W. REAVELL & E. W. JONES.

FLUID PRESSURE ENGINE, PUMP, EXHAUSTER, OR COMPRESSOR.

APPLICATION FILED JULY 29, 1910.

1,006,980. **Patented Oct. 24, 1911.**

2 SHEETS—SHEET 1.

FIG. 1.

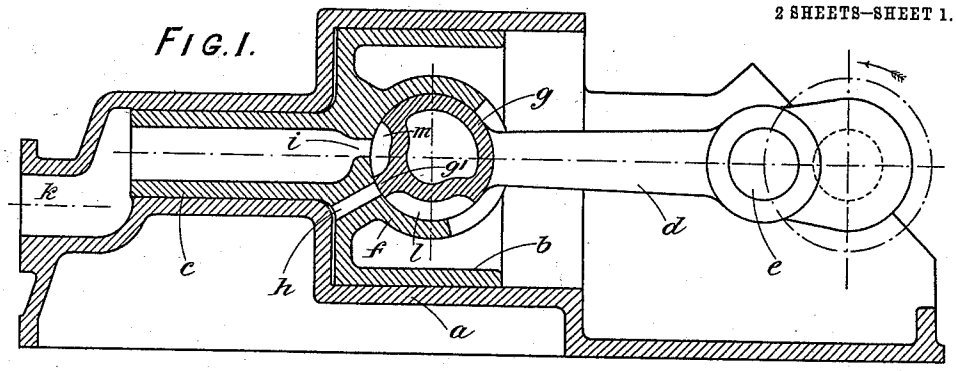


FIG. 2.

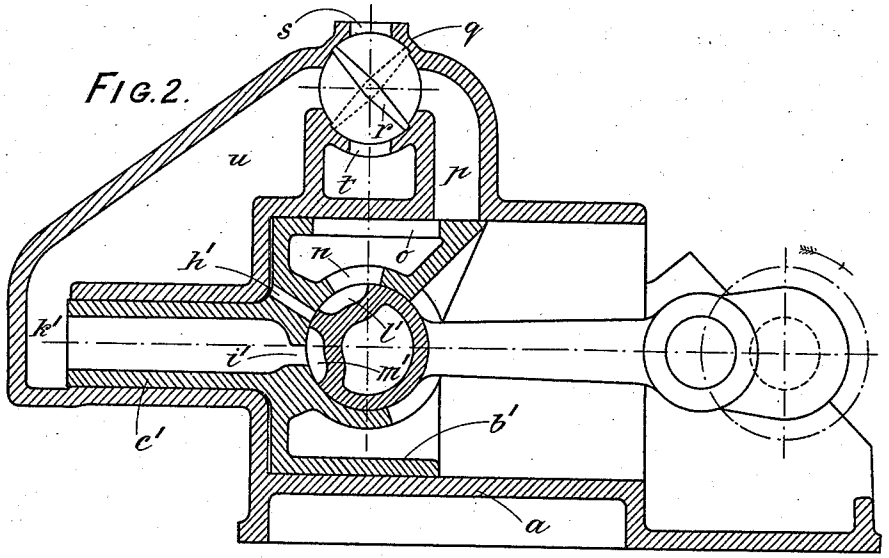
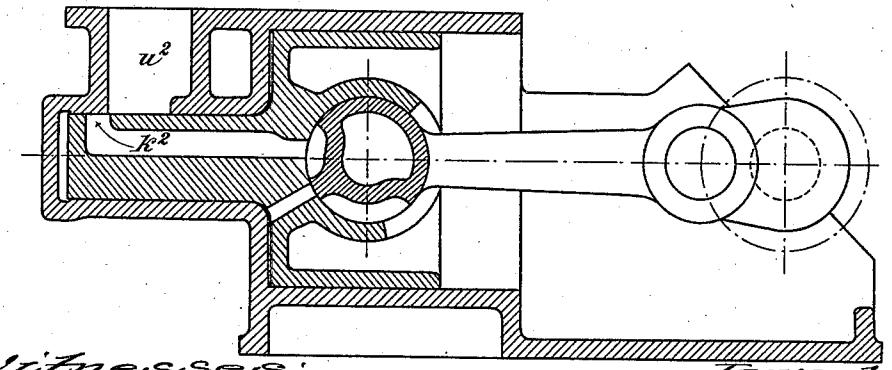


FIG. 3.



Witnesses;

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2 SHEETS—SHEET 2.

FIG. 4.

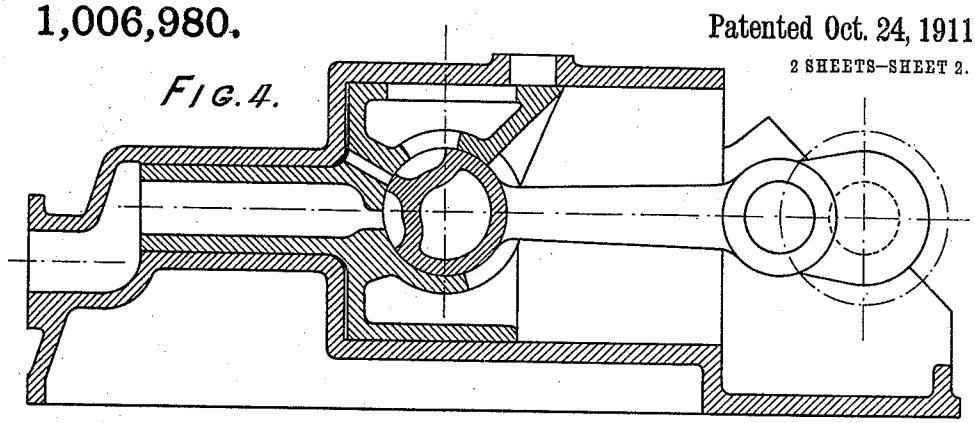


FIG. 5.

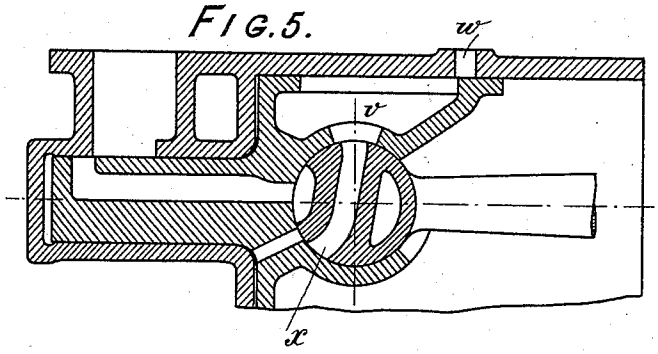


FIG. 6.

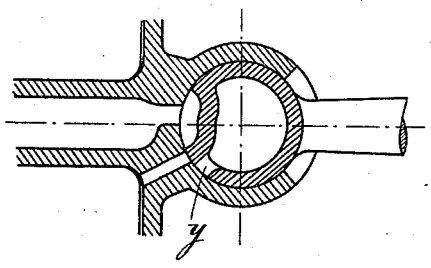
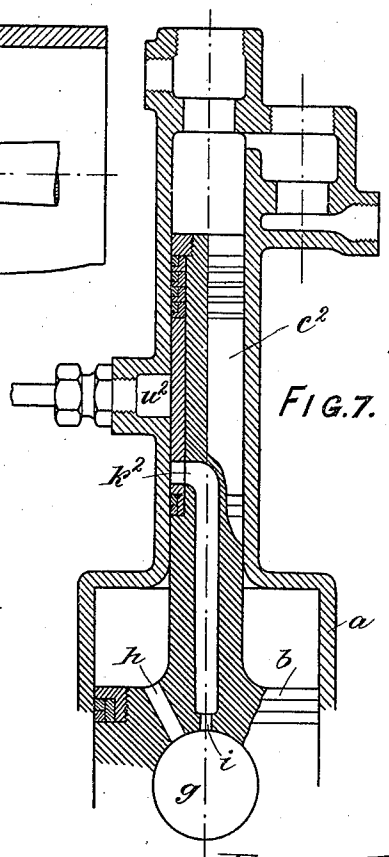


FIG. 7.



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UNITED STATES PATENT OFFICE.

WILLIAM REAVELL AND EDWIN WALTER JONES, OF IPSWICH, ENGLAND.

FLUID-PRESSURE ENGINE, PUMP, EXHAUSTER, OR COMPRESSOR.

1,006,980. Specification of Letters Patent. Patented Oct. 24, 1911.

Application filed July 29, 1910. Serial No. 574,472.

To all whom it may concern:

Be it known that we, WILLIAM REAVELL, mechanical engineer, and EDWIN WALTER JONES, mechanical engineer, subjects of the King of the British Dominions, residing at Ipswich, in the county of Suffolk, England, have invented certain new and useful Improvements in Fluid-Pressure Engines, Pumps, Exhausters, or Compressors, of which the following is a specification.

This invention relates to that class of piston engines, pumps and compressors, in which the oscillating motion of the connecting rod and gudgeon is utilized for periodically opening and closing one or more ports formed in the reciprocating piston, the gudgeon being adapted to act as an oscillating valve, the ports being formed in the cylindrical valve seat, and the cylinder being provided with an axial rear extension of smaller diameter, in which moves a pilot piston. A compressor of this type is shown, for instance, in the specification of the British Patent No. 9220 of 1903.

The present improvements have for their principal object, to construct the piston and gudgeon in such a manner, that the gudgeon acts not only as a suction but also as a delivery-valve, and that separate valves are entirely dispensed with.

Our improvements are applicable to single-cylinder machines and to multi-cylinder machines, for instance, the quadruple machines described in the British patent specification No. 9220 of 1903.

The same or a similar arrangement of ports will enable the machine to operate as a motive power engine using steam or air as a working fluid, and also as an air compressor or exhauster, or as a water pump or a water pressure engine.

In the drawings Figure 1 shows the construction of the machine in the simplest form, with two sets of ports in the gudgeon or valve seat, instead of the one set of suction ports shown in the specification of said British Patent No. 9220 of 1903, Figs. 2 to 7 represent modifications.

a is the main cylinder, *b* the main piston, provided with a cylindrical extension or pilot piston *c*, *d* is the connecting rod or piston rod, *e* the crank pin.

The piston is a hollow trunk piston forming in the center a cylindrical casing or valve seat *f* for the oscillating gudgeon *g* serving as a pivot for the connecting rod. The valve seat *f* has a port *h* leading to the end or rear of the main piston, as is the case, for instance, with the compressor shown in Fig. 2 of the aforesaid British patent, and it has also a port *i* leading through the interior of the pilot piston to the delivery or pressure supply pipe *k* and an additional port *z* formed by a portion of the opening through which the inner end of the connecting rod *d* extends, said port *z* facing the open front end of the main piston and communicating with the atmosphere. The gudgeon has in its circumference a pair of cavities *l* and *m* similar to those of an ordinary Corliss valve. If the crank is in the position shown in Fig. 1 and turned in a direction opposite to that of a clock-hand, atmospheric air will be drawn through the port *z* and the recess *l* of the gudgeon into and through the suction port *h* into the space formed behind the main piston and will fill the same. On the subsequent return stroke of the piston the air drawn into the main cylinder will be compressed, until the port *h* communicates through the circumferential recess *m* of the gudgeon with the port *i*, after which the compressed air will flow out through the delivery pipe *k*. On the other hand, if the engine is used as a motor, the crank turns in the direction of a clock-hand, compressed air from the pipe *k* will flow through the pilot piston, port *i*, and recess *m* into the port *h* and will act on the piston *b*, causing the latter to turn the crank. Before the completion of the outstroke, the port *h* will again be closed, so as to stop the supply of air to the cylinder. During the subsequent return stroke the port *h* will communicate with the recess *l* and allow the air inclosed behind the piston to flow through the said recess and the port *z* into the atmosphere.

Fig. 2 shows, in what manner this mechanism may be rendered reversible. For this purpose the valve seat is provided with a third port *n* leading to a port *o* in the side of the piston, and a turn-over valve, such as *r*, is provided, which is adjustable in a casing *q* communicating on one side with a passage *p* leading to the port *o*, and on the other side with a passage *u* leading to the open extremity k^1 of the pilot piston. Between the said passages *p* and *u* the valve casing *q* has two diametrically opposite ports *s* and *t*. If the turn-over valve *r* occupies the position shown by full lines, and

the crank turns in the same direction as a clock-hand (as shown by the arrow) air will enter through the port s, passage p, ports p, n, and will flow through the recess l^1 and port h^1 to the back of the piston. The subsequent outflow will take place through ports i^1, k^1, passage u, and port t. When it is desired to reverse the mechanism, the valve r is turned 90°, so as to occupy the position shown by dotted lines. The machine may then be reversed to run in the direction opposite to the arrow shown. Under these circumstances air will enter through the port s and flow through the passage u into the open extremity k^1 of the pilot piston, through the port i^1, the port m^1 in the gudgeon and the port h^1 in the back of the piston. It will then be delivered through ports h^1, l^1 in the gudgeon, ports n and o in the piston, port p in the cylinder and port t.

In Fig. 3 the outlet k^2 from the interior of the pilot piston is situated on the side of the same and is adapted to communicate with an outlet port u^2 formed in the extension of the cylinder. During the return stroke of the piston, when the port k^2 is temporarily closed, a higher compression is produced, than is the case with the arrangement shown by Fig. 1, and the degree of compression may be varied by changing the position of the port k^2. If desired, this port k^2 may be rendered adjustable on any particular machine.

Fig. 4 shows an arrangement suitable as a water pump or a water pressure engine, water being admitted or delivered during the whole of the stroke. The same construction may be used for elastic fluids, instead of that shown in Fig. 1 and is preferable, when dealing with certain elastic fluids.

In applying our invention to exhausters, we adopt by preference the modification represented in Fig. 5 of the accompanying drawings, that is to say, we form in the valve seat a third port v terminating in the side of the piston and in the cylinder a suction port w, adapted to communicate with the port v, and instead of the open cavity l shown in Fig. 1 of the drawings we produce in the gudgeon a port x forming one end of an approximately diametrical passage, the other end of which faces the port v.

The arrangement shown in Fig. 1 and Fig. 3 may be modified in the manner illustrated in Fig. 6, that is to say, instead of an open cavity l communicating directly with the atmosphere, we may provide a port y communicating with the interior of the gudgeon, which is hollow and open at the ends, as shown in British Patents No. 13161 of 1899 and No. 9220 of 1903, or at a suitable point of the circumference.

Although our improvements in air compressors are described with reference to single cylinder- and single stage-compressors, they may be applied also to multi-cylinder and multi-stage compressors of the type described in our British Patents No. 13161 of 1899 and No. 9220 of 1903 and to single and compound engines.

Fig. 7 shows, in what manner our invention may be applied to the low pressure stage of multi-stage compressors, in which the low pressure piston b and the high-pressure or third-stage piston c^2 are made in one piece, the piston c^2 taking the place of the pilot piston described above. The piston b has an oscillating gudgeon valve g and a pair of ports h and i, of which port i forms one end of an axial bore leading at the other end to a port k^2 formed in the side of the piston c^2. The port k^2 is adapted to communicate at the proper time with an outlet u^2 formed in the side of the high-pressure cylinder. The outlet u^2 is assumed to communicate through a pipe with the second-stage cylinder (not shown), the delivery pipe of which leads to the valve box shown at the end of the high-pressure-cylinder provided with an inlet- and outlet valve, as usual. As shown in Fig. 7, the small or high pressure piston c^2 has two sets of piston-packings placed sufficiently far apart, to afford the necessary room for the ports and for the motion of the piston.

It will be understood, that in the case of large machines one or more of the ports may be duplicated or triplicated, without departing from our invention.

What we claim is:—

1. In a fluid pressure apparatus, the combination of a main cylinder provided with a cylindrical extension of reduced diameter; a reciprocating main piston working in the main cylinder and provided with a pilot piston of reduced diameter working in said extension, said pilot piston having an opening extending therethrough and said main piston having an opening and a circularly-curved valve seat formed with a plurality of ports, one of which ports leads into the opening in the pilot piston, while another leads directly through the back of the main piston, while a third faces and communicates with the opening in said main piston, and an oscillating piston rod having a gudgeon movably fitted in said valve seat and constituting an oscillating valve, said gudgeon being provided with circumferential recesses adapted to register with said ports, said ports and recesses serving as inlets and outlets for the working fluid during the motion of the main piston.

2. In a fluid pressure apparatus, the combination of a main cylinder provided with a cylindrical extension of reduced diameter and with a lateral opening for the motive

fluid; a reciprocating main piston working in the main cylinder and provided with a pilot piston of reduced diameter working in said extension, said pilot piston having an opening extending therethrough and said main piston having a lateral opening adapted to register with the lateral opening in the main cylinder and having also a circularly curved valve seat formed with a plurality of ports, one of which ports leads into the opening in the pilot piston, while a second leads directly through the back of the main piston, and a third faces and communicates with the lateral opening in said main piston; and an oscillating piston rod having a gudgeon movably fitted in said valve seat and constituting an oscillating valve, said gudgeon being provided with circumferential recesses adapted to register with said ports, said ports and recesses serving as inlets and outlets for the working fluid during the motion of the main piston.

3. In a fluid pressure apparatus, the combination of a main cylinder provided with a cylindrical extension of reduced diameter; a reciprocating main piston working in the main cylinder and provided with a pilot piston of reduced diameter working in said extension, said pilot piston having an opening extending therethrough and said main piston having a lateral opening and also a circularly curved valve seat formed with a plurality of ports, one of which ports leads into the opening in the pilot piston, while a second leads directly through the back of the main piston, and a third faces and communicates with the lateral opening in said main piston; an oscillating piston rod having a gudgeon movably fitted in said valve seat and constituting an oscillating valve, said gudgeon being formed with a pair of circumferential recesses adapted to establish communication alternately between the first and second ports and between the second and third ports; and a reversing device consisting of a valve-box provided with a pair of main ports, one of which serves as a fluid inlet to the apparatus and the other as a fluid outlet from the same, and with a pair of intermediate passages, one of said intermediate passages communicating with the rear end of said extension while the other leads through the side of said main cylinder facing the lateral opening in said main piston and is adapted to communicate with the same, and a reversing valve disposed within said valve-box and adapted to establish communication alternately between said inlet port and one of said intermediate passages, and between said outlet port and the other intermediate passage.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

WILLIAM REAVELL.
EDWIN WALTER JONES.

Witnesses:
DONALD A. PALMER,
FRANK E. DUNNETT.