No. 734,282. PATENTED JULY 21, 1903.

J. PENGILLY.

FLUID PRESSURE ENGINE.

APPLICATION FILED OCT. 2, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

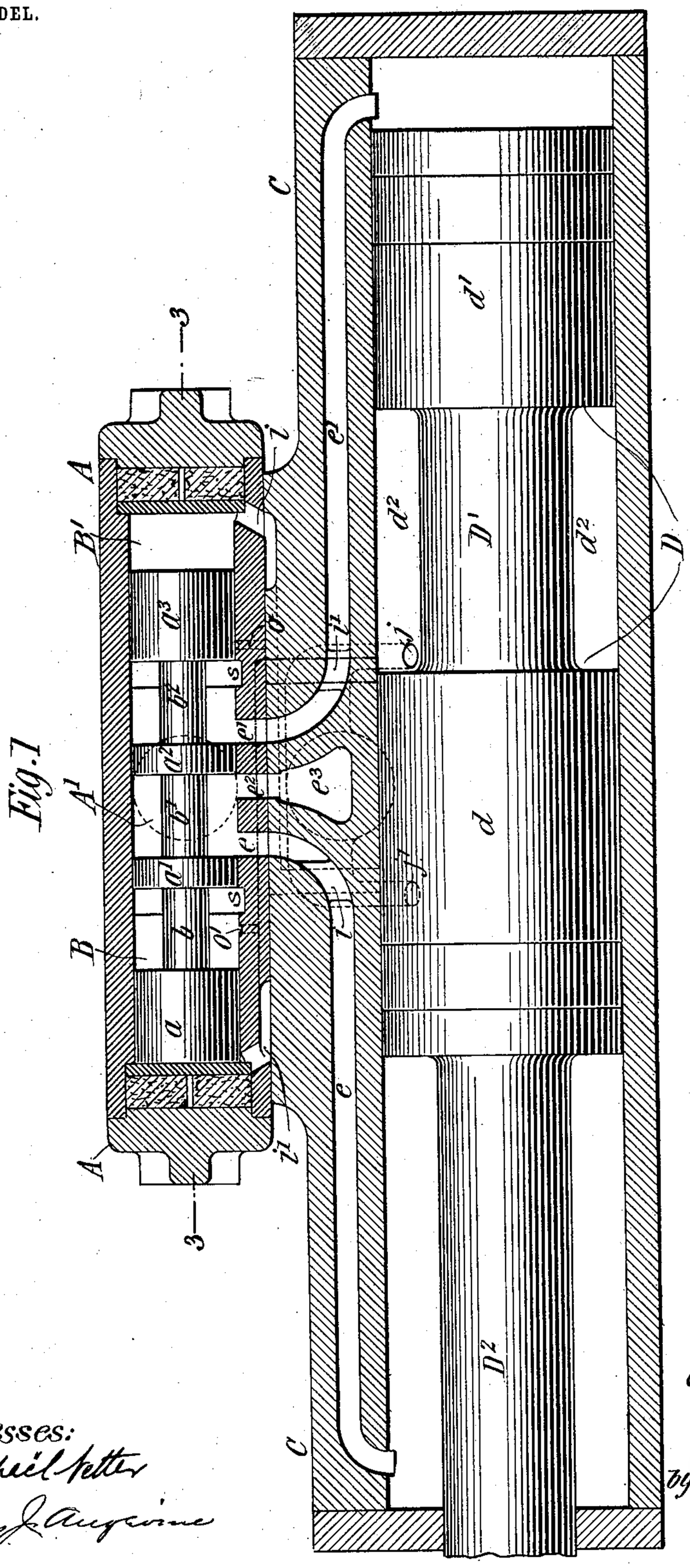


Fig. 1

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*Fig. 3*

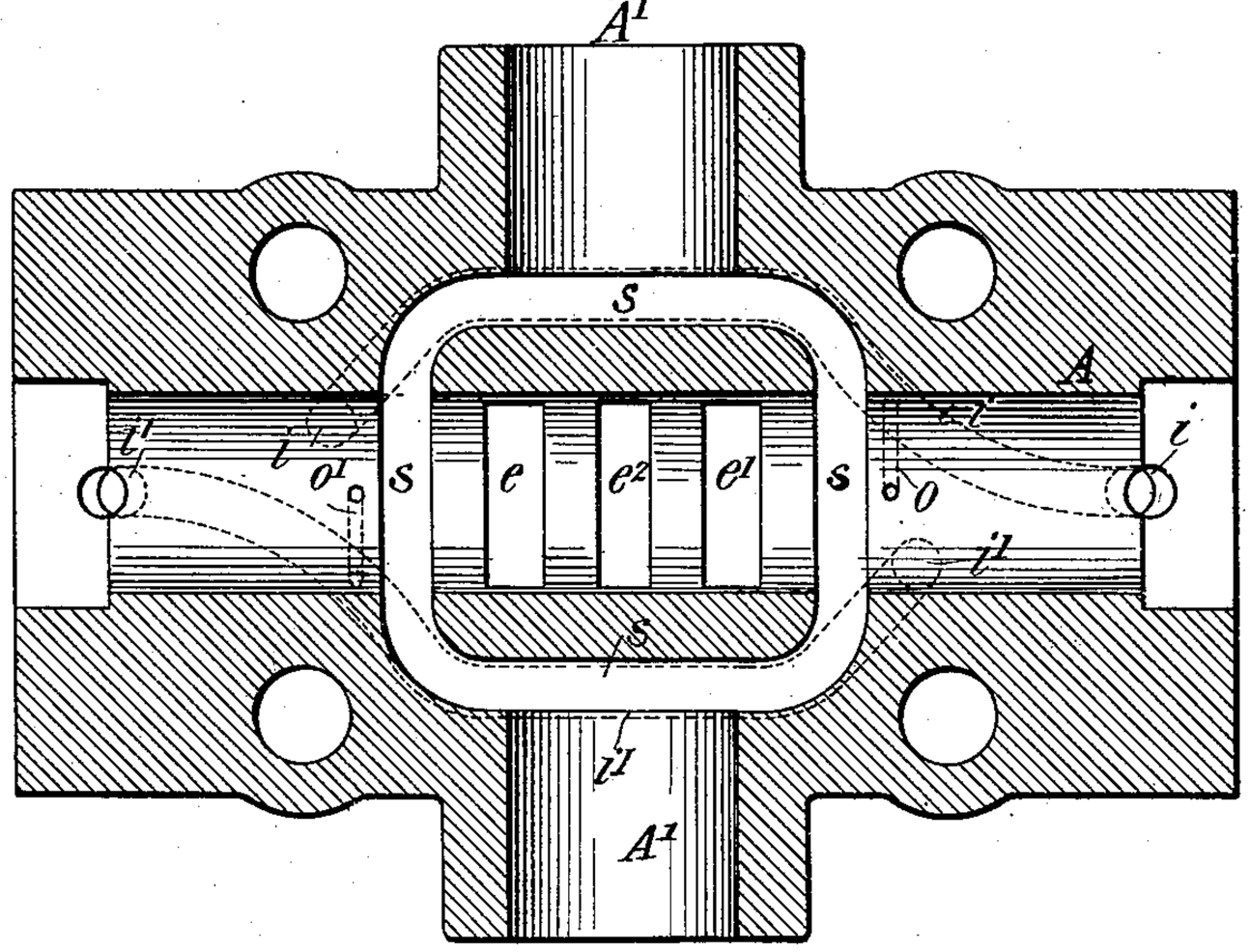



*Fig. 2*

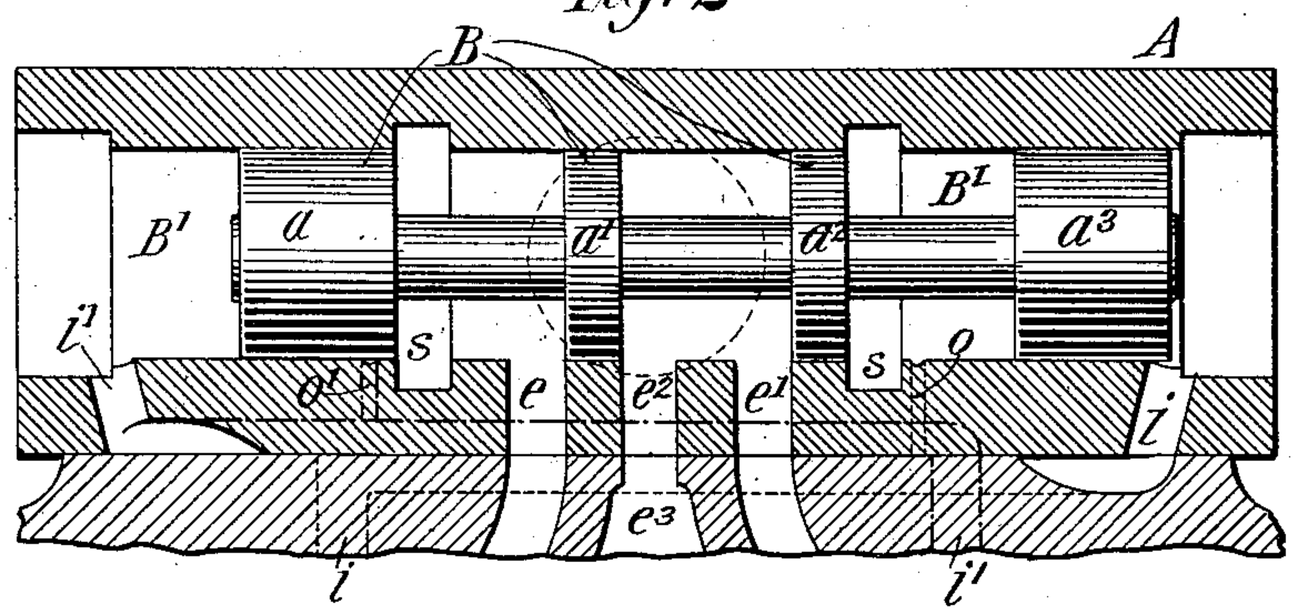
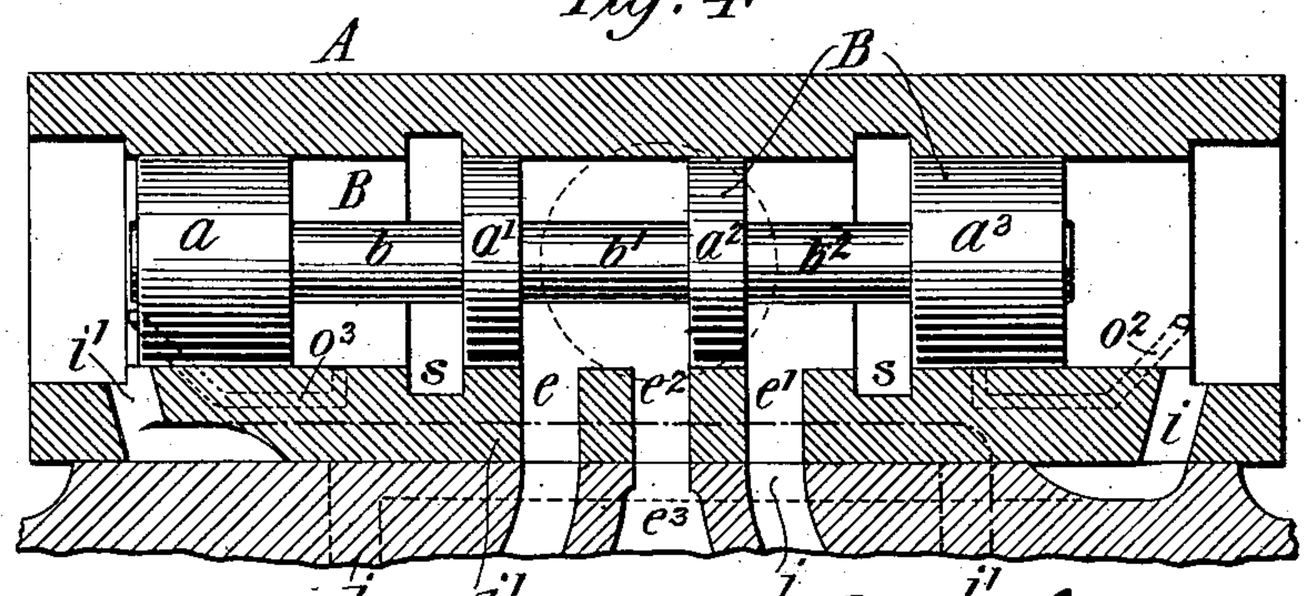



*Fig. 4*

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No. 734,282. Patented July 21, 1903.

# UNITED STATES PATENT OFFICE.

JOHN PENGILLY, OF DOVER, NEW JERSEY, ASSIGNOR TO McKIERNAN DRILL COMPANY, OF DOVER, NEW JERSEY, A CORPORATION OF NEW JERSEY.

## FLUID-PRESSURE ENGINE.

SPECIFICATION forming part of Letters Patent No. 734,282, dated July 21, 1903.

Application filed October 2, 1902. Serial No. 125,678. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN PENGILLY, a citizen of the United States, residing at Dover, in the county of Morris, State of New Jersey, have invented certain new and useful Improvements in Fluid-Pressure Engines, of which the following is a full, clear, and exact description, reference being had to the drawings accompanying and forming a part of the same.

This invention relates to improvements in fluid-pressure engines of the general class or type of which those set forth in Patents Nos. 202,060 and 497,043 are examples and wherein a valve of the piston type controls the movement of the piston in its cylinder, and such piston controls the movements of such valve by means of ports and passages between the valve-chest and cylinder. The valve in this class of engines is actuated by fluid-pressure of any desired kind accumulating at one end thereof and the discharge or exhaust of similar pressure at the other end which had previously accumulated at that point and performed its work.

The object of my invention is to provide combinations of ports and passages with a valve-chest and cylinder of a fluid-pressure engine, whereby the action of the valve may be improved.

My invention consists in certain new and useful combinations of ports and passages between the valve-chest and cylinder, all of which will be hereinafter fully described, and particularly pointed out in the claims, which form a part of this specification.

Like letters of reference wherever they occur indicate corresponding parts in all of the figures.

Figure 1 shows in longitudinal section and in a diagrammatic way a fluid-pressure engine of the above-named general type having my invention applied thereto, with the piston and piston-valve in position they may assume and are so shown for explanatory purposes. Fig. 2 shows the valve-chest in longitudinal section, as in Fig. 1, with the piston-valve in its reverse position from that seen in Fig. 1. Fig. 3 shows the portion of the cylinder of the engine which receives the valve-chest and the chest itself in section on line 3 3 of Fig. 1 and with the piston-valve removed to show the ports and passages as they may appear in the portions thus shown. Fig. 4 shows a modification in the arrangement of the passages leading out from the interior of the valve-chamber to the ends of the same.

In Fig. 1, A represents the valve-chest; B, the piston-valve working in the valve-chamber B′ of the chest, which valve, as shown, has four heads or piston portions $a$ $a'$ $a^2$ $a^3$, connected together by stems or portions $b$, $b'$, and $b^2$, the heads or end portions of the valve $a$ and $a^3$ being preferably of considerably greater length as compared to their diameter than is the case with the heads or portions $a'$ and $a^2$. The valve B has an endwise play or movement back and forth in its chamber B′, as is common in this class of engines, and the ends of the valve-chamber become cylinders or portions of a common cylinder in which the heads $a$ and $a^3$ work back and forth by the admission and exhaust of fluid-pressure to such cylinders or portions of a cylinder to act upon the heads or piston portions $a$ and $a^3$ in a well-known manner. C represents the cylinder; D, the piston having heads $d$ and $d'$ and connecting portion D′ and piston-rod $D^2$. Between the piston-heads $d$ and $d'$ an annular space $d^2$ is formed by the entire wall of the cylinder and the exterior surface of D′ and inner end portions of heads $a$ and $a^3$. The valve-chest is provided with a suitable fluid-pressure inlet A′, (indicated by a dotted circle nearly midway of the valve-chamber B′ in Fig. 1,) which is connected with any suitable supply—such as a steam, compressed-air, or other desired form of plant adapted to supply steam, compressed air, or other desired form of fluid-pressure motive agent to the valve-chamber of the engine.

The engine may be of any desired form of the foregoing general type and may be used for any desired purpose, such as for drilling rock or similar work.

As shown, the valve-chamber B′, near its middle portion, is provided with a port or passage $e$, leading therefrom into and along the cylinder C to the left-hand end, (seen in Fig. 1,) where such passage enters that end of the cylinder. A similar port or passage $e'$

is provided, leading from near the middle of the valve-chamber to the right-hand end of cylinder C. A port or passage $e^2$, as shown, is formed in the valve-chamber between the passages or ports $e$ and $e'$, which leads to an exhaust-chamber $e^3$, which opens to the atmosphere by an opening indicated by a dotted circle seen back of exhaust-chamber $e^3$ in Fig. 1. These ports or passages $e$, $e'$, and $e^2$ are controlled by heads $a'$ and $a^2$ of valve B, alternately opening port $e'$ to the pressure-supply portion of the valve-chamber, as seen in Fig. 1, and then cutting such port off from such portion by the endwise movement of the valve B, carrying the heads with it. When the valve has moved into the position seen in Fig. 1 and opened port $e'$ to the pressure-supply, it has by its movement carried head $a'$ to the left, as shown, and cut off port $e$ from the same supply and opened such port $e$ to port $e^2$ through the space between the heads $a'$ and $a^2$, which space is cut off from the supply by heads $a'$ and $a^2$, working in valve-chamber B′ and practically fitting therein and forming a space practically isolated from the pressure-supply of the valve-chamber. On the reverse movement of valve B the head $a'$ is moved over port E and on the other side of it, so that such head rests in the chamber between ports $e$ and $e^2$, as seen in Fig. 2, and cutting port $e$ off from port $e^2$ and opening it to the pressure-supply portion of the chamber, as is well known. The movement of the heads $a'$ and $a^2$ relatively to the ports or passages $e$, $e'$, and $e^2$ alternately admits air or steam to one end of piston D and opens the other end to the atmosphere, and piston D is moved back and forth in its cylinder accordingly as valve B controls passages or ports $e$, $e'$, and $e^2$.

As shown, a port $i$ is formed in the right-hand end of valve-chamber B′ and leads into the cylinder and enters its interior to the left of the exhaust-chamber $e^3$. A similar port or passage $i'$ is formed at the left-hand end of the valve-chamber and leads into the cylinder at the right of exhaust-chamber $e^3$. Also, as shown, these ports or passages $i$ and $i'$ enter that portion of the cylinder C alternately occupied more or less by the heads $d$ and $d'$ of piston D, so as to be alternately opened and closed to the annular space $d^2$, which is in communication with exhaust-chamber $e^3$ by two openings $j$ and $j'$ between such chamber and the interior of cylinder C, also as before shown.

The foregoing arrangement of parts and passages or ports is shown as a convenient one, and any arrangement may be used that is desired so long as the general character or mode of operation of the engine is not materially changed from that of the examples heretofore mentioned.

In engines of this class fluid-pressure has been admitted to the ends of the valve-chamber by leakage past the heads of the valve or by equivalent means, provision being made for this either by somewhat loosely fitting the heads in the valve-chamber or in some other manner, and the admission was practically taking place to each end portion of the valve-chamber at the same time or to passages leading thereto, from one of which the fluid-pressure could readily escape, while from the other it could not until permitted by the movement of the piston in the cylinder, which movement shut off the escape or exhaust of fluid-pressure from that end of the valve-chamber from which it was previously free to escape.

The fluid-supply inlet A′ to the valve-chamber B′ connects with a channel $s$, which branches and extends crosswise of the valve-chamber on opposite sides of the ports or passages $e$, $e'$, and $e^2$, as indicated by full lines in Fig. 3, two inlets A′ being there shown, only one of which is intended to be in use at a time, the other being plugged up, as is customary many times with engines of this class, that inlet of the two desired being used. As shown in Fig. 3, these branches of channel $s$ divide the valve-chamber B′ into three portions—one at the right-hand end of Fig. 3, in which head $a^3$ of valve B works back and forth; another at the left end of the chamber, in which head $a$ of valve works, and a middle portion, in which ports or passages $e$, $e'$, and $e^2$ open and in which heads $a'$ and $a^2$ of the valve work in controlling such ports or passages. In the right-hand end portion of chamber B′ and adjacent to the channel $s$, leading to the supply-inlet, a port or passage $o$ is formed and preferably leads from this portion into the exhaust-passage, $i$ which leads from the outer end of such portion to the midway portion of the cylinder C, as before explained. As shown in Fig. 1, this port or passage $o$ is closed or cut off from the fluid-pressure supply through channel $s$, by the head $a^3$, by valve B occupying that portion of the valve-chamber into which port or passage $o$ opens. In the left-hand portion a similar port or passage $o'$ is formed, which preferably leads into exhaust passage or port $i'$, which port $o'$ is similarly located relatively to the supply inlet and channel $s$ toward that end of the valve-chamber as is port or passage $o$ at the opposite end of such channel. As shown in Fig. 1, port or passage $o'$ is open to channel $s$ by reason of head $a$ of valve B being near the extreme left of the chamber and that portion into which port $o'$ opens is unoccupied by such head.

With the parts in the positions seen in Fig. 1 the valve B is supposed to have just moved to the left to the extent seen and to have opened port of passage $e$ to exhaust-port $e^2$ for the exhaust of the pressure at the left-hand end of the piston D to the atmosphere and to have opened port or passage $e'$ to the supply portion of the valve-chamber for the admission of pressure to the right-hand end of piston D to move it to the left, which piston is shown at or near the end of its stroke to the right and ready to begin its movement to the left. Exhaust port or passage $i'$ is

shown as in open communication with the left end of the valve-chamber and with the atmosphere through annular space $d^2$, opening $j$, and exhaust-chamber $e^3$. As port or passage $o'$ enters port or passage $i'$, whatever fluid-pressure, as air or steam, which passes through port $o'$ is free to escape to the atmosphere so long as passage $i'$ remains open, as just described, and there is no substantial accumulation of pressure in the left-hand portion of the valve-chamber behind head $a$ or within port or passage $i'$. Port or passage $i'$ remains open to the atmosphere until piston-head $d'$ has moved to the left sufficiently to cover opening $j$ from the interior of the cylinder C to exhaust-chamber $e^3$, when it is closed and remains closed until the return movement of piston D opens it to the annular space $d^2$ between piston-heads $d$ and $d'$. At this time passage $i'$ is suddenly opened to the atmosphere, and whatever air or steam that had been admitted to passage $i'$ and at the left of head $a$ of valve B is suddenly exhausted therefrom, permitting the pressure at the opposite end of the valve B to move it to the left, as seen in Fig. 1, from the position where it is seen in Fig. 2. On the movement of the piston-head $d$ to the left it passes beyond the opening $j'$ from the cylinder to the exhaust-chamber $e^3$, and annular space $d^2$ is brought into communication with exhaust-passage $i$, leading from the right-hand end of the valve-chamber to the cylinder, when whatever air or steam is within that end of the chamber and in passage $i$ is suddenly exhausted to the open air and permitting the air or steam admitted to port or passage $i'$ and the left-hand end of the valve-chamber through port or passage $o'$ to expand and move the valve from the position seen in Fig. 1 to that seen in Fig. 2, at the same time uncovering port or passage $o$ from the right-hand portion of the valve-chamber to port or passage $i$, and thence to the open air through annular space $d^2$, opening $j'$, and exhaust-chamber $e^3$. This causes valve B to move into the position seen in Fig. 2, opening port $e'$ to port $e^2$ and the exhaust-chamber $e^3$, and also opening port $e$ to the supply portion of the valve-chamber, permitting the steam or air which forced the piston to the left to escape to the open air and also admitting steam or air to the left-hand end of the piston to return it to the position seen in Fig. 1. In this movement exhaust port or passage $i$ is closed, leaving port or passage $o$ open thereto and to the right-hand end of the valve-chamber for the admission of steam or air thereto to move valve B to the left and exhaust port or passage $i'$ is opened and port or passage $o'$ is closed.

Ports or passages $o$ and $o'$ are conveniently arranged relatively to exhaust-passages $i$ and $i'$, the valve-chamber, and valve-heads $a$ and $a^3$ as here shown; but they may be differently arranged, if desired, so long as the mode of operation is not materially changed. For instance, an arrangement similar to that shown in Fig. 4 may be adopted, if desired, this simply indicating one change among those which may be made, if desired.

In Fig. 4 the parts are similar to those seen in preceding figures, but the arrangement of ports or passages $o^2$ and $o^3$ relatively to the other ports, passages, and parts is somewhat changed. The valve B is in the same position in Fig. 4 as in Fig. 1 and it is movable from one position to the other in the same way notwithstanding the change in arrangement just referred to. The port or passage $o^2$, which corresponds in substance to port or passage $o$ of the construction seen in preceding figures, leads from the right-hand portion of valve-chamber B, at a point adjacent to channel $s$ near that portion of the chamber, down and outside thereof until near the right-hand end, where it opens into the chamber between its end wall and head $a^3$, as indicated at the right of Fig. 4. The port or passage $o^3$, corresponding in substance to port or passage $o'$ of preceding figures, leads from the left-hand portion of chamber B, as indicated in Fig. 4, to a point between the end wall of that portion and head $a$. When valve B is in the position shown in Fig. 4, head $a^3$ closes port or passage $o^2$, the channel $s$, and air or steam is cut off from entering passage $o^2$ and between head $a^3$ and the right end wall of the chamber and thence through exhaust-passage $i$ until such head has moved to the right and uncovered port or passage $o^2$. When valve B is in the position shown in Fig. 4, port or passage $o^3$ is open to the valve-chamber and channel $s$ and air or steam is free to enter port or passage $o^3$ and flow from thence into the chamber between head $a$ of valve B and the left end wall of such chamber and from thence into exhaust port or passage $i'$, as in the case of the construction and arrangement seen in preceding figures. In Fig. 4 air or steam is first admitted to the spaces between the end walls of valve-chamber B′ and the heads $a$ and $a^3$ and thence into the exhaust-passages, while in Figs. 1 and 3, inclusive, steam or air is first admitted to the exhaust-passages and thence to the spaces between the end walls of the valve-chamber and the heads $a$ and $a^3$. It is simply a difference in the path of admission of air or steam into such spaces for the purpose of actuating the valve B and not a material difference in the work done or in the mode of operation of the parts in doing such work.

It is to be observed that the passages $o$, $o'$, $o^2$, and $o^3$, which lead out of the interior of the valve-chest, communicate with the opposite ends of such chest, and by reason of this fluid-pressure may pass through such passages or ports, enter and accumulate in such opposite ends alternately as the exhaust-passages leading from such ends of the valve-chest and communicating with the cylinder are closed by the movements of the piston, as before explained; also, that when such

exhaust-passages are not closed by the piston whatever fluid-pressure that passes out and through such passages $o$, $o'$, $o^2$, and $o^3$ is free to pass or exhaust to the open air.

It will be manifest to those skilled in the art to which this invention pertains that other changes in arrangement may be made without departing from the principle of the invention, and therefore I do not wish to confine myself to the specific forms and arrangements herein set forth and wish to include such forms and arrangements as may be within the spirit of my invention.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a fluid-pressure engine the combination, substantially as set forth, of a cylinder, a piston therefor, a valve-chest, a piston-valve therefor, exhaust-passages leading from near the ends of the valve-chest and communicating with the cylinder which are controlled by the movements of the piston in the cylinder, passages leading out from the interior of the valve-chamber and communicating with the opposite ends thereof, the ports of which are alternately opened and closed by the movements of the valve in the chamber.

2. In a fluid-pressure engine the combination, substantially as set forth of a cylinder, a piston therefor, a valve-chest, a piston-valve therefor, a supply-passage leading into the valve-chamber of the chest, exhaust-passages leading from near the ends of the valve-chamber and communicating with the cylinder which are controlled by the movements of the piston in the cylinder, and passages leading out from the interior of the valve-chamber and communicating with the opposite ends thereof, the ports of which are alternately closed from and opened to the supply-passage by the movement of the valve in the chamber.

3. In a fluid-pressure engine the combination, substantially as set forth, of a cylinder, a piston therefor, a valve-chest, a piston-valve therefor provided with four heads, a supply-passage leading around and to opposite sides of the two middle heads in the valve-chamber, exhaust-passages leading from near the ends of the valve-chest and communicating with the cylinder which are controlled by the movements of the piston in the cylinder, and passages leading out from the interior of the valve-chamber adjacent to the supply-passage and communicating with the opposite ends thereof, which are alternately closed from and opened to such supply-passage by the movements of the valve in the chamber.

4. In a fluid-pressure engine the combination, substantially as set forth, of a cylinder, a piston therefor, a valve-chest, a piston-valve therefor provided with four heads, a supply-passage leading into the spaces between the two middle and their adjacent end heads of the piston-valve, exhaust-passages leading from near the ends of the valve-chest and communicating with the cylinder, which are controlled by the movements of the piston in the cylinder, and passages leading out from the interior of the valve-chamber adjacent to the supply-passage and communicating with the opposite ends thereof, which are alternately opened and closed by the movements of the end heads of the valve in the chamber.

5. In a fluid-pressure engine the combination substantially as set forth of a cylinder, a piston therefor, a valve-chest, a piston-valve therefor, a supply-passage leading into the valve-chamber of the chest, exhaust-passages leading from near the ends of the valve-chamber and communicating with the cylinder which are controlled by the movements of the piston in the cylinder, and passages leading out from the interior of the valve-chamber and communicating with the opposite ends thereof, each of which is open to the supply-passage and its end of the valve-chamber when the valve has moved some distance toward such end and is closed therefrom on the return movement of such valve.

6. In a fluid-pressure engine the combination, substantially as set forth, of a cylinder, a piston therefor, a valve-chest, a piston-valve therefor, exhaust-passages leading from near the ends of the valve-chamber to the cylinder which are controlled by the movements of the piston in the cylinder and passages leading out from the interior of the valve-chamber into the exhaust-passages respectively which are alternately opened and closed by the movements of the piston-valve in its chamber.

7. In a fluid-pressure engine the combination, substantially as set forth of a cylinder, a piston therefor, a valve-chest, a piston-valve therefor provided with end heads exhaust-passages leading from near the ends of the valve-chamber to the cylinder which are controlled by the movements of the piston in the cylinder and passages leading out from the interior of the valve-chamber into the exhaust-passages, one passage for each exhaust-passage and adjacent to that end of the valve-chamber into which such exhaust-passage opens and in position to be closed by the movement of the head of the valve at that end of the valve-chest as such valve moves toward the opposite end of the chest.

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