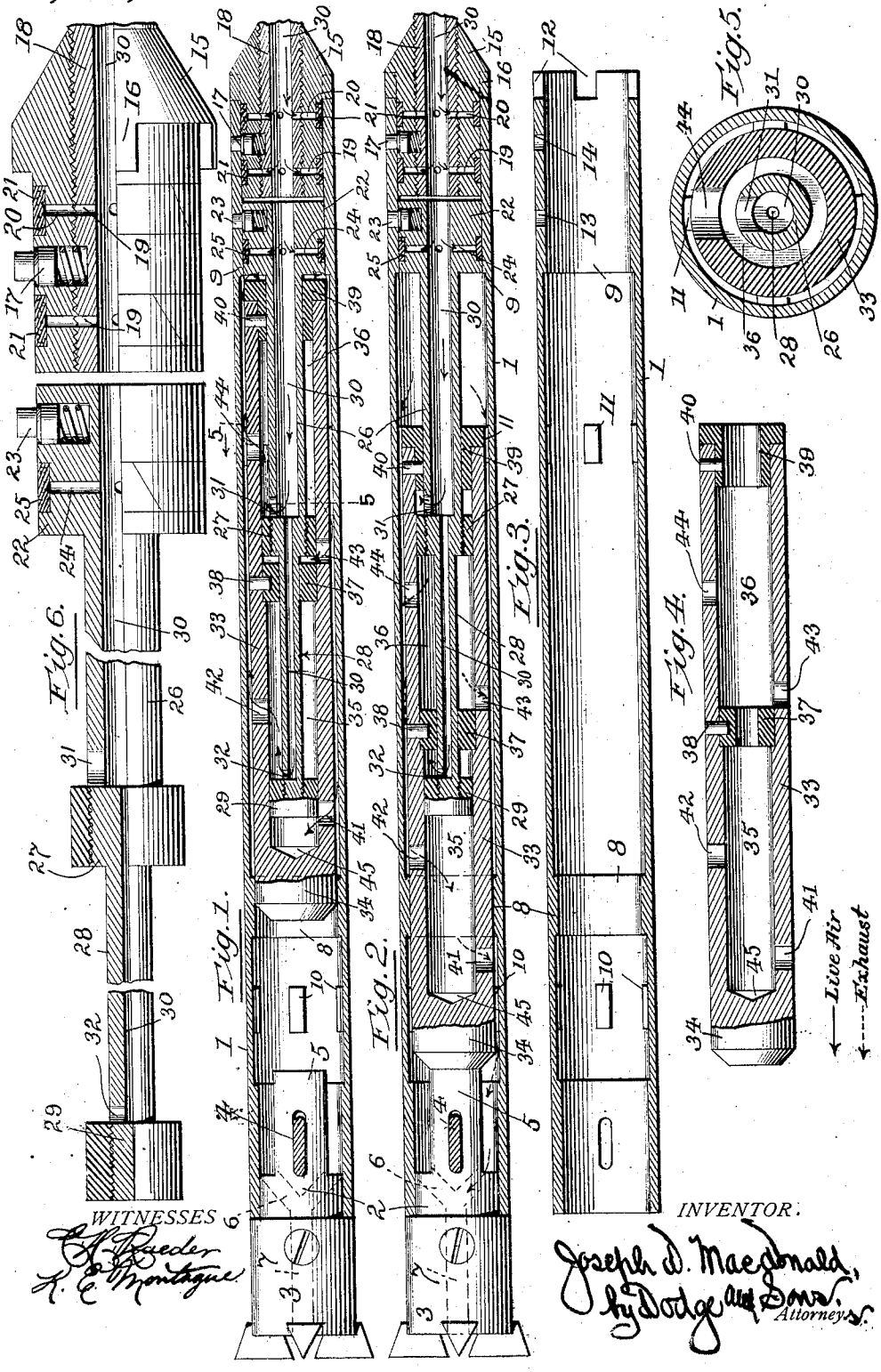
J. D. MacDONALD.

PNEUMATIC ENGINE OR TOOL.

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Patented Nov. 5, 1912



WITNESSES

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PNEUMATIC ENGINE OR TOOL.

1,043,529. Specification of Letters Patent. Patented Nov. 5, 1912.

Application filed March 22, 1911. Serial No. 616,199.

To all whom it may concern:

Be it known that I, JOSEPH D. MacDONALD, a citizen of the United States, residing at Butte, in the county of Silver Bow and State of Montana, have invented certain new and useful Improvements in Pneumatic Engines or Tools, of which the following is a specification.

My present invention pertains to an improved pneumatic engine or tool, the construction and advantages of which will be hereinafter set forth, reference being had to the annexed drawings, wherein:

Figure 1 is a longitudinal sectional view, showing the parts in that position in which the live air is in the act of forcing the hammer forwardly or to the left to deliver a blow, the course of the air being shown by the arrows in full lines; Fig. 2 a similar view, the hammer being shown as actually delivering a blow or coming into contact with the drill-head or tool, the course of the exhaust air being shown by arrows in dotted lines; Fig. 3 a longitudinal sectional view of the outer cylindrical shell or casing; Fig. 4 a longitudinal sectional view of the hammer proper; Fig. 5 a transverse sectional view, taken on the line 5—5 of Fig. 1; and Fig. 6 a sectional elevation upon an enlarged scale of the combined guide and abutments against which the compressed air works, with the head to which the feed bar is attached, said members likewise forming the conduit through which the compressed air or other motive fluid is introduced.

The main object of the present invention is to produce a simple and highly efficient pneumatic tool which by reason of its construction is small in diameter and is free of valves except as the movable piston hammer itself performs the function of a valve, or a plurality of valves.

The tool or hammer is of the tandem type, and the compressed air is introduced centrally into the piston-hammer support and thence distributed through suitable ports so that it may act equally upon all of the abutments or fixed faces to cause a forward impulse or movement to be imparted to the hammer or movable piston. The ports are likewise so arranged that immediately the hammer has delivered its blow the air which caused the hammer to function will be freely exhausted and the incoming compressed air will act to return the piston-hammer to its initial position. The force by which the hammer is returned to its initial position preparatory to delivering a second blow is less than that which is employed in delivering the blow, and this by reason of the fact that the air acts upon a less number of faces or abutments in the return stroke than it does in the outward or hammer stroke. In the present instance three abutments or faces are exposed to the compressed air in making the outward stroke, while but two faces are brought into use in making the return stroke. It is conceivable that a greater or less number of faces may be used, but in each instance the fixed abutments or faces employed in producing or effecting the hammer blow should be greater in number than those employed in causing the return of the hammer to a position where the live air is again delivered to the parts to effect the hammer blow.

The accompanying drawings illustrate but one form of the invention, though it will be readily appreciated by those skilled in the art that any number of stages may be employed to produce the result above set forth.

In the drawings 1 denotes a cylindrical shell or casing in the outer end of which is inserted a stem or neck 2, of a drill head 3, a cross pin 4 passing through an elongated slot in the reduced end 5 and serving to hold the drill in position with reference to the casing. The drill-head, as will be seen upon reference to Figs. 1 and 2, is provided with channels 6 and 7 which permit the exhaust air from the hammer to pass outwardly from the tool into the hole or opening being drilled. The cylindrical shell or casing is provided with an annular internal collar or enlargement 8, near its outer end, while at the inner or right-hand end thereof the shell is provided with an internal enlargement 9 of considerable length. Guiding ribs 10 are formed upon the inner face of the cylinder between the collar and the enlarged portion in which the drill proper is mounted, and a second series of ribs 11 is likewise provided between the collar 8 and the enlarged portion 9, being located somewhat closer to said latter member than the former. This construction provides two enlarged chambers within the cylindrical casing 1, a long chamber formed between the collar 8 and the enlarged portion 9, and a somewhat shorter chamber between the collar 8 and the drill proper, which is mounted in the outer end of the shell or casing.

The inner end of the shell or casing, as will be seen upon reference to Fig. 3, is provided with a series of notches 12 and in its side wall with openings 13 and 14. A head 15 is mounted and secured in the inner or right-hand end of the cylindrical shell or casing, said head being somewhat enlarged at the outer portion thereof and provided with lugs 16 which, when the reduced portion of the head is forced into the end of the shell or casing 1 will pass into the notches 12 and thus prevent the rotation of the parts with relation to each other. In order to hold the head against endwise movement, an outwardly spring-pressed pin 17 is mounted in the head and when the end of said pin comes into alinement with the opening 14, it is moved outwardly and passes into the opening, as shown in Figs. 1, and 2, thereby preventing endwise movement of the head.

A hollow feed bar 18 is screwed or otherwise secured on the head and is provided with lateral ports or openings 19, which correspond with similar ports 20 formed in the head. The outer face of the head is provided with circumferential grooves or channels in which are seated packing rings 21 formed of suitable material, as for instance, leather, and as will be readily appreciated the compressed air which is forced in through the feed bar will pass into the openings 19 and 20 and come against the inner face of the packing rings and force the same outwardly into contact with the adjacent inner wall of the member 9, thus preventing leakage around the head.

Mounted within the cylindrical shell or casing and having its support or point of attachment in the enlarged portion 9, is a combined piston-guide and fixed abutment member, said member comprising a head 22 which makes a close fit with the bore of the enlarged portion 9, said head carrying a spring-pressed pin 23 which, when the parts are properly positioned, comes into alinement with the hole or opening 13 and passes outwardly into such opening, locking the head and guide against movement. Said head is likewise provided with a series of laterally-extending ports or channels 24 which terminate beneath a packing ring 25 seated in a groove or channel formed around the outer face of the head 22. The compressed air which passes into said channels 24 forces the packing outwardly and forms a tight joint between the head 22 and the adjacent wall or face of the cylindrical shell or casing, or more specifically, the inner face of the enlarged section 9 of said shell.

Extending from the head 22 is a hollow stem 26 terminating in a cylindrical head or abutment 27, and from said head there extends a second hollow stem 28 which terminates in a fixed head or abutment 29. Said heads 27 and 29 will preferably be formed with separate sleeves threaded or sweated onto the other portions of the structure. This construction enables the parts to be assembled, or in other words, permits the piston-hammer, hereinafter set forth, to be mounted upon the parts just described.

A continuous conduit or passage 30 extends through the head 22, stem 26, head or abutment 27, and stem 28, the head 29 being solid. The stem 26 is provided with a port 31 adjacent to the right-hand face of the fixed abutment 27, and the stem 28 is provided with a port 32 adjacent to the right-hand end of the fixed head or abutment 29, said ports 31 and 32 opening directly into the passage or conduit 30.

The heads 27 and 29, in addition to forming fixed abutments against which the compressed air may operate, as will be hereinafter set forth, form the main guides and supports for the piston-hammer. Said piston-hammer is shown in detail in Fig. 4. It comprises a cylindrical member 33, having at the left-hand or outer end thereof a closed head 34, the outer edge of which is preferably beveled or chamfered. The piston is formed with two bores or chambers, 35 and 36, the former being of a diameter slightly less than the latter, or equal to the outer diameter of the fixed head or abutment 29, while the latter (36) is of a diameter equal to the outer diameter of the fixed head or abutment 27. The two bores or chambers 35 and 36 are separated from each other by a fixed ring or collar 37 which, as will be seen, is secured in position by a pin 38 securely driven to place. The internal diameter of the ring or collar 37 is such as to make a close fit with the smaller stem 28 of the hammer-piston support over which it slides as the piston-hammer is moved back and forth.

In the right-hand or inner end of the piston-hammer there is secured a sleeve or bushing 39, said sleeve being held in position by a pin 40, the internal diameter of such sleeve being the same as the outer diameter of the stem 26 of the piston-guide with which it makes a relatively close fit. The piston-hammer is provided with four ports, two of which (41 and 42) open into the chamber 35, while the other two (43 and 44) open into the enlarged chamber 36. The port 41 is located adjacent to the outer end of the chamber 35, while the port 42 is located substantially at the mid-length of said chamber 35. Port 43 is situated adjacent to the collar or abutment 37, while the port 44 is at the mid-length of the chamber 36.

As will be seen upon reference to Figs. 1 and 2, the piston-hammer makes a close fit at all times with the inner face of the ring-shaped abutment or enlargement 8, so that no air, or at least no appreciable amount of

air, can pass between the faces of the contacting members at this point. The same is true of the head or abutment 27 and the head or abutment 29, and the faces of the chambers 35 and 36 with which they work. Again, the stems 26 and 28 make close contact with the sleeve 39 and the collar 37 respectively, and no appreciable amount of air can pass between the contacting faces of these parts.

In operation, and having reference more particularly to Figs. 1 and 2, and with the understanding that the live air which is constantly fed to the machine through the hollow feed bar is indicated by the full-line arrows, and that the exhaust air is indicated by the dotted arrows, it will be seen that the live air passes into the conduit 30, thence outwardly through the port 31, into the chamber 36, thence outwardly through the port 44 into the chamber or space left between the outer face of the piston-hammer and the interior face of the cylindrical shell or casing, or in other words into the enlarged chamber formed in said casing, the compressed air likewise passing through the port 32 into the chamber 35, and out through the port 42 into the chamber just referred to. The air passes from the enlarged chamber through the port 43, into the left-hand end of the chamber 36, between the fixed abutment or head 27 and the right-hand face of the collar 37. The air at the same time passes between the face of the sleeve 39 and the adjacent face of the fixed head 22. It also passes through the port 41 and enters the outer end of the chamber 35, between the outer face of the fixed head or abutment 29 and the end wall 45 of the chamber 35. It will thus be seen that the compressed air is acting upon the piston-hammer at three different points to force the same outwardly to effect a blow upon the drill-head. The compressed air continues to act to force the piston hammer outwardly until the parts reach the position shown in Fig. 2 when, as will be noted, the piston-hammer will have delivered its blow and the position of the ports will be so changed as to permit the air which has been acting to force the piston-hammer outwardly to be exhausted, as indicated in dotted lines in said figure. The course of the exhaust air is from the enlarged chamber into the cylindrical shell or casing, through the port 42, into the chamber 35, through the port 41, thence through the smaller cylindrical chamber into the channels or ports 6 and 7. The air will also pass from the chamber 36 through the ports 43 and 44, into the cylindrical chamber and outwardly in the course just outlined. At the same time, the live air which is constantly fed through the feed bar and into the conduit or passage 30, will pass through the port 31 and likewise through the port 32 and acting upon the inner end or face of the sleeve 39 and the right-hand end of the fixed abutment 27 and against the outer face of the collar 37, and the inner or right-hand end or face of the abutment 29, acts to force the piston-hammer inwardly or to the right. This movement will continue until the parts assume the positions shown in Fig. 1, when, as will be seen, the exhaust will have been cut off and the live air will again act to force the piston-hammer outwardly. The same cycle of operations will then be repeated.

From the foregoing it will be seen that the compressed air is introduced into one end of the shell and exhausted at the opposite end, preferably through the drill-head, and that there is in effect no reversal of the air-currents, which is a matter of importance in a tool of this character, in that it enables the drill to act with greater rapidity than where the air-currents have to be reversed, as in those drills which employ a controlling valve which acts both as an inlet and an outlet valve.

The term "air" in the foregoing specification and the following claims is to be understood as the equivalent of any suitable gaseous medium capable of being compressed and giving off power due to expansion. So, too, the term "pneumatic" is used in its generic sense.

The introduction of air through the central conduit or passage 30 and the distribution of the same in the manner set forth into the piston chambers, or the chambers within the cylindrical shell or casing surrounding the piston-hammer, enables me to produce a hammer without valves, and also to provide a hammer of relatively small diameter, and one which can be carried down into the opening or hole being drilled by a mere extension of the feed bar. This latter feature is of marked advantage in that it brings the hammer and operating parts thereof into close relationship with the drill-head.

While the device has been described as being used in conjunction with a drill, it will be readily appreciated that it may be employed for other purposes, any suitable tool being substituted for the drill herein shown.

Having thus described my invention, what I claim is:

1. In a pneumatic hammer, the combination of a shell or casing adapted to carry a cutting tool at its outer or forward end; a hollow hammer piston mounted and movable therein; and a combined piston-support and abutment member located within the piston and secured to the shell, said piston and support being provided with suitable ports for the passage of air in rear of the piston, thence forwardly through and in advance of the piston, and finally through the forward or outer end of the casing, whereby

the piston is caused to reciprocate and the air is caused to pass continually in a forward direction.

2. In a pneumatic hammer, the combination of a shell or casing; a fixed support extending lengthwise of the casing and being spaced therefrom; a plurality of fixed abutments carried by the support, said support being provided with air ports adjacent to each abutment through which compressed air may pass outwardly; and a piston-hammer mounted upon said support, the piston being provided with two chambers, one adapted to act in conjunction with one pair of abutments, and the other with the second pair, each of said chambers being provided with two ports for the admission and exhaust of compressed air.

3. In a pneumatic hammer, the combination of a shell or casing provided with an interior enlargement intermediate its ends; a hollow member secured to one end of the shell, said member being provided with a plurality of fixed heads or abutments, said abutments being spaced away from the wall of the shell; and a hollow hammer-piston having one closed end and an internal abutment or enlarged member located between said end and the opposite end, said piston being mounted and movable upon the heads or abutments of the fixed member, said fixed member being provided with two ports which open, respectively, into the hollow piston upon opposite sides of the internal enlargement carried thereby, and said piston being likewise provided with two ports upon each side of said enlargement, said ports opening into the space intermediate the piston and the inner wall of the shell.

4. In a pneumatic hammer, the combination of a shell or casing; a combined piston-support and abutment member mounted therein, said member being hollow and having a port opening adjacent to the abutment; and a piston-hammer mounted on said support and working in conjunction with said abutment, said piston having ports all adapted to act in conjunction with the abutment alternately as inlet and exhaust ports, the live and exhaust pressure fluid moving in the same general direction through the hammer in both expansive and exhaust conditions.

5. In a pneumatic hammer, the combination of a shell or casing; a hollow reciprocating piston mounted therein; fixed abutments working in conjunction with the piston; and means for introducing the pressure-fluid interiorly into the piston to cause the same to deliver a blow and then to exhaust forwardly through the piston and shell in the same direction of movement as it had when acting to cause the blow.

6. In a pneumatic hammer, the combination of a shell or casing provided with an internal enlargement; a hollow member secured to one end of the shell or casing and extending forwardly therein toward said enlargement; a plurality of fixed abutments carried by said member; a piston-hammer mounted and movable upon said abutments, the outer diameter of said hammer being such as to make a close fit with the internal enlargement of the shell or casing; and a ring-shaped member mounted within the piston hammer and adapted to work between the outermost abutments of the fixed member aforesaid, said fixed member being provided with a port adjacent to each of the abutments carried thereby, and the piston-hammer being likewise provided with two pairs of ports opening into the same, one pair being located to one side of the fixed ring-shaped member and the other upon the opposite side thereof.

7. In a pneumatic hammer, the combination of a shell or casing provided with an internal enlargement adjacent to one end thereof; a head fixed to the inner end of said shell or casing; a hollow feed bar connected to said head; a fixed member mounted within the shell or casing, said member being provided with a head adapted to be secured within the shell or casing adjacent to the head aforesaid and with two hollow stems extending outwardly from the head, said stems being of varying diameters, and the outer stem being smaller than the one next to the head; a fixed abutment carried by the stems adjacent to their point of junction; a second abutment carried at the outer end of the smaller stem, said stems being hollow and affording means of communication for the air from the hollow feed bar, and each stem being provided with a port adjacent to the inner face of its abutment; a hollow piston-hammer; a fixed member secured within said piston-hammer and dividing the same into two chambers, the bores of which are, respectively, equal to the outer diameter of the fixed abutments aforesaid, said abutments working within said chambers when the parts are assembled, and each chamber being provided with a port located adjacent to its outer end, and with a second port extending through the wall of the piston-hammer at approximately the mid-length thereof; a fixed sleeve secured to one end of the piston-hammer and adapted to work over the larger stem of the fixed member; and a drill-head mounted in the outer end of the shell or casing.

8. In a pneumatic hammer, the combination of a shell or casing provided adjacent to one end thereof with an internal enlargement; a piston mounted within said shell or casing and adapted to make a close fit with said enlargement and to be moved therethrough, said piston being hollow; a fixed head or abutment carried by the shell

or casing adjacent to that end opposite the internal enlargement aforesaid; a fixed abutment mounted within the hollow piston and over which the latter is adpated to be moved back and forth; and a hollow member extending from the fixed head and forming the support for said fixed abutment, said member being provided with a port adjacent to the head and opening into the space left within the piston between the hollow member and the internal wall of said piston, said piston being likewise provided with two ports, one opening into the outer end thereof and the other into the same at approximately its mid-length, whereby compressed air or other pressure fluid may be introduced through the hollow member which supports the fixed abutment and caused to pass outwardly through the port in said member, thence outwardly through the middle port in the piston, and to act upon the inner end of the piston and the fixed abutment secured thereto, and likewise to pass in through the port adjacent to the end of the piston and act upon the fixed abutment and the inner face or head of the piston, causing a forward impulse to be given to the piston, the parts being so arranged that when the piston reaches its limit of outward travel the air will be exhausted from the parts just mentioned and the live air will act upon the inner end of the piston and the inner face of the fixed abutment to cause a retrograde movement of the piston.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSEPH D. MacDONALD.

Witnesses:

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