No. 676,778. Patented June 18, 1901.

W. SPENCE & F. LAFFERTY.

PUMP.

(Application filed Sept. 27, 1900.)

(No Model.) 2 Sheets—Sheet 1.

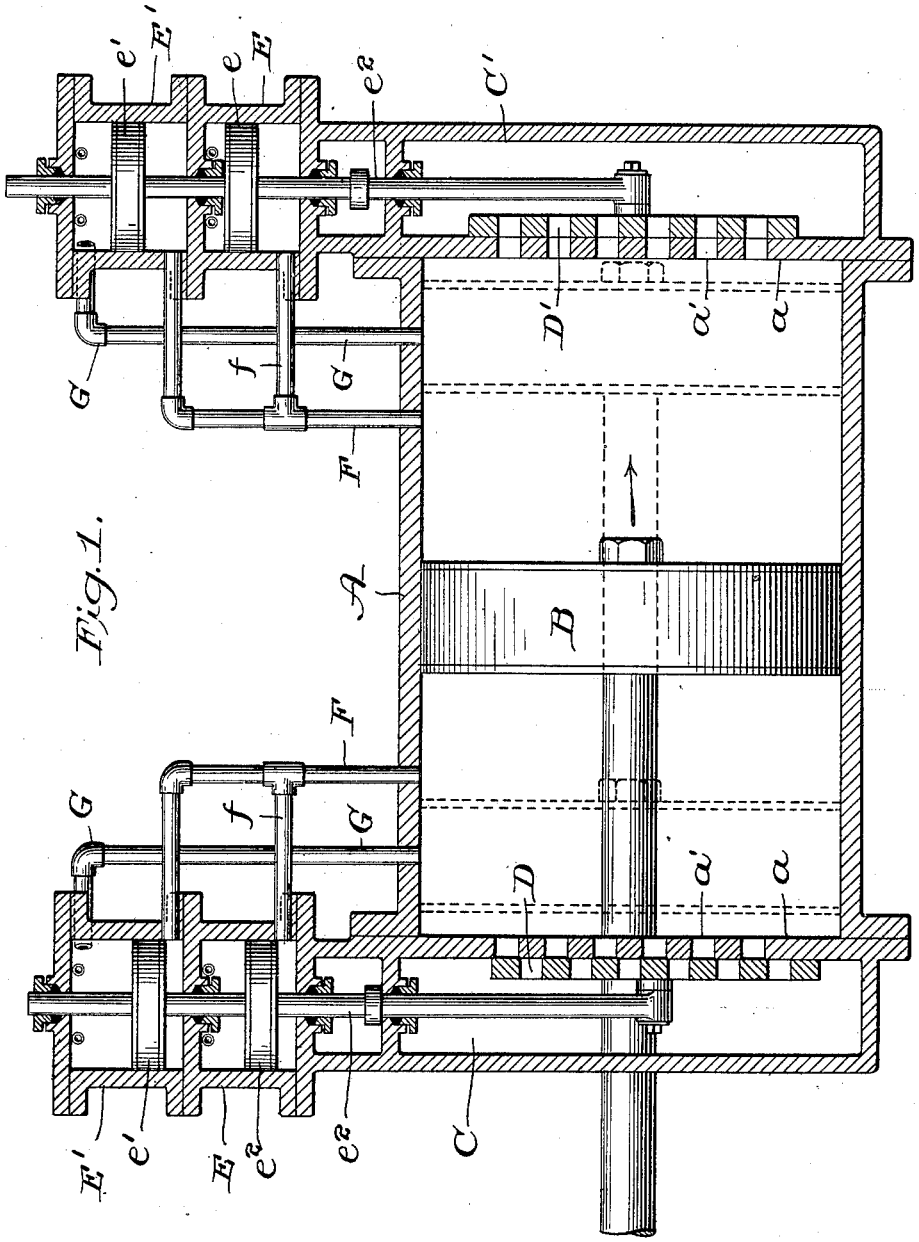

Fig. 1.

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Fig. 4.

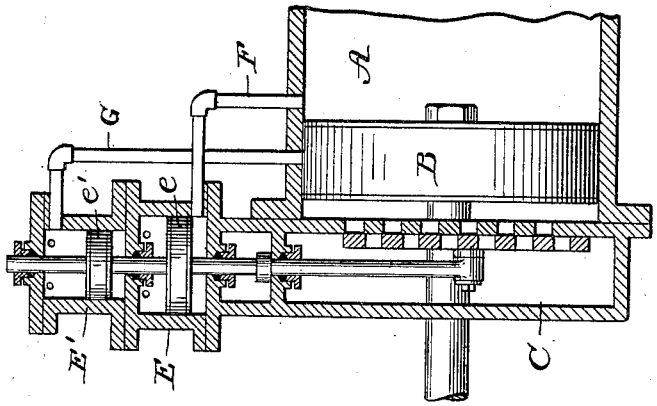


Fig. 3.

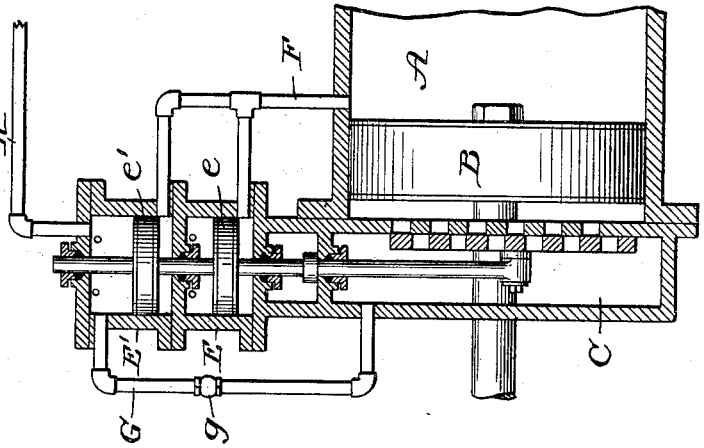
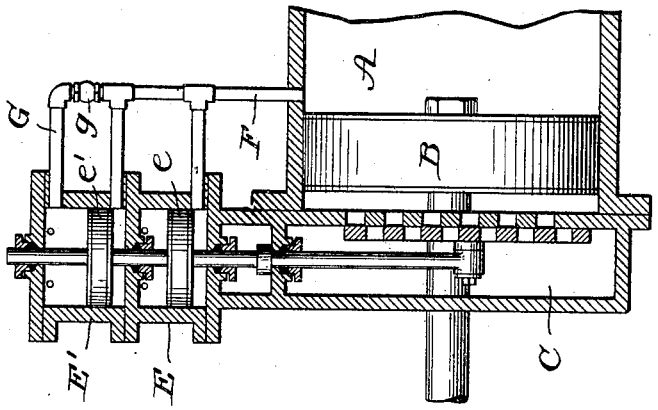


Fig. 2.



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PUMP.

SPECIFICATION forming part of Letters Patent No. 676,778, dated June 18, 1901.

Application filed September 27, 1900. Serial No. 31,240. (No model.)

To all whom it may concern:

Be it known that we, WATSON SPENCE, residing in the city and county of Philadelphia, in the State of Pennsylvania, and FRANK LAFFERTY, residing at Elyria, in the county of Lorain and State of Ohio, citizens of the United States, have invented certain new and useful Improvements in Pumps, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

This invention relates to that class of pumps in which a piston forces air, water, or other fluid from a cylinder into a discharge-chamber, our object herein being to provide a simple and efficient construction for effecting the periodical opening and closing of the discharge-valves through devices actuated and controlled by the pressure generated in the cylinder by the reciprocations of the piston, as will be hereinafter particularly described and claimed.

In the drawings, Figure 1 is a horizontal section of the cylinder and adjuncts of a pump or engine embodying our invention. Figs. 2, 3, and 4 are similar sections illustrating modifications of the valve-controlling mechanism.

Referring to Fig. 1, A is the cylinder, B the reciprocative power-piston therein, and C C′ the discharge-chambers at the respective ends of the cylinder. The cylinder-heads *a* are provided with ports *a′*, which afford communication between the cylinder and the respective discharge-chambers. D D′ are suitably-located slide-valves, whereby the ports in the respective heads may be opened and closed in alternate succession during the reciprocations of the piston.

E E′ are two horizontally-disposed cylinders arranged adjacent to each of the discharge-chambers, *e e′* are pistons in said cylinders, respectively, and e^2 is a common rod for said pistons connected with the adjacent slide-valve, whereby when such rod is reciprocated the valve will be actuated accordingly. The relative positions of the parts are such that during the reciprocations of the power-piston when one pair of valve-actuating pistons is outward the other pair is inward, and the converse.

Leading from each end of the main cylinder are two pipes F and G, the latter of which opens into the outer end of the adjacent cylinder E′, while the former pipe opens into the inner end of said cylinder E′ and is provided with a lateral branch pipe *f*, which opens into the inner end of the cylinder E. The connections between these pipes and the main cylinder are such that when the power-piston B is at the end of its stroke the mouth of the pipe G at that end of the cylinder is closed, while the mouth of the adjacent pipe F is in open communication with such cylinder, as indicated by the dotted lines.

In the drawings the power-piston is illustrated as traveling toward the right-hand end of the cylinder, a portion of the compressed air (or other fluid) therein having entered the two right-hand pipes F and G, so as to act upon the two faces of the piston *e′* and upon the inner face of the piston *e*. By virtue of the combined pressure against the inner faces of the two pistons the pressure upon the outer face of the piston *e′* is overcome and the two pistons thereby forced outward, thus opening the exhaust-valve D′. As the power-piston approaches the end of its stroke it closes the communication between the pipe G and the main cylinder and clears the mouth of the pipe F, as above mentioned, whereupon the pressure on the inner sides of the pistons *e e′* escapes by way of the latter pipe to the main cylinder, while the confined pressure in the pipe G acts upon the piston *e′* in a manner to move the same inward, and thereby effect the closing of the exhaust-valve D′ before the piston reaches the end of its stroke. In the reverse stroke of the piston a similar action of the compressed air or other fluid is had upon the valve-actuating pistons at the left-hand end of the cylinder, and the exhaust-valve D is thereby opened and closed. In this way the two exhaust-valves are opened and closed in alternate succession during the reciprocations of the power-piston.

In Fig. 2 of the drawings is shown a modification of the invention wherein the pipe G instead of extending from the main cylinder leads from and constitutes, in effect, a branch or continuation of the pipe F, a suitably-disposed check-valve *g* being provided in such

branch or continuation. This valve is so arranged that during the stroke of the piston the compressed air or other fluid which enters the pipe F passes to the outer end of the cylinder E′ as well as to the inner end thereof and also to the inner end of the cylinder E to effect the shifting of the exhaust-valve. When the piston passes the mouth of the pipe F, the check-valve is automatically closed. Hence the air escapes from the inner sides of the pistons *e e′* only, while the pressure acting on the outer face of the piston *e′* is confined, thereby effecting the inward movement of the two pistons and a corresponding shifting of the exhaust-valve to close the same.

In the construction shown in Fig. 3 the pipe F and its connections with the main cylinder and with the lower ends of the cylinders E E′ are the same as illustrated in Fig. 1, but instead of the pipe G leading from the main cylinder to the upper end of the cylinder E′ said pipe leads from the interior of the discharge-chamber to the upper end of the cylinder E′ and is provided with a check-valve *g*. During the stroke of the power-piston the pressure generated thereby enters the pipes F and G and acts upon the pistons *e* and *e′*, as in the first-described construction, in a manner to force the same outward and effect the opening of the exhaust-valve. When the power-piston passes the mouth of the pipe F, the air is exhausted from the inner side of the pistons *e e′* into the main cylinder, whereupon the confined pressure on the outer side of the piston *e′* moves the pistons inward and effects the closing of the exhaust-valve before the power-piston reaches the end of its stroke.

In Fig. 3 we have shown a pipe H leading into the top of the cylinder E′. This pipe may be connected with an independent pump, whereby an initial shifting of the valve-actuating pistons may be had, if necessary.

In Fig. 4 is shown a construction wherein the diameter of the inner cylinder E is somewhat greater than that of the outer cylinder E′ and wherein the pipes F and G occupy the same relation to each other and to the respective cylinders as in the construction shown in Fig. 1, excepting that the pipe F leads to the inner end only of the cylinder E in Fig. 4. During the stroke of the power-piston a portion of the compressed air in the main cylinder enters the pipes F and G, so as to act upon the inner and outer faces of the pistons *e e′*, respectively, and by virtue of the larger diameter of the inner piston *e* the counter-pressure upon the smaller outer piston *e′* is overcome and the two pistons thereby shifted to open the exhaust-valve. As the power-piston approaches the end of its stroke it closes the communication between the pipe G and the main cylinder and clears the mouth of the pipe F in the same manner and with the same effect as explained with regard to the first-described construction.

In each of the constructions above described it will be seen that the discharge-valves are positively actuated and controlled by the pressure generated in the main cylinder by the reciprocating piston.

It may be added that so far as our invention is concerned it may be applied either to a vertical or a horizontal cylinder.

The small circles shown in the outer ends of the cylinders E E′ are designed merely to indicate exhaust-valve and petcock connections.

We claim—

1. In a pump, the combination with the cylinder, the piston therein, the receiving-chamber, and valve mechanism for opening and closing communication between the said cylinder and chamber, of a pair of small pistons, cylinders therefor, and connections leading from said latter cylinders, respectively, and opening directly into the cylinder first named, at different points in the path of the piston first named, so that when the latter is at the end of its stroke the mouth of one of said connections is closed while that of the other connection is open, whereby the said mechanism is actuated and controlled in both operations by the pressure generated in the cylinder first named, substantially as described.

2. In a pump, the combination with the cylinder, the piston therein, and the receiving-chamber communicable with said cylinder, of the slide-valve for controlling the communication between said chamber and cylinder, and means whereby the said valve is reciprocated at predetermined intervals by the pressure generated in the cylinder, said means including a pair of small cylinders, pistons therein, connections between said pistons and the slide-valve, and passages leading from the said latter cylinders, respectively, and opening directly into the cylinder first named, at different points in the path of the first-mentioned piston, substantially as described.

3. In a pump, the combination with the cylinder, the power-piston therein, and the receiving-chamber communicable with said cylinder, of the valve for controlling the communication between said chamber and cylinder, a pair of small cylinders, reciprocative pistons therein connected with said valve, pipes opening into the corresponding ends of said small cylinders and having communication with the cylinder first named, and a pipe opening into the opposite end of one of said small cylinders and having operative communication with the cylinder first named, whereby the pressure in the cylinder first named is caused to act oppositely at predetermined intervals on said pistons to effect the reciprocation thereof, substantially as described.

4. In a pump, the combination with the main cylinder, the power-piston therein, the receiving-chamber communicable with said cylinder, and a valve for controlling communication between said chamber and cylinder, of a pair of small cylinders separated from each other, pistons therein connected with

said valve, and pipes leading from each of the latter cylinders and having operative communication with the main cylinder at different points in the path of the power-piston, whereby the pressure in the said main cylinder is caused to act oppositely at predetermined intervals on said small-cylinder pistons to effect their reciprocation, substantially as described.

5. In a pump, the combination with the main cylinder, the power-piston, the receiving-chamber, and the valve for controlling communication between said cylinder and chamber, of a pair of small cylinders, pistons therein, a connection between said pistons and the valve, a pair of pipes opening into the inner ends of the latter cylinders respectively, and a pipe opening into the outer end of the outer cylinder, said pipes having communication with the main cylinder, whereby the pressure in the said main cylinder is caused to act oppositely at predetermined intervals on said latter pistons to effect their reciprocation, substantially as described.

6. In a pump, the combination with the main cylinder, the power-piston, the receiving-chamber, and the valve for controlling communication between said cylinder and chamber, of a pair of small cylinders, pistons therein, a connection between said pistons and the valve, the pipes F and G leading from the main cylinder and having operative communication with the said small cylinders, whereby the pressure in the said main cylinder is caused to act oppositely at predetermined intervals on said latter pistons to effect their reciprocation, substantially as described.

In testimony whereof we have hereunto affixed our signatures.

WATSON SPENCE.
FRANK LAFFERTY.

Witnesses as to signature of Watson Spence:

ANDREW V. GROUPE,
JOHN R. NOLAN.

Witnesses as to signature of Frank Lafferty:

WM. D. PLANT,
J. M. RYALS.