No. 844,437. PATENTED FEB. 19, 1907.

J. H. ALLEN & T. VICKERS.

FLUID PRESSURE ENGINE.

APPLICATION FILED JUNE 2, 1904.

3 SHEETS—SHEET 1.

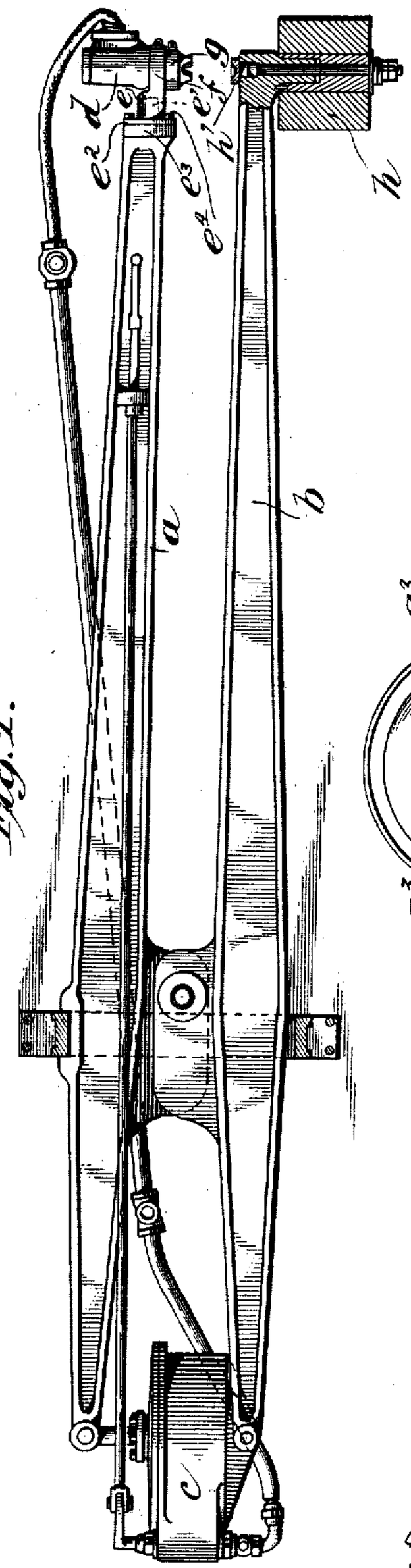

Fig. 1.

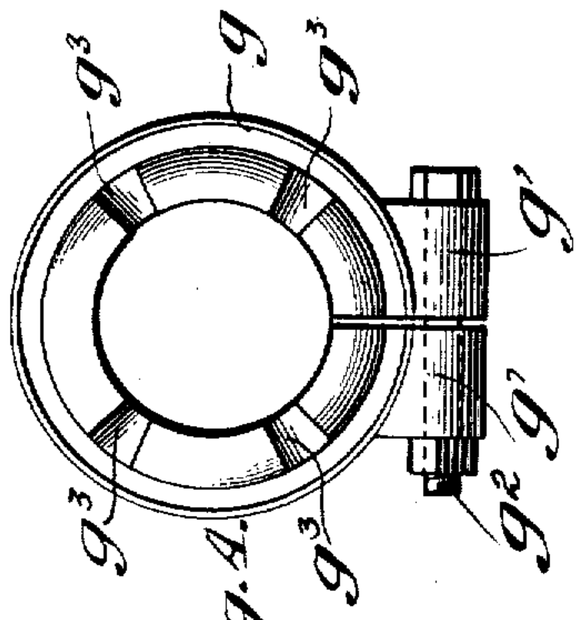

Fig. 4.

Witnesses
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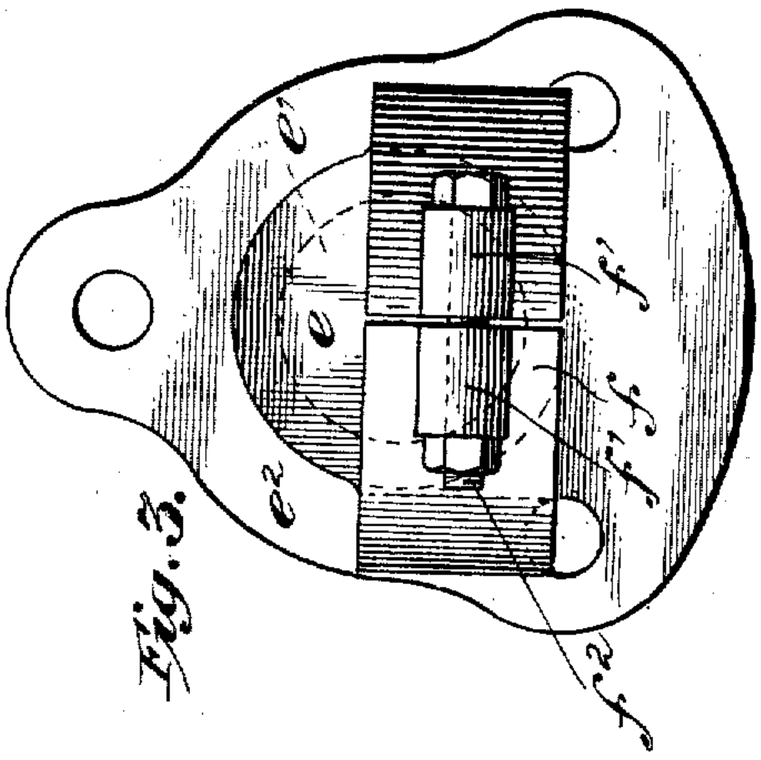

Fig. 3.

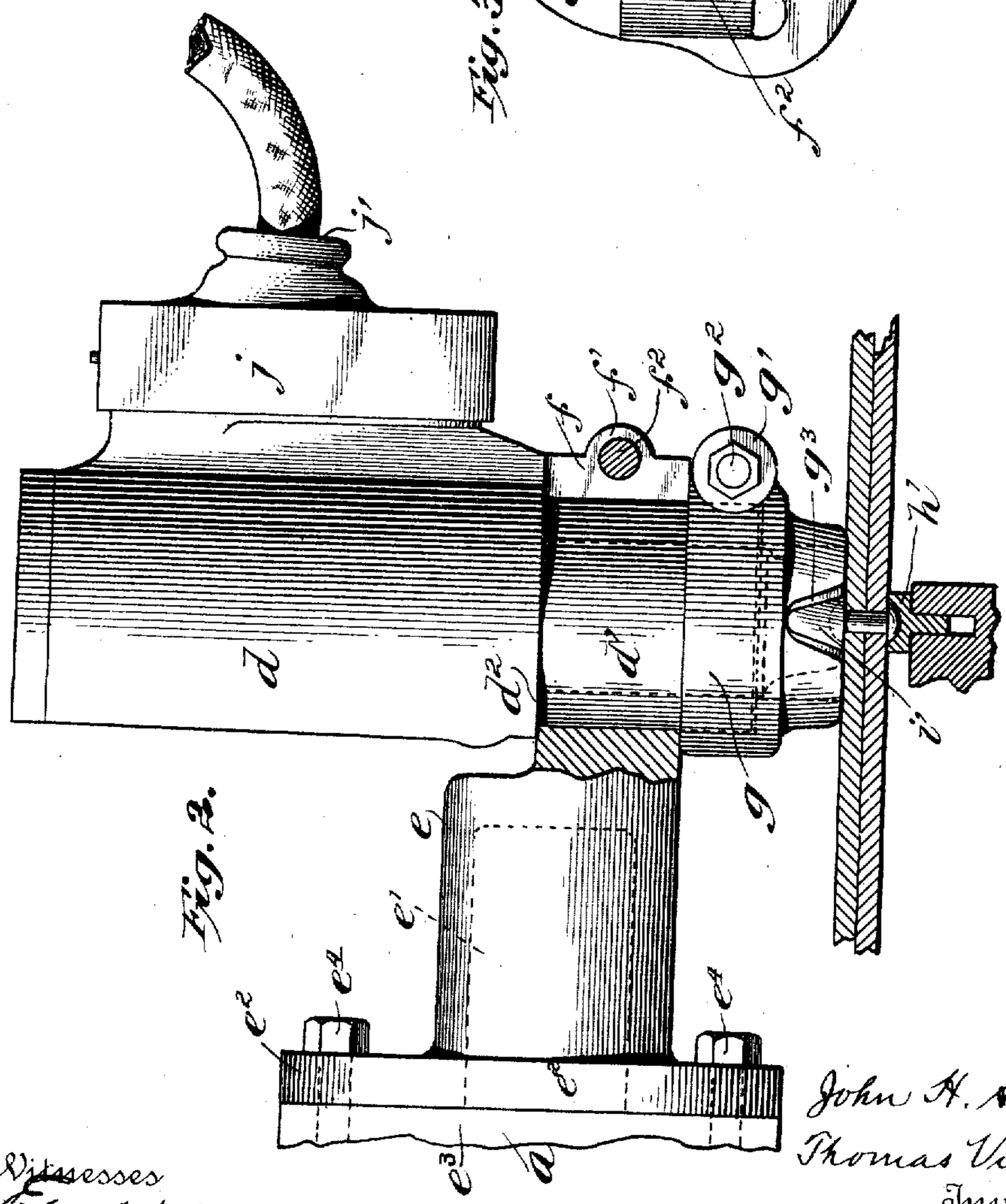

Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 7.

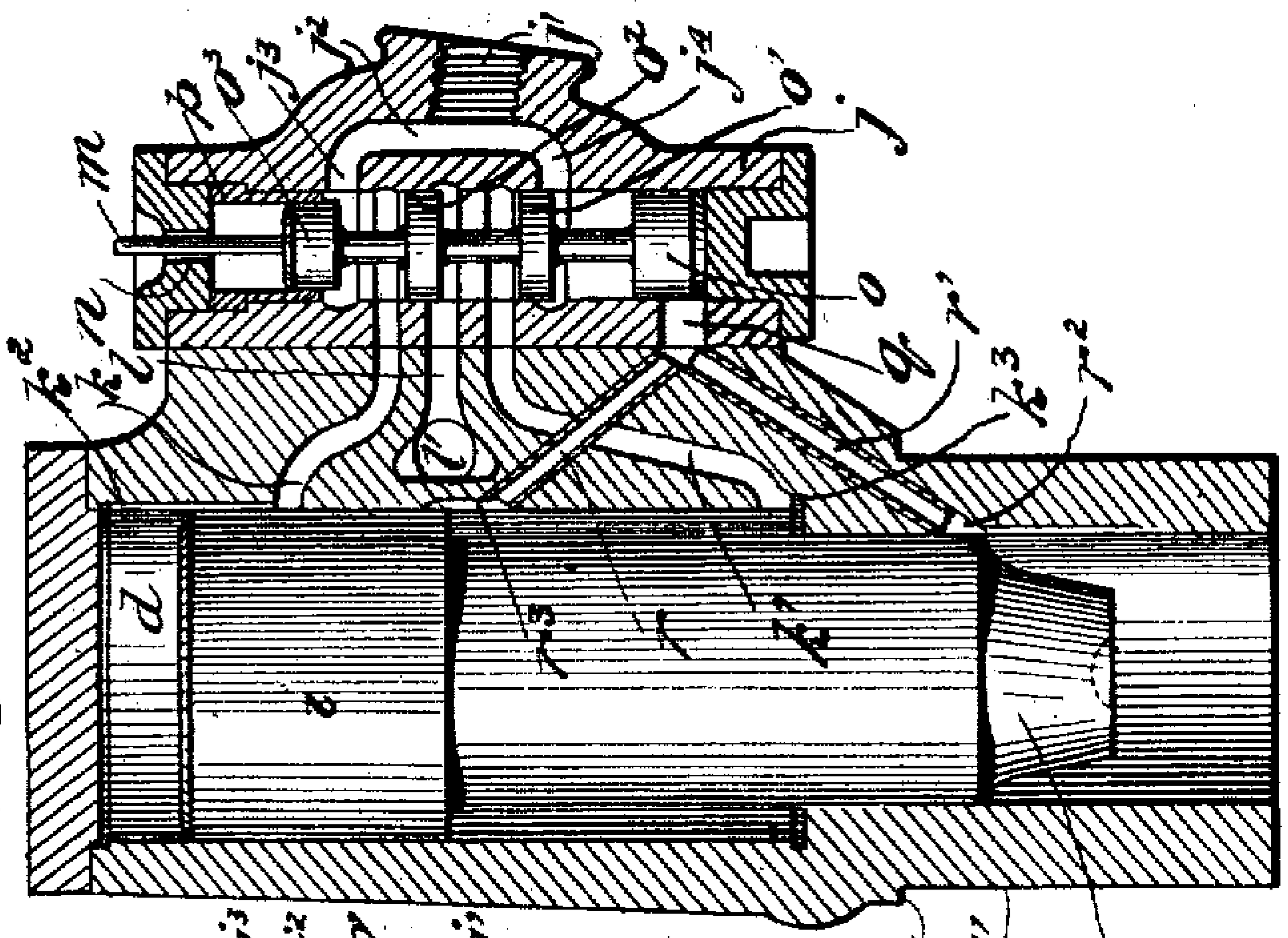


Fig. 6.

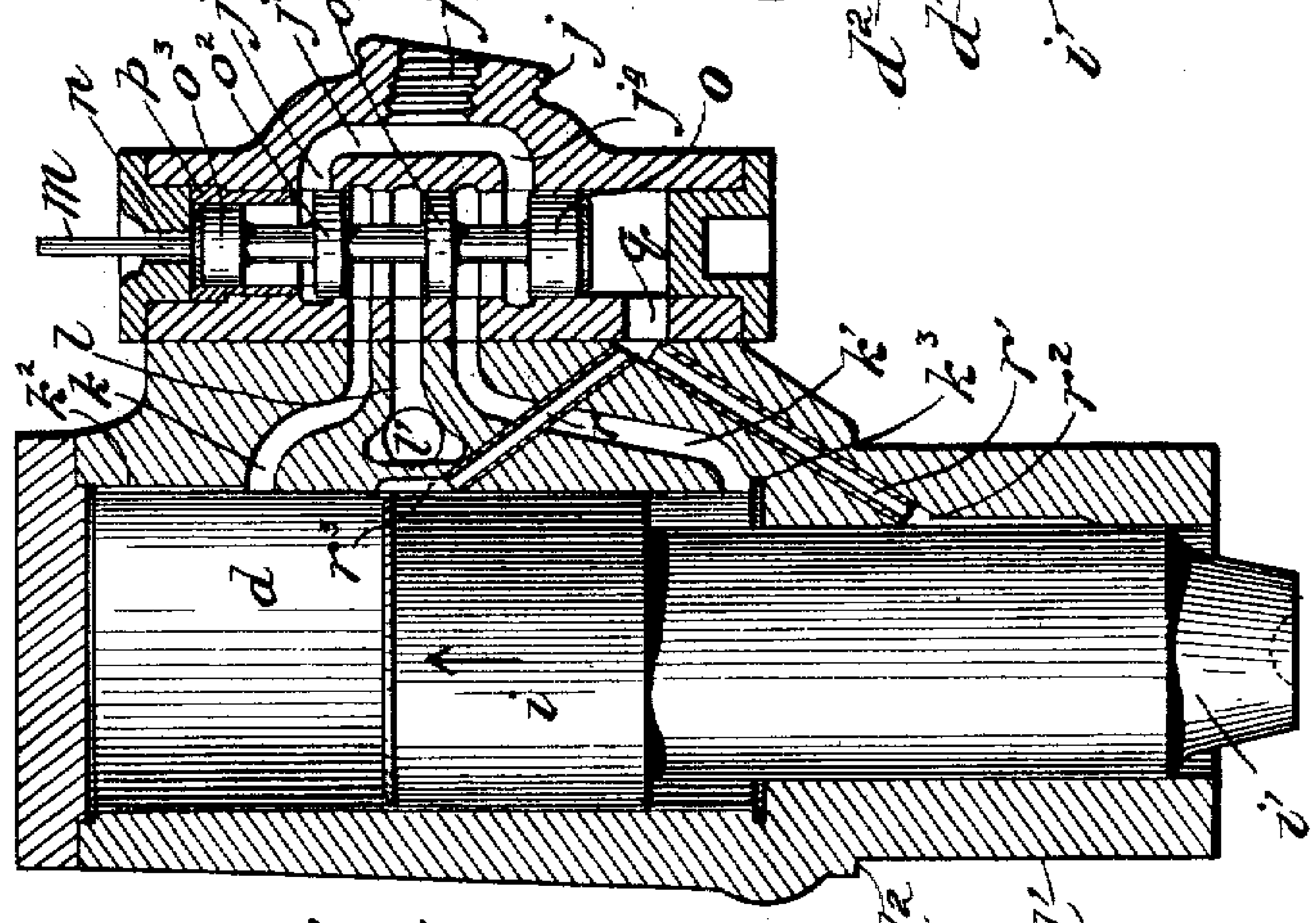
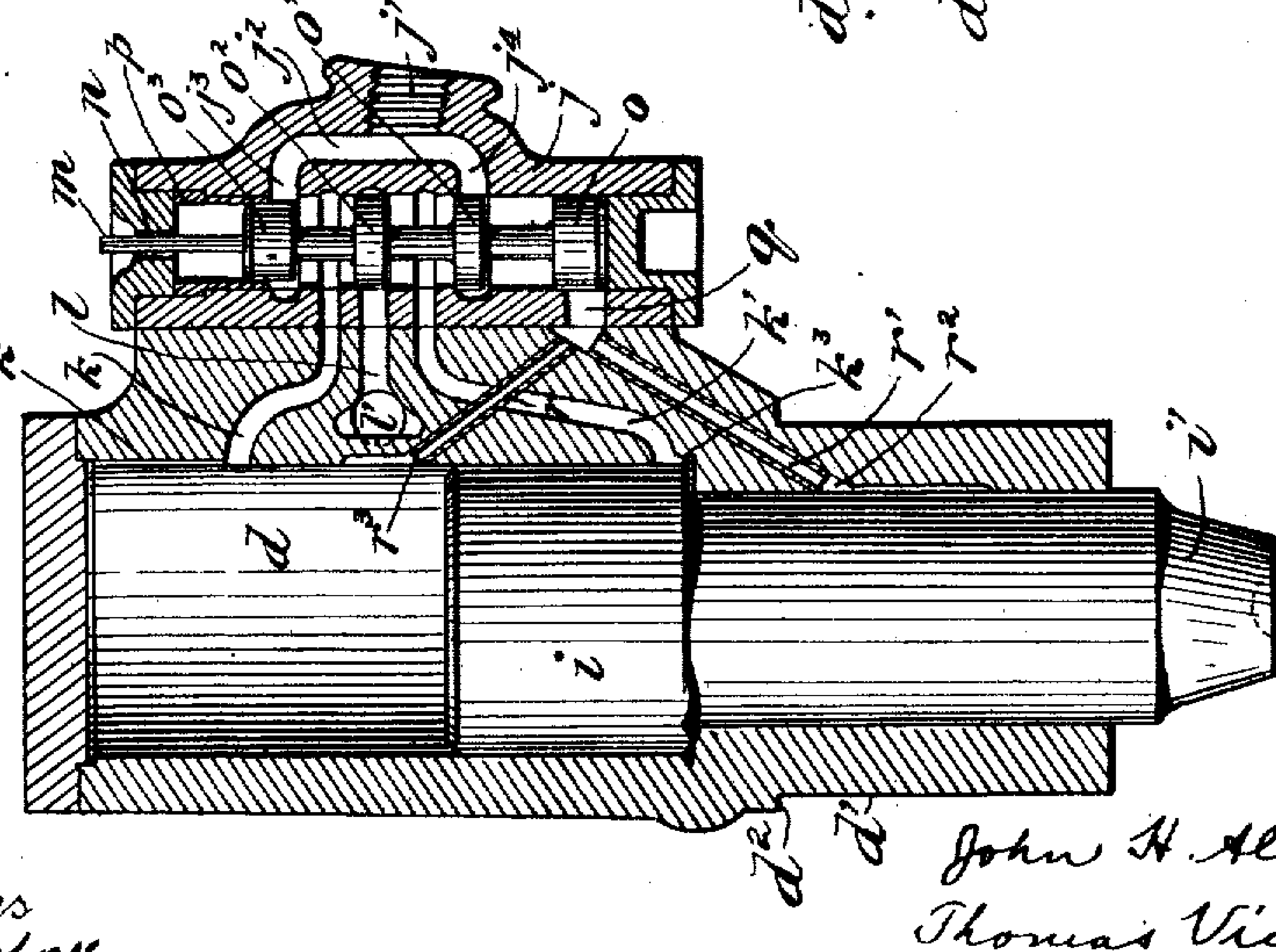


Fig. 5.



Witnesses
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UNITED STATES PATENT OFFICE.

JOHN H. ALLEN AND THOMAS VICKERS, OF NEW YORK, N. Y.

FLUID-PRESSURE ENGINE.

No. 844,437. Specification of Letters Patent. Patented Feb. 19, 1907.

Application filed June 2, 1904. Serial No. 210,780.

To all whom it may concern:

Be it known that we, JOHN H. ALLEN and THOMAS VICKERS, citizens of the United States, residing at the borough of Brooklyn, city of New York, county of Kings, State of New York, and the borough of the Bronx, city of New York, in the county of New York and State of New York, respectively, have invented certain new and useful Improvements in Fluid-Pressure Engines, of which the following is a specification, reference being had therein to the accompanying drawings, forming a part thereof.

This invention relates to fluid-pressure engines, and is particularly applicable to machines employing fluid-pressure-actuated hammers, such as riveting-machines; and the objects of the invention are to provide a reliable, simple, and economical machine of the described class in which the action of the valve controlling the reciprocation of the tool-operating piston is automatic and is controlled by fluid-pressure in both directions.

Further objects of the invention will appear from the following specification.

We will now describe the construction shown in the accompanying drawings and embodying our invention and will thereafter point out our invention in claims.

Figure 1 is a side elevation, partly in section, of a riveting-machine in connection with which the invention is particularly applicable. Fig. 2 is an enlarged detail side elevation of the fluid-pressure cylinder for operating the hammer and also shows the parts immediately in connection with the pressure-cylinder, all of these parts being shown at the completion of a riveting operation. Fig. 3 is a detail end elevation of the supporting-socket for the pressure-cylinder. Fig. 4 is a detail end elevation of the clamp-head at the plate-engaging end of the pressure-cylinder. Figs. 5, 6, and 7 are detail sectional views of the fluid-pressure cylinder, valve-chest, and valve, the parts being in three different positions.

Referring to Fig. 1, a riveting-machine is shown comprising a pair of tongs composed of members or levers *a b*, suitably pivoted together and suitably supported in any well-known or convenient manner. The short arms of the levers of the tongs are equipped with a fluid-pressure-actuating device, such as *c*, for opening and closing the long arms of the tongs. This actuating device and parts connected therewith are of the well-known construction of Allen riveting-machine.

The fluid-pressure cylinder *d* is supported on one of the long arms of the tongs *a b* by suitable means, (shown more in detail in Figs. 2 and 3,) the lever *a* having affixed to its outer end an end member *e*, which is provided with a bore to receive a stud *e'*, projecting outwardly from the lever *a* and entering the bore thereof. The end member *e* is provided with a base-flange e^2, which is placed against the flange e^3 at the end of the arm *e* and around its stud *e'*, these two flanges being firmly and rigidly secured together by means of fastening-bolts e^4. This means of attachment holds the end member and parts supported thereby firmly in position against detachment, while the stud *e'*, entering the end member, stiffens the latter and takes up the lateral strains. The end member *e* is provided with a split socket *f*, preferably circular in form, and the two portions formed by splitting the socket are provided with outwardly-extending ears *f'*, through which passes a clamping-bolt f^2. The two portions of the socket are of a springy nature, and the clamping-bolt f^2 clamps the same firmly upon the extension portion *d'* of the fluid-pressure cylinder *d*, which passes therethrough, and which, to correspond therewith, is of circular form. By loosening the bolt f^2 the pressure of the clamp on the cylinder is relieved and the cylinder may be turned on its axis and adjusted to any position and fixed in that position by retightening the bolt f^2. Between the extension *d'* and the main body *d* of the pressure-cylinder is located a shoulder d^2, which abuts against one side of the socket *f*, the extension *d'* being long enough to protrude a suitable distance beyond the opposite side of the socket. The protruding portion of the cylinder extension *d'* receives a clamp-head, such as *g*, which is shown in end elevation in Fig. 4, which clamp-head is also split at one side and is there provided with ears or lugs *g'*, through which passes a tightening-bolt g^2. The bolt g^2 binds the clamp-head *g* firmly upon the protruding end of the cylinder extension, and, in connection with the shoulder at the opposite side of the socket *f*, assists in retaining the fluid-pressure cylinder rigidly in position. The upper surface of the clamp-head *g* bears upon the under surface of the split socket *f*, and the bottom of the clamp-head *g* bears

upon the work which is to be riveted, whereby the clamp-head *g* receives all the thrust existing between the split socket and the work, thus relieving the fluid-pressure cylinder *d* of such thrust. In place of the clamp-head *g* it is evident that other suitable means may be provided. It is desirable to taper the outer end, or that end of the clamp-head *g* which is to bear directly upon the surface of one of the plates to be riveted, and to provide the same with sight-openings g^3, so that the riveting or other operation which takes place may be viewed. The lever *b* of the tongs of the riveting-machine is provided with an opposing weight *h* in a well-known manner, which opposes the blows or concussions produced by the hammer operated by the fluid in the fluid-pressure cylinder, and is adapted to receive interchangeable dies, such as *h'*, to hold the headed end of the rivet during the riveting operation.

The means for actuating the tool-operating piston *i*, as shown in Figs. 5, 6, and 7 in detail, will now be described. The piston is provided with a piston rod or shank *i'*, forming an extension or hammer end thereof. The valve for controlling the pressure-actuated movement of the piston *i* is automatic in its action, being acted upon by fluid-pressure in both directions of its movement. The form of the valve is of the differential type for the purpose of making use of differential pressures, which are in part controlled from the piston. The valve-chest *j* is provided at one side with a pressure-fluid inlet *j'*, which communicates with a branch passage j^2, one leg of which, j^3, extends to one side of the inlet *j'*, and the other leg j^4 to the opposite side. Between the legs j^3 j^4 and the branch passage j^2 there extend from the valve-chamber the fluid-pressure supply channels or passages *k k'*, which lead, respectively, to opposite ends of the fluid-pressure cylinder and at opposite ends of the piston or piston-head *i*. The supply-channel *k* extends to a longitudinal recess or groove k^3, located at that end of the fluid-pressure cylinder adjacent its extension. The supply-channel *k'* communicates with a small annular recess or groove k^3 in the opposite end of the fluid-pressure cylinder. Intermediate of the channels or passages *k k'* is an exhaust channel or passage *l*, leading to an exhaust-outlet *l'*. The valve which is guided in the valve chest or box comprises a valve-stem *m*, one end of which is extended beyond the valve-heads and protrudes through and is guided in an air-inlet *n* at one end of the valve-chest for manual operation of the valve in lubricating or at starting should it not be properly lubricated. Upon the valve-stem *m* are located and suitably disposed the valve-heads *o*, *o'*, o^2, and o^3, respectively, four in number, and the air-inlet opening *n* places the outer face of the valve-head o^3 in constant communication with the atmospheric air. The intermediate valve-heads *o'* and o^2, with their four surfaces, furnish the active valves for controlling the communication between the fluid-pressure supply and the passages or channels *k* and *k'*, on the one hand to supply fluid-pressure to the fluid-pressure cylinder and on the other hand to connect the said passages or channels with the exhaust. The head *o* constitutes a valve-shifting head, and fluid-pressure acts upon both faces thereof, as will appear hereinafter. The fourth valve-head o^3 is also a valve-shifting head, and fluid-pressure acts only upon the inner or lower surface thereof. It will be seen, therefore, that there are seven surfaces on these valve-heads which are acted upon by fluid-pressure. The pressure on four of the surfaces is balanced, as is evident—namely, the pressure on the adjacent faces of the heads *o* and *o'* and the pressure upon the adjacent faces of the heads *o'* and o^2. The pressure on these faces may hence be ignored in the understanding of the differential features of the invention, which reside mainly in connection with the heads *o* and o^3. The valve-head o^3 is of less diameter than either of the other three heads, which are of equal diameter, and it is guided in a smaller extension of the chamber of the valve-chest, which is preferably formed as by a bushing *p*, suitably secured in that end of the valve-chest adjacent the air-inlet *m*. The space of the valve-chamber which is between the outer or lower face of the valve-head *o* and the adjacent end wall of the said chamber is at intervals placed in connection alternately with the outer air and with the fluid-pressure cylinder *d*. The means of communication is an opening *q* in the adjacent wall of the valve-chamber, from which branch in opposite directions ducts *r* *r'*, respectively, the former leading to an opening or port r^3 in the inner wall of the cylinder *d* and the latter leading to an opening or port r^2 in the inner wall of the extension *d'* of the cylinder. The port r^3 is located intermediate of the cylinder extremities and the channels or passages *k k'*.

Having described the construction of the parts shown in the drawings, the operation of the form of valve-controlling means shown will now be described.

The piston and the valve are assumed to be at the outset and when the fluid-pressure is first let on in the lower position. (Shown in Fig. 5.) Compressed air or steam being now admitted in the well-known manner through the inlet-opening *j'* passes into the branch passages j^3 j^4 and into those portions of the chamber valve-chest which are located between the adjacent faces of the valve-heads *o o'* and o^2 o^3. It will be understood that the pressure on the equal adjacent faces of the heads *o o'* is balanced, whereas there is a differential pressure on the adjacent faces of

the heads o^2 o^3, tending to maintain the valve in lower position. In this position of the valve the pressure fluid will flow into the valve-chest by way of the passage j^3 and pass through the passage or channel k into the fluid-pressure cylinder and will pass, by way of duct r, from the fluid-pressure cylinder into the space at the lower or outer end of the valve-head o and will overcome the differential pressure which tends to hold the valve down and will reciprocate the valve into the upper position, (shown in Fig. 6,) thereby shutting off communication between the channel or passage k and the fluid-pressure inlet and establishing communication between the inlet and branch passage j^2 and the channel or passage k'. Fluid-pressure being thereby let in under the piston i or at that end adjoining its extension i' the piston will be raised. It will be observed that pressure fluid which has been admitted into the space and duct controlled by the duct r will be entrapped therein as soon as the outer end of the piston passes the port r^3. This pressure holds the valve in the upper position (indicated in Fig. 6) until it is to be reciprocated in the opposite direction. Now as the piston i moves upward its extension i' is caused to pass and open the port r^2, thereby permitting the fluid pressure stored within the ducts r r' and the space controlled thereby to escape into the surrounding air, thereby relieving the pressure on the lower or outer face of the valve-head o. This pressure being relieved, the valve is immediately reciprocated into the lower position (shown in Fig. 7) due to the effect of differential pressures on the adjacent faces of the valve-heads o^2 o^3. In point of fact it will be seen that at the moment the reverse reciprocation of the valve takes place the opposite ends of the valve are both in communication with atmospheric air. The reversal of the position of the valve cuts off the supply of fluid-pressure to the lower part of the cylinder, opens the lower part of the cylinder to the exhaust, and admits the fluid-pressure to the upper part of the cylinder, thereby producing the blow of the hammer upon the head of the rivet or the blow of whatever operating-tool may be attached to the piston. As soon as the outer end of the piston passes the duct r^3 fluid-pressure is admitted into the space at the outer end of the valve-head o and the position of the valve is reversed, as before described, and the repeated blows of the hammer or other operating-tool will be produced, together with accompanying controlling motions of the valve, the two working together to effectuate the desired results.

It is evident that certain changes and details are within the principles and scope of the invention and that certain parts may be used with others or to the exclusion of others, as may seem both desirable and according to the work in hand and the results to be produced.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. The combination of a fluid-pressure cylinder provided with an extension and a duct in the extension and open to the air, a piston working in the cylinder and provided with an extension part adapted to open and close the said duct, a valve-chest, a valve therein, means controlled by the valve for admitting fluid to either end of the cylinder, means controlled by the valve for exhaust and means controlled by the piston for admitting pressure fluid from the cylinder to one part of said valve-chest to shift the valve in one direction, the aforesaid extension-duct also communicating with the same part of the valve-chest to shift the valve in the opposite direction.

2. The combination of a fluid-pressure cylinder provided with an extension and a duct in the extension and open to the air, a piston working in the cylinder and provided with an extension part adapted to open and close the said duct, a valve-chest, a valve therein, means controlled by the valve for admitting fluid to either end of the cylinder, means controlled by the valve for exhaust and a duct controlled by the piston for admitting pressure fluid from the cylinder to one part of said valve-chest to shift the valve in one direction, the aforesaid extension-duct also communicating with the same part of the valve-chest to shift the valve in the opposite direction.

3. The combination of a fluid-pressure cylinder provided with an extension-guide having a duct therein open to the air, a piston working in the cylinder and provided with an extension-shank adapted to open and close the said duct, a valve-chest, a valve therein, means controlled by the valve for admitting fluid to either end of the cylinder, means controlled by the valve for exhaust and means controlled by the piston for admitting pressure fluid from the cylinder to one part of said valve-chest to shift the valve in one direction, the aforesaid extension-duct also communicating with the same part of the valve-chest to shift the valve in the opposite direction.

4. The combination of a fluid-pressure cylinder provided with an extension and a duct in the extension and open to the air, a piston working in the cylinder and provided with an extension part adapted to open and close the said duct, a valve-chest, a differential valve therein, means controlled by the valve for admitting fluid to either end of the cylinder, means controlled by the valve for exhaust and means controlled by the piston for admitting pressure fluid from the cylinder to

one part of said valve-chest to shift the valve in one direction, the aforesaid extension-duct also communicating with the same part of the valve-chest to shift the valve in the opposite direction.

5. The combination of a fluid-pressure cylinder provided with an extension and a valve-controlling exhaust-duct in the extension and communicating with the air, a piston within the cylinder, a piston extension connected with the piston and reciprocating in the cylinder extension and controlling the exhaust-duct therein, a valve-chest having a pressure-fluid inlet, a valve reciprocating in said chest and comprising a valve-stem and four valve-heads one of which is of less diameter than the others and is exposed on one given side to constant communication with the outer air and another of which is exposed on an opposing side to communication with the exhaust-duct, and means for establishing communication between such opposing side of the last-mentioned valve-head and the fluid-pressure cylinder while the valve-controlling exhaust-duct is closed by the piston extension.

In testimony whereof we have affixed our signatures in presence of two witnesses.

JOHN H. ALLEN.
THOMAS VICKERS.

Witnesses:
ALBERT V. T. DAY,
HENRY BARNES.