No. 817,384. PATENTED APR. 10, 1906.

R. A. NORLING.

PNEUMATIC MOTOR.

APPLICATION FILED JULY 20, 1904.

4 SHEETS—SHEET 1.

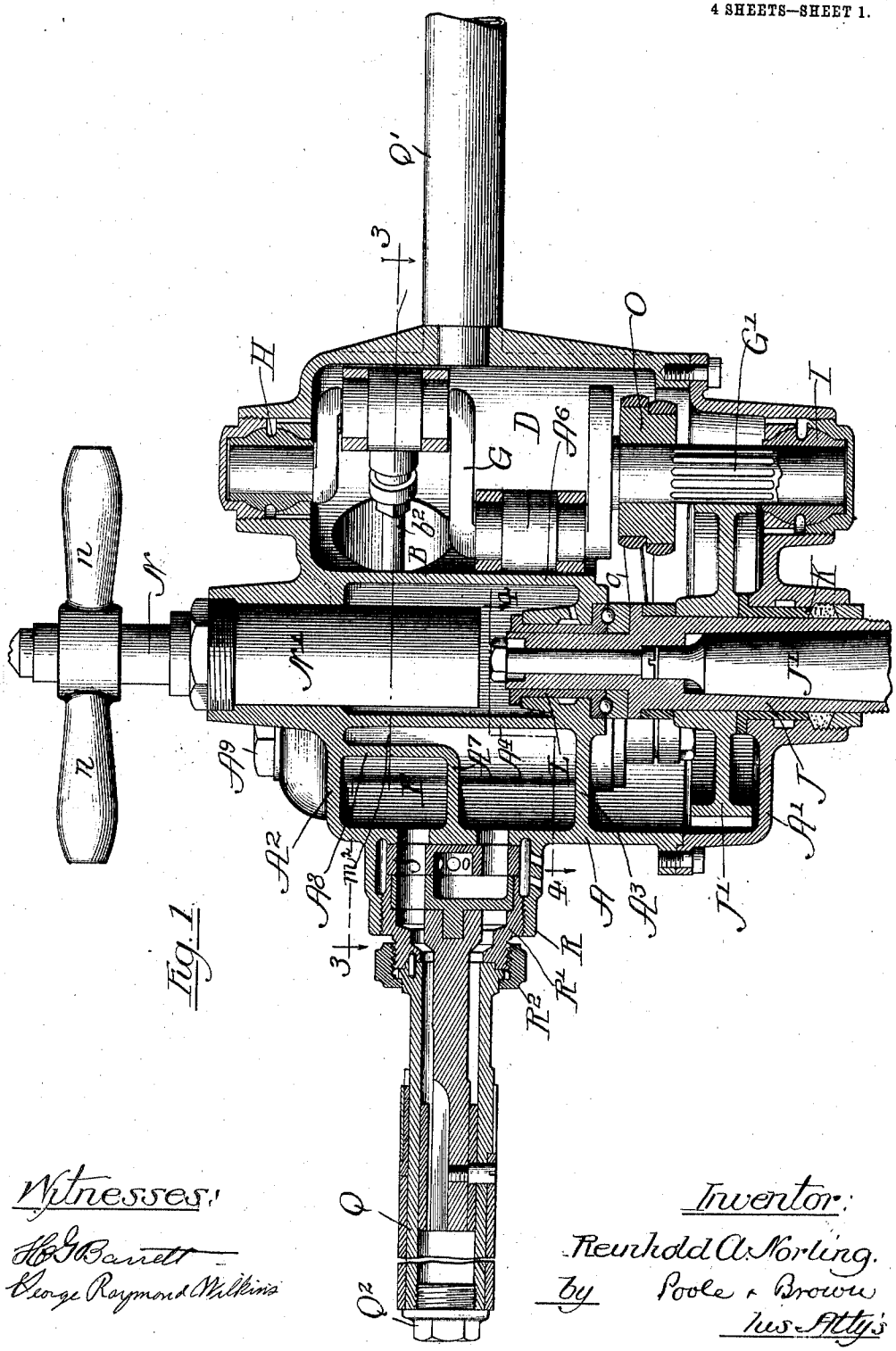

Fig. 1.

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by Poole & Brown
his Attys

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4 SHEETS—SHEET 2.

Fig. 2

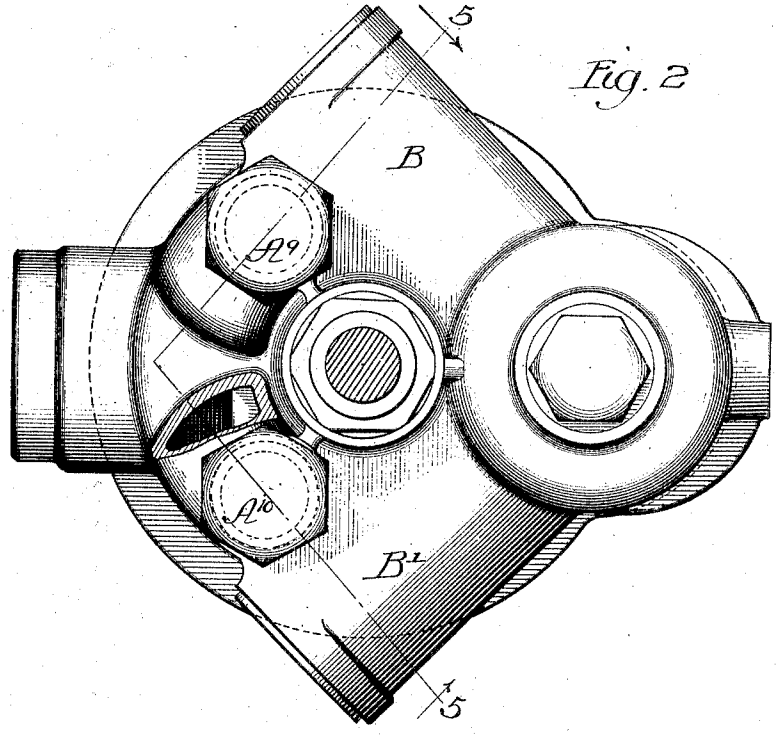
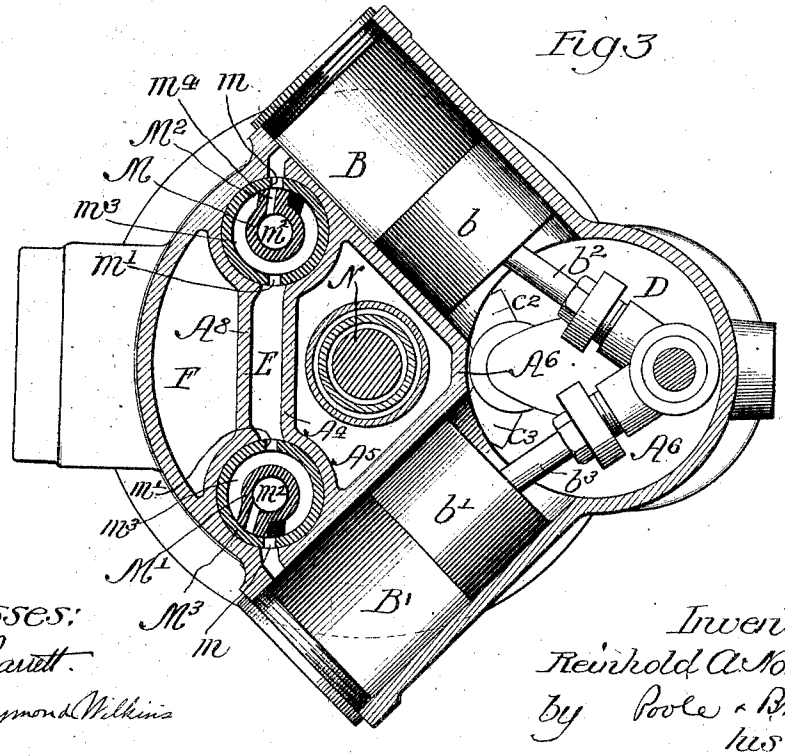


Fig 3



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4 SHEETS—SHEET 3.

Fig. 4

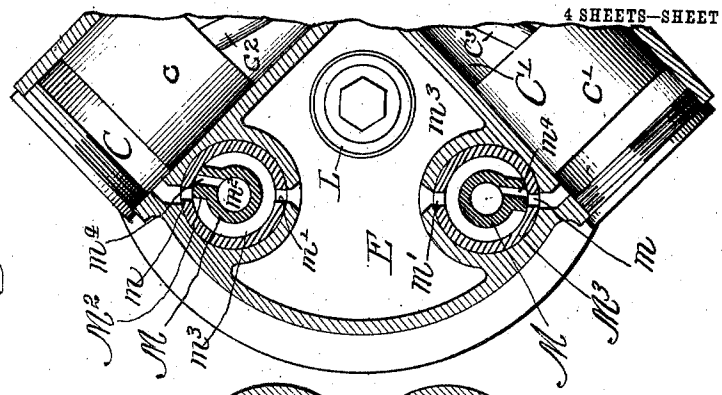
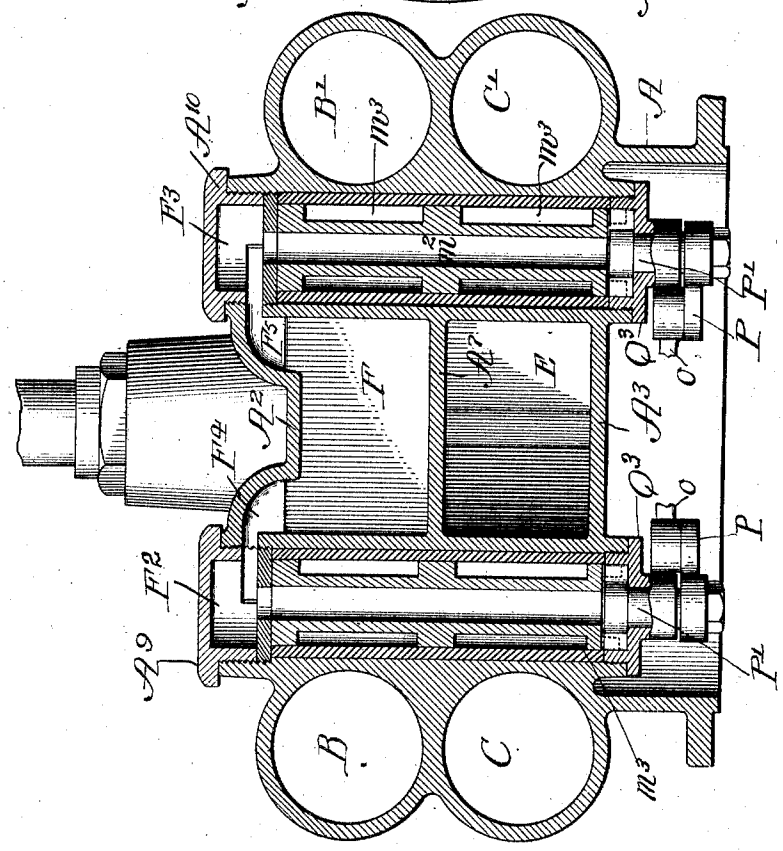


Fig. 5



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4 SHEETS—SHEET 4.

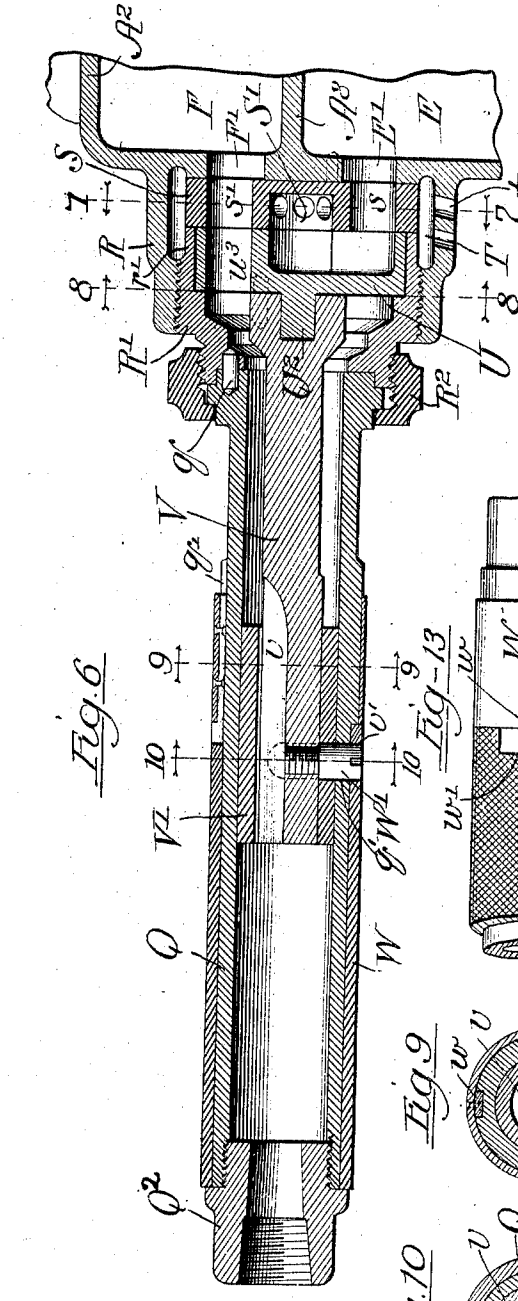

Fig. 6

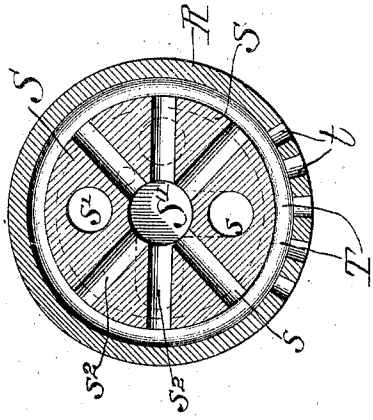

Fig. 7

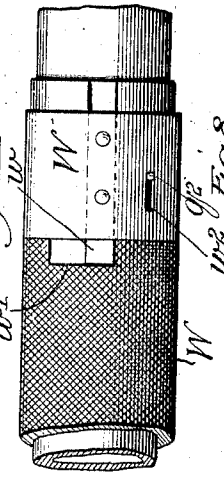

Fig. 13

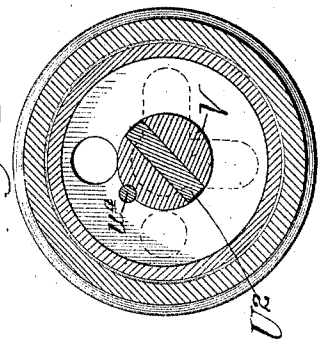

Fig. 8

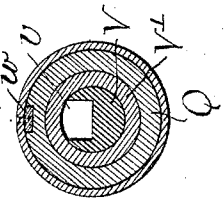

Fig. 9

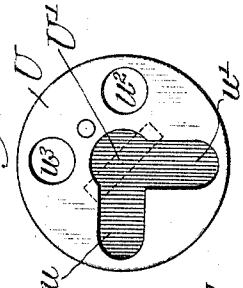

Fig. 11

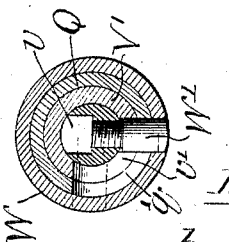

Fig. 10

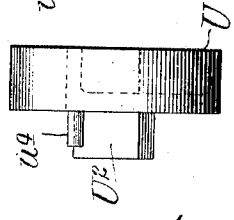

Fig. 12

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UNITED STATES PATENT OFFICE.

REINHOLD A. NORLING, OF AURORA, ILLINOIS, ASSIGNOR TO AURORA AUTOMATIC MACHINERY COMPANY, OF AURORA, ILLINOIS, A CORPORATION OF ILLINOIS.

PNEUMATIC MOTOR.

No. 817,384. Specification of Letters Patent. Patented April 10, 1906.

Application filed July 20, 1904. Serial No. 217,372.

To all whom it may concern:

Be it known that I, REINHOLD A. NORLING, a citizen of the United States, residing at Aurora, in the county of Kane and State of Illinois, have invented certain new and useful Improvements in Pneumatic Motors; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in portable pneumatic drills or mechanisms of that kind embracing a fluid-pressure engine of portable form applied to operate a drill or like tool—such, for instance, as is illustrated and described in United States Letters Patent No. 762,932, granted to me on the 21st day of June, 1904.

The invention relates to improvements in machines of the kind above described designed to make the same reversible or capable of giving to the tool driven thereby rotary motion in either direction at the will of the operator.

The invention consists in the matters hereinafter set forth, and pointed out in the appended claims.

In the accompanying drawings, illustrating my invention, Figure 1 is a sectional view of a machine embodying my invention, taken on a plane passing through the central axis of the tool-actuating spindle and the crank-shaft thereof. Fig. 2 is a plan view of the engine. Fig. 3 is a sectional view thereof, taken upon line 3 3 of Fig. 1. Fig. 4 is a partial section taken on the line 4 4 of Fig. 1. Fig. 5 is a sectional view through the casing of the machine, taken on the plane indicated by the indirect line 5 5 of Fig. 2. Fig. 6 is an enlarged detail sectional view of the reversing or throttle valve of the engine. Fig. 7 is a detail section taken upon line 7 7 of Fig. 6. Fig. 8 is a detail section taken upon line 8 8 of Fig. 6. Fig. 9 is a detail section taken upon line 9 9 of Fig. 6. Fig. 10 is a detail section taken upon line 10 10 of Fig. 6. Fig. 11 is a face view of the rotative valve-disk shown in Fig. 6. Fig. 12 is a side view of the valve-disk shown in Fig. 11. Fig. 13 is a fragmentary exterior view of part of the rotative sleeve and air-tube shown in Fig. 6.

As shown in said drawings, A indicates the main casing of the machine, which contains four power-cylinders B B′, C C′, a crank-chamber D, and air-chambers E and F. To the bottom of the main casing A is attached a cap or auxiliary casing A′. The cylinders B B′ C C′ are arranged in pairs, with the two cylinders B C and B′ C′ constituting each pair parallel with each other, the air-chambers E and F being located in the sector-shaped space between the pairs of cylinders. Within the crank-chamber D is a crank-shaft G, which engages at its upper end a bearing H in the top wall of the main casing and at its lower end a crank-bearing I in the auxiliary casing or cap A′. The pistons b b' c c' within said cylinders are connected by connecting-rods b^2 b^3 c^2 c^3 with the cranks of the crank-shaft G.

J indicates the main driving-spindle of the machine, through which motion is transmitted to the rotative tool or other part to be driven. J′ indicates the shank of a drill inserted in a socket in said spindle J. Said spindle J passes through the cap A′, having a bearing K therein, and into the main casing, which is provided with a bearing L for the inner end of the said spindle. The driving-spindle J is actuated from the crank-shaft G by means of a pinion G′ on the crank-shaft, which intermeshes with a gear-wheel J′ on the spindle.

M M′ indicate oscillating cylindric valve-plugs which are arranged with their central axes or axes of rotation transverse to the cylinders B B′ and C C′ and which turn in cylindric seats or chambers formed therefor in the main casing A. Each of the oscillating valve-plugs is arranged to operate in connection with one pair of the cylinders, the valve M being arranged to operate in connection with the cylinders B C, while the valve M′ operates in connection with the cylinders B′ C′. The said valve-chambers are formed in the casing A between the pairs of cylinders B C and B′ C′ and extend across the outer ends of said cylinders, the valves being interposed between the outer ends of said cylinders and the chambers E and F, which latter occupy the central space in the casing between the outer ends of said cylinders and extend between the top wall A^2 of the casing and a wall or diaphragm A^3, which forms the bottom of

the air-chamber E. The inner wall of the said air-chamber E is formed by a partition A^4, which extends from the diaphragm A^3 upwardly to the top wall A^2 and separates the air-chamber E from a central space or chamber A^5, located adjacent to the crank-chamber between the inner ends of the cylinders and separated from the said crank-chamber by a partition A^6. A feed-screw N is arranged in alinement with the driving-spindle J and is mounted in a sleeve N', which is attached to the top wall A^2 of the casing and extends into said chamber A^5, said feed-screw N having radial handles *n*, by which it may be operated. The air-chamber F is located adjacent to the top wall A^2 of the casing, and the chamber E is located adjacent to the bottom wall A^3 thereof. Said chambers E and F are separated from each other by a horizontal diaphragm or partition A^7, arranged about midway between the top wall A^2 and the bottom wall A^3 and by a vertical partition A^8, which joins the rear edge of the partition A^7 and rises to the top wall A^2, said wall A^8 being located between the partition A^4 and the front wall of the casing and extending between the upper parts of the valve-chambers, as clearly seen in Fig. 3. The air-chambers E and F constitute either air supply or exhaust chambers, according to the direction in which the motor is running.

The valve seats or chambers are shown as provided with bushings or cylindric tubular linings M^2 M^3, which form the bearing-surfaces for the valve-plugs and which are provided with slots or openings which constitute inlet and outlet ports and coöperate with the ports or passages in the valve-plugs, the said bushings and the valve-plugs having each two sets of ports and passages, one for each of the two cylinders with which the valve is associated. The ports in said valve-casings M^2 M^3 are lettered alike in the drawings for all four cylinders, those affording communication between the interior of the valve-seats and the cylinders being marked *m*, while those which communicate with the air-chamber E are marked *m'*.

The valve-plugs M M' are like those illustrated and described in United States Letters Patent No. 762,934, granted to me June 21, 1904. The several sets of ports and passages of said valve-plugs are lettered alike in the drawings. Each plug is provided with a longitudinally centrally-arranged passage m^2, with two external recesses m^3 m^3, one for each cylinder, which extend partially around the plug and form passages adapted to connect the outer ends of the cylinders with the air-chamber E, and with two transverse ports or passages m^4 m^4, which extend from the central passage m^2 to the side face of the plug at points between the ends of the external recesses m^3 m^3. When the plug is turned in the position to bring one end of one of said passages m^3 opposite one of the cylinder-ports *m*, communication will be established between the cylinder and the air-chamber E, the said recess m^3 being always in communication with the supply-port *m'*. The said ports m^4 m^4 are adapted to bring the central passage m^2 into communication with the cylinder-ports *m m* when the valve-plug is turned to bring one or the other of said ports into register with said cylinder-ports. The sets of passages and ports m^3 m^4 in each plug are arranged at an angle to each other, so that when the plug is turned to bring one port m^4 into register at its end with one of the cylinder-ports, thereby bringing the central passage m^2 into communication with the outer end of one of the cylinder-ports, the other port m^4 in the plug will be out of register with its associate cylinder-port, and the latter will be in communication with the recess m^3.

The valve seats or chambers for the valve-plugs M M' open at their upper ends into spaces or chambers F^2 F^3, formed by means of upward extensions of the top wall A^2 and preferably closed by means of removable caps A^9 A^{10}. Said chambers F^2 F^3 communicate with the exhaust-chamber F by means of laterally and downwardly directed passages F^4 F^5, leading from the upper ends of the valve-chambers into the top of the said chamber F, as clearly seen in Figs. 2 and 5. Said chamber F, being separated from the chamber E by the horizontal diaphragm or partition A^7, extends downwardly from the top wall A^2 only about one-half the length of the valve-chambers; but the rear or inner part of the chamber E extends practically the full length of said valve-chambers, the space between the partitions A^4 and A^7 constituting a part or upward extension of the chamber E, so that both the ports *m' m'* of both the valve-chambers are in communication with said chamber E, as clearly seen in Figs. 3 and 4.

From the above it will be understood that if air be supplied under pressure to the chamber E it will pass from said chamber to either one of the cylinders, when the valve-plug is turned to the required position, through one of the ports *m'*, the external passage m^3, and the cylinder-port *m* to the cylinder, while exhaust-air from the said cylinder will pass outwardly from said cylinder-port *m* through the port m^4 to the central exhaust-passage m^2 and from the upper end of said exhaust-passage through the chamber F^2 and passage F^4 to the chamber F, which is in this case the exhaust-chamber.

The above describes the passage of the air when the engine is running in its normal or usual direction; but when the direction of rotation of the driving-spindle is reversed through the reversing-valve hereinafter described the air will enter the chamber F, will

pass from said chamber through the passages F^4 F^2, then through the central passage m^2 of the valve-plug, and thence through the port m^4 to the cylinder-port m, while the exhaust-air from said cylinder will pass through said cylinder-port m, the external passage m^3, and the port m', from which it will enter the chamber E, which in this case becomes the exhaust-chamber.

The valve-plugs M M′ are given oscillatory movement from a double eccentric O, mounted on the crank-shaft G between the gear-pinion G′ and the cranks, through the medium of two eccentric-rods o o, which are connected with crank-arms P P, attached to rock-shafts P′ P′, which have bearing in caps Q^3 Q^3, which caps are attached to the wall A^3 and close the lower ends of the valve-chambers, said rock-shafts being connected with the lower ends of said valve-plugs, so as to turn the same. These parts are like the corresponding features of the engine shown in my prior patent, No. 762,934, hereinbefore referred to.

Now referring to the reversing-valve which forms part of the invention, Q indicates a tube which is rigidly attached to the casing A and forms one of the handles of the tool and through which compressed air is supplied to drive the motor. Another handle Q′ is shown as attached to the casing A at the side thereof opposite said tube Q. The tube Q is provided at its outer end with a nipple Q^2, by which a flexible air-supply pipe or hose may be connected therewith. R indicates a valve-casing which projects from the side wall of the casing A and is located on the said casing A in such manner as to extend above and below the partition A^7, which separates the air-chambers E and F from each other. Said valve-casing R is shown as having the form of an outwardly-extending cylindric flange on the wall of the casing and as provided with a cap R′, which forms a removable head or closure for the valve-casing R and is shown as entering the outer end of and having screw-threaded engagement with the said valve-casing. The tube Q is attached at its inner end to the cap R′ and is shown as secured or attached to the same by means of a screw-collar R^2, having screw-threaded engagement with the outer end of the cap and engaging an annular flange on the inner end of said tube Q, the said tube being held from turning relatively to the cap by means of a pin q, which engages both of said parts at their meeting edges.

Within the valve-casing R is located a circular fixed or non-rotative disk S, the outer face of which forms a valve-seat and which is held or clamped in place within the casing by means of an inwardly-extending annular flange r' on the cap R′. The outer face of the wall A of the casing within the valve-casing R is made flat to form a bearing-surface against which rests the seat-disk S, while the end of the cylindric flange r' bears against the outer margin of said disk and acts to hold or clamp the same against the said wall of the casing. The said seat-disk S is provided with diametrically opposite valve-ports s s', while the wall of the casing is provided with two ports opening severally into the chambers E and F and arranged in register with or to form continuations of the said ports s' s. The ports or openings E′ and s' constitute a passage leading from the interior of the valve-casing to the air-chamber E, and the ports F′ and s' form a passage leading from the interior of said valve-chamber to the chamber F.

Within the valve-casing R and surrounding the stationary seat-disk S is formed an exhaust-passage T, which communicates with the outer air through outlet-openings t t, and the said valve-plate S is provided in its outer or bearing face with a central recess or depression S′, which communicates with said exhaust-passage T by means of radial passages s^2 s^2, formed in said disk.

U indicates a rotative valve-disk which is located within the valve-casing and bears at its inner face against the stationary seat-disk. Said valve-disk U is provided on its inner or bearing surface with a central recess U′, which corresponds in position with and is in communication with the central recess S′ of the stationary seat-disk S and with two radial grooves or passages u u', which extend radially outward in the inner face of said valve-disk at an angle of ninety degrees from each other and are adapted for communication at their outer ends with either one of the ports s s' of the valve-disk S. Said valve-disk U is also provided with two ports or holes u^2 u^3, which extend through the same and are located at an angular distance from each other of ninety degrees and also at an angular distance of ninety degrees from the passages u u'. Connected with said valve-disk U is an actuating rod or stem V, which extends outwardly through the tube Q and has bearing at its outer end in a sleeve V′, which fits within said tube Q. Said stem V is made sufficiently smaller than the tube Q to permit the free passage of air around the same to the space within the cap R′, and a longitudinal groove v is formed in the part of the said stem which enters the sleeve V′, so that air may pass freely from the outer end of the tube Q through said groove v to the space surrounding the stem V.

For actuating the valve-disk U or giving rotative motion to the same devices are provided as follows: W indicates an external sleeve, constituting a hand-grip, which surrounds the outer part of the tube Q and is adapted to turn or rotate thereon. Said sleeve W is connected with the stem V by means of a stud W′, which passes through a transverse slot q' in the tube Q and a like slot

v' in the sleeve V'. Said stud W' is shown as having screw-threaded engagement at its inner end with the stem V. The rotative valve-disk U is loosely connected with the stem V in such manner that the said valve-disk may be held by the air-pressure against the seat-disk S, the connecting devices illustrated consisting of a flat-sided central lug U^2 on the said disk U, which enters a correspondingly-shaped socket in the end of said valve-stem, and a stud u^4, which is fixed in the said valve-disk and engages a notch in the outer face of said stem, as clearly seen in Fig. 6.

Fig. 5 shows the position of the parts described when the valve-disk U is turned in position for the passage of air from the supply-pipe to the air-chamber F and the exhaust of the air from the air-chamber E. In this position of the parts the port u^3 of the rotative valve-disk registers with the port s' of the stationary disk, and air from the interior of the tube Q passes through said ports u^3 and s' to the interior of the chamber F. Exhaust-air from the chamber E passes, in this instance, outwardly through the port s in the stationary seat-disk and then through one of the radial passages u' in the plate U to the central recess S' of the stationary seat-disk, from which it passes outwardly through the passages s^2 to the exhaust-passage T, from which it is exhausted through the holes t t to the outer air. By turning the valve-disk one-fourth of a revolution from the position shown in Fig. 5 the end of the passage u will coincide with the port s', while the port u^2 will coincide with the passage s, and then the movement of the air will be reversed and the air-supply will enter the said ports u^2 and s, while the exhaust will take place through the port s' and the central recess S' of the plate S. The valve-disk U is shown as provided with two ports u^2 u^3 and two passages u u', arranged at an angle of ninety degrees (90°) to each other in the manner shown in order that the reversal of the engine may be effected by a quarter-turn only of the rotative sleeve or grip W, it being of course understood that in case said disk should be made with only one port and one recess they would be arranged diametrically opposite to each other and then a half-rotation of the valve-disk would be required for reversing the engine. The valve arranged as described operates both as a reversing-valve and as a cut-off or throttle valve, it being manifest that when one of the ports u^2 or u^3 is opposite one of the ports s or s' if the valve-disk U be turned about an eighth of a turn the imperforate part of the disk U between the said ports u^2 u^3 will be brought over the port s or s', and the air-supply will then be entirely cut off.

In connection with the valve arranged both as a cut-off or throttle valve and a reversing-valve, as above described, I have provided means for limiting the rotative movement of the grip W, so that when the operator desires to run the motor in one direction only he may not inadvertently reverse its direction of motion by turning the grip too far for admitting and cutting off the air-supply. For this purpose I provide upon the tube Q adjacent to the inner end of the rotative sleeve or grip W a sliding ring W', having attached to it a longitudinal stop-bar w, which engages and slides endwise in a recess or groove q' in the tube Q and projects beyond the edge of said ring W' in position to engage a notch w' in the said sleeve W, Fig. 10, when the ring is thrust toward the sleeve. Said notch w' is made of sufficient width or length circumferentially of the sleeve to permit rotative movement of the sleeve during a distance of about one-eighth of a turn, this being sufficient to cut off and admit air to the motor, but preventing sufficient rotative movement of the valve-disk to effect reversal of the motor. When, however, it is desired to reverse the motor, then the ring W' is slid away from the sleeve W far enough to disengage the stop-bar w from said sleeve, when the latter will be left free to turn. For limiting the movement of the sliding ring W' on the tube Q a stop-pin q^2 is inserted in the tube Q and projects outwardly into a slot w^2, formed in the said ring W'.

I claim as my invention—

1. A pneumatic motor comprising a power-cylinder, a valve for controlling the admission of pressure fluid to and its exit from said cylinder, a supply-pipe, and a reversing-valve embracing a valve-casing with which said supply-pipe is connected, said valve-casing being provided with an outwardly-facing valve-seat having two ports, both of which are in communication with said cylinder by supply and exhaust passages controlled by said cylinder-valve, a rotative valve-disk bearing on said seat and adapted for bringing either of said ports in communication either with the air-supply pipe or with the outer air, a valve-operating stem connected with the valve and extending into said supply-pipe, and a sleeve mounted to turn on said pipe and forming a hand-grip, said sleeve being connected with said valve-stem by operating means extending through a slot in said pipe.

2. A pneumatic motor comprising a power-cylinder, a valve for controlling the admission of pressure fluid to and its exit from said cylinder, a supply-pipe, and a reversing-valve embracing a valve-casing with which said supply-pipe is connected and which is provided with an outwardly-facing valve-seat having two ports, both of which are in communication with the cylinder by supply and exhaust passages controlled by said cylinder-valve, a rotative valve-disk bearing on said seat and adapted for bringing either of said

ports into communication either with the air-supply pipe or with the outer air, and means for operating said valve-disk from the exterior of said pipe, said valve-operating means being loosely connected with said valve-disk so that the pressure in the supply-pipe tends to hold the valve-disk against the seat.

3. A pneumatic motor comprising a power-cylinder, a valve for controlling the admission of pressure fluid to and its exit from said cylinder, an air-supply pipe and a reversing-valve embracing a valve-casing with which the supply-pipe is connected and which is provided with an outwardly-facing valve-seat, and a rotative valve-disk bearing on said seat, said valve-seat being provided with two eccentrically-arranged ports which are in communication with the cylinder supply and exhaust passages controlled by said cylinder-valve, with a central recess and with passages leading from said central recess and communicating with the outer air, and the said valve-disk being provided with an eccentrically-arranged port extending therethrough and adapted to register with either of said ports in the seat by turning the disk, and said disk being provided in its bearing-face with a radial groove or recess adapted to connect the said central recess of the valve-seat with either of said ports in the valve-seat.

4. A portable pneumatic motor comprising an exterior casing provided with a power-cylinder, a valve for controlling the admission of pressure fluid to and its exit from said cylinder, a supply-pipe and a reversing-valve comprising a valve-casing attached to the said motor-casing and with which said supply-pipe is connected, a stationary valve-seat disk located within the casing and provided with two eccentrically-arranged ports which communicate with cylinder supply and exhaust passages in the motor-casing that are controlled by the cylinder-valve, said valve-seat disk being also provided in its bearing-face with a central recess and with radial passages leading outwardly from said central recess and opening to the outer air, and a rotative valve-disk bearing against said seat-disk and provided with an eccentric port adapted to register with either of said ports in the said seat-disk and having in its inner face a radial groove or passage adapted to bring said central recess of the seat-disk into communication with either of said ports in said seat-disk.

5. A pneumatic motor comprising a power-cylinder, a valve for controlling the admission of pressure fluid to and its exit from said cylinder, an air-supply pipe, and a reversing-valve embracing a valve-casing with which the supply-pipe is connected and which is provided with a stationary valve-seat disk and a rotative valve-disk bearing on said seat, said valve-seat disk being provided with two eccentrically-arranged ports which are in communication with the cylinders, supply-passages controlled by said cylinder-valve, with a central recess and with passages leading outwardly from said central recess, and said valve-casing being provided outside of said valve-seat disk with an annular exhaust-passage with which the outer ends of said radial passage in the seat-disk communicate and which opens to the outer air, and the said rotative valve-disk being provided with an eccentrically-arranged port extending therethrough and adapted to register with either of said ports in the seat-disk by turning the disk, and said valve-disk being provided in its bearing-face with a radial groove or recess adapted to connect the said central recess of the valve-seat with either of said ports in the seat-disk.

6. A portable pneumatic motor comprising an exterior casing provided with a power-cylinder, a valve for controlling the admission of pressure fluid to and its exit from said cylinder, an air-supply pipe and a reversing-valve embracing a valve-casing with which the supply-pipe is connected and which is provided with an outwardly-facing valve-seat, and a rotative valve-disk bearing on said seat, said valve-seat being provided with two eccentrically-arranged ports which are in communication with the cylinder and supply-passages controlled by said cylinder-valve, with a central recess and with passages leading from said central recess and communicating with the outer air, and the said valve-disk being provided with two eccentrically-arranged ports extending therethrough and in its bearing-face with two radial grooves or recesses joined at the center of the disk and adapted to connect said central recess of the valve-seat with either of said ports therein.

7. A portable pneumatic motor comprising an exterior casing provided with a power-cylinder, a valve for controlling the admission of pressure fluid to and its exit from said cylinder, a supply-pipe, and a reversing-valve comprising a valve-casing attached to said motor-casing and with which said supply-pipe is connected, a stationary valve-seat disk located within the valve-casing and provided with two eccentrically-arranged ports which communicate with cylinder supply and exhaust passages in the motor-casing that are controlled by the cylinder-valve, said valve-casing being provided with a cap having an inwardly-extending flange which bears against the marginal part of said valve-seat disk and holds the same against the inner wall of the casing, said valve-disk being provided in its bearing-face with a central recess and with radial passages leading outwardly from said central recess and opening to the outer air, and a rotative valve-disk bearing against said seat-disk and provided

with an eccentric port adapted to register with either of said ports in the seat-disk and having in its inner face a radial groove or passage adapted to bring said central recess of the seat-disk into communication with either of said ports in said seat-disk.

8. A pneumatic motor comprising a power-cylinder, a valve for controlling the admission of pressure fluid to and its exit from said cylinder, a supply-pipe and a reversing-valve embracing a valve-casing with which said supply-pipe is connected, said valve-casing being provided with a valve-seat having two ports both of which are in communication with the cylinder supply and exhaust passages controlled by said cylinder-valve, a rotative valve-disk bearing on said seat and adapted for bringing either of said ports into communication either with the air-supply pipe or with the outer air, a valve-operating stem connected with the valve and extending into said supply-pipe, a sleeve mounted to turn on said pipe and forming a hand-grip, said sleeve being connected with said valve-stem, and a shiftable stop mounted on said supply-pipe and adapted to engage said sleeve to limit the turning movement thereof.

9. A pneumatic motor comprising a power-cylinder, a valve for controlling the admission of pressure fluid to and its exit from said cylinder, a supply-pipe, and a reversing-valve embracing a valve-casing with which said supply-pipe is connected, said valve-casing being provided with a valve-seat having two ports both of which are in communication with the cylinder supply and exhaust passages controlled by said cylinder-valve, a rotative valve-disk bearing on said seat and adapted for bringing either of said ports into communication either with the air-supply pipe or with the outer air, a valve-operating stem connected with the valve and extending into said supply-pipe, a sleeve mounted to turn on said pipe and forming a hand-grip, said sleeve being connected with said valve-stem, and a sliding ring mounted on said air-pipe adjacent to one end of the sleeve and provided with a non-rotative stop projection adapted to engage stop-surfaces on said sleeve to limit the turning movement of the latter.

10. A pneumatic motor comprising a power-cylinder, a valve for controlling the admission of pressure fluid to and its exit from said cylinder, a supply-pipe, and a combined reversing and throttle valve embracing a valve-casing with which the supply-pipe is connected and which is provided with an outwardly-facing valve-seat having two ports both of which are connected with said cylinder by cylinder supply and exhaust passages controlled by the cylinder-valve, a rotative valve-disk which rests against said seat and is adapted for bringing either of said ports into communication either with the air-supply pipe or with the outer air, and also for closing communication between both of said ports and said air-supply pipe, a valve-operating stem connected with said valve-disk and extending into said air-supply pipe and a rotative hand-grip mounted on the air-supply pipe and connected by means extending through a slot in the said pipe with said valve-disk for turning the latter.

11. A pneumatic motor comprising a power-cylinder, a valve for controlling the admission of pressure fluid to and its exit from said cylinder, an air-supply pipe and a combined reversing and throttle valve embracing a valve-casing with which the supply-pipe is connected, and which is provided with an outwardly-facing valve-seat, and a rotative valve-disk bearing on said seat, said valve-seat being provided with two eccentrically-arranged ports, which are in communication with the cylinder-supply passages controlled by said cylinder-valves, with a central recess and with passages leading from said central recess to the outer air, and the said valve-disk being provided with an eccentrically-arranged port extending therethrough and adapted to register with either of said ports in the seat by turning the disk, and said disk being provided in its bearing-face with a radial groove or recess adapted to connect said central recess of the valve-seat with either of said ports in the valve-seat, said disk being adapted to close both of said ports in the valve-seat when turned to an intermediate position.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, this 14th day of July, A. D. 1904.

REINHOLD A. NORLING.

Witnesses:
W. H. PEASE,
CARRIE MUSCHLER.