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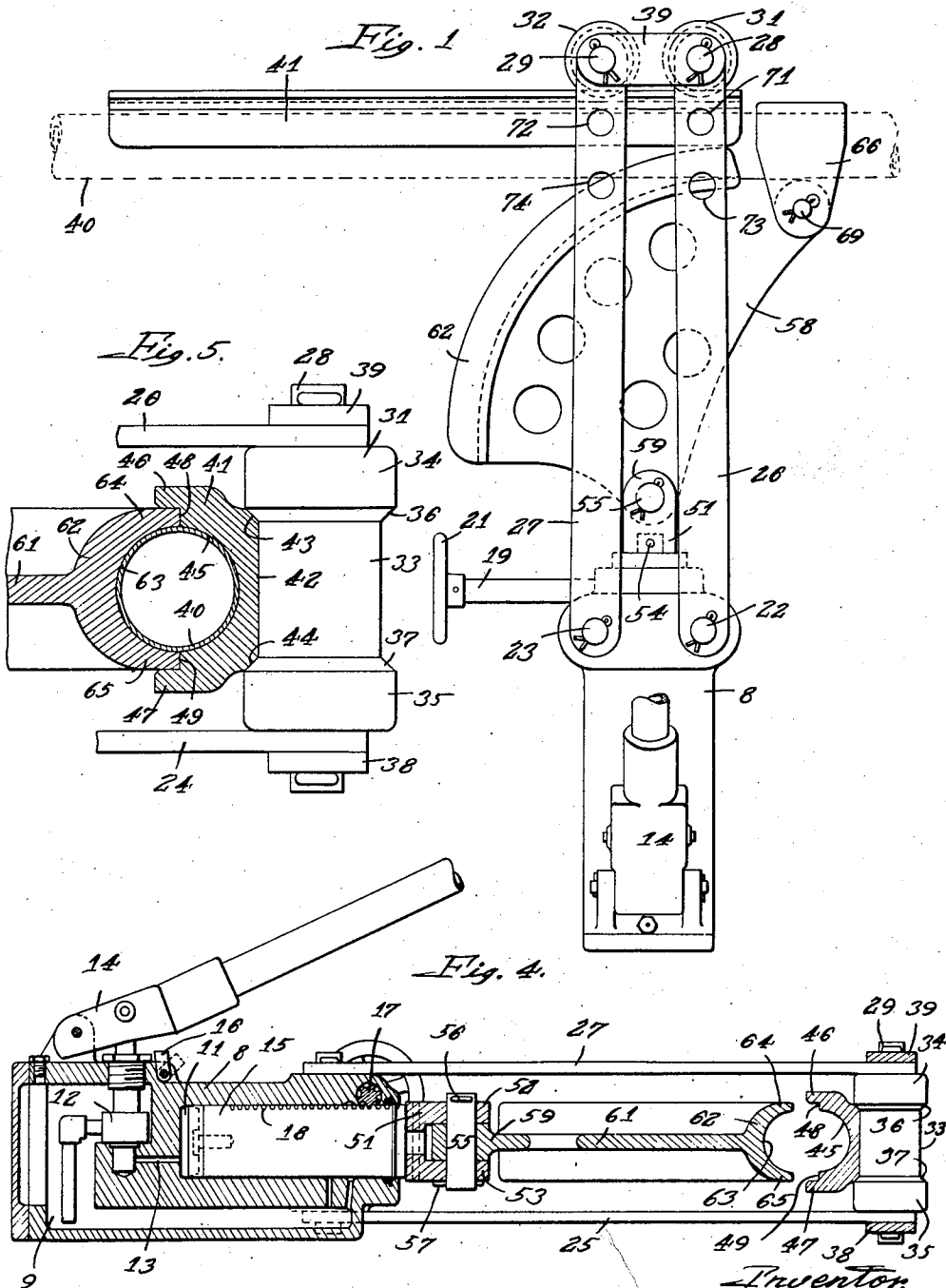
J. H. ABRAMSON ET AL

1,935,604

TUBE BENDER

Filed June 17, 1931

2 Sheets-Sheet. 1



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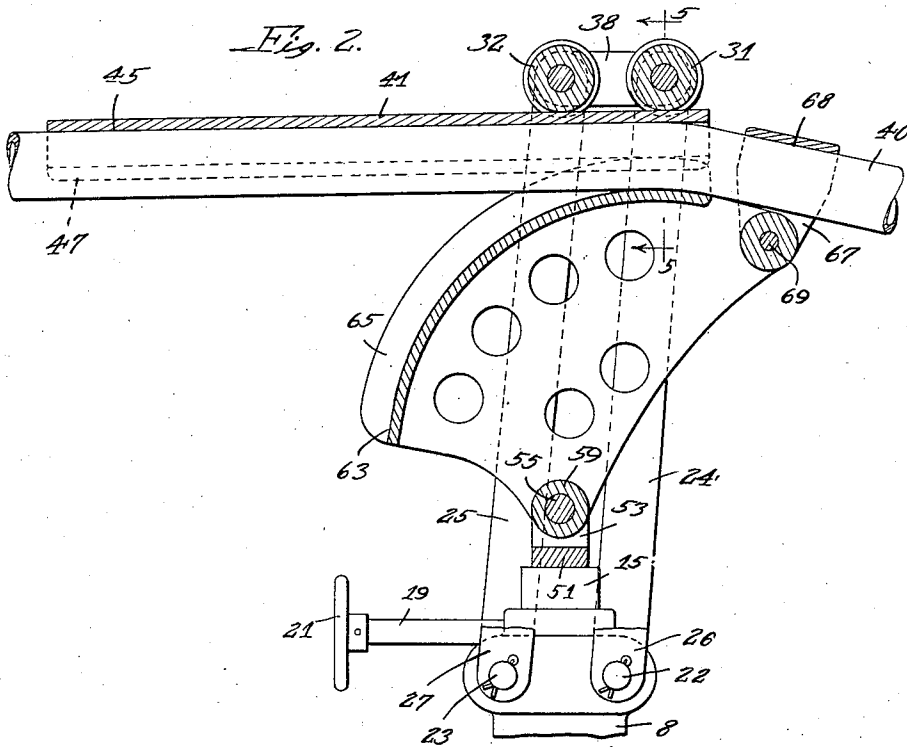
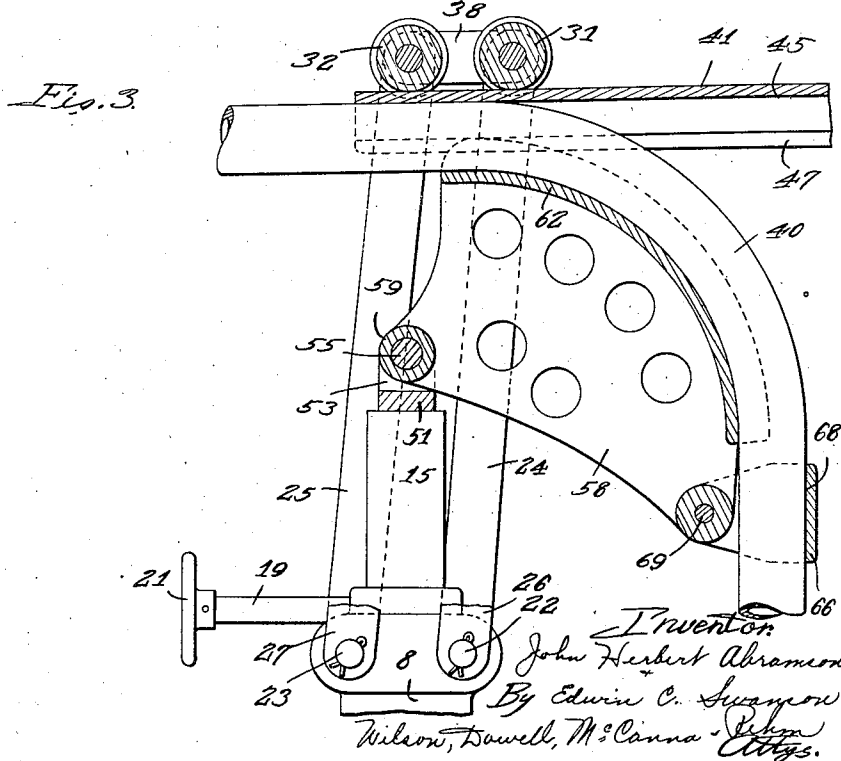
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UNITED STATES PATENT OFFICE

1,935,604

TUBE BENDER

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Application June 17, 1931. Serial No. 544,992

19 Claims. (Cl. 153—40)

This invention relates to tube benders and has special reference to a portable device for bending thin walled metal tubes such as those employed for electrical conduit pipes.

5 Considerable difficulty has been experienced in the past in bending thin walled tubes at the point of installation. Machines are known with which the bending of this type of tubes may be satisfactorily accomplished but these are large machines incapable of being transported about on the job at which the tubes must be installed. In the construction of large buildings this means a great deal of lost time while the workman is going between the point of installation of the conduit and the bender, sometimes requiring the workman to go from the twentieth or thirtieth floor to the basement to put a bend in a piece of conduit tube. On the other hand, many of the large machines are found to be incapable of properly bending very thin walled tubes, such as will come into use for conduits with the development of satisfactory device for bending them at their point of use. Such a device must be capable of producing a smooth even bend without undesirably distorting or materially flattening the tube.

10 We have therefore aimed to provide a portable tube bender capable of bending thin walled metal tubes having means for simultaneously compressing the tube and bending it in the compressed area.

Another object of the invention is the provision of a bender which may be rapidly and conveniently altered to accommodate tubes of various sizes.

15 A further object of the invention is the provision of a bender having a member provided with a tube holding surface, a member provided with an arcuate tube receiving surface and means for bringing the two surfaces together in a manner such as to roll the tube against and to the curvature of the arcuate surface.

20 A still further object of the invention is the provision of a hydraulically driven bender having a laterally movable follow bar adapted to receive a tube, a tube shoe having an arcuate surface cooperable therewith, and a hydraulic piston pivotally secured to the tube shoe for driving it in bending a tube.

Other objects and attendant advantages will become apparent to those skilled in the art from the following description and the accompanying drawings in which—

25 Figure 1 is a top view of the bender with the parts in the position they occupy when the tube is inserted for bending;

Fig. 2 is a top view partly in section showing the position of the parts shortly after the bending operation has begun;

Fig. 3 is a view similar to Fig. 2 showing the position of the parts at the completion of the bending operation;

Fig. 4 is a vertical longitudinal section through the bender; and

Fig. 5 is a section on the line 5—5 of Fig. 2, showing the manner in which the tube is held from undesirable distortion during the bending operation.

In a general way the invention contemplates the provision of a follow bar having a surface depression adapted to partially receive a tube to be bent, a tube shoe having an arcuate surface provided with a depression adapted to cooperate with the follow bar in circumferentially enclosing the tube, means for limiting the longitudinal movement of the follow bar while permitting lateral movement thereof, and means for supporting and moving the tube shoe against the follow bar to move the follow bar laterally and move the tube against the arcuate depression in the tube shoe, whereby a uniform and smooth bend is formed in the tube.

While any suitable or desired driving means may be employed, we have shown in this instance a hydraulic device substantially similar to that shown in our copending application, Serial No. 466,094, filed July 7, 1930, wherein a body 8 is arranged to provide a well 9 and a cylinder chamber 11. An injector 12 is positioned in the body to transfer fluid from the well 9 to the cylinder chamber 11 through a channel 13 through oscillatory movement of an injector lever 14, thereby moving a piston 15 outward in a power stroke. As described in the aforesaid application, a stop 16 normally limits the downward movement of the injector lever 14 during the injection of fluid into the cylinder chamber 11 but may be moved to the dotted line position shown in Fig. 4 to permit the lever to move downward beyond its normal stroke whereby the fluid is released from the cylinder chamber 11 through the channel 13. A pinion 17 is positioned in the body 8 and is adapted to engage teeth 18 on the piston 15 whereby to permit the piston to be easily retracted into the cylinder chamber. The pinion 17 is fixed to a shaft 19 having a hand wheel 21 to permit the manual rotation of the pinion 17 in retracting the piston.

Pins 22 and 23 are positioned in the body 8 at opposite sides thereof and serve to support links 24 and 25 against the bottom side of the body 10

and links 26 and 27 against the upper side of the body 10 to provide vertically spaced pairs of links. Pins 28 and 29 are positioned in the opposite ends of the links 24, 25, 26 and 27, the pin 28 connecting links 24 and 26 and the pin 29 connecting links 25 and 27. Backing members comprising rollers 31 and 32, are rotatably positioned upon the pins 28 and 29 between the links 24 and 26 and the links 25 and 27, each of these rollers having a central face 33 of smaller diameter than the remainder of the roller and end shoulders 34 and 35, inclined faces 36 and 37 connecting the shoulders 34 and 35 with the face 33. It is advisable, though not essential, that cross-links 38 and 39 be provided to connect the pins 28 and 29. These links may advantageously be placed against the outer faces of the links 24 and 25 and the links 26 and 27 respectively. We have found it to be advisable to arrange these links so as to hold the pins 28 and 29 in slightly closer proximity than the pins 22 and 23 so that the links 24 and 26 and the links 25 and 27 will converge slightly toward the pins 28 and 29 for a purpose presently to be set forth.

A follow bar designated generally by the numeral 41 is provided with a flat back 42 adapted to bear against the face 33 of the rollers 31 and 32 and sloping marginal faces 43 and 44 adapted to bear against faces 36 and 37, the cooperating faces serving to accurately position the follow bar when forced against the rollers 31 and 32. The forward side of the follow bar is provided with a semicircular depression 45 of curvature substantially similar to that of the tube 40 to be bent and with outwardly projecting side edges 46 and 47. Shoulders 48 and 49 are provided on the edges 46 and 47 to provide a guide and stop for a tube shoe presently to be described.

A yoke 51 having ears 52 and 53 is secured to the outer end of the piston 15 by means of a pin 54. A pin 55 extends between the ears 52 and 53 and is maintained therein by means of cotter pins 56 and 57. The pin 55 serves to rotatably support a tube shoe designated generally by the numeral 58. This consists of a bearing portion 59 adapted to rotatably receive the pin 55, a web portion 61 and an arcuate side 62 constituting a tube receiving and forming portion. The tube shoe constitutes a segment of a disk into which the bearing portion 59 is eccentrically positioned and in which the arcuate side 62 constitutes a portion of the periphery. The side 62 is provided with a semicircular depression 63 of curvature substantially similar to the tube to be bent and with outwardly projecting side edges 64 and 65 adapted to be received between the side edges 46 and 47 of the follow bar and bear against the shoulders 48 and 49 thereof in which position the semicircular faces 45 of the follow bar and 63 of the tube shoe cooperate to form a circle. This circle is adapted to be slightly smaller than the outside circumference of the tube 40, whereby the tube is placed under compression by bringing the edges 64 and 65 of the tube shoe against the shoulders 48 and 49 of the follow bar. It will be seen, however, that since the side 62 and the edges 64 and 65 are arcuate in shape the tube will be compressed throughout only a small portion of its length, since the edges 64 and 65 of the shoulders 48 and 49 are in contact at only a single point.

A tube saddle 66 is positioned on the tube shoe 58 slightly beyond the forward end of the arcuate side 62. This consists of a block having an opening 67 for receiving the tube 40 and an ar-

uate inner face 68 adapted to bear against the tube 40. The saddle is pivotally secured to the tube shoe by means of a pin 69 passing there-through. The pivotal support causes the face 68 to frictionally engage the side of the tube when the tube saddle 58 is moved to produce a bending movement on the tube against the follow bar.

In order to permit tubes of various sizes to be bent with the device, auxiliary tube shoes and follow bars having the desired curvatures at 63 and at 45 are provided with the device. When tubes of small diameter are to be bent it may be necessary to bring the backing members 31 and 32 closer to the body 8. We have, therefore, provided sets of openings 71, 72, 73 and 74 to receive the pins 28 and 29 to permit the backing members to be positioned at varying distances from the body 8.

One of the primary objects of the invention has been to produce a device of simple operation and accurate results. In order to produce a bend in a tube it is merely necessary for the operator to bring the parts into the position shown in Fig. 1 and insert the tube as shown in dotted lines in this figure. It will be seen that the tube may be inserted through the saddle 66 as far as may be desired, which permits the bend to be placed at any required point in a length of tubing. The injector handle 14 is then reciprocated whereby the tube shoe 58 is brought into contact with the follow bar 41, compressing the tube therebetween. As reciprocation of the handle 14 continues, the tube shoe will be brought against the follow bar with greater force causing the latter to roll laterally toward the right facing Fig. 1, because of the tendency of the tube shoe to rotate about the pin 55 as a result of its eccentric position. This tendency is further increased by the position of the pins 28 and 29, in closer proximity than the pins 22 and 23 since thereby the links 24, 25, 26 and 27 are swung to the right facing Fig. 1 as shown in Fig. 2 and 3 by the rotation tendency of the tube shoe. As a result of this lateral movement of the links, and because of the links 38 and 39, the pin 29 and the backing member 32 are drawn slightly closer to the body 8 while the pin 28 and the backing member 31 are drawn slightly away. As reciprocation of the handle 14 proceeds the edges 64 and 65 of the tube shoe roll along the shoulders 48 and 49 of the follow bar and the follow bar in turn rolls toward the right facing Fig. 1 on the rotatable backing members 31 and 32 until the rear end of the side 62 on the tube shoe is brought into contact with the follow bar as shown in Fig. 3, at which point the bending operation is completed. In this connection I have found it to be advisable to make the follow bar 41 somewhat longer than the distance along the arcuate side 62 so that when the parts reach the position shown in Fig. 3 the follow bar will project out beyond the rear end of the tube shoe to provide a substantial bearing for the tube.

The device is so constructed that the operation of compressing the tube and of bending are driven from the same source of power and cooperation between the two forces as to time and place is automatically brought about. The same force serves to move the follow bar along the backing members 31 and 32. Another highly advantageous characteristic of the machine is the fact that the tube is under pressure only in the area where bending is momentarily occurring. Fur-

thermore, the backing members 31 and 32 serve not only to permit the follow bar to move laterally but also act to position the follow bar and, through the follow bar, the vertical position of the tube shoe. Thus when the tube is inserted and force is applied the follow bar is maintained against the face 33 of the backing members throughout the full length of its lateral movement while the marginal edges 46 and 47 of the follow bar and hold the tube shoe in the desired position throughout the bending operation. The edges 64 and 65 of the tube shoe and the shoulders 48 and 49 of the follow bar determine the amount of compression on the tube 40 and insure that this pressure will be the same throughout the full length of the bend. Movement of the follow bar along the backing members is facilitated by placing the links 24, 25, 26 and 27 in slightly converging relation so that when pressure is applied the follow bar is slightly inclined and has a natural tendency under the force to move in the desired direction.

It will be obvious that the bend in the tube is formed more through what might be termed a rolling or molding operation than through strictly a bending operation. The tube is, in reality, rolled against the semi-circular face 63 of the tube shoe. A further distinctive feature of the device is the fact that throughout its operation the metal flows only in that very restricted portion in which the tube is under pressure between the tube shoe and the follow bar. This prevents the tube from collapsing or becoming distorted in an undesirable manner during the operation and results in a perfectly smooth, even bend in the tube. Even when very thin wall tubes are bent in this manner there is no appreciable flattening of the tube walls. As a result of this perfection and operation the device may be satisfactorily employed for bending thin wall conduit tubes which it has heretofore been impossible to bend on other than complicated and high priced machines.

While we have thus described and illustrated a specific embodiment of our invention we are aware that numerous alterations and changes may be made therein without materially departing from the spirit of the invention or the scope of the appended claims—

We claim:

1. A tube bender comprising, in combination, a laterally movable follow bar adapted to receive a tube, a tube shoe in the form of a segment adapted to meet said follow bar to peripherally completely enclose said tube, means for securing said tube in said tube shoe, and means eccentrically secured to said tube shoe to force the same against said follow bar and to roll the former along the latter to bend said tube through an arc during said rolling movement.

2. A tube bender comprising, in combination, a laterally movable follow bar, backing members for backing and positioning said follow bar, a tube shoe having an arcuate side adapted to cooperate with said follow bar to clamp a tube therebetween, means for securing said tube to said tube shoe, means eccentrically secured to said tube shoe to force the same against said follow bar whereby to roll the former along the latter and bend said tube through an arc, and a plurality of links for flexibly supporting said backing members upon said last-mentioned means.

3. A tube bender comprising, in combination, a portable driving unit having a frame and a driving member, links secured to said frame, rotat-

able backing members supported by said links in spaced relation to said frame, a follow bar adapted to bear against said backing members having a depression for receiving a tube, a tube shoe having an arcuate side provided with a depression for receiving said tube and outwardly projecting edges adapted to bear against said follow bar whereby said tube may be compressed between said follow bar and said tube shoe, means for securing said tube to said tube shoe, and pivotal means for eccentrically connecting said driving member with said tube shoe whereby to move the same along said follow bar to simultaneously compress and bend said tube.

4. In a portable tube bender the combination of a follow bar having a semicircular depression adapted to receive one side of a tube and marginal side walls provided with shoulders, a tube shoe having an arcuate side provided with a semicircular depression adapted to receive the opposite side of said tube and marginal side walls adapted to bear against said shoulders to limit the pressure on said tube, means for securing said tube to the forward end of said arcuate side, and hydraulic means eccentrically connected to said tube shoe for applying pressure to said tube shoe and rolling the marginal side walls along said shoulders, whereby said tube is rolled against said arcuate side.

5. In a tube bender the combination of a follow bar having a semicircular depression for receiving one side of a tube, a tube shoe having an arcuate side provided with a semicircular depression for receiving the opposite side of said tube, means for pressing said tube shoe against said follow bar to place a pressure on said tube, means for limiting the pressure on said tube, means for holding said tube against said tube shoe, and means for rolling said tube shoe along said follow bar to roll said tube against the arcuate side of said tube shoe to place a bend in said tube.

6. In a bender the combination of a follow bar, a tube shoe having an arcuate side adapted to bear against said follow bar to enclose and compress a limited portion of a tube held therebetween, and hydraulic means eccentrically connected to said tube shoe for progressively moving the area of compression along said tube and simultaneously bending the same to place an arcuate bend in said tube.

7. In a tube bender having a body a pair of spaced backing members comprising rotatable rollers having a bearing face, a tube forming member having a face contacting with the bearing faces, means on said rollers and said member for guiding the latter in longitudinal movement over the former, spaced links for flexibly supporting said rollers on said body, and a second tube forming member arranged to press a tube against said member to compress said tube and move said first mentioned member longitudinally to bend said tube.

8. In a bender, a tube shoe comprising, a segment having an arcuate side provided with a depression of a curvature to receive a tube to be bent, a pivotal bearing for supporting said shoe eccentrically positioned with respect to said arcuate side, means for securing said tube in said depression at one end of said arcuate side, and means for imparting straight line movement to said bearing to drive said tube shoe.

9. In a tube bender a follow bar comprising a bar having a longitudinal bearing face, a longitudinal tube receiving depression, side edges

along opposed sides of said depression, and longitudinally extending bearing and guiding shoulders at the junction of said side edges and said depression, said bearing and guiding shoulders being in a different plane from the face of said side edges.

10. In a tube bender, a follow bar comprising, a bar having a longitudinal bearing face along one side thereof, follow bar guiding faces on each side of said bearing face, a longitudinal tube receiving depression along the opposite side thereof, side edges along opposed sides of said depression, and longitudinally extending bearing and guiding shoulders at the junctions of said side edges and said depression, said guiding and bearing shoulders being in a different plane from the face of said side edges.

11. In a tube bender, a follow bar having a longitudinal tube receiving depression, a tube shoe having an arcuate tube receiving depression, means eccentrically secured to said shoe for pressing the same against said follow bar with said tube receiving depressions in registration to compress a tube therebetween, and means for holding said tube within the depression in said tube shoe, the shape and position of said tube shoe causing movement of said follow bar longitudinally to bend said tube.

12. In a portable tube bender, a body, at least one backing member supported on said body in spaced relation thereto, a follow bar positioned against said backing member and having a tube receiving depression, a tube shoe having an arcuate tube receiving depression, means on said body eccentrically connected to said tube shoe for pressing the same against said follow bar with said tube receiving depressions in registration to compress a tube therebetween, and means for holding said tube within the depression in said tube shoe, the shape and position of said tube shoe causing movement of said follow bar to bend said tube.

13. In a tube bender a follow bar having a longitudinal tube receiving depression, a tube shoe having an arcuate tube receiving depression, manually operable means eccentrically connected to said tube shoe for pressing the latter against said follow bar with said tube receiving depressions in registration to compress a tube therebetween, and means for holding said tube within the depression in said tube shoe, of the shape and position of said tube shoe causing movement of said follow bar longitudinally to bend said tube.

14. In a tube bender, a body, at least one backing member supported on said body in spaced relation thereto, a follow bar positioned against said backing member and having a tube receiving depression, a tube shoe having an arcuate tube receiving depression, manually operable hydraulic means on said body eccentrically connected to said tube shoe for pressing the same against said follow bar with said tube receiving depressions in registration to compress a tube therebetween, and means for holding said tube within the depression in said tube shoe, the shape and position of said tube shoe causing movement of said follow bar to bend said tube.

15. In a portable tube bender, a body, at least one backing member, links for supporting said backing member on said body in spaced relation thereto, a follow bar positioned against said backing member and having a tube receiving depression, a tube shoe having an arcuate tube receiving depression, means on said body eccentrically connected to said tube shoe for supporting the

same and pressing said tube shoe against said follow bar with said tube receiving depressions in registration to compress a tube therebetween, and means for holding said tube within the depression in said tube shoe, the eccentric mounting of said tube shoe and the space relation between said tube shoe, said follow bar, and said backing member causing said follow bar to move with said tube shoe and bend said tube.

16. In a tube bender, a follow bar having a tube receiving depression, a tube shoe having an arcuate tube receiving depression, means for holding a tube within the tube receiving depression of said tube shoe, a body having a cylinder chamber, means on said body for supporting said follow bar in spaced relation thereto, a piston in said cylinder chamber arranged to rotatably support said tube shoe, manually operable means for forcing fluid into said cylinder chamber to project said cylinder and press said tube shoe against said follow bar with said tube receiving depressions in registration to compress said tube therebetween and move said tube shoe along said follow bar to simultaneously compress and bend said tube.

17. A bender comprising, in combination, a body having a chamber and a reservoir, a piston in said body, manually operable means for transferring liquid from said reservoir to said chamber to project said piston, and for releasing the fluid therefrom, rack and pinion mechanism for retracting said piston, spaced links pivotally secured at one end to said body in pairs above and below said piston, a pair of backing members pivotally supported in opposed links of each pair, a tube shoe pivotally and eccentrically secured to said piston, having an arcuate side adapted to receive a tube, means thereon for securing said tube, and a follow bar between said tube shoe and said backing members against which said tube shoe is pressed by projection of said piston to compress said tube and cause said follow bar and tube shoe to move laterally with respect to said piston to roll said tube therebetween against the arcuate side of said tube shoe while under compression to bend said tube.

18. A portable tube bender comprising a hydraulic unit adapted to rest upon the floor including a body having a cylinder, a piston in said cylinder, and a manually operable means for injecting fluid into said cylinder to project said piston, a tube shoe eccentrically connected to said piston, a follow bar operably positioned with respect to said tube shoe arranged to hold a pipe to be bent, at least one backing member for supporting said follow bar, links for supporting said backing member on said body, and means for securing said pipe to said tube shoe, the parts being so positioned that projection of said piston brings about longitudinal movement of said follow bar and rotation of said tube shoe thereagainst.

19. In a tube bender, the combination of a follow bar, a pivotally supporting tube shoe having an arcuate side adapted to bear against said follow bar to enclose and compress a portion of a tube therebetween, and means for imparting straight line movement to the tube shoe at said pivotal support to progressively move the area of compression along said tube, and simultaneously bend the same to place an arcuate bend in the tube.

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