C. B. RICHARDS.

IMPACT TOOL.

APPLICATION FILED NOV. 30, 1906.

904,724. Patented Nov. 24, 1908.

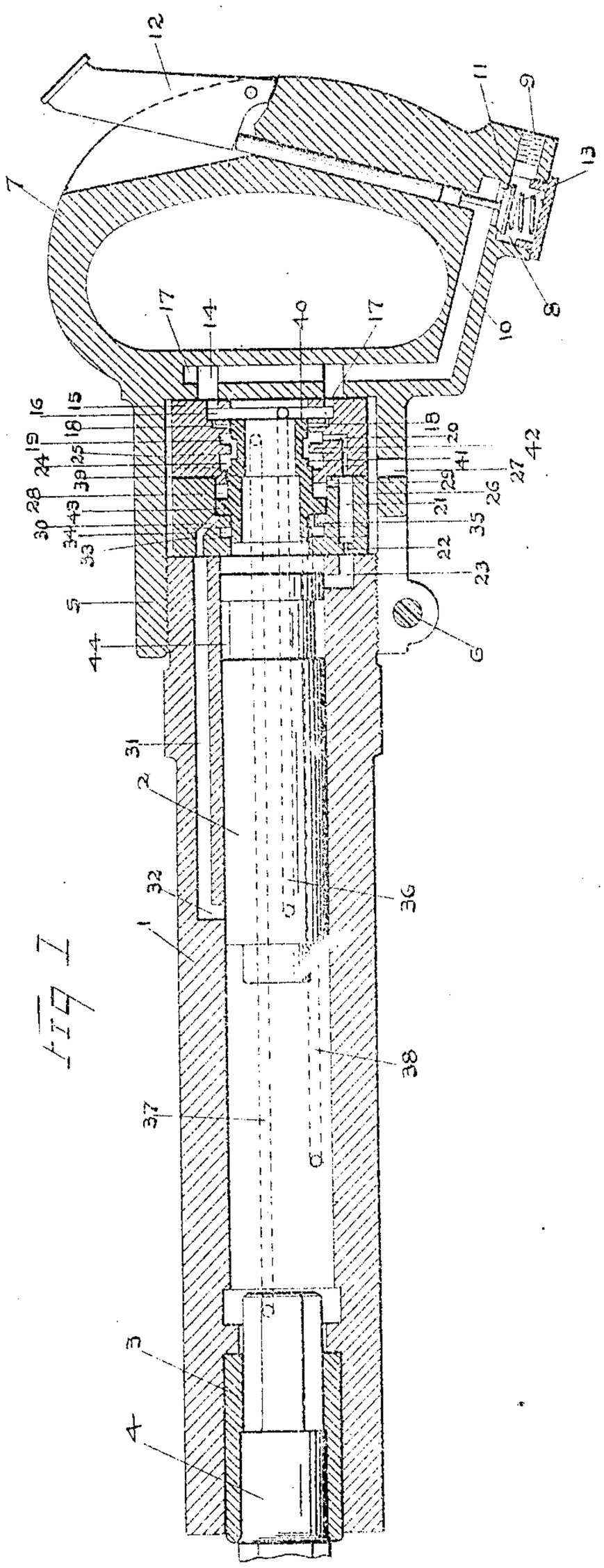

FIG I

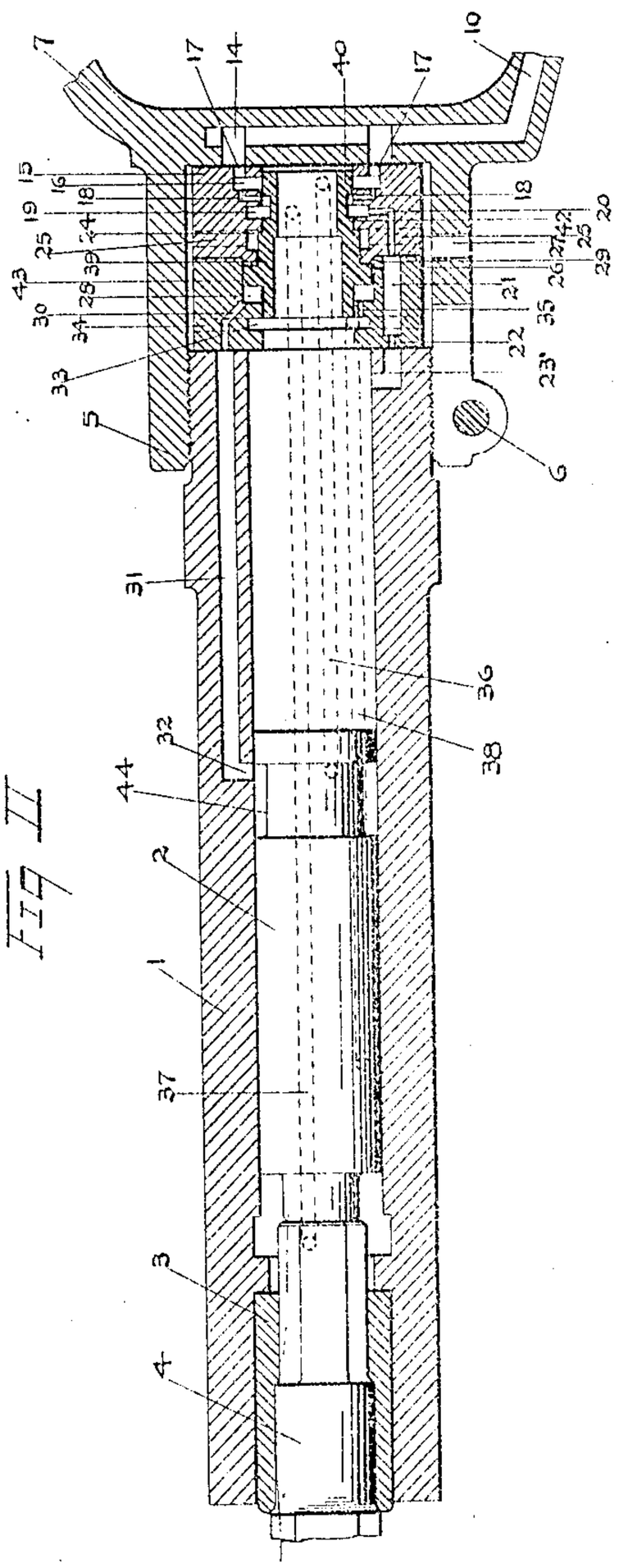

FIG II

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CHARLES B. RICHARDS, OF CLEVELAND, OHIO, ASSIGNOR TO CLEVELAND PNEUMATIC TOOL COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

IMPACT-TOOL.

No. 904,724. Specification of Letters Patent. Patented Nov. 24, 1908.

Application filed November 30, 1906. Serial No. 345,793.

To all whom it may concern:

Be it known that I, CHARLES B. RICHARDS, a citizen of the United States, resident of Cleveland, county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Impact-Tools, 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.

The annexed drawings and the following description set forth in detail, one mechanical form embodying the invention; such detail construction being but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawings Figure I represents an axial section of my improved impact tool, showing the valve in position to control the motive fluid to be admitted to the rear or upper end of the working cylinder to throw the plunger forward, and Fig. II, an axial section of the tool with a portion of the handle broken away and removed, and showing the valve in position to control the motive fluid to admit the same at the forward or lower end of the working cylinder to throw the plunger rearward or upward.

The tool has a working-cylinder or barrel, 1, within the cylindrical bore of which a plunger, 2, reciprocates. The front or lower end of this barrel is formed with a tool-socket 3, into which the shank, 4, of the working-tool is inserted. This latter tool may be a chisel, a calking tool, a rivet set or whatever other form of tool may be required for the work to be done. The rear or upper end of the barrel is threaded and is screwed into the outer end of a socket, 5, which outer end is internally threaded and longitudinally slitted so as to be firmly clamped upon the screwthreaded end of the barrel by means of a clamping-bolt, 6. Said socket forms a part of the handle, 7, upon which is formed a throttle-valve casing, 8, having an internally screwthreaded socket, 9, into which the nipple of a hose through which the motive fluid is supplied may be screwed. An inlet passage, 10, is formed through the side of the handle having the valve-casing, through which latter this passage connects with the inlet-nipple, and a throttle-valve, 11, connected to be actuated by a suitable trigger, 12, pivoted in the handle, controls the passage through the valve-casing and is held normally closed by a suitable spring, 13. An annular groove or channel, 14, is formed in the bottom of the handle-socket and communicates with the inlet-channel and forms a part thereof.

A valve-block, 15, is clamped between the rear or upper end of the barrel and the bottom of the handle-socket, and said valve-block has an axial valve-chamber formed with a number of annular grooves or ports, which will hereinafter be more fully described. An annular inlet groove or port, 16, is formed in the valve-chamber near its rear or upper end, and communicates with the annular inlet-channel 14 through a series of holes 17. A series of right-angled passages 18, extend from the bottom of this annular port 16 and open into the sides of the valve-chamber, a short distance below the port. An annular distributing groove or port 19, is formed in the interior of the valve-chamber immediately below these right-angled passages, and one or more right-angled passages, 20, extend from this port into a large longitudinal passage, 21, in the valve-block, which longitudinal passage has a restricted opening, 22, through the lower or forward end of the valve-block. This last-mentioned restricted opening communicates with a right-angled passage, 23, in the rear or upper end of the barrel, which passage opens from the end of the barrel and into the bore of the barrel near the rear or upper end. An annular exhaust-port, 24, is formed in the side of the valve-chamber a short distance below the annular port 19, and exhaust-ports, 25, are formed through the sides of the valve-block from this annular port and open into an annular exhaust-space, 26, formed between the valve-block and the interior of the handle-socket. Said exhaust-space communicates with the outer air through one or more exhaust-ports, 27, in the socket. An annular piston-chamber 28, of proportionally considerable length or width is formed in the interior of the valve-chamber below the annular exhaust-port 24. The upper end of this piston-chamber communicates by means of a passage, 29, with the longitudinal passage 21. The lower end of the annular piston-chamber communicates by means of an oblique passage, 30, opening through the lower end of the valve-block, with a longitudinal bore, 31, in the side of

the barrel, the lower end of which bore opens into the interior of the working-cylinder through a port, 32. An annular exhaust-port, 33, is formed in the interior of the valve-chamber, below the annular piston-chamber, and said exhaust-port communicates by means of radial exhaust-ports 34, with the exhaust-space surrounding the valve-block and thence with the atmosphere. A small port, 35, is formed through the partition which separates the annular chamber from this exhaust-port, so as to form a small permanent exhaust from the lower end of the annular chamber. A bore, 36, is formed through the sides of the valve-block and the barrel and extends from the upper live-air groove or port 16 to a point at about the middle of the working-cylinder, registering with the port 32 which has communication to the lower end of the annular piston-chamber 28 in the valve-chamber. A longitudinal bore, 37, is formed through the side of the valve-block and barrel and extends from the annular distributing-groove or port 19 to the lower end of the working-cylinder. A longitudinal bore, 38, is formed through the side of the valve-block and the barrel and extends from the lower exhaust-port 33 to near the lower end of the working-cylinder so as to form a permanent exhaust from the lower portion of the working-cylinder. A hollow valve, 39, has play in the valve-chamber and has at its upper end a piston, 40, which has play over the annular inlet-port 16 so as to cover the same when the valve is in its upper position and to uncover the same when the valve is in its lower position, and so as to cover the right-angled passages 18 when the valve is in such position.

A step or shoulder, 41, is formed upon the valve so as to have bearing against the partition 42, which separates the annular distributing port 19 from the annular exhaust-port 24 when the valve is in its upper position. A piston, 43, is formed upon the valve to have play in the annular piston chamber 28, and the lower end of the valve has play over the annular exhaust-port 33 so as to cover the same when the valve is in its lower position and to uncover the same when the valve is in its upper position. The plunger 2 has an annular groove, 44, near its upper end so as to register with the port 32 and lower end of the bore 36, so as to place these two ports and their bores in communication when the plunger is at the extreme of its forward or down stroke. The two ends of the valve have the same pressure area, so that the valve is balanced in its chamber. In the drawings, the axial bore of the valve is larger at the lower end than at the upper end, but the combined areas of the lower end of the valve and of the shoulder within the bore of the valve equal the area of the upper end of the valve. By the formation of the shoulder 41 upon the middle of the valve, the walls of the latter are thicker at the middle than at the ends, so that the upper pressure area of the large valve-piston 43 is less than the lower pressure area of the same. The valve-block is made in two pieces for the purpose of permitting the large valve-piston to be fitted into the large annular piston-chamber, but the two pieces form one valve-block. An annular channel, 45 is formed around the valve between the upper piston of the latter and the stepped or shouldered portion so that, when the valve is in its lower position, it may connect the distributing-port 19 with the exhaust-port 24 and, when the valve is in its upper position, it may connect the right-angled passages 18 with the annular distributing-port 19 and right-angled passage 20.

When the tool is to be put in operation, the inlet-socket 9 is coupled to a hose or other flexible connection with the supply of motive fluid,—compressed air being usually the motive fluid. The working-tool is placed against the work to be acted upon,—the operator grasping the tool by the handle and forcing the latter against the work. The throttle-valve is now opened so as to admit air into the tool, which will cause the piston to reciprocate and deliver rapid blows upon the shank of the working-tool. This operation is accomplished in the following manner: We will assume that the parts of the tool are in the positions shown in Fig. I, in which the valve is shown in its lowermost position and the piston is shown in its uppermost position. The air will pass from the inlet passage in the handle, through the annular series of holes in the upper end of the valve-block into the upper annular inlet-port, which is uncovered by the valve, and thence through the hollow valve into the upper portion of the working-cylinder, where it will drive the plunger downward to deliver its blow upon the shank of the working-tool. While the plunger is descending, air below the same is forced out of the lower end of the working-cylinder by the descending plunger through the permanent exhaust-passage 38 to the lower annular exhaust-port and out to the atmosphere, and also through the distributing passage 37 to the annular distributing-port 19 which communicates with the upper exhaust-port 24, whence the exhausting air passes out to the atmosphere. When the plunger arrives at the lower extreme of its stroke, the annular groove in the upper portion of the plunger will form communication between the port of the live-air passage 36 and the port 32 and passage 31, so that live-air may pass up through said latter passage and pass into the lower portion of the annular valve-piston chamber, thus forcing the valve upward. The air above the valve-piston passes

out through the port 29 in the upper end of the piston-chamber and through the right-angled passage 20 and distributing-port 19 to the upper exhaust-port 24. Also, as the lower area of the valve-piston is greater than the upper area of the same, the pressure from below quickly overcomes any back-pressure from above. When the valve has arrived at its upper position, it has uncovered the lower exhaust-port in the valve-chamber and covered the upper inlet-port in the latter. Live-air will now pass through the right-angled passages 18 to the annular port 19, whence it will pass down through the bore or passage 37 to the lower end of the working-cylinder, driving the plunger upward. The air behind the plunger will freely exhaust through the lower exhaust-port and out to the atmosphere. The upper exhaust-port in the valve-chamber is closed by the shouldered portion of the valve. Live air will also pass from the annular distributing-port 19 through the right-angled passage 20 and passage 21 and thence through the restricted opening 22 and passage 23 into the upper end of the cylinder, all as will appear by reference to Fig. II. As soon as the plunger arrives at the extreme of its upstroke, it will close this right-angled passage 23 and confine the live-air in the passage 21, so that said air will pass through the port 29 into the annular piston-chamber, to act against the upper side of the large valve-piston, while live-air in the distributing-port 19 also acts against the step or shoulder of the valve, thereby forcing the valve down, so that the parts will occupy the position shown in Fig. I, when the operation will again be repeated.

As the right-angled passage which controls the forward or downward movement of the valve is located some distance from the rear or upper end of the cylinder, said passage will be closed by the returning plunger shortly before the latter arrives at the end of its stroke and the valve will be shifted before the plunger strikes the valve-block, so as to close the rear-end exhaust and open the inlet to admit air into the cylinder to cushion the plunger and drive the same forward. The action of this tool is very rapid, as the connection of the two ports at the middle of the cylinder by the groove in the plunger will be immediately followed by shifting upward of the valve and return of the plunger, and the closing by the plunger of the right-angled controlling passage at the upper end of the cylinder will immediately produce forward or downward movement of the valve and cushioning and forward or downward movement of the plunger. By this movement of the valve in a direction opposite to that of the plunger and before the latter reaches the extreme of its return stroke, all jar or shock by the returning plunger is avoided. By making the valve hollow or in the form of a shell-valve, the valve may be made of proportionally considerable diameter, so as to have a large wearing surface, and at the same time be of comparatively light weight so as to be easily moved. As the inlet-air passes through the hollow interior of the valve and directly into the cylinder, the air will flow into the cylinder in a large and unobstructed volume to drive the plunger forward or downward. The exhaust from the rear or upper end of the cylinder does not flow through the valve but directly out through the lower exhaust-port immediately above the rear or upper end of the cylinder. By providing an individual exhaust for each end of the cylinder, exhaust will take place freely and immediately upon shifting of the valve. There is at all times a flow of live-air into the passage 21 and acting against the upper face of the valve-piston, but the pressure of such air is less than the normal pressure and will not move the valve, owing to the fact that some air is escaping through the right-angled passage 20 or the restricted passage 22. It is only when the port 23 is closed by the plunger and exhaust is thus cut off, that there is full normal pressure against the upper face of the valve-piston to move the valve. This valve movement is equally well adapted for use in hammers in which the stroke of the plunger is longer than the plunger itself, or so-called long-stroke hammers as well as in hammers of the type herein illustrated, in which the stroke of the plunger is shorter than the plunger itself, or so-called short-stroke hammers. The only change required is in the plunger, which is made without the circumferential groove, and the barrel, in which the bore 36 is dispensed with, as well as the permanent exhaust bore 38, in place of which holes through the sides of the barrel are provided. The valve-block and the valve are of the same construction and in all respects identical in the two types of tool.

Other modes of applying the principle of my invention may be employed for the mode herein explained. Change may therefore be made as regards the mechanism thus disclosed, provided the principles of construction set forth respectively in the following claims are employed.

I therefore particularly point out and distinctly claim as my invention:—

1. In a pneumatic impact tool, the combination with a working-cylinder and a plunger reciprocable therein, of a valve controlling the motive fluid to reciprocate the plunger and consisting of a hollow shell or cylinder having its end-areas equal to balance it and formed with a piston acted upon on alternate sides by motive fluid under normal pressure controlled by the plunger.

2. In a pneumatic impact tool, the combi-

nation of a working-cylinder, a plunger reciprocable therein, inlet and exhaust passages for the motive fluid, a valve movable in a chamber at one end of the cylinder and serving to control admission and exhaust of motive fluid to and from the cylinder, said valve having two pressure faces, a passage to one of said pressure faces and to a point in the cylinder where it may be connected to the motive fluid supply when the plunger is at one end of its stroke, and a passage open to the other pressure face and having means for admitting and exhausting motive fluid into and out of it and opening into the cylinder to be covered by the plunger when the latter is at the other end of its stroke.

3. In a pneumatic impact tool, the combination of a working-cylinder, a plunger reciprocable therein, inlet and exhaust passages for the motive fluid, a valve movable in a chamber at one end of the cylinder and serving to control admission and exhaust of motive fluid to and from the cylinder and having its end-areas equal to balance it, said valve having a piston formed with two pressure faces, a passage to one of said pressure faces and to a point in the cylinder where it may be connected to the motive fluid supply when the plunger is at one end of its stroke, and a passage open to the other pressure face and having means for admitting and exhausting motive fluid into and out of it and opening into the cylinder to be covered by the plunger when the latter is at the other end of its stroke.

4. In a pneumatic impact tool, the combination of a working-cylinder having an inlet and exhaust port and passage leading from its forward end, a reciprocable plunger in such cylinder, a valve-chamber in axial alinement with said cylinder and open to the rear end of the same outside the path of travel of the plunger and formed with an inlet-port at its rear end and an exhaust-port at its forward end and with an exhaust-port and an inlet-port and a distributing port between the same and communicating with the forward port and passage of the cylinder, a tubular valve reciprocable in the valve-chamber to alternately cover and uncover the end inlet and exhaust ports with its ends and formed with pistons to alternately connect the end-port and passage of the cylinder with the inlet and exhaust, and plunger-controlled means for reciprocating the valve.

5. In a pneumatic impact tool, the combination of a working-cylinder having an inlet and exhaust port and passage leading from its forward end, a reciprocable plunger in such cylinder, a valve-chamber in axial alinement with said cylinder and open to the rear end of the same outside the path of travel of the plunger and formed with an inlet-port at its rear end and an exhaust-port at its forward end and with another exhaust-port, a tubular valve reciprocable in the valve-chamber to alternately cover and uncover the end inlet and exhaust ports with its ends and formed with pistons to alternately connect the end-port and passage of the cylinder with the inlet and exhaust, and plunger-controlled means for reciprocating the valve.

In testimony that I claim the foregoing to be my invention I have hereunto set my hand this 11th day of June, A. D. 1906.

CHARLES B. RICHARDS.

Witnesses:
C. GREVES,
WM. SECHER.