure of the cylinder 48 on said ratchet bar 50 presses said bar against the pin 69 and the respective teeth 64—65 engaging said pin.

From a broad viewpoint, the bed plate 20 may be considered a part of the stationary frame 14.

The drawings illustrate a commercial form of the invention, but it will be understood that the same is capable of certain modifications as to details of construction, arrangement and combination of parts within the scope of the invention herein disclosed.

What we claim is:

1. In a machine of the class described, a stationary frame, a swingable bending frame, a pivot pin connecting the swingable bending frame to the stationary frame, a die turnably mounted on the pivot pin, means on the stationary frame for holding an elongated member on the die to be bent thereon, means on the die for clamping the elongated member onto said holding means to prevent endwise movement thereof during bending, a bar in one of its adjustments projecting transversely of the stationary frame and rearwardly, a link pivoted at its inner end portion to the stationary frame and pivoted at its outer end to the front end portion of the bar, said link holding the bar for endwise movement therewith and for relative swinging movement in the plane thereof, a cylinder pivoted to the bar at its front end portion, and a fluid-actuated pis-

ton in the cylinder for action on the swingable bending frame for imparting steps of movement thereto to bend said member on the die.

2. The structure defined in claim 1, further including two stop members on the bar in engagement with the stationary frame, one of said stop members limiting the rear endwise movement of the bar and the other limiting the inward swinging movement of the bar.

3. The structure defined in claim 1, further including a handle on the bar for use in manipulating the same.

4. The structure defined in claim 1, further including a dog on the stationary frame and means spaced longitudinally on the bar for successively engaging the dog for holding the bar in different endwise adjustment.

5. The structure defined in claim 1, further including a guard pivoted to the stationary frame for limiting the outwardly swinging movement of the bar relative to the stationary frame.

6. The structure defined in claim 1 in which the link includes an upper bar and a lower bar, and a U-shaped member rigidly connecting the bars on their inner end portions, said member extending transversely and outwardly of the link.

7. In a machine of the class described, a stationary frame, a swingable bending frame, a pivot pin connecting the swingable bending frame to the stationary frame, a die turnably mounted on the pivot pin, means on the stationary frame for holding an elongated member on the die to be bent thereon, means on the die for clamping the elongated member onto said holding means to prevent endwise movement thereof during bending, a ratchet bar in one of its adjustments extending transversely of the stationary frame and rearwardly, a link pivoted at its inner end to the stationary frame and pivoted at its other end portion to the front end portion of the ratchet bar, said link holding the ratchet bar for endwise movement therewith and for relative swinging movement in the plane thereof, a cylinder pivoted to the front end portion of the ratchet bar, a fluid-actuated piston in the cylinder for action on the swingable bending frame for imparting steps of movement thereto to bend said member on the die, a dog on the stationary frame, and longitudinally spaced ratchet teeth on the ratchet bar for successive engagement with the dog.

8. In a machine of the class described, a stationary frame comprising an upper bar and a lower bar, a bed plate interposed between the rear end portions of the bars and rigidly secured thereto, a swingable bending frame extending at one end portion between the front end portions of the bars of the stationary frame, a pivot pin connecting the bars of the stationary



frame and the swingable bending frame, a die turnably mounted on the pivot pin, means on the stationary frame for holding an elongated member on the die, means on the die for clamping the elongated member onto said holding means to prevent endwise movement thereof during bending, a ratchet bar formed of a single member folded at its rear end upon itself to afford an upper member and a lower member, the outer end portion of the bed plate extending between the members of the ratchet bar, a link comprising an upper member and a lower member, said bed plate extending between the members of the link at their inner end portions, said inner end portions of the link being pivoted to the bed plate, said ratchet bar at its front end portion extending between the outer ends of the members of the link and pivoted thereto, a cylinder having at its outer end a lug that extends between the front end portions of the members of the ratchet bar and pivoted thereto, a fluid-actuated piston in the cylinder for action on the swingable bending frame for imparting steps of movement thereto to bend the elongated member on the die, a pair of stop plates between the members of the ratchet bar, one of said stop plates being in engagement with the front edge of the bed plate to limit the rear endwise movement of the ratchet bar, the other stop plate being in engagement with the outer end of the bed plate to limit the inward swinging movement of the ratchet bar, a dog extending through the bed plate, and ratchet teeth on the inner longitudinal edge portions of the members of the ratchet bar for engagement with the dog.

9. The structure defined in claim 8, further including a T-shaped guard for limiting the outwardly swinging movement of the ratchet bar, the head of the guard being arranged to be engaged by the outer side of the upper member of the ratchet bar, the body of the guard extending transversely over the ratchet bar and pivoted to the dog.

10. The structure defined in claim 8, further including a U-member extending forwardly of the link at the inner end portion and rigidly secured to the member of the link.

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