J. A. PIERSON.

PORTABLE ELECTRIC ROCK DRILL.

APPLICATION FILED MAY 17, 1911.

1,011,841.

Patented Dec. 12, 1911.

3 SHEETS—SHEET 1.

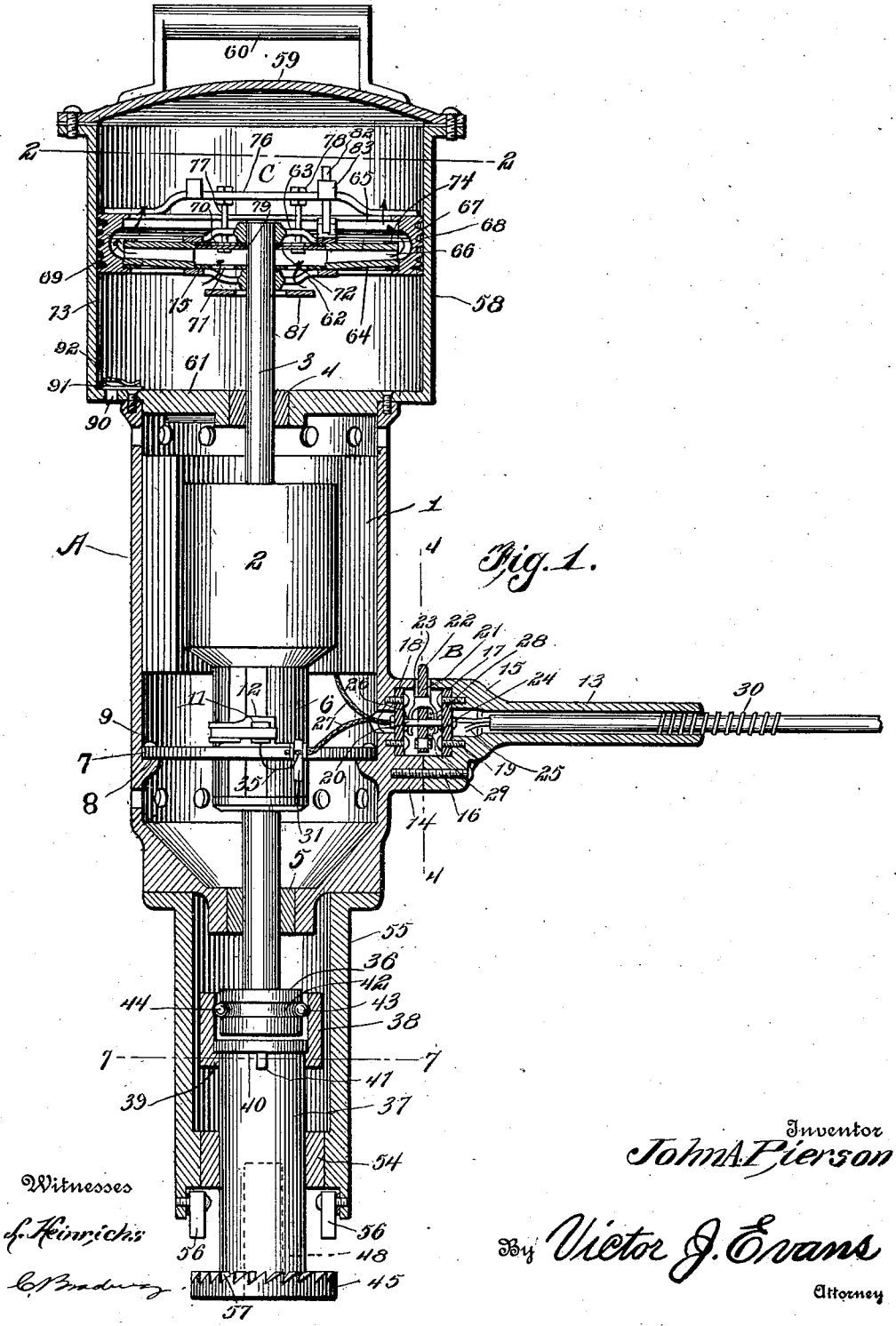

Fig. 1.

Witnesses

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3 SHEETS—SHEET 2.

Fig. 2.

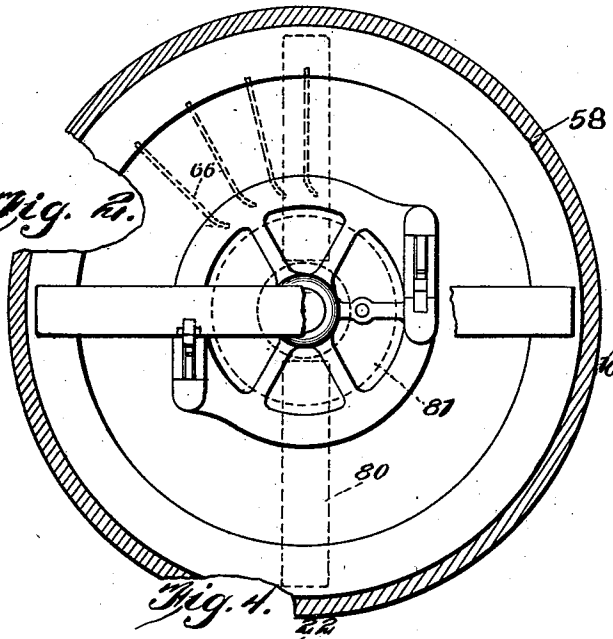


Fig. 3.

Fig. 4.

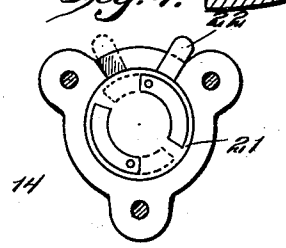


Fig. 5.

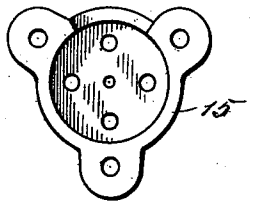
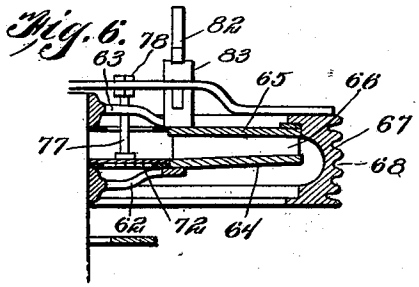


Fig. 6.



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3 SHEETS—SHEET 3.

Fig. 7.

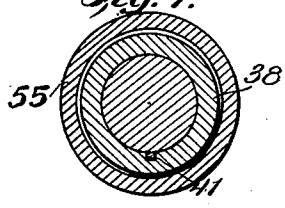


Fig. 8.

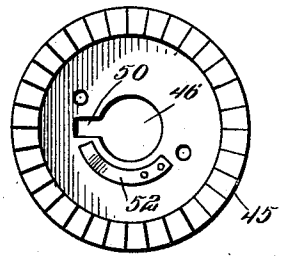


Fig. 9.

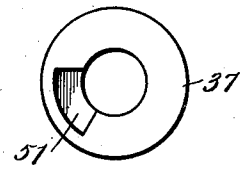


Fig. 10.

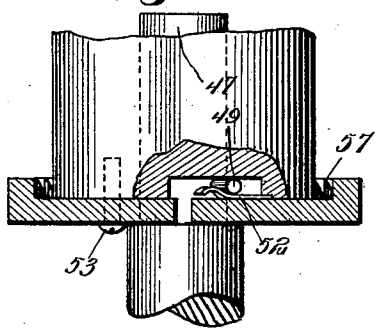


Fig. 11.

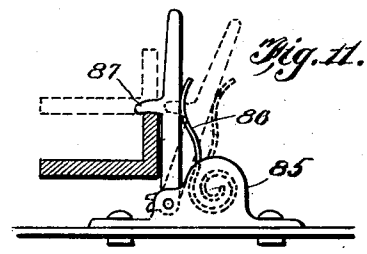


Fig. 12.

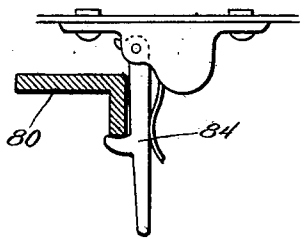


Fig. 13.

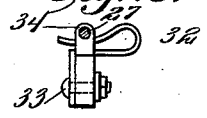
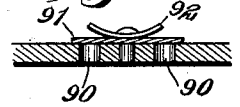


Fig. 14.

Fig. 15.



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UNITED STATES PATENT OFFICE.

JOHN ALBERT PIERSON, OF PIGEON COVE, MASSACHUSETTS.

PORTABLE ELECTRIC ROCK-DRILL.

1,011,841. Specification of Letters Patent. **Patented Dec. 12, 1911.**

Application filed May 17, 1911. Serial No. 627,853.

To all whom it may concern:

Be it known that I, JOHN A. PIERSON, a citizen of the United States, residing at Pigeon Cove, in the county of Essex and State of Massachusetts, have invented new and useful Improvements in Portable Electric Rock-Drills, of which the following is a specification.

This invention relates to a rock drill of that type in which the drill chuck is reciprocated by means of a rotating element, such as the armature of an electric motor, there being means whereby the rotary movement of the armature is translated into longitudinal reciprocatory movement of the drill chuck that is connected with the armature.

The invention has for one of its objects to improve and simplify the construction and operation of tools of this character so as to be reliable and efficient in use, comparatively inexpensive to manufacture, and readily manipulated.

Another object of the invention is the provision of a pneumatic motion-translating device whereby the rotary movement of the motor armature is converted into longitudinal reciprocatory movement thereof whereby the blows are imparted to the drill, with a cushioning effect so as not to injure the machine.

With these objects in view and others, as will appear as the description proceeds, the invention comprises the various novel features of construction and arrangement of parts which will be more fully described hereinafter and set forth with particularity in the claims appended hereto.

In the accompanying drawings, which illustrate one embodiment of the invention, Figure 1 is a central vertical section of the machine with certain parts in elevation. Fig. 2 is a section on line 2—2, Fig. 1. Fig. 3 is a fragmentary view of the brush rocker or yoke of the motor. Fig. 4 is a transverse section on line 4—4, Fig. 1, showing the switch for turning on and off the current. Fig. 5 is a view of the inner end of the handle showing part of the housing for the switch. Fig. 6 is a detail sectional view of the pneumatic reciprocating means showing the parts in the other extreme position to that shown in Fig. 1. Fig. 7 is a section on line 7—7, Fig. 1. Fig. 8 is a plan view of the ratchet wheel on the bottom of the chuck for turning the latter step by step, and for holding the drill in the chuck. Fig. 9 is a bottom plan view of the chuck with the ratchet wheel removed. Fig. 10 is a side elevation of the lower end of the chuck with a portion broken away. Fig. 11 is an enlarged detail view of one of the upper valve-holding catches of the pneumatic reciprocating means. Fig. 12 is a view of one of the lower valve catches. Fig. 13 is a detail view of one of the clips for connecting the brushes with the motor terminal leads. Fig. 14 is a detail view of one of the pawls for rotating the chuck. Fig. 15 is a detail view of one of the inlet check valves for the pneumatic reciprocating means.

Similar reference characters are employed to designate corresponding parts throughout the views.

Referring to the drawings, A designates the cylindrical casing of the motor in which is mounted the stationary field 1 that may consist of any desired arrangement of coils, and within the field is the armature 2 and this armature is secured to a rotary and reciprocatory shaft 3 that turns and slides in bearings 4 and 5 in the ends of the casing A. The commutator 6 is of appropriate length to permit the armature and its shaft to move longitudinally throughout the range of the drill strokes and the stationary brushes not slide off. Within the casing A is a yoke or rocker 7 which rests on an internal shoulder or lug 8 and this rocker is held in place by screws 9 passing through elongated slots 10 in the rocker and screwing into the shoulder 8, the slots permitting of the rocker to be circumferentially adjusted in order to properly position the brushes 11 on the commutator. The brushes 11 are mounted in holders 12 that are fastened on the rocker 7 to be adjusted therewith. The motor may be series wound and the current is turned on and off by means of a switch B arranged at the inner end of one of the handles 13 of the machine.

Formed on the casing A is a hollow boss 14 and on the inner end of the handle 13 is a hollow head 15 which coöperates with the boss 14 to form a housing for the parts of the switch, the handle 13 being fastened to the boss by screws 16. Within the switch housing are separate disks 17 and 18 which are spaced apart and held in place by screws 19, and passing through these disks of insulation is a central shaft in the form of a bolt 20 that forms an axle for the movable

element 21 of the switch. This element 21 is in the form of a disk of insulation that has a lug or handle 22 that projects out of a slot 23 in the housing, so that the switch can be manipulated by the thumb or finger of the hand that grips the handle 13. On the disk 17 are binding posts 24 to which the supply wires 25 are connected, and these binding posts form contacts at the ends opposite to where the wires 25 are connected. On the disk 18 are binding posts 26 to which the motor terminal wires 27 are connected, and the inner ends of these binding posts also form contacts. On the element 21 are two pairs of spring contact fingers 28 that pass through the element 21 and are adapted to engage the contacts formed by the binding posts. The spiral spring 29 is connected with the element 21 and with its axle 20, and this spring operates on the element to hold its spring contacts normally out of engagement with the contacts formed by the binding posts so that the circuit will normally be opened, and consequently it will be necessary for the operator to maintain his finger or thumb on the handle 22 of the switch as long as the drill is in operation. The handle 13 is tubular so that the wires 25, in the form of a cord conductor, can lead into the switch through the handle, and at the outer end of the handle, the cord conductor is provided with a helical spring 30 which protects the insulation where the conductor is liable to bend sharply on the end of the handle. Connection is had with the brushes by means of clips 31 arranged on the rocker 7, one of the clips being shown in detail in Fig. 13. The clip consists of a doubled spring 32 that is secured by a bolt 33 to the rocker and has its free end movable between apertured lugs 34, and through the aperture of these lugs is passed the bare end of the wire 27. A wire 35 leads from the brush holder, Fig. 1, and its end is tucked between the spring 32 of the clip and the wire 27 so that the pressure of the spring 32 will maintain good electrical connection between the wires 27 and 35.

On the lower end of the armature shaft 3 is a head 36 to which the chuck 37 is connected by means of a coupling sleeve 38. This sleeve 38 has an internal flange 39 at its lower end which forms a shoulder that engages under a shoulder 40 on the upper end of the chuck formed by a collar or ring fastened thereto, the said ring having lugs 41 that engage in recesses in the sleeve 38 so that the sleeve and chuck will rotate together as the drill is turned step by step. The head 36 and sleeve 38 have opposed ball races 42 and 43 in which are balls 44 that serve to connect the chuck with the armature shaft to cause axial reciprocation of the two parts together while the shaft 3 is free to rotate without the chuck turning with it. On the lower end of the chuck is a disk 45 which, as shown in Fig. 8, has a keyhole opening 46 and through this opening the reduced end 47 of the drill enters the bore 48 in the lower end of the chuck, the said drill having a laterally-extending pin 49 that enters the recess 50 of the opening 46. As shown in Fig. 9, the lower end of the bottom surface of the chuck has a sector slot 51 into which the pin 49 enters and is locked by a slight turning movement of the drill. On the disk 45 is a leaf spring catch 52 that yieldingly engages the locking pin 49 of the drill so as to hold the same on the chuck and prevent the pin of the drill from accidentally returning into alinement with the recess 50 of the opening 46, where the drill would drop out of the chuck. The disk 45 is fastened to the chuck by screws 53 passing through openings 54 in the disk and screwing into the bottom of the chuck. The chuck 37 slides in a bearing 54 which is secured in the lower end of a bracket or extension piece 55 bolted or otherwise secured to the lower end of the casing A, and on the lower end of this bracket or extension piece 55 are oppositely-disposed pivoted dogs or pawls 56 which are adapted to engage crown teeth 57 on the disk 45 when the chuck moves upwardly. As the crown teeth engage the dog or dogs 56, the latter are tilted from the full to the dotted line position, Fig. 14, and the chuck is thereby caused to turn. By this arrangement, the drill is given a partial turn with each reciprocation so as to more effectively drill the hole in the rock. As the drill starts on its succeeding down-stroke, the dogs 56 will gravitate to normal position so as to operate on the crown teeth during the last part of the succeeding upstroke so as to give the chuck and drill another partial turn. The rotation of the motor armature is accompanied by the longitudinal axial movement and this is accomplished by a pneumatic reciprocating means or motor C in the form of a plunger that reciprocates in a cylinder 58 fastened to the upper end of the cylinder A. The cylinder is closed at its top by a head 59 which has a handle 60 whereby the machine can be gripped and steadied by one hand of the operator, while the other hand grips the handle 13. The lower end of the cylinder 58 forms the upper end or head 61 of the casing A. The shaft 3 extends through the head 61 and connects with the reciprocating plunger or piston C. This plunger or piston includes a rotary impeller or fan wheel that consists of spaced spiders 62 and 63 fastened to the shaft 3 to rotate therewith and suitably secured to the said spiders are flat or nearly flat rings 64 and 65, respectively, between which are approximately radial vanes or blades 66, the inner ends of the blades may be curved

as shown in Fig. 2 so as to receive the air from the direction of rotation at the center of the wheel or impeller. This wheel or impeller is adapted to transfer air from one side of the piston and deliver it to the other, so that air under considerable pressure operates on opposite sides of the piston so as to reciprocate the same. It will thus be seen that the rotation of the motor armature produces longitudinal movement thereof and of the drill, through the medium of the impeller or wheel carried by the piston C. Surrounding the impeller is a ring 67 that forms a part of the piston and is of approximately the same diameter as the cylinder and the circumferential surface of this ring 67 is provided with grooves 68 so that leakage of air from the high to the low pressure side of the piston will be sufficiently prevented. This ring has an internal annular groove 69 which is considerably greater in axial dimensions than the width of the impeller wheel so that the air from the latter passes through the groove or chamber 69 that is deflected thereby to the upper or lower end of the cylinder, according to the position occupied by the ring 68. This ring 68 is shifted over with respect to the impeller or fan wheel and thus constitutes a valve surrounding the wheel and governs the direction in which the air delivered by the wheel flows. The air is drawn into the spaces between the vanes through openings or annular ports 70 and 71 at the spiders, and a floating valve in the form of a disk 72 is adapted to close these openings alternately so as to take the air from the upper side of the piston and deliver it to the lower side, or vice versa, the said valve being movable with the surrounding annular valve 68 so as to coöperate therewith to transfer air from one side of the piston to the other. The annular valve or ring 68 has seats 73 with which the impeller or fan wheel is adapted to engage, and on the wheel are packings 74 of felt or other material so as to engage the seats and form air-tight joints. On the spiders 62 and 63 are rings 75 of felt with which the disk valve 72 is adapted to engage to form air-tight joints. The ring valve 68 is provided with an arched cross bar 76, and this is connected by posts 77 with the inner disk valve 72 so that both valves will float together, and by means of the nuts 78 on the posts 77 above and below the cross bar 76, the valve 72 can be adjusted to properly seat. The disk valve 72 has a central opening 79 so as to accommodate the shaft 3. The ring valve 68 has a lower cross bar 80 that is formed with a central ring 81 through which the armature shaft 3 extends. As the pressure on one side of the valve 72 is always higher than that on the other side, it is necessary to hold such valve locked against movement while the piston C is moving through the effective range of its stroke. For this purpose, the upper spider 63 is provided with a pair of upwardly-extending catches 82 that are adapted to engage lugs 83 on the upper cross bar 76, while the lower spider is provided with a pair of depending catches 84 that are adapted to engage the lower cross bar 80. The upper set of catches are disposed in a plane at right angles to the lower pair of catches so that in the section of Fig. 1, the lower catches will not be seen. As shown in Figs. 11 and 12, the catches are pivotally mounted in frames 85 on their respective spiders and the catches are pressed by spring 86 to locking position, each catch having a lug 87 for engaging its respective cross bar on the floating part of the piston C. When the parts are in the position shown in Fig. 1, the inlet controlling valve 72 and discharge valve 68 are locked in their raised position with respect to the impeller or fan wheel so that air will be sucked from the under side of the piston and discharged to the upper side, as indicated by the arrow. This means that a partial vacuum is established below the piston and air under considerable pressure is supplied to the space above the piston, and as a consequence the piston moves downwardly. At this time, the catches 84 on the lower spider are engaged with the cross bar 80 so that the valve 72 will be held in the position shown. At the last part of the down-stroke of the piston, the catches 84 will strike the lower head 61 of the cylinder and the catches will be released from the lower cross bar 80 and by reason of the higher pressure on the upper side of the piston, the valves 72 and 68 will be quickly forced downwardly to open the port 70 and close the port 71 and at the same time connect the discharge of the fan wheel with the cylinder space below the piston. As the valves 68 and 72 are thus moved downwardly, the upper catches 82 automatically engage the upper ends of the lugs 83 on the upper cross bar 76 and thus lock the valves in the position to which they have just moved. In other words, the upper catches move from the dotted to the full line position, Fig. 11. During this transposition of the valves, the fan wheel continues to rotate and air will now be drawn from the upper side of the piston and delivered to the lower side, as indicated by the arrows in Fig. 6. The piston, together with the armature and drill chuck, will now be raised until the upper catches 62 strike the top of the piston cylinder, when said catches will be released to allow the valves 68 and 72 to be shifted. It will thus be seen that the piston will be automatically reversed and be caused to move back and forth by the superior air pressure acting

alternately in opposite ends of the piston cylinder. During the reciprocation of the piston C, air can be admitted to the cylinder 58 through ports 90 controlled by a flexible disk or flap valve 91 that has a backing piece 92, said valve being shown in detail in Fig. 15.

From the foregoing description, taken in connection with the accompanying drawings, the advantages of the construction and of the method of operation will be readily apparent to those skilled in the art to which the invention appertains, and while I have described the principle of operation of the invention, together with the apparatus which I now consider to be the best embodiment thereof, I desire to have it understood that the apparatus shown is merely illustrative and that such changes may be made when desired as are within the scope of the claims appended hereto.

Having thus described the invention, what I claim as new, is:—

1. The combination of a reciprocating tool chuck, a motor including a rotary and reciprocatory element connected with the chuck, and pneumatic means actuated by the said motor element for producing reciprocation thereof.

2. A tool of the class described comprising a chuck, a rotary motor element operatively connected with the chuck and mounted for reciprocation, and pneumatic means connected with the said element and including a rotary device for producing fluid pressure acting alternately in opposite directions to reciprocate the motor element.

3. A tool of the class described comprising a rotary and reciprocatory tool-operating element, a piston and cylinder for reciprocating the element, and means for producing fluid pressure alternately on opposite sides of the piston to reciprocate the said element.

4. A tool of the class described comprising a driving element mounted for rotary and longitudinal movement, a cylinder, and a piston in the cylinder connected with the said element and including rotary means for alternately establishing a greater air pressure on one side of the piston than the other to reciprocate the element.

5. A tool of the class described comprising a tool operating element mounted for rotary and longitudinal movement, a cylinder, and a piston in the cylinder for reciprocating the element, the said piston including a fan, and means for admitting air to the fan alternately from opposite sides of the piston and delivering it to the other side to reciprocate the piston.

6. A tool of the class described comprising a tool-operating element mounted for rotary and reciprocatory movement, a cylinder, a piston in the cylinder connected with the element for reciprocating the same, said piston including a fan wheel secured to the element to rotate therewith, separate valves coöperating to admit air to the fan from one side of the piston and to deliver the air from the fan to the opposite side of the piston, means for connecting the valves together to cause simultaneous shifting at the end of each stroke of the piston, and releasable locking means for holding the valves against movement during the effective portions of the strokes of the piston.

7. A tool of the class described comprising a tool actuating element mounted for rotary and reciprocatory movement, a cylinder, a piston in the cylinder connected with the element, said piston embodying a fan wheel adapted to receive air from either side of the piston and deliver it to the other side, and an automatically actuated inlet and discharge valve for controlling the transfer of air under pressure from one side of the piston to the other to effect reciprocation thereof.

8. A tool of the class described comprising a tool actuating element mounted for rotary and reciprocatory movement, a cylinder, a piston in the cylinder connected with the element, said piston embodying a fan wheel adapted to receive air from either side of the piston and deliver it to the other side, an automatically actuated inlet and discharge valve for controlling the transfer of air under pressure from one side of the piston to the other to effect reciprocation thereof, and valve locking devices adapted to be released automatically at the ends of the piston strokes to permit the valves to shift and reverse the direction of movement of the piston.

9. A tool of the class described comprising a rotary and reciprocatory tool actuating element, a cylinder, a fan wheel in the cylinder connected with the element to turn therewith and having separate central inlet ports and a peripheral outlet, a floating valve movable from one inlet port to the other, a floating discharge valve at the peripheral discharge of the fan, said valves cooperating with the fan to form a piston, means connecting the valves together to shift independently of the fan whereby air is alternately transferred from one side of the piston to the other, and locking devices automatically released by engagement with the ends of the cylinder to hold the valves against movement during the main portions of the strokes of the piston.

10. A tool of the class described comprising a rotary and reciprocatory tool operating element, a cylinder into which the element extends, a pair of spaced spiders on the element, rings secured to the spiders, vanes between the rings, a disk valve floating between the spiders to control the inlet

of air to the vanes, an annular valve surrounding the said rings and vanes and having a chamber through which the air discharged from the vanes passes to one end of the cylinder or the other, cross bars connected with the said annular valve, a connection between one of the cross bars and the disk valve to cause both valves to move together, and spring-set catches arranged on the spiders to respectively engage the cross bars during alternate strokes of the said element and hold the valves in position to cause air to be transferred from one end of the cylinder to the other for reciprocating the element, said catches being automatically released at the ends of the strokes by engagement with the walls of the cylinder.

11. A tool of the class described comprising an electric motor including a rotary and reciprocatory armature, and a pneumatic device including a rotary fan operated by the armature, and means for alternately reversing the direction of the blast from the fan to reciprocate the armature.

12. A tool of the class described comprising an electric motor including a rotary and reciprocatory armature, a shaft for the armature, a chuck, a connection between the chuck and shaft for permitting the latter to rotate without the chuck, a plurality of ratchet teeth on the chuck, and a pawl with which the ratchet teeth engage at the end of each return stroke of the chuck to rotate the chuck step by step.

13. A tool of the class described comprising a motor casing, a shaft extending therethrough, an armature on the shaft, a magnetic field operating on the armature, means for converting the rotary movement of the shaft into longitudinal movement thereof, a chuck, a bearing in which the chuck reciprocates, a slip joint between the shaft and chuck for permitting the shaft to rotate independently of the chuck, an extension piece on the casing for holding the said bearing, crown teeth on the other end of the chuck, and pivoted pawls on the said extension piece arranged to engage the crown teeth adjacent the inner end of the stroke of the chuck for turning the latter step by step.

14. A tool of the class described comprising a casing, a reciprocatory rotatable shaft extending out of the casing, a head on the shaft having a ball race, a sleeve surrounding the head and having a ball race, a plurality of balls engaging in the ball races, a chuck, interlocking shoulders on the chuck and sleeve, an extension piece on the casing surrounding the sleeve and head, a bearing on the extension piece in which the chuck slides, teeth on the chuck, and pawls with which the teeth engage at the end of each inward stroke to receive a step by step rotary movement from the pawls.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN ALBERT PIERSON.

Witnesses:

ANDREW PEARSON,

ALFRED SWENSON.