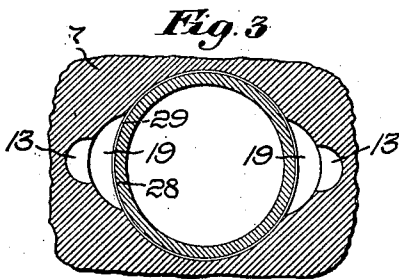
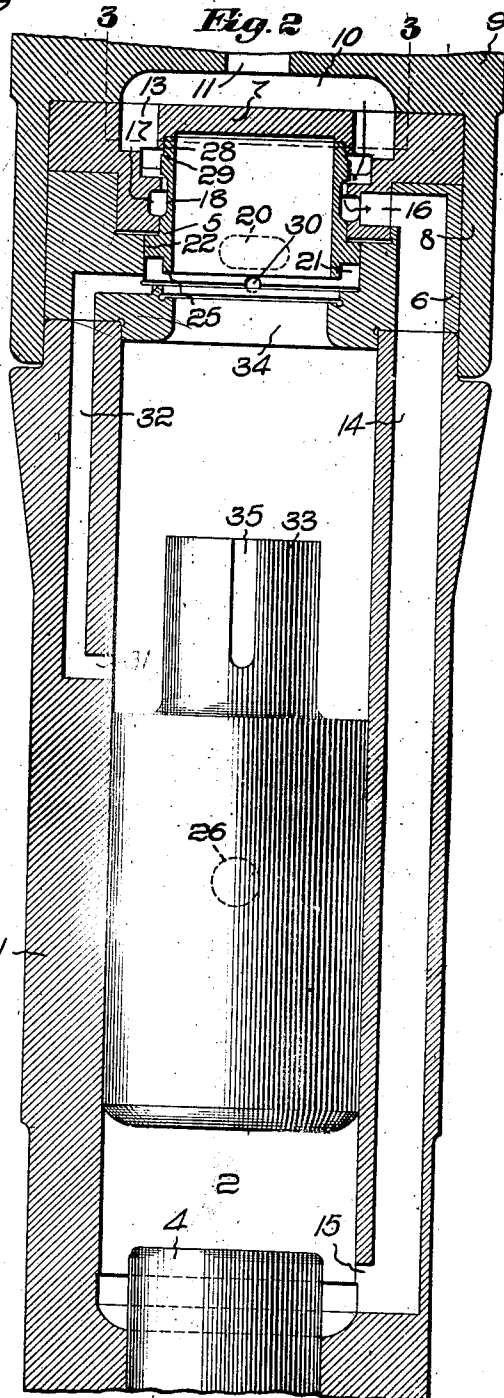
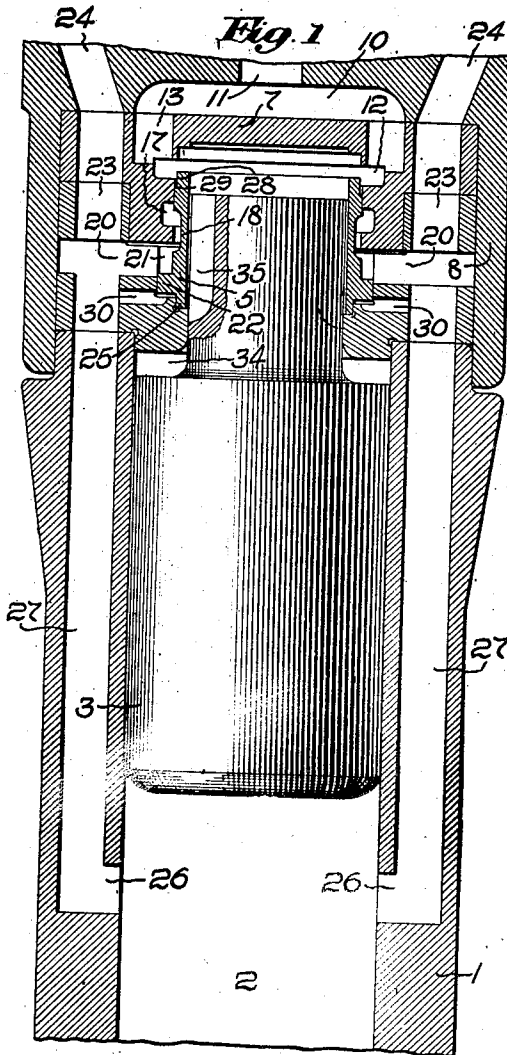


G. H. GILMAN.  
 FLUID PRESSURE ACTUATED TOOL.  
 APPLICATION FILED MAY 19, 1909.

1,095,848.

Patented May 5, 1914.



**Witnesses:**

*Horace A. Crossman*  
*Robert H. Hammler*

**Inventor:**  
*George H. Gilman*  
 by *Emery & Booth* Attys.

# UNITED STATES PATENT OFFICE.

GEORGE H. GILMAN, OF CLAREMONT, NEW HAMPSHIRE, ASSIGNOR, BY MESNE ASSIGNMENTS, TO SULLIVAN MACHINERY COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

## FLUID-PRESSURE-ACTUATED TOOL.

1,095,848.

Specification of Letters Patent.

Patented May 5, 1914.

Application filed May 19, 1909. Serial No. 496,918.

*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 Fluid-Pressure-Actuated 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 fluid pressure-actuated tools and more particularly to the valve mechanism for controlling the admission of the motive fluid to and exhaust from the cylinder.

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 a central, longitudinal section, partially broken away, taken through the cylinder and valve block, of a pressure fluid percussive tool embodying one form of my invention; Fig. 2 is a similar view showing the valve and the piston hammer in a different relation; and Fig. 3 is a detail in sectional plan on the line 3-3 in Fig. 2.

Referring to the drawings, for the sake of illustration I have there shown one embodiment of my invention, the same comprising a pneumatic hammer drill. The latter has the cylinder 1, the forward portion of which is shown broken away. The cylinder chamber 2 contains a reciprocating piston 3, which is adapted to deliver its blow against any suitable receiving member, such, for example, as the impact block 4, which herein is interposed between the head of the piston and the drill or other tool carried, as usual, in the forward end of the cylinder, but not herein shown.

The movements of the piston are controlled by a controlling valve 5, herein in the form of a hollow cylindrical shell located in a valve chamber at the rear of the cylinder chamber but in line therewith, such valve chamber being provided herein by a two-

part valve block, composed of the forward section 6 and the rear section 7. Both sections of the valve block are seated within the walls of a suitable casing 8 which projects from the head block 9, the rear portion of the latter being broken away. The head block is provided with a supply chamber 10 for the motive fluid, to which the latter is constantly admitted from any suitable source of supply through the supply passage 11.

For the admission of motive fluid to the rear of the cylinder chamber, the valve chamber is provided with an annular admission groove 12, which has constant communication with the supply chamber 10 through the rearwardly extending passages 13, of which there may be provided any suitable or desired number. When in its rearward position (see Fig. 2), the rear end of the valve enters that portion of the valve chamber behind the admission groove 12, thereby cutting off the interior of the valve and the rear of the cylinder chamber from the motive fluid. In the forward position of the valve, however (see Fig. 1), the interior of the valve is opened freely to the admission groove 12 so that the motive fluid flows freely to the interior of the valve and thence to the rear of the cylinder chamber to drive the piston forward.

The forward end of the cylinder chamber is supplied with motive fluid when the valve is at its rearward position (see Fig. 2) by means of the return pressure passage 14, which extends longitudinally through the walls of the cylinder and opens into the cylinder chamber through the port 15. At its rear end such passage extends through the valve block section 6 and terminates in a lateral port 16 opening into an annular valve block groove 17. In the rearward position of the valve the groove 17 is connected with the motive fluid by means of the circumferential valve groove 18, the admission groove 12 being cut away at (see Figs. 2 and 3) immediately below one or more of the admission passages 13, so as to give a sufficiently free admission of motive fluid to the groove 17 by way of the valve

groove 18 to return the piston hammer. From the groove 17 the motive fluid passes through the port 16, passage 14 and port 15 to the forward end of the cylinder.

- 5 To exhaust the motive fluid from the rear of the cylinder chamber, lateral exhaust passages 20 are provided in the valve block, which passages open into the valve chamber at the annular groove or enlargement 21, which latter forms an annular chamber to receive the circumferential enlargement 22 near the forward end of the valve. These lateral exhaust ports communicate with the longitudinal exhaust ports 23 extending through the valve block, the longitudinal ports at their rear communicating with the permanently open exhaust ports 24 formed in the head block. When the valve is in its rearward position (Fig. 2), the prolonged
- 20 portion 25 of the valve which extends beyond the circumferential enlargement 22, lifts from its seat sufficiently to open the rear of the cylinder chamber to the bottom of the valve block chamber 21, thus placing
- 25 the rear of the cylinder chamber in communication with the exhaust ports 20. As shown in the drawings, the ports 20 are only partially uncovered by the valve when in this position, but such ports may be, and
- 30 preferably are, of an elongated cross-section, as shown in dotted lines in Fig. 2, so that, by suitably proportioning such ports, the exhaust from the rear of the cylinder chamber may be made as free or restricted as
- 35 desired.

- To exhaust motive fluid from the forward end of the cylinder chamber, the latter is provided with one or more (herein two) exhaust ports 26, adapted to be uncovered by
- 40 the piston before the completion of the rearward movement thereof, such ports being connected with the longitudinal exhaust passages 27 and thereby with the atmosphere through the permanently open exhaust passages 23 and 24. In addition to this, the forward end of the cylinder is maintained open for the exhaust of motive fluid during the forward movement of the piston, and
- 50 after the closure of the exhaust ports 26, through the return port 14, the latter being there connected through the valve chamber when the valve is positioned as shown in Fig. 1, with the valve groove 18, the exhaust chamber 21 and the exhaust ports 20.
- 55 Referring now more particularly to the provision for moving the valve to reverse the piston, the rear end portion 28 of the valve is of slightly reduced diameter, having a sliding fit in the corresponding reduced
- 60 portion of the valve chamber beyond the admission groove 12. This forms a small circumferential shoulder 29 which constitutes a small pressure area constantly exposed to the motive fluid in the admission groove 12.
- 65 On the other hand, the lower face of the

circumferential enlargement 22 constitutes an opposing differential pressure area of relatively greater proportions.

When the valve is in its forward position (shown in Fig. 1) the valve is maintained in such position during the forward movement of the piston by the pressure on the small area 29 augmented by the pressure on the rear end area of the valve, there being then no substantial pressure against the larger opposing pressure area in the lower end of the chamber 21. To insure the absence of substantial pressure against this larger area there may be, and preferably are, provided one or more release ports 30 (herein two in number) connecting the lower end of such chamber with the exhaust passage or passages 23, these serving to exhaust any pressure fluid trapped in the bottom of said chamber or entering therein by leakage from the cylinder chamber. Means are provided, however, whereby the piston during its forward movement is adapted to admit pressure fluid to the large opposing pressure area to lift the valve to the position shown in Fig. 2 and thereby reverse its own movement. To this end a port 31 is provided which is adapted to be uncovered by the piston to the motive fluid at the rear thereof, such port conducting the motive fluid through the rearwardly extending passage 32 to the bottom of the chamber 21 and against the large opposing pressure area formed on the under face of the circumferential enlargement 22. The port 31 may be located at any suitable point, but preferably so that it is uncovered just prior to the striking of the blow. When uncovered, the pressure upon the large opposing differential area exceeds that on the small pressure area 29 and the end area of the valve, and quickly reverses the valve, lifting to the position shown in Fig. 2. As above described, this admits motive fluid to the forward end of the cylinder chamber and opens the rear end thereof to the exhaust, so that the piston, having delivered its blow, moves back on its return stroke.

The piston carries projecting from its rear end a plug portion 33 which, in the illustrated embodiment of my invention, is of lesser diameter than the piston itself. This plug portion is adapted to project out of and beyond the piston or cylinder chamber in the rearward position of the valve, and through an aperture 34 in the valve block in which it preferably has a sliding fit, and which constitutes a port leading from the valve chamber to the piston chamber. The valve having been reversed, the piston during its return movement expels the motive fluid at the rear of the cylinder chamber through the exhaust chamber 21 and the exhaust ports 20. During this movement of the piston, the slight pressure maintained by

the discharging exhaust fluid in the exhaust chamber 21 and against the large opposing pressure area at the bottom of the circumferential enlargement 22 predominates over the constant pressure acting against the small pressure area 29, and is sufficient to maintain the valve reversed in the position shown in Fig. 2, to which position, as above described, it has been thrown by motive fluid admitted by the piston through the passage 32. This condition continues and the valve is held reversed by the action of the exhaust pressure preferably after the plug portion 33 enters the aperture 34 and so long as there is any substantial pressure exerted by the remaining exhaust fluid. When the piston, however, reaches some such position as is represented in Fig. 1 (the valve still being in the position shown in Fig. 2), a fluid cushion is formed between the end of the piston 3 and the opposing face of the valve block section 6 by reason of the closure of the aperture 34 by the plug 33. This brings the piston to rest and prevents it from striking the valve block should the valve fail to reverse. About the same time, however, the remanant motive fluid, having been substantially expelled, the pressure of the discharging exhaust against the larger pressure area of the valve is reduced to such a low point that the valve is quickly reversed by the superior pressure against the small pressure area 29. As above described, this admits live pressure fluid from the admission groove 12, driving the piston forward. At the same time the forward end of the piston chamber which has been previously opened to the exhaust by the uncovering of the exhaust ports 26, is also opened to the exhaust through the valve chamber by way of the return port 14, this condition holding until the valve is again reversed. The valve, when reversed, is held securely in its forward position, since the release ports 30 relieve the larger pressure area of the pressure of any accumulated motive fluid.

While the length of the projecting plug portion 33 might be reduced so as not to project within the valve in the rearmost position of the piston, herein, for the sake of reducing the clearance within the valve chamber, it is somewhat prolonged, as shown in the drawings, so that it not only passes through and closes the port-like aperture 34, but also enters part way into the valve itself. The interior diameter of the valve, however, is made slightly greater than the exterior diameter of the plug, so that a small clearance space remains between the valve and the entering portion of the plug. This permits the motive fluid trapped within the valve chamber to escape back and about the sides of the plug to the exhaust chamber 21 when the plug enters the valve.

Such escape, moreover, may be facilitated, if desired, by any suitable formation of the plug, such, for example, as the provision of one or more longitudinal grooves 35 cut part way on the surface of the plug.

The described form of valve being very delicately balanced, acts quickly to reverse near the close of the rearward piston movement so that very high speed and a very powerful blow can be secured through its employment. Moreover, the clearance in the cylinder and valve chamber being reduced to a minimum, a very high efficiency can be obtained.

It may be observed that the pressure exerted by the escaping exhaust against the larger pressure area can be varied, and the action of the valve thereby varied within wide limits, through increasing or decreasing the available cross-sectional area of the exhaust ports opened to the exhaust chamber 21 on the backward movement of the valve by the circumferential enlargement 22. That is to say, by increasing the area or the number of the exhaust ports 20, or by increasing the extent of exhaust port opening, when the valve is moved to the position shown in Fig. 2, the valve-lifting pressure, due to the exhaust, is diminished. Conversely, by decreasing the area or number of such ports, the valve-lifting pressure is increased and prolonged.

It will be observed that the valve, being located in a separate chamber behind the piston chamber and between the latter and the head block, it is not necessary for the operation of the tool that any part of the piston enter the valve. Herein the plug 33 carried by the piston is caused to enter the valve chamber to reduce the clearance therein, but such is not essential. The clearance within the valve chamber might be reduced by making the valve solid except for a central axial admission passage through the same, or with a valve proportioned as shown, a stationary plug might be employed projecting forwardly within the valve from the valve block section 7.

While I have herein shown and described for purposes of illustration one specific form of my invention, it is to be understood that wide deviations may be made from the mechanical construction herein shown, the form and relative arrangements of the parts and the application or use herein made of the invention, without departing from the spirit of the same.

Having thus described my invention, what I claim is:

1. A pressure fluid percussive tool having a piston hammer, a valve having two pressure areas at different points, respectively, in its length and separated from each other by a cylindrical surface, means fitting said cylindrical surface in one position of the valve,

means to cause said valve to be moved into another position by motive fluid acting against one of said pressure areas, and means to cause the valve to be held, when so moved, by the pressure of the discharged exhaust acting against both of said areas.

2. A pressure fluid percussive tool having a piston hammer, an annular valve, means to cause said valve to be moved in opposite directions by pressure fluid, means for closing the rear end of said valve in its rearmost position, a release port and means for causing said valve to be held in its rearmost position by the pressure of the exhaust fluid escaping from the interior of said valve radially outward across the forward end of the valve to said release port.

3. A pressure fluid percussive tool having a piston hammer provided with a plug portion, a piston chamber, an annular valve, a valve chamber located at the rear of the cylinder chamber, an axially arranged port connecting the valve chamber and piston chamber into which port the plug portion is adapted to enter, means for admitting pressure fluid to the rear end of the plug portion and to the rear end of the piston chamber through the hollow interior of the valve, and means for exhausting pressure fluid from the rear of the piston about the forward end of the valve.

4. A pressure fluid percussive tool having a piston hammer provided with a rearwardly projecting plug portion, an annular valve, said tool having means including exhaust ports adjacent the forward end of the valve for releasing the exhaust fluid from the rear end of the cylinder chamber radially outward about and across the forward end of the valve, the interior of the valve being formed to permit the escape of exhaust fluid radially outward to said exhaust ports from the interior of the valve.

5. A pressure fluid percussive tool having a cylinder chamber, a piston hammer provided with a rearwardly projecting plug portion, a valve located behind said cylinder chamber, a port connecting the valve chamber and cylinder chamber, through which port said projecting plug portion passes on rearward movement of the piston, said plug portion being also extended to enter the valve, the interior of said valve and said plug portion being formed to permit the escape of exhaust fluid from the rear inner end of the valve about the forward end thereof, while also formed closely to fit said port to provide for the formation of a fluid cushion at the rear of the piston.

6. A pressure fluid percussive tool having a piston hammer and an annular valve at the rear thereof; a projecting plug portion of the hammer adapted to enter the valve and forming with said valve a passage permitting the escape of exhaust motive fluid from one

end thereof to the other; means to move said valve in one direction by constantly acting pressure against an area thereof; means to move said valve in the opposite direction by pressure intermittently admitted to a larger pressure area thereof; and means to hold the valve in said last named position by the action of the escaping exhaust.

7. A pressure fluid percussive tool having a piston hammer and an annular valve, means for closing the rear end of said valve in its rearmost position, means including an exhaust port for releasing the exhaust fluid from the interior of said valve radially outward across one end of the valve to said release port thereby to hold said valve in position to permit such release of the exhaust fluid, and means to move said valve to a reverse position solely by constantly acting pressure fluid acting against a pressure area of the valve.

8. A pressure fluid percussive tool having a piston hammer, a piston chamber, an annular controlling valve open at both ends located at the rear of, and in line with the piston chamber, said valve being interiorly open for the passage of fluid therethrough from one end thereof to the other, means for admitting live pressure fluid through the said valve to drive said piston forward, and means for holding the valve in one position by motive fluid and in the opposite position by exhaust fluid.

9. A pressure fluid percussive tool having a piston chamber, an annular valve which communicates interiorly at one end with the piston chamber, an admission space at the opposite end of the valve, an exhaust space exteriorly of the valve at its first mentioned end, said valve when in one position connecting the piston chamber with the admission space about the end of the valve and through its hollow interior, and when in the reverse position connecting the piston chamber with the exhaust space about the opposite end of the valve, a pressure area at the admission end of the valve being constantly exposed to motive fluid and a larger pressure area at the exhaust end of the valve exposed to the exhaust fluid and serving to hold the valve open during exhaust.

10. A pressure fluid percussive tool having a piston chamber, an annular valve which communicates interiorly at one end with the piston chamber, an admission space at the opposite end of the valve, an exhaust space exteriorly of the valve at its first mentioned end, said valve when in one position connecting the piston chamber with the admission space about the end of the valve and through its hollow interior, and when in the reverse position connecting the piston chamber with the exhaust space about the opposite end of the valve, a pressure area at the admission end of the valve being constantly

exposed to motive fluid and a larger pressure area at the exhaust end of the valve exposed to the exhaust fluid and serving to hold the valve open during exhaust, a piston and a part carried by the end of the piston adapted to enter the valve on movement of the piston in one direction and substantially fill the interior thereof.

11. A pressure fluid percussive tool having a piston hammer provided with a plug portion, a piston chamber, an annular valve, a valve chamber located at the rear of the cylinder chamber, an axially arranged port connecting the valve chamber and piston chamber into which port the plug portion is adapted to enter and have a sliding fit, means for admitting pressure fluid to the rear end of the piston chamber through the hollow interior of the valve, and means for exhausting pressure fluid from the rear of the piston about the forward end of the valve.

12. A pressure fluid percussive tool having a cylinder chamber, a piston hammer provided with a rearwardly projecting plug portion, a valve located behind said cylinder chamber, a port connecting the valve chamber and cylinder chamber, through which port said projecting plug portion passes on rearward movement of the piston, the interior of said valve and said plug portion being formed to permit the escape of exhaust fluid from the rear inner end of the valve about the forward end thereof, while also formed closely to fit said port to provide for the formation of a fluid cushion at the rear of the piston.

13. A pressure fluid percussive tool having a piston hammer provided with a plug portion, an annular valve at the rear of the piston hammer, said tool having a piston chamber and a port forming a communication between the piston chamber and the interior of the valve, into which port the plug portion is adapted to enter and closely fit; means to move said valve in one direction by constantly acting pressure against an area thereof; means to move said valve in the opposite direction by pressure intermittently admitted to a larger pressure area thereof; and means to hold the valve in the last named position by the action of the escaping exhaust.

14. A pressure fluid percussive tool having a piston hammer, an annular valve having a pressure area, a piston chamber having communication with the interior of the valve, means to move the valve in a direction opposite to the piston by motive fluid passing through the valve into the piston chamber and thence to said pressure area of the valve, and means to hold the valve, when so moved, by the pressure of the exhausting fluid flowing across and acting against said pressure area.

15. A pressure fluid percussive tool hav-

ing a piston chamber, an annular valve which communicates interiorly at its forward end with the piston chamber, an admission space at the rear end of the valve adapted to communicate with the piston chamber through the interior of the valve, an exhaust space exteriorly of the valve at its forward end, said valve when in its foremost position connecting the piston chamber with the admission space about the rear end of the valve and through its hollow interior, and when in the reverse position connecting the piston chamber with the exhaust space about the opposite end of the valve, a pressure area at the admission end of the valve being constantly exposed to motive fluid and a larger pressure area at the exhaust end of the valve exposed to the exhaust fluid and serving to hold the valve open during the exhaust.

16. A pressure fluid percussive tool having a piston chamber, an annular valve which communicates interiorly at one end with the piston chamber, an admission space at the opposite end of the valve, an exhaust space exteriorly of the valve at its opposite end, said valve when in one position connecting the piston chamber with the admission space about the end of the valve and through its hollow interior, and when in the reverse position connecting the piston chamber with the exhaust space about the opposite end of the valve, a pressure area at the admission end of the valve being constantly exposed to motive fluid and a larger pressure area at the exhaust end of the valve exposed to the exhaust fluid and serving to hold the valve open during exhaust, and a piston hammer arranged to reciprocate within said piston chamber.

17. A pressure fluid percussive tool having a piston chamber, an annular valve which communicates interiorly at its forward end with the piston chamber, an admission space constantly open to motive fluid at the opposite end of the valve, an exhaust space exteriorly of the valve at its forward end, said valve when in one position connecting the piston chamber with the admission space about the forward end of the valve and through its hollow interior, and when in the reverse position connecting the piston chamber with the exhaust space about the opposite end of the valve, a pressure area at the admission end of the valve being constantly exposed to motive fluid and a larger pressure area at the exhaust end of the valve exposed to the exhaust fluid and serving to hold the valve open during exhaust, and a piston hammer arranged to reciprocate within said piston chamber.

18. A pressure fluid percussive tool having a cylinder chamber, a piston hammer provided with a rearwardly projecting plug portion, and a hollow valve located behind

said cylinder chamber, a port connecting the  
valve chamber and cylinder chamber,  
through which port said projecting plug  
portion passes into said valve on rearward  
5 movement of the piston, said plug portion  
being formed closely to fit said port to pro-  
vide for the formation of a fluid cushion at  
the rear of the piston.

In testimony whereof, I have signed my  
name to this specification, in the presence of 10  
two subscribing witnesses.

GEORGE H. GILMAN.

Witnesses:

E. J. BRUCHARD,  
S. T. CHANDLER.