R. E. BATES.
PNEUMATIC POWER HAMMER.
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3 SHEETS—SHEET 1.

Fig. 1

Fig. 2

Witnesses

Frederick M. Reid.
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To all whom it may concern:

Be it known that I, RALPH E. BATES, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Improvement in Pneumatic Power-Hammers, of which the following is a specification.

The principal object of this invention is the provision of power hammers which shall be more efficient and convenient in use than those hitherto constructed, to use the least number of parts for sake of economy and shall be readily controlled in action and to enable such hammers to be readily arranged according to the purposes for which they may be designed, so that the hammer-head or ram and its dies used therewith may be easily employed in one or more or all of the ways following—that is to say: first, to make strokes of any desired length; second to strike blows of any desirable force; third, to be held away for any desirable period from the anvil; fourth, to hold objects securely upon the anvil. I attain these objects by the mechanism illustrated in the accompanying drawings, in which—Figure 1 is a vertical section of the entire machine; Fig. 2 a partial top view; Fig. 3 a horizontal section taken at a—a, Fig. 1; Fig. 4 a side view of the air controlling valve; Fig. 5 a sectional view taken at y—y, Fig. 6; Figs. 6, 7 and 8 a section of the valve and ports taken at a—a, Fig. 3; Figs. 9, 10 and 11 a section of the valve and ports taken at a—a, Fig. 3.

Similar letters refer to similar parts throughout the several views. As shown in the drawings the hammer construction consists of two main members one of which constitutes a housing 1, having the other 2, mounted thereon and secured by bolts 3. Forming a part of member 2 is a cylinder 4 inclosing a reciprocating hammer member or ram which consists of the piston 5 from which projects piston rods 6 and 7, the lower end of 7 having secured thereto the tup or hammer-head 8 carrying the dies 9 and the upper piston rod 6 having four flat sides fitting closely the cylinder-head 49 to prevent rotation of the piston.

10 is the anvil having the cap 11 which supports the die 12 upon which the material to be worked upon is placed.

Within the housing 1 is a power cylinder inclosing a piston 14 secured by connecting-rod 15 to crank 16 of shaft 17 which revolves in bearings 18 and 19 fastened to the housing 1 and carrying tight and loose pulleys 20 and 21. A convenient opening 22 allows of assembling and is provided with a cover 23.

In the upper frame member 2 are located two compartments 24 and 25 divided by partition 26. A system of communicating ports connects the cylinders and compartments through the valve 27. 28 is a pipe connecting chamber 24 with the outer air.

The valve 27 is centrally located between the two cylinders 4 and 13 and passes entirely through the frame 2 being retained in position by plate 29 fastened to the frame at the rear and plate 30 fastened to the front of the frame. The valve 27 has an operating stem 31 rigidly secured thereto projecting through plate 30 and to which is secured handle lever 32. The valve has three major positions, all intermediate positions giving a gradual change from one to the other of the three. Figs. 6 and 9 show the valve in the proper position to allow the pressing of the hammer-head or ram upon the work. Figs. 7 and 10 show the valve position for elevating the ram away from the work and Figs. 8 and 11 show the valve in position for allowing the delivery of the full force of blow. Figs. 6, 7, and 8 are sections taken at a—a, Fig. 3 and Figs. 9, 10 and 11 are taken at a—a, Fig. 3.

The valve 27 is in the form of a cylinder having two recesses 33 and 34, a chamber 35 from which two sets of holes 36 and 37 communicate with the outside. Within this chamber are two non-return valves 38 with air holes 39. Located between recesses 33 and 34 is a hole 39 passing entirely through the valve and 40 is another hole passing from recess 34 through the valve to a position properly located to fulfill a function to be explained farther on.

The port 41 connects the ram cylinder 4 with the valve, port 42 connects the valve with the power cylinder 13, port 43 connects the valve with chamber 25, port 44 connects the valve with chamber 24 and port 45 connects the valve with the upper end of the ram cylinder 4. Ports 41 and 44 have recesses 46 and 47 capable of being connected by hole 39 in the valve at the proper time. 48 is a by-pass forming a communication between port 45 and holes 37 in the valve. It
will be noted that the ram piston closes or covers the port 45 when at its upper position. A small port 49 connects the space over the ram piston through the cylinder-head 49, with the port 45 and contains a non-return valve in such a position as to allow air to pass to the cylinder but not in the reverse direction.

The ram cylinder-head 49 has an inner projecting formation 50 adapted to fit closely into the piston 5 to increase the bearing surface economically and an outer projection 49' for the same purpose.

The power piston 14 has a number of holes 51 placed at its upper end opening into an enlargement in the bore of the cylinder and at 52 are holes piercing the cylinder at a position where they will be uncovered when the piston is at its lowest position thus connecting the space above the piston with the housing interior.

The operation of the hammer for the different functions hereinbefore named is as follows:—Full force of blow: The valve 27 is placed in the position shown in Figs. 1, 3, 8 and 11. As the power piston 14 rises air is forced through the valve and ports 41 and 45 thereby causing ram to ascend. As the ram approaches the end of its stroke its piston covers the port 45 entrapping air above the piston and thus compresses the air which then expands causing the ram to reverse its movement and descend. By this time the power piston has reversed its movement and as the previously compressed air which forced the ram up has escaped through the holes 51 and through the piston into the housing atmospheric equilibrium has been established and the ram is assisted in its descent by the suction of the descending power piston. When the pistons are at their lower positions the holes 52 allow air from the housing interior to flow into the cylinder above the piston to fill the vacuum and again restore atmospheric equilibrium.

As the above mentioned actions are taking place the air from above the ram piston has passed back and forth through ports 46, 34, 44, chamber 24 and pipe 28.

Elevating ram.—The valve 27 is placed in the position shown in Figs. 7 and 10. The power piston will now force air through port 42, non-return valve 39 and ports 36 and 41. As the air cannot return but is trapped in the ram cylinder the ram and its piston will remain at their highest position. The air over the ram in this case having passed through ports 45, 32, 40, 44 and thence to chamber 24, to the pipe 28 and to the open air. After the ram piston has closed the port 45 it will slowly ascend to its highest position as there is a small allowance of space between the fitted parts where the trapped air can escape. The chamber 25 receives any surplus of air through port 43 after the ram has ascended, as the power piston is in continuous operation.

Vising or pressing the ram downwardly upon the work.—The valve is placed in the position shown in Figs. 5, 6 and 9. The power piston will now force air through port 42, non-return valve 38, port 37, by-pass 48 and port 45 to the ram cylinder above the ram either through port 49' or 45, according to the position of the ram at this time. As the air cannot return but is trapped, in the ram cylinder the ram piston will descend and remain so. The air under the ram in this case having passed through port 41, by-pass 46, hole in valve 39, by-pass 47, port 44, to chamber 24 and to the outer air through pipe 28. The chamber 25 acts as in the case of elevating the ram.

Referring to Fig. 1 it will be noted that the crankshaft 17 is supported in bearings 18 and 19 and it is evident that there should be no longitudinal movement. There are various means for accomplishing this such as filling in the space between the bearings by extending the hubs of the pulleys 20 and 21 or having collars or flanges formed on the shaft but the method I have devised and illustrate is more desirable from both an economical and practical standpoint and consists of cutting a recess in the outboard end of the shaft to fit the bearing located there while the remaining length of shaft is of one diameter. This construction has a two-fold purpose, i.e., a relatively cheaper construction and a proper sizing of bearings, placing a larger bearing at the crank end where a greater strain is borne by the shaft than at the outer end.

I claim:
1. In a pneumatic power hammer, in combination, the frame or housing comprising an upper portion and a lower portion, a pump cylinder within said lower portion, a hammer cylinder within said upper portion, the lower portion constituting a closure for the hammer cylinder and the upper portion constituting a closure for the pump cylinder, substantially as described.
2. In a pneumatic power hammer having a pump cylinder and a hammer cylinder and its piston, the combination with the hammer cylinder of a port opening into its upper end and adapted to be closed by the piston and a non-return valve located in the upper end of the hammer cylinder opening inwardly, substantially as described.
3. In a pneumatic power hammer the combination of a pump cylinder and a hammer cylinder with ports to connect the two ends of the hammer cylinder with one end only of the pump cylinder, means for diverting the flow of air to either of said hammer cylinder ends as desired.
4. In a pneumatic power hammer the combination of a pump cylinder; a hammer...
cylinder; an air chamber; an air diverting device; a non-return valve incorporated in said device; a port connecting said device with the pump cylinder; a port connecting said device with the upper end of the hammer cylinder; a port connecting said device with the lower end of the hammer cylinder, a port connecting said device with said air chamber whereby when the device is brought to the proper position air passes from the pump cylinder to the upper end of the hammer cylinder through the non-return valve, from the lower end of the hammer cylinder to the outer atmosphere and to and from the pump cylinder and air chamber, substantially as described.

5. In a pneumatic power hammer having a hammer cylinder and a hammer chamber having closures at each end, the combination with the hammer cylinder of a piston-rod extending through both of said closures and having a piston formation intermediate its length and means for preventing rotation of said piston and its rod.

6. In a pneumatic power hammer having a pump cylinder and a hammer cylinder formed in the said upper portion, said upper portion constituting a cover for said pump cylinder and ports connecting both cylinders, substantially as described.

7. In a pneumatic power hammer having a pump cylinder and a hammer cylinder the combination with the cylinders of the hammer piston; an intermediate diverting device; ports connecting each cylinder with said device and a port connecting the device with the hammer cylinder at its upper end at a position where its outlet into the cylinder will be closed by said piston, substantially as described.

8. In a pneumatic power hammer the combination of a pump cylinder; a hammer cylinder; an air diverting device; a port connecting said diverting device with the said pump cylinder; a port connecting the diverting device with the upper end of the hammer cylinder; a port connecting the diverting device with the lower end of the hammer cylinder whereby air passes freely to and from the pump cylinder and lower end of hammer cylinder and to and from the upper end of the hammer cylinder to the outer atmosphere when the diverting device is properly positioned for the purpose, substantially as described.

9. In a pneumatic power hammer the combination of a pump cylinder; a hammer cylinder; an air chamber; an air diverting device, a non-return valve incorporated in said device; a port connecting said diverting device with the pump cylinder; a port connecting said diverting device with the upper end of the hammer cylinder; a port connecting the diverting device with the lower end of the hammer cylinder; a port connecting the said air chamber with the diverting device whereby when said device is brought to the proper position air passes from the pump cylinder to the lower end of the hammer cylinder through the non-return valve, from the upper end of the hammer cylinder to the outer atmosphere and to and from the pump cylinder and said air chamber, substantially as described.

10. In a pneumatic power hammer having a pump cylinder, a hammer cylinder, ports, an air diverting means and a non-return valve incorporated therein the combination with the housing of two chambers one of said chambers communicating with the said pump cylinder when said diverting means is in the proper position to direct flow of air to either the upper or lower end of said hammer cylinder and the other of said air chambers having communication through said diverting means with the hammer cylinder to its upper or lower end opposite to the end synchronically receiving air, substantially as described.

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Witnesses:

Norman E. Bates,
Effie A. Wilcox.