No. 675,401. Patented June 4, 1901.

P. F. ODDIE.

PUMP.

(Application filed July 28, 1900.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

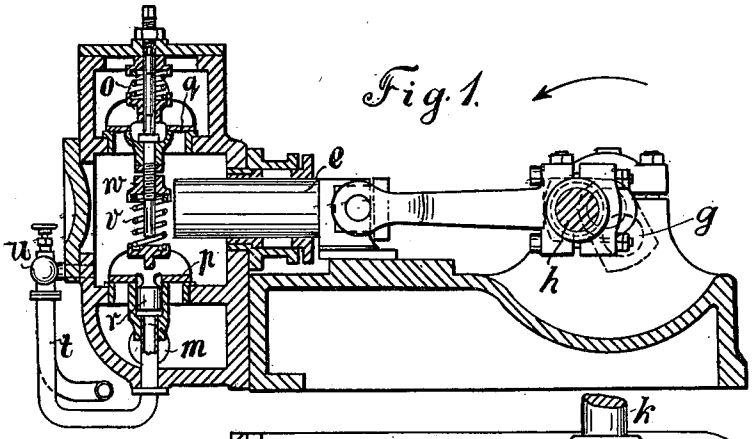


Fig. 2.

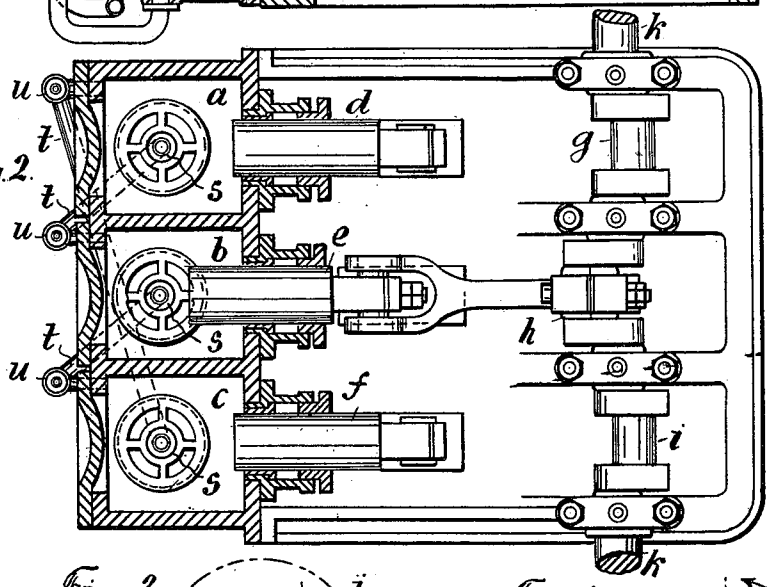


Fig. 3.

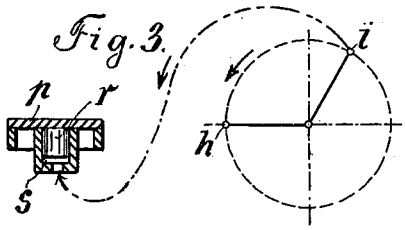


Fig. 4.

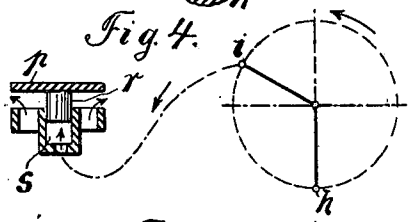


Fig. 5.

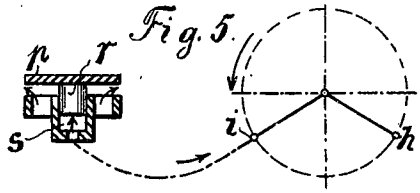
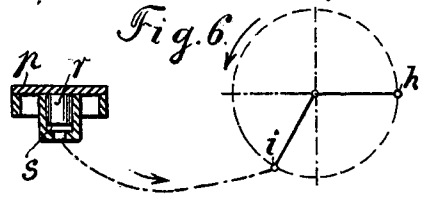


Fig. 6.



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No. 675,401. Patented June 4, 1901.

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PUMP.

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(No Model.) 2 Sheets—Sheet 2.

Fig. 7.

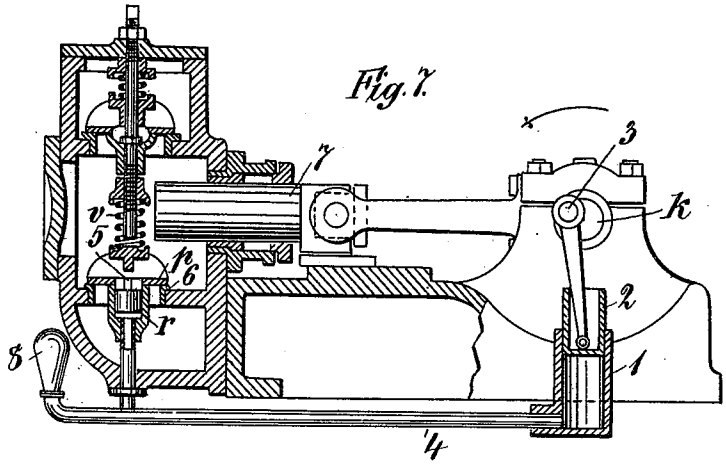
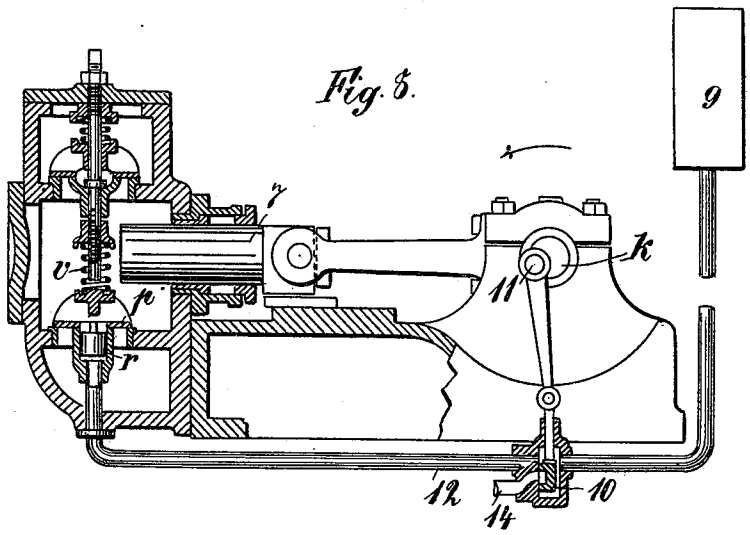


Fig. 8.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

PHILIP F. ODDIE, OF LONDON, ENGLAND.

PUMP.

SPECIFICATION forming part of Letters Patent No. 675,401, dated June 4, 1901.

Application filed July 28, 1900. Serial No. 25,195. (No model.)

To all whom it may concern:

Be it known that I, PHILIP FRANCIS ODDIE, engineer, a subject of the Queen of Great Britain, and a resident of Wimbledon, London, England, have invented certain new and useful Improvements in Pumps; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to characters of reference marked thereon, which form a part of this specification.

The subject of the present invention is a pump which by a special arrangement of the valves is able to run at extremely high speeds, while the valves themselves always close exactly at the correct time. It is a well-known fact that with the ordinary construction of suction and delivery valves any attempt to drive the pump beyond a certain moderate fixed limit is attended by severe shocks and bangs. These bangs occur at the beginning of each stroke and are caused by the change of pressure in the pump-cylinder, which forces the valve violently on its seat. These bangs can to a certain extent be lessened by providing the valves with springs, so as to load them, which accomplishes or in any case assists the complete or partial closing of the valve and before the consequent change of pressure has taken place in the cylinder. These springs must, however, of necessity be weak, for if the valves are too heavily loaded they would be prevented from opening quickly. This is especially the case with the suction-valves, which are opened only by the atmospheric pressure and if too heavily loaded would not open at all. In the present pump the opening of the suction-valves is not dependent on atmospheric pressure, but is regulated by the pressure of a neighboring pump-cylinder or by means of an auxiliary plunger, a pressure-reservoir, or pressure-pipe, &c. By this arrangement there is practically no limit to the strength of spring that can be used, and the valves can be so arranged that they are completely closed before the change of pressure takes place in the pump-cylinder, by which means all shocks and bangs are prevented and the pump will work quietly at the highest speeds.

A suitable type of pump to which the present invention can be conveniently applied is the three-throw-crank pump. These pumps are fitted with three plungers, which three plungers are connected with a three-throw-crank shaft in which each crank is set with reference to the other at an angle of one hundred and twenty degrees. In such a pump fitted with this invention the valve in the first pump-cylinder is controlled by the pressure in the second pump-cylinder, and the valve in the second cylinder is controlled by the pressure in the third pump-cylinder, and, finally, the valve of the third is in its turn regulated by the pressure in the first pump-cylinder.

Referring to the drawings, Figure 1 shows in longitudinal section, and Fig. 2 in sectional plan, a pump of this description with suction-valves fitted with the present invention. Figs. 3, 4, 5, and 6 illustrate different positions of the parts during the operation of the pump, and Figs. 7 and 8 are sectional views of modifications of my invention.

In each of the three pump-cylinders *a b c* work pistons *d e f*, which are joined, by means of connecting-rods, to the cranks *g h i* of the crank-shaft *k*. The suction-chamber is provided with a suction-opening *m* and the pressure-chamber with the delivery-opening *o*. Each pump-cylinder is provided with a suction-valve *p* and a pressure-valve *q*. Each suction-valve *p* is provided with a plunger *r*, which works in a cylinder *s* of the valve-seat. From this cylinder *s* a pipe *t* leads to the adjacent pump-cylinder, which pipe is provided with an adjustable regulating-valve *u*. The valve-cylinder *s* in the pump-cylinder *a* is connected, by means of the pipe *t*, with the cylinder of the pump *b*, and the valve-cylinder *s* of the pump *b* communicates with the pump-cylinder *c*, while the valve-cylinder of the pump *c* is connected with the pump-cylinder *a*.

Each suction-valve *p* is loaded by means of a strong spring *v* or weight, which presses the valve hard on its seat. The amount of the pressure of the spring can be regulated by means of the nut *w*.

Figs. 3, 4, 5, and 6 show, respectively, the

positions of the piston *e* from the beginning to the end of its suction stroke and the corresponding positions of the piston *r* of the valve *p*. The valve shown in these figures is the suction-valve of the pump *b*, and its valve-cylinder *s* is consequently in connection with the pump-cylinder *c*. The manner of working is as follows: In Fig. 3 the piston *e* is at the beginning of its suction-stroke, while the piston *f* has begun its inward or pressure stroke. The cranks *h* and *i* are then in the position shown in Fig. 3 on the crank-circle. In consequence of the inward stroke of the piston *f* there is pressure in the pump-cylinder *c*, which acts, by means of the pipe *t*, on the piston *s* in the pump-cylinder *b* and tries to open the suction-valve *p* of this cylinder. This valve remains closed till the pump-piston *e* begins its outward or suction stroke, and thereby reduces the pressure in the cylinder, and consequently on the suction-valve of this cylinder. After this has occurred the pressure, acting on the valve-piston *r*, overcomes the downward pressure of the spring *v* and opens the valve. In Fig. 4 the piston *e* has arrived in the middle position of its stroke while the piston *f* is still in its pressure-stroke and leads continuously pressure under the piston *r* of the valve *p* and by this way keeps the valve completely opened. In Fig. 5 the piston *e* has reached nearly the end of its suction-stroke. The piston *f* has already begun its suction-stroke, and consequently a reduction of pressure has occurred under the valve-piston *r*, and the spring *v* now begins to close the valve. The time required for the closing of the valve depends clearly on the time which the water in the valve-cylinder requires to return through the pipe *t* into the pump-cylinder *c*. This time can be regulated, by means of the throttle-valve *u* or by any other suitable throttling arrangement, so that the valve is closed shortly before the piston has reached the end of its stroke. Exactly the same action takes place between the other pairs of pistons *d* and *e* and *f* and *d*. This arrangement is not limited to a three-cylinder pump, but is also applicable to pumps with one or more than three working pistons. In order to lift the valves, a special auxiliary piston may be used, which has only to regulate the motion of the valves.

Instead of obtaining pressure for the lifting of the valves from the other pump-piston or an auxiliary piston the valves may sometimes be connected with a reservoir in which in many ways—say through an accumulator—a certain pressure is maintained and by suitable mechanism driven by the crank-shaft, so that a connection between the pressure-reservoir and the valve-pistons is made at the right time, and instead of the pressure-reservoir the valve may be connected with the pressure-pipe, the said modifications herein referred to being particularly described below.

Fig. 7 shows the valve opened by means of an auxiliary pump. The auxiliary pump 1, with plunger 2, is driven by an eccentric or eccentric-pin 3 on the crank-shaft *k*. A delivery 4 leads from the pump-cylinder 1 to the back of the small piston *r*, coöperating with the suction-valve *p*. The piston *r* is fixed to the valve-spindle 5 and is acted upon by the strong spring *v*, which tends to keep the valve firmly pressed onto its seat 6. The eccentric 3 is so placed with reference to the crank-shaft *k* that the small pump always commences its downward stroke some time before the main plunger 7 of a single pump commences its suction-stroke. The fluid in pipe 4 is therefore under pressure, which pressure, acting on the surface of piston *r*, tends to compress the springs and open the suction-valve *p*. The valve, however, cannot open until the change of stroke of the main plunger, being kept closed by the pressure in the pump. For preventing an excessive pressure in the pipe 4 an air-box 8 is provided. At once, however, at the commencement of the suction-stroke of the main plunger the suction-valve is opened by the pressure acting on the piston *r* and compressing the spring *v*.

Fig. 8 shows the valve opened by means of the pressure of water taken from the tank 9. The numeral 10 indicates a valve worked by means of an eccentric-pin 11 on the crank-shaft *k*, which admits the pressure from the tank 9 along the pipe 12 under the piston *r* before the main plunger 7 commences its suction-stroke. Before the end of the suction-stroke the valve 10 has changed its position, allowing the liquid to pass back from the pipe 12 to the outlet 14, and consequently causing the suction-valve to close. The same arrangement can be provided if the valve is connected with a pressure-pipe—for instance, a water-conduit.

Having now described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a pump, the combination of a cylinder, a plunger operating therein and suction and discharge valves, of means for closing the suction-valve, and means for transmitting a positively-acting pressure to the suction-valve to tend to open it before the suction-stroke begins, said opening-pressure exceeding the force of the closing means whereby the suction-valve is opened by positively-acting pressure at the commencement of the suction-stroke independently of atmospheric pressure on said valve, substantially as described.

2. In a pump, the combination of a cylinder, a plunger operating therein and suction and discharge valves, of means for closing the suction-valve and means for transmitting a positively-acting pressure to the under side of the suction-valve to tend to open it before the suction-stroke begins, said opening-pressure exceeding the weight of the valve and the force of the closing means, whereby the suction-valve is opened by positively-acting pres-

sure at the commencement of the suction-stroke independently of the atmospheric pressure on said valve, substantially as described.

3. In a multiple-cylinder pump, the combination with the cylinders and a plunger operating in each cylinder and suction and discharge valves for each cylinder, of means for closing the suction-valves and pipes or passages leading from one cylinder to another to transmit pressure to tend to open the suction-valves before the suction-strokes begin, said opening-pressure exceeding the force of the closing means, whereby such suction-valves are opened by positively-acting pressure at the commencement of the suction-strokes independently of the atmospheric pressure on said valves, substantially as described.

4. In a multiple-cylinder pump, the combination with a plurality of cylinders and a plunger operating in each cylinder, and suction and discharge valves for each cylinder, of means for closing each of the suction-valves, a source of pressure and pipes or passages for conveying pressure to each suction-valve from said source to tend to open the suction-valve, such opening-pressure exceeding the force of the closing means, whereby said suction-valve is opened by positively-acting pressure at the commencement of the suction-stroke independently of the atmospheric pressure on said valve, substantially as described.

5. In a multiple-cylinder pump, the combination with a plurality of cylinders, a plunger operating in each cylinder and suction and discharge valves in the cylinders, of means for closing each of the suction-valves and pipes or passages connecting the pressure-chamber of each cylinder with the suction-chamber of another cylinder in the series to transmit to such suction-chamber pressure to tend to open its suction-valve before the suction-stroke begins, said opening-pressure exceeding the force of the closing means, whereby said suction-valve is opened by positively-acting pressure at the commencement of the suction-stroke independently of the atmospheric pressure on said valve, substantially as described.

6. In a pump, the combination with a cylinder, a plunger operating therein and suction and discharge valves, of means for holding the suction-valve to its seat until the beginning of the suction-stroke and for closing such valve before suction ceases and a pipe or passage leading to the suction-valve, a source of pressure greater than the force of the means for closing the suction-valve, and supplying such pressure to the pipe or passage, whereby the suction-valve is opened by positively-acting pressure at the commencement of the suction-stroke and closed before the stroke is changed from suction to forcing, substantially as described.

7. In a pump, the combination with a cylinder, a plunger operating therein and suction and discharge valves, of means for holding the suction-valve to its seat until the beginning of the suction-stroke and for closing such valve before suction ceases, and a pipe or passage leading to the suction-valve, a source of pressure greater than the force of the means for closing the suction-valve and supplying pressure to the pipe or passage and means for regulating such pressure, whereby the suction-valve is opened by positively-acting pressure at the commencement of the suction-stroke and closed before the stroke is changed from suction to forcing, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

PHILIP F. ODDIE.

Witnesses:
GEORGE LOUBIER,
JOHANNES D. HEIN.