Feb. 14, 1950 H. A. MUELLER 2,497,622

PIPE BENDING APPARATUS WITH PIVOTED SIDE SHAPERS

Filed Jan. 16, 1947 3 Sheets-Sheet 1

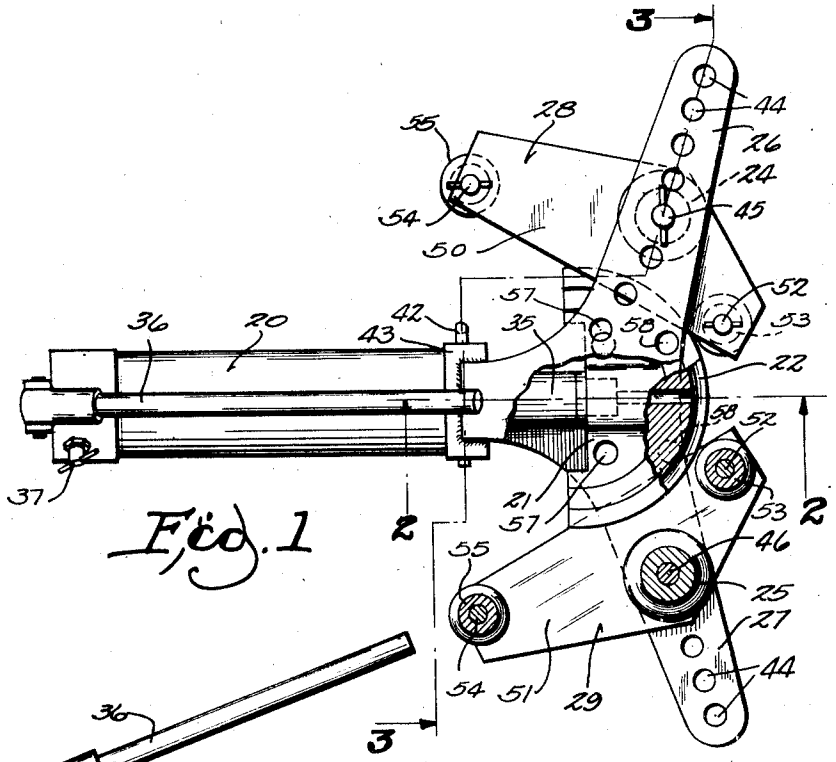


Fig. 1

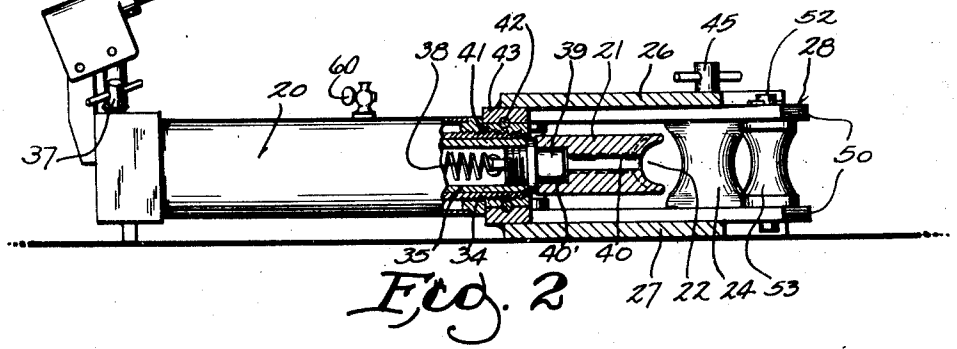


Fig. 2

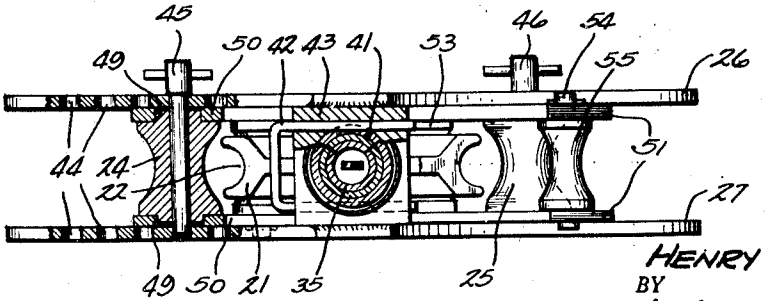


Fig. 3

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PIPE BENDING APPARATUS WITH PIVOTED SIDE SHAPERS

Filed Jan. 16, 1947 3 Sheets-Sheet 2

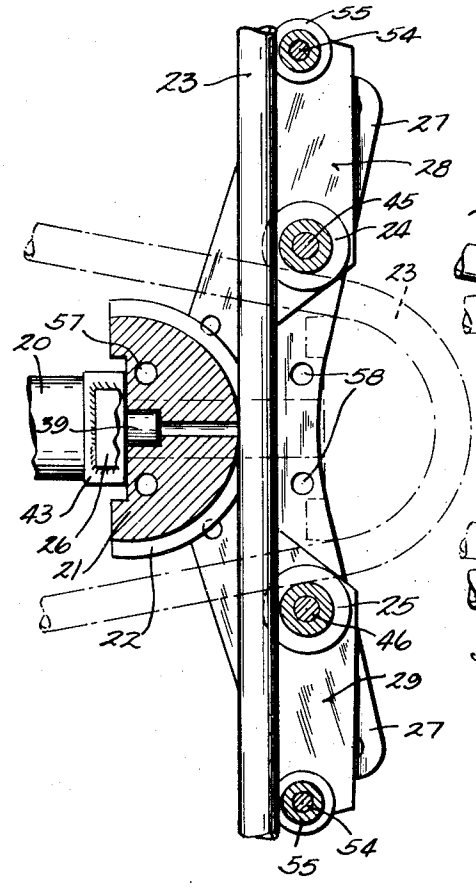


Fig. 4

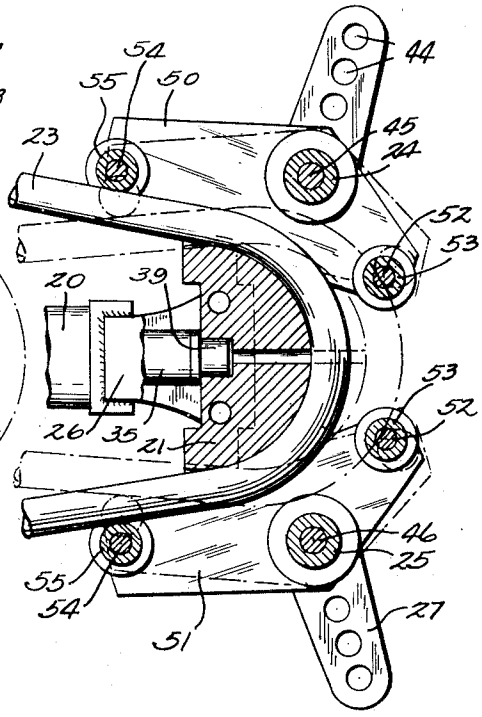


Fig. 5

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Filed Jan. 16, 1947 3 Sheets-Sheet 3

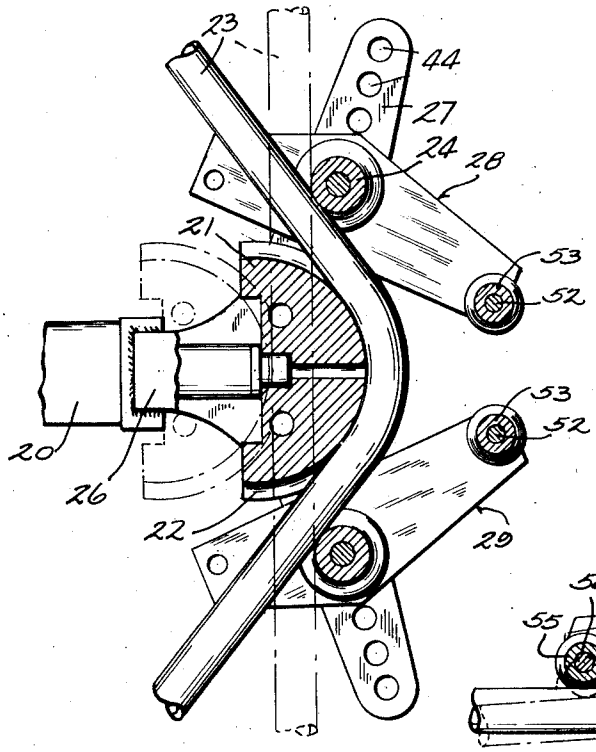


Fig. 6

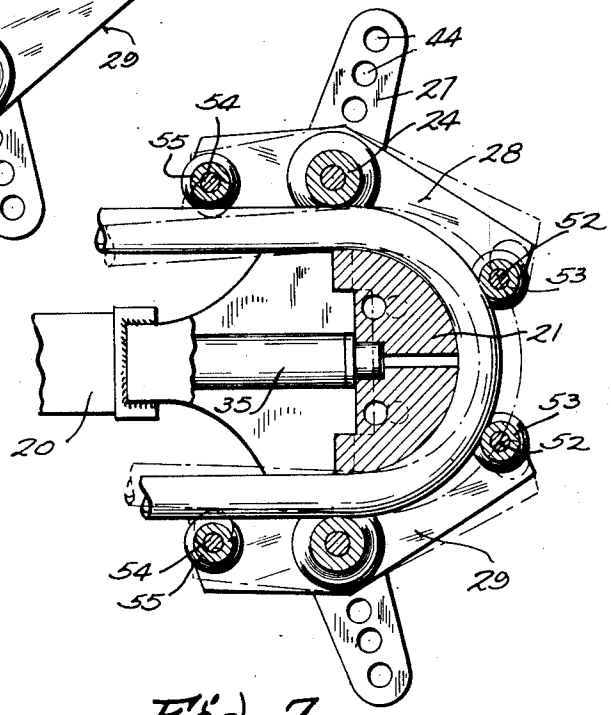


Fig. 7

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UNITED STATES PATENT OFFICE

2,497,622

PIPE BENDING APPARATUS WITH PIVOTED SIDE SHAPERS

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Application January 16, 1947, Serial No. 722,410

14 Claims. (Cl. 153—33)

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This invention relates to improvements in pipe bending apparatus, to provide bends up to 180° more or less in pipe, bars, rails, or other cylindrical members.

It is a general object of my invention to provide an improved pipe bending tool. More particularly, the primary object of the invention is to provide a device of the character described which will form regular bends up to 180° in pipe without deforming the latter, and which will provide such bends in pipes of varying lengths and diameters.

This application is a companion to application for U. S. patent on Pipe bending apparatus, executed of even date by Edward T. Tal.

The nature of the foregoing as well as other objects of the present invention will become clearly apparent from a consideration of the following description and claims, together with the accompanying drawings wherein:

Figure 1 is a top plan view of a pipe bending tool embodying the features of the present invention, a forward portion of the tool being broken away as shown in section.

Figure 2 is a sectional view taken along the line 2—2 in Figure 1.

Figure 3 is a sectional view taken along the line 3—3 in Figure 1.

Figures 4 and 5 are diagrammatic views illustrating successive steps of forming a 180° bend in a pipe, Figure 4 showing in full line a straight section of pipe to be bent, and in dotted line an intermediate forming position of the pipe, and Figure 5 showing in dotted line the final position to which the pipe is bent, this bend being somewhat greater than 180°.

Figure 6 is a transverse sectional view through the forward portion of a modified form of pipe bending tool embodying the features of the present invention, a length of partially formed pipe being shown therein.

Figure 7 is a view similar to Figure 6 but showing, in dotted line, a bend of somewhat greater than 180° in the pipe, and, in full line, the bend of approximately 180° to which the pipe will return when removed from the tool.

Referring to the drawings, wherein like parts are designated by the same reference numerals in the several views, the apparatus in general comprises a hydraulic jack 20 which carries a former 21. The leading edge of the former is of arcuate form, as viewed in plan, while the said edge is channeled at 22, i. e., is concave as viewed in transverse section. The pipe 23 being shaped in the device is progressively pressed into conformity with the channel 22 as the former 21 is forced between the spaced spools 24, 25 rotatably carried between opposed, divergent, frame pieces 26, 27 joined at their base to the casing of jack 20. However, when a permanent bend of 180° is to be provided in the pipe, it is necessary that the device actually bend the pipe to an extent somewhat greater than 180°, for once the pipe is released it will spring back to a certain extent due to the resiliency of the metal in the pipe. Bending past 180° is effected by means of bell crank members 28, 29 which are mounted between the frame pieces 26, 27 and are oscillatable with the spools 24, 25. As the former 21 and the pipe 23 carried thereby are forced ahead between the spools 24, 25, the pipe engages spools 53, 53, carried by the forward arms of the cranks 28, 29, and thereby forces spools 55, 55, carried by the rear arms of the cranks, inwardly into engagement with pipe sections which lie just behind the former 21. Due to the action of the bell cranks, the pipe is provided with an initial bend which is somewhat greater than 180°.

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Referring more in detail to the various structural elements of the device, the hydraulic jack 20 includes a cylinder 34 and a ram 35 working within the cylinder in the conventional manner, hydraulic pressure behind the ram being generated by pumping the handle 36. A screw 37 serves to release the pressure behind the ram when desired, and with the release of pressure a spring 38 acts to draw the ram into the cylinder. The ram 35 has a head portion 39 which carries former 21, said former being provided with a bore 40 and a counterbore 40' which receives the head 39.

As noted above, the forward, or leading edge 22 of the former 21 is arcuate, and when it is used to provide bends of 180°, should itself extend somewhat more than 180°, as shown in the drawings. The edge has a substantially semi-circular channel 22 to accommodate pipe being shaped thereover, a former with a channel of the proper size being preferably selected for use with a corresponding size of pipe.

A block 41 is threadably engaged about the forward end of the cylinder 34, and detachably secured to block 41 by means of a U-shaped key 42 in a second block 43 which carries the wing-like frame pieces 26, 27. These pieces are provided at each side of the apparatus with a plurality of pairs of opposed apertures 44. Spindles 45 and 46 are inserted between like-positioned pairs of these apertures at each side of the device, and the central spools 24 and 25 are rotat-

ably carried by said spindles between the frame pieces 26, 27.

The spools 24, 25 are provided at each end with annular shoulders 49, and about the shoulders on spool 24 are fitted a pair of spaced bell crank plates 50, while spool 25 is similarly fitted with a pair of plates 51, the spindles 45 and 46 acting as the center posts about which the respective pairs of bell crank plates pivot coaxially with the spools. The members of the respective pairs of bell crank plates 50 and 51 are set far enough apart to receive therebetween the former 21 and any size of pipe which the device is capable of handling. The forward arms of each pair of bell crank plates are provided with opposed openings to receive spindles 52, and spools 53 are rotatably mounted about the spindles 52 between the pairs of plates 50, 51. The rearward arms of the plates similarly carry spindles 54 and spools 55. The spindles 52, 54 in the bell crank plates, and the spools 53, 55, may be removed or inserted as desired.

The pairs of plates 50, 51, with their associated spindle and spool members, make up unitary bell crank members 28 and 29, respectively, which cranks oscillate about the center spindles 45, 46. The cranks 28, 29 may be set at any desired position with reference to the former 21 by changing the setting of the spindles 45, 46 in the apertures 44, this setting being governed by the size of pipe to be bent and the sharpness of bend desired.

In the form of device illustrated in Figures 1–5, the forward arm of each bell crank is somewhat shorter than the rearward arm, though in the modified form of device illustrated in Figures 6 and 7, the forward arm is the longer of the two.

Either form of bending tool illustrated in the drawings may be employed to form a relatively shallow bend in a pipe without inserting the spindle and spool means in the arms of the bell crank members, the pipe in this case simply being shaped about the former 21 as the pipe engages the central spools 24, 25 and is pressed therebetween. However, when a 180° bend is to be provided in the pipe, the various spool and spindle members must be inserted in the bell cranks at one stage or another of the bending operation.

When the device illustrated in Figures 1 through 5 is used to provide a bend of 180° in a pipe, spindles 54 and spools 55 are inserted in the rearward arms of crank members 28, 29, as illustrated in Figure 4, and the pipe 23 to be bent is set behind the spools 24, 25 and 55 and ahead of the edge 22 on former 21. The ram 35 and former 21 carried thereon are then moved forwardly until the pipe is bent by spools 24, 25 to approximately the shape indicated in dotted line in Figure 4. The pipe is then withdrawn to substantially the position shown in full line, Figure 5, whereupon the spindles 52 and spools 53 are inserted in the forward arms of the cranks. (Spindles 54 and spools 55 may be inserted at this time if they are not already in place.) The ram and former are then again advanced until the pipe, pressing against the spools 53, causes spools 55 to engage and force inwardly the portions of pipe 23 which lie immediately behind the forming element 21, thereby providing a bend somewhat greater than 180° in the pipe, which bend is indicated by the dotted line position of the pipe in Figure 5.

The apparatus illustrated herein is provided with means whereby the ram 35 may be utilized to remove a piece of formed pipe which may have become lodged in channel 22, but such means form no part of the present invention and are described in more detail in the application of Edward T. Tal, Serial No. 722,380, for Pipe bending apparatus, filed January 16, 1947, issued as Patent No. 2,477,910 August 2, 1949. In brief, such means comprise openings 58 in frame members 26 and 27, and other openings 57 in former 21, which openings may be brought into registry and a pin inserted therethrough to anchor said former 21 to the frame members 26, 27. The ram 35 may then be utilized to drive a pin through bore 48 to dislodge the formed pipe section. The spools 24, 25 and the levers 28, 29 will normally be removed before attempting to bring the openings 57 and 58 into registry and ejecting the pipe from channel 22.

In the modified form of invention shown in Figures 6 and 7, lever plates 28, 29 are the same as the corresponding members in Figures 1–5, but in this modified form of invention these plates are reversed end for end so that the short legs of the levers are now in the rearward position and the long legs are in the forward position. When using this arrangement of parts, the rollers 55 are removed to clear the pipe during the first stage of the bending operation, and the bending is continued until the pipe is bent to substantially 180°, as shown in full lines in Figure 7, or is bent at least far enough for the pipe to clear the position occupied by the rollers 55. The rollers 55 are then mounted on the levers by means of spindles 54. The forward rollers 53 are acted upon as the pipe bent around the front of the former engages them and forces them apart, thereby moving the rearward rollers 55 against the pipe to bend it in excess of 180°, the position shown in broken lines in Figure 7.

In both constructions, the levers 28 and 29 and associated rollers may be omitted until needed, but time is saved by keeping the assembly as complete as possible. In both constructions the rollers are preferably omitted from the short ends of the lever plates until the bending operation has progressed far enough so that these rollers may be mounted without interference. The temporary dismantling of the rollers is required in the specific apparatus disclosed only because this apparatus is designed for use with a conventional ram, in which the throw is short.

The construction of apparatus illustrated in Figures 4 and 5 is adapted to all pipe sizes but requires the ram to be backed off. The construction of Figures 6 and 7 does not require that the ram be backed off, but is adaptable to a limited number of pipe sizes. Since the identical parts are used in both forms of construction, the assembly may be made according to the work at hand.

With either form of device, the pipe will permanently retain a bend of substantially 180° if the initial bend provided by the apparatus has been slightly in excess of 180°. The lessening of the arc of the bend which occurs on removing the pipe from the apparatus is caused by the resiliency of the material, a factor which must be taken into account in forming a bend of this character.

It will be observed that the rearward spools 55 on the bell crank members 28, 29, enage the pipe closely behind forming element 21. This feature of the invention makes it possible to provide

180° bends even in relatively short lengths of pipe.

In dismantling the apparatus, the hydraulic jack 20 may be detached from the frame pieces 26, 27 simply by withdrawing the U-shaped key 42. A petcock 60 on the jack will normally be closed when the unit is transported to prevent the escape of any oil.

While I have described my device as being powered by a hydraulic member, other sources of power, as ratchet and screw members, could be used, so far as the present invention is concerned.

I claim:

1. A pipe bending machine comprising, in combination, a frame, a pair of spaced formers mounted on said frame, a forming element carried on said frame and arranged for movement between said formers, said element having an arcuate leading surface over which a pipe is bent, means arranged to impart movement to the forming element, a pair of levers severally pivoted on the frame beside the path of movement of said element, pipe engaged means mounted on the levers to effect lever oscillation as the element advances, and pipe engaging means on the levers disposed for acting on the pipe portions behind the advancing element in a direction to urge such portions toward each other.

2. The combination of claim 1 wherein the leading surface of the forming element has a periphered arc exceeding 180°.

3. A pipe bending machine comprising, in combination, opposed frame members, a pair of spaced rollers journaled between said frame members, forming means mounted for movement between said frame members and said rollers, said forming means having an arcuate leading surface over which a pipe is bent as said forming means advances between said rollers, actuating means for moving said forming means, levers intermediately fulcrumed between said frame members and pivotal coaxially with said rollers, pipe engaged means mounted on the forward arms of said levers to oscillate said levers as the actuating means is advanced, and pipe engaging means mounted on the rearward arms of said levers to communicate movement of said levers to pipe portions extending behind said advancing forming means in a direction to urge such pipe portions toward each other.

4. The machine of claim 3 in further combination with a pair of spaced spindles removably supported between opposed openings in said frame members, the rollers being journaled on said spindles.

5. The combination of claim 3 wherein said forming means is provided with a channeled arcuate leading surface having a peripheral extent in excess of 180°.

6. A pipe bending machine comprising, in combination, a pair of spaced opposed frame members each having a series of openings therein in registry with those in the opposed member, a pair of spaced spindles removably supported between selected openings in said members; rollers journaled upon said spindles; a pair of bell cranks mounted between the frame members and pivotal coaxially with said rollers, said bell cranks each comprising a pair of spaced plates having pipe engaged means disposed between the plates on the forward crank arms and having pipe engaging means disposed between the plates on the rearward crank arms, and forming means mounted for movement between said rollers and between the plates on the bell cranks, said forming means

having a channeled, arcuate surface over which a pipe is progressively shaped as the pipe is pressed between said rollers and engages the forward pipe engaged means whereby the rearward pipe engaging means are swung against the pipe portions extending behind the forming element.

7. A pipe bending machine comprising the combination of an arcuate pressure applying element, a set of fixed guiding wings between which said element is mounted for movement against a pipe, spaced pipe engaging rollers mounted between said wings, a fixed hydraulic cylinder provided with a plunger in line with said element and adapted to force the same against a pipe between the portions engaged by said rollers, and levers intermediately fulcrumed on the wings and having angularly disposed forward and rearward arms provided with means for engagement with the pipe, the levers being arranged to communicate advancing motion of said pipe against said means of the forwardly disposed arms to cause inward bending of pipe sections extending behind said element by said means of said rearwardly disposed arms.

8. A bending fixture comprising a cylinder, a plunger operable in said cylinder, a pair of opposed, outwardly extending frame members mounted on said cylinder, a pair of spindles journaled between opposed apertures in said frame members, spools rotatably mounted about the spindles, pipe forming means arranged to be carried on said plunger between said frame members and between said spools, said forming means having a channeled, arcuate leading surface having a peripheral extent in excess of 180°, bell cranks oscillatable about each of said spindles, pipe engaged means mounted on forward arms of said cranks in the path of a pipe carried on the forming means, and pipe engaging means mounted on rearward arms of the cranks and disposed to communicate movement of the cranks to pipe portions extending behind the advancing forming means in a direction to urge such portions toward each other.

9. The combination of claim 8 wherein said spools are provided with shoulders adjacent their ends and each bell crank comprises spaced plates mounted about the respective shoulders on each spool.

10. The combination of claim 8 wherein each bell crank comprises a pair of spaced plates arranged to receive therebetween the forming element and a pipe carried thereon, and wherein said pipe engaged and pipe engaging means comprise spools rotatably mounted about spindles removably supported between the plates on the forward and rearward arms respectively of said cranks.

11. A pipe bending machine comprising, in combination, a framework having spaced, parallel members; actuating means mounted on said framework, said actuating means including a reciprocating rod; a forming element arranged to be advanced by said rod and having a path of movement between the frame members, said forming element having a channeled, forwardly arched leading surface extending in excess of 180° over which surface a pipe may be shaped; a pair of spaced rollers mounted between said frame members; bell cranks pivotally mounted between said frame members for coaxial movement with said rollers, each crank having forwardly and rearwardly projecting arms; pipe engaged means on the forward crank arm; and pipe engaging means on the rearward crank arms; the tool being so arranged that engagement by the pipe of said pipe

engaged means oscillates the cranks and effects inward bending of the pipe portions lying behind the forming element by said pipe engaging means, whereby a bend in excess of 180° may be provided in the pipe.

12. The machine of claim 11, wherein said bell cranks are generally hollowed between said pipe engaged and pipe engaging means to accommodate the forming element and any pipe carried on the leading surface thereof.

13. The machine of claim 11, wherein said bell cranks each comprise a pair of spaced plates, and the pipe engaged and pipe engaging means comprise rollers journaled about spindles removably supported between said plates.

14. A pipe bending machine comprising, in combination, a hydraulic jack having a cylinder, a ram mounted for reciprocating movement in said cylinder, and means for actuating the ram; a pair of spaced, opposed frame members rigidly mounted with respect to said jack; a pair of rotatably mounted spools carried in adjustable spaced relationship between said frame members; a forming means detachably secured to said ram and having a path of movement between said spools, said forming means having an arcuate channeled leading surface over which a pipe may be formed; and bell cranks, having forwardly and rearwardly disposed arms, pivotally mounted between the frame members for coaxial movement with said spools, each bell crank comprising a pair of spaced plates having spools journaled therebetween adjacent the extremities of each crank arm, the spools in the forward crank arms being engaged by a pipe advanced by the forming means whereby the spools carried by the rearward crank arms are swung into engagement with pipe portions extending rearwardly of the forming means to press such portions toward each other.

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