May 31, 1960 S. J. RHODES 2,938,564

THREE POINT BENDER WITH ROD GUIDED RAM

Filed July 5, 1957 3 Sheets-Sheet 1

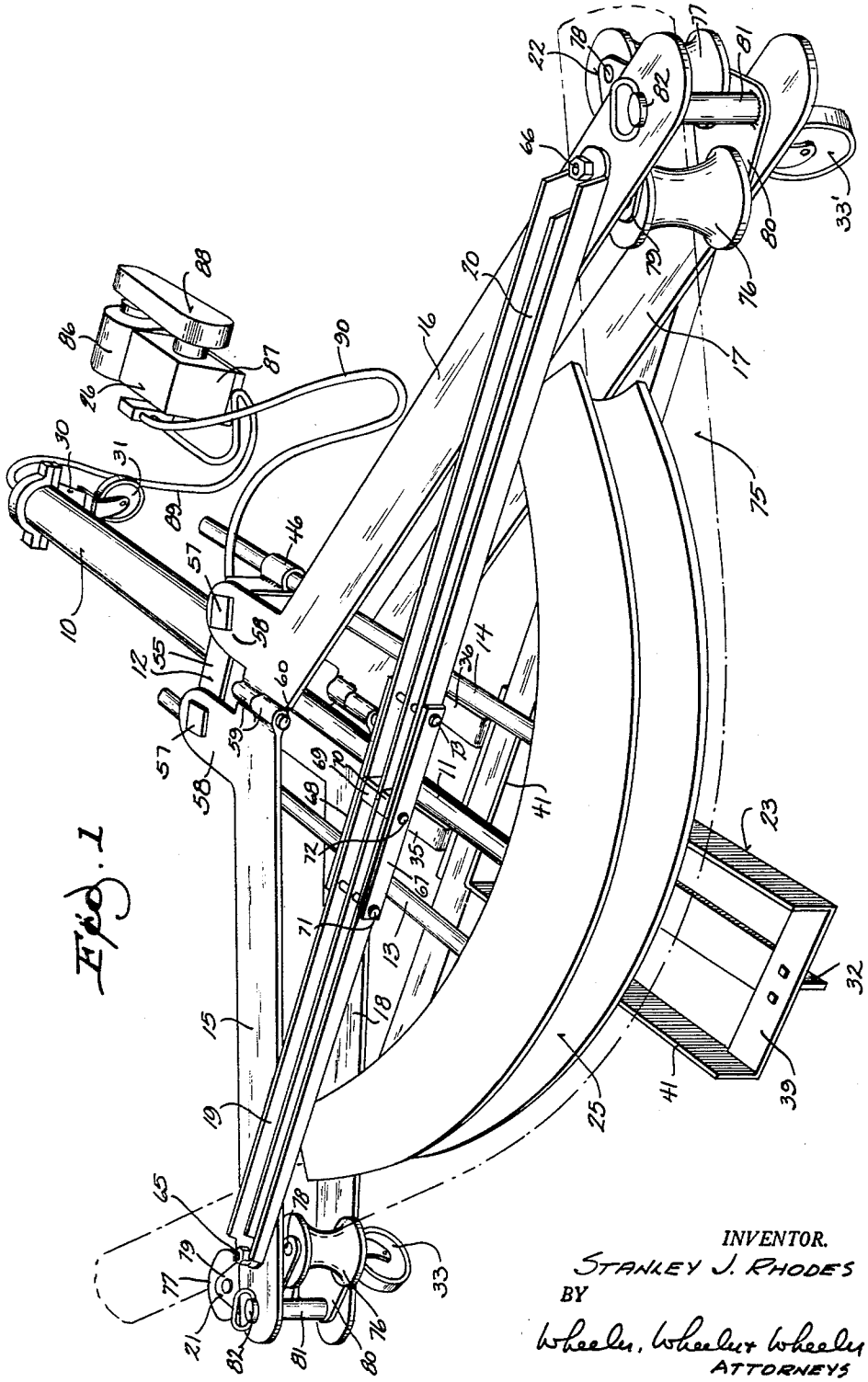


Fig. 1

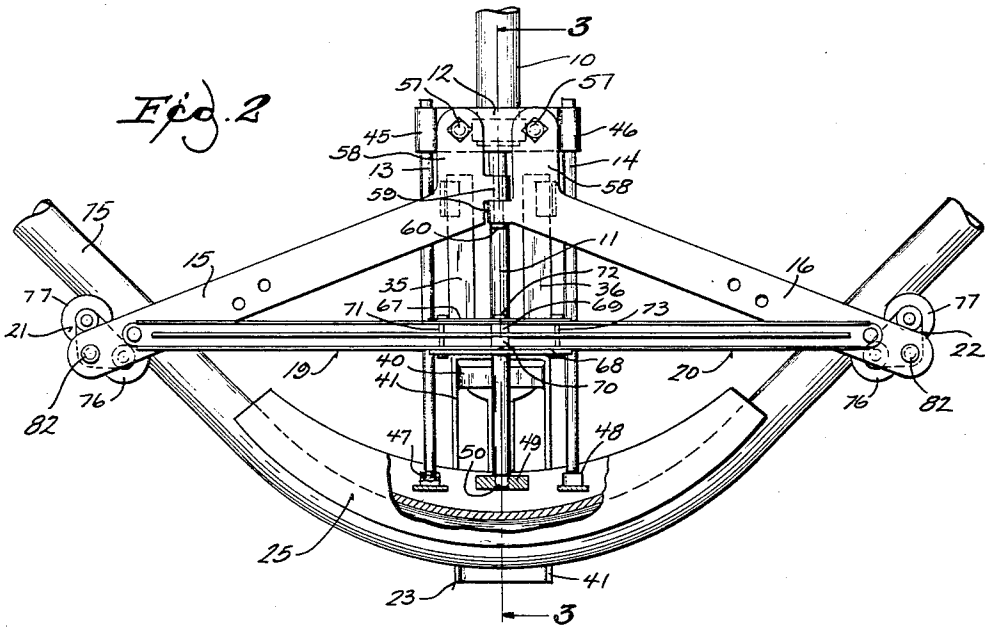
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Fig. 2



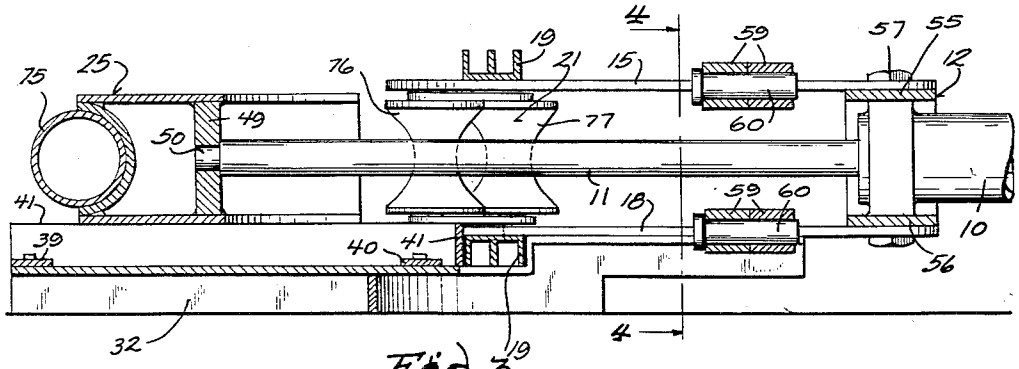


Fig. 3

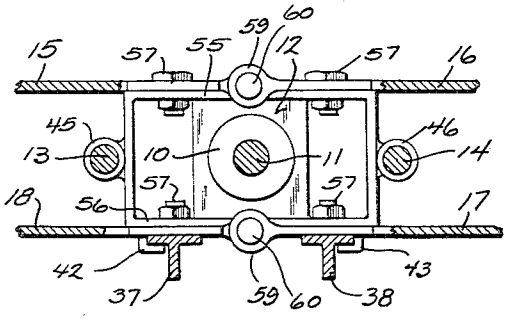


Fig. 4

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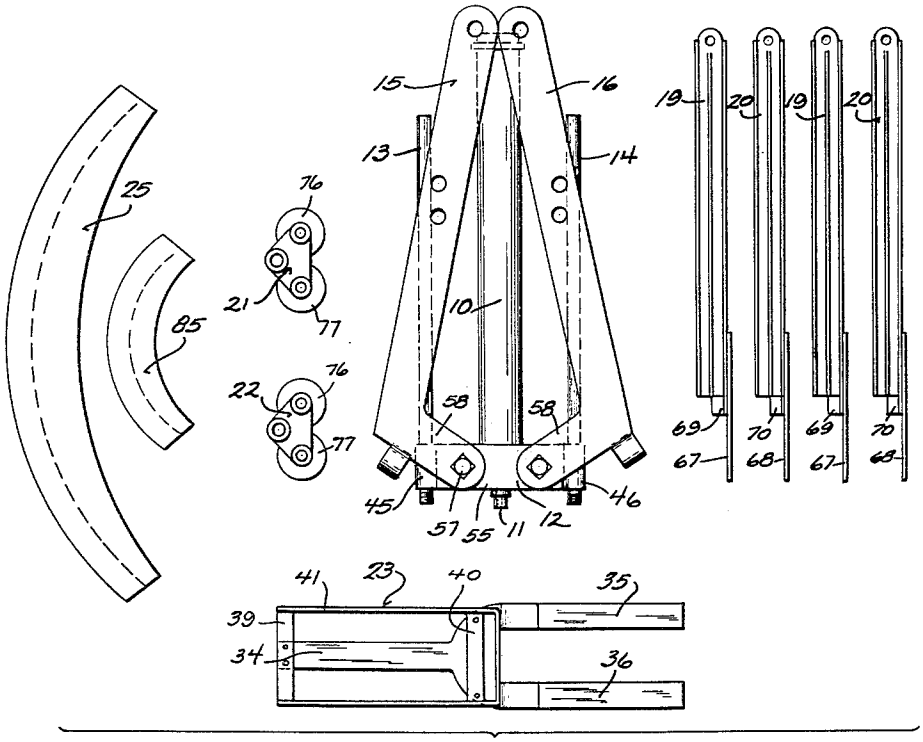


Fig. 5

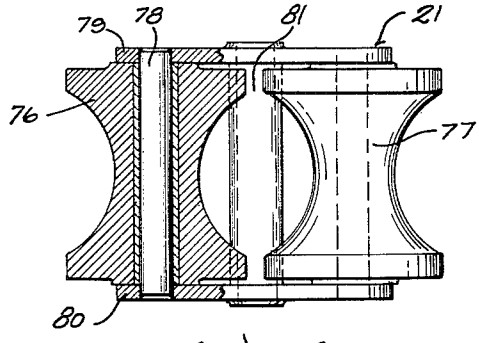


Fig. 6

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THREE POINT BENDER WITH ROD GUIDED RAM

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2 Claims. (Cl. 153—38)

This invention relates to improvements in bending machines.

This bending machine is adapted for large and heavy work such as the bending of bars or tubes especially those larger than 4" in diameter. It is a portable hydraulically operated apparatus, is foldable, and yet, because of its design, is relatively light and rigid. It is partly because of its rigidity when unfolded and prepared for use in a bending operation that the bending operations are carried on with a startling minimum of hydraulic pressure required for accomplishing what was heretofore considered to be a very "heavy" bend requiring much heavier hydraulic pressure.

In the drawings:

Fig. 1 is a perspective of the bending machine, showing in dotted lines an 8" O.D. pipe having a 7/16" wall thickness and, as shown, the bending operation has proceeded sufficiently to provide an almost completed 90 degree bend in the pipe.

Fig. 2 is a plan view of the bending machine and pipe shown in Fig. 1 but with the pipe in a completed 90 degree bend.

Fig. 3 is a section on line 3—3 of Fig. 2.

Fig. 4 is a section on line 4—4 of Fig. 3.

Fig. 5 is a composite view of the structural parts of this bending machine; the central view showing the larger structural parts folded for transport.

Fig. 6 is a side view of a roller dolly with its tubular pintle bearing and its frame supported pair of rollers, with portions of the frame being shown in vertical section.

The principal structural parts of this bending machine, as shown in Fig. 1, comprise a large hydraulic cylinder 10; a ram 11 extending from the cylinder; a heavy head 12 for the cylinder 10, providing mounting support for two guide bars 13 and 14 extending parallel with the ram 11; this head 12 also providing mounting support for four wing frame members 15, 16, 17 and 18, frame tension members 19 and 20, roller dolly assemblies 21 and 22, and connection to base frame 23.

To complete the list of larger parts of the machine, there is a shoe 25 mounted upon the extended ends of guide bars 13 and 14 and upon the extended end of ram 11. This shoe 25 is shaped for a 90 degree bend of the pipe or bar to be bent and is of such dimensions as to be suited to the bending of a bar or pipe of certain outside dimensions. If a bar or pipe of different dimensions is to be bent, the shoe 25 will be supplanted by another size and shape of shoe.

In Fig. 1, there is seen a power driven pump apparatus 26 with appropriate connections for double acting operation of the cylinder and ram 10—11 as will be described below.

In greater detail, the parts and functions of the bending machine are described as follows, the forward end of the machine being considered as shown in Fig. 1 to comprise the end in the direction toward which the ram

forces the shoe 25 and the rearward end of the machine including the hydraulic cylinder toward which the parts are folded or retracted when the machine is conditioned for transportation.

At the extreme rearward end of the cylinder 10, there is a clamp-like supporting bracket 30 provided with a caster 31 adapted to support the entire rearward portion of the machine at a level commensurate with that provided by a base frame skid 32 at the forward end of the machine. Then at the extended outer ends of the wing frame members 17 and 18, there are casters 33 and 33'. The base frame 23 comprises fundamentally a Y-shaped construction shown in plan in Fig. 5 where it will be seen that a forwardly extending single central frame strap 34 is developed into a pair of frame straps 35 and 36 beneath which are skids 37 and 38 respectively integrally formed in T relation as shown in Fig. 4. To complete this base frame, a crosshead 39 and a similarly shaped plate 40 provide support for a U-shaped shoe slide 41, the upper margins of which are at a level to provide support for shoe 25 as the shoe is advanced by the ram 11.

Reference has already been made to the heavy head 12 on the forward end of cylinder 10. This head provides strong tubular elements at 45 and 46 to slidably receive and guide the two guide rods 13 and 14. It is upon the forward ends of the guide rods that shoe 25 is threadedly engaged as shown most clearly at 47 and 48 in Fig. 2. Between the threaded connections at 47 and 48, there is a thrust plate 49 on the shoe 25 against which the ram is adapted to bear in a forward thrusting motion and the thrust plate is recessed to receive relatively loosely the reduced spud-like end 50 of the ram.

The head 12 is also provided with a top plate 55 and a bottom plate 56 against which respectively the upper and lower pairs of wing frame members are swingably held by pivot bolts 57. It will be noted that the wing frame members are somewhat elbow shaped and that each of them has a short leg 58 through which a bolt 57 extends. Each of the wing frame members is provided with a tension pintle tube 59 arranged to be aligned mateably with a similar tube of the paired frame members as shown most clearly in Fig. 1 so that a tension pin 60 retractably inserted through two of the aligned pintle tubes may hold a pair of extended wing frame members in the position shown in Fig. 1. However, when this pin is withdrawn, a pair of wing frame members may be swung about the respective bolts 57 to a retracted position approximately along the cylinder 10 as shown in Fig. 5.

When the four wing frame members are in the position shown in Fig. 1 and the respective pins 60 are in position in tubes 59, frame tension members 19 and 20 may be assembled as shown in Fig. 1 with respect to the top wing frame members and the bottom wing frame members respectively, and tension member bolts 65 and 66 restrain outward or folding motion of the wing frame members while a bending operation takes place.

To facilitate the compact package folding of the entire apparatus, tension members 19 and 20 are made up as separate halves of a complete tension member connectable at a midpoint in the entire length between 65 and 66 by using splice plates 67 and 68, spacer blocks 69 and 70 and assembly bolts 71, 72 and 73 as shown most clearly in Fig. 1.

It will now be seen that the four wing frame members assembled with the frame tension members 19 and 20 above and below the space provided for movement of the shoe 25 complete a pair of triangular frame elements having great tensile strength as to each portion of the frame adequate to withstand the strains of a bending operation as described below.

It will be understood from the above description that the shoe **25**, guide rods **13—14** and ram **11** may be retracted rearwardly so that the shoe **25** may take a position between the wing frame members permitting a pipe **75** in straight unbent condition to be inserted in tangential relation to the curve of the shoe **25** and between the extended extremities of the wing frame members. Then a pair of roller dolly assemblies **21** and **22** may be inserted between the said extended frame extremities in such position as to cause rollers **76** and **77** of each dolly to bear against the pipe. The rollers are spool shaped to conform approximately to the curvature of the pipe wall and to be centered in line with the axis of the ram. The rollers are carried by roller bearing pins **78** extended between top and bottom dolly plates **79—80** respectively. These plates are also provided with a tubular spacer **81** so that a handled dolly pin **82** extending through the upper and lower wing frame members may also extend through the tube **81** and provide a pivot about which the dolly assembly may swing as a bending operation progresses. It will be noted that the position of the dolly assemblies is such that the pipe and shoe may move forwardly between the dollies while the dollies restrain the pipe against forward movement at either side of the shoe.

Referring now to the view of the bending machine parts shown in Fig. 5, the cylinder **10** and the head **12** are the principal structural members upon which the guide rods **13** and **14** are slidably retracted after these rods have been threadedly disengaged from a shoe. Frame tension members **19** and **20**, for each of the upper and lower tension members, to extend between bolts **65** and **66** are shown at the right in disassembled relation. The upper two wing frame members **15—16** are shown in folded relation as they are positioned after being pivotally moved rearwardly about pivot bolts **57**. It will be understood that the lower pair of wing frame members **17** and **18** are similarly folded and are in position below the wing frame members **15—16**. Dolly assemblies **21** and **22** are shown at the left of the folded and retracted parts in Fig. 5, and at the left of the dollies two different sizes of bending shoes are shown. The larger bending shoe **25** is the same one shown in Figs. 1 and 2 whereas an additional shoe **85** is for a smaller size pipe or bar.

To set up the disassembled apparatus shown in Fig. 5, the two lower wing frame members **17** and **18** are rotated respectively outwardly with reference to the cylinder **10** until they assume a position approximately coincidental with the angular position of the upper wing frame members shown in Fig. 2. Then the base frame **23** shown at the lower portion of Fig. 5 is turned 90 degrees counterclockwise and the frame straps **35** and **36** are slidably positioned in the ways **42** and **43** as shown in Fig. 4. Two of the tension members **19—20** are then assembled to make one long tension member extending between bolts **65** and **66** on the underside of the lower wing frame members, and when in position, this lower tension member is located just rearwardly of the U-shaped shoe slide **41** (see Fig. 3). The particular shoe **25**, **85** or shoe of whatever size is to be used for the particular bending operation, is then laid on the upper margins of the shoe slide **41** and the guide rods **13—14** are manually brought forward slidably in the tubular elements **45** and **46** so that they may be rotatably threadedly engaged in the threaded connections **47** and **48** at the rear of the shoe. Assuming that the shoe and the guide rods of the ram are in their rearward positions, the pipe or bar to be bent may now be laid against and tangentially of the shoe and supported by the lower wing frame members **17** and **18**. The upper wing frame members **15** and **16** may then be swung about their respective pivot bolts **57** into the position shown in Figs. 1 or 2 whereupon tension pins **60** may be placed in their respective pintle tubes for the upper and lower wing frame members. The other pair of tension members **19—20** may then be assembled and installed as shown in Figs. 1 and 2.

The dollies **21** and **22** may now be installed between the upper and lower wing frame members as shown in Fig. 1 so that their respective pins **82** may be extended through the upper wing frame members, through the dollies, and through the lower wing frame members in readiness to receive the thrust of the pipe against the respective rollers **76** and **77** of each dolly.

Only general reference has thus far been made to the pump apparatus **26** shown in Fig. 1. This apparatus includes a motor **86**, a hydraulic pump and sump shown only in box-like configuration at **87** and a drive between the motor and pump and shown diagrammatically in the housing **88**. The output of the pump in the housing **87** may alternatively be directed into the tube **89** to thrust the ram forwardly or through tube **90** to thrust the ram rearwardly. When pressure is directed in one or the other of pipe **89** or **90**, the other of said pipes serves as an exhaust or relief pipe to carry fluid back to the sump in housing **87** in a manner well known in the art of hydraulic cylinder and ram operation.

A pipe bending operation is carried on with a minimum of upward, downward or lateral movement of shoe **25**. Heretofore, shoes mounted merely upon the end of ram **11** without benefit of directional assistance from such guide rods as **13** and **14** necessarily placed upon the ram a great deal of bending strain. Actually, the pipe or rod to be bent was the only assistance directionally for the ram **11**, but in the instant apparatus, the guide rods **13** and **14**, the spaced rollers and the dollies and the top margins of the U frame **41** combine to provide straight line operation of the shoe in a bending operation.

Emphasis has been laid in this description upon the guide rods, spaced rollers and dollies, and the guiding of the shoe provided by the top margins of the U frame. The reason for this is that a startling minimum of power is found to be necessary in carrying out a bending operation in the described bending machine. In the bending of an 8" O.D. steel pipe having 7/16" wall thickness, it has been found that hydraulic pressure in the cylinder **10** does not exceed 4500 pounds pressure. In any other known types of bending machines, a similar 90 degree bend of a 4" O.D. pipe would require at least this much hydraulic pressure. It is believed that an important contribution to this startling result in the use of the instant bending machine resides in the directional mounting of the shoe and the relationship of the spool shaped rollers in the dollies so positioned as to assist in guiding the bending operation and lessening the lateral bending moment applied to the ram.

I claim:

1. A bending machine comprising a cylinder having a head with a ram opening, said head having laterally extending spaced top and bottom plates, guide elements on said head spaced from said ram opening and positioned between said top and bottom plates, a ram operatively mounted in said cylinder and extending through said ram opening, guide rods slidably mounted in said guide elements and parallel to said ram, a bending shoe mounted on the ends of said guide rods whereby said bending shoe is guided in its motion toward and away from said cylinder, there being a relatively loose connection between said shoe and said ram, wing frame members secured to said top and bottom plates, and rollers carried by and between said wing frame members and positioned beyond the ends of said bending shoe whereby said rollers and said bending shoe mounted on said guide rods prevent bending strain from being placed on said ram during the bending of a work piece.

2. A bending machine having a forwardly and rearwardly movable arcuate shoe and actuator therefor, said actuator including a head having upper and lower plates, a pair of wing frame members pivotally mounted against each plate, the pairs being pivotally swingable from a retracted position adjacent the actuator to a forward divergent relationship, said paired wing frame member-

having pintle tubes near their pivoted ends mateably aligned and in contiguity in said divergent relationship, a pin in said tubes to prevent rearward motion, a tension member extending between the other ends of said wing frame consisting of two parts each having splice plates and spacer blocks held in contact by assembly bolts, and means adjacent the ends of said wing frame members remote from their pivot mountings to restrain a work piece against forward movement, said shoe being aligned for forward movement against the restrained work piece.

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