5 Sheets—Sheet 1.

D. DAVIES.

FORGING APPARATUS.

No. 82,093. Patented Sept. 15, 1868.

Fig. 1.

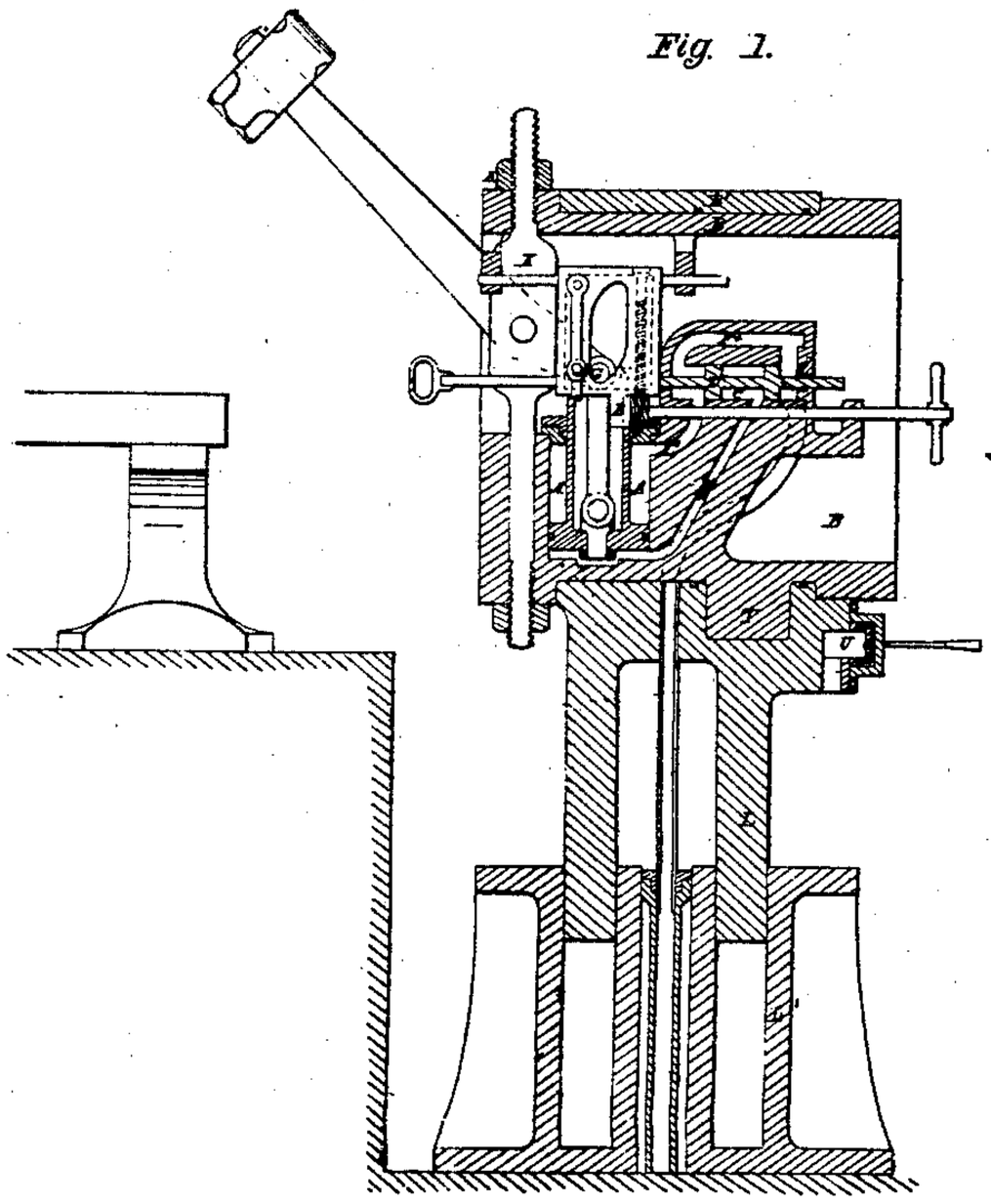


Fig. 4.

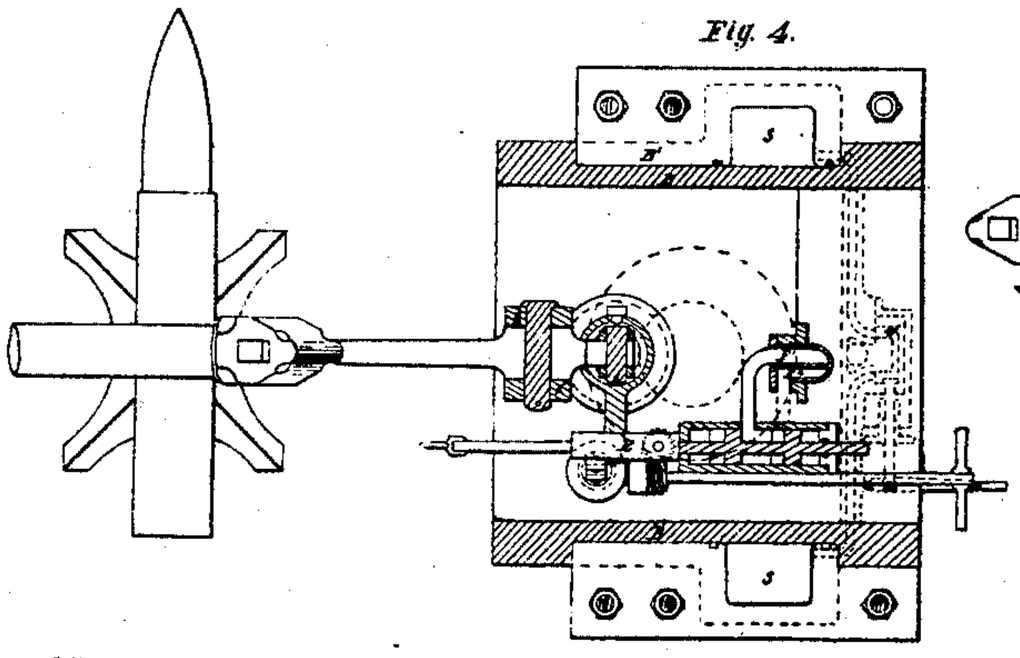


Fig. 6.

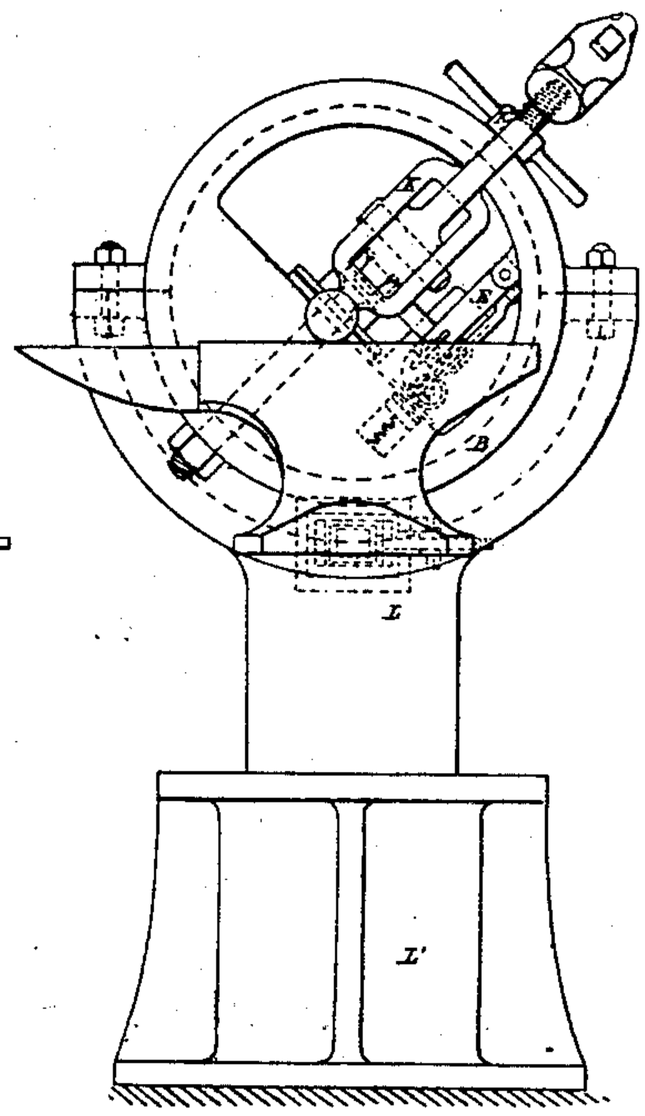
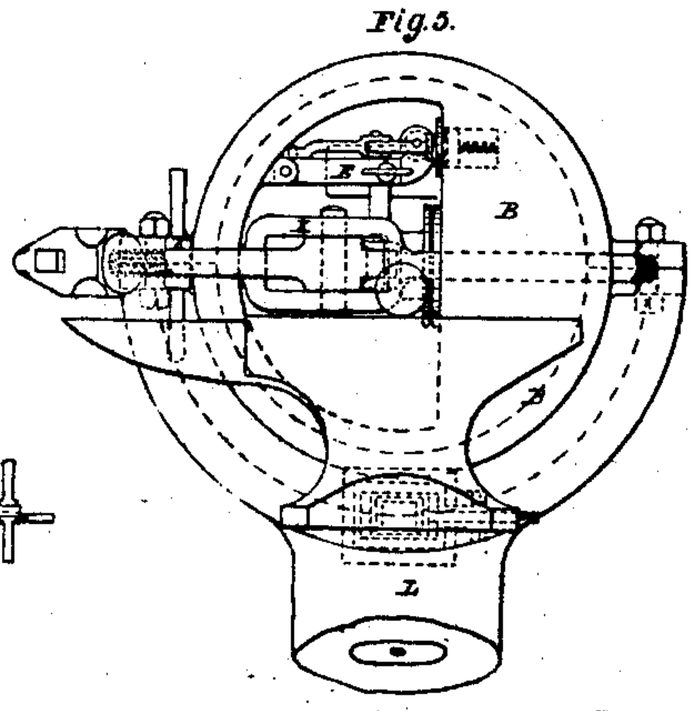


Fig. 5.



Witnesses:

Inventor:

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No. 82,093. Patented Sept. 15, 1868.

Fig. 3.

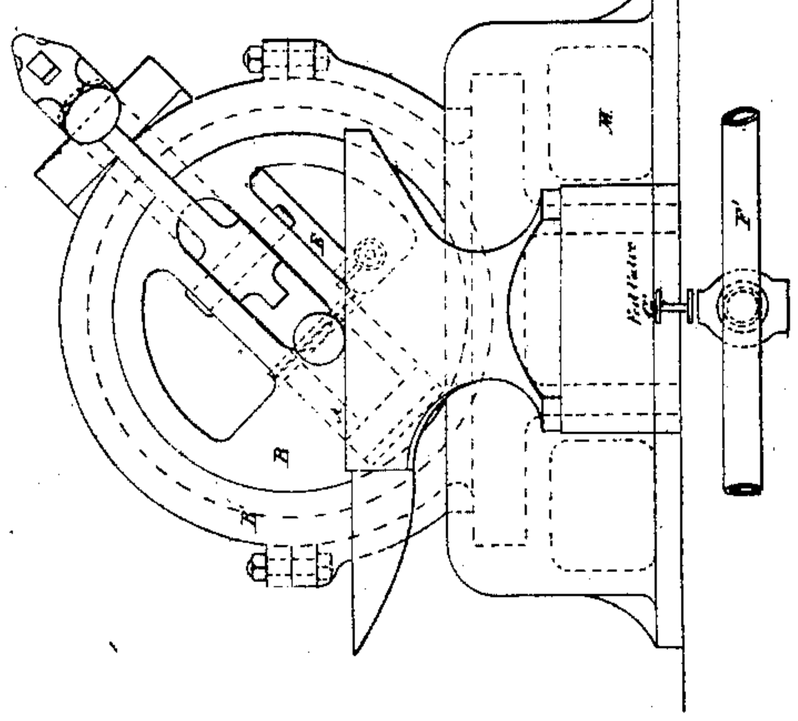


Fig. 10.

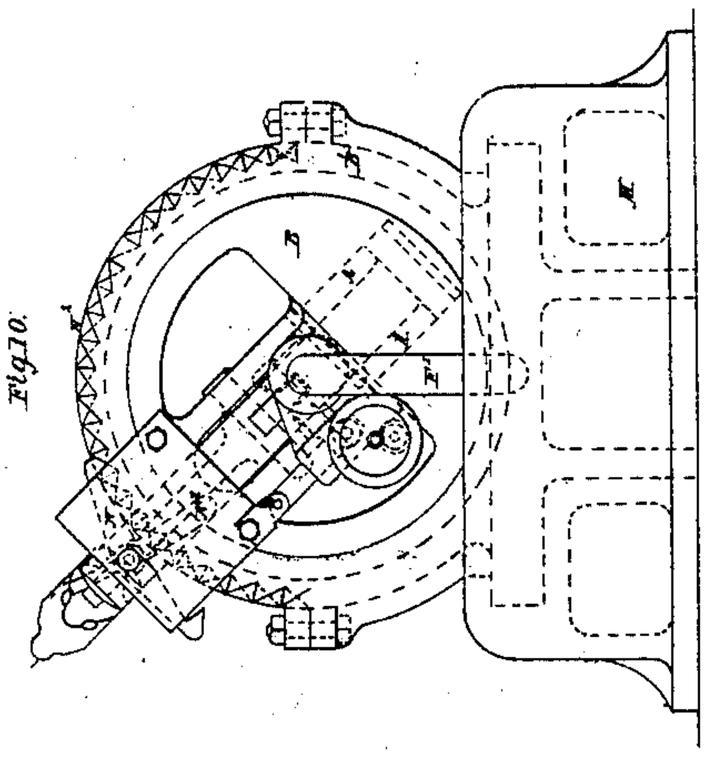


Fig. 23.

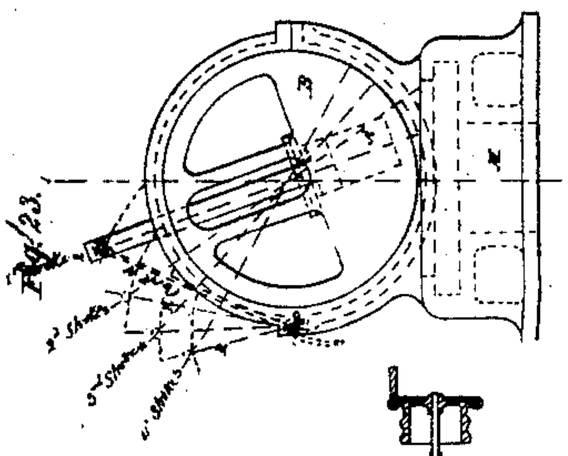


Fig. 8.

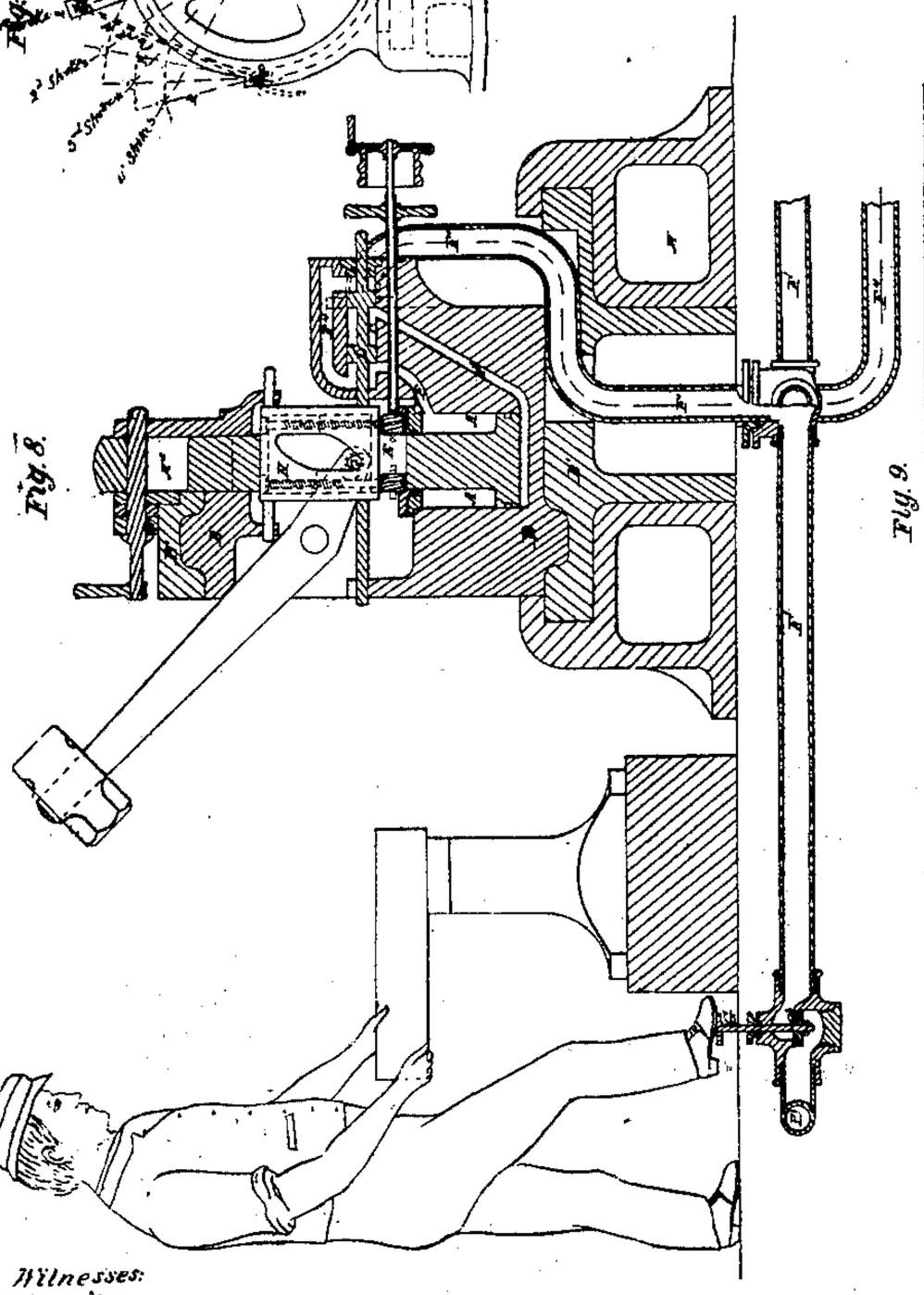
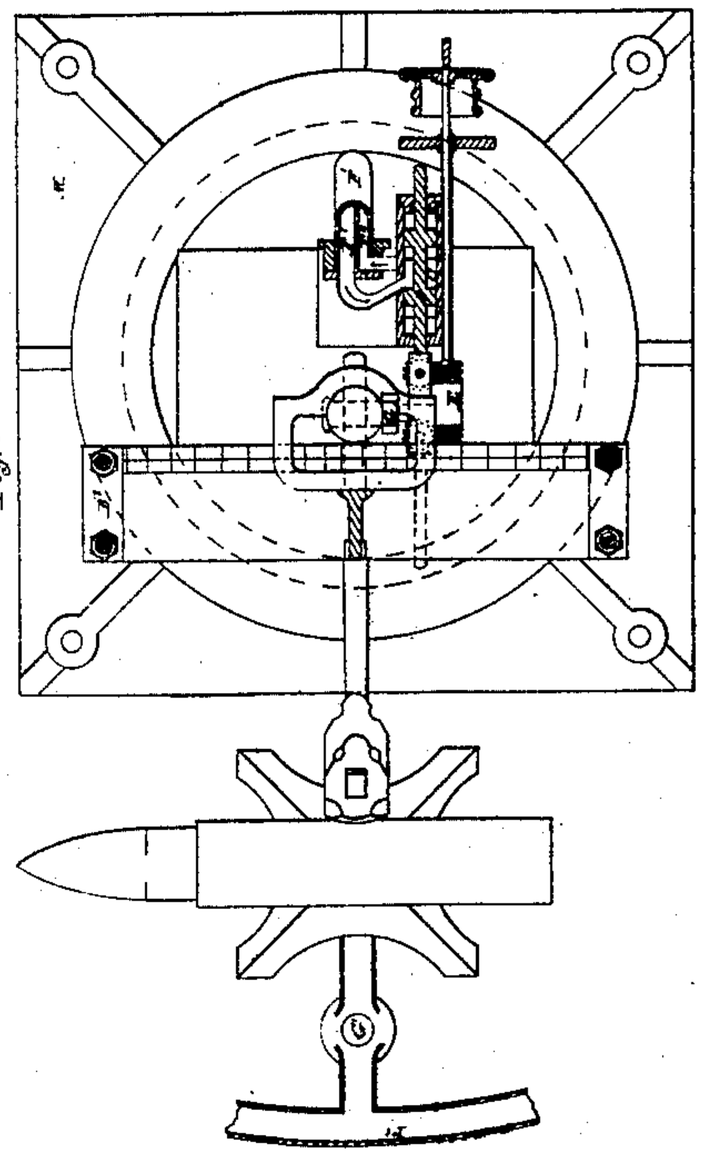


Fig. 9.



Witnesses:

Inventor

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D. DAVIES.

FORGING APPARATUS.

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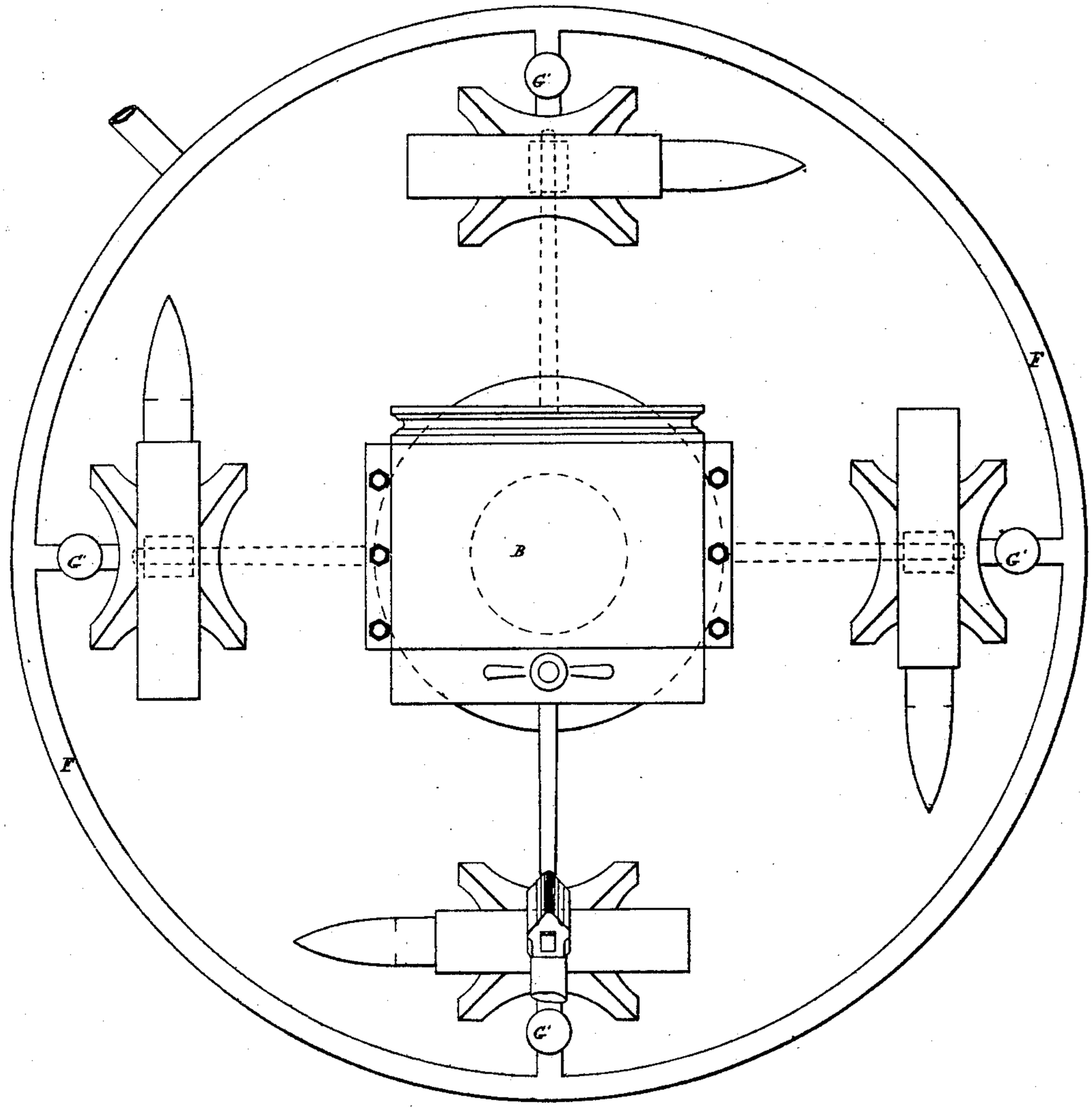

Fig. 7.

Witnesses:

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5 Sheets—Sheet 4.

D. DAVIES.

FORGING APPARATUS.

No. 82,093. Patented Sept. 15, 1868.

Fig. 13.

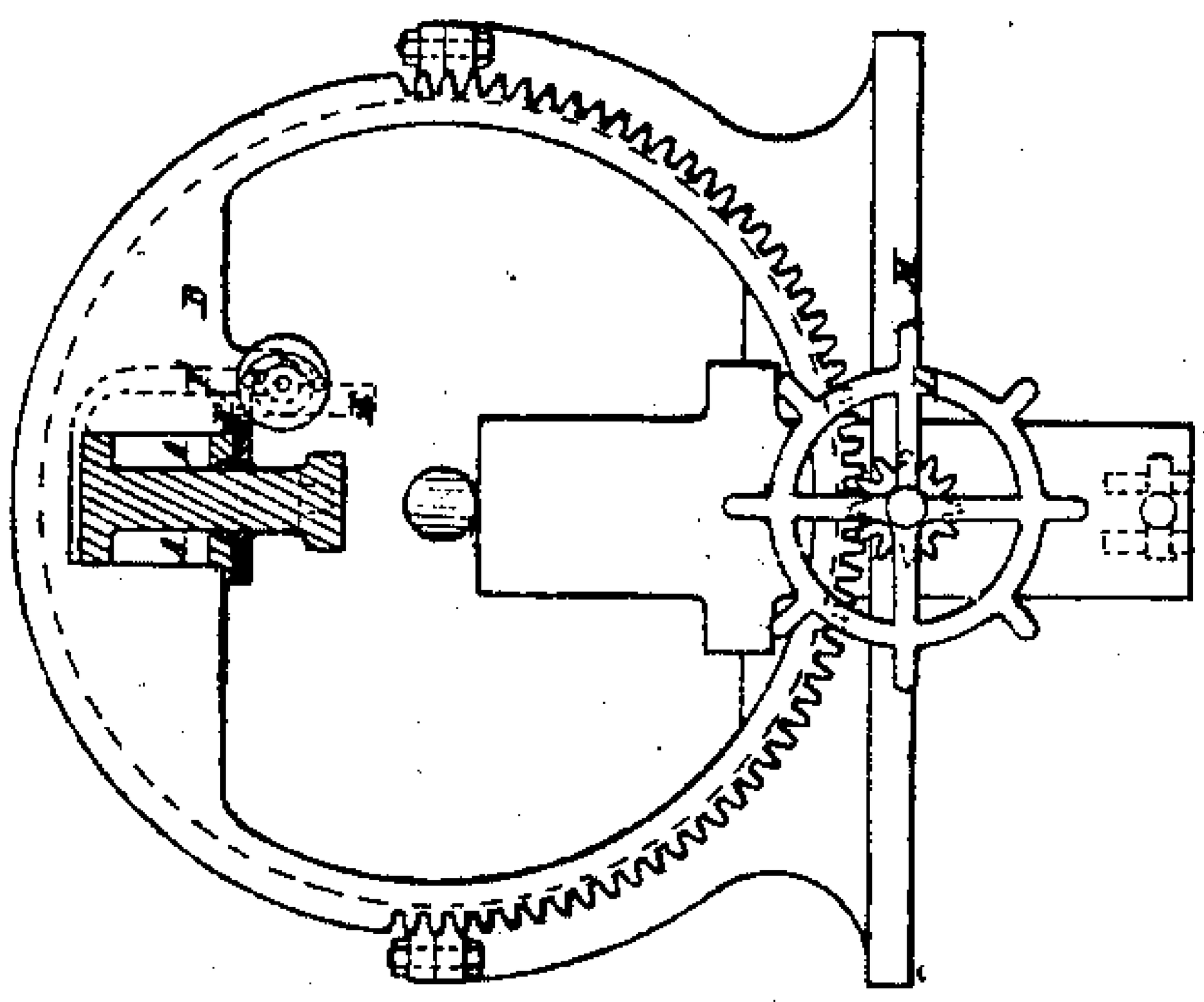


Fig. 15.

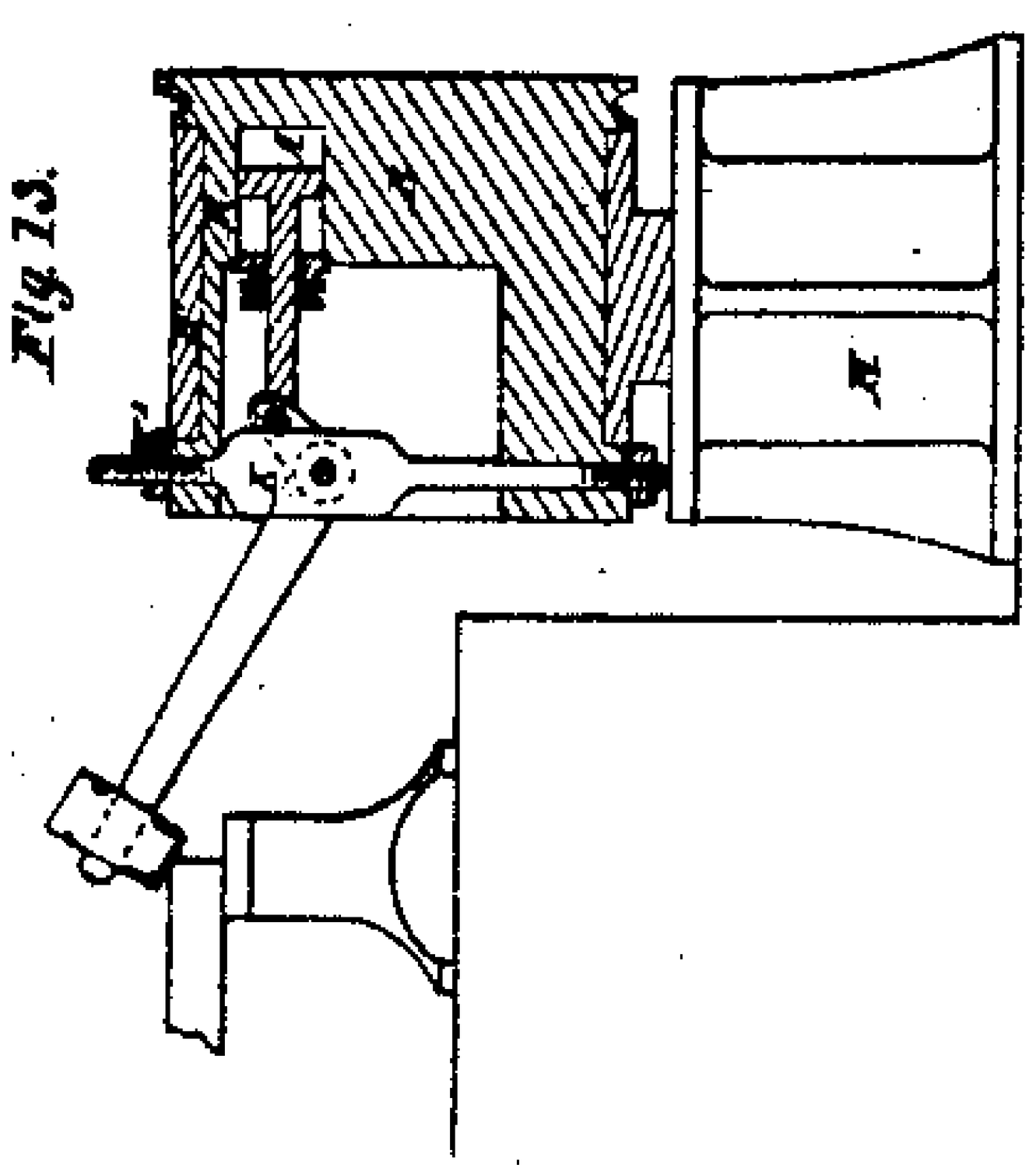


Fig. 14.

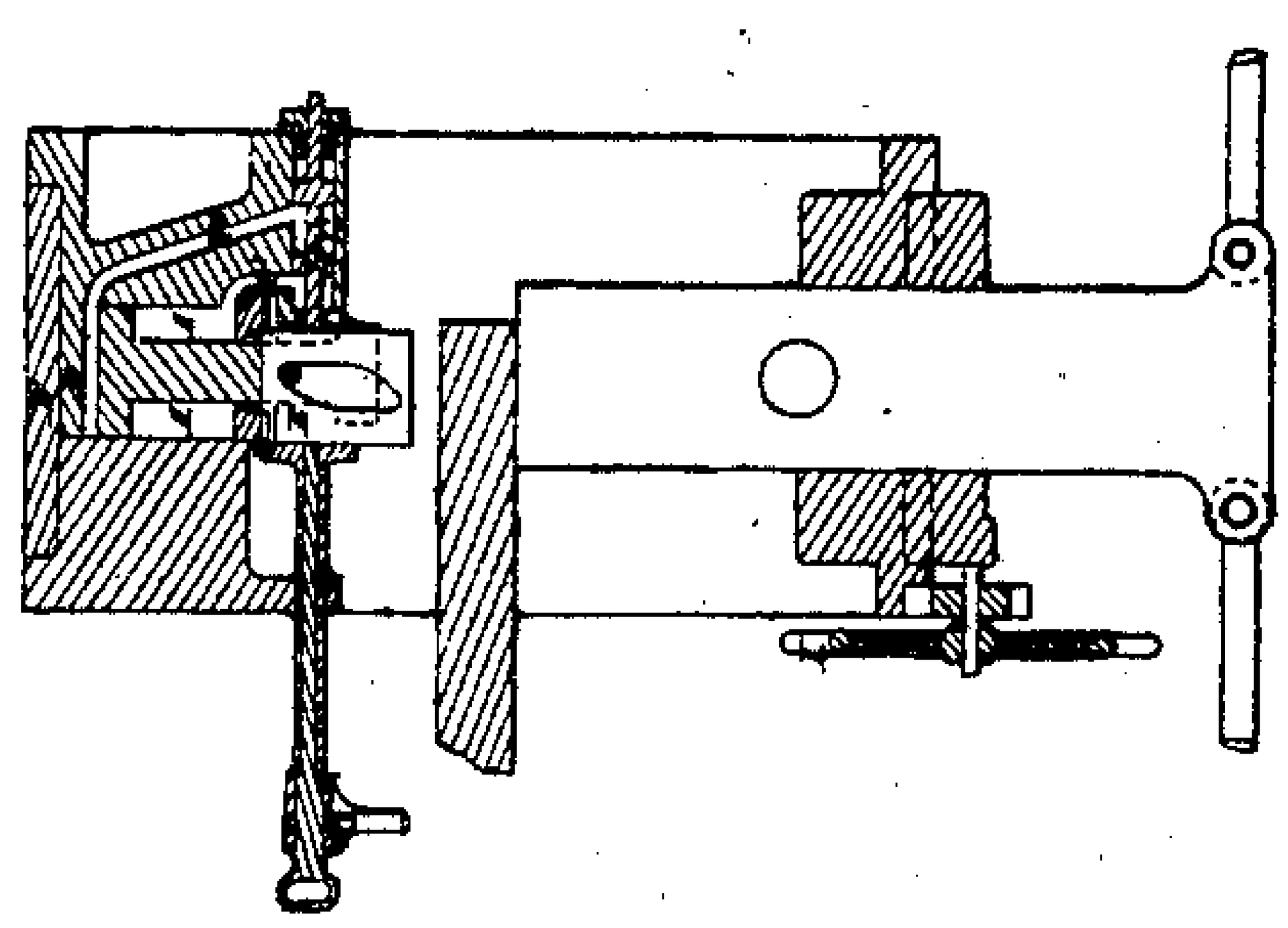


Fig. 11.

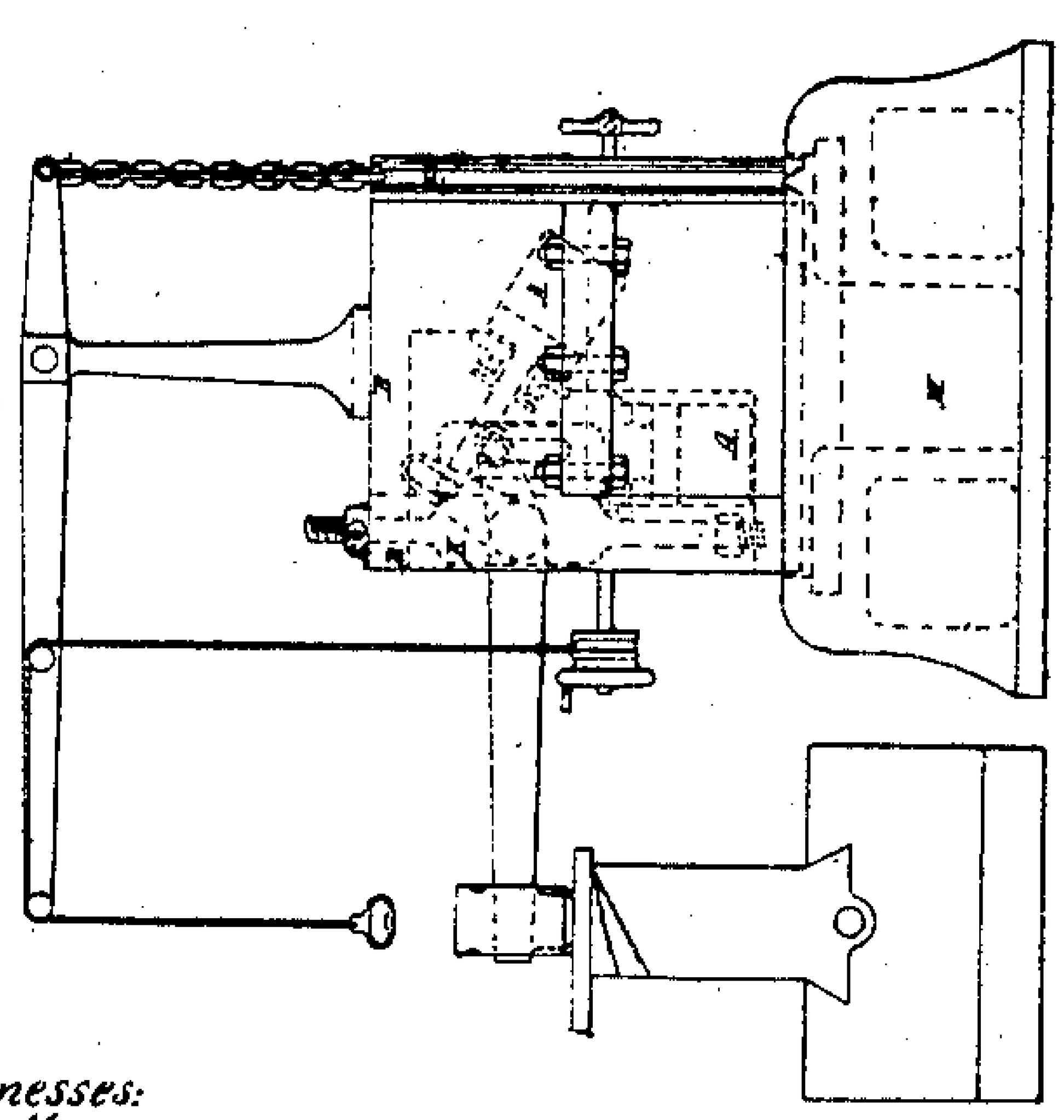
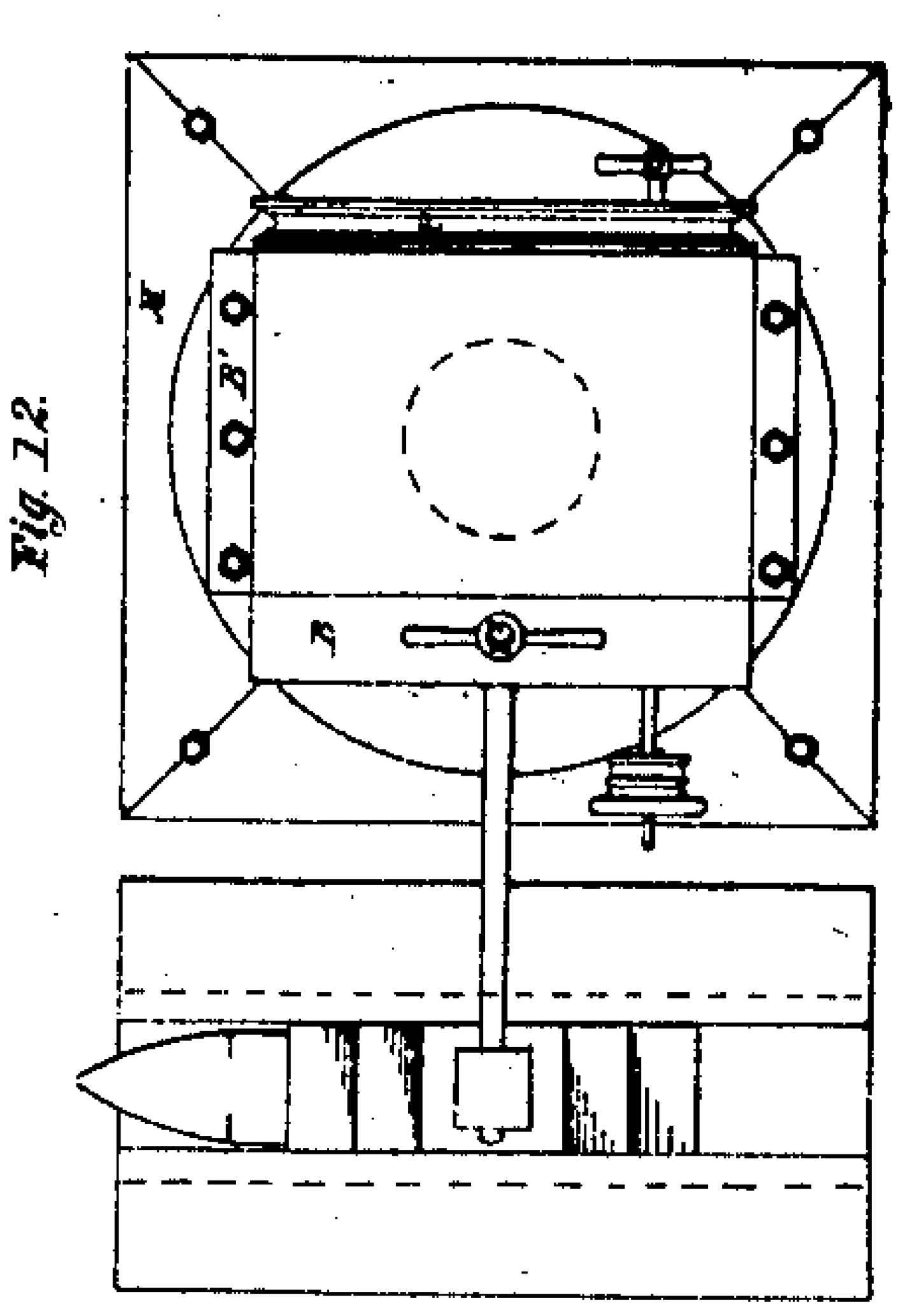


Fig. 12.



Witnesses:

Inventor:

5 Sheets—Sheet 5.

D. DAVIES.

FORGING APPARATUS.

No. 82,093. Patented Sept. 15, 1868.

Fig 16.

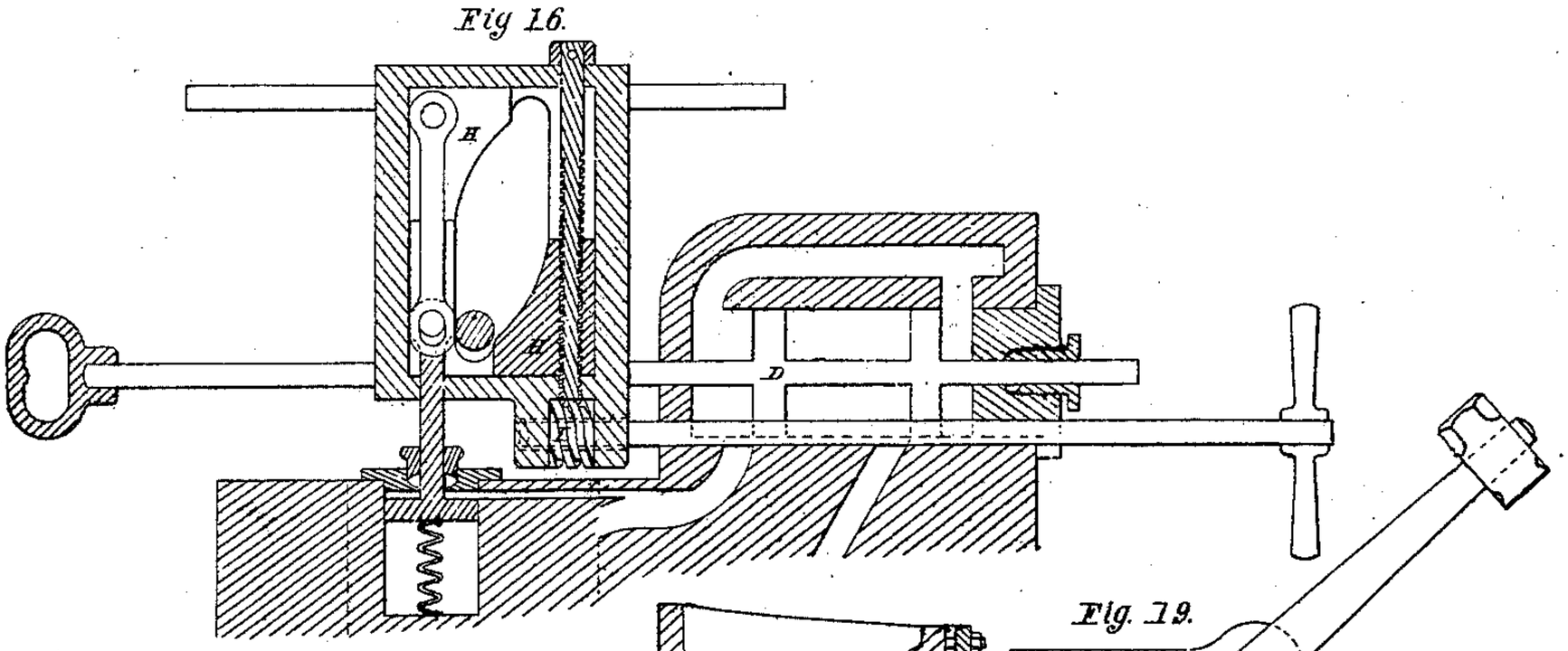


Fig 17.

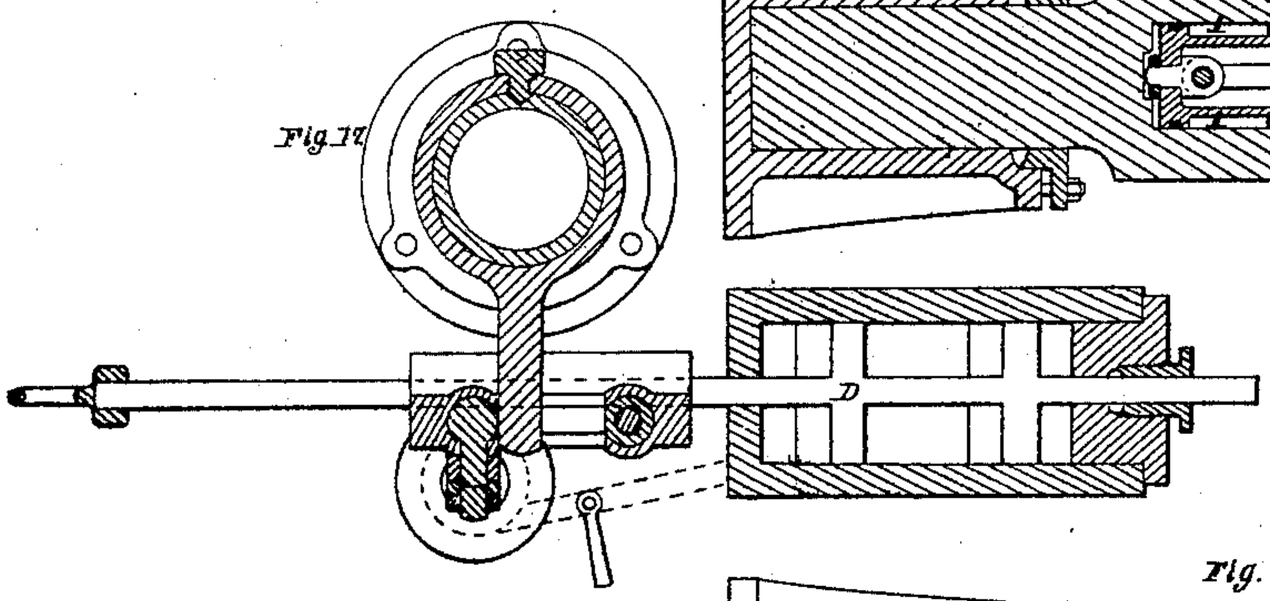


Fig. 19.

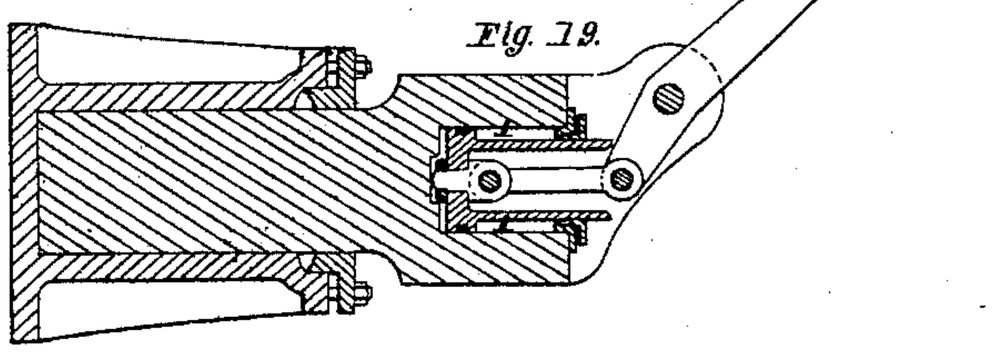


Fig. 20.

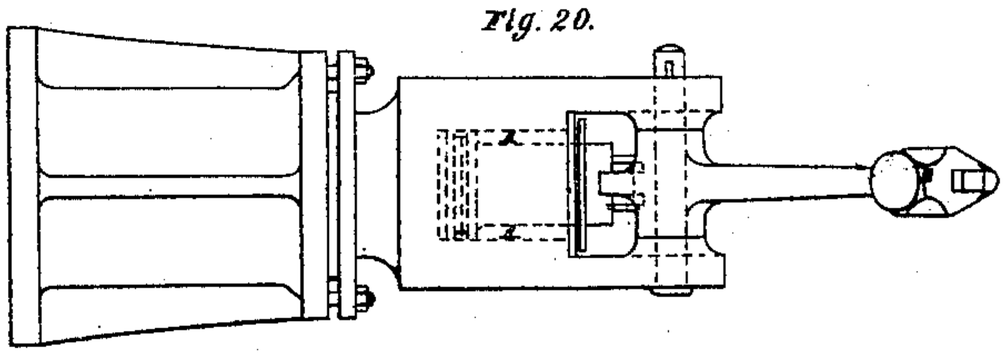


Fig 18.

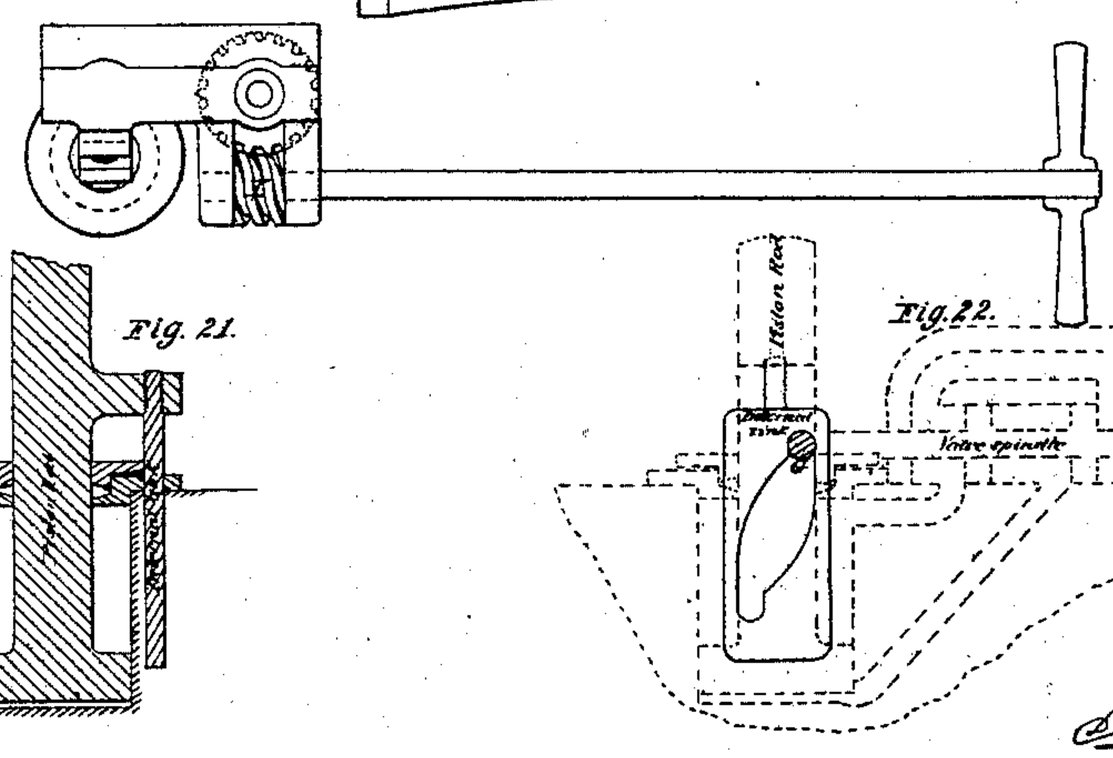


Fig. 21.

Fig. 22.

Witnesses:
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Chas. F. Copeland

Inventor:
D. Davies

United States Patent Office.

DAVID DAVIES, OF CRUMLIN, ENGLAND.

Letters Patent No. 82,093, *dated September* 15, 1868.

IMPROVED FORGING-APPARATUS.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, DAVID DAVIES, of Crumlin, in the county of Monmouth, England, have invented certain new and useful Improvements in Steam-Hammers; and I do hereby declare that the following is a full, clear, and exact description thereof.

My invention, secured in England by Letters Patent, dated the 24th of August, 1865, and sealed the 20th of February, 1866, consists in rendering steam-hammers capable of delivering blows, not only perpendicularly to the face of the anvil, but also in directions inclined to the face of the anvil, as may be required, during the operation of forging, the hammer at the same time being capable of delivering blows with various lengths of stroke and of various degrees of force.

I fix the steam-cylinder, which is employed in working the hammer, whether by means of an arm or by direct action, inside of and in firm connection with a horizontal cylinder, the two cylinders having their axes at a right angle or at any other angle to each other, or they may have their axes in parallel lines to each other.

The horizontal cylinder is so fitted as to be capable of being turned round on its axis in suitable bearings, in a vertical plane, and so carry with it the steam-cylinder and hammer, and the hammer is by this means rendered capable of delivering its blows in various directions.

The horizontal cylinder may be turned round in the bearings by various means, whether by levers or otherwise, which means can be placed under the control of the smith or other person using the hammer.

I place the steam-chest at right angles to the axis of the steam-cylinder, the steam-chest being fitted with common cylindrical equilibrium-valves, and I work the valves by an internal link or eccentric-cam, which is actuated by a stud projecting from the piston-rod.

The internal link is fitted with a sliding plate at each end, by means of which I regulate the length of stroke and vary the force of the blows to suit the size and nature of the forging.

If preferred, water or compressed air may be used, instead of steam, to actuate the piston.

Where the hammer is worked by an arm, I fit the socket supporting the arm so that it can be raised or lowered, relative to the centre of the horizontal cylinder by which it is supported, to suit the various sizes of forgings.

I also, where an arm is used, support the bearings on which the horizontal cylinder rests, either on a bed-plate, fixed to the floor, or on the piston of a hydraulic ram, or on some other arrangement of machinery by means of which the horizontal cylinder can be raised or lowered for the purpose of varying the angles of blows in relation to the face of the anvil, and the ram or other machinery can be so constructed that the hammer may be brought to bear on any number of anvils placed at equal distances from the centre round which the hammer turns.

Having thus set forth the nature and object of my said invention, I shall endeavor more particularly to describe the same, and in order thereto I shall refer to the accompanying sheets of drawings, on which the same letters refer to the same portions on the different figures, thus:

Figures 1 and 8, 4 and 9, show vertical and horizontal sections of the apparatus.

Figure 3, front view, showing the hammer up.

Figure 5, front view, showing the hammer striking horizontal blows suitable for upsetting.

Figure 6, front view, showing the hammer in position to strike at an angle of forty-five degrees.

Figure 7, Drawing No. 5, shows plan as arranged for four anvils.

Figure 10 shows end view of fig. 8.

Figure 11, Drawing No. 3, elevation with steam-cylinder, shown dotted at an angle of thirty degrees, inclined to the axis of the horizontal cylinder.

Figure 12, plan of same.

Figure 13, part elevation, with steam-cylinder in section, showing mode of striking at an angle to the face of the anvil.

Figures 14 and 15 show vertical and transverse sections of a direct-acting hammer.

Figure 16, Drawing No. 4, shows enlarged sectional elevation of the internal link.

Figure 18, plan of same.

Figure 17, section of same.

A shows a vertical steam-cylinder, (but compressed air or water may be employed to actuate the piston, if thought preferable to steam,) which cylinder is of the kind known as double-acting, and may be cast inside at a right or any other angle to the axis of the horizontal cylinder, as shown in drawing, which shows the horizontal cylinder so formed as to contain within it the steam-cylinder, steam-chest, inlet, outlet, and all the necessary induction and eduction-ports, cast in one piece; but the steam-cylinder may be so formed by casting it separately and placing it inside the horizontal cylinder, but I prefer the method shown, for simplicity.

The horizontal cylinder is so fitted that it can be turned around in its bearings in a vertical plane in either direction, and so carry with it the steam-cylinder, hammer, and hammer-arm, for the purpose of causing the blows to be struck to radiate from the centre or face of the anvil, as may be required during the operation of forging.

The steam-cylinder is shown on Drawing No. 1, with its axis at right angles to the axis of the horizontal cylinder, but this may be altered, if necessary, by placing the axis of the steam-cylinder at any other angle to the axis of the horizontal cylinder, as shown in Drawing No. 3, fig. 11, on which the steam-cylinder is shown with its axis placed at an angle of thirty degrees, inclined to that of the horizontal cylinder, or it may be placed parallel to the axis of the horizontal cylinder, as shown on Drawing No. 3, fig. 13.

The horizontal cylinder can be revolved in its bearings in either direction for the purpose of varying the angle of blows to be struck on either the right or left hand of the smith, either by a light chain fastened in a groove, P, cast in a flange on the horizontal cylinder, and connected to the short end of the lever, which lever is within reach of the smith, and is supported by a light pillar standing on the gland B′ of the horizontal cylinder, as shown in Drawing No. 3, fig. 11, or, where the horizontal cylinder is supported on a hydraulic ram, it may be turned in its bearings by placing a light chain in the groove, and passing it over a pulley or pulleys, to bring it within the reach of the smith, who can vary the angles by simply dropping the chain on a stud near the anvil, as it will be seen that if the end of the chain is held by the stud while the pressure is turned under the hydraulic ram, it will cause the horizontal cylinder to revolve in its bearings, and at the same time vary the angles of blows to be struck; or it may be revolved by a treadle or by a hand-wheel, as shown in fig. 15, Drawing No. 3, or otherwise by a separate cylinder or piston, or it may be revolved by causing the piston-rod of the steam-cylinder to actuate a pawl or ratchet, as shown in Drawing No. 2, fig. 10. The piston is of the ordinary construction, and the piston-rod is slotted to receive the hammer-arm, which plays in the slot, and the two are connected by a cross-stud or pin, G, secured to the piston-rod, the hole in the hammer-arm, through which the stud or pin passes, being elongated, as shown by dotted lines in fig. 8, to give the required play. The stud or pin G projects from one side of the piston-rod into a cam-formed opening in the link, to operate the valve, as shown in figs. 8 and 9. But this mode of connecting the hammer-arm with the piston may be changed in various ways, as, for instance, in Figures 1, 4, 17, and 19, in which the hammer-arm is connected with the piston by a jointed link, which is free to vibrate within a hollow piston-rod called a "trunk."

It will be understood that the mode of connecting the hammer-arm with the piston may be greatly varied, as it makes no part of my invention.

C, steam-chest, which is shown at right angles to the axis of the steam-cylinder, but it may be placed in any other position, if preferred, and is fitted with a cylindrical valve, D, but any other form of valve may be used, if preferred, and may be worked directly, or otherwise, from an internal link, E, which link is actuated by a stud or pin, G, projecting from the piston-rod, or the link may be made to move with the piston-rod, to give lateral motion to the stud on the valve-spindle. F^1, steam-inlet; F^2, port leading to top of piston; F^3, port leading to bottom of piston; F^4, exhaust, which port communicates with the pipe F^1 F^4. This pipe is made double, by casting a diaphragm, represented in figs. 4 and 9, in the inside, which makes it serve the double purpose of a steam and exhaust-pipe.

The internal link E and stud G serve to make the machine self-acting, by controlling the main valve at the height of fall of the hammer, and consequent force of the blows can be regulated to any degree of nicety by the smith or other person using the hammer.

The above-mentioned internal link is made the exact length, corresponding to the full length of the stroke of the piston, plus the clearance at each end of the cylinder, for the purpose of working the piston to its full length of stroke. But it is fitted with a sliding plate, H, at each end, which sliding plates are so fitted that they can be moved or adjusted to any required position, either from the top or bottom of the link, for the purpose of so actuating the main valve as to work the piston through any fraction of the stroke, either from the top or bottom of the cylinder.

These sliding plates H can be moved or adjusted to any required position, by the worm, I, as shown in Drawing No. 4, figs. 16 and 18, or they can be moved by cutting teeth in each plate, to allow a pinion to work therein, or they may be moved by any other means, if preferable to the modes explained.

The above-named sliding plates, by being moved up or down, which may be done as above described, so actuate the main valve as to admit, suppress, and release the steam at any required fraction of the stroke. The said form of link may, however, be made solid, that is, the slide-plates may be dispensed with, if necessary.

Where the hammer-arm is supported on a movable or adjustable pivot, I fix the pivot in a wrought-iron socket, K, which supports the hammer-arm, as shown in drawings 1 and 3, figs. 1, 11, and 13, and this socket is so fitted that it can be raised or lowered, to suit the various-sized forgings, by means of the hand-wrench K^1.

Thus, if a piece of iron, say, four inches in diameter, is required to be forged round and true, without swages, the fulcrum of the hammer-arm must describe a circle of four inches. The hammer-pivot would in this case stand two inches above the centre of the horizontal cylinder, and would consequently, if the horizontal cylinder were rotated, describe a circle of four inches in diameter on the anvil, as the distance of the stud-

pin (on which the hammer hinges) from the centre of the cylinder would become the radius of the circle described by the hammer-face upon the face of the anvil in all cases, and this distance can be varied at pleasure by the hand-wrench K¹, which works on a thread formed on the top of the socket, for the purpose of altering the position of the stud relatively to the horizontal cylinder, as before stated.

L is an annular hydraulic ram, which raises and lowers the horizontal cylinder with its hammer and arm, for the purpose of striking level blows on any given thickness, and also for varying the angles of blows to the face of the anvil. The top of this ram is so formed as to become the bottom bearing of the horizontal cylinder, and is so fitted that it can be turned around in a horizontal plane, to suit any number of anvils arranged at equal distances from the centre, as shown in Drawings No. 5, fig. 7, arranged for four anvils.

If thought preferable to fixing the horizontal cylinder on the top of a hydraulic ram, or some other suitable machinery, for the purpose of raising and lowering the steam-cylinder, as just described, it may be made as shown in Drawing No. 2, figs. 8 and 9, which show the bearing of the horizontal cylinder fitted into a cast-iron bed-plate, marked M, which is secured to the floor of the smithy. The horizontal cylinder can in this case be turned around in its bearings by chains, levers, or otherwise, or it can be revolved by causing the piston-rod to actuate a pawl, which works into ratchet-teeth cast on the gland of the horizontal cylinder, as shown in Drawing No. 2, fig. 10.

N¹ is an inclined slot formed in the piston-rod, for the purpose of giving lateral motion to the slide-block which carries the pawls. These pawls work in the ratchet-teeth N², formed in the gland B¹ of the horizontal cylinder, and so cause the horizontal cylinder to revolve to any desired angle. Then the pawls are disengaged from the ratchet-teeth by hand, and, as the hammer in this case is only capable of varying its blows on either the right or left hand of the smith from a vertical line, and as it will be often necessary to strike blows at any angle from a horizontal line, the face of the anvil-block may be made with bevelled divisions, as shown in figs. 11 and 12, which anvil-block can be moved laterally, by a screw or otherwise, so as to bring the required bevel directly under the hammer-face, thereby rendering the hammer capable of striking blows at given angles from a horizontal line; or the anvil may be so fitted that it can be turned around on its centre in a horizontal plane, so as to bring any required swage-hole directly under the hammer-face. The horizontal cylinder may in this case be so fitted in its bed-plate that it can be turned around in a horizontal plane, to suit any number of anvils placed at equal distances around the centre, as shown in Drawing No. 5, fig. 7.

L¹ is the hydraulic cylinder, which is made annular, for the purpose of allowing the steam-pipe F¹ to pass through. The steam-pipe is in this case fitted with a gland and stuffing-box, to permit the steam-pipe to be raised and lowered with the steam-cylinder; or, in other words, the steam-pipe is made telescopic inside the annular space of the hydraulic cylinder, as shown in Drawing No. 1, fig. 1; or the ram may pass through the bottom of the cylinder, to receive the steam-pipe which connects the steam-chest with any suitable boiler. This steam-pipe has a branch-pipe, E¹, provided with an admission-valve, C′, for the purpose of putting the hammer in action, which valve I place near the anvil, for the purpose of being actuated by the smith's foot, as shown in Drawing No. 2, figs. 8 and 9.

Where the hammer is arranged for any number of anvils, I place a foot-valve near each anvil, as shown in plan for four anvils, fig. 7. The hammer may be moved from one anvil to the other, either by hand or by a separate cylinder or piston, or by any other separate machinery.

The above arrangements are also applicable to working a direct-acting hammer, as shown in Drawing No. 3, figs. 14 and 15, in which it will be seen that the steam-cylinder A is cast inside, at a right angle to the axis of the horizontal cylinder B, and the steam-chest C is at right angles to the axis of the steam-cylinder, and is fitted with an equilibrium-valve, D, which is worked direct by an internal link, actuated as before described.

It will be seen that this hammer can be moved to any desired angle, from a vertical to a horizontal line, by either of the modes explained for revolving the cylinder of a pivot-hammer, or it can be revolved by a hand-wheel, I, which gives motion to a pinion working into teeth cast on the horizontal cylinder, as shown, or it may be otherwise revolved by a separate hydraulic or steam-cylinder.

Having now fully described and illustrated my said invention, together with the best means I am acquainted with for carrying the same into practical effect, I wish it to be understood that I do not confine myself to the precise forms, dimensions, or relative proportions hereinbefore mentioned or referred to, as they may be considerably varied without departing from the principle of my invention; neither do I claim the use of the equilibrium-valve; but

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The steam-cylinder and piston, connected with the hammer-arm, so as to operate the same, in combination with the horizontal cylinder, arranged so that it can be turned, and in which the steam-cylinder is mounted, substantially as described, so that the direction of the blows, relatively to the face of the anvil, can be changed.

2. The steam-cylinder and piston, connected with the hammer-arm, so as to operate the same, and mounted in the horizontal cylinder, arranged so that it can be turned, to change the direction of the blows, relatively to the face of the anvil, substantially as described, in combination with the hydraulic ram, for raising and lowering the same, to adapt it to articles of various thicknesses or height, substantially as described.

3. Connecting the horizontal cylinder with its base, so that it can be turned in a horizontal plane, in combination with the steam-cylinder and piston connected with the hammer, substantially as and for the purpose described.

DAVID DAVIES.

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JOHN V. KNAPP.