



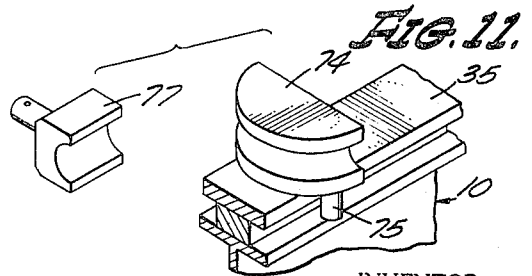
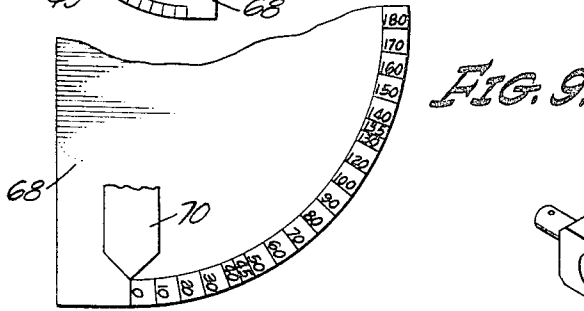
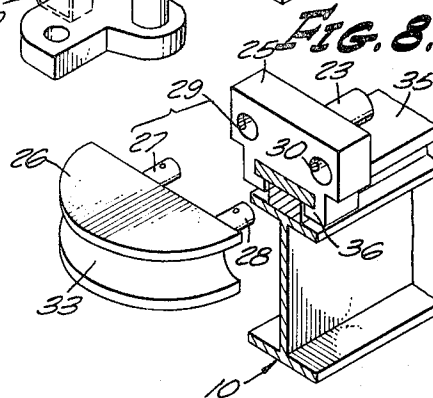
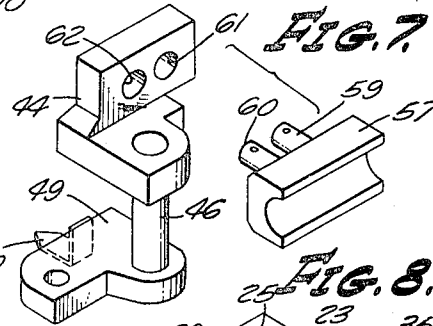
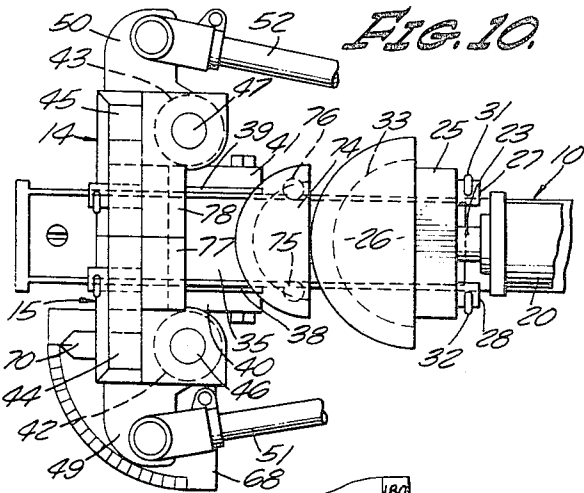
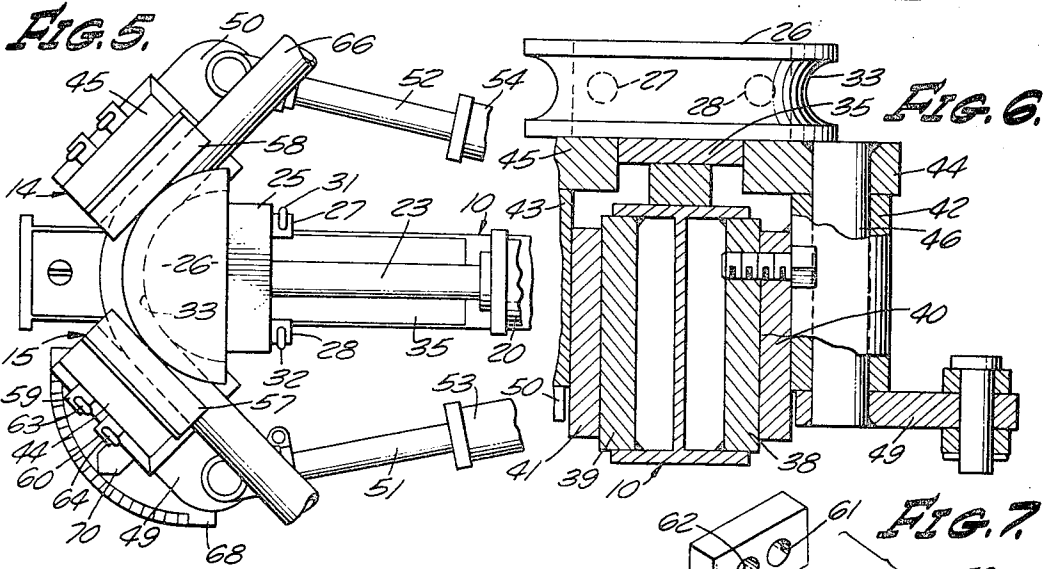
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TUBING BENDER

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Sheet 2 of 2



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**TUBING BENDER**

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**ABSTRACT OF THE DISCLOSURE**

An apparatus for bending tubing employing a hydraulic ram operated die and pivotal shoes. Different size dies and shoes can be readily and quickly attached or removed from the apparatus. A depth of bend indicator is provided for indicating the depth of bend of tubing.

This invention relates to an improved tubing bender and more particularly to an improved pipe bending machine.

Various pipe bending machines have been devised in the past. Typically, these machines are employed for bending tubing such as automobile exhaust and tail pipes. Although these machines have been found to operate and perform their functions satisfactorily, some difficulties arise with respect to the accuracy of bending, as well as the set-up time required for bending various sizes of pipes.

Accordingly, it is an object of the present invention to provide an improved tubing bender.

It is an additional object of this invention to provide a machine enabling pipe to be bent accurately.

It is a further object of this invention to provide a bending machine which may be set up for bending various sizes of tubing in a quick and efficient manner.

Other objects and features of this invention will become more apparent through a detailed consideration of the following description taken in conjunction with the drawings in which:

FIGURE 1 is a top view of a portion of a bending apparatus embodying features of the present invention;

FIGURE 2 is a side view of the apparatus taken along line 2—2 of FIGURE 1;

FIGURE 3 is an end view of the apparatus taken along line 3—3 of FIGURE 2;

FIGURE 4 is a partial top view of the apparatus having a length of tubing engaged thereby;

FIGURE 5 is a partial top view similar to FIGURE 4, but with the apparatus in a position whereby the tubing is bent;

FIGURE 6 is a partial sectional view taken along line 6—6 of FIGURE 2;

FIGURE 7 is a perspective view of a portion of the apparatus shown in FIGURE 1;

FIGURE 8 is a perspective view of a portion of the apparatus shown in FIGURE 1;

FIGURE 9 is a partial top view of a portion of the apparatus shown in FIGURE 1;

FIGURE 10 is a partial top view of the apparatus shown in FIGURE 1 but having an additional die and shoes for bending different diameter tubing; and

FIGURE 11 is a perspective view of the die and one shoe of FIGURE 10.

Referring now to the drawings, and particularly to FIGURES 1 and 2, bending apparatus constructed in accordance with the teachings of the present invention includes an I beam 10 supported by a pair of legs 11 and 12 affixed to the I beam near the respective ends thereof. A hydraulic ram 13 and a pair of pivotally mounted shoes

14 and 15 are mounted upon the upper leg of the I beam as hereinafter will be described in detail.

A bracket 18 is secured near one end of the I beam 10 for receiving a pin 19 through the bracket thereby forming a pivotal connection. The hydraulic ram 13 includes a cylinder 20 having a pair of brackets 21 and 22 extending from an end thereof which are coupled by the pin 19 to the bracket 18. A piston rod 23 extends from the opposite end of the cylinder 20. Suitable hydraulic lines (not shown) are coupled to the ends of the cylinder 20 so that fluid under pressure may be applied in a conventional manner to either side of a piston (not shown) on the piston rod 23 within the cylinder 20.

The piston rod 23 carries a die bracket 25 (note also FIGURE 8) at its exterior extremity. A curved bending die 26 includes dowels 27 and 28 extending from the back face thereof and are adapted to be inserted into perspective apertures 29 and 30 in the die bracket 25. Thus, the die bracket 25 supports the die 26, with the die being readily removable from the bracket. Holes are provided in the dowels 27 and 28 through which clips or pins 31 and 32 (note FIGURE 1) may be placed to secure the die 26 to the bracket 25. The front face of the die 26 has a radius of curvature which determines the bend to be applied to tubing. This curved face of the die 26 is grooved, as at 33, the radius of curvature of groove being the same as the diameter of the tube to be bent.

Mounted on the upper leg of the I beam 26 is a T bar 35 (note FIGURES 1, 2 and 8), the cross of which supports the die bracket 25. The bottom of the bracket 25 forms a gib 36 which engages the cross of the T bar 35 thereby guiding the bracket 25 during extension or withdrawal of the piston rod 23.

A pair of mounting plates 38 and 39 (note FIGURES 3 and 6) are secured, as by welding, on each side of the underleg of the I beam 10. Plates or brackets 40 and 41 are secured to and support respective sleeves 42 and 43. The brackets 40 and 41 are bolted to the respective plates 38 and 39. A pair of pivotal shoe brackets 44 and 45 are secured to respective shafts 46 and 47 which project through the respective sleeves 42 and 43 (note FIGURES 3 and 6) whereby the shoe brackets are pivotally mounted. Rocker arms 49 and 50 are secured to the lower ends of the respective shafts 46 and 47, and piston rods 51 and 52 are pivotally coupled with the respective rocker arms 49 and 50. Each of the piston rods 51 and 52 carries a piston (not shown) thereon within respective compression cylinders 53 and 54. Brackets 55 and 56 are mounted on opposite sides of the I beam 10 to which the ends of the respective compression cylinders 53 and 54 are pivotally connected.

Each of the shoe brackets 44 and 45 carries a respective shoe 57 and 58. Each shoe includes a pair of dowels extending from the back face thereof which engage apertures within the shoe brackets. For example, the shoe 57 has dowels 59 and 60 which extend into respective apertures 61 and 62 in the bracket 44. Holes may be provided in the dowels to receive clips, such as clips 63 and 64, for retaining the shoes on the brackets. This arrangement enables the shoes to be readily and quickly removed, thus shortening set-up time. The front face of each shoe includes a groove having a radius of curvature the same as the diameter of the pipe to be bent. Tubing 66 is positioned between the die 26 and the shoes 57 and 58, as shown in FIGURE 4, and upon extension of the piston rod 23 the tubing 66 is bent as shown in FIGURE 5.

As is well known to those skilled in the art, a hydraulic system generally is utilized to operate bending apparatus of the nature described above. Typically, a hydraulic system includes a motor, a pump, hydraulic

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reservoir and control valves. These components are interconnected with the hydraulic ram cylinder 20 and the compression cylinders 53 and 54. When a hand or control valve is moved to a forward position, fluid under pressure is delivered to the cylinder 20 thereby extending to the left (as shown in FIGURES 1 and 2) the piston rod 23. As the piston rod 23 moves, the tubing 66 is bent as illustrated in FIGURE 5. As the shoes 14 and 15 pivot, the piston within the compression cylinders 53 and 54 resist the pivoting action because of hydraulic fluid within these cylinders. Typically, this resistance is fixed by adjusting a suitable needle valve or valves. Fluid is then expelled from the cylinders 53 and 54 at a predetermined rate thereby setting the resistance thereof.

After the tubing 66 is bent, fluid under pressure is delivered to the cylinders 53 and 54 thereby extending their respective piston rods 51 and 52. At the same time, fluid is delivered to the cylinder 20 at the opposite end thereof to return the piston rod 23 to its initial position as shown in FIGURES 1 and 2.

A bend indicator is coupled to indicate the angular movement of a pivotable shoe to thereby indicate the angle of bend applied to the tubing 66. The bend indicator includes a dial plate 68 secured to the supporting leg 11 by a bracket 69. A pointer 70 is secured to the rocker arm 49. The dial plate 68 may be calibrated in degrees as shown in FIGURE 9 and as the tubing 66 is bent, the pointer 70 indicates the degree of bend thereof. This arrangement enables accurate bending of the tubing 66 to be accomplished.

Various pipes of a diameter smaller than that normally bent with the die 26 may be bent with a die 74 (note FIGURES 10 and 11). The die 74 has a configuration similar to the die 26, but the forward face thereof has a groove with a smaller radius of curvature. The die 74 includes a pair of dowels 75 and 76 extending from the bottom thereof which are arranged to straddle the top of the T bar 35. Thus, the die 74 may be positioned on the T bar 35 in front of the forward face of the die 26. Half shoes 77 and 78 having approximately half the width of the shoes 57 and 58, each include a dowel extending from the back surface thereof which may be inserted into the innermost aperture of the shoe brackets 44 and 45.

Other tube forming operations, such as tube expanding, flaring, etc., may be performed by apparatus which may be used with the machine of the present invention. Exemplary apparatus may be found in U.S. patent application Ser. No. 528,454, now Patent No. 3,385,087, entitled "Swaging Tool," filed by applicant concurrently herewith.

It will be understood that although an exemplary embodiment of the present invention has been disclosed and discussed, other configurations, structural arrangements and applications are possible and that the embodiment disclosed may be subjected to various changes, modifications, and substitutions without necessarily departing from the spirit of the invention.

What is claimed is:

1. Apparatus for bending tubing, and the like, having hydraulic ram means for moving die means to engage a portion of said tubing and shoe means for bearing against other portions of said tubing, and having support means for supporting said hydraulic ram means, said die means and said shoe means, the combination comprising,

die bracket means movable by said hydraulic ram means,

bar means mounted on said supporting means for retaining said die bracket means and allowing said die bracket means to be movable by said hydraulic ram means,

said die means including first and second dies, means removably coupling said first die with said die bracket means,

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said second die being positioned on said bar means and having protuberances extending from said second die straddling said bar means whereby said first and second dies may be moved as said die bracket means is moved by said hydraulic ram means,

pivotally mounted shoe bracket means, hydraulic means coupled with said shoe bracket means for resisting movement thereof, and

means removably coupling said shoe means to respective shoe bracket means whereby tubing may be positioned between said second die and said shoe means and bent upon movement of said second die toward said shoe means under the force of said hydraulic ram means.

2. Apparatus for bending tubing, and the like, having hydraulic ram means for moving die means to engage a portion of said tubing and shoe means for bearing against other portions of said tubing, and having support means for supporting said hydraulic ram means, said die means and said shoe means, the combination comprising, die bracket means movable by said hydraulic ram means,

bar means mounted on said support means for retaining said die bracket means and allowing said die bracket means to be movable by said hydraulic ram means, said die means including first and second dies, means removably coupling said first die with said die bracket means,

said second die being positioned on said bar means and having protuberances extending from said second die straddling said bar means whereby said first and second dies may be moved as said die bracket means is moved by said hydraulic ram means,

shoe bracket means pivotally mounted on said support means,

hydraulic means coupled with said shoe bracket means for resisting movement thereof,

means removably coupling said shoe means to respective shoe bracket means whereby tubing may be positioned between said second die and said shoe means and bent upon movement of said second die toward said shoe means under the force of said hydraulic ram means, and

indicator means including a pointer and scale, said indicator means being coupled with one shoe bracket means and the pointer and scale thereof being relatively movable by said one shoe bracket means to indicate the degree of bend of tubing.

3. Apparatus for bending tubing, and the like, having ram means for moving die means to engage a portion of said tubing and shoe means for bearing against other portions of said tubing, the combination comprising

a die bracket movable by said ram means, said die bracket including at least an aperture,

bar means for retaining said die bracket and allowing said die bracket to be movable by said ram means,

a first die, said first die including at least a protuberance removably engageable with said aperture in said die bracket,

a second die, said second die being positioned on said bar means and including protuberances straddling said bar means thereby allowing said second die to move with said first die,

a pair of shoe brackets, each of said shoe brackets including at least an aperture, and

a pair of shoes, each of said shoes including a protuberance removably engageable with respective apertures in said shoe brackets.

4. A bending machine for bending different size tubing, and the like, the combination comprising

hydraulic ram means,

supporting means for supporting said hydraulic ram means,

die means mounted on said supporting means and movable with respect thereto by said hydraulic ram

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means, said die means comprising a pair of members coupled together for ready assembly and disassembly thereof, one of said members having a plurality of protuberances and the other of said members having a pair of mating openings to allow a first of said members of one size which serves as a die to be readily removed and interchanged with a first member of another size,

a pair of shoe means pivotally mounted on said supporting means, each of said shoe means including a pair of members coupled together for ready assembly and disassembly thereof, one of each pair of members having at least a protuberance and the other having at least a mating opening to allow a first member of one size of said shoe means which serves as a shoe to be readily removed and interchanged with a first member of said shoe means of another size, and hydraulic means coupled with said shoe means for resisting angular movement thereof.

5. A bending machine for bending different size tubing, and the like, the combination comprising hydraulic ram means, supporting means for supporting said hydraulic ram means, die means mounted on said supporting means and movable with respect thereto by said hydraulic ram means, said die means comprising a pair of members coupled together for ready assembly and disassembly thereof, one of said members having a plurality of protuberances and the other of said members having a pair of mating openings to allow a first of said members of one size which serves as a die to be readily removed and interchanged with a first member of another size,

a pair of shoe means pivotally mounted on said supporting means, each of said shoe means including a pair of members coupled together for ready assembly and disassembly thereof, one of each pair of members having at least a mating opening to allow a first member of one size of said shoe means which serves as a shoe to be readily removed and interchanged with a first member of said shoe means of another size, hydraulic means coupled with said shoe means for resisting angular movement thereof, and indicator means including a pointer and scale, said indicator means being coupled with one of said shoe means and the pointer and scale thereof being relatively movable by said one shoe means to indicate the degree of bend of tubing.

6. Apparatus for bending different size tubing having ram means for moving die means to engage a portion of a length of tubing and shoe means for bearing against other portions of said length of tubing, the combination comprising a die bracket movable by said ram means, bar means for retaining said die bracket and allowing said die bracket to be movable by said ram means, a pair of pivotally mounted shoe brackets, and first and second dies, a pair of full shoes and a pair of half shoes, said first die being coupled with said die bracket and said pair of full shoes being coupled with said shoe brackets for enabling a first size tubing to be bent; and said second die being removably coupleable with said apparatus for movement with said die bracket, and complementary coupling means between said shoe brackets and said full shoes and between said shoe brackets and said half shoes for allowing said half shoes to be readily interchanged with said full shoes and coupled with said shoe brackets for enabling a second size tubing to be bent.

7. A bending machine for bending different size tubing, and the like, the combination comprising hydraulic ram means, supporting means for supporting said hydraulic ram means, die means mounted on said supporting means and movable with respect thereto by said hydraulic ram means, said die means comprising a pair of members coupled together for ready assembly and disassembly thereof, one of said members having a plurality of protuberances and the other of said members having a pair of mating openings to allow a first of said members of one size which serves as a die to be readily removed and interchanged with a first member of another size,

a pair of shoe means pivotally mounted on said supporting means, each of said shoe means including a pair of members coupled together for ready assembly and disassembly thereof, one of each pair of members having at least a protuberance and the other having at least a mating opening to allow a first member of one size of said shoe means which serves as a shoe to be readily removed and interchanged with a first member of said shoe means of another size, hydraulic means coupled with said shoe means for resisting angular movement thereof, and indicator means including a pointer and scale, said indicator means being coupled with one of said shoe brackets and the pointer and scale thereof being relatively movable by said one shoe bracket to indicate the degree of bend of tubing.

8. Apparatus for bending various size tubing, and the like, having ram means for moving die means to engage a portion of said tubing and shoe means for bearing against other portions of said tubing, the combination comprising a die bracket movable by said ram means, said die bracket including at least an aperture, bar means for retaining said die bracket and allowing said die bracket to be movable by said ram means, a die including at least a protuberance readily removably engageable with said aperture in said die bracket, a pair of shoe brackets pivotally mounted about an axis which is fixed with respect to said bar means, each of said shoe brackets including at least an aperture therein, a pair of full shoes and a pair of half shoes, said shoes being readily interchangeable for enabling different size tubing to be bent, each of said shoes including at least a protuberance readily removably engageable with respective apertures in said shoe brackets, and indicator means for indicating the degree of bend of tubing, said indicator means including a pointer coupled with one of said shoe brackets and a scale fixed with respect to said bar means, said pointer being movable in response to movement of said one shoe bracket for indicating on said scale the degree of bend of tubing.

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