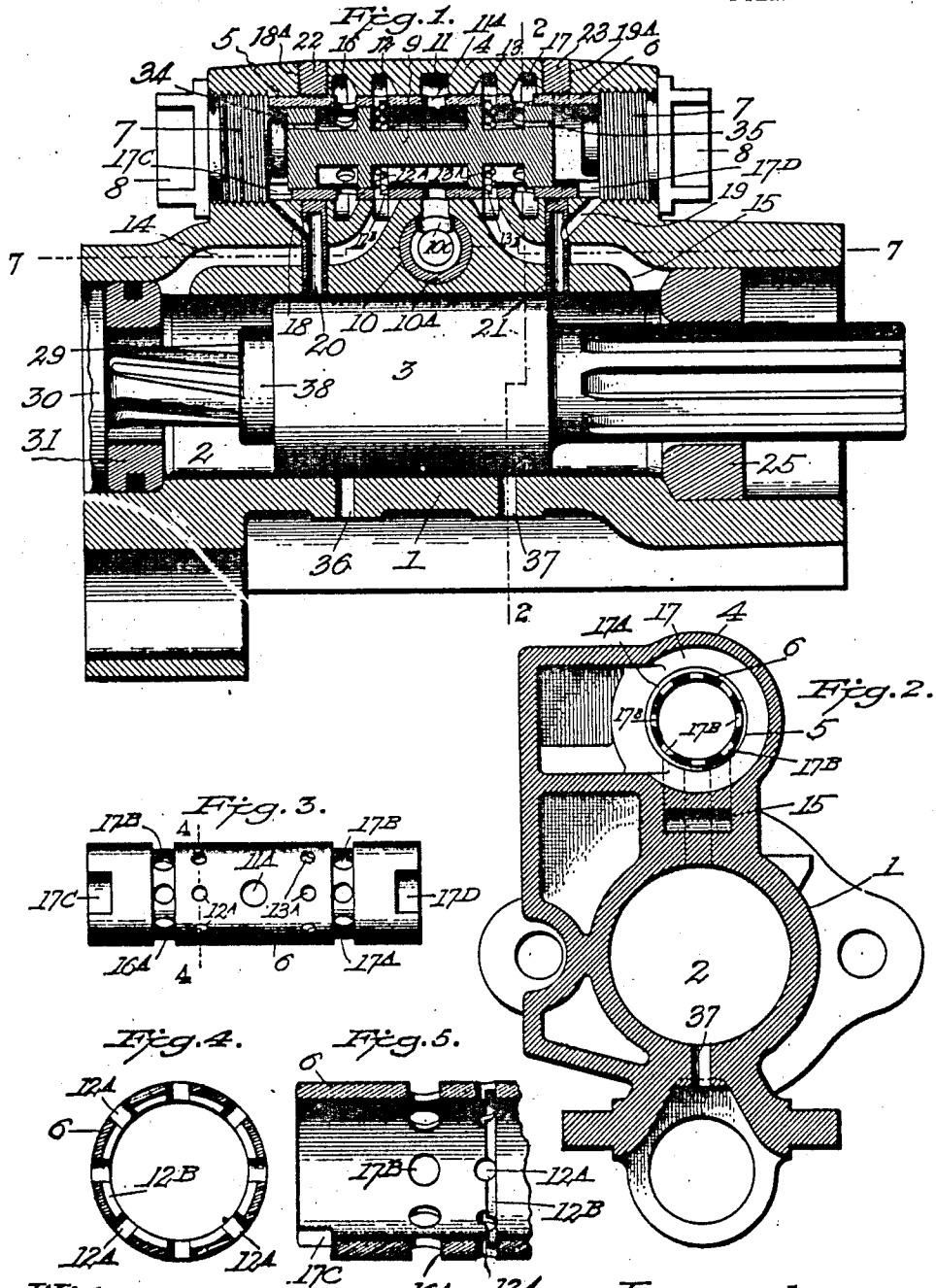


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2 SHEETS—SHEET 1.



Witnesses:

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Adella M. Towle

Inventor:

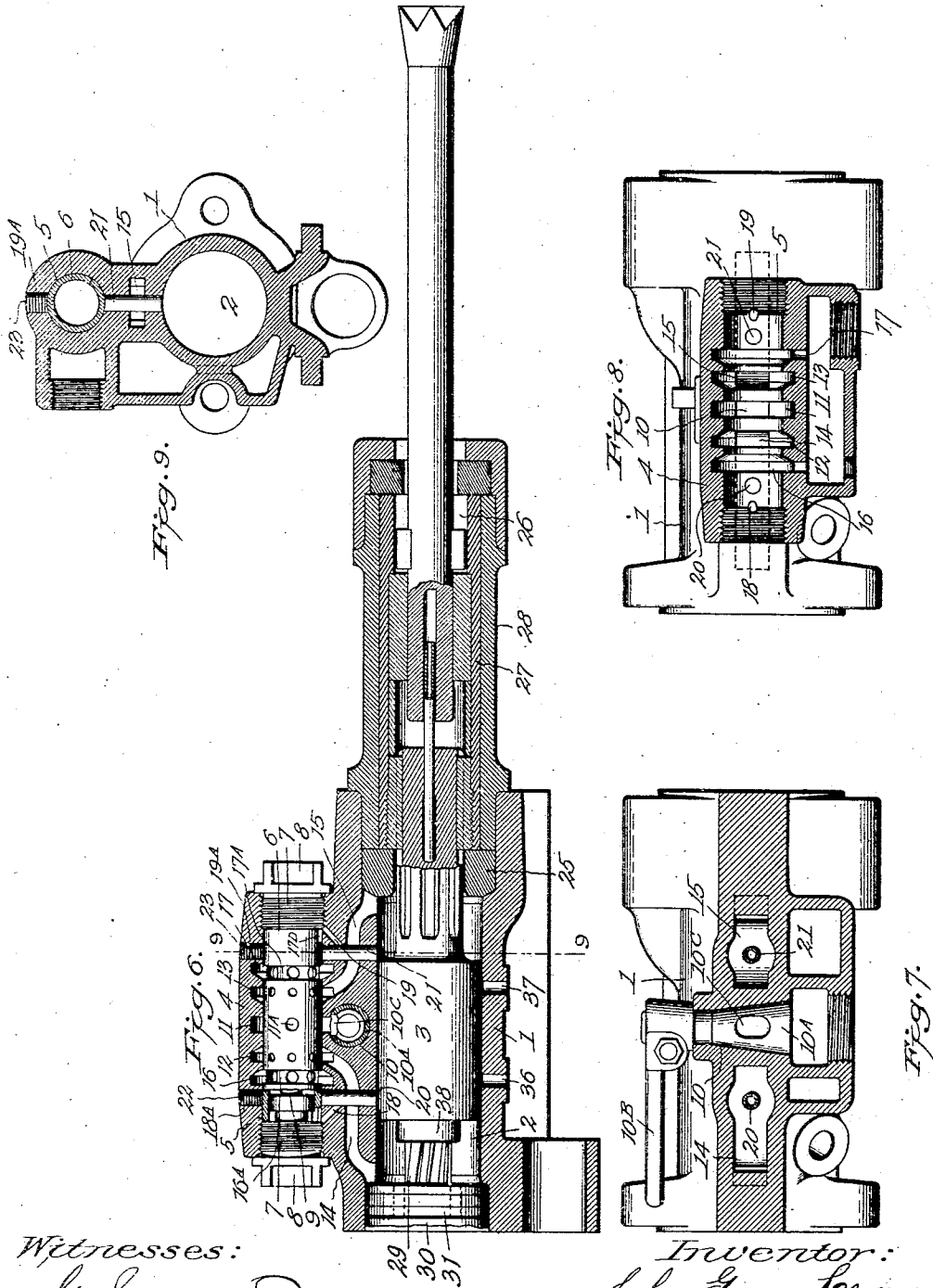
By John George Leyner
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UNITED STATES PATENT OFFICE.

JOHN GEORGE LEYNER, OF DENVER, COLORADO.

VALVE MECHANISM FOR ROCK-DRILLING ENGINES.

1,058,074.

Specification of Letters Patent.

Patented Apr. 8, 1913.

Application filed October 23, 1911. Serial No. 656,266.

To all whom it may concern:

Be it known that I, JOHN GEORGE LEYNER, a citizen of the United States of America, residing in the city and county of Denver and State of Colorado, have invented a new and useful Fluid-Actuated Valve Mechanism for Rock-Drilling Engines, of which the following is a specification.

My invention relates to improvements in fluid actuated valve mechanism for rock drilling engines, and the objects of my invention are: First, to provide a valve controlled port mechanism that is so arranged that the live pressure of the actuating fluid is exerted directly against the opposite ends of the hammer piston and of the valve simultaneously, and is also so arranged that the reciprocal movement of the hammer piston controls the movements of the valve to cause said actuating fluid to cushion the forward or drill bit driving strokes of the hammer piston and the rearward or inoperative strokes of the hammer piston, to any predetermined differing degrees of cushioning action desired, to permit the hammer piston to strike free from restraining pressures, to the full limit of its operative drill bit driving strokes, and to fully cushion it on its rearward strokes against the rear end part of the cylinder, and to provide independent and auxiliary exhaust ports for instantly releasing the hammer piston of back pressures independent of the regular exhaust port feature of the valve controlled port mechanism. Second, to provide a valve mechanism in which the actuating fluid is directed to impinge the opposite ends of the hammer piston and lateral pressure of the actuating fluid against the piston is avoided, and in which direct and auxiliary exhaust ports to the atmosphere are provided at opposite end portions of the cylinder independent of the valve and hammer piston's actuating fluid inlet ports. And third, to provide a removable and renewable valve inclosing bushing that is adapted to be inserted in the valve chest and is arranged with ports registering with the operative actuating fluid inlet exhaust ports, and that is adapted with the valve to be removed and replaced by a new bushing and valve when they have worn away to such an extent that they interfere with their efficiency in controlling the actuating fluid. I attain these objects by the mechanism illustrated in the accompanying drawings, in which:

Figure 1 is a vertical longitudinal sectional view of the hammer piston cylinder and valve chest of a rock drilling engine, illustrating the improved valve mechanism. Fig. 2 is a transverse vertical sectional view on the line 2—2 of Fig. 1. Fig. 3 is a plan view of the valve inclosing bushing taken from the under side thereof. Fig. 4 is an enlarged transverse sectional view thereof on the line 4—4 of Fig. 3. Fig. 5 is an enlarged longitudinal sectional view through a portion of the bushing. Fig. 6 is a vertical longitudinal sectional view through the hammer piston cylinder and forward end of a drilling engine, showing the hammer piston midway of its forward stroke, and the drill bit in the chuck, in position to receive the blows from the said hammer piston. Fig. 7 is a horizontal sectional view of the cylinder on the line 7—7 of Fig. 1. Fig. 8 is a horizontal sectional view through the valve chest of the cylinder, the sleeve or bushing therein being removed. And Fig. 9 is a transverse sectional view on the line 9—9 of Fig. 6.

Similar letters of reference refer to similar parts throughout the several views.

Referring to the drawings, the numeral 1 designates a cylinder of an actuating fluid operating rock drilling engine, and in Fig. 1 an enlarged view of the cylinder portion and of the hammer piston and the adjacent parts, is illustrated. The parts of the drilling engine that support the drill bit in operative relation are shown in Fig. 6, and some other parts of the drilling engine are not illustrated, as they do not form a part of my present invention. The cylinder 1 is provided with a cylindrical bore 2, that is adapted to receive a reciprocating rock cutting drill bit driving hammer piston 3. The cylinder is provided with a valve chest 4, in which a cylindrical bore 5 is formed. A cylindrical bushing 6, which is made of any suitable metal, but which is preferably made of steel, is removably fitted in the bore of the valve chest. The ends of the cylindrical bore of the valve chest are threaded and plugs 7 are threaded to them and are provided with wrench receiving surfaces 8, by which they may be readily turned into and out of the end of the valve chest, and the bushing extends throughout the length of the valve chest and fits between their inner ends. The valve chest bushing is adapted to form a removable and a renewable lining for a circular stem form of valve 9,

which is reciprocally mounted in the lining, but if desired, this bushing may be dispensed with and the valve fitted reciprocally in the bore of the valve chest. The valve chest is provided with an actuating fluid inlet port aperture 10, in which an operative hollow plug form of valve 10^A is rotatably seated. This valve projects from the opposite end of the cylinder from the inlet port, and is provided with a handle 10^B, and it is also provided with a port 10^C. This port 10^C registers with an operative system of actuating fluid inlet and exhaust ports, that lead the actuating fluid into and out of the valve chest and valve and the opposite ends of the cylinder. These ports comprise a central port 11, that leads from the inlet port 10 into the center of the valve chest and its bushing and of the valve, and two annular ports 12 and 13, which are formed at short but equal distances from the central port 10, on opposite sides of it, which register with two ports 14 and 15, that extend from the ports 12 and 13 through the shell of the cylinder to the opposite ends of the hammer piston's bore of the cylinder, and a pair of exhaust ports 16 and 17, that are formed outside of the ports 12 and 13 from the central port 10, and at a short distance from them, and between them and the ends of the valve chamber in the bushing.

The bushing when used, is provided with circumferential rows of ports that register with the inlet and exhaust ports of the valve chest. Thus the central inlet port 11 of the valve chest registers with ports 11^A of the bushing, ports 12 and 13 register with ports 12^A and 13^A of the bushing, and the interior wall of the bushing is provided with annular groove ports 12^B and 13^B that are cut into one-half of the diameter of port holes 12^A and 13^A, and these inner port grooves are formed in the sides of each row of the port holes 12^A and 13^A of the bushing that lie nearest to the central inlet port holes 11^A, and the groove port 12^B acts to admit a fuller and freer volume of the actuating fluid to the cylinder port 14 at the beginning of the valve's opening movement of the bushing ports 12^A, which provides a quick and large volume of cushioning fluid for the rearward stroke of the hammer piston, while the groove port 13^B is arranged to admit a fuller volume of the actuating fluid at the close of the opening movement of the valve. The bushing is also provided with two circumferential exhaust port grooves 16^A and 17^A, at its opposite ends, in the bottom of which a circumferential row of exhaust port holes 17^B is formed. The circumferential exhaust grooves register with the exhaust ports 16 and 17 of the valve chest. There is also an open slot port 17^C on one end of the bushing and an open slot port 17^D in the opposite end of the bushing, which register

with ports 18 and 19 formed in the bottom of the opposite ends of the valve chamber, and which I term live actuating fluid ports, and which extend from predetermined points in the hammer piston bore of the cylinder to the ends of the valve chamber of the valve chest. These ports may be formed in any suitable manner. I preferably, however, form them in the following manner: Apertures 18^A and 19^A are drilled down through the valve chest and cylinder into the hammer piston bore of the cylinder, and these holes at their end portions that extend from the piston bore toward the valve chest are plugged up with metal pins 20 and 21, in which axial apertures are drilled from the cylinder ends to within a short distance from their opposite ends, and far enough to be intersected by angular port holes drilled from the opposite ends of the inside bottom wall of the valve chamber through the shell of the cylinder and the pins into their axial aperture, thus forming continuous passage-way from the opposite ends of the hammer piston's bore to the adjacent ends of the valve chest chamber, as the top of the pins are closed. The entrances to the holes in which the port pins are driven are also closed by plugs 22 and 23, which are tightly threaded in them. These live actuating fluid ports are the essential feature of my present invention, and their exact position in the cylinder relative to the reciprocal strokes of the hammer piston is predetermined, in order that the results desired may be obtained. The function of these ports is to admit the actuating fluid from the end of the hammer piston cylinder into the adjacent end of the valve chamber by a short and direct path as the openings of these ports into the hammer piston cylinder are alternately uncovered by said piston in its reciprocating movement. The effect upon the valve of thus allowing the hammer piston actuating fluid to act against its ends is to cause the valve to move in the same direction as the hammer piston. This movement of the valve closes one set of ports and opens another set, whereby actuating fluid is allowed to flow into the opposite end of the hammer piston cylinder before the hammer piston reaches the extreme end of its stroke, and this causes said piston to be cushioned. The degree to which said piston is cushioned may vary from a great degree down to practically no cushioning effect at all, depending upon the location of these port openings 20, 21 in the walls with respect to the travel of the piston. As can be easily seen from a consideration of the drawings, the sooner such a port is uncovered by the hammer piston as it moves from the beginning of its stroke in a certain direction under the influence of the fluid on one of its ends, just so much sooner will said fluid en-

ter the valve chamber and throw the valve in the same direction to close the previously opened inlet port and to open the opposite one, letting in live fluid to the other end of the said cylinder and thus cushioning the cylinder. I have found in practice that the best results are obtained when these ports are positioned in such relation to the piston and its stroke as to permit the piston to strike an uncushioned blow upon the drill, the cushioning commencing immediately after the impact of the piston on the drill. The piston moves, thereafter, with a retarded motion to the end of its stroke, at which point it is abutting the collar 25. The cushioning of the piston on its rearward stroke is adjusted to begin earlier in this stroke to prevent any impact of the piston against the rear cylinder ring 31.

My present valve mechanism is a great improvement over that shown in my above mentioned pending application, inasmuch as it admits the live actuating fluid by direct and short ports from the cylinder to the nearest port of the opposite ends of the valve, and moves it much quicker and with a greater energy of pressure behind it.

In the old valve port mechanism of my former patents the actuating fluid ports from the cylinder to the opposite ends of the valve are tortuous and extend in a round-about way that creates a great deal of friction and causes a retarding effect on the flow of the actuating fluid that makes it slower in acting on the end of the valve.

The valve is a stem form of valve that is arranged with four collars 33, two of which are at its opposite ends and the other two are intermediate of its ends. These collars are arranged to register operatively with the inlet ports 12 and 13, and the exhaust ports 16 and 17, and through the flanges of its opposite end collars ports 34 and 35 are formed, which permit the actuating fluid to exhaust through these ports into the regular exhaust ports 17^B and 16 and 17.

In order to facilitate the exhaust of the actuating fluid from the hammer piston cylinder, I provide its shell portion with two auxiliary exhaust ports 36 and 37. These auxiliary exhaust ports are preferably placed in the opposite side of the cylinder from the valve chest and its ports, and they are preferably positioned close to the inner end of the forward stroke of the hammer piston and to the inner end of its rearward stroke, so that at the instant the hammer piston has delivered its forward blow the actuating fluid has an open exhaust port directly behind the rear end of the piston and on its rearward stroke directly in front of the front end of the hammer piston, when at the end of its rearward stroke, which permits a portion of the actuating fluid to instantly exhaust the atmosphere, and to that extent

relieves the hammer piston from back pressure, which if these ports were not present, would tend to retard its free reciprocal action under the entering live actuating fluid, while not of practical use in cushioning its reciprocal strokes at the proper instant, and in its cushioning positions in the cylinder.

The hammer piston is provided with a spirally fluted nut 38, that preferably projects from its rear end, and the rear cylinder ring is provided with an axial aperture large enough for it to move into on the rear stroke of the hammer piston. The rifle bar 29 is shown projecting from the nut through the cylinder ring, and it is provided with a head portion 30, that rests against the rear side of the cylinder ring. These features do not form a part of my present application, but are fully described with the rear portion of an operative rock drilling engine in my above mentioned pending application.

The operation of my improved valve mechanism is as follows: Any suitable actuating fluid may be used, such as compressed air or steam, compressed air being preferably used. This air is admitted to the inlet port by any suitable means and the actuating fluid is turned on or off from the inlet ports and valve controlled port mechanism by manually turning the throttle valve by its handle, and the actuating fluid on being admitted to the central valve chest port enters the bushing and the valve between its inner collars and enters the cylinder port that happens to be either partially or wholly open, as the valve and the inlet ports are arranged so that either one or the other of the cylinder inlet ports to the hammer piston bore is either partially or wholly open. As soon as the hammer piston starts to reciprocate it uncovers the valve actuating ports and allows the live actuating fluid to flow directly and instantaneously to the respective adjacent end of the valve and moves it with a quick positive throw movement that opens and closes the cylinder inlet and exhaust ports and properly cushions the hammer piston at the opposite ends of its reciprocal strokes, while the auxiliary exhaust port apertures allow a part of the exhaust fluid near the opposite ends of the hammer piston when at the ends of its forward and rearward strokes, to quickly exhaust by short straight ports to the atmosphere.

My improved valve controlled port mechanism provides a positive lightning action piston and valve operating mechanism that gives to the hammer piston the greatest drill bit driving blows obtainable, inasmuch as it eliminates cushioning and back pressures, except at the actual points and at the instant they are required.

While I have illustrated and described the preferred construction and arrangement

of my invention, I do not wish to be limited to the construction and arrangement shown, as many versions of the same might be made without departing from the spirit of my invention.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A rock-drilling engine having a casting comprising a cylinder and a superposed valve-chest, a piston in said cylinder, said cylinder having fluid inlet and exhaust ports leading from said valve-chest, a valve in said valve-chest controlling said ports, said valve and said cylinder having cooperating ports, the walls of said ports having parts cut away at the port openings whereby to permit of the admission of a large amount of fluid for cushioning said piston at the instant said valve begins to open said ports.

2. In a valve controlled port mechanism for rock drilling engines, the combination of the cylinder, the hammer piston reciprocally mounted therein, the valve chest on said cylinder, and the system of fluid inlet and exhaust ports in said valve chest, with a renewable bushing removably secured in said chest, said bushing being provided with circumferential rows of actuating fluid inlet and exhaust ports, and circumferential grooves on the inner peripheral wall of said bushing, arranged in predetermined positions to intersect a part of the diameter of said circumferential row of inlet ports, and having an outer annular groove arranged to inclose the circumferential rows of exhaust ports of said bushing, and a valve reciprocally mounted in said bushing, valve actuating fluid ports in said cylinder at the opposite ends of said valve chamber, and ports in the opposite ends of said bushing registering with said valve chamber ports.

3. In a valve mechanism as specified, a casting comprising a cylinder and valve chest, and having cylinder ports extending from the central portion of the valve chest to the opposite ends of the cylinder, and valve chest ports extending from the opposite ends of the valve chest, and opening into the cylinder at suitable distances from its ends, said latter ports being in the form of tubes which extend through the cylinder ports, and which are tapped at their upper

ends to communicate with short ports leading from the said opposite ends of the valve chest, a slide valve in the chest for controlling said ports, a hammer piston which opens the valve chest ports in alternate order, and a throttle valve connected with a pressure supply, with the valve chest and with the cylinder ports.

4. In a valve mechanism as specified, a cylinder and a valve chest connected by a system of ports consisting of a pair of cylinder ports which extend from the central part of the valve chest to the opposite ends of the cylinder, valve chest ports in the form of tubes which extend down through the cylinder ports and open into the cylinder intermediate of its ends, and which connect at their upper ends with ports leading to the adjacent ends of the valve chest, a hammer piston in the cylinder which opens the valve chest ports in alternate order, a slide valve in the valve chest for controlling the cylinder ports, an inlet port being formed in the valve chest between the cylinder ports and communicating with them, and a throttle valve connected with a pressure supply and with the said inlet port.

5. In a valve mechanism as specified, a casting comprising a cylinder and valve chest and having cylinder ports extending from the central part of the valve chest to the opposite ends of the cylinder, oblique valve chest ports extending in from opposite ends of the valve chest, and tubes communicating with said ports, and extending from the valve chest down through the cylinder ports and opening into the cylinder at predetermined distances from its ends, the upper ends of said tubes being closed, a hammer piston in the cylinder which opens the valve chest ports in alternate order, a slide valve in the valve chest, said chest being provided with an inlet port communicating with the cylinder ports, and with exhaust ports, said exhaust and cylinder ports being controlled by the slide valve, and a throttle valve connected with a pressure source and with the said inlet port.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN GEORGE LEYNER.

Witnesses:

ROBERT J. WALTMAN,
ELIZABETH F. MCKOON.