A. P. STROM.

PORTABLE PNEUMATIC DRILL.

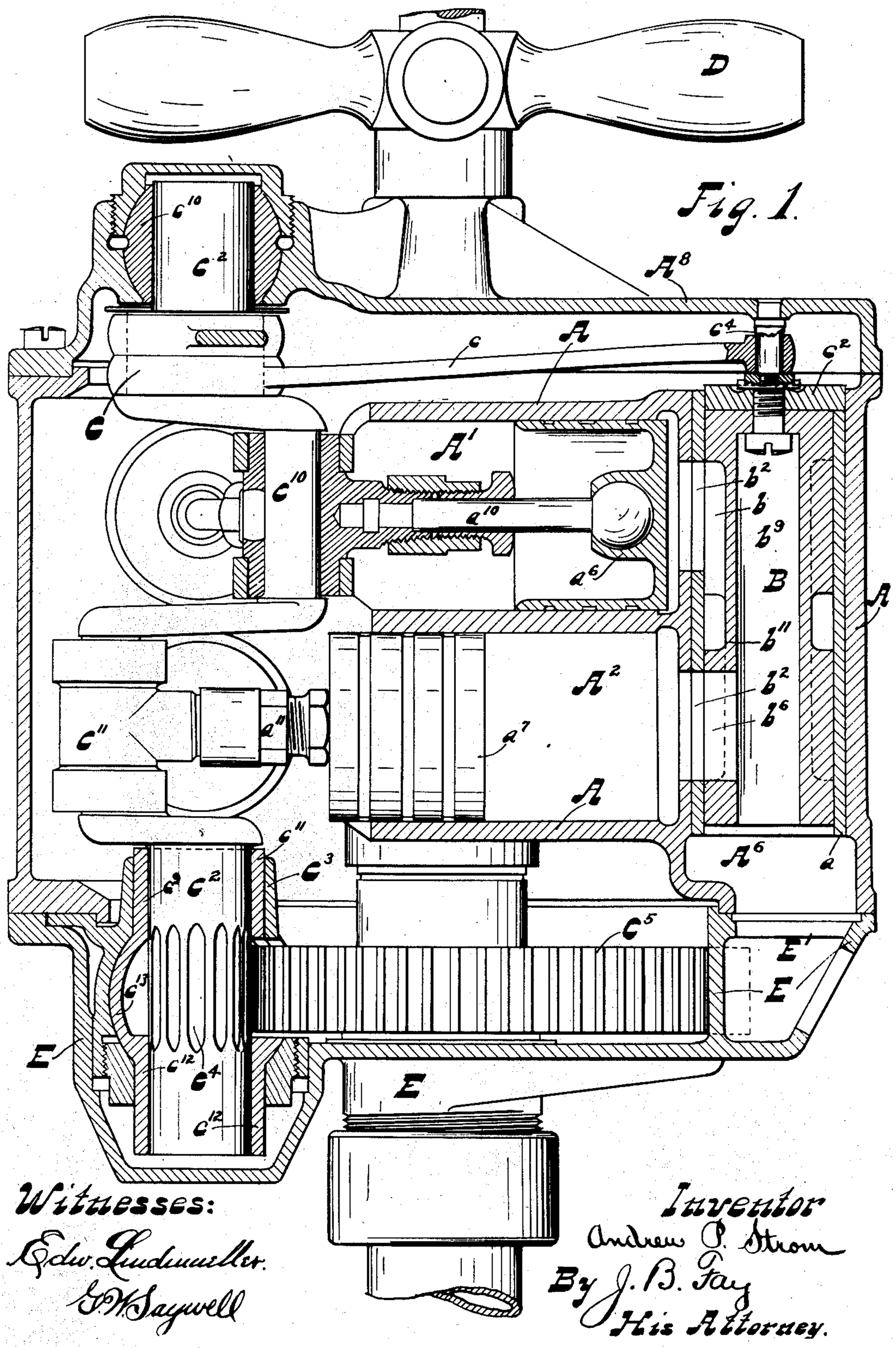
APPLICATION FILED APR. 5, 1906.

907,096.

Patented Dec. 15, 1908.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

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4 SHEETS—SHEET 2.

Fig. 2

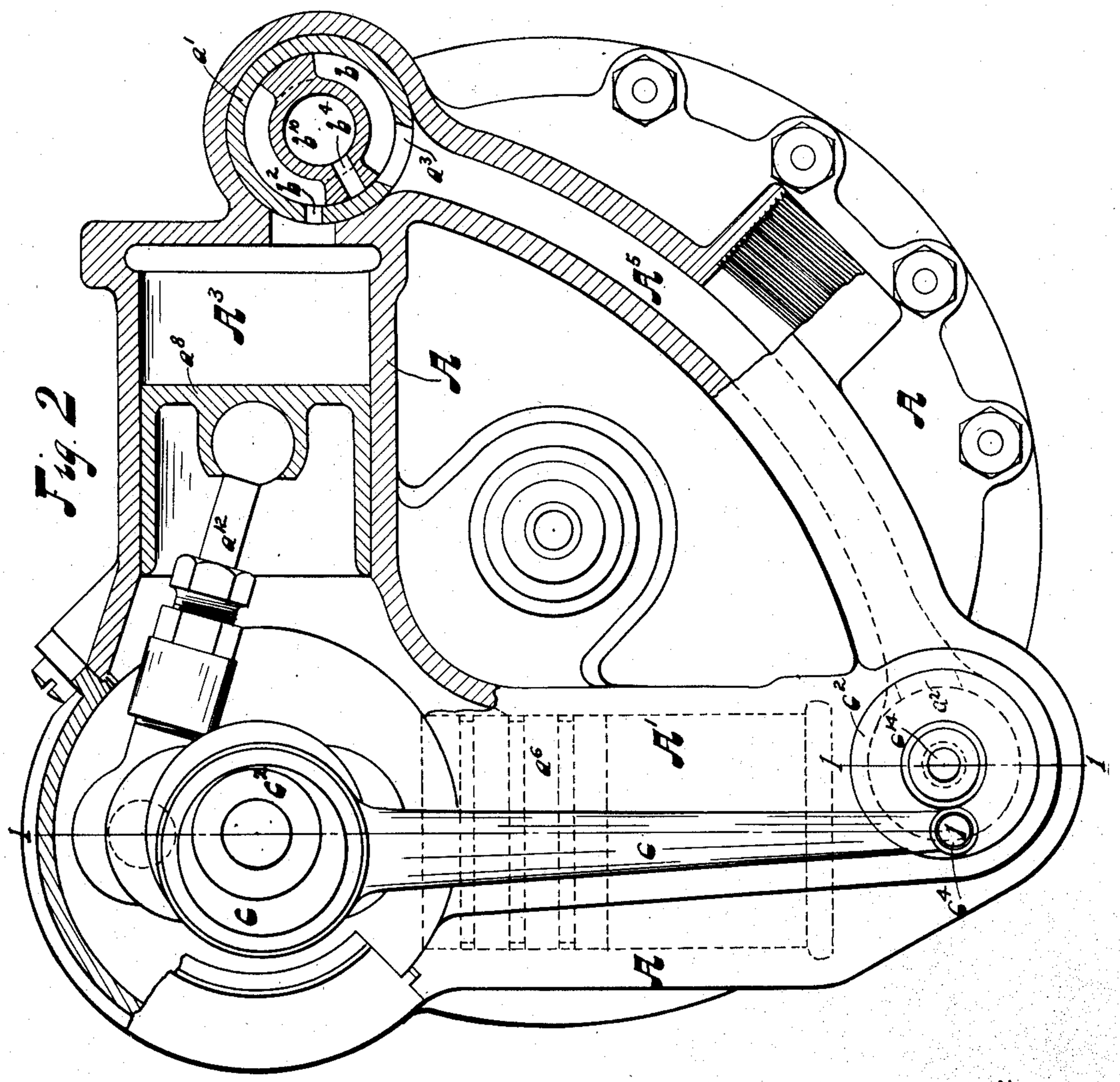
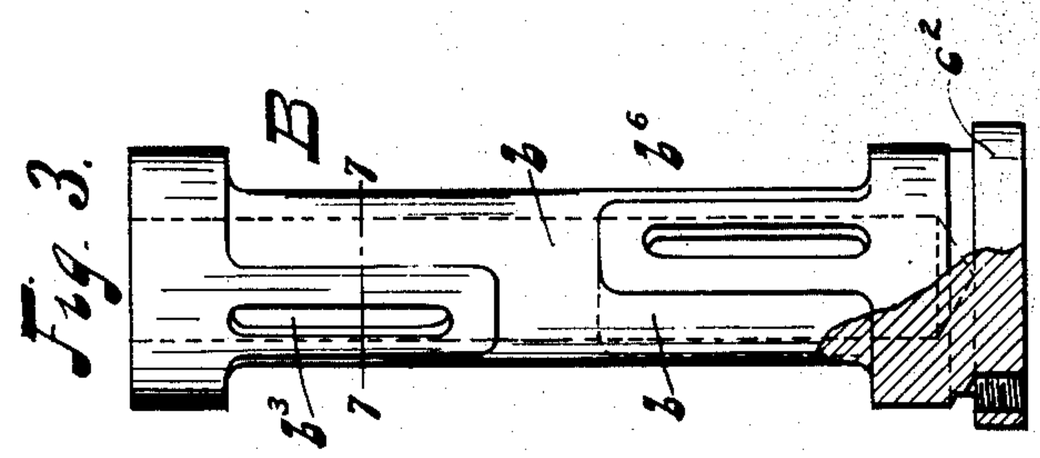


Fig. 3.



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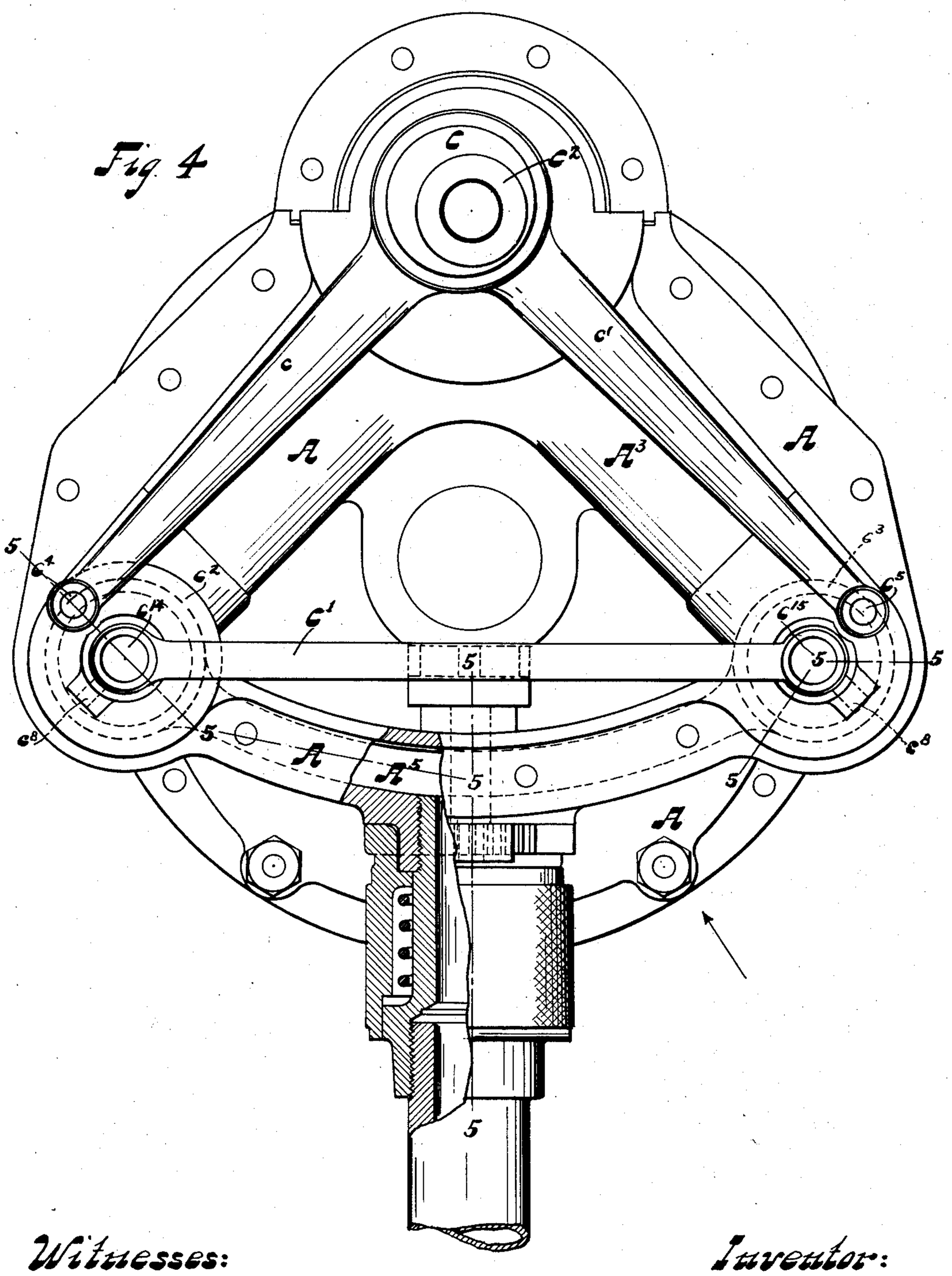
4 SHEETS—SHEET 3.

Fig. 4



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4 SHEETS—SHEET 4.

Fig. 5

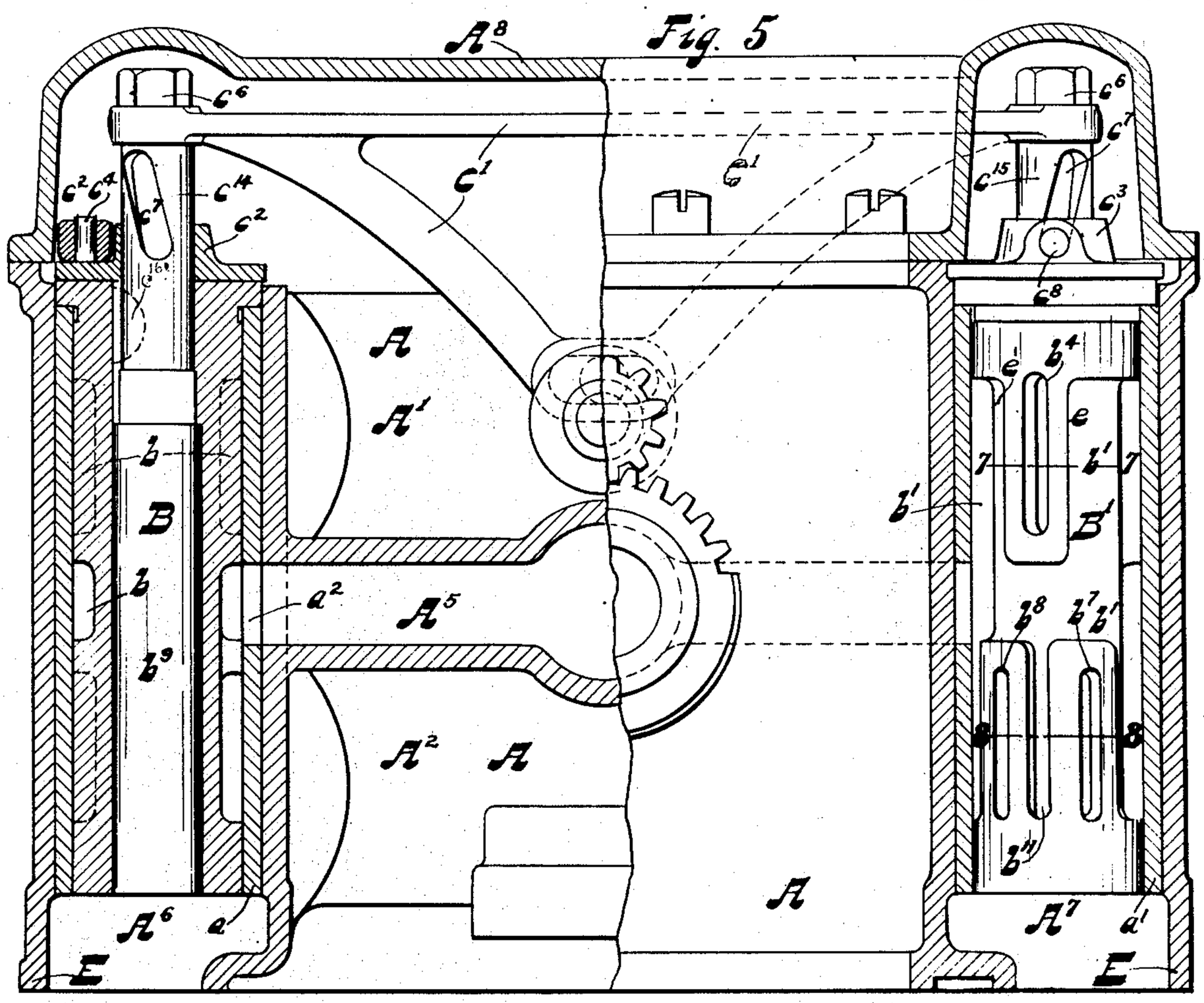


Fig. 6.

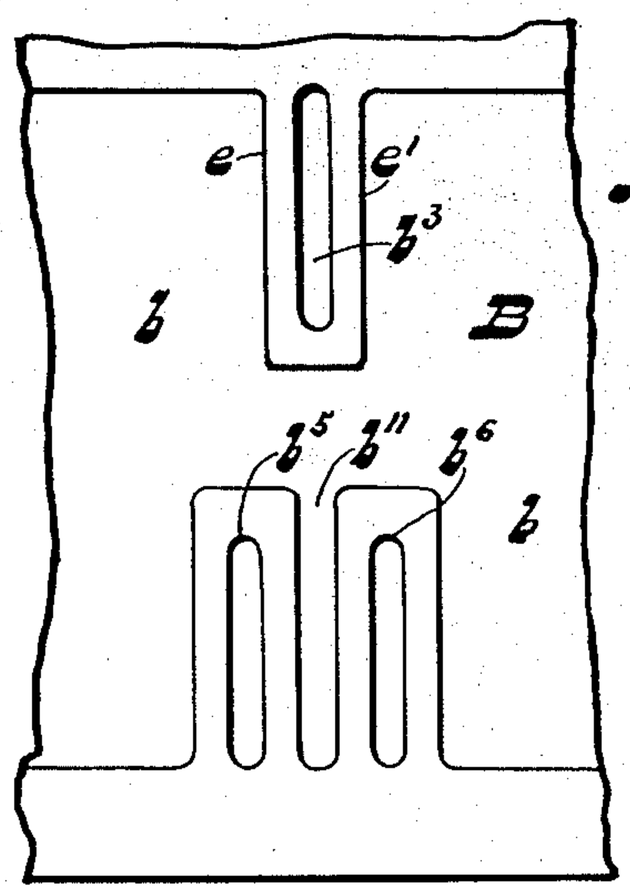


Fig. 7.

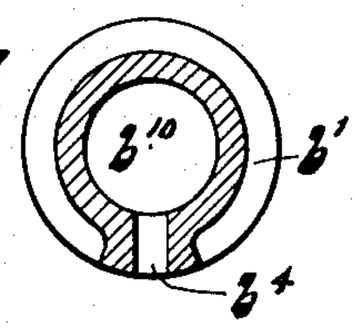
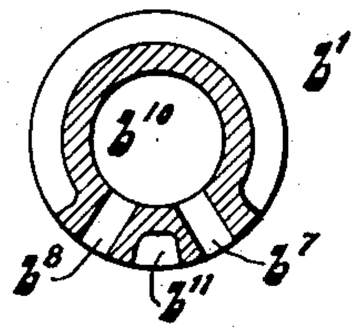


Fig. 8



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UNITED STATES PATENT OFFICE.

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PORTABLE PNEUMATIC DRILL.

No. 907,096. Specification of Letters Patent. Patented Dec. 15, 1908.

Application filed April 5, 1906. Serial No. 309,982.

To all whom it may concern:

Be it known that I, ANDREW P. STROM, a citizen of the United States, resident of Cleveland, county of Cuyahoga, and State of Ohio, have invented a new and useful Improvement in Portable Pneumatic Drills, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

My invention relates to pneumatic tools and especially to certain improvements in portable drills, and consists of means hereinafter fully described and specifically set forth in the claims.

My improved pneumatic portable drill comprises essentially three important new features, as follows:

(1) Partially-rotatable or oscillatory controlling valves of the Corliss type located in the heads of the power cylinders served by them, which power cylinders are positioned at right angles to each other; and, also, the wrist-pins of the valves are contained in planes intersecting each other at right angles, so that said valves may be actuated by only one eccentric upon the crank-shaft, each valve being connected to said eccentric by a suitable eccentric strap. I thus make the cylinder heads serve also as a valve chest, although on account of expediency in manufacture I have made the chest a part of the main cylinder casting in such a way that a straight line drawn from the center of the crank to the center of the wrist-pin of the valve will be parallel with a line passing centrally through the cylinder from end to end and, consequently, parallel with the path of travel of the piston;

(2) A simple and effective controlling valve-structure and arrangement combining in itself a reversing feature; and

(3) The provision of only one bearing for the whole gear-end of the crank-shaft, including the gear or pinion on said shaft which engages with the gear carried upon the tool socket, a suitable opening being made through the bearing and its socket to admit the teeth of the latter gear, whereby I have really made two bearings in one, since this bearing acts upon the crank-shaft on both sides of the pinion or gear, and thus the total number of bearings upon the whole crank is reduced to two, one at each end; whereas other similar machines require three or more bearings which necessitate a great amount of costly and unsatisfactory work in boring them in the proper alinement; whereas two bearings, whose outsides are spheres, will aline themselves whenever the crank or spindle is inserted through them, and if they are left free to turn in their sockets until the shaft is in place.

I am aware that a disposition of controlling valves, embodying some of the features which I have described in "(1)" above, has been heretofore made, but, in so far as I am informed, it has always been confined to slide valves of the piston type, which, however, have not been positioned in the cylinder heads, nor have they been in the same vertical plane as the cylinders with their axes at right angles to the latter; whereas I utilize the partially-rotatable Corliss valves arranged as hereinbefore mentioned and as will be hereinafter fully described. Whenever Corliss valves have heretofore been used in pneumatic drills, they have been positioned in such a way relative to the crank and cylinders as to necessitate the use of two or more eccentrics on the crank, one eccentric for each valve, or, if one eccentric was utilized for more than one valve, it was done through the medium of an eccentric strap or a lever composed of more than one part for each valve; whereas by my improvement one eccentric can be made to serve for two or more valves, each valve operated by an eccentric strap comprising only one piece.

The annexed drawings and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting the preferred mechanical form in which the principle of the invention may be used.

In said annexed drawings: Figure 1 represents a vertical sectional elevation of the drill, taken upon the planes indicated by the lines 1—1, Fig. 2, the controlling valve embodying the means for reversing not being shown in this form of invention, the engine herein illustrated being designed to run in only one direction; Fig. 2 represents a partial plan view and a partial horizontal section of the drill illustrated in Fig. 1 with the cover removed, showing the connections between the crank-shaft and the controlling valves; Fig. 3 represents an elevation of one of the controlling valves shown in Fig. 1, the

lower part thereof being partially shown in section; Fig. 4 represents a plan view of the drill, with the cover removed, the valve therein shown embodying the means for reversing the machine, also showing one set of means for actuating the reversing features of the valve, which means may be of any suitable construction; Fig. 5 represents a vertical sectional view taken upon the planes indicated by the lines 5—5, Fig. 4, and looking in the direction indicated by the arrow, showing the construction of the reversible controlling valves; Fig. 6 represents a layout or development of one of the reversible controlling valves; and Figs. 7 and 8 represent horizontal sections of said valve taken upon the planes indicated by the lines 7—7 and 8—8, respectively, Fig. 5.

My improved drill is of the piston type, with fixed cylinders having cylindrical controlling valves fixed in what would otherwise be the cylinder heads, as hereinbefore mentioned. The pistons are connected to a crank-shaft which latter operates the drill spindle or the tool-socket by means of gearing connecting the latter to said crank-shaft. The controlling valves are oscillated in their bushings from one eccentric upon the crank-shaft, connected by means of suitable rods to the respective valves, such rods or operative connections being arranged substantially at right angles to each other. During the revolution of the crank-shaft, the valves are oscillated by the eccentric to control the admission and exhaust of the fluid pressure to and from the working cylinders. These cylinders are preferably arranged in sets, usually a pair in each set, one above the other, there being two sets in the invention which I have illustrated, having their central longitudinal axes substantially at right angles to one another. The valves are of the rotative plug type and each one is common to all the cylinders in any one set of cylinders. The fluid pressure is admitted to the machine-body from any suitable source, preferably through a hollow handle, into a pressure chamber centrally-located between the outer ends of the cylinders, whence it passes through the valves into the working cylinders, and thence is exhausted through the valves. Said fluid pressure may pass from the pressure chamber through a central longitudinal chamber in the valves into the working cylinders, and thence be exhausted through said valves by means of passages in the outer surface of the latter, or it may enter such working cylinders through such external passages in the valves and be exhausted through the central longitudinal chambers in said valves, and it is this latter form of construction that I prefer and have illustrated in the accompanying drawings; although, obviously, the admission or discharge of the fluid pressure may be caused to occur either through the central passage or along the exterior passage of the valve, and such operations effected alternately would themselves constitute a reversing feature.

In the form of construction illustrated in Figs. 4 and 5, the controlling valves are connected by means of a yoke or any other suitable means to a reversing sleeve on the handle of the machine, or any other suitable manually-operated member, by means of which the valves are capable of being directly actuated to reverse the direction of the rotation of the crank-shaft, each of said controlling valves of the reversible type having one exhaust passage which is common both to the normal and the reverse workings of the upper cylinders with which they are respectively associated; and a pair of exhaust passages for the lower cylinders with which they are respectively associated, one of said pair acting as an exhaust passage for the normal working, and the other acting as an exhaust passage for the reverse working of said lower cylinders. The inlet of air to the cylinders from said reversible valves, however, is permitted from two passages, or rather from two edges of one general exterior passage, so far as the upper cylinders with which said valves are associated are concerned, one edge serving for the normal and the other edge serving for the reverse working of said cylinders; whereas, one inlet passage to said cylinders from said valves serves for both the normal and reverse workings of the lower cylinders.

I have provided, in one casting, an exterior casing A, two pairs of power-cylinders A', A^2, and A^3, A^4, respectively, cylinder A^4 not being shown in the drawings, any suitable fluid pressure chamber A^5 disposed between the respective pairs of cylinders and the controlling valves; and chambers A^6 and A^7 for said controlling valves. Suitably secured to said outer casing A, and forming an end cap or cover therefor, is the member A^8.

Any suitable form of feed-screw head is illustrated at D, Fig. 1.

It will be noted that the valve-chambers A^6 and A^7 are arranged in the cylinder heads the chamber A^6 being arranged in the heads of the pair of cylinders A', A^2, and the chamber A^7 being arranged in the heads of the pair of cylinders A^3 and A^4. Said valve chambers have their central longitudinal axes arranged at right angles to the axes of the cylinders with which they are associated but not in the same plane, the distance between the planes being the same as the distance between the center of the valve and the axis of the wrist-pin to which the strap is fastened which connects the valve and the eccentric, Figs. 2 and 4. The operative points of the valves, viz., the points where the straps are fastened to them, are located at right angles to each other, and this is the

reason they can be operated by one eccentric. However, the angle between the centers of the valves is less than a right angle, as can be plainly seen from Figs. 2 and 4.

Contained within the respective valve chambers A^6 and A^7 are valve bushings a, a', respectively, provided with suitable ports a^2 and a^3, communicating with the central pressure chamber A^5.

Referring now particularly to the reversible controlling valves shown in Figs. 4, 5, 6, 7, and 8, positioned within the bushings a and a' are the controlling valves B and B', respectively, provided with the exterior annular pressure chambers b and b' communicating with the pressure chamber A^5 and the respective pairs of cylinders, the latter communication being through the passages b^2 Fig. 1 in the bushings a and a'; said valves B and B' are provided with exhaust ports b^3 and b^4, respectively, in the upper parts of said valves, and b^5, b^6, b^7, and b^8, respectively, in the lower parts of said valves, said exhaust ports providing pressure communication by means of the passages b^2 in the valve bushings a and a' between the respective sets of cylinders and the central axial passages b^9 and b^{10}, provided in said valves, respectively.

In the lower parts of the valves B and B' are provided the passages b^{11} intermediate of the sets of exhaust passages b^5 b^6 and b^7 b^8, respectively. Said passages b^{11} form the sole ports for the entrance of live air from the pressure chambers b and b' to the lower cylinders A^2 and A^4, respectively, during both the normal and reverse workings of the machine. Live air is passed into the upper cylinders A' and A^3, during the forward working of the machine along the edge e' (Figs. 5 and 6) of the exterior passages b and b', and during the reverse working of the machine along the edge e the throw of the valve during the reversing of the machine being substantially equal to the distance between either of the edges e and e' and the edge of the exhaust passage b^3 farthest removed from said edge. When the crank-shaft is rotated in the normal direction the exhaust ports for the valve B are the ports b^3 and b^6 for the cylinders A' and A^2, respectively, and for the valve B' the ports b^4 and b^8 for the cylinders A^3 and A^4, respectively. When the crank-shaft is rotated in the reverse direction, these functions are served by the ports b^3 and b^5, b^4 and b^7, respectively.

In the form of valve shown in Figs. 1, 2, and 3, the reversing element is omitted so that one of the exhaust ports in the lower part of the valve is dispensed with, so that the upper and lower parts of the valve are similar. The controlling valves B B' are so oscillated in their bushings by means of eccentric C that they control the inlet and exhaust of the fluid pressure to and from the working cylinders, the valves being provided with disks c^2 c^3 respectively, which are connected by means of eccentric rods c c' and the wrist pins c^4 c^5 to the eccentric C. The disks to which the operative connections between said valve and the eccentric on the crank shaft are thus secured are fixed to the valve and may be made either integral therewith or as a separate piece. However, when the valve is designed to be reversed as shown in Figs. 5, 6, 7 and 8, an additional exhaust port must be provided, since the reversal of a valve throws one of the exhaust ports out of commission; this will be apparent from an inspection of the lay-out of the valve in Fig. 6. In the construction shown in Figs. 4 and 5 in which the valves embody the reversing feature a triangular yoke C' is fastened to stems c^{14} and c^{15}, reduced diameters upon said stems bearing freely in the ends of the cross-bar of said yoke, which is retained upon the stems by means of nuts c^6 screwed upon threaded ends of said stems c^{14} and c^{15}. Said stems c^{14} and c^{15} are a part of the means which are provided as an element of the valve structure to reverse the valves, said stems having cut in them spiral grooves c^7 which are engaged through a key or pin c^8 to the disks c^2 and c^3,—which disks can be rotated or oscillated only by the eccentric C—the arrangement being such that when stems c^{14} and c^{15} are raised or lowered by the yoke C' or by any other suitable means, said stems will partially rotate. The stems are engaged to the valve-structure proper by means of a feather-key c^{16} so that when the stems are raised or lowered by external means, the valves are rotated with the stems, thus bringing the other set of ports into operative position relative to the wrist-pins, eccentric and cylinders. The yoke C' may be of any standard construction and may be actuated by any suitable means to raise and lower the controlling valves B and B'. Located at the adjacent ends of the cylinders A', A^2, and A^3, A^4, is a crank chamber, in which is journaled in bearings c^9 and c^{10} a crank-shaft C^2, Fig. 1. I will call special attention to the bearing c^9, which is of a length sufficient to support the whole gear-end of the crank-shaft C^2, as will be noted from Fig. 1, said bearing having the two end-portions c^{11} and c^{12} and the intermediate partial spherical portion c^{13}, the whole bearing or shell being incased in a socket C^3 of the same inside conformation and size as the outside of the bearing c^9. Carried upon said crank-shaft and within said bearing c^9 is a pinion C^4 which meshes with a gear C^5 carried on the tool-socket so as to revolve the latter, said bearing c^9 and the socket C^3 being provided with suitable openings to receive the teeth of the gear C^5.

The cylinders A', A^2, A^3 and A^4, are provided with suitable pistons a^6, a^7, a^8, and a^9, respectively, which are connected to cranks

C^{10} and C^{11}, by means of the piston rods a^{10}, a^{11}, a^{12}, and a^{13} respectively. The gear-end of the crank C^2 and the gear C^5 are suitably incased in a crank-case E, upon the side of which but not communicating with the interior thereof are cast passages E′ communicating with the valve-chambers A^6 and A^7 in the cylinder casting through which the exhaust from the central passages b^9 and b^{10} in the valves B and B′ is discharged into the atmosphere.

In operation, as will be evident from previous references to the specific action of the several elements constituting the device, fluid pressure, in the case in hand air, will be admitted to the machine body from any suitable source through the hollow handle into the pressure chamber A^5 disposed between the respective pairs of valve chambers A^6, A^7 and corresponding cylinders. Having regard, then, to one valve only, the operation of the other being exactly the same, the fluid will be seen to pass from such chamber A^5 through the port a^2 of the valve chamber bushing a into the exterior annular pressure chamber b of the corresponding valve B. Thence the fluid is admitted to the power cylinders first one then the other by way of ports b^2. Actuation of the piston in either of such cylinders and resulting oscillation of the valve will cut off this connection and substitute connection between the cylinder and exhaust ports b^3 or b^6, as the case may be, by which the exhaust fluid is admitted into the hollow interior of the valve finally escaping from the valve through passage E′ into the open. Upon reversal the course of the fluid is substantially the same save that instead of ports b^3, b^6 as previously explained, ports b^3 b^5 serve as exhaust ports by reason of the changed angular relation of the valve to its operative connection, specifically eccentric rod c. The above general description applies equally to the other valve B′ the arrangement of ports being exactly the same.

The improved construction, the simplicity, and other described advantages of my pneumatic drill all render it a machine which produces power much superior in amount to that developed in any other drill or engine of the same size and type.

Having thus described my invention in detail, that which I particularly point out and distinctly claim is:—

1. In a portable pneumatic drill, the combination of a casing; a pair of power-cylinders and a crank-chamber formed therein; controlling valves for said cylinders; a crank-shaft located in said chamber; a pinion carried upon said crank-shaft; bearings for the latter, said pinion being wholly contained within one of said bearings; a gear carried upon the tool-socket of the machine and meshing with said pinion; pistons for said cylinders connected to said crank-shaft; and operative connections between said valves and said crank-shaft.

2. In a portable pneumatic drill, the combination of a casing; a pair of power-cylinders and a crank-chamber formed therein; controlling valves for said cylinders; a crank-shaft located in said chamber; a single bearing for the whole gear-end of said crank-shaft comprising a substantially cylindrical shell having plane ends and a spherically-shaped central portion; a pinion carried upon said crank-shaft within the spherical portion of said shell; a gear carried upon the tool-socket of the machine and meshing with said pinion; pistons for said cylinders connected to said crank-shaft; and operative connections between said valves and said crank-shaft.

3. In mechanism of the class described, the combination of a power-cylinder; a piston working therein; a crank-shaft connected to said piston; a rotatable controlling valve for said cylinder; a stem longitudinally movable relatively to said valve but rotatably fixed thereto; a rod operatively connecting said valve with said crank-shaft, such connection with said valve being angularly adjustable by longitudinal movement of said valve stem; and means for thus moving the latter.

4. In mechanism of the class described, the combination of a power-cylinder; a piston working therein; a crank-shaft connected with said piston; a rotatable controlling valve for said cylinder; a rod operatively connecting said valve with said crank shaft; and a stem for thus connecting said rod with said valve, said stem being longitudinally movable relatively to said rod and valve but being rotatably fixed with respect to the former and having helical engagement with respect to the latter.

5. In mechanism of the class described, the combination of a plurality of power cylinders; pistons working therein; a crank-shaft connected with said pistons; a rotatable controlling valve for each of said cylinders; a stem longitudinally movable relatively to each of said valves but rotatably fixed thereto; a rod operatively connecting each of said valves with said crank-shaft, such connection with said valves being angularly adjustable by longitudinal movement of said valve stems; and means for simultaneously thus moving the latter.

6. In a portable pneumatic drill, the combination of a pair of power-cylinders; pistons working therein; a crank-shaft connected to said pistons; controlling valves for said cylinders; operative connections between said valves and said crank-shaft; a yoke longitudinally secured to said valves, the latter being rotatable upon said yoke; means for raising and lowering said yoke; and, means, including a helical groove in the valve-struc-

ture, adapted to reverse the latter upon the actuation of the same by said yoke.

7. In a portable pneumatic drill, the combination of a pair of power-cylinders; pistons working therein; a crank-shaft connected to said pistons; oscillatory controlling valves for said cylinders; operative connections between said valves and said crank-shaft; stems longitudinally movable relatively to said valves, rotatably fixed to the same, and having helical grooves; a yoke longitudinally secured to said stems, the latter being rotatable upon said yoke; means for raising and lowering said yoke; and means adapted to engage said grooves to reverse said valves, upon the actuation of said stems by said yoke.

8. In a portable pneumatic drill, the combination of a pair of power-cylinders; pistons working therein; a crank-shaft connected to said pistons; oscillatory controlling valves for said cylinders; disks connected to said valves; eccentric-straps connecting said crank-shaft and said disks; stems secured to said valves by means of feather-keys, intersecting said disks and having helical grooves; keys fixed to said disks and adapted to engage with said grooves; a yoke longitudinally secured to said stems, the latter being rotatable upon said yoke; and means for raising and lowering said yoke.

Signed by me, this 31″ day of March 1906.

ANDREW P. STROM

Attested by—

JNO. F. OBERLIN,

G. W. SAYWELL.