J. C. PORTER.

FLUID PRESSURE ENGINE.

APPLICATION FILED SEPT. 12, 1913.

1,187,091.

Patented June 13, 1916.

Fig. 1.

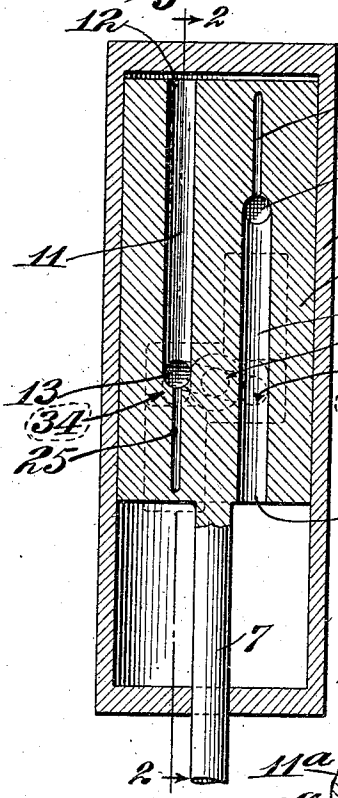


Fig. 2.

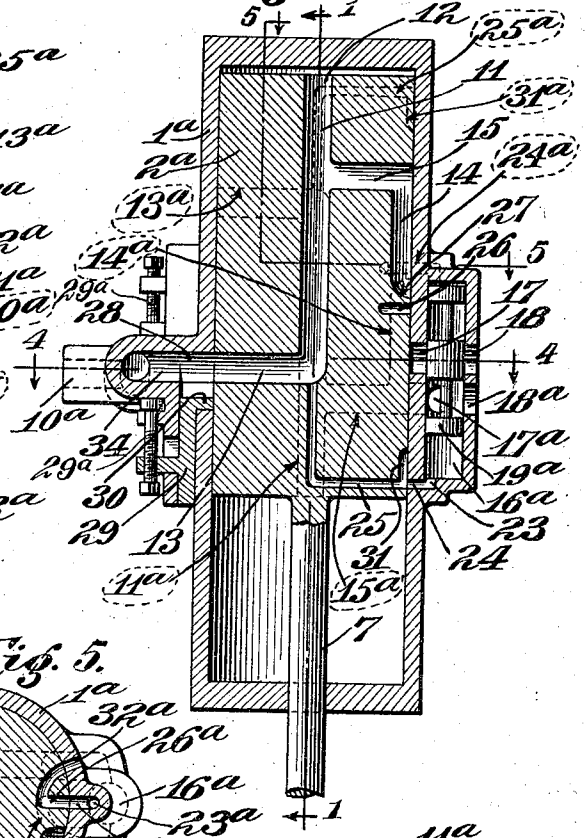


Fig. 5.

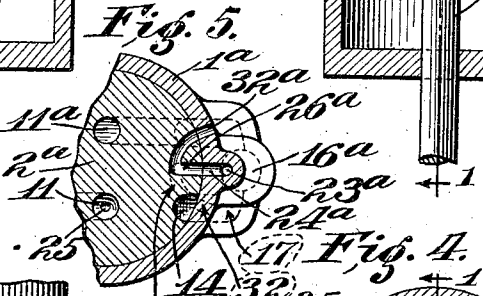


Fig. 3.

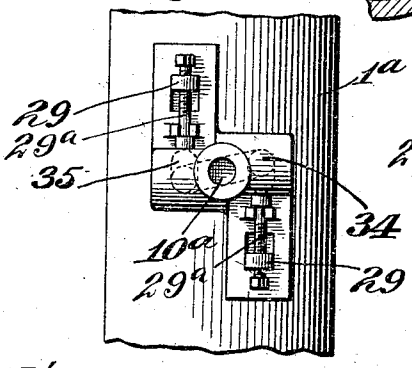
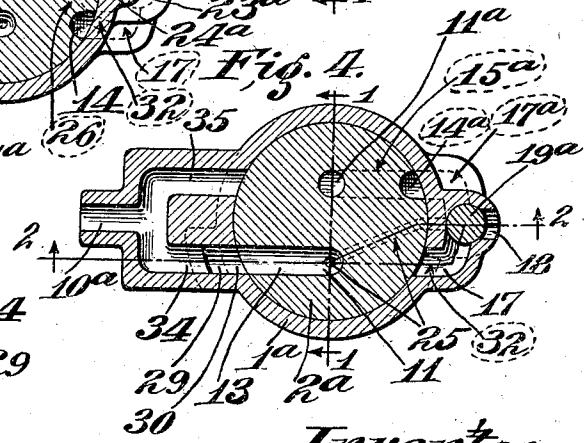


Fig. 4.



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FLUID-PRESSURE ENGINE.

1,187,091. Specification of Letters Patent. Patented June 13, 1916.

Application filed September 12, 1913. Serial No. 789,434.

To all whom it may concern:

Be it known that I, JOHN COOPER PORTER, a citizen of the United States, residing in Northampton, county of Hampshire, and State of Massachusetts, have invented new and useful Improvements in Fluid-Pressure Engines, of which the following is a specification.

This invention relates to reciprocating-piston engines.

It has for its principal objects to produce a simple, compact and durable engine, utilizing the velocity and expansion of steam, compressed air, or suitable gaseous fluids under pressure; to eliminate mechanically-operated valves and small or frail working parts; to minimize separate working parts; to avoid waste and to secure a maximum benefit of the velocity and expansion of the motive fluid; and to attain certain advantages which will hereinafter more fully appear.

The invention consists in the parts and in the arrangements and combinations of parts hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a longitudinal section of a double-acting engine, illustrating an embodiment of the invention, the section being taken on the lines 1—1 of Figs. 2 and 4; Fig. 2 is a longitudinal section on the lines 2—2 of Figs. 1 and 4; Fig. 3 is a fragmentary side elevation showing the relative arrangement of the supply ducts for the motive fluid; Fig. 4 is a cross section on the line 4—4 of Fig. 2; and Fig. 5 is a fragmentary cross section on the line 5—5 of Fig. 2.

In the drawing a double-acting engine is illustrated. The cylinder and piston arrangements of this engine are such that the ports and passage-ways are duplicated, but reversed, so that the piston is moved in both directions with power. The cylinder 1^a is provided with an intake duct 10^a having branches 34 and 35 which communicate, respectively, with the passage-way 11 in the piston 2^a through its end portion 13, and the reverse passage-way 11^a through its end portion 13^a. The passageway 11 communicates with a longitudinal, grooved exhaust passageway 14 through a connecting passageway 15, and the passage-way 11^a communicates with an exhaust passage-way 14^a, like the passage-way 14, through a connecting passage-way 15^a. The exhaust passageway 14 is arranged to communicate with exhaust openings 17 and 18, and the exhaust passage-way 14^a is arranged to communicate with exhaust openings 17^a and 18^a which are similar to the openings 17 and 18 and positioned with respect thereto so as to be controlled by a single valve-block 19^a working in a chamber 16^a. The piston 2^a is provided with a passage-way 25^a arranged and adapted to communicate at one end with the passageway 11^a and at its opposite end with a port 24^a and a passage-way 23^a for supplying pressure at one end of the valve cylinder 16^a and being disposed in a manner similar to passage-ways 23 and 25 and port 24 which communicate with the passageway 11. The piston is also provided with oppositely-disposed exhaust passage-ways 26 and 26^a adapted to communicate, repectively, with exhaust ports 32 and 32^a and said ports 24 and 24^a in the power cylinder 1^a.

The valve block 19^a has a cylindrical middle portion adapted to close the exhaust openings 17 and 18 or 17^a and 18^a, depending upon which of its two positions the valve block may be in. At opposite ends of the middle portion are stems at the outer ends of which are heads against which the fluid pressure is applied to move the valve block and hold it to either of its positions.

In the operation of the engine, assuming the piston to be in the position shown in Fig. 2, steam or other motive fluid under pressure is admitted to the passageway 11, whence it passes into the cylinder. The pressure fluid is also admitted to the lower portion of the valve chamber 16^a through the passageway 25, port 24, and passage-way 23. This causes the valve block 19^a to be moved and held to a position where it closes the exhaust openings 17 and 18 and uncovers the exhaust openings 17^a and 18^a. Initially, under direct pressure of the motive fluid, the piston moves until the end portion 13 of the passageway 11 passes out of communication with the intake duct 10^a, after which the expansion of the pressure fluid in the cylinder and the passage-ways in the piston drives the piston to the end of its stroke. After the passageway 25 is taken out of communication with the valve chamber 16^a, the pressure of the fluid confined in said chamber holds the valve block 19^a in the position to which it has just previously been moved, until the piston has completed its stroke and the exhaust pas-

sageway 26 is brought into communication with the port 24 and the exhaust port 32, whereupon the pressure is exhausted out of the valve chamber 16^a and thereby permits the valve block 19^a to be moved to the end of the chamber opposite to that which it then occupies. By this time the passageway 11^a is brought into communication with the intake duct 10^a and the pressure fluid is conducted to the lower end of the cylinder, and through the passageway 25^a, port 24^a and passageway 23^a into the upper portion of the valve chamber 16'. The valve block 19^a is thereupon moved to the lower end of said valve chamber, thereby uncovering the exhaust openings 17 and 18 and closing the exhaust openings 17^a and 18^a, and the piston is driven back to the upper end of the cylinder, at the completion of which stroke, the exhaust passageway 26^a is brought into communication with the port 24^a and the exhaust port 32^a so as to release the pressure fluid in the upper portion of the valve chamber 16^a. The valve-block 19^a is thereupon moved to the upper end of said chamber, and the piston is driven downward as before described, the operation of the engine thus continuing as long as the supply of the motive fluid is furnished through the intake dust 10^a.

The inner end portions 27 of the passageways 14 and 14^a of the piston are so correlated with respect to the branches 34 and 35 of the intake duct 10^a and also with respect to the end portions 13 and 13^a of the passageways 11 and 11^a, that there is no communication between said passageways 14 and 14^a and the respective exhaust openings 17 and 17^a during the time said portions 13 and 13^a of the passageways 11 and 11^a are in communication with said branches 34 and 35, respectively, of the intake duct 10^a. That is, assuming the piston has reached the end of its stroke in either direction, and as shown more clearly in Fig. 2, it will travel a considerable distance on its reverse stroke before the end portion 27 of the passageway 14 reaches the exhaust port 17. So, too, as the piston is nearing the end of its stroke the end portion 27 of the passageway 14^a will pass out of communication with its exhaust port 17^a just before the end portion 13^a of the passageway 11^a is brought into communication with the branch 35 of the intake duct 10^a. Hence, none of the fresh supply of the pressure fluid is wasted out of the exhaust openings and the piston is cushioned at the end of its stroke; and the compression is advantageous in starting the piston back on its reverse stroke.

It is to be noted that the branches 34 and 35 of the intake duct 10^a are elongated diametrically, as at 28, at their inner ends and in a direction longitudinally of the cylinder, the maximum elongation thereof corresponding to the distance between the inner end portions 27 of the passageways 14 or 14^a and the respective exhaust ports 17 or 17^a when the piston is at the end of its stroke. The major diameter of the portion 28 of the branch 34 or 35 of the intake duct 10^a may be varied by adjusting a vertically-movable block 29 whose inner end portion is provided with an inwardly extending lip 30 which is concaved to correspond to the radius of the normal outer portion of the branch 34 or 35. The blocks 29 are manipulated and held in adjusted position by screws 29^a having heads at one end which are swiveled in slotted lugs on the outside of the cylinder and squared heads at their opposite ends for the reception of a wrench, said screws working through screw-threaded lugs projecting laterally from said blocks 29. It is also preferable to elongate the passageways 25 and 25^a by grooving the piston as at 31 and 31^a. The length of the grooves may be varied in different engines, depending upon the length of time it is desired to maintain direct fluid pressure in the valve chamber 16^a. However, in operating and controlling the valve block 19^a, it is only necessary to supply the pressure fluid momentarily, as the expansion of the fluid confined in the valve chamber is sufficient to hold the valve block. Hence, in some cases, the passageways 25 and 25^a will not have the elongations 31 and 31^a.

Obviously, the engine admits of considerable modification without departing from the spirit of the invention. Therefore, I do not wish to be limited to any of the specific constructions and arrangements shown.

I claim:

1. In a fluid-pressure engine, the combination with a power cylinder having an intake opening for the motive fluid and an outlet opening therefor, of a piston sliding within said cylinder and operating to close said intake and outlet openings, said piston having a longitudinal passage-way therein, said passage-way terminating at one end in a port in the end of the piston and at its opposite end in a port in the side of the piston, said side port being located so as to communicate periodically with the intake opening of the power cylinder when the piston is at or near the end of its return stroke, said piston having a longitudinal circumferential groove located so as to communicate with the outlet opening of the power cylinder after the piston has moved so that its side port is out of communication with the intake opening of the power cylinder, and a fluid-pressure-controlled closure for the outlet opening of the power cylinder, separate from, but controlled by the piston, whereby said outlet opening is opened at the end of the power stroke of the piston and closed at the end of the return stroke thereof.

2. A fluid-pressure engine comprising a power cylinder and a piston sliding therein, said power cylinder having an intake opening for the motive fluid and an outlet opening therefor, said piston operating to control the admission and exhaustion of the motive fluid within said power cylinder, through passage-ways and ports in said piston arranged and adapted for coöperation, respectively, with said intake opening and outlet opening of the power cylinder, said passageways and ports and said intake and outlet openings being so correlated that the exhaust passageway and the outlet opening are out of communication during the time the intake opening and the supply passageway are in communication, and means for varying the relative widths of said intake opening of the power cylinder and the port in the piston which coöperates therewith, such variation being longitudinal with respect to the axis of said power cylinder and piston, whereby the period of communication between said intake opening and port may be varied.

3. In an engine, a power cylinder, a piston reciprocating therein, said piston having a fluid pressure supply passageway therein, said passageway terminating at one end in a port at the end of the piston and at its opposite end in a port in the side of the piston, said cylinder having an inlet opening in its side arranged and adapted for communication with the port in the side of the piston, and means for increasing and diminishing the width of said inlet opening in a direction longitudinally of the cylinder.

4. In an engine, a power cylinder, a piston reciprocating therein, said piston having a fluid pressure supply passageway therein, said passageway terminating at one end in a port at the end of the piston and at its opposite end in a port in the side of the piston, said cylinder having an inlet opening in its side arranged and adapted for communication with the port in the side of the piston, and means for increasing and diminishing the width of said inlet opening in a direction longitudinally of the cylinder, said means comprising a slidable member fitted in a slotted portion of the cylinder so as to prevent leakage, the end portion of said member being shaped to conform to the normal minimum size of the inlet opening and to the increased size thereof, and adjusting and holding means for said member operating externally of the cylinder.

5. In an engine, a power cylinder, a piston reciprocating therein, said cylinder having a pair of intake openings in its side for the motive fluid and a pair of outlet openings in its side for the exhaustion of the motive fluid, one of said intake openings being correlated to one of said outlet openings, and the two other openings being similarly correlated, said piston having a supply passageway therein, said passageway terminating at one end in a port at the end of the piston and at its opposite end in a port in the side of the piston, and a circumferentially-grooved exhaust passageway in its side, said exhaust passageway communicating with said supply passageway, said piston having a duplicate set of such passageways, one of said supply passageways being in communication with its coöperating intake opening of the cylinder when the piston is at or near either end of the cylinder, and the correlated exhaust pasageway of the piston being out of communication with its coöperating outlet opening of the cylinder during the time the intake opening and supply passageway are in communication, a valve chamber on the outside of said power cylinder, said valve chamber having communication with the outlet openings of the power cylinder, said valve chamber also having outlet openings in coöperative relation to said outlet openings of the power cylinder, and a reciprocatory valve member in said valve chamber, said valve member being arranged and adapted to alternately cover the respective coöperating outlet openings, said power cylinder having exhaust ports in coöperative relation to the ports which communicate with the end portions of said valve chamber, and said piston having a duplicate set of oppositely-disposed passageways, the one passageway of each set being in communication at one end with the corresponding motive fluid supply passageway of the piston and terminating at its opposite end in a port in the side of the piston so as to communicate with one of the ports in the power cylinder which communicates with the end portion of the valve chamber when the piston is at one end of the power cylinder, the other passageway of the particular set being arranged and adapted to effect communication between said last mentioned port and the coöperating exhaust port of the power cylinder when the piston is at the opposite end of said cylinder, whereby said valve-member is shifted from one end to the other of said valve-chamber on each stroke of the piston.

6. In an engine, a power cylinder, a piston reciprocating therein, said cylinder having an intake opening in its side for the motive fluid, and an outlet opening in its side for exhausting the motive fluid, said piston being arranged, adapted and operating to cut off said intake openings during the power and return strokes of the piston, said piston having a passageway therein terminating at one end in a port at the end of the piston and at its opposite end in a port in the side of the piston so as to communicate with said intake opening of the power cylinder when the piston is at or near

one end of the cylinder, said piston having an exhaust passageway arranged and adapted to communicate with the outlet opening of the power cylinder, a valve chamber on the outside of said power cylinder, said power cylinder having a port in communication with one end portion of said valve chamber and closed by said piston when the latter is moved from either end of the power cylinder, said valve chamber communicating with the outlet opening of the power cylinder and having an outlet opening in coöperative relation to said other outlet opening, a reciprocatory valve member in said valve chamber arranged and adapted to close said outlet openings when it is at one end of said chamber, said power cylinder having an exhaust port in coöperative relation to said port which communicates with the end portion of said valve chamber and said piston having a passageway communicating at one end with the motive fluid supply passageway therein and terminating at its opposite end in a port arranged and adapted to communicate with the port which is in communication with said valve chamber when the said supply passageway of the piston is in communication with said intake opening of the power cylinder, said piston having a passageway for effecting communication between said last mentioned port of the power cylinder and the coöperating exhaust port when the piston is at or near the end of its power stroke.

In testimony whereof, I have hereunto set my hand in presence of two subscribing witnesses.

JOHN COOPER PORTER.

Witnesses:
GEO. EIGEL,
G. A. PENNINGTON.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."