G. H. GILMAN.

PNEUMATIC TOOL.

APPLICATION FILED APR. 2, 1909.

1,148,310. Patented July 27, 1915.

Fig. 1.

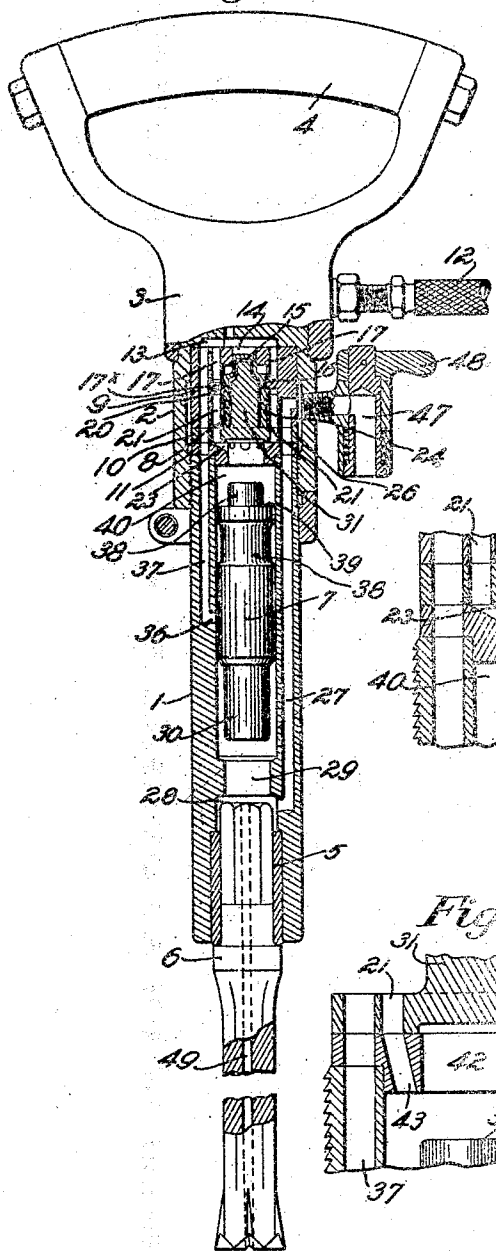


Fig. 2.

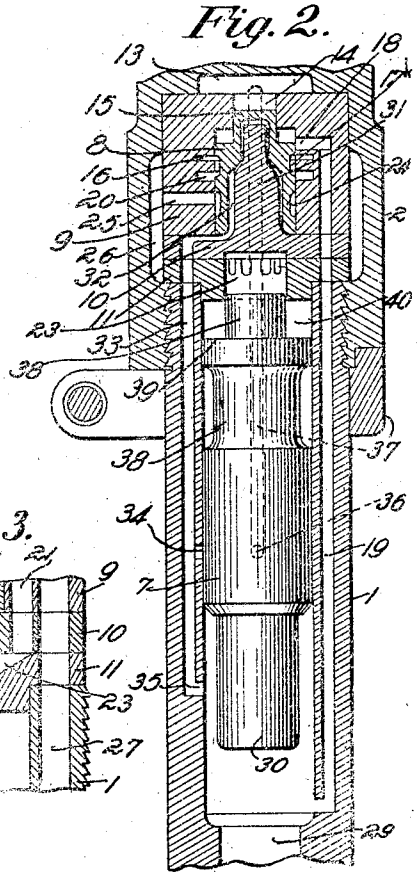


Fig. 3.

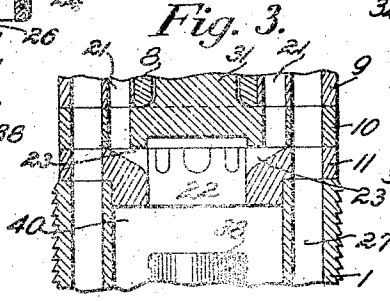
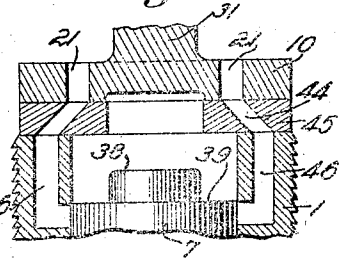


Fig. 4.

Fig. 5.



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UNITED STATES PATENT OFFICE.

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PNEUMATIC TOOL.

1,148,310. Specification of Letters Patent. Patented July 27, 1915.

Application filed April 2, 1909. Serial No. 487,506.

To all whom it may concern:

Be it known that I, GEORGE H. GILMAN, a citizen of the United States, residing at Claremont, in the county of Sullivan and State of New Hampshire, have invented an Improvement in Pneumatic Tools, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention relates to pneumatic tools, consisting more particularly, though not exclusively, in the provision of means for securing the easy and quiet operation of the tool while at the same time maintaining its high efficiency.

My invention will be best understood by reference to the following description when taken in connection with the accompanying illustration of one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings Figure 1 is an elevation in partial central section showing a hand tool embodying one form of my invention; Fig. 2 is a similar section, partly broken away and on a larger scale, such section being taken in a different plane to show other ports and passages; Fig. 3 is an enlarged section of the cushioning plate and adjacent ports; Fig. 4 shows in section a cushion plate of a modified construction; and Fig. 5 shows still another modification.

Referring to the drawings and to the embodiment of my invention there shown, I have selected for illustration a pneumatic hammer drill of a type generally employed for stone working, although it is to be understood that my invention has application to tools of different construction than the one herein shown and intended for use with other motive fluids than air and for other purposes than drilling.

The illustrated form of tool is provided with a cylinder 1, which latter is embraced at its rear end by the head block or casing 2, on which is mounted the handle 3 having the grasping portion 4. In the forward end of the cylinder there is provided a chuck 5 through which passes the shank or head of the drill tool 6, the inner end thereof being positioned to receive the blows of the hammer-piston 7 which reciprocates within the cylinder.

The hammer piston is actuated by pressure fluid controlled by the pressure actuated valve 8, which herein is of the general type shown in the prior U. S. Patent No. 902,288 granted to me October 27, 1908. The valve 8 is located in alinement with the piston and at the rear thereof within a valve chamber formed in the valve block 9, which latter is seated in the casing 2. Between the valve block and the cylinder there is provided a valve plate 10 and a second plate 11 to be more fully referred to. The general operation of this type of valve is well understood. The pressure fluid is conducted to the tool from any suitable source (not shown) through the supply pipe 12 and through any suitable throttling device (also not shown) to the constant pressure chamber 13 at the rear of the valve block. The valve chamber at its rear end communicates with the constant pressure chamber through an opening 14 of reduced cross sectional area, and the valve has a contracted portion 15 slidable in said opening and constantly exposed to the working pressure fluid in the constant pressure chamber. The valve block is provided with a constant pressure groove 16 to which the working pressure is constantly admitted through one or more longitudinal passages 17, the latter extending from said groove rearwardly to the constant pressure chamber. In the rear position of the valve, working pressure is conducted from the pressure groove 16 to the forward end of the cylinder to return the piston by way of the circumferential valve groove 17× to the port 18 (Fig. 2) and thence to the forward end of the cylinder through the longitudinal port 19. On the other hand, in the forward position of the valve, working pressure fluid is conducted to the rear end of the cylinder from the pressure groove 16 about the circumferential groove 17× on the valve to the valve block groove 20 and thence forward through the longitudinal passages 21. The latter are cut through the valve block 9 and the valve plate 10 and enter a contracted chamber 22 formed at the end of the cylinder chamber in the plate 11, entrance to said chamber being had from said longitudinal passages through one or more inclined admission ports 23. Exhaust is effected from the rear of the cylinder, when the valve is in its rearward po-

sition, through the said ports 23, longitudinal passages 21, the valve-block groove 20, the forward circumferential groove 24 on the valve and one or more transverse exhaust ports 25 (Fig. 2) which open laterally from the valve chamber into the annular exhaust space 26, which latter is formed between the casing 2 and the valve block 9. From the forward end of the cylinder exhaust takes place through the longitudinal exhaust passage 27 (Fig. 1), which latter at its rear end opens into the said annular exhaust space 26 and at its forward end into the chamber 28 which surrounds the head of the tool. The said chamber is connected with the main cylinder chamber through an opening 29 of reduced cross section, which opening the forward contracted portion 30 of the piston hammer enters prior to striking the tool. When, therefore, the piston hammer is in its forward position, with the contracted portion 30 within the opening 29, the forward end of the cylinder chamber is cut off from the exhaust chamber 28. On the rearward movement of the piston, however, as soon as the contracted portion 30 has withdrawn from the opening 29 the forward end of the piston is connected with the exhaust through the said chamber 28 and longitudinal passages 27.

The valve is reciprocated by differential pressure, being provided with means for intermittently applying pressure fluid to the forward or larger area of the valve to intermittently lift it against the constant pressure in the pressure chamber 13. To this end, the valve is constructed in the form of a hollow shell, the interior of which is partially filled by the plug 31, the latter having the groove or passage 32 (Fig. 2) formed in its side connecting with the intermittent pressure passage 33. The pressure passage 33 is connected with two ports 34 and 35 opening into the cylinder chamber at different points lengthwise the same, the port 34 being in substantially the same plane as a second port 36, which latter is in constant communication with the constant pressure chamber 13 through the longitudinal passage 37 (see Fig. 1). When the piston moves forward, the port 34 is connected with the constant pressure port 36 by means of the reduced portion 38 on the piston, and the valve is reversed by pressure admitted to the large area thereof from the constant pressure chamber. On the other hand, when the piston moves backward pressure fluid is exhausted from the larger area of the valve by the piston uncovering the port 35 and connecting the latter to the exhaust through the chamber 28 and exhaust passage 27. The port 35 is preferably, though not necessarily, so positioned that it is uncovered at about the same time. Through the reciprocation of the valve and the transfer of pressure fluid through the described ports and passages, the hammer piston is caused to move reciprocatively within the cylinder and deliver its blows against the head of the tool with great rapidity, as will be well understood. Such reciprocations of the piston and the valve, however, are usually accompanied by considerable vibration and much effort is required to be expended by the operator to withstand the shock and force of these vibrations. I have found that, by forming a cushioning chamber at the rear of the cylinder chamber and so arranging the piston that it acts to cut off such chamber from the admission port near the end of its stroke and to form a cushion by means of the pressure fluid trapped therein, much of the vibration referred to can be eliminated while still maintaining a high working efficiency for the tool, provided the valve is moved to admit working pressure fluid to the said chamber before the latter is cut off from the admission ports, so that the piston acts to compress live or working pressure fluid. In the construction shown in Figs. 1, 2 and 3 such cushioning chamber is provided by interposing the cushioning plate 11 with its contracted chamber 22 between the valve chamber and the valve plate 10 and providing upon the rear end of the piston the projecting member 38 of such a diameter that it is capable of entering the chamber 22 near the end of the rearward piston stroke and cutting off communication between the same and the space in the rear part of the main cylinder chamber which still remains between the front walls of the cushion plate and the main rear wall 39 of the piston.

Referring to Fig. 2, it will be seen that the ports are so arranged that prior to the entrance of the contracted portion 38 into the chamber 22 and the closing of communication between the cushioning portion 40 of the cylinder chamber and the admission ports 23, the valve 8 has been thrown to its forward position to admit working pressure to the rear of the piston, so that live or working pressure fluid as distinguished from exhaust fluid is trapped in the cushioning space. With live pressure fluid trapped in the cushion space 40, the piston is brought to rest with little or no shock and, on its reverse movement, the work done in compressing the fluid is restored to the piston and the projection 38 withdraws from the chamber 22 with the fluid in the cushioning chamber at substantially the working pressure. In other words, by trapping working pressure fluid in the said cushioning space, there is no wasteful clearance space introduced in the cylinder, while, at the same time, the entire rear working area of the piston, including the end of the projection 38, is at all times, during the cushioning action, exposed to at least the full working pressure. It will be

seen that the passages 21 are so arranged that after and during the formation of the cushion they continue to admit the live pressure fluid to the end pressure area of the piston presented by the projection 38 so that the supply of pressure fluid to the piston or to a pressure area thereof is uninterrupted by the formation and continuation of the cushion.

In Fig. 4, I have shown a construction slightly modified over that shown in Fig. 3, there being employed a cushioning plate 41 wherein the central chamber 42 which receives the piston projection 38 is disconnected from the admission ports and itself forms the cushioning chamber. The admission ports 43 open directly from the longitudinal passages 21 into the rear end of the cylinder, so that the cushion is formed at the end of the projection 38 instead of against the main area 39 of the piston.

In Fig. 5, I have shown still another form wherein the longitudinal passages 21 in the valve plate 10 register with passages 44 in the cushion plate 45, and the latter with other passages 46 formed in the cylinder walls, which passages enter the cylinder chamber laterally at a point sufficiently forward from the rear end of the chamber to permit the piston to overrun the same and form a cushion at the rear thereof. In each case it is of course understood that a port arrangement is adopted, as in Figs. 1 to 3, whereby the valve acts to admit working pressure to the cushion chamber prior to the cutting off of the same from the cylinder admission ports.

In Fig. 1, I have shown in connection with the exhaust ports an exhaust controlling valve. Such valve comprises a valve member 47 controlled by the cock or handle 48 and adapted to vary the extent of the port opening from the annular exhaust space 26 to the atmosphere, so that the exhaust may be more or less throttled or entirely cut off if desired. In connection with such exhaust valve, the tool 6 is preferably provided with an axial or other passage 49 leading from the head end to the working edge of the tool, so that the exhaust fluid can pass from the chamber 28 to the cutting edge of the tool, and thereby be employed for clearing the cut of dust and cuttings. By closing the exhaust valve 47 more or less, the amount of exhaust fluid thus discharged through the tool may be controlled.

While I have shown and described one specific form of my invention for purposes of illustration, it is to be understood that the same is not limited to the specific details shown nor to the particular form or arrangement of parts, but that extensive deviations may be made from the described form without departing from the spirit of my invention.

Having thus described my invention, what I claim is:

1. A pressure fluid tool comprising, in combination, a cylinder, a piston working therein, said cylinder having a cushioning chamber at one end thereof to which working fluid is admitted by said valve through a suitable admission port or ports, said piston being suitably arranged to cut off said chamber from said port near the end of its normal stroke to provide a cushion through the fluid trapped therein, and means to cause said valve to admit working pressure fluid prior and while said chamber is cut off, thereby to cushion said piston against working pressure fluid.

2. A pneumatic tool having a cylinder, a hammer piston, a valve block with its valve chamber and a valve therein at the rear of said cylinder and in alinement with said piston, a cushion plate between the valve block and the end of the cylinder and presenting a contracted opening, a projection of reduced cross sectional area on the rear of the piston adapted to enter said opening adjacent the end of the normal stroke and close communication between the same and the main cylinder chamber, and means for moving the valve to admit pressure fluid to said cylinder end prior to the entrance of said projection into said opening.

3. A pneumatic tool having a cylinder 1, a piston hammer 7, valve 8, projection 38 of reduced cross sectional area, and cushion plate 11 with chamber 22 the valve moving means acting to open the rear of the cylinder to pressure fluid before and during the entrance of the projection within the cushion chamber.

4. A pneumatic tool having a cylinder, a hammer piston, a valve at one end thereof, and said piston having an end projection of reduced cross sectional area and forming two end pressure areas for the piston, the rear of the cylinder chamber presenting a contracted opening into which the said projection is adapted to enter adjacent the end of the normal stroke to close communication between the same and the rear of the cylinder and forming thereby a cushion at the rear of the cylinder, and means for moving the valve to admit pressure fluid to the rear end of the cylinder before the entrance of the projection into the said opening to cause the formation of the cushion on live pressure fluid, the admission passage or passages entering said contracted opening to continue the admission of pressure fluid against the end projection of the piston during the continuation of the said cushion.

5. A pneumatic tool having a cylinder, a hammer piston, a valve at one end thereof and said piston having an end projection of reduced cross sectional area and forming two end pressure areas for the piston, the rear

of the cylinder opening presenting a contracted opening into which the said projection is adapted to enter adjacent the end of the normal stroke to close communication between the same and the rear of the cylinder and forming thereby a cushion; means for moving the valve to admit pressure fluid to said cylinder-end before the entrance of the projection into the opening to cause the formation of the cushion on live pressure fluid, the admission passage or passages being so located as to continue the admission of pressure fluid against one of said piston areas during the continuation of the cushion.

6. A pneumatic tool having a cylinder, a hammer piston, a valve, said cylinder having a cushioning chamber at one end thereof to which working fluid is admitted by said valve through a suitable admission port or ports, said hammer being suitably formed to cut off said chamber from said port adjacent the end of its normal stroke to provide a cushion through the fluid trapped therein, and means to move said valve to admit working pressure fluid prior to the cutting off of said chamber, thereby to cushion the piston against working pressure fluid, said piston being provided with a pressure area against which pressure fluid is admitted during the continuation of the cushion.

7. A pneumatic tool having a cylinder, a hammer piston, a valve block with a valve chamber and valve therein at the rear of said cylinder and in alinement with said piston, a grasping handle at the rear of said valve block, said cylinder having a cushioning chamber at one end thereof to which working fluid is admitted by said valve through a suitable admission port, said hammer being suitably formed to cut off said chamber from said port adjacent the end of its normal stroke to provide a cushion through the fluid trapped therein, and means to move said valve to admit working pressure fluid prior to the cutting off of said chamber, thereby to cushion the piston against working pressure fluid, said piston being provided with a pressure area against which pressure fluid is admitted during the continuation of the cushion.

8. A pneumatic tool having a cylinder, a hammer piston, a valve block with its valve chamber and a valve therein at the rear of said cylinder and in alinement with said piston, means presenting an axial contracted opening at the rear end of the cylinder, said valve block having a constant pressure space and a passage or passages controlled by said valve leading from said constant pressure space laterally of said valve, and said means having a passage or passages leading from the valve block passage inward and communicating with the rear end of said cylinder, a projection of reduced cross sectional area on the rear of the piston adapted to enter said opening and close communication between the same and the main cylinder chamber, and means for moving the valve to admit pressure fluid from said pressure space about the sides of said valve through said passages to said cylinder end prior to the entrance of said projection into said opening.

9. A pneumatic tool having a cylinder, a hammer piston, a valve block with its valve chamber and a valve therein at the rear of said cylinder and in alinement with said piston, means presenting an axial contracted opening at the rear end of said cylinder, said valve block having a constant pressure groove and a passage or passages controlled by said valve leading from said groove laterally of said valve, and communicating with the rear end of said cylinder, a projection of reduced cross sectional area on the rear of the piston adapted to enter said opening and close communication between the same and the main cylinder chamber, and means for moving the valve to admit pressure fluid from said pressure groove through said passage, to said cylinder end prior to the entrance of said projection into said opening.

10. A pneumatic tool having a cylinder, a hammer piston, a valve block with its valve chamber and a valve therein at the rear of said cylinder and in alinement with said piston, means presenting a contracted opening at the rear end of said cylinder, said valve block and said means having a passage or passages controlled by said valve leading from a pressure space at the rear of said valve laterally of said valve into communication with the rear end of said cylinder, a projection of reduced cross sectional area on the rear of the piston adapted to enter said opening and close communication between the same and the main cylinder chamber, and means for moving the valve to admit pressure fluid from said pressure space through said passage to said cylinder end prior to the entrance of said projection into said opening.

11. A pressure fluid engine comprising, in combination, a cylinder, a piston working therein, a valve, said piston having an end projection of reduced cross-sectional area and forming two end pressure areas for the piston, the rear of the cylinder chamber presenting a contracted opening into which said projection is adapted to enter adjacent the end of the normal stroke to close communication between the same and the rear of the cylinder and forming thereby a cushion at the rear of the cylinder, and means for moving the valve to admit pressure fluid to the rear end of the cylinder before the entrance of the projection into the said opening to cause the formation of the

cushion on live pressure fluid, the admission passage or passages entering said contracted opening to continue the admission of pressure fluid against the end projection of the piston during the continuation of said cushion.

12. A pressure fluid engine comprising, in combination, a cylinder, a piston working therein, a valve, said piston having an end projection of reduced cross-sectional area and forming two end pressure areas for the piston, the rear of the cylinder opening presenting a contracted opening into which the said projection is adapted to enter adjacent the end of the normal stroke to close communication between the same and the rear of the cylinder and forming thereby a cushion, means for moving the valve to admit pressure fluid to said cylinder end before the entrance of the projection into the opening to cause the formation of the cushion on live pressure fluid, the admission passage or passages being so located as to continue the admission of pressure fluid against one of said piston areas during the continuation of the cushion.

13. A pressure fluid engine comprising, in combination, a cylinder, a piston working therein, a valve, said cylinder having a cushioning chamber at one end thereof to which working fluid is admitted by said valve, through a suitable port or ports, said piston being suitably arranged to cut off said chamber from said port adjacent the end of its normal stroke to provide a cushion through the fluid trapped therein, and means to move said valve to admit working pressure fluid prior to the cutting off of said chamber thereby to cushion the piston against working pressure fluid, said piston being provided with a pressure area against which pressure fluid is admitted during the continuation of the cushion.

14. A pressure fluid tool comprising, in combination, a cylinder, a piston working therein, a valve block with a valve chamber and valve therein, said cylinder having a cushioning chamber at one end thereof to which working fluid is admitted by said valve through a suitable admission port, said piston being suitably arranged to cut off said chamber from said port adjacent the end of its normal stroke to provide a cushion through the fluid trapped therein, and means to move said valve to admit working pressure fluid prior to the cutting off of said chamber, thereby to cushion the piston against working pressure fluid, said piston being provided with a pressure area against which pressure fluid is admitted during the continuation of the cushion.

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

GEORGE H. GILMAN.

Witnesses:

E. J. BOUCHARD,

L. W. HALL.