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PIPE BENDING MACHINE.  
APPLICATION FILED APR. 30, 1907.

Patented Nov. 22, 1910.

3 SHEETS—SHEET 1.

976,599.

Fig. 1,

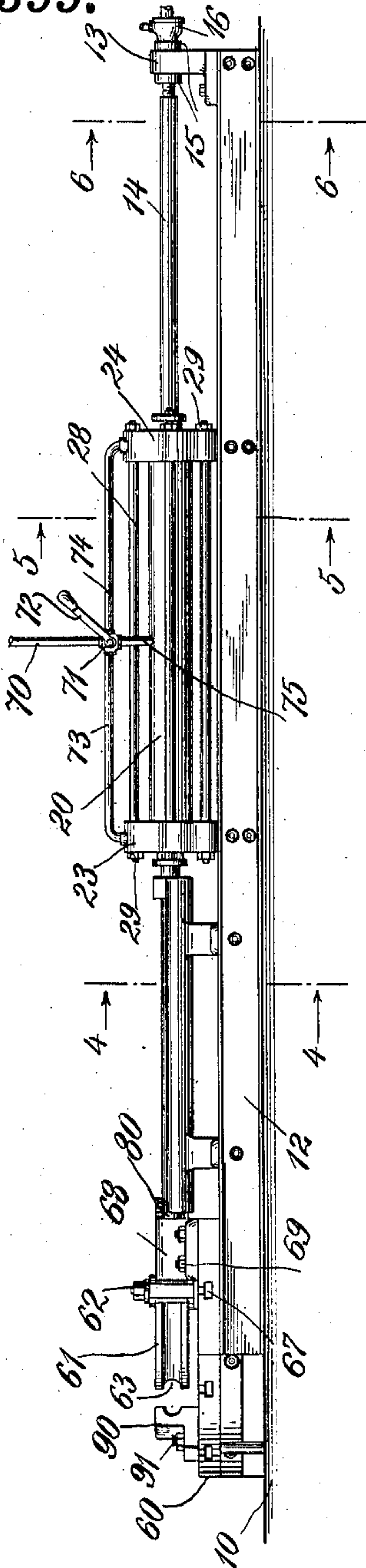
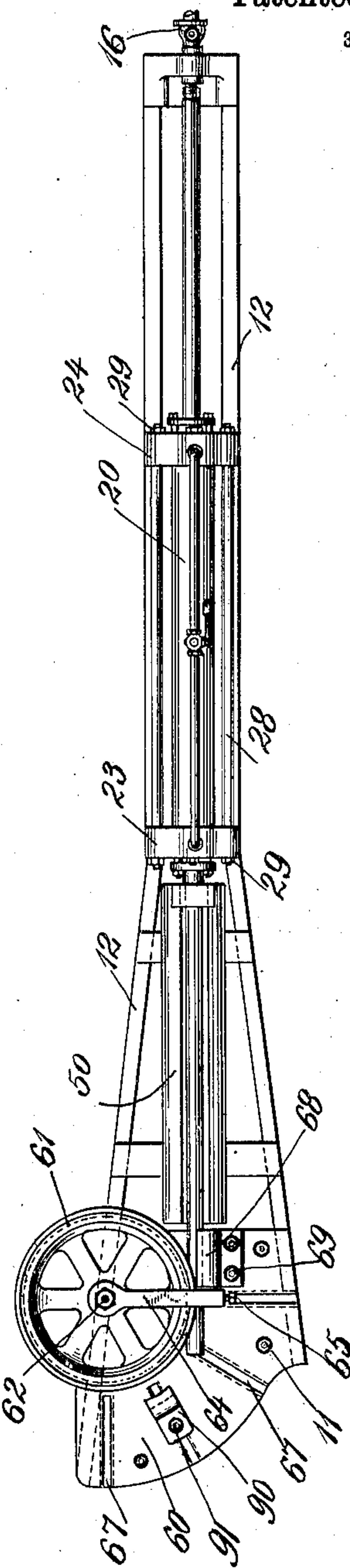


Fig. 2,



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3 SHEETS-SHEET 2.

Fig. 3,

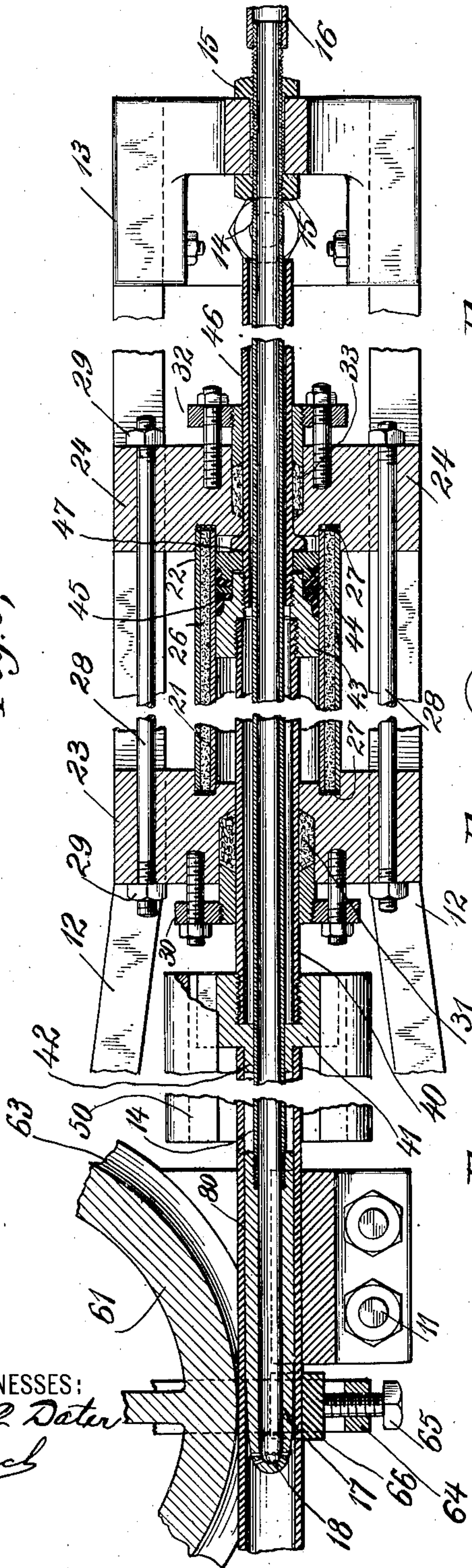


Fig. 6,

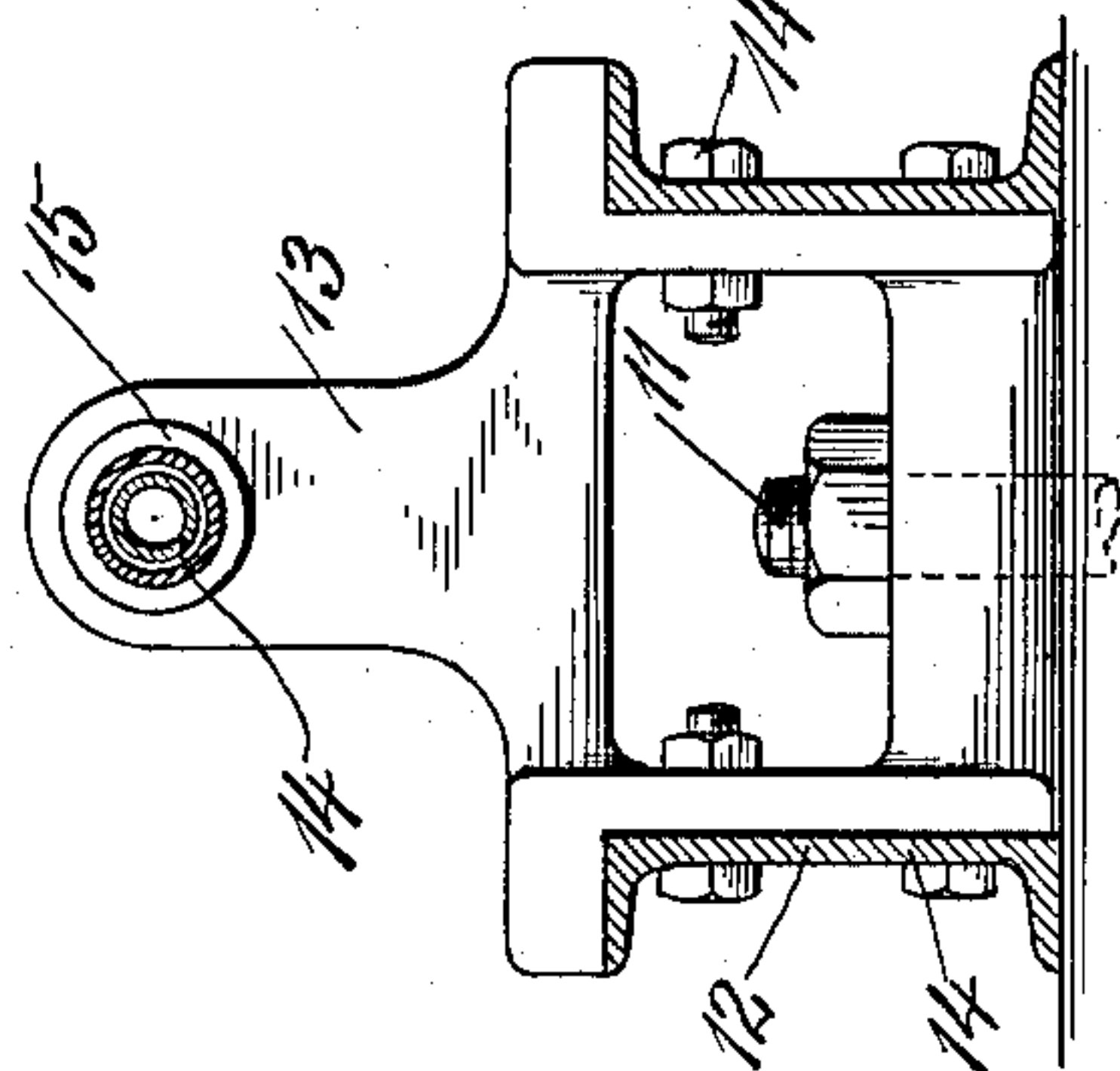


Fig. 5,

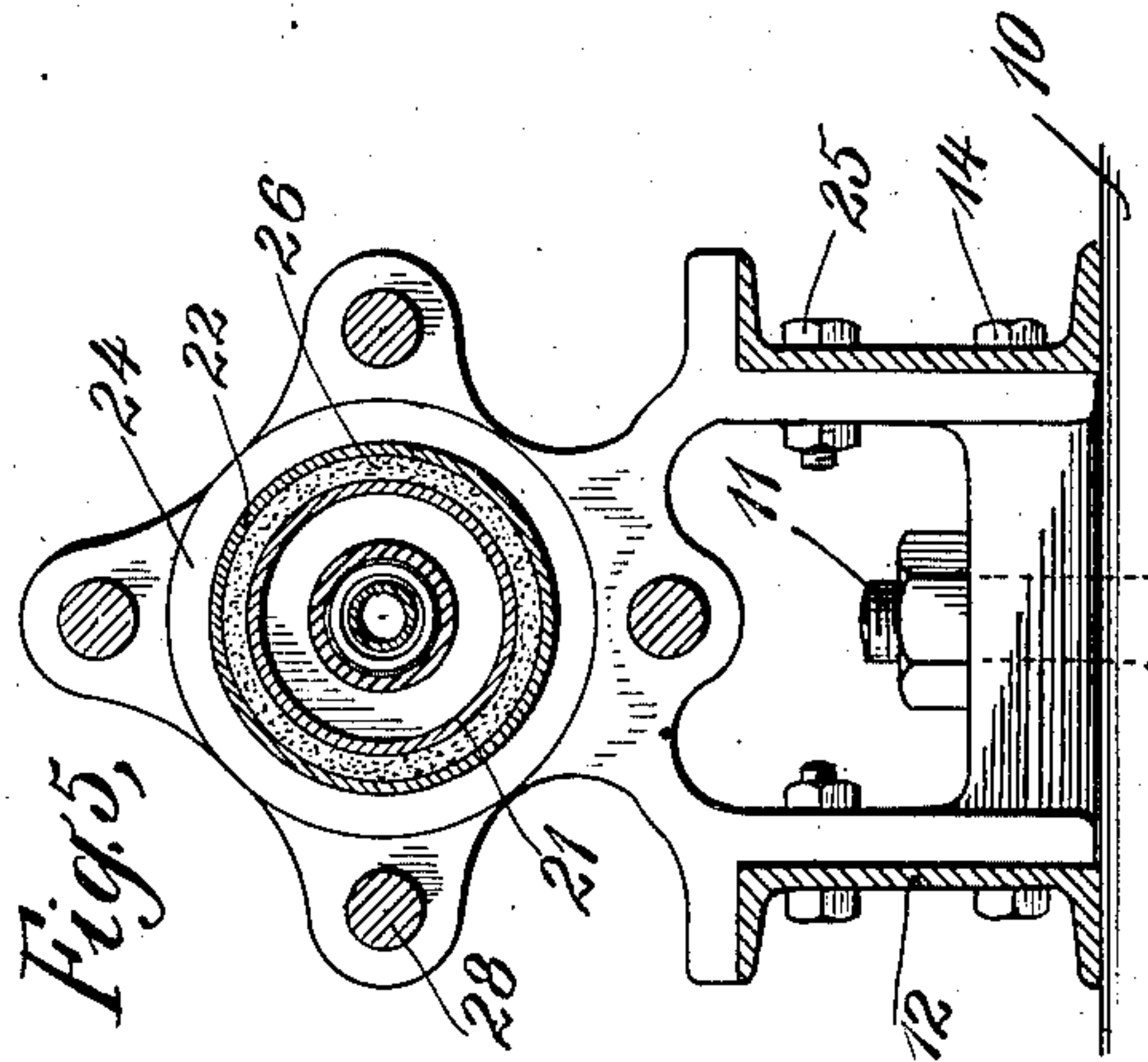
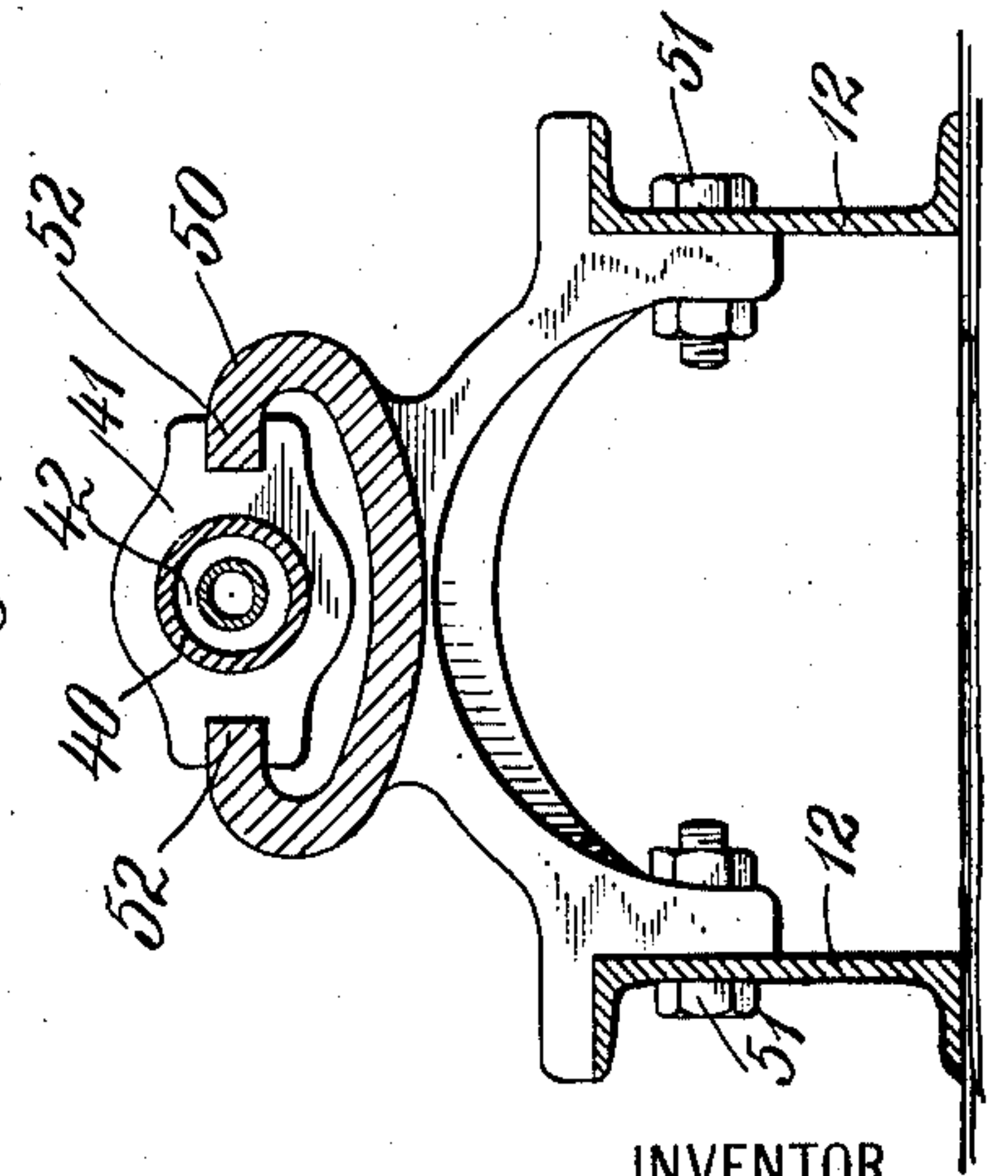


Fig. 4,



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3 SHEETS—SHEET 3.

Fig. 8,

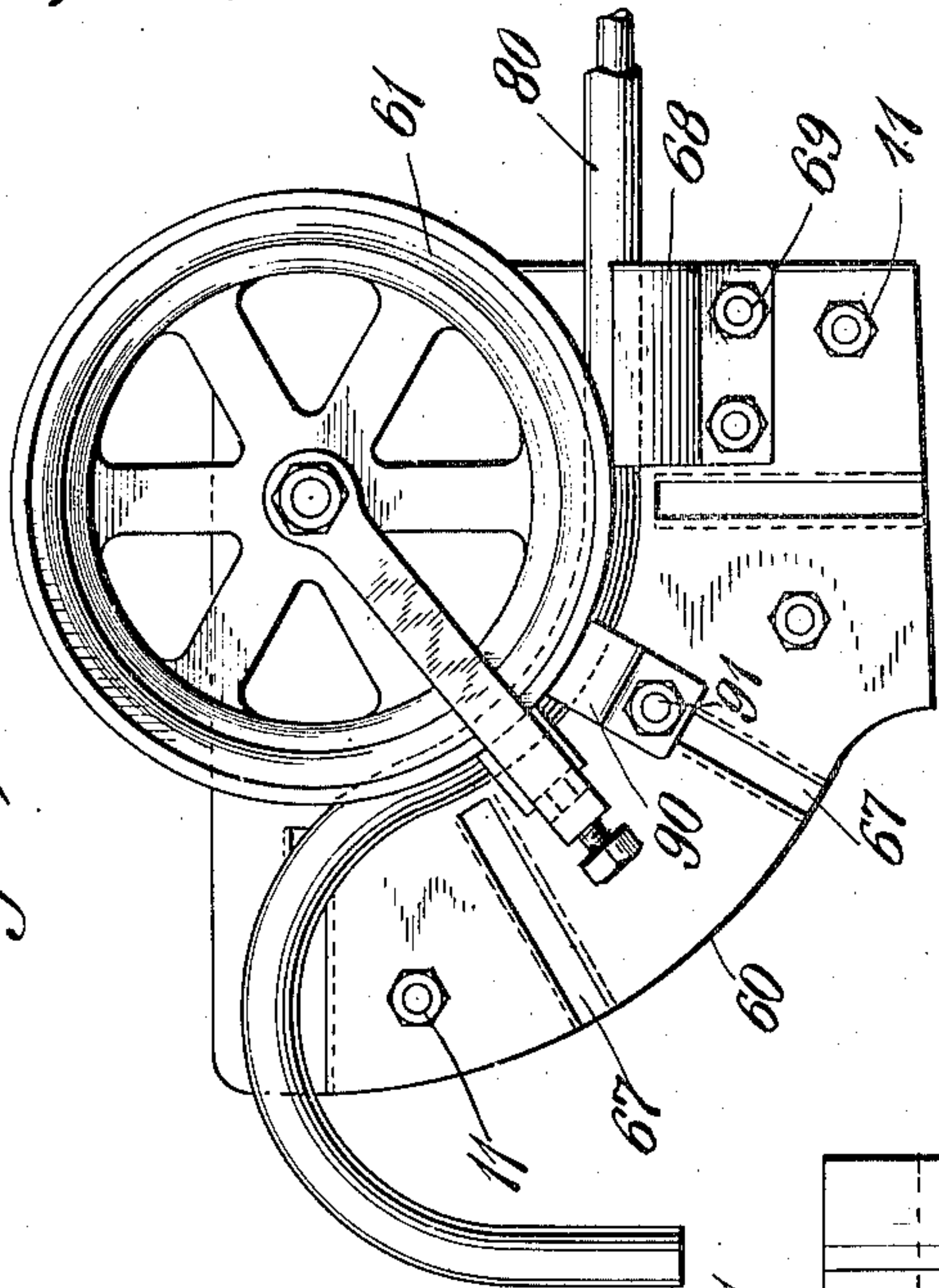


Fig. 9,

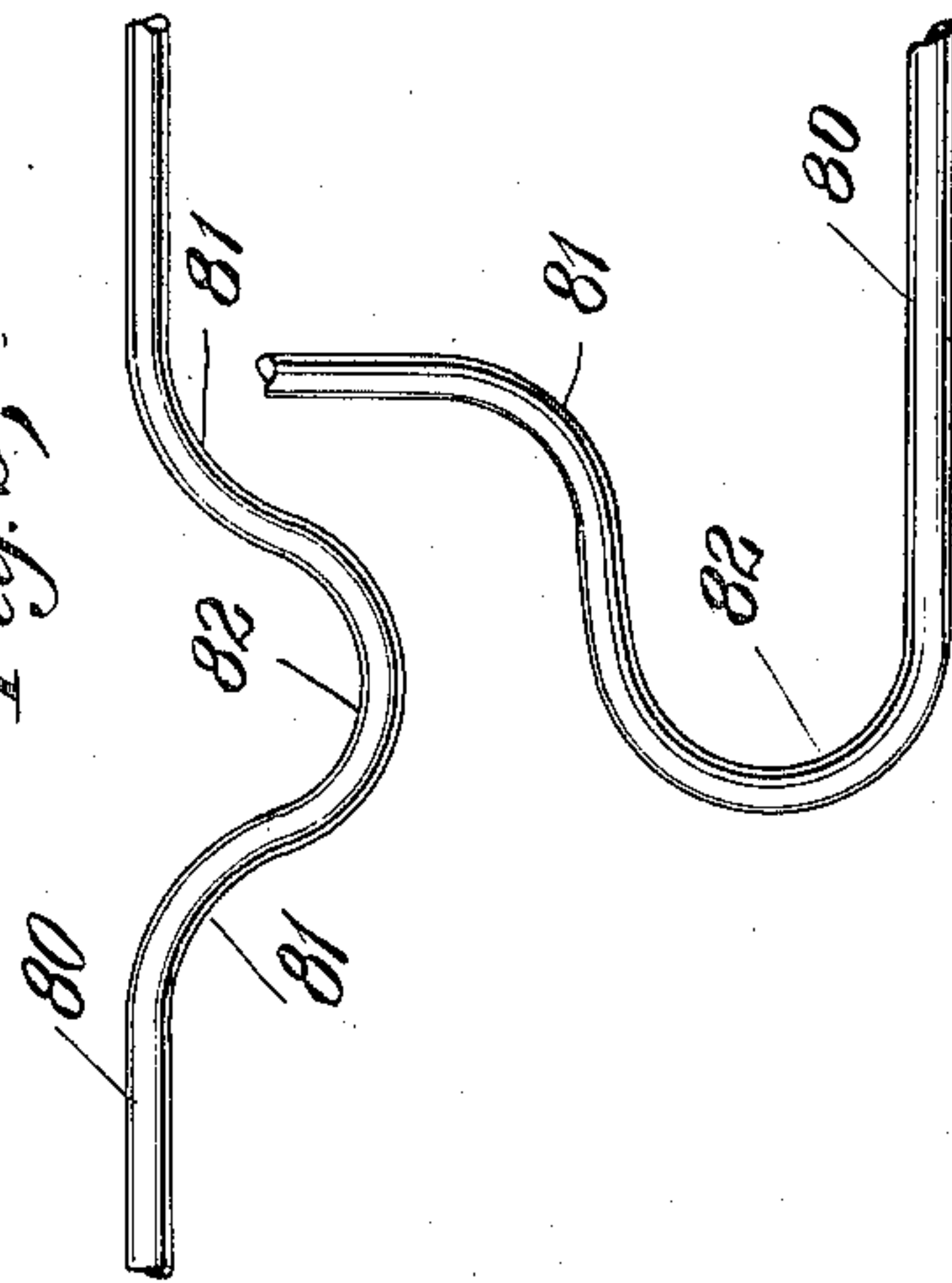
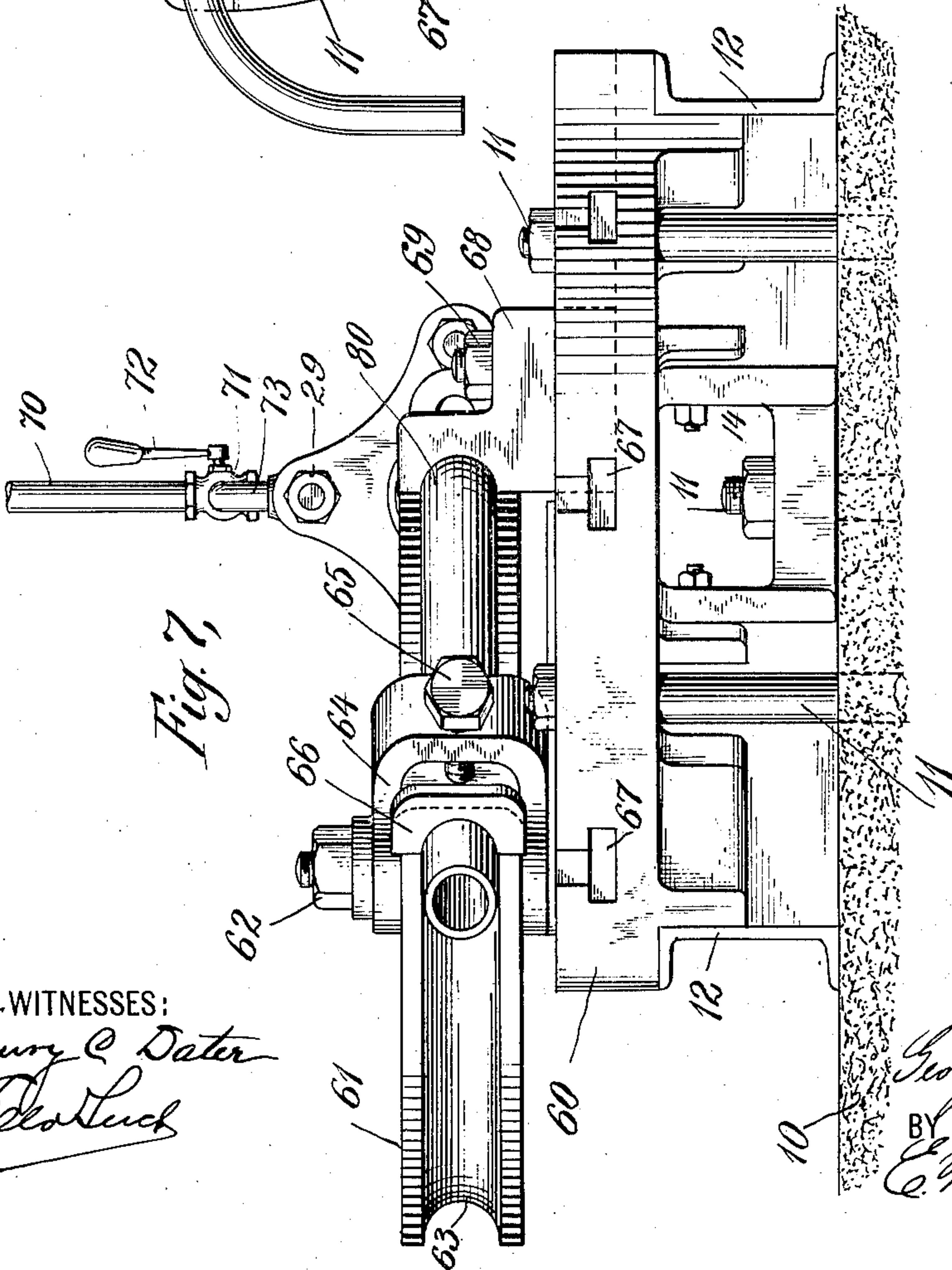


Fig. 7,



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# UNITED STATES PATENT OFFICE.

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## PIPE-BENDING MACHINE.

976,599.

Specification of Letters Patent.

Patented Nov. 22, 1910.

Application filed April 30, 1907. Serial No. 371,157.

*To all whom it may concern:*

Be it known that I, GEORGE H. REYNOLDS, a citizen of the United States, and a resident of Mansfield Depot, in the county of Tolland and State of Connecticut, United States of America, have invented certain new and useful Improvements in Pipe-Bending Machines, of which the following is a specification.

My invention relates to new and useful improvements in pipe bending machines and it consists in the construction and arrangement of parts which I will describe in the following specification and the novel features whereof I will set forth in claims.

Referring to the drawings, Figure 1 is a side elevation of a pipe bending machine made according to my invention. Fig. 2 is a plan view of the same. Fig. 3 is a sectional plan view on an enlarged scale of some of the parts of which my machine is constructed. Fig. 4 is a sectional end view of my machine, the section being taken through the line 4—4 of Fig. 1, and the view being taken in the direction of the arrows. Figs. 5 and 6 are similar end views, the sections being taken through the lines 5—5 and 6—6, respectively, of Fig. 1. These Figs. 4, 5 and 6 are on a larger scale than used in Fig. 1 through which the sections are taken. Fig. 7 is an end elevation of my pipe bending machine showing a portion of a pipe as it appears during the process of being bent. Fig. 8 is a plan view of a portion of my machine and a pipe showing the relative positions of these parts while the pipe is being bent. Fig. 9 is a plan view of two portions of pipe illustrating some of the work which may be done upon pipe with my improved apparatus.

Like characters of reference designate corresponding parts in all of the figures.

10 designates a foundation base or floor of concrete or other suitable material upon which the apparatus may be supported and to which it may be secured by means of foundation bolts 11.

12, 12 designate channel-irons placed upon the foundation, and these channel-irons form a frame upon which the various parts of the apparatus are mounted and by which they are connected.

13 designates a tail-bracket which is attached to the channel-irons 12, 12 and which

may be secured to the floor by one of the foundation bolts 11. A hole is provided in the upper end of this tail-bracket for the reception of a pipe 14, the end of which is threaded and is secured to the tail-bracket by means of nuts 15, 15. A mixing valve 16 is screwed onto the back end of the pipe 14. To the other end of this pipe a supporting plug 17 is attached, and burner holes 18 are provided in the end of the supporting plug.

20 designates a cylinder of special construction which I will now describe. It comprises a lining 21 preferably of brass or other non-corrosive metal and an outer shell 22 which may be of steel or other suitable material.

23 designates the front cylinder head and 24 the back cylinder head. These cylinder heads may be castings constructed and arranged, as shown in Fig. 5, to be attached to the channel-irons 12 by bolts 25, and to the floor by the foundation bolts 11. Grooves are turned in the inner surfaces of these cylinder heads, the inner diameter of which corresponds with the inner diameter of the lining 21 and the outer diameter of which corresponds with the outer diameter of the shell 22. These grooves serve to hold the lining 21 and the shell 22 in proper position with their axes in common. The annular space formed between the lining 21 and the shell 22 may be filled with a non-compressible material 26 such, for example, as resin which may be poured into the space in a molten condition and then allowed to harden. It is preferable, also, to have this filling material a non-conductor of heat.

Packing rings 27, 27 are placed at the bottom of the grooves of the cylinder heads, and the heads are securely held together and made to force the lining and shell against the packing ring 27 by means of tie-bolts 28 and nuts 29.

A stuffing-box 30 of ordinary construction may be placed in the front cylinder head and arranged to hold a packing 31 in the desired position. A similar stuffing-box 32 may be placed in the back cylinder head 24 and arranged to hold a packing 33 in the desired position.

40 designates a hollow piston-rod, the outer end of which is threaded and arranged to carry a cross-head 41 which may be



screwed onto the threaded portion of the piston-rod 40. The forward end 42 of this cross-head is circular in form and of a diameter corresponding with that of the inside of a pipe which is to be acted upon by this apparatus. The piston-rod 40 is arranged to pass through the packing 31 and the front cylinder head 23 into the cylinder 20. The inner end of this piston-rod is also threaded and the main portion 43 of a piston is securely attached thereto. This piston also comprises a secondary member 44 between which and the main portion 43 a packing 45 of desired material and form may be placed.

46 designates a tail-piece, the inner end of which is threaded into the inside of the main portion 43 of the piston. This tail-piece is provided with a shoulder 47 which is adapted to engage with the secondary member 44 of the piston to force the latter forward toward the main portion of the piston and to thereby support and maintain the packing 45 in compression. The rear end of the tail-piece 46 is arranged to pass through the back cylinder head and the packing 33 and is made hollow to allow it to pass freely over the pipe 14.

50 designates a stationary horizontal guiding member which is constructed as shown in Fig. 4 to fit over and to be attached to the channel-irons 12 by means of bolts 51. This guiding member 50 is arranged to form horizontal guides 52 over which grooves in the cross-head 41 are fitted so that the latter is supported by the guides but allowed to move horizontally along them.

60 designates a base-plate which is securely attached to the foundation or floor 10 by means of foundation bolts 11 and to the channel-irons 12. A forming sheave 61 is connected with this base-plate by means of a pivot 62. The outer periphery of the forming sheave is constructed to form a semicircular groove 63 which is approximately of the diameter of the pipe operated upon by this apparatus. The radius of the wheel itself is approximately equal to the radius of the desired curve into which the pipe is to be bent.

64 designates a strap, the ends of which are arranged to fit over the pivot 62 at either side of the hub of the forming sheave 61. A clamping screw 65 is fitted into the end of this strap and arranged to coact with a clamping dog 66.

Inverted T-grooves 67, 67 are provided in the base-plate 60 radially disposed about the pivot 62. A supporting and guiding block 68 is securely attached to the base-plate 60 by means of bolts 69.

70 designates a water pipe from a suitable source of supply under pressure which leads to a four-way valve 71. This valve is arranged to be operated by a hand lever 72

and is connected with the front end of cylinder 20 by a pipe 73 and with the back end of the cylinder by a pipe 74.

75 is an exhaust pipe connected with valve 71.

It may be seen that by this arrangement water may be admitted to the front end of the cylinder 20 and the rear end of cylinder 20 at the same time connected with the exhaust pipe 75, or vice-versa.

80 designates a pipe to be acted upon by this apparatus.

In operating this device the pipe 80 is slipped over the guiding supporting plug 17, which is slightly smaller in diameter than the inside of the pipe, and pushed back until one end abuts the shoulder of the cross-head 41. The pipe will then be placed between the groove 63 of the forming sheave and a similar groove in the guiding block 68. The clamping dog 66 is then placed within the strap 64 and forced down against the pipe by means of the clamping screw 65 so that the pipe is thereby securely clamped to the forming sheave 61 at the point opposite the strap 64. The inner surface of the clamping dog is also grooved to fit the pipe 80. A mixture of gas and air may then be admitted through the mixing valve 16 and the pipe 14 and this mixture may be lighted at the openings 18 within the pipe 80. The portion of the pipe which surrounds the supporting plug 17 will thereby become heated.

Hydraulic pressure is then admitted to the rear end of cylinder 20 behind the piston and the latter is forced forward. The pipe 80 is thus pushed forward through the piston-rod 40 and the cross-head 41. The pipe is clamped to the periphery of the forming sheave 61, as I have shown, by the clamping dog 66 and the screw 65. The pipe is prevented from buckling by the guiding block 68. As the pipe is pushed forward it has to conform to the radius of the forming sheave, and in that way becomes bent into the desired curve. After the pipe has thus been moved a short distance, a guiding clamp such as 90 may be secured in one of the inverted T-grooves 67 in the base-plate and pushed up against the pipe 80 to prevent any buckling between the guiding block 68 and the point at which the pipe is clamped to the forming sheave. A plurality of T-grooves are provided and as many of these guiding clamps may be used as is found to be necessary.

If it is desired to form more than one bend in a pipe this result may be obtained by performing the operation above described until the pipe has been given a bend in one direction of as great a length as may be desired, after which the clamping screw 65 may be loosened, the strap and clamping dog returned to their original position, the pipe rotated a desired amount and again



clamped by the clamping dog and strap. The bending operation may then proceed again in the manner above described. In this way a variety of curves may be obtained in one pipe. For example, by referring to Fig. 9, it may be seen that the pipe 80 may be given two convex curves 81, 81 and one concave curve 82, or it may be given one convex curve 81 and a long concave curve 82. The pipe shown in Fig. 8 illustrates another combination of bends which may be made in one pipe by this apparatus. The pipes bent into the forms illustrated in Fig. 9 may be used for expansion pipes.

It is within the scope of this invention and needs only such mechanical skill as one versed in the art should possess to vary the curves and bends which may be made in the pipe by using this apparatus. Bends of different radii may be obtained by means of removing the forming sheave and inserting in its place one of different size. If a pipe longer than the stroke of the piston within cylinder 20 is to be acted upon, the apparatus may be arranged to provide for the insertion of an intermediate follower between the cross-head 41 and the rear end of the pipe 80.

For acting upon pipes of different diameter it is necessary to change but few of the parts of this apparatus. For example, it is in most cases necessary only to change the forming sheave 61, the supporting plug 17 and the guiding block 68 in order to make this apparatus operative for pipes of different diameters.

The process of bending a pipe by this apparatus does not subject the heated portion of the pipe to any tensional strains. On the contrary, the bending of the pipe is accomplished entirely by the pressure applied to the end of the pipe by the hydraulic cylinder and piston, and this has a tendency to compress rather than draw out the fibers of the pipe. The heating apparatus is efficient as it is arranged to apply heat directly to the point where it is needed.

What I claim is.—

1. In a pipe-bending machine, a rotatable forming sheave, means for clamping a pipe to said sheave, a hydraulic cylinder, a hollow piston within the cylinder, a hollow piston-rod and a hollow tail-piece connected with the piston, a stationary gas-pipe within the piston, piston-rod and tail-piece, said piston being arranged to move the pipe and the sheave together to bend the pipe.

2. In a pipe-bending machine, a rotatable forming sheave, means for clamping a pipe to said sheave, a hydraulic cylinder, a hollow piston within the cylinder, a hollow piston-rod and a hollow tail-piece connected with the piston, a stationary member within the piston, piston-rod and tail-piece, and a supporting-plug upon the stationary

member, said piston being arranged to move the pipe and the sheave together to bend the pipe.

3. In a pipe-bending machine, a rotatable forming sheave, means for clamping a pipe to said sheave, a hydraulic cylinder, a hollow piston within the cylinder, a hollow piston-rod and a hollow tail-piece connected with the piston, a stationary gas-pipe within the piston, piston-rod and tail-piece, a supporting-plug upon the gas-pipe, and a gas-burner on the supporting-plug, said piston being arranged to move the pipe and the sheave together to bend the pipe.

4. In a pipe-bending machine, a frame, a rotatable forming sheave associated therewith, means for clamping a pipe to said sheave, a hydraulic cylinder comprising a lining, a shell and an intermediate non-compressible filler; cylinder-heads attached to the frame, a circular groove in each of the cylinder-heads, said grooves being arranged to hold the cylinder, packing in said grooves, a plurality of tie-bolts arranged to hold the cylinder-heads and cylinder together, and a piston within the cylinder, said piston being arranged to move the pipe and the sheave together to bend the pipe.

5. In a pipe-bending machine, a frame, a rotatable forming sheave associated therewith, means for clamping a pipe to said sheave, a hydraulic cylinder comprising a lining, a shell and an intermediate non-compressible filler, cylinder-heads attached to the frame, a circular groove in each of the cylinder-heads, said grooves being arranged to hold the cylinder, packing in said grooves, a plurality of tie-bolts arranged to hold the cylinder-heads and cylinder together, a hollow piston within the cylinder, a hollow piston-rod and a hollow tail-piece connected with the piston, a stationary gas-pipe within the piston, piston rod and tail-piece, said piston being arranged to move the pipe and the sheave together to bend the pipe, a supporting-plug attached to the gas-pipe within the clamped pipe, and a gas-burner on the end of the supporting-plug.

6. In a pipe-bending machine, a frame, a base-plate, a rotatable forming sheave, a pivot therefor affixed to said base-plate, the base-plate being constructed to form T-grooves radially disposed about said pivot, a strap connected with the pivot, a clamping-dog carried by the strap, a screw in the strap arranged to clamp a pipe between the sheave and the clamping-dog, a stationary supporting-block attached to the base-plate, an adjustable guiding-clamp arranged to be held by said T-grooves, a hydraulic cylinder comprising a lining, a shell and an intermediate non-compressible filler, cylinder-heads attached to the frame and arranged to support said cylinder, a piston within the cylinder, said piston being arranged to move



the pipe and the sheave together, and a gas-burner within the pipe.

7. In a pipe-bending machine, a frame, a base-plate, a rotatable forming sheave, a pivot therefor affixed to said base-plate, the base-plate being constructed to form T-grooves radially disposed about said pivot, a strap connected with the pivot, a clamping-dog carried by the strap, a screw in the strap arranged to clamp a pipe between the sheave and the clamping-dog, a stationary supporting-block attached to the base-plate, an adjustable guiding-clamp arranged to be held in said T-grooves, a hydraulic cylinder comprising a lining, a shell and an intermediate non-compressible filler, cylinder-heads attached to the frame, a circular groove in each of the cylinder-heads, said grooves being arranged to hold the cylinder, packing in said grooves, a plurality of tie-bolts arranged to hold the cylinder-heads and cylinder together, a piston within the cylinder, said piston being arranged to move the pipe and the sheave together to bend the pipe, a valve arranged to control the movement of the piston, a supporting-plug within the pipe, a gas-burner in said supporting-plug, and a mixing-valve associated with said gas-burner.

8. In a pipe-bending machine, a frame, a base-plate, a rotatable forming sheave, a pivot therefor affixed to said base-plate, the base-plate being constructed to form T-

grooves radially disposed about said pivot, a strap connected with the pivot, a clamping-dog carried by the strap, a screw in the strap arranged to clamp a pipe within the sheave and the clamping-dog, a stationary supporting-block attached to the base-plate, an adjustable guiding-clamp arranged to be held in said T-grooves, a hydraulic cylinder comprising a lining, a shell and an intermediate non-compressible filler, cylinder-heads attached to the frame, each of the cylinder-heads being constructed to form a circular groove, packing in said grooves, said grooves being arranged to hold the cylinder-heads in position on the cylinder, a hollow piston within the cylinder, a hollow piston-rod and a hollow tail-piece connected with the piston, a stationary gas-pipe within the piston, piston-rod and tail-piece, said piston being arranged to move the pipe and sheave together to bend the pipe, a supporting-plug attached to one end of the gas-pipe within the clamped pipe, a gas-burner on the end of the supporting-plug, and a mixing-valve on the other end of said gas-pipe.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

GEORGE H. REYNOLDS.

Witnesses:

ERNEST W. MARSHALL,  
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