(No Model.)

5 Sheets—Sheet 1.

J. H. MANNING.

PNEUMATIC DRILL.

No. 591,284. Patented Oct. 5, 1897.

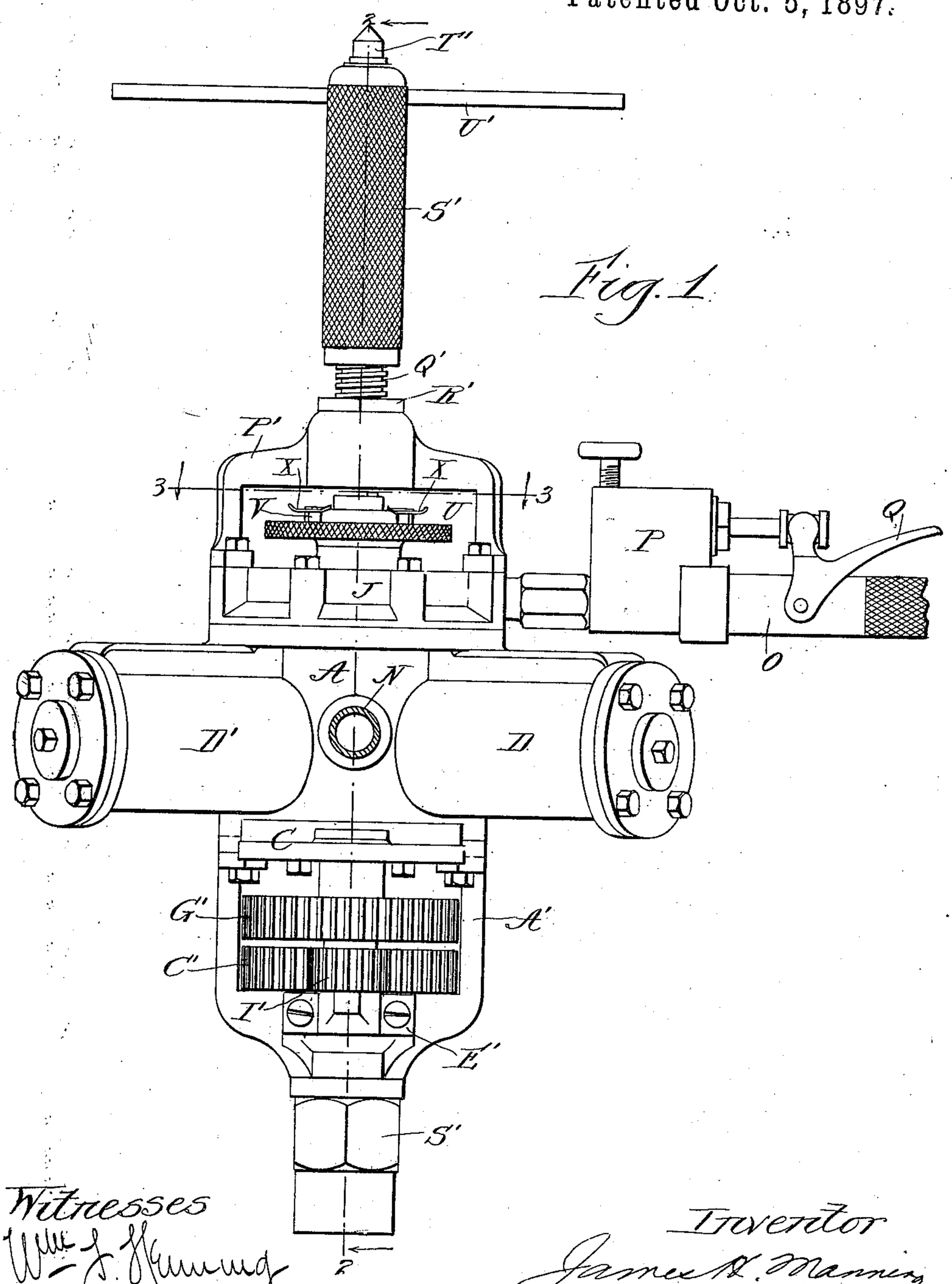

Fig. 1.

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(No Model.)

5 Sheets—Sheet 2.

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PNEUMATIC DRILL.

No. 591,284. Patented Oct. 5, 1897.

Fig. 2.

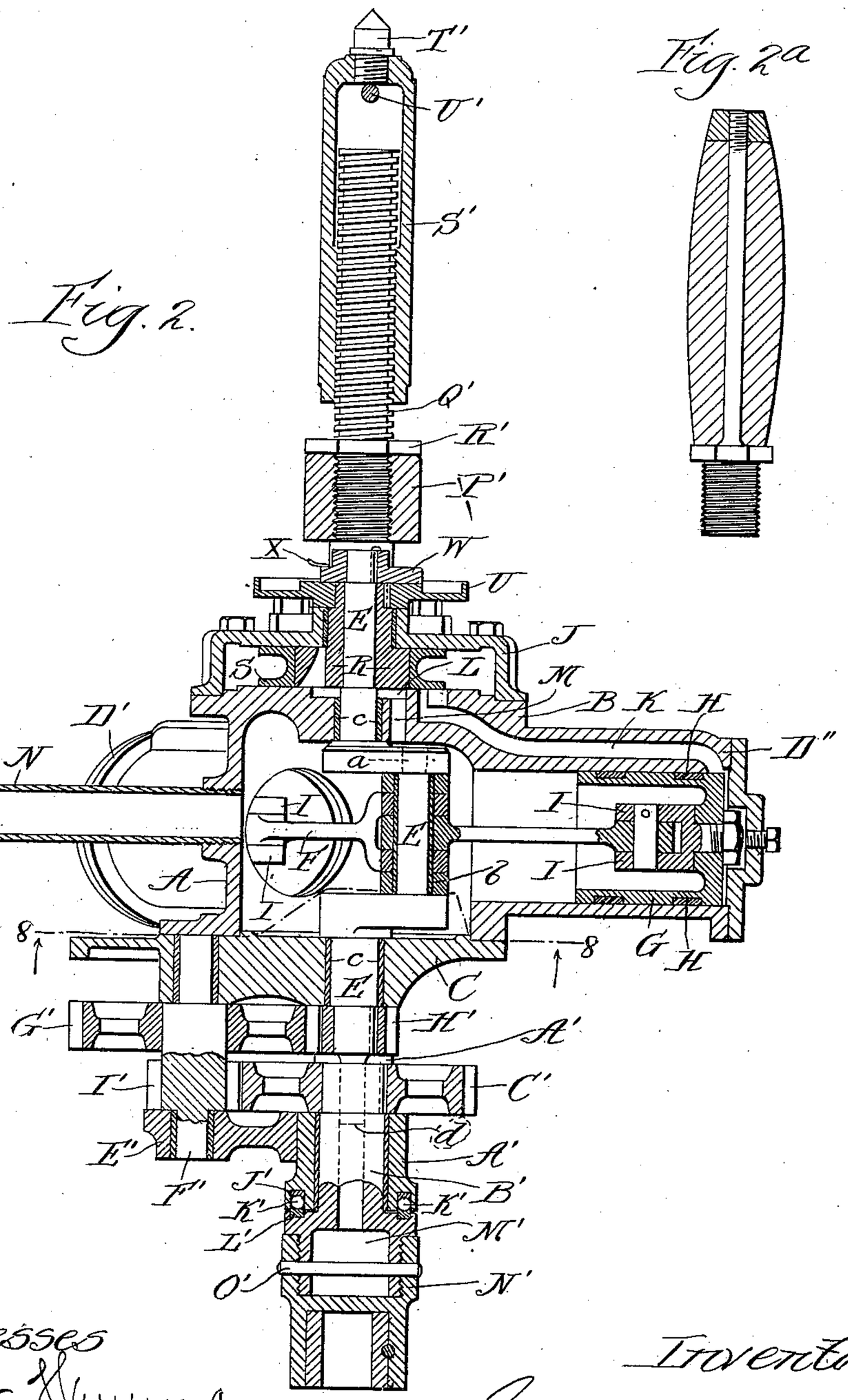

Fig. 2a.

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PNEUMATIC DRILL.

No. 591,284. Patented Oct. 5, 1897.

Fig. 3.

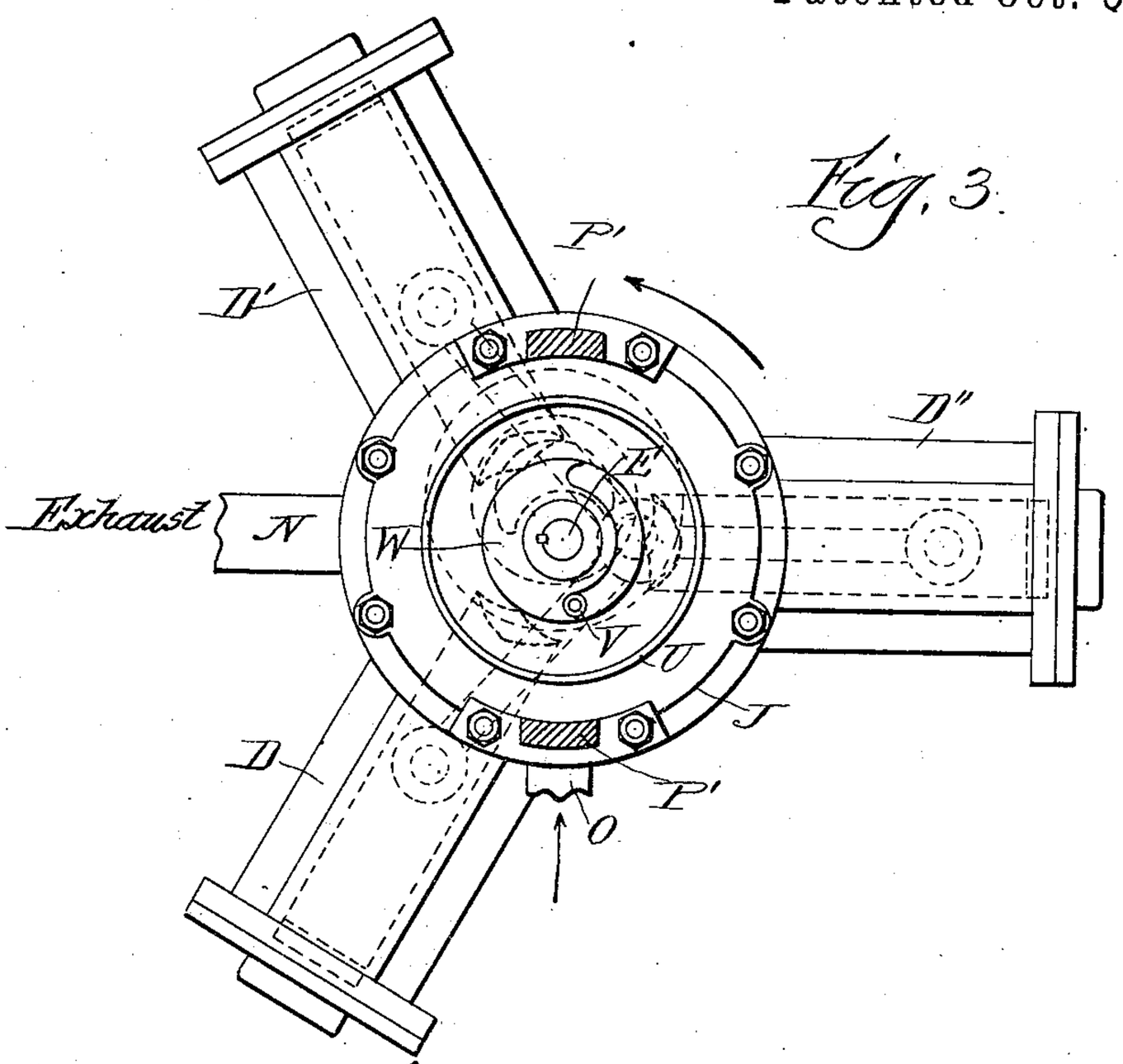
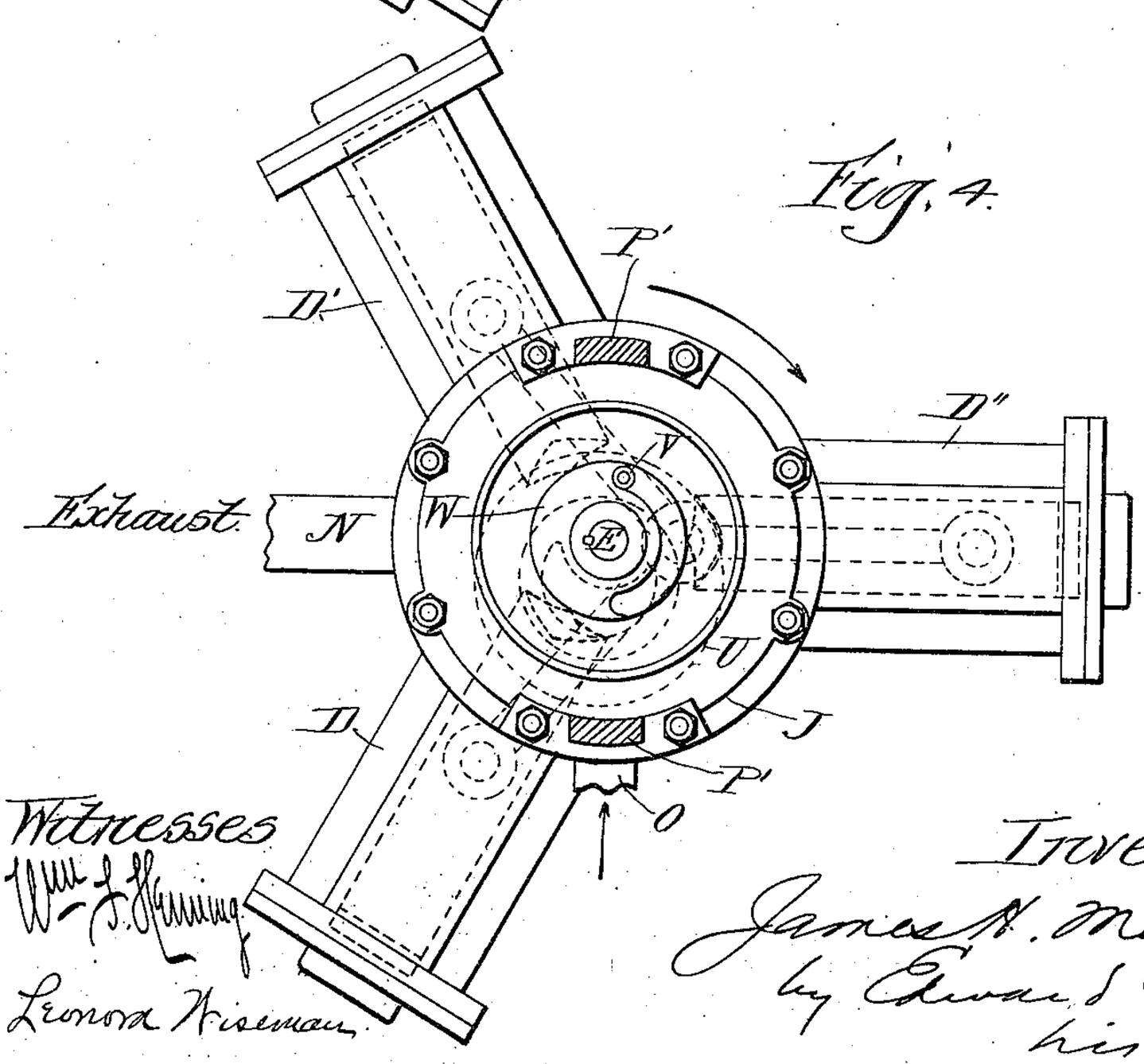


Fig. 4.



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PNEUMATIC DRILL.

No. 591,284. Patented Oct. 5, 1897.

Fig. 5.

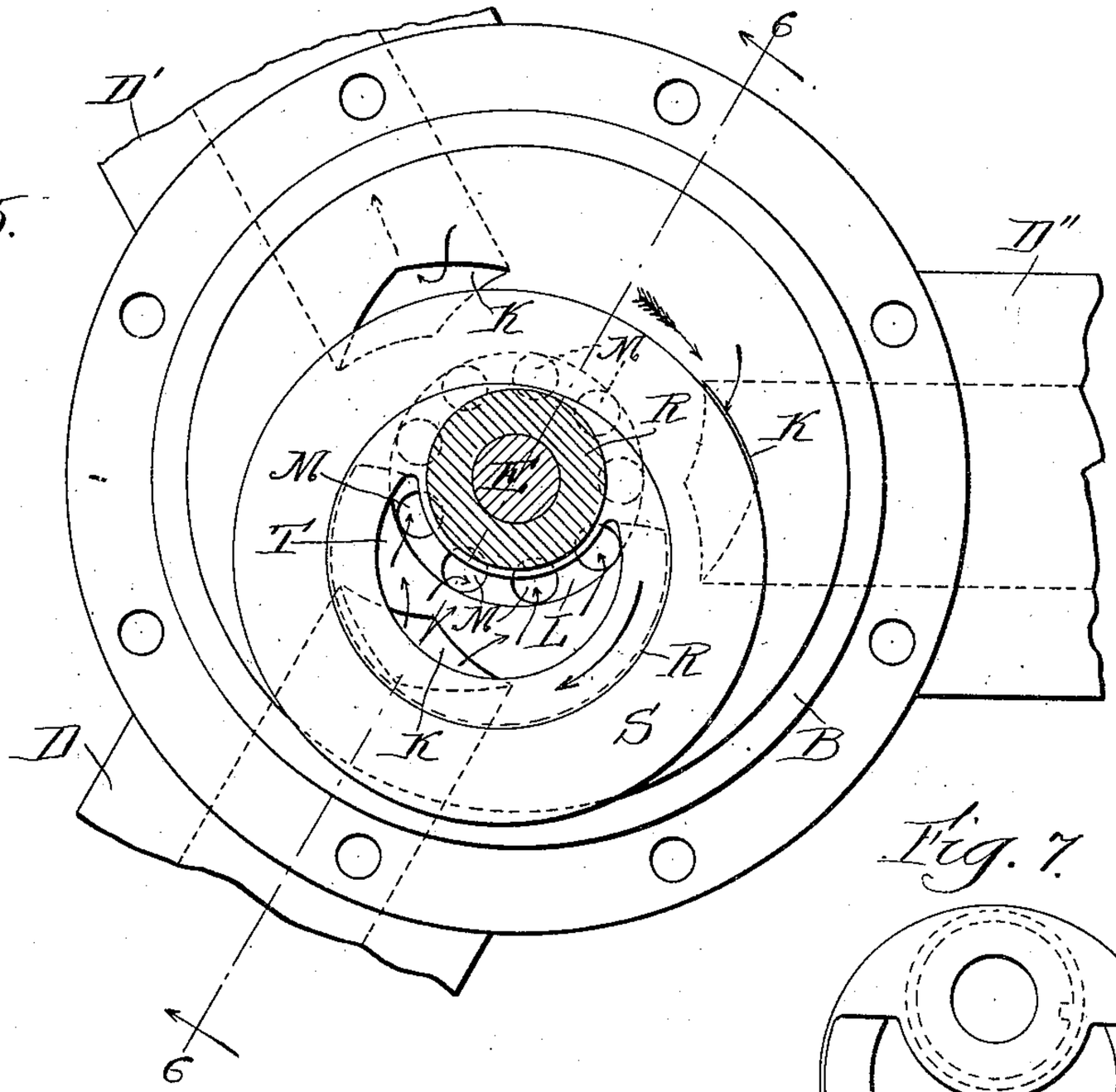


Fig. 7.

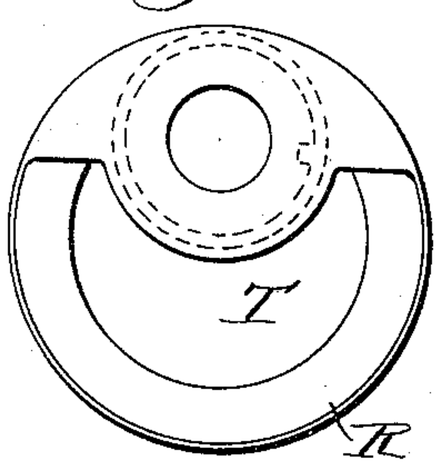
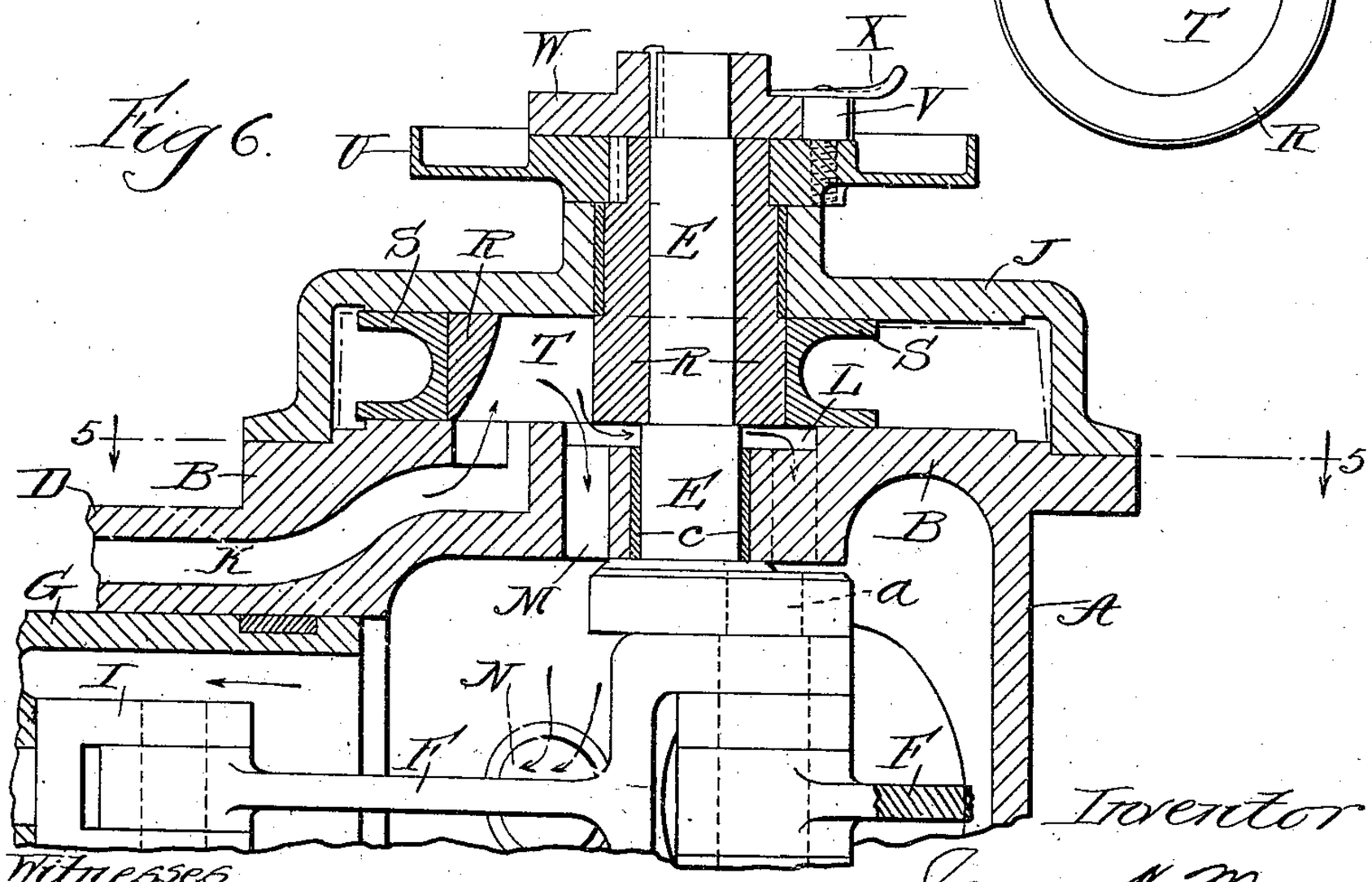


Fig 6.



Witnesses.
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(No Model.)

5 Sheets—Sheet 5.

J. H. MANNING.

PNEUMATIC DRILL.

No. 591,284. Patented Oct. 5, 1897.

Fig. 8

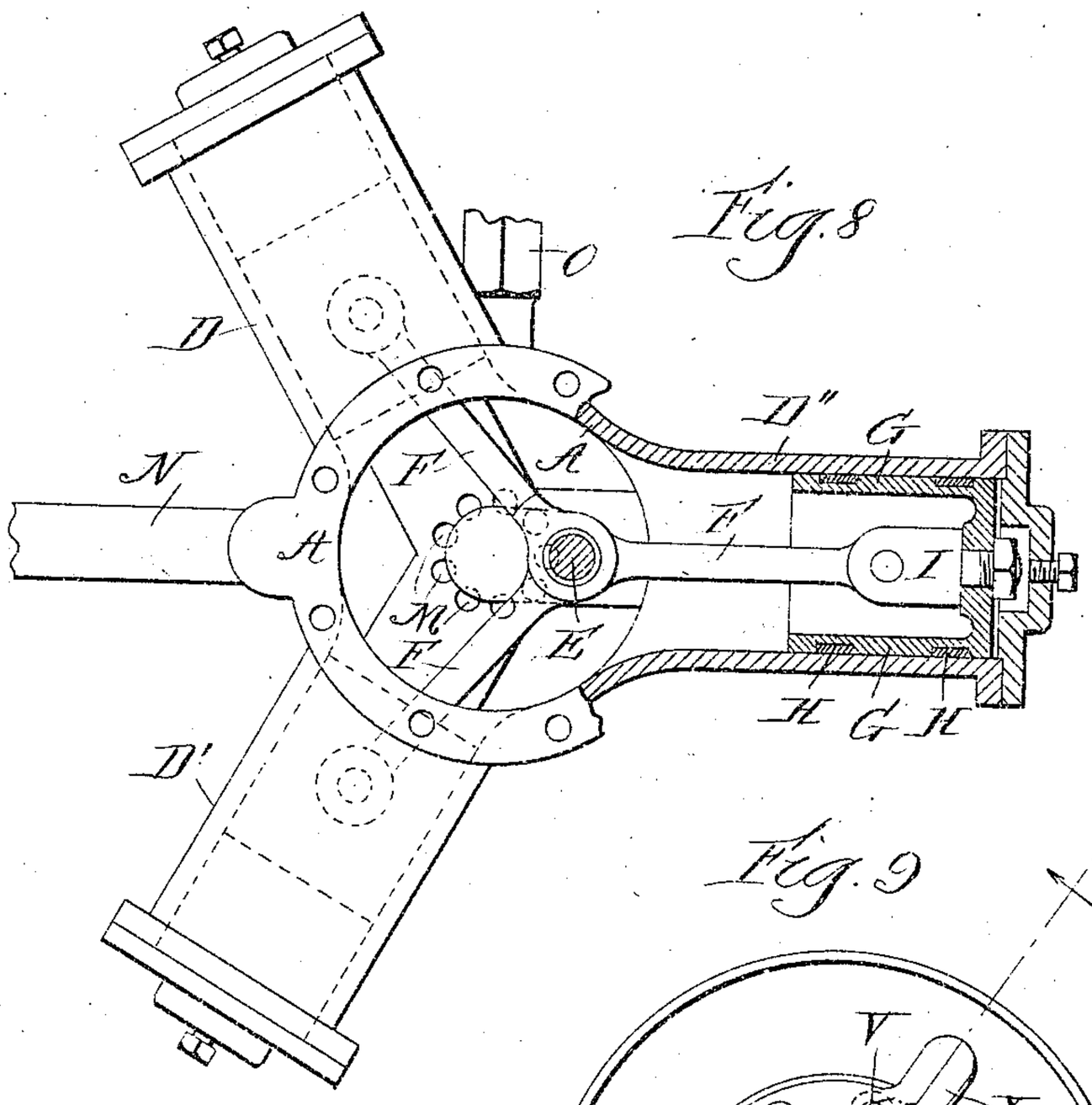


Fig. 9

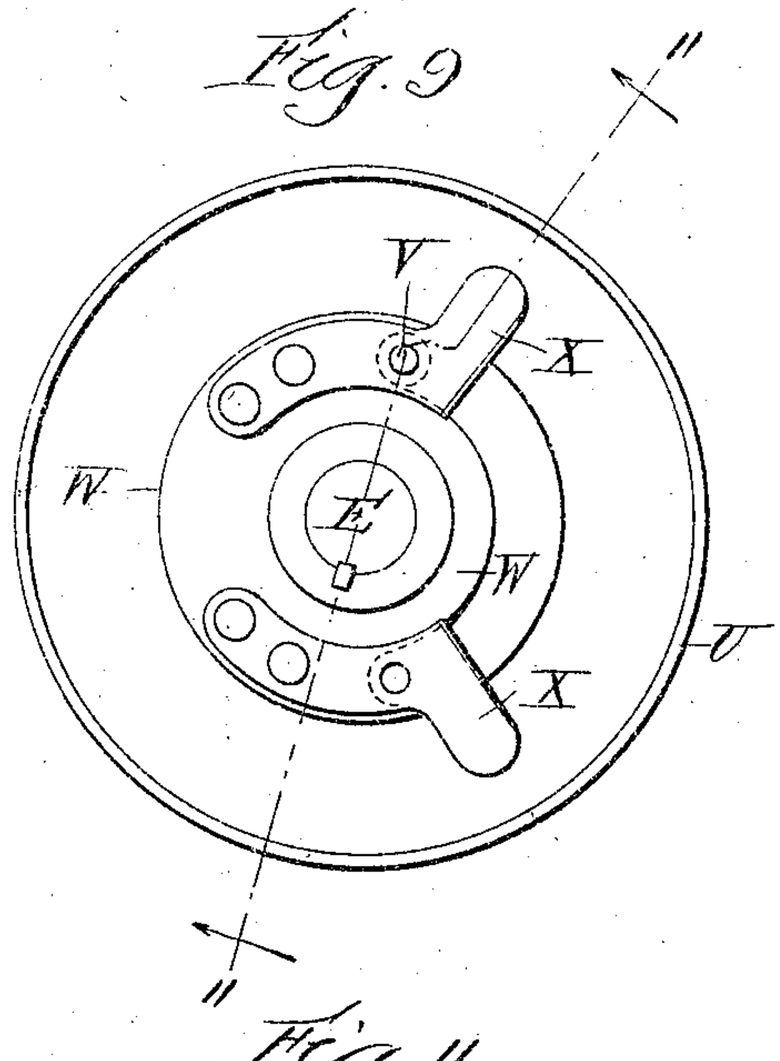


Fig. 10.

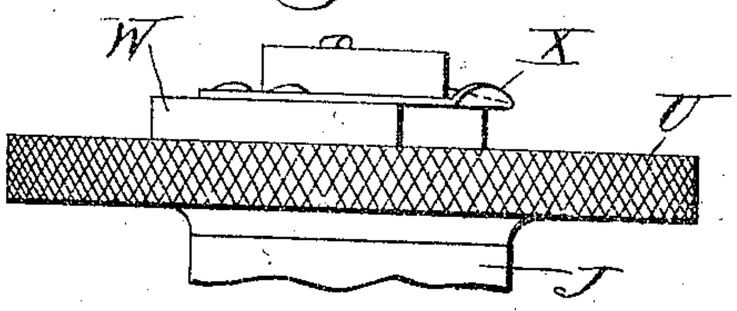
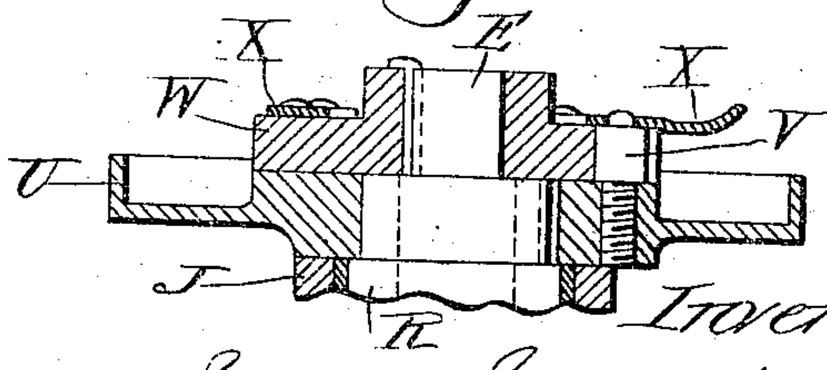


Fig. 11.



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Leonora Rosenau

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UNITED STATES PATENT OFFICE.

JAMES H. MANNING, OF OMAHA, NEBRASKA.

PNEUMATIC DRILL.

SPECIFICATION forming part of Letters Patent No. 591,284, dated October 5, 1897.

Application filed July 9, 1896. Serial No. 598,524. (No model.)

To all whom it may concern:

Be it known that I, JAMES H. MANNING, a citizen of the United States, residing at Omaha, in the county of Douglas, in the State of Nebraska, have invented a certain new and useful Pneumatic Drill, of which the following is a description, reference being had to the accompanying drawings, forming part of this specification.

While I have termed my machine a "pneumatic drill," its use is not restricted to drilling, as will be hereinafter explained.

The object of my invention is to provide a light, portable, self-contained machine embodying an engine operated by compressed air or steam (preferably the former) to drive a rotary shaft fitted with a connection to engage suitable sockets to receive drills, taps, reamers, and other tools and provided with a hand feeding device and with a simple reversing-gear, so that the machine may be equipped with drills, taps, reamers, or other suitable tools for the work to be done and so that a bolt or nut having either a right or left hand thread may be driven in either direction, the whole machine to be of such design that it will be suitable for machine-shop work or for bridge, boiler, and miscellaneous structural work, and which may be readily handled by the workman and held in any position necessary for the work and be equally effective in operation, whether in vertical, horizontal, or other position.

Having thus indicated the general nature of my invention, I will proceed to describe the particular embodiment of it illustrated in the accompanying drawings, in which—

Figure 1 is an elevation of the machine facing the main exhaust-pipe and at right angles to the air-inlet pipe; Fig. 2, a vertical section approximately on the line 2 2 of Fig. 1; Fig. 2^a, a detail view of the removable handle; Figs. 3 and 4, sectional plan views on the line 3 3 of Fig. 1, showing the reversing-gear in different positions; Fig. 5, an enlarged detail view approximately on the line 5 5 of Fig. 6, showing the eccentric valve and the ports controlled by it; Fig. 6, a vertical section on the line 6 6 of Fig. 5; Fig. 7, a detail view of the eccentric of the valve; Fig. 8, a bottom plan view of the machine with the lower head of the cylinder or body and parts carried by it removed and with one of the cylinders and its piston and the crank-shaft shown in section; Fig. 9, an enlarged detail plan view of the reversing-gear; Fig. 10, a side elevation of the same, and Fig. 11 a vertical section.

The same letters of reference are used to indicate corresponding parts in the several views.

The central body portion of the machine is composed of the hollow cylindrical shell A, whose upper end is closed by an integral head B, Figs. 2 and 6, and whose lower end is closed by a removable head C, bolted to the under side of the body A. Radiating from the cylindrical body A, at angles of one hundred and twenty degrees from each other, are the three cylinders D D′ D″. The upper and lower heads B C of the body A are provided with central bores, through which extend the opposite ends of a crank-shaft E, whose middle eccentric portion is surrounded by the inner ends of the connecting-rods F, which are jointed at their outer ends to the pistons G within the respective cylinders, said pistons in the present instance being cup-shaped and provided with the usual snap-rings H and with ears or jaws I, between which the outer ends of the connecting-rods F are pivoted. The inner ends of the connecting-rods F are forked to straddle one another upon the crank-shaft E, as seen in Figs. 2 and 6. The crank-shaft E is formed of two separate parts, which are connected at *a*, Figs. 2 and 6, where, as indicated by the dotted lines, the upper end of the middle eccentric portion of the shaft fits in an eye in the upper arm of the shaft. This middle portion of the crank-shaft between its two arms is surrounded by a bushing or sleeve *b*, around which the inner ends of the connecting-rods F fit, while the bores in the heads B and C, through which the opposite ends of the crank-shaft pass, are likewise provided with sleeves or bushings *c*.

The head B has bolted to its upper side a cylindrical cap or valve-box J, the space within which above the top of the head B constitutes the valve-chamber. The upper surface of the head B within the valve-box J is turned off true and smooth and forms the valve-face, through which open the inner ends of the ports K, leading to the outer ends of

the respective cylinders. The inner ends of these ports, which open through the valve-face, are in the present instance of the shape best shown in Fig. 5. Formed in the upper surface of the head B, concentric to the crank-shaft E, is a circular recess L, Figs. 2, 5, and 6, which communicates by a series of vertical holes M with the interior of the shell A, which latter is constantly open to the atmosphere through the exhaust-pipe N. The compressed air or other motive fluid for operating the machine is admitted to the valve-chamber through a supply-pipe O, which has connected to it a flexible tube leading to the source of supply and has interposed in it a throttle-valve P, Fig. 1, operated by a hand-lever Q for controlling the admission of the motive fluid. When the port K, leading to the outer end of either cylinder, is placed in communication with the valve-chamber, the motive fluid will therefore be admitted to the outer end of such cylinder and drive its piston inward, while when such communication with the valve-chamber is cut off and the port K is put into communication with the recess L the motive fluid in the outer end of the cylinder will be permitted to exhaust through said recess and the ports M into the shell A and thence out the exhaust-pipe N. The valve for controlling the admission and exhaust of the motive fluid to and from the outer ends of the cylinders consists of an eccentric R, fitted upon the crank-shaft E within the valve-chamber and surrounded by a flanged ring S, loose upon the eccentric. The upper and lower surfaces of the ring S are ground to closely fit the upper and lower surfaces of the valve-chamber, so that the pressure of the motive fluid within said chamber bears only upon the periphery of the valve and the latter is properly balanced. The eccentric R is connected with the crank-shaft E in the manner and by the means hereinafter described, so as to turn with said shaft, and is provided upon one side of said shaft with a large opening T, flaring outward at the bottom and extending entirely through the eccentric from its upper to its lower side, Figs. 2, 5, 6, and 7. Now assuming the parts to be in the position shown in Figs. 4, 5, and 6, the port K, leading to the cylinder D, will be in communication at its inner end, through the opening T in the eccentric R, with the exhaust-recess L and ports M, while the inner end of the port K, leading to the cylinder D', will be substantially uncovered by the valve-ring S, so that said cylinder will be in communication with the valve-chamber and the port K, leading to the cylinder D'', will be very slightly uncovered by said valve-ring. Upon admitting the motive fluid to the valve-chamber through the pipe O it will pass freely through the port K to the outer end of the cylinder D' and in lesser volume through the port K of the cylinder D'' to the outer end of the latter and serve to force the pistons of these cylinders inward and drive the crank-shaft in the direction of the arrow, forcing the piston in the cylinder D outward. As the eccentric R turns from the position shown in Fig. 5 the inner end of the port K, leading to the cylinder D', will be gradually closed by the valve-ring S and the port leading to the cylinder D'' gradually opened. At the same time the opening T in the eccentric R will be carried away from the inner end of the port K, leading to the cylinder D, and that port be first closed by the valve-ring and then gradually opened into communication with the valve-chamber to admit the motive fluid to the outer end of the cylinder D, and so on in succession with all the cylinders as the crank-shaft and eccentric continue their rotation. If the eccentric R were secured in fixed position upon the crank-shaft, the latter would necessarily always be driven in the same direction in the manner above described, but I have provided means for releasably connecting the eccentric with the shaft and for shifting it to position which will reverse the direction of the movement of the shaft under the action of the motive fluid. To this end the stem or hub of the eccentric R is extended upward through the top of the valve-box J and has keyed upon its upper end a milled hand-wheel U, which has secured in it and projecting from its upper side a stud or pin V. The upper end of the crank-shaft E extends entirely through the hub of the eccentric R and projects above the same, and its upper end has keyed upon it a dog W, of the shape best shown in Figs. 3 and 4. This dog is composed of a disk which is cut away at one side for approximately one-half the circumference of the disk, the cut-away portion terminating at its opposite ends in concave shoulders adapted to receive and fit the stud V on the hand-wheel U when the latter is turned until such stud contacts with one or the other of such shoulders. The dog W has fast upon its upper side adjacent such shoulders two flat springs X, each provided with a hole or recess adapted to fit over the reduced upper end of the stud V and hold the latter in contact with the shoulder of the dog W. The outer ends of the springs X are bent upward to enable the upper end of the stud V to ride under them when the hand-wheel U is turned from one position to another and become engaged with the hole in the spring, also to better enable the springs to be grasped with the thumb and finger and pressed upward when it is desired to release the stud from them.

In the position of the parts shown in Figs. 4 and 5 the stud V of the hand-wheel is engaged with the upper shoulder of the dog W in Fig. 4 and, as has been explained, the parts stand in such relative position that when the motive fluid is admitted to the valve-chamber the machine will be driven in the direction of the arrows in Figs. 4 and 5. If, however, the hand-wheel be turned from the position shown in Fig. 4 until its stud V

contacts with the lower shoulder of the dog W, as in Fig. 3, the eccentric-valve will be brought into the position relatively to the ports K, leading to the respective cylinders, which is shown in Fig. 3. As will be seen by the dotted lines therein, the port leading to the cylinder D is open to the motive fluid in the valve-chamber and the port leading to the cylinder D'' slightly open thereto, while the port leading to the cylinder D' is open to the exhaust. In this position of the parts, therefore, when the motive fluid is admitted to the machine the crank-shaft will be driven in the direction of the arrow in Fig. 3, so that the direction of motion will be the reverse of that in Figs. 4 and 5. (The springs X are omitted in Figs. 3 and 4 to better show the parts beneath them.)

It will be understood that inasmuch as the hand-wheel U is fast to the eccentric R, while the dog W is fast upon the crank-shaft, and inasmuch as the springs X firmly connect the hand-wheel and dog together when the hand-wheel is turned to its limit of movement in either direction and brought into contact with one or the other shoulder of the dog, the hand-wheel and eccentric are connected with the crank-shaft and turn with the latter in whichever direction it may be driven, and that when it is desired to reverse the direction of motion all that is necessary is to stop the machine and disengage the spring X of the dog W from the pin V of the hand-wheel and turn the latter until its pin abuts against the opposite shoulder of the dog and is engaged by the spring X, adjacent thereto.

Bolted to the under side of the cylindrical body of the machine by bolts passed through the head C and entering the shell A is a yoke A', Figs. 1 and 2, in the bridge of which yoke, Fig. 2, is journaled a short shaft B', which has keyed upon its upper end, immediately above the bridge of the yoke, a gear-wheel C'. The shaft B' is the shaft to which the socket for receiving the tap, drill, or bolt is secured, and it is driven from the crank-shaft E through the medium of a train of speed-reducing gears as follows: The bridge of the yoke A' has secured to one side of it a laterally-projecting bracket E', Figs. 1 and 2, in which is journaled the lower end of a vertical shaft or spindle F', whose upper end is journaled in the head C. This shaft F' has fast upon it, immediately below the head C, a gear-wheel G', which meshes with a pinion H', keyed upon the crank-shaft E immediately below the head C, while formed upon the shaft or spindle F', below the gear G', is a pinion I', which meshes with the gear-wheel C', which is keyed upon the upper end of the shaft B', as heretofore described. In this manner and by these means the shaft B' is driven by the shaft E and at a much lower speed than the latter. The upper end of the shaft B' is bored out to receive the reduced lower end of the shaft E, which fits within the shaft B' and terminates at the point indicated by the dotted line at *d* in Fig. 2.

The bridge of the yoke A' is provided upon its under side with a deep circular groove concentric to the shaft B' to receive the hardened ring J' and the balls K', while the enlarged lower end or head of the shaft B', immediately below the yoke A', is provided with a coincident circular groove to receive the hardened ring L', in which the balls K' rest. The end thrust of the machine is taken up by these balls and the friction between the shaft B' and its bearing-surface on the yoke A' or frame of the machine thereby relieved.

The enlarged head upon the lower end of the shaft B' is in the present instance bored out at M' to dispense with unnecessary weight of metal and is exteriorly threaded to receive the interiorly-threaded upper end of the removable socket-piece N', which is adapted to receive in its lower end the drill, tap, bolt, or other tool or part to be driven by the shaft B'. A pin O' is passed through the upper end of the socket-piece N' and the threaded lower end of the shaft B' to prevent the socket-piece from becoming unscrewed while the machine is in operation. When it is desired to change the socket-piece to fit some other form of tool than the one being used, the pin O' may be driven out and the socket-piece removed and a new one put in its place.

Bolted to the upper side of the body of the machine by bolts passing through the valve-box J is a yoke P', Figs. 1 and 2, whose bridge is provided at its middle with a threaded opening adapted to receive either the handle shown in Fig. 2ª or the hand feeding devices shown in Figs. 1 and 2. In the latter views there is screwed into the opening in the yoke P' the lower end of a threaded spindle Q', which is locked in position by a nut R' and upon which fits a cylindrical nut S', provided at its outer end with a central bearing-point T' and having passed transversely through it a rod or handle U' for turning it. In drilling or other work requiring a force feed the point T' at the upper end of the nut U' will be engaged with a fixed abutment, while the tool carried by the socket at the opposite end of the machine is engaged with the work and forced against the latter by turning the nut S'. In work such as driving stay-bolts in boilers, where a force feed is not required, the handle shown in Fig. 2ª may be substituted for the devices shown in Figs. 1 and 2.

The speed of the tool-carrying shaft B' can be regulated by the proportion given the gearing by which it is driven from the main or engine shaft E, which should be arranged to suit the work to be done.

My new machine is of such size and weight that it may be readily handled by a single workman and moved by him from place to place and held in different positions, according to the requirements of the work; but where it can be conveniently done it is preferable to suspend the machine from an adjustable

counterbalancing device which will support the weight of the machine, but permit it to be readily moved by the workman from one position to another.

I am aware that engines of the type I employ in my machine have been before used as stationary engines, but so far as I am aware I am the first to so adapt it in size, proportion, and arrangement of its parts and combine such an engine with the other necessary elements as to produce a machine of the character described and suited to the purposes and possessing the capabilities of my new machine.

Having thus fully described my invention, I claim—

1. A machine of the character described, composed of the casing or shell having the plurality of cylinders, the crank-shaft extending at its opposite ends through the casing and journaled therein, the pistons in the cylinders having their rods connected to the crank-shaft, a valve mounted upon the projecting upper end of the crank-shaft within a valve-chamber at the upper end of the casing and controlling the ports leading to the outer ends of the cylinders, a pinion fast upon the projecting lower end of the crank-shaft, on the opposite side of the casing from the valve, a tool-holding shaft journaled in a support upon the underside of the casing beneath and in line with the projecting lower end of the crank-shaft, a gear fast upon the upper end of said tool-holding shaft, a spindle journaled in a support at one side of and parallel with the lower end of the crank-shaft and upper end of the tool-holding shaft, and a gear-wheel and pinion fast upon said spindle and meshing respectively with the pinion upon the lower end of the crank-shaft and the gear-wheel upon the upper end of the tool-holding shaft, substantially as described.

2. A machine of the character described, composed of the casing or shell having the plurality of cylinders, the crank-shaft extending at its opposite ends through the casing and journaled therein, the pistons in the cylinders having their rods connected to the crank-shaft, an eccentric valve mounted upon the projecting upper end of the crank-shaft within a valve-chamber at the upper end of the casing and controlling the ports leading to the outer ends of the cylinders, means for connecting said eccentric valve to and disconnecting it from the shaft and turning it from one position to another thereon, for the purpose of reversing the direction of rotation of the shaft, a tool-holding shaft journaled in a support upon the under side of the casing beneath and in line with the lower end of the crank-shaft, and a train of speed-reducing gearing connecting the lower end of the crank-shaft with the upper end of said tool-holding shaft, substantially as described.

3. A machine of the character described, composed of the casing or shell having the plurality of cylinders, the crank-shaft extending at its opposite ends through the casing and journaled therein, the pistons in the cylinders having their rods connected to the crank-shaft, a valve mounted upon the upper end of the crank-shaft within a valve-chamber at the upper end of the casing and controlling the ports leading to the outer ends of the cylinders, a tool-holding shaft journaled in a support upon the under side of the casing beneath and in line with the lower end of the crank-shaft, a train of speed-reducing gearing connecting the lower end of the crank-shaft with the upper end of said tool-holding shaft, and a force-feeding device at the upper side of the casing above and in line with the upper end of the crank-shaft, substantially as described.

4. A machine of the character described, composed of a multiple-cylinder engine, a rotary crank-shaft driven thereby and projecting below the casing of the engine, an independent tool-holding shaft journaled in a support upon the under side of the casing beneath and in line with the lower end of the crank-shaft and driven by the crank-shaft through a train of speed-reducing gearing, a force-feeding device mounted in a support on the upper side of the casing above and in line with the upper end of the crank-shaft, and a circle of antifriction-balls interposed between the tool-holding shaft and the support upon the underside of the casing in which said shaft is journaled, to take the end thrust of the machine produced by the force-feeding device at its upper end, substantially as described.

5. The combination of the central casing or shell A having the integral upper end or head B and the detachable lower end or cap C and the three projecting cylinders D D′ and D″ having the ports K leading to their outer ends, the crank-shaft E projecting at its opposite ends through the upper head B and lower cap C of the casing, the pistons G located in the several cylinders and having their rods F connected to the crank-pin of the shaft E, the valve-box J bolted to the upper side of the head of the casing A, the upper surface of said head B constituting the valve-face through which the inner ends of the ports K open and being provided with the annular recess L around the shaft E and the circle of ports M connecting said recess with the exhaust-chamber within the casing A, and the eccentric valve R S turning with the shaft E within the valve-box J and controlling communication between the interior thereof and the ports K, and between the ports K and the exhaust-recess L, substantially as described.

6. The combination of the central casing or shell A having the plurality of projecting cylinders, the crank-shaft E extending at its opposite ends through said casing and journaled therein, the pistons G located in the several cylinders and having their rods connected to the crank-shaft E, a valve mounted upon the upper end of the crank-shaft E within the valve-box J and controlling the ports K leading to the outer ends of the cyl-

inders, the yoke A′ secured to the lower end of the casing A, the tool-holding shaft B′ journaled in said yoke beneath and in line with the lower end of the crank-shaft E, the pinion H′ fast upon the lower end of the crank-shaft and the gear C′ fast upon the upper end of the tool-holding shaft B′, the spindle F′ journaled in supports at the side of the shafts E and B′, and the gear G′ and pinion I′ fast upon said spindle and meshing respectively with the pinion H′ and gear C′, substantially as described.

7. The combination of the central casing or shell A having the plurality of projecting cylinders, the crank-shaft E extending at its opposite ends through said casing and journaled therein, the pistons G located in the several cylinders and having their rods connected to the crank-shaft E, a valve mounted upon the upper end of the crank-shaft E within the valve-box J and controlling the ports K leading to the outer ends of the cylinders, the yoke A′ secured to the lower end of the casing A, the tool-holding shaft B′ journaled in said yoke beneath and in line with the lower end of the crank-shaft E, the pinion H′ fast upon the lower end of the crank-shaft and the gear C′ fast upon the upper end of the tool-holding shaft B′, the spindle F′ journaled in supports at the side of the shafts E and B′, the gear G′ and pinion I′ fast upon said spindle and meshing respectively with the pinion H′ and gear C′, the yoke P′ secured to the upper end of the casing A, the screw Q′ fixed at its lower end in said yoke in line with the crank-shaft E, the nut S′ applied to said screw and having the centering-pin T′ at its upper end, and the circle of antifriction-balls K′ interposed between the yoke A′ and an annular shoulder upon the tool-holding shaft B′ to take the end thrust of the machine produced by turning the nut S′ upon the screw Q′, substantially as described.

8. A machine of the character described, comprising a multiple-cylinder engine, a rotary shaft driven thereby, the eccentric valve mounted upon the shaft and controlling the ports leading from the valve-chamber to the exhaust and to the cylinders, the hand-wheel secured to the eccentric of the valve, for turning it upon the shaft, the dog fast upon the shaft, and the clutch devices between the hand-wheel and dog for connecting them together at the opposite positions of the hand-wheel, for the purpose specified.

9. In a machine of the character described, the combination of the cylinders D D′ D″, the pistons G therein, the rotary crank-shaft E, the rods F connecting said shaft with the several pistons, the eccentric valve mounted upon the shaft E within the valve-chamber and controlling the ports leading to the exhaust and to the outer ends of the cylinders, the hand-wheel U secured to the upper end of the stem of the eccentric and provided with a stud V, and the dog W having the two shoulders and the springs X cooperating with the stud V, as and for the purpose set forth.

10. A machine of the character described, composed of the casing or shell having the plurality of cylinders, the crank-shaft extending at its opposite ends through said casing and journaled therein, the pistons in the cylinders having their rods connected to the crank-shaft, the eccentric valve located in the valve box or chamber at the upper side of the main casing of the machine and controlling the inlet and exhaust to the outer ends of the respective cylinders, the eccentric valve being provided with an extended sleeve or hub projecting through the upper side of the valve-chamber, and the upper end of the crank-shaft extending through and projecting above said valve and hub, a hand-wheel secured upon the upper end of said hub, by which the eccentric valve may be turned to reverse the direction of motion of the crank-shaft, the dog fast upon the upper end of the crank-shaft, a clutch connection between said hand-wheel and dog by which they may be connected with and disconnected from each other at will, to connect the eccentric valve with and disconnect it from the crank-shaft, the tool-holding shaft journaled in a yoke secured to the lower side of the machine, in line with the crank-shaft, and a train of speed-reducing gearing interposed between the crank-shaft and tool-holding shaft, for the purpose described.

11. A machine of the character described, composed of the casing or shell having the plurality of cylinders, the crank-shaft projecting at its opposite ends through the upper and lower sides of said casing and journaled therein, the pistons in the respective cylinders having their rods connected to the crank-shaft, the valve mounted upon the upper end of the crank-shaft within a valve box or chamber at the upper side of the casing, and operating to control the inlet and exhaust to the outer ends of the cylinders, the force-feeding device at the upper end of the machine, the hollow tool-holding shaft journaled in a yoke secured to the under side of the machine, in line with the crank-shaft and having the lower end of the latter fitting within its upper end, a train of speed-reducing gears between said crank-shaft and tool-holding shaft, through which the latter is driven by the former, and ball-bearings interposed between the tool-holding shaft and the yoke in which it is journaled, for the purpose described.

12. A machine of the character described, composed of the casing or shell having the plurality of cylinders, the crank-shaft journaled therein and having its opposite ends projecting through and beyond the upper and lower sides of the casing, said crank-shaft being formed in two parts connected together by one end of its eccentric portion fitted in an eye or opening in one of its arms, the pistons in the respective cylinders having their

rods connected to said crank-shaft, the valve mounted upon the upper end of said shaft in a valve box or chamber at the upper side of the casing and controlling the inlet and exhaust to the outer ends of the cylinders, the tool-holding shaft journaled in a yoke secured to the under side of the machine, in line with the crank-shaft and driven by the latter through a train of speed-reducing gears, and ball-bearings interposed between said tool-holding shaft and the yoke in which it is journaled, to take the end thrust of the machine, as described.

13. A machine of the character described, composed of the multiple-cylinder engine, the crank-shaft driven thereby, the valve mounted upon the upper end of said shaft within the valve-box or chamber at the upper side of the machine, the force-feeding device at the upper side of the machine, the hollow tool-holding shaft B' journaled in the yoke A' secured to the under side of the machine, in line with the crank-shaft and having the lower end of the latter fitting in its upper end, and driven by the crank-shaft through a train of speed-reducing gears, and the ball-bearings K' interposed between the lower end of the yoke A' and the annular shoulder or enlargement of the tool-holding shaft B', and having their seats in the rings J' L' seated respectively in said yoke and shoulder, for the purpose described.

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