No. 644,294. Patented Feb. 27, 1900.

M. KENNEDY.

MACHINE FOR BENDING, FORGING, WELDING, AND SHAPING METAL.

(No Model.) (Application filed June 15, 1899.)

5 Sheets—Sheet 1.

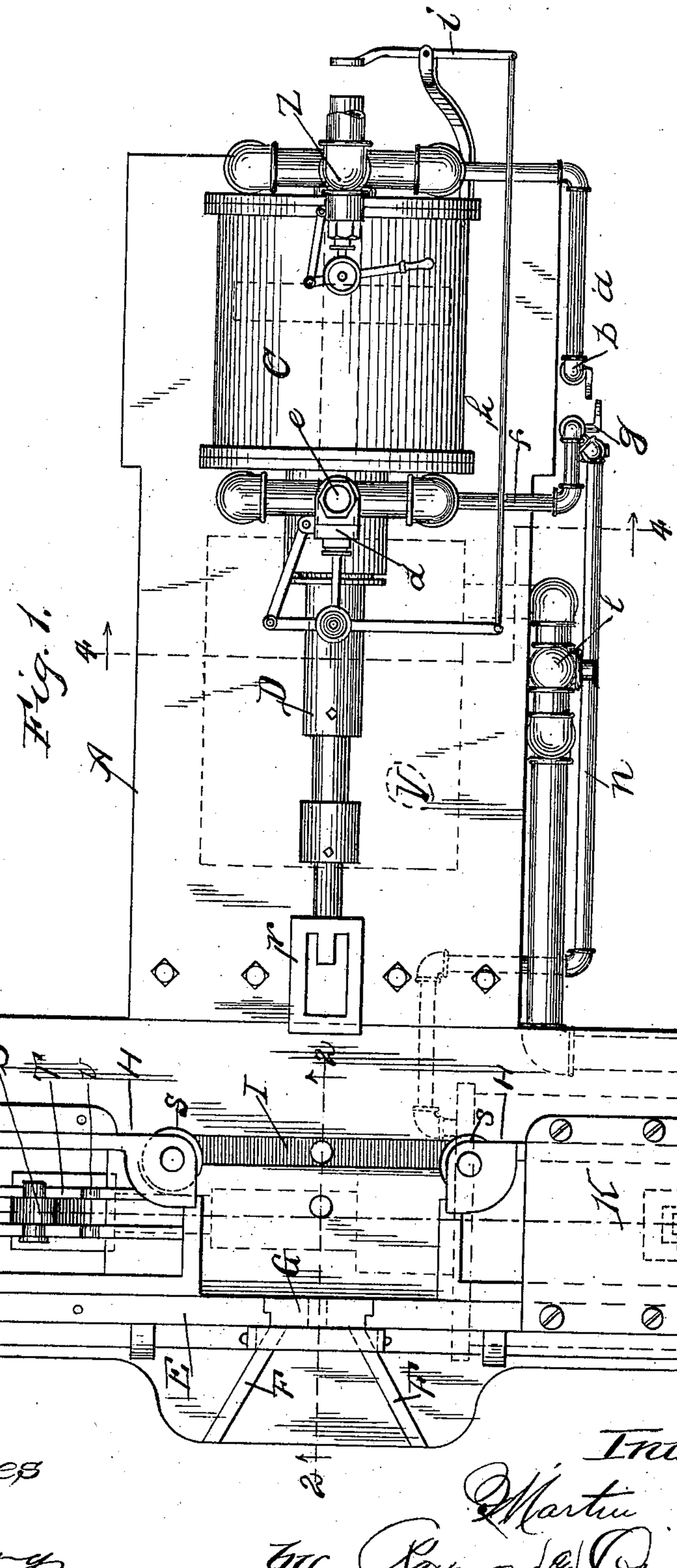

Fig. 1.

Witnesses
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No. 644,294. Patented Feb. 27, 1900.

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MACHINE FOR BENDING, FORGING, WELDING, AND SHAPING METAL.

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(No Model.) 5 Sheets—Sheet 2.

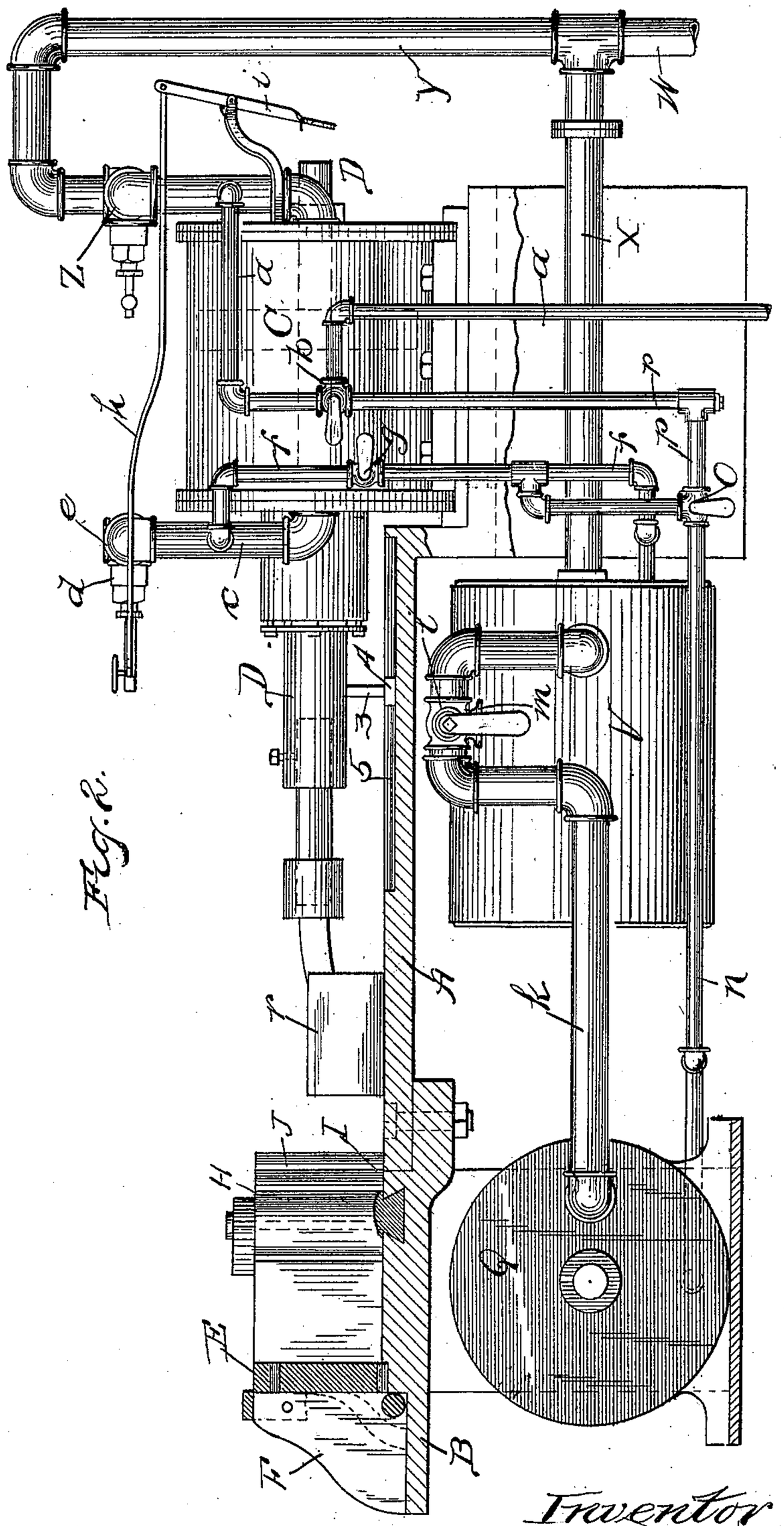

Fig. 2.

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No. 644,294. Patented Feb. 27, 1900.

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MACHINE FOR BENDING, FORGING, WELDING, AND SHAPING METAL.

(Application filed June 15, 1899.)

(No Model.) 5 Sheets—Sheet 3.

Fig. 3.

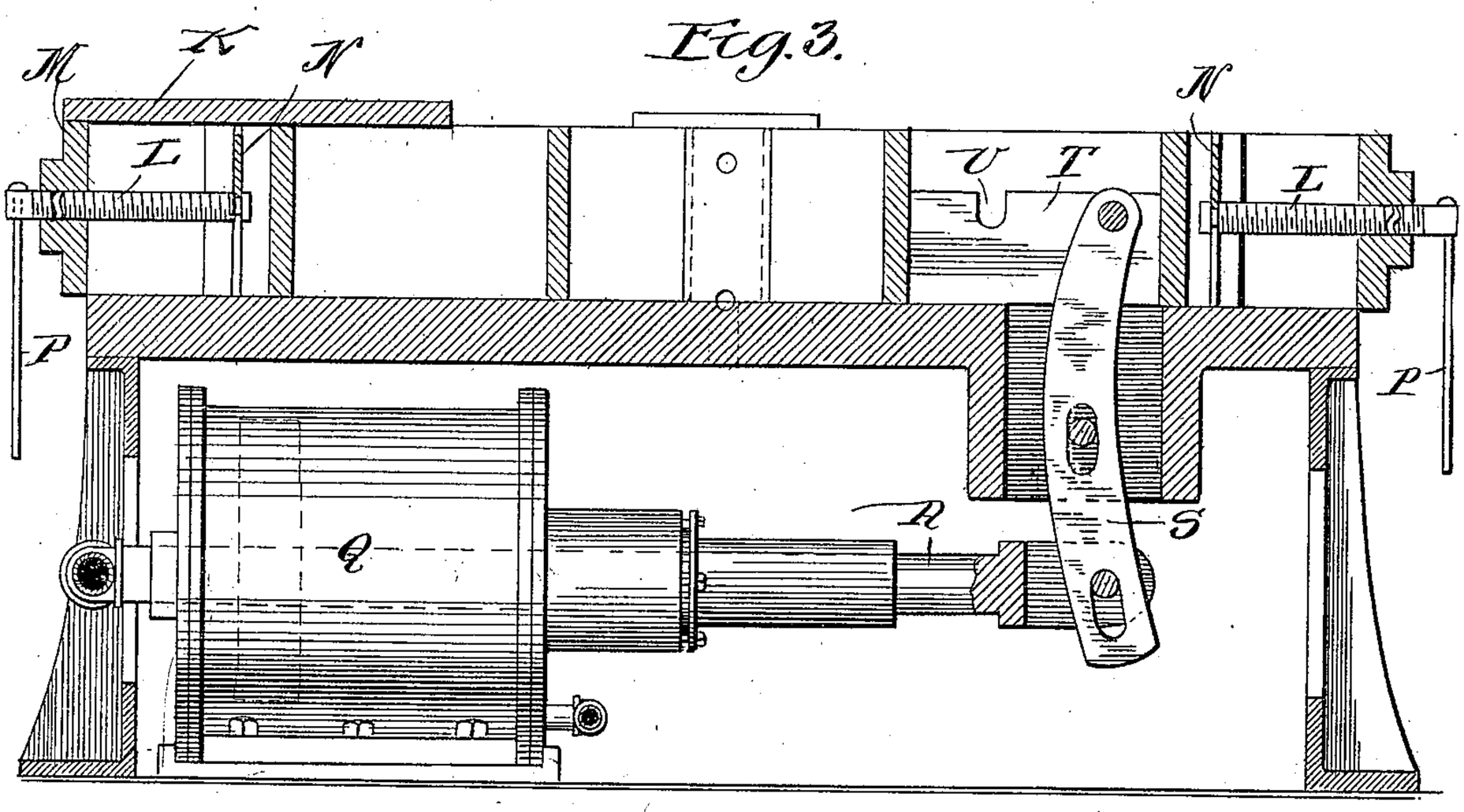
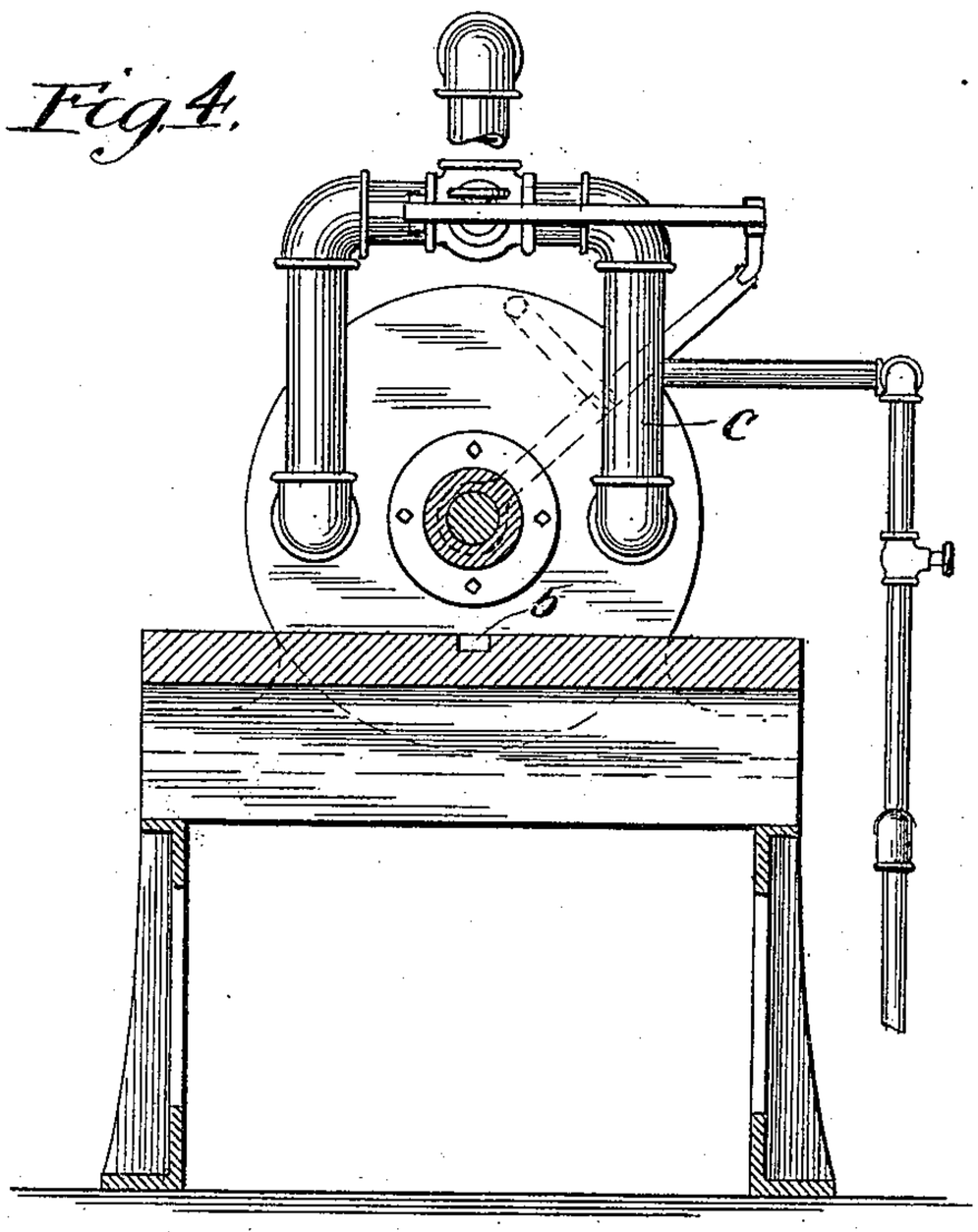


Fig. 4.



Witnesses
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MACHINE FOR BENDING, FORGING, WELDING, AND SHAPING METAL.

(Application filed June 15, 1899.)

(No Model.) 5 Sheets—Sheet 4

Fig. 5.

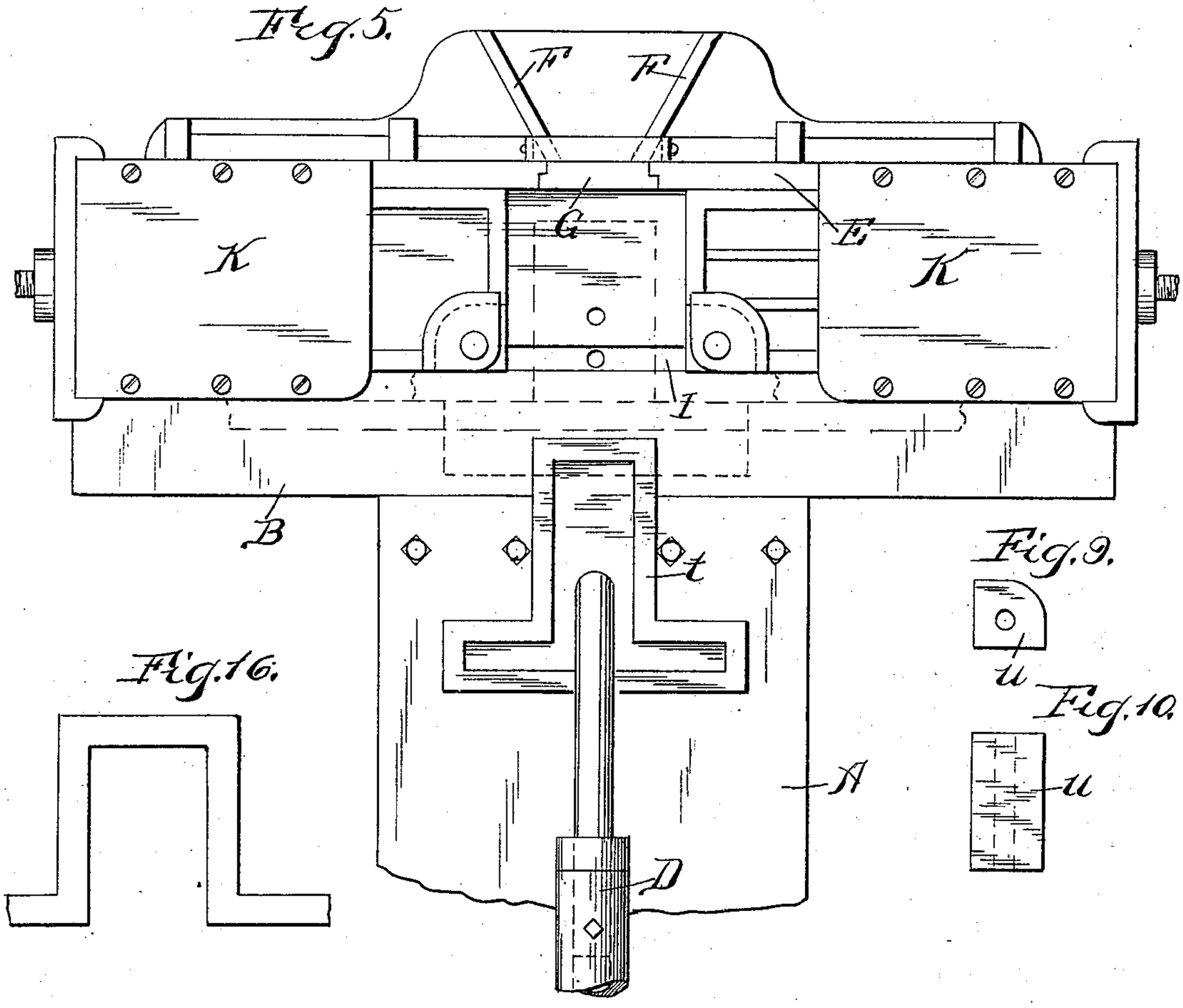


Fig. 9.

Fig. 10.

Fig. 16.

Fig. 11.

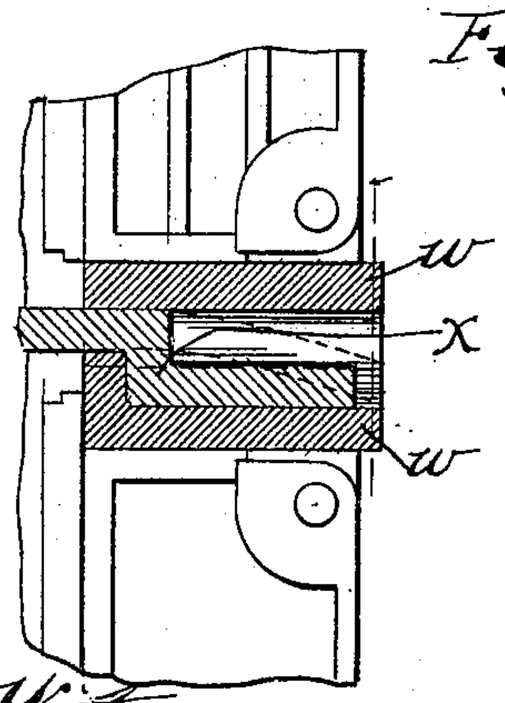


Fig. 12.

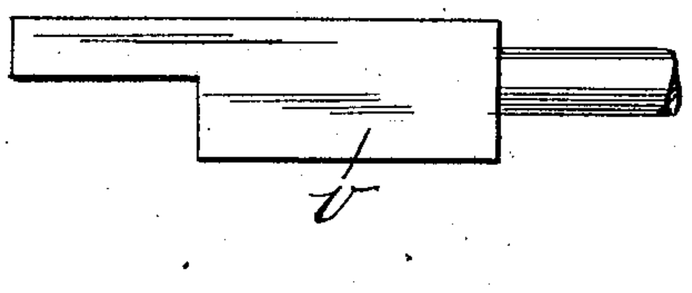
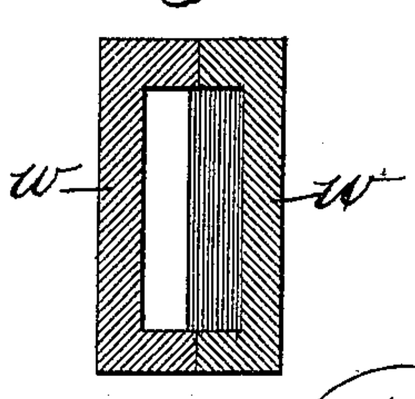


Fig. 13.



Witnesses
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MACHINE FOR BENDING, FORGING, WELDING, AND SHAPING METAL.

(No Model.) (Application filed June 15, 1899.)

5 Sheets—Sheet 5.

Fig. 6.

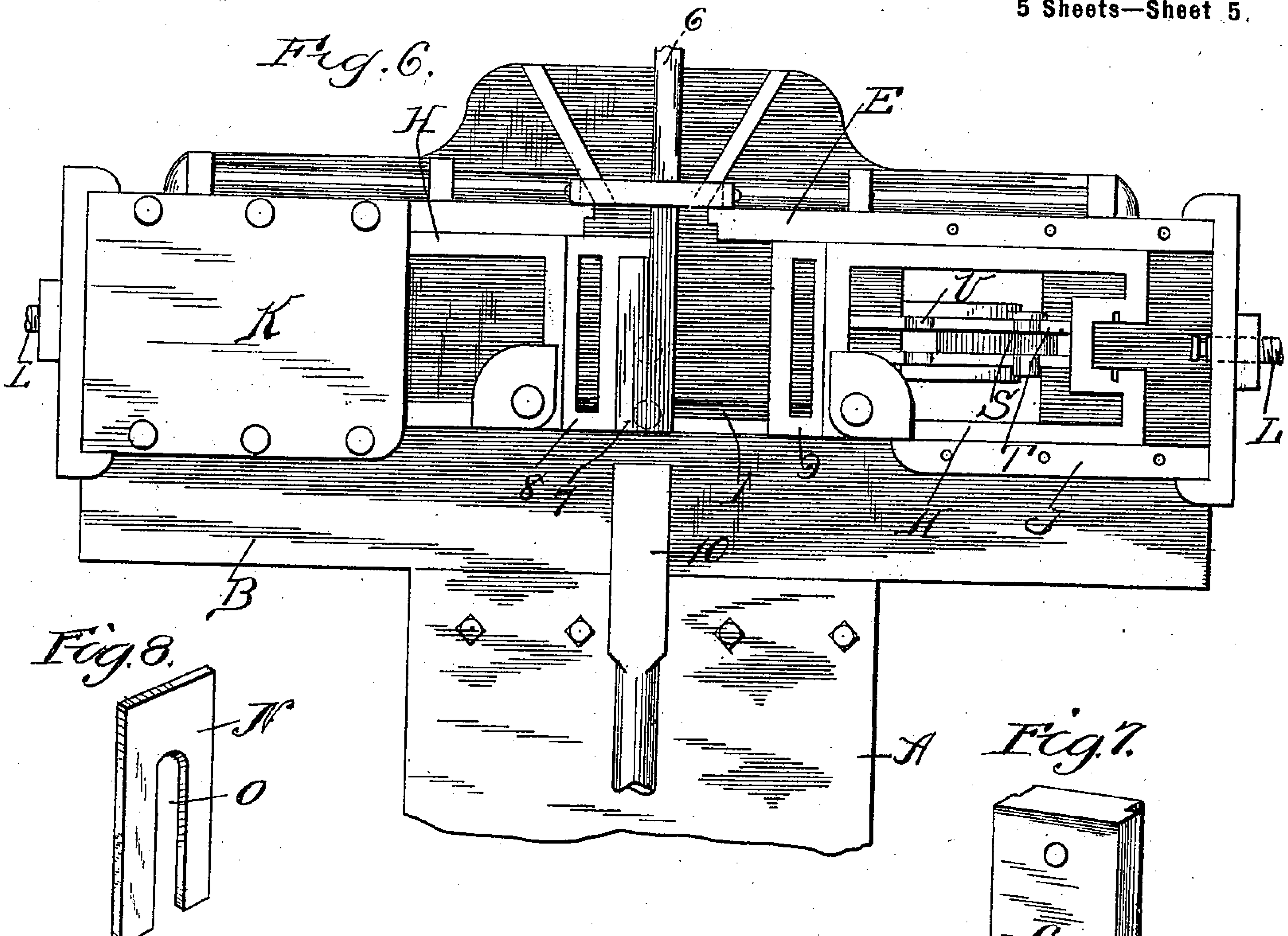


Fig. 8.

Fig. 7.

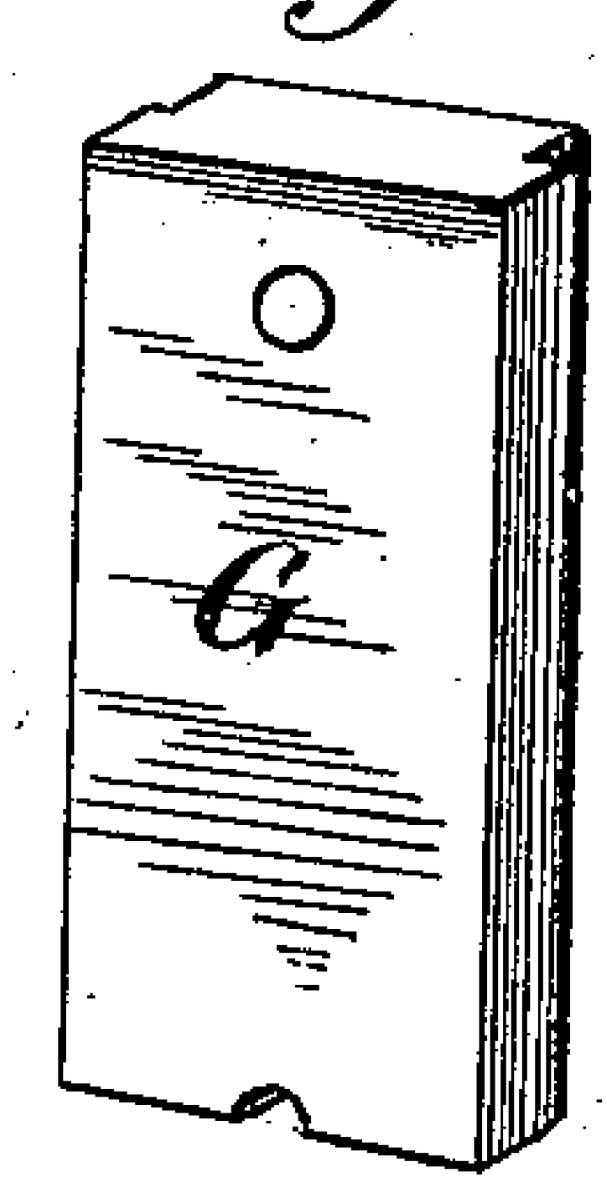


Fig. 17.

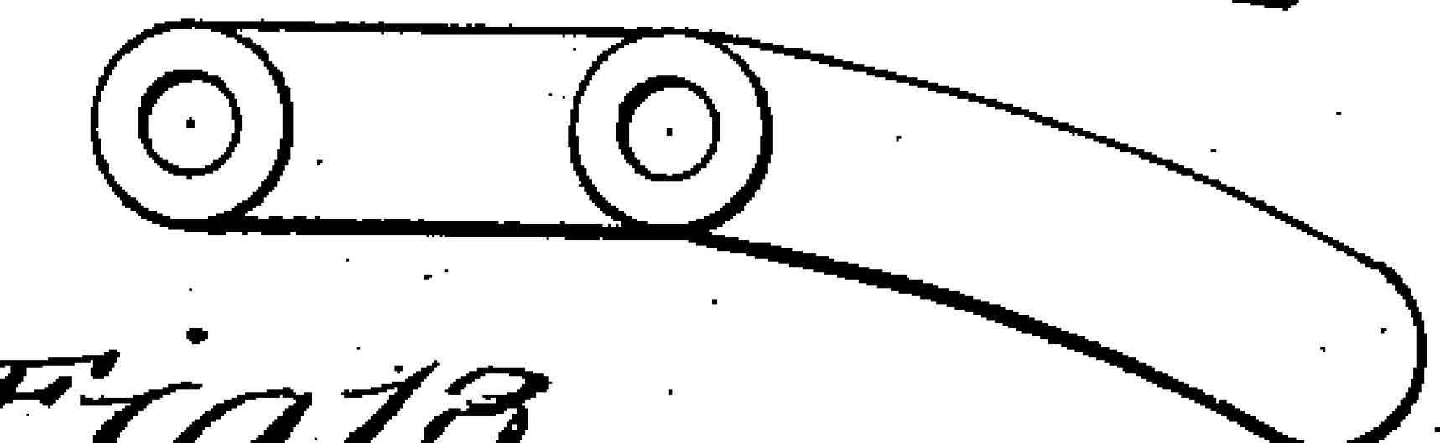


Fig. 13.

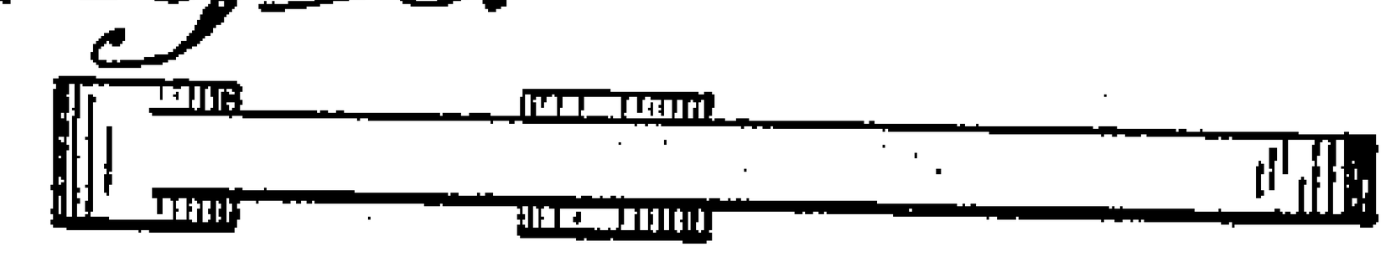


Fig. 14.

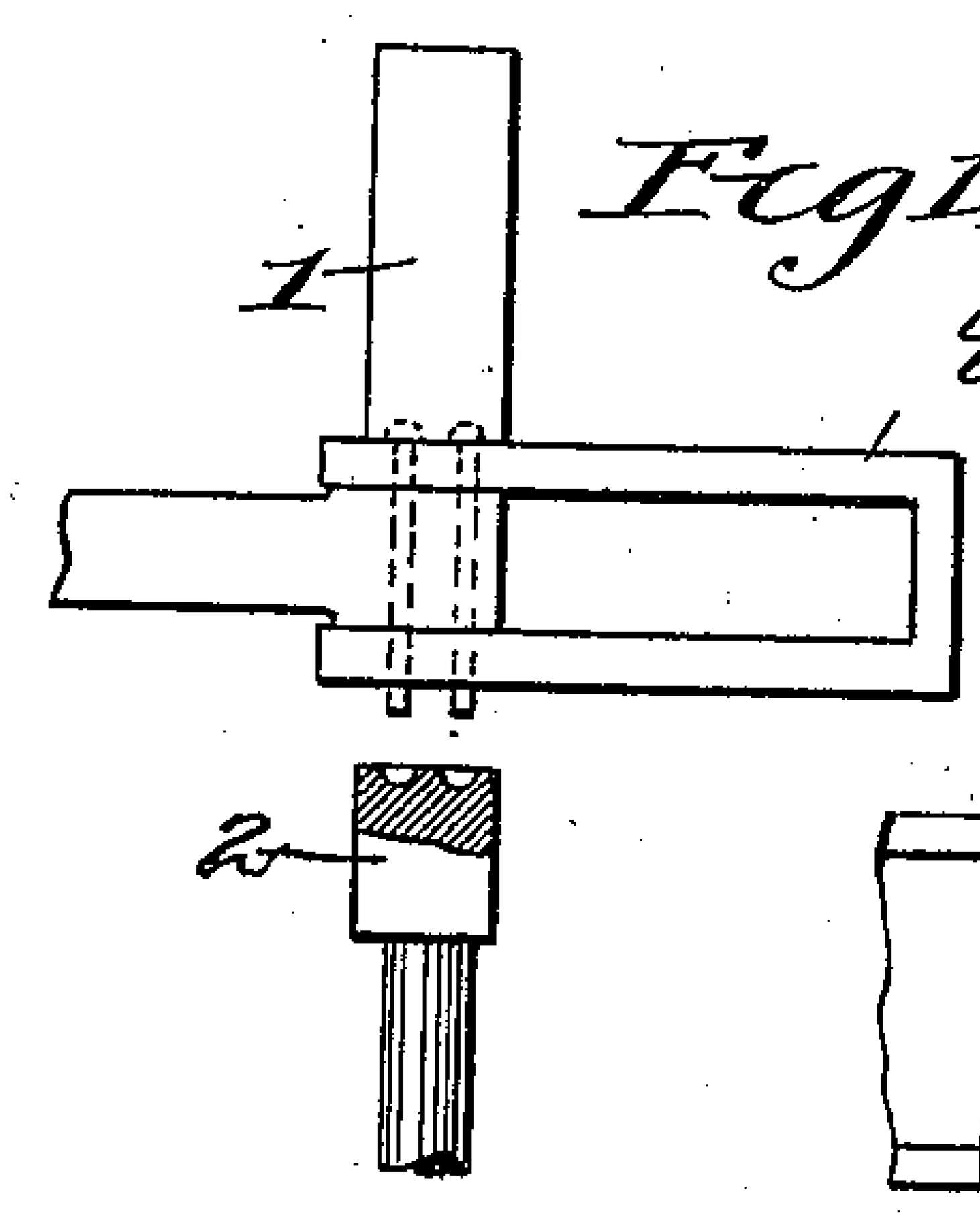


Fig. 15.

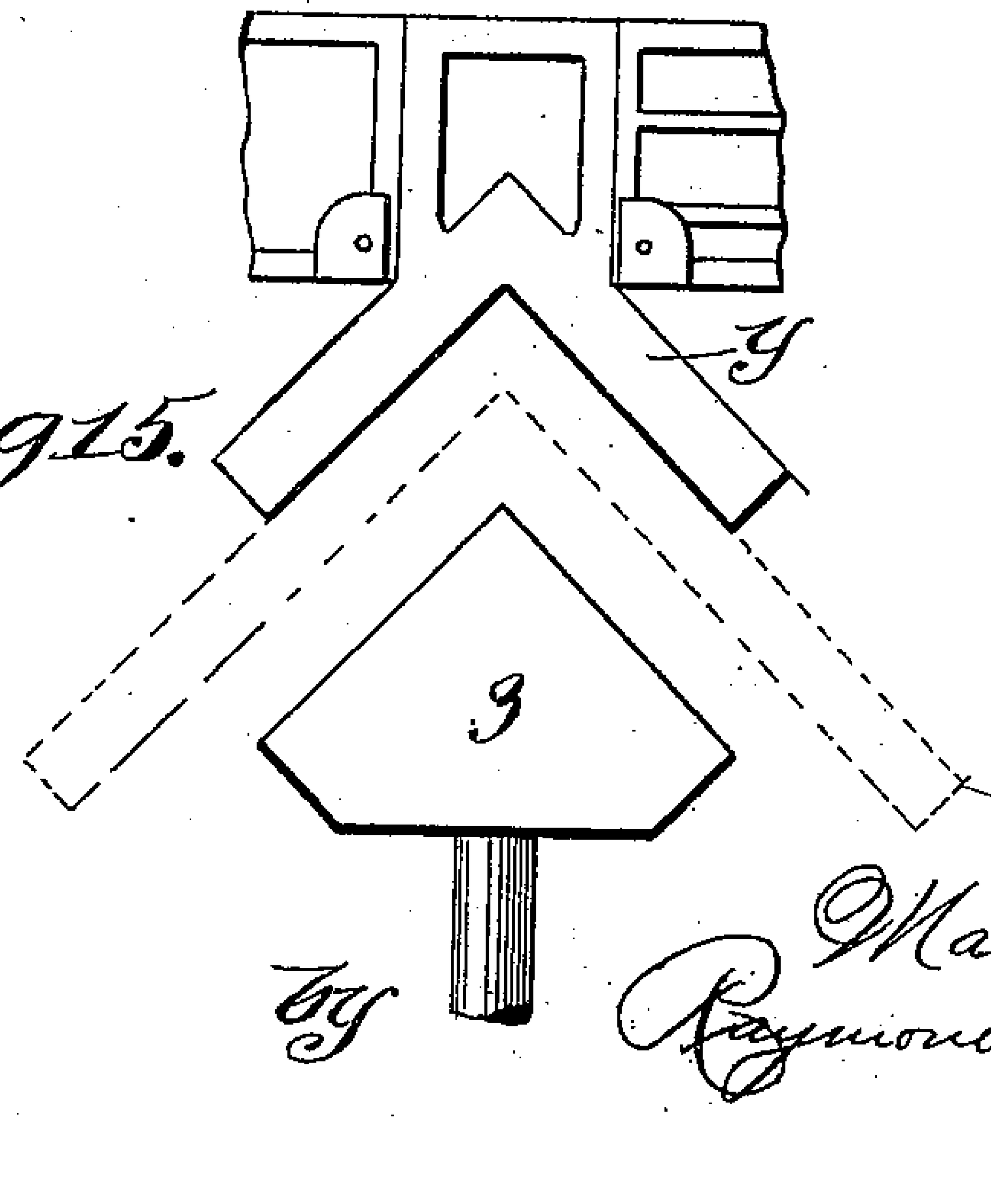
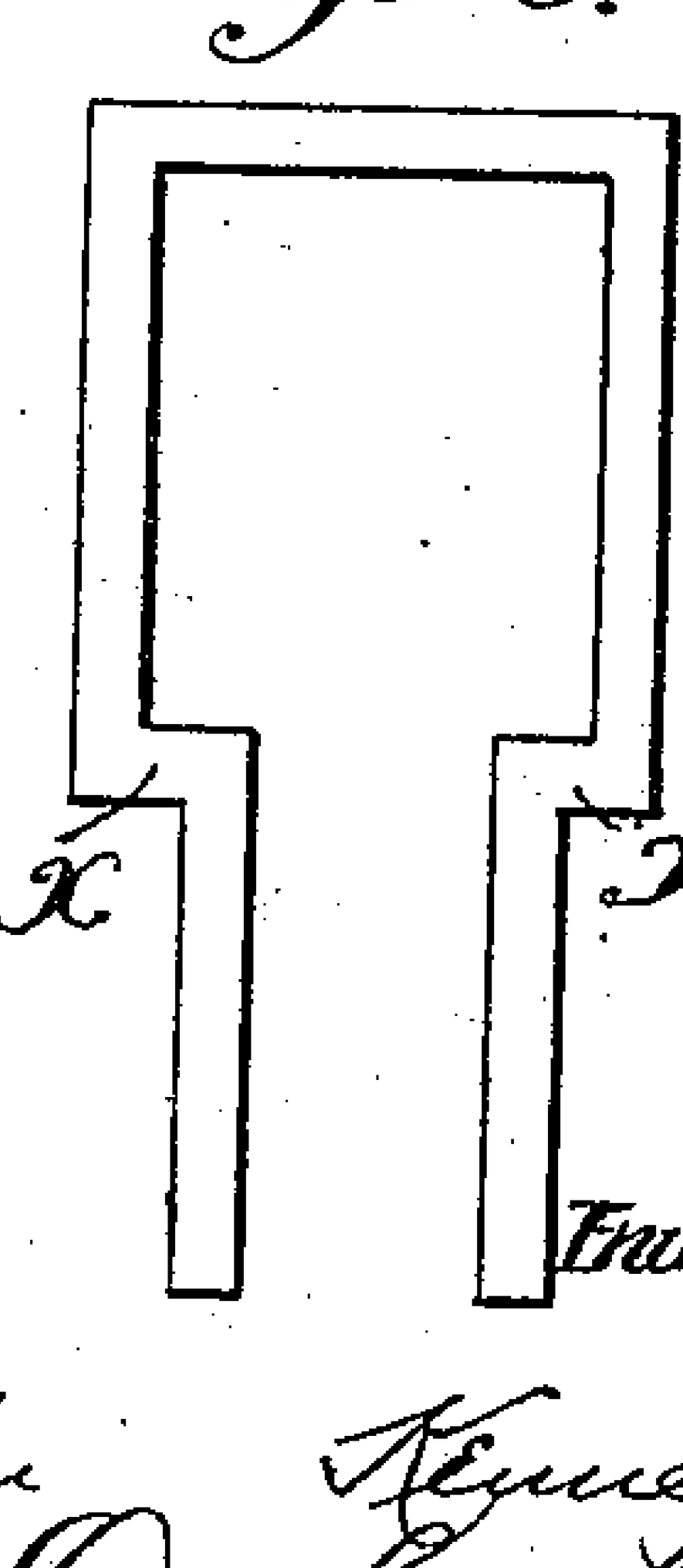


Fig. 19.



Witnesses
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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

MARTIN KENNEDY, OF CHICAGO, ILLINOIS.

MACHINE FOR BENDING, FORGING, WELDING, AND SHAPING METAL.

SPECIFICATION forming part of Letters Patent No. 644,294, dated February 27, 1900.

Application filed June 15, 1899. Serial No. 720,676. (No model.)

To all whom it may concern:

Be it known that I, MARTIN KENNEDY, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Machines for Bending, Forging, Welding, and Shaping Metal, of which the following is a specification.

This invention relates to improvements in machines for bending, forging, welding, and shaping metal, and my machine may be properly called a "mechanical blacksmith," because it is capable of doing any work that a blacksmith can do by the use of proper and interchangeable tools.

The primary object of this invention is to have a machine of this character not only capable of doing the ordinary work of a blacksmith, but also capable of forging, riveting, bending, welding, pressing, and forming metal of all shapes into articles of many different contours, and a machine that performs all of the functions of a forging-machine, a riveting-machine, and a bulldozer, but which has a die-space and capacity for interchangeability, as well as modes of operation, entirely beyond the capacity of any such machines.

Another object is to have the machine of such simple construction as to be capable of ready handling for all of its work by a single operator, and yet adapted for delivering blows, both laterally and longitudinally, upon the metal being operated upon and of varying degrees of power, and which shall also be capable of delivering either a striking blow or a mere pressing action within the easy control of the operator.

A further object is to have the die-space adjustable to receive dies of widely-varying dimensions and contours, and at the same time the die-blocks are capable of use as the jaws of a vise, while one of said blocks may be quickly converted into a hammer for delivering blows or pressure laterally upon the metal being operated upon.

These and such other objects as may hereinafter appear are attained by the devices illustrated in the accompanying drawings, in which—

Figure 1 represents a plan view of a machine embodying my invention. Fig. 2 represents a side elevation thereof with the bed-plate cut through on the longitudinal center thereof on the line 2 2 of Fig. 1. Fig. 3 is a transverse vertical section on the line 3 3 of Fig. 1 looking in the direction indicated by the arrows. Fig. 4 is another transverse vertical section on the line 4 4 of Fig. 1 looking in the direction indicated by the arrows. Fig. 5 is a plan view showing the parts substantially in the position shown in Fig. 1, but with the dies adjusted for a different kind of work. Fig. 6 is a detail plan view showing the cover-plate for one of the die-blocks removed and the parts adjusted for doing a job of welding. Figs. 7, 8, 9, and 10 are detail views of parts of the machine which will be fully described farther on. Figs. 11, 12, 13, 14, and 15 are detail views of different kinds of tools for use in connection with the machine which will be described fully farther on; and Figs. 16, 17, 18, and 19 are detail views of examples of different forms produced upon the machine.

Similar letters of reference indicate the same parts in the several figures of the drawings.

My machine may be operated by any kind of power and particularly a fluid-power; but in the machines which I have built I have preferred to use compressed air as best adapted and most economical for use in connection with my machine because of the comparative cheapness of its production and the rapidity with which it operates, and which, of course, facilitates the work done by the machine.

Referring now by letter to the accompanying drawings, A and B indicate the two sections of the bed-plate, which are suitably secured together in a common plane, so as to form a general T-shaped bed-plate, the part A forming the body of the T and the part B forming the cross thereof. Mounted longitudinally and centrally upon the section A of the bed-plate is a cylinder C, provided with a piston of usual or ordinary construction, which I have not deemed it necessary to illustrate in the drawings, the rod D of which piston preferably works through both ends of the cylinder for the purpose hereinafter explained, the end thereof toward the cross B being the driving end of the rod and provided

with suitable sockets to receive the stems of the various tools inserted therein, such rod when so equipped being substantially a pneumatic hammer receiving its motion and power from any fluid admitted into the cylinder C on opposite sides of the piston, such as compressed air.

Upon the forward edge of the section-cross B of the bed-plate is provided by casting or otherwise a vertical flange E, which extends at right angles to the pneumatic tool just referred to and constitutes an abutment against which the metal being operated upon is driven or forced under the action of the tool. The central portion of this abutment, which directly receives the impact produced by the pneumatic tool, is reinforced or supported by the vertical flanges F between the flange or abutment E and the section B of the bed-plate, being preferably cast integral with the abutment and bed-plate, although, of course, they may be formed separately and rigidly secured thereto. At its center of length the abutment is provided with a removable section G, which I will call a "filling-plate," having a rabbeted connection at its side edges with the abutment, so as to lie in a plane therewith, the ends of said plate being opposed by the flanges F, which support the same against the shock or impact resulting from the operation of the machine when the filling-plate is in place. I may here state that for some classes of work, such as welding and upsetting the ends of bars, it is necessary to remove this section of the abutment, all of which will be described in detail farther on.

At opposite ends of the cross or section B of the bed-plate are arranged adjustable die-blocks H, which are preferably rectangular in plan view and have a dovetailed and groove connection, as at I, Fig. 2, with the bed-plate to hold the same as against vertical displacement, said die-blocks working back and forth between ways formed by the abutment E and the parallel upright flanges J, positioned at the opposite side of the bed-plate in proper place, the space between the abutment and said flanges in which the die-blocks work being preferably provided with removable covers K to keep out dirt, scales, and other foreign substances and to assist in maintaining the various parts in position during operation. These die-blocks are adjustable independently toward and away from each other by means of the screws L, working through suitable end plates M, secured to the bed-plate and engaging at the other ends removable plates like that shown in detail in Fig. 8, removably fitting grooves formed in opposing faces of suitable sockets in the ends of the die-blocks. The ends of the screws L are provided with annular grooves, while the removable plates N are provided with slots O, extending in from the lower edge thereof and of a width substantially corresponding to the reduced diameter of the screws L at the grooves. Thus the screws are free to rotate (handles of any suitable form, such as the handles P shown in the drawings, being provided for this purpose) in the plates N, but will cause an endwise movement of said plates, and consequently of the die-blocks, corresponding with the endwise movements of the screws through the plates M, so that by means of such a connection the die-blocks may be adjusted toward and away from each other independently. It is desirable, however, in some classes of work, and particularly in welding and forging, to have one of these die-blocks capable of use as a pneumatic hammer, the other being properly adjusted to a fixed position. To this end I provide an auxiliary cylinder Q beneath the cross-section B of the bed-plate and extending longitudinally therewith or transversely of the machine as a whole, in which cylinder is a piston of ordinary construction, (not shown,) the rod R of which is connected by a suitable lever S, pivoted upon the bed-plate, with central longitudinal bars T in the center of the die-block at the opposite side of the machine, the pivot connecting the lever with the die-block preferably resting in one of a series of notches U, formed in the upper sides of the bars T, so that when the pivot-pin is dropped into one or the other of these notches the initial position of the die-block will correspondingly vary. To permit of the operation of the die-block by such means, it is necessary to disconnect the adjusting-screw L therefrom, and this is readily and quickly accomplished by withdrawing the plate N from its seat in the die-blocks and, if necessary, running back the screw, as clearly shown at the right side of Fig. 6. It will now be seen that when the air is let into the cylinder Q alternately upon the opposite sides of the piston therein the lever S will be caused to vibrate, and the die-blocks will have a corresponding reciprocation under the influence thereof, so as to act as a hammer for delivering lateral blows upon the metal between the die-blocks.

I will now describe the means shown in the drawings for causing the reciprocation of the pistons in the cylinders C and Q, and consequently the reciprocating action of the tool carried by the piston of the first-mentioned cylinder and the die-block connected with the last-mentioned cylinder, it being understood that I may use only the cylinder C and the pneumatic hammer carried by the piston thereof upon some kinds of work, during which the die-blocks will be first properly adjusted and thereafter remain stationary, while on other kinds of work both the cylinders C and Q, with the parts connected therewith, may be operated alternately first to set up the reciprocating die-block or to use the same as a hammer and next to bring up the pneumatic tool operated by the cylinder C, or vice versa, or for still other work, such as welding, I may use only the cylinder Q and the reciprocating die-block, all of which va-

riations will appear as I proceed and will be perfectly obvious to any one using the machine.

Turning now to the means for operating the piston of the cylinder C and referring more particularly to Figs. 1, 2, and 4, V indicates a reservoir preferably located under the section A of the bed-plate, although, of course, it may be located at any convenient point, and W indicates the main supply-pipe, having a branch X in open communication with the reservoir V to maintain a constant pressure therein, and a branch Y leading to the rear end of the cylinder C and containing a controlling-valve Z of any suitable construction to regulate the supply of air to that end of the cylinder which is the power end. With the pipe Y, at a point between its connection with the cylinder C and the valve Z, is connected an exhaust-pipe *a*, leading to some suitable point of exhaust, in which pipe is located a valve *b* for controlling the exhaust from the power end of the cylinder. From the opposite end of the cylinder leads a large exhaust-pipe *c*, preferably opening into the atmosphere and controlled by a suitable valve *d*, the point *e* indicating the atmospheric exhaust from the valve-casing, although, of course, a pipe may be connected with this exhaust-port leading to any desired point. It will be seen that the pipe *c* is of substantially the same diameter as the supply-pipe Y, so as to afford a large and prompt exhaust of the air from the opposite side of the cylinder after such air has been used to return the piston to its initial position at the extreme end of the power-cylinder.

From the pipe *c* between its point of connection with the cylinder C and the valve *d* leads a small pipe *f* down to the reservoir V, said pipe containing a suitable valve *g* for controlling the supply of air to the return end of the cylinder C in restoring the piston to its original position after each stroke of the hammer. The stem of the valve *d* is connected by a rod *h* with a lever *i*, pivoted upon the rear end of the cylinder C, the free end of which projects into the path of the rear end of the piston-rod D, which works through both heads of the cylinder C, so as to be struck thereby when the piston is forced back, and thus cause the automatic opening of the valve *d*.

Assuming the piston to be in its retracted position ready to receive air into the power end of the cylinder, upon the opening of the valve Z the air under pressure from the pipe Y will enter the power end of the cylinder C and force the piston to the opposite end of the cylinder, thus causing the pneumatic hammer attached to the piston thereof to be forced against the metal between the dies. If the valve Z is opened suddenly and fully, or nearly so, the full pressure will instantly enter the cylinder and cause the hammer to make a striking blow upon the metal being operated upon; but if the valve Z is opened slowly, then the air will enter the cylinder slowly and cause the hammer to move forward slowly and produce simply a pressing power or effect upon the metal being operated upon.

The pressure of the air in the cylinder may be maintained as long as desired, and as long as it is maintained the pressure of the hammer upon the metal being operated upon will be maintained. If now the valve Z is closed and the valve *b* is opened, the air from the power end of the cylinder will be exhausted through the pipe *a*, which is small as compared with the supply-pipe. In practice I take advantage of the relative sizes of these pipes and prefer to leave the exhaust-valve *b* open slightly at all times when it is desired to deliver a striking blow with the hammer, because little air can escape through the slightly-opened exhaust-valve when the full pressure is suddenly turned into the power end of the cylinder, and I know from practice that not enough can escape to materially affect the efficiency of the blow of the hammer. It is only when I desire to maintain the pressure of the hammer upon the metal being operated upon after the blow is struck that I entirely close the exhaust-valve *b* or when I desire to cause the hammer to exert a slow pressing force upon the metal being operated upon on some classes of work. The air-pressure being now removed from the power end of the cylinder, the piston is free to move back, and the valve *d* being first closed by pulling upon the rod *h* or otherwise the valve *g* is then opened and air admitted to the return end of the cylinder, so as to drive the piston in the opposite direction back to the power end of the cylinder. As the piston approaches its extreme retracted position the rear end of the piston-rod D strikes the end of the lever *i*, and through the medium of the rod *h* instantly opens the valve *d* to the atmosphere and exhausts the air from the return end of the cylinder. Of course a repetition of these operations will cause a repetition of the reciprocations of the piston, and consequently of the pneumatic hammer, and the operation of the hammer and the kind of force exerted thereby, whether it be striking or pressing, are readily within the control of the operator.

Now turning to the pneumatic operation of the reciprocating die-block the air is admitted to the power end of the cylinder Q through the large pipe *k*, connected at its ends, respectively, with said cylinder and with the reservoir V, said pipe *k* containing an ordinary three-way cock *l*, having one of its ports—say the port *m*—connected so as to discharge into the atmosphere, although, of course, a pipe may be connected with this portion, so as to lead the air off to any desired point. When the handle of the valve *l* is in one position—say the vertical position shown in the drawings—the ports thereof are so disposed as to cut off communication between the reservoir V and the cylinder Q, while establish-

ing communication between the power end of said cylinder and the atmosphere. When the handle of the valve *l* is turned, say, to a horizontal position, the ports therethrough are so disposed as to establish communication between the reservoir and the cylinder, while cutting off communication between the cylinder and the atmosphere. Hence when the valve is moved to this position the air from the reservoir flows into the power end of the cylinder and drives the piston thereof to the opposite end of the cylinder, carrying with it the piston-rod R, and through the medium of the lever S causes a die-block connected therewith to move toward the metal being operated upon suddenly or slowly, according to the degree of opening of the valve *l*, this action, however, by reason of the work it is designed to perform, being generally a violent and quick action, imparting a hard blow to the metal being operated upon at right angles to the direction in which the metal is struck by the pneumatic hammer. Upon restoration of the valve *l* to its normal position the supply of air will be cut off and the power end of the cylinder instantly exhausted. To restore the piston to its retracted position, the air is let into the return end of the cylinder Q through a small pipe *n*, connecting either directly with the reservoir V or with the pipe *f*, as shown in the drawings, at such point as to afford open communication with the cylinder. In the pipe *n* is located another three-way cock *o*, the discharge-port of which is connected by a pipe *p* with the exhaust-pipe *a* either directly or preferably through the exhaust-valve *b*. The operation of this three-way cock *o* is in all respects similar to that of the cock *l*. When the valve is in one position, the exhaust of the atmosphere from the cylinder Q is cut off, while communication is established between said cylinder and the reservoir. When in its other position, communication between the reservoir and the cylinder is cut off and communication between the return end of the reservoir-pipe *a* or the atmosphere is established.

It will of course be understood that by proper and successive operations of the cocks *l* and *o* the cylinder in the piston Q, and consequently the die-blocks, will be caused to reciprocate as desired.

Assume now a simple piece of metal-bending is to be done, such as forming the part *q*, (shown in Fig. 14,) which is made out of strap or bar metal. To form this part, a tool substantially like the tool *r* (shown in Fig. 1) is fitted into the end of the piston D, such tool being of a width corresponding to the distance apart of the side arms of the part *q*. The die-blocks are then adjusted toward the center of the machine, with the filling-plate G in position, as shown in Fig. 1, until the distance between them equals the distance between the outer faces of the side arms of the part *q*. In the corners of the die-blocks adjacent to the tool *r* are loosely journaled rollers *s*, around which the metal is bent. The flat bar of metal properly heated is then placed centrally upon the bed-plate B against the rollers *s* and spanning the space therebetween. By proper manipulation of the air-supply to the power end of the cylinder C the pneumatic hammer is then driven forward with a quick blow and the central part of the metal bar is forced between the die-blocks running freely around the rollers *s* and the tool *r*, forming the rectangular or cross end of the part *q*. The formation of this part is exceedingly simple and rapid, and the speed with which it can be accomplished is limited only by the rapidity with which the bars can be placed in position and removed, as the formation of the part is almost instantaneous. Of course one or more assistants handle the heated metal, while a single operator controls the machine.

The formation of the stirrup (shown in Fig. 16) is accomplished the same way as that of the part shown in Fig. 14, excepting that the tool *r* of the pneumatic hammer is replaced by the tool *t*, (shown in Fig. 5,) while the rollers *s* are replaced by the blocks *u*, (illustrated in detail in Figs. 9 and 10,) which present a square corner at the corner of the die-blocks and of course do not revolve therein. The position of the parts for forming the stirrup (shown in Fig. 16) is clearly illustrated in Fig. 5, the bar from which the stirrup is formed, as well as the completed stirrup and the position of the pneumatic hammer when the stirrup is completed, being shown by the dotted lines.

If now we desire to form the part shown in Fig. 19, the tool *t* is replaced by the tool *v* (shown in Fig. 12) and the two-part die *w* (shown in Figs. 11 and 13) is inserted and firmly secured between the die-blocks, which now act as a vise. One end of the metal to be operated upon is inserted through the opening in the abutment into an opening in the end of the die *w*, the end of the bar being bent laterally, as shown by the dotted lines in Fig. 11, by some suitable tool, so as to admit of the entrance between the sections of the dies *w* of the reduced end of the tool *v* at one side of the end of the rod. The tool *v* is now brought forward and at a single blow bends the end of the rod laterally, so as to form the offset or shoulder *x* therein. This end of the bar is then removed and the other end of the bar is treated in like manner. When both ends of the bar have been properly offset, the dies *w* are removed, the bar is set centrally across the die-blocks, so as to span the space therebetween, and the tool *r*, or one of similar shape and proper dimensions, is placed upon the piston D and driven with a proper blow against the center of the bar, thus bending the same into a substantially U shape, the offset portions *x* lapping around the rear end of the tool when the part is completely formed; but to form a plate or bar having a right-angle bend the filling-block G is again replaced, and the

die *y* (shown in Fig. 15) is fixed between the die-blocks serving as a vise, and the tool *z* is fitted into the end of the piston D. The heated bar while straight is centrally disposed across the die *y*, and when the tool *z* is driven forward the bar or plate is bent to the angular form shown by dotted lines in Fig. 15 or to any other angular form, according to the arrangement of the opposing faces of the die and tool.

To form the forging, (illustrated in Figs. 17 and 18,) the filling-block G must be removed, proper-shaped dies inserted between the die-blocks, and a proper-shaped tool inserted in the pneumatic hammer to form, in conjunction with the dies, the bosses on the forging by upsetting the metal from the bar, it being obvious that the reciprocating die-block may be used in connection with the pneumatic hammer to assist in the shaping of this part, the hammer being held up to position against the metal during the operation of the die-block to which the die is rigidly secured, so as to move therewith.

Assuming now that it is desired to rivet the part *q* (shown in Fig. 14) to any other part, such as that shown in Fig. 14, the parts are properly drilled to receive the rivets, which are of course headed at one end, the block, 1 with concave depressions there into receive the heads of the rivets, is inserted and held between the die-blocks, and the riveting-tool 2, with concave depressions therein opposing the unheaded ends of the rivets, is inserted in the piston D. A blow from the pneumatic hammer carrying the tool 2 will instantly upset and form the other heads for the rivets, it being understood that in this operation the filling-plate G is in position.

For some classes of work, and particularly that of riveting, where the tool cannot rest upon the bed-plate, it is necessary to provide some means for preventing rotation of the tool, and one such means I have shown in the drawings, consisting of an arm 3, depending from the piston-rod D and provided with a head 4, working in a longitudinal slot 5, formed in the upper surface of the bed-plate underlying the piston-rod.

In Fig. 6 I have shown a simple job of welding, being the addition to a straight bar 6 of a lateral short section 7, instead of upsetting the end of the bar to make this form, which of course can be done on some classes of work, as I know from experience. To do this job, the filling-plate G is removed, suitable dies 8 and 9 are attached to the die-blocks, respectively, one of said blocks being fixedly adjusted, while the other is now arranged to be reciprocated pneumatically, and the tool 10 is inserted in the piston-rod D, the die 8, secured to the adjustable die-block, having an extension at its rear end to take the end thrust of the pneumatic hammer 10. The reciprocating die-block and the pneumatic hammer are now operated alternately to deliver blows to the two pieces of metal, which of course are at a proper temperature and which under the hammering action of the reciprocating die-block and the pneumatic hammer will be welded together in a very short time.

Obviously many forms of devices and many changes in the mode and sequence of operation in the formation of different parts or devices may be employed without departing from the spirit of my invention, as I have found from practice that more than one hundred different parts of locomotives, tenders, and passenger and freight cars may be formed upon my machine, and, in fact, I can form thereon by the use of proper and interchangeable tools and dies any part or device that can be formed by a blacksmith, a forging-machine of any kind, or a bulldozer, and I can also upon the same machine rivet together any kind or disposition of parts, as well as weld the parts together or upset the ends of beams—such as the transom-beams in car-trucks or body-bolsters—and many other parts which it is not necessary herein to illustrate or describe.

Of course a machine embodying my invention may be made as strong as may be desirable, and yet I find from practice that it may be light as compared with an ordinary bulldozer for the power to be gotten out of the machine, and the power of the blow to be struck by the machine or the pressure to be exerted thereby upon the metal being operated upon may be varied by simply varying the pressure of the actuating fluid in the cylinders, and of course the ultimate pressure is substantially without practical limitations because controlled only by the size of the various cylinders and the pressure of the actuating fluid. In a machine I now have in daily operation, with an air-pressure of one hundred and twenty pounds to the square inch, I can get a striking blow of ten to twelve tons, and by modifying the air-pressure, as well as the quantity or rather the rapidity with which it is admitted to the cylinders, I can strike a blow of almost any force, from a pound or so to the maximum.

A machine embodying my invention is in reality very simple and compact in form, very strong, and with little liability to breakage, may be used in all kinds of shops where blacksmithing, forging, riveting, and welding and such like operations are necessary, and the number of different kinds or forms of devices which can be made therewith rapidly and economically is limited only by the number of dies and tools employed.

Having described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a machine of the class described, the combination with a bed-plate and a reciprocating tool-carrying hammer operated by fluid under pressure, of a pair of die-blocks horizontally adjustable toward and away from each other and at right angles to the hammer, and a vertical flange on the bed-plate at

one side of said die-blocks and constituting an abutment against which the hammer operates and spanning the space between said die-blocks, substantially as and for the purpose described.

2. In a machine of the class described, the combination with a bed-plate and a reciprocating tool-carrying hammer operated by fluid under pressure, of a pair of die-blocks horizontally adjustable toward and away from each other and at right angles to the hammer, means for reciprocating one of said blocks by fluid under pressure, and a vertical flange on the bed-plate at one side of said die-blocks and constituting an abutment against which the hammer operates and spanning the space between said die-blocks, substantially as and for the purpose described.

3. In a machine of the class described, the combination with a bed-plate and a reciprocating tool-carrying hammer operated by fluid under pressure, of a pair of die-blocks, one of which is horizontally adjustable toward and away from the other and at right angles to the hammer, while the other block is horizontally reciprocable by fluid under pressure toward and away from the adjustable block and a vertical flange on the bed-plate at one side of said die-blocks and constituting an abutment against which the hammer operates and spanning the space between said die-blocks, substantially as and for the purpose set forth.

4. In a machine of the class described, the combination with a reciprocating tool-carrying hammer, operated by fluid under pressure, of a pair of die-blocks adjustable toward and away from each other and at right angles to the hammer, an abutment against which the hammer operates and a removable filling-plate at the center of length of said abutment between the die-blocks, substantially as and for the purpose described.

5. In a machine of the class described, the combination with a reciprocating tool-carrying hammer operated by fluid under pressure, of a pair of die-blocks one of which is adjustable toward and away from the other and at right angles to the hammer, while the other block is reciprocable by fluid under pressure toward and away from the adjustable block, an abutment against which the hammer operates and a removable filling-plate at the center of length of said abutment between said blocks, substantially as and for the purpose described.

6. In a machine of the class described, the combination with a reciprocating tool-carrying hammer operated by fluid under pressure, of a pair of die-blocks adjustable toward and away from each other and at right angles to the hammer, each of said blocks being provided at the corner thereof nearest the hammer with curved sockets and removable and interchangeable corner-pieces, adapted to fit in said sockets, either rotatively or non-rotatively, substantially as and for the purpose described.

7. In a machine of the class described, the combination with a bed-plate, a reciprocating tool-carrying hammer operated by fluid under pressure, and a vertical flange upon the bed-plate constituting an abutment for the hammer, of a pair of die-blocks adjustable toward and away from each other and at right angles to the hammer, a pair of vertical flanges on the bed-plate parallel with the abutment at opposite ends thereof, which, in conjunction with the abutment constitute guides for the die-blocks, screws working through suitable fixed bearings and rotatively connected with the die-blocks so that said blocks will have only longitudinal movement with the screws, substantially as and for the purpose described.

8. In a machine of the class described, the combination with a bed-plate, the reciprocating tool-carrying hammer operated by fluid under pressure, and a vertical flange upon the bed-plate constituting an abutment for the hammer, of a pair of die-blocks adjustable toward and away from each other and at right angles to the hammer, a pair of vertical flanges on the bed-plate parallel with the abutment at opposite ends thereof, which, in conjunction with the abutment constitute guides for the die-blocks, screws working through suitable fixed bearings and detachable and rotatively connected with the die-blocks so that said blocks will have only longitudinal movement with the screws, substantially as and for the purpose described.

9. In a machine of the class described, the combination with a bed-plate, a reciprocating tool-carrying hammer operated by fluid under pressure and an abutment against which the hammer operates, of a pair of die-blocks adjustable toward and away from each other and at right angles to the hammer, screws working through suitable fixed bearings and rotatively but detachably connected with the die-blocks and means for reciprocating one of said die-blocks by fluid under pressure when disconnected from its adjusting-screw, substantially as described.

10. In a machine of the class described, the combination with a bed-plate, a reciprocating tool-carrying hammer operated by fluid under pressure and an abutment against which the hammer operates, of a pair of die-blocks adjustable toward and away from each other and at right angles to the hammer, screws working through suitable fixed bearings and rotatively but detachably connected with the die-blocks, a lever pivoted to the bed-plate and adjustably connected at one end with one of said die-blocks and means for vibrating said lever by fluid under pressure, substantially as described.

11. In a machine of the class described, the combination with a bed-plate, a reciprocating tool-carrying hammer operated by fluid un-

der pressure, an abutment against which the hammer operates and a removable filling-plate at the center of length of said abutment, of a pair of die-blocks adjustable toward and away from each other and at right angles to the hammer, screws working through suitable fixed bearings and rotatively but detachably connected with the die-blocks and means for reciprocating one of said blocks by fluid under pressure when disconnected from its adjusting-screw, substantially as described.

12. In a machine of the class described, the combination with a bed-plate, a reciprocating tool-carrying hammer operated by fluid under pressure and a vertical flange upon the bed-plate constituting an abutment for the hammer, of a pair of die-blocks adjustable toward and away from each other and at right angles to the hammer, a pair of vertical flanges on the bed-plate parallel with the abutment at opposite ends thereof, which, in conjunction with the abutment constituting guides for the die-blocks, a dovetail-and-groove connection between the die-blocks and the bed-plate along the side thereof next the hammer, and means for adjusting said blocks toward and away from each other and at right angles to the hammer, substantially as described.

13. In a machine of the class described, the combination with a bed-plate, a reciprocating tool-carrying hammer operated by fluid under pressure and a vertical flange upon the bed-plate constituting an abutment for the hammer, of a pair of die-blocks adjustable toward and away from each other and at right angles to the hammer, a pair of vertical flanges on the bed-plate parallel with the abutment at opposite ends thereof, which, in conjunction with the abutment constituting guides for the die-blocks, a dovetail-and-groove connection between the die-blocks and the bed-plate along the side thereof next the hammer, means for adjusting said blocks toward and away from each other and at right angles to the hammer, and means for reciprocating one of said blocks by fluid under pressure, substantially as described.

14. In a machine of the class described, the combination with a bed-plate, a reciprocating tool-carrying hammer operated by fluid under pressure and a vertical flange upon the bed-plate constituting an abutment for the hammer, of a pair of die-blocks adjustable toward and away from each other and at right angles to the hammer, a pair of vertical flanges on the bed-plate parallel with the abutment at opposite ends thereof, which, in conjunction with the abutment constituting guides for the die-blocks, a dovetail-and-groove connection between the die-blocks and the bed-plate along the side thereof next the hammer, screws working through suitable fixed bearings and rotatively but detachably connected with the die-blocks for adjusting the same, substantially as described.

15. In a machine of the class described, the combination with a bed-plate, a reciprocating tool-carrying hammer operated by fluid under pressure and a vertical flange upon the bed-plate constituting an abutment for the hammer, of a pair of die-blocks adjustable toward and away from each other and at right angles to the hammer, a pair of vertical flanges on the bed-plate parallel with the abutment at opposite ends thereof, which, in conjunction with the abutment constituting guides for the die-blocks, a dovetail-and-groove connection between the die-blocks and the bed-plate along the side thereof next the hammer, screws working through suitable fixed bearings and rotatively but detachably connected with the die-blocks for adjusting the same and means for reciprocating one of said die-blocks by fluid under pressure when disconnected from its adjusting-screw, substantially as described.

MARTIN KENNEDY.

Witnesses:
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J. N. RAYMOND.