(Model.)

J. A. TILDEN.

FLUID ENGINE OR METER.

No. 248,679. Patented Oct. 25, 1881.

Fig. 1.

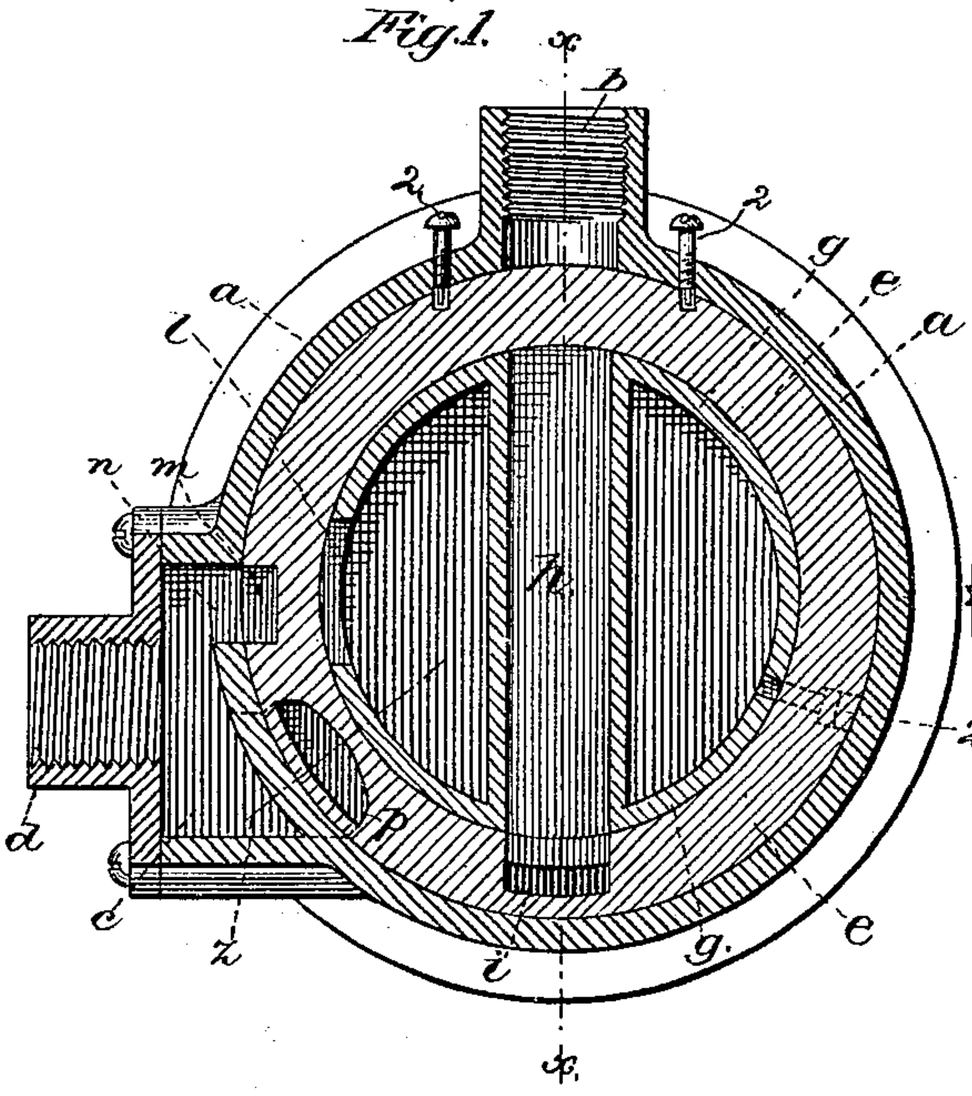


Fig. 2.

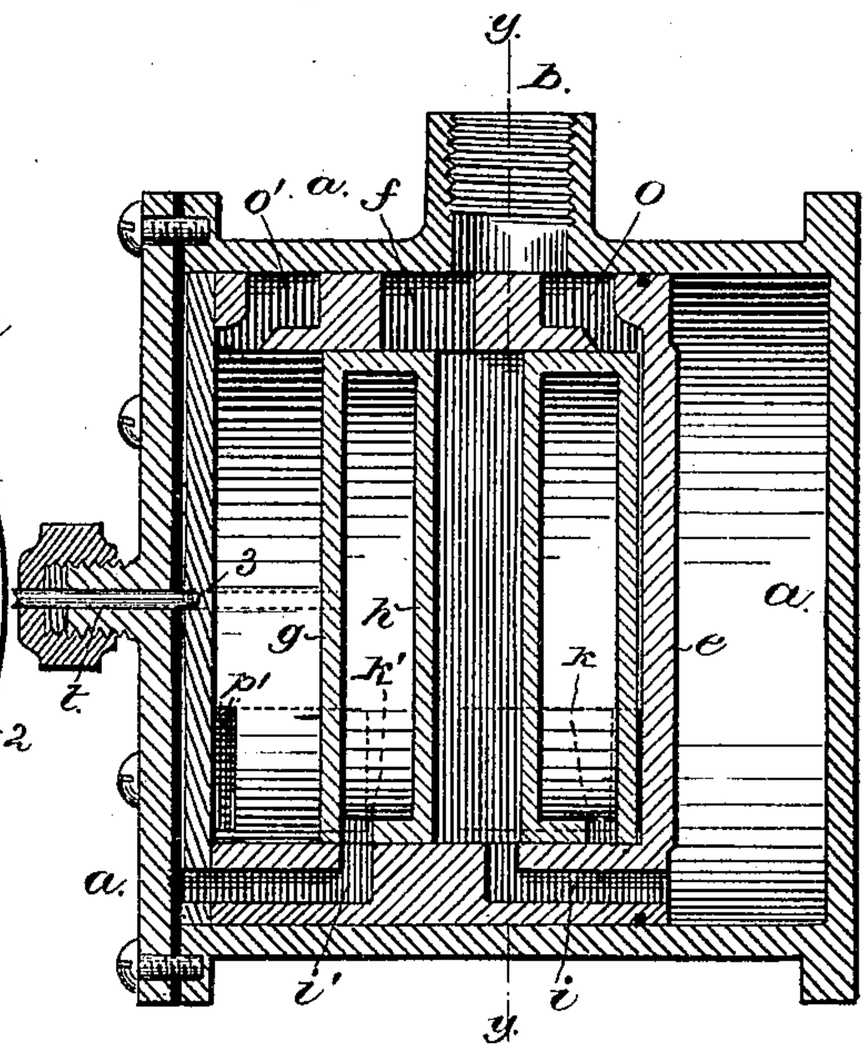


Fig. 3

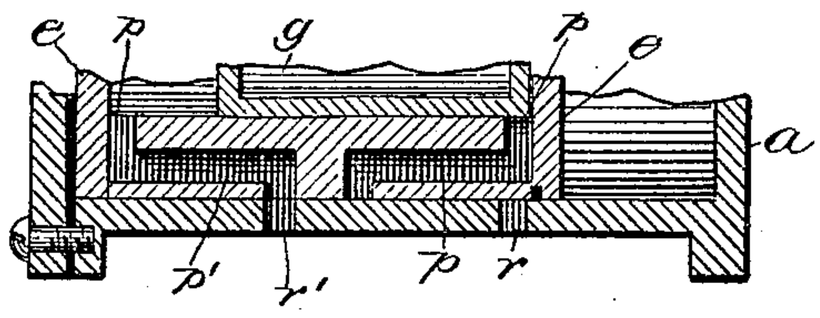


Fig. 4.

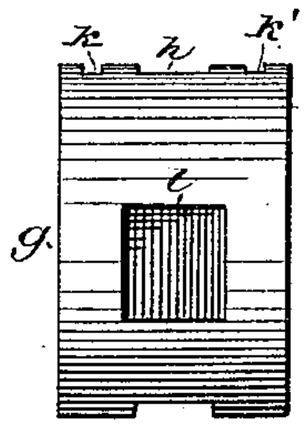


Fig. 5.

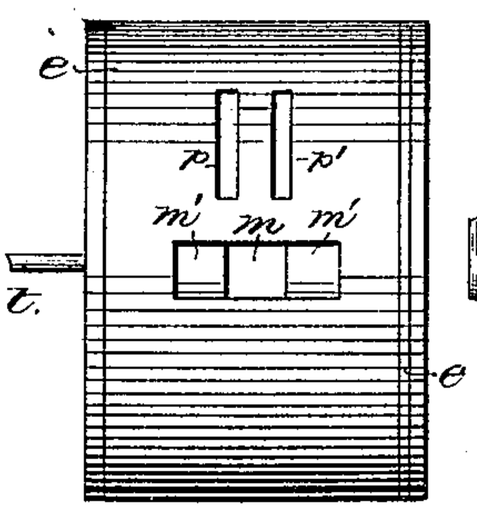
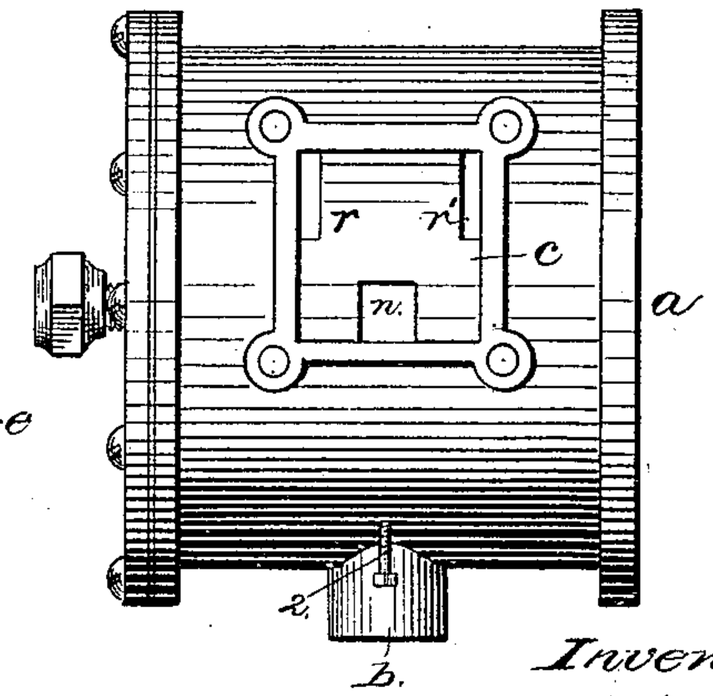


Fig. 6.



Witnesses.

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FLUID ENGINE OR METER.

SPECIFICATION forming part of Letters Patent No. 248,679, dated October 25, 1881.

Application filed January 31, 1881. (Model.)

To all whom it may concern:

Be it known that I, JAMES A. TILDEN, of Hyde Park, Norfolk county, and State of Massachusetts, have invented Improvements in Fluid Engines or Meters, of which the following description, in connection with the accompanying drawings, is a specification.

My invention relates to a water-engine, which is also capable of being used as a fluid-meter, and has for its object to produce an engine operated without valves or valve-gearing, and at the same time of simple and cheap construction.

The engine consists, essentially, of a cylinder in which the main piston travels back and forth under the pressure of the water or other fluid entering the said cylinder, thus allowing a determined quantity of water to pass through the apparatus at each stroke, it being expelled or exhausted from the space in the cylinder toward which the piston is moved. The piston itself is made as a cylinder and contains a secondary piston, the two pistons and cylinder being provided with suitable ports to control the flow of the water through the apparatus and the consequent movement of the two pistons. When the secondary piston makes its stroke in the main piston the fluid in the said main piston is exhausted, so that the total amount of fluid passing through the apparatus at each stroke, and measured thereby, consists of the exhaust of the main piston and the cylinder added together. The admission of fluid to the main cylinder on one side of the main piston and its exhaust on the other side thereof is controlled by the secondary piston, and the admission and exhaust of fluid to and from the main piston to operate the secondary piston is controlled by the main piston, the exhaust-port of the secondary piston being opened by the main piston when the said main piston has arrived at the end of its stroke, by which movement the entrance of the fluid to operate the secondary piston is also allowed. By this arrangement the main piston completes its stroke in one direction, the secondary piston remaining in the same relative position therein, after which the secondary piston makes its stroke, at the end of which it opens the exhaust for the main piston to allow the liquid which impelled it in its last stroke to escape, and at the same time admits the liquid to the cylinder on the other side of the main piston to cause it to make its return-stroke, at the end of which the secondary piston makes its stroke in the reverse direction to that last described, and the operation goes on continuously.

The secondary piston will be spoken of as stationary when it has completed its stroke in the main piston and remains stationary relative to the said main piston, although the latter, of course, is carrying the former with it in making its stroke in the cylinder. By their mutual control of one another each piston remains stationary while the other is making its stroke, since it is only when one has arrived at the extreme end of its stroke that it brings the proper ports in connection to cause the other piston to make its stroke.

In the description the ports and passages leading the fluid to and from the main cylinder to operate the main piston will be distinguished by the word "main" from those admitting and withdrawing the fluid to and from the main piston to operate the secondary piston, which will be called "secondary."

The main inlet-passage for the fluid is at the side of the main cylinder, midway of its length, and the main piston is provided with an inlet-passage midway of its length, on the same side as the said inlet to the cylinder, while the secondary piston has a tubular passage extending across from side to side midway of its length, its direction being the same as that of the two passages last described.

The pistons are of such length relative to the length of their respective strokes that the passages last described will never be wholly disconnected, and together form the main inlet-passage through which the fluid enters, to be afterward directed to one or the other end of the main cylinder, according to the position of the secondary piston. The tubular passage in the secondary piston, at its end opposite to the inlet-passage of the main piston, will be brought at the end of its strokes into connection with one or the other of two ports in the main piston leading into the main cylinder at each end of the said main piston, respectively, the said

ports acting alternately for induction and eduction, like the ports of an ordinary steam-engine cylinder.

The secondary piston, which is made as a hollow drum, has two main exhaust-ports leading to its interior, and so located that when its tubular passage is in connection with one of the ports of the main piston, as last described, for the induction of fluid to one end of the cylinder, one of the said main exhaust-ports leading to the interior of the secondary piston coincides with the other port of the main piston for the eduction of fluid from the other end of the main cylinder into the interior of the secondary piston, whence it flows out of the apparatus by the exhaust-passages through the side of the secondary and main pistons, so arranged as to remain connected during the entire stroke of the main piston, just as the inlet-passages and tubular passage of the secondary piston remain always in connection, as previously described.

The main piston is provided with two secondary inlet-ports on the same side as the main inlet-passage, previously described, and so arranged that one is brought into connection with the inlet to the main cylinder at the end of the stroke of the main piston, thus admitting the water into the main piston on one side of the secondary piston to cause the latter to make its stroke. The main piston is also provided with two secondary exhaust-ports properly located to be brought into coincidence with secondary exhaust-passages through the side of the main cylinder only at the end of the stroke of the main piston.

The secondary exhaust-passage of the main cylinder and the main exhaust-passages lead to an exhaust-chamber from which the fluid may be led by a suitable pipe, and the fluid will apparently flow uniformly therethrough, it entering first the main cylinder on one side of the main piston and passing out at the other, after which it enters the main piston at one side, and passes out therefrom at the other side of the secondary piston.

The fluid may, if desired, pass through the apparatus in the opposite direction, in which case what are described as inlet-passages will become outlet-passages, and the reverse.

Figure 1 is a transverse section on line *y y*, Fig. 2, of an apparatus constructed in accordance with my invention; Fig. 2, a longitudinal section thereof on line *x x*, Fig. 1; Fig. 3, a partial longitudinal section on line *z*, Fig. 1, showing the operation of the exhaust of the secondary piston; Figs. 4, 5, 6, side elevations of the secondary and main pistons and cylinder, respectively, in a position inverted relatively to that shown in Fig. 2.

The main cylinder *a* is provided with an inlet-passage, *b*, at one side, midway between its ends, and with an exhaust-chamber, *c*, and exhaust-passage, *d*, leading therefrom, also placed midway between its ends.

The main piston *e* (shown as of a length considerably more than half of the interior of the cylinder) is provided with a main inlet-passage, *f*, on the same side thereof as the inlet-passage *b*, the two passages *b f* being of such width relative to the length of the stroke that they are never wholly disconnected, as will be seen from Fig. 2, where the main piston is shown at the extreme end of its stroke.

The secondary piston *g*, fitted within the main piston *e*, is made hollow, and provided with a tubular passage, *h*, extending diametrically across it in the proper direction to meet the inlet-passage *f* of the main piston, and is of such width relative to the said passage that it is never wholly disconnected therefrom, so that the fluid entering the main cylinder at *b* will always have a free passage to the opposite end of the tubular passage *h*. The pistons are prevented from turning on their axes to bring their ports out of proper position by suitable guides, 2. (See Fig. 1.)

The main piston *e* is provided on the opposite side to the inlet-passage *f* with two ports, *i i'*, leading from the inside of the said piston to the main cylinder, at each end thereof, the opening within the piston being so located that the secondary piston never passes wholly beyond them in making its stroke, and at the end of each stroke brings the tubular passage *h* into connection with one of the said ports *i i'*.

The secondary piston *g* is provided with two main exhaust-ports, *k k'*, so placed that when at the end of its stroke the tubular passage *h* is connected with one of the ports, as *i*, of the main cylinder, the other port, *i'*, thereof will be in connection with the corresponding exhaust-port *k'*, leading into the secondary cylinder, so that as the fluid, in entering, passes through the passages *b*, *f*, *h*, and *i* into the cylinder *a* on one side of the main piston *e* the fluid in the cylinder on the other side of the main piston will have a passage through the ports *i' k'* into the secondary cylinder *g*, whence it will pass to the exhaust-chamber *c* of the cylinder by the following passages. (Best seen in Figs. 1, 4, 5, 6.)

The secondary piston *g* has an opening, *l*, in its side of such width that during its entire stroke it remains in connection with the corresponding passage *m* through the side of the main piston, the outer portions of the said passage *m* being extended, as shown at *m'*, Fig. 5, so that it remains in connection with the port *n* through the side of the main cylinder during the entire stroke of the said main piston, and there is always a free exhaust-passage from the space in the secondary piston around its tubular passage to the outside of the cylinder, just as there is a free inlet for the fluid through the passages *b m f* to the end of the tubular passage *h*.

It will thus be seen that the ports *i i'* of the main piston *e* are alternately inlet and exhaust ports, being controlled by the secondary

piston *g*, which acts as a valve therefor, and while at one end of the said main piston, as shown in Fig. 2, admits the fluid to one side thereof through the passage *i*, and allows it to pass out from the other side thereof through the passages *i' k' l m n*. After the main piston has completed its stroke in one direction, as is shown in Fig. 2, the secondary piston is operated to change the connection of the ports *i i'* and cause the main piston to move in the opposite direction, as follows:

The main piston *e* is provided with two secondary inlet-passages, *o o'*, on the same side with the main inlet-passage *f*, and so placed that they are brought into connection with the inlet *b* of the cylinder *a*, one at the end of each stroke of the said main piston, the said passages leading to the space within the main piston at each side of the secondary piston, respectively. The main piston is also provided with secondary exhaust-ports *p p'*, (see Fig. 3,) leading from the ends of the inside space of the said piston *e* to the outside, where the openings are near the middle thereof and come against the inner surface of the cylinder *a*, which is provided with secondary exhaust-ports *r r'*, so located as to coincide with the outer openings of the ports *p p'*, respectively, only when the main piston has arrived at the end of each stroke. The exhaust-passage *p'* from one end of the main piston *e* is thus brought into connection with the corresponding exhaust-port *r'* to give a free eduction-passage on one side of the secondary piston at the same time that the secondary inlet-port *o* is brought into connection with the inlet-passage *b* to admit the water to the other end of the main piston to act upon the secondary piston.

The operation is as follows: The parts are shown in Fig. 2 in the position assumed when the main piston has just completed a stroke, the fluid having entered through the passages *b*, *f*, *h*, and *i* to one end of the cylinder *a* and passed out from the other end thereof through the passages *i'*, *k'*, *l*, *m*, and *n*. At this time the secondary inlet-port *o* of the main piston has been brought into connection with the inlet-passage *b* of the cylinder *a*, admitting the fluid to one end of the said piston to operate on the corresponding end of the secondary piston therein, while the secondary exhaust-port *p'* is brought into connection with the secondary exhaust-port *r'* through the side of the main cylinder to permit the fluid to pass from the main piston at the other side of the secondary piston to allow the secondary piston to make its stroke. At the end of this stroke of the secondary piston *g* its tubular passage *h* (without being at any moment disconnected from the passage *f*) is brought into connection with the port *i'* of the main piston, thus permitting the fluid to enter from the passage *b* through the said port *i'* the end of the cylinder which has just been exhausted, and at the same time the exhaust-port *k* of the secondary piston is brought into connection with the port *i* of the main piston, allowing the water or fluid to pass from the full end of the cylinder through the said ports *i k* into the secondary piston, and thence out through the main exhaust-ports *l m n*, as previously described. The main piston will thus be caused to make its return-stroke while the secondary piston is carried with it, but without movement relative to the main piston, until at the end of the stroke of the main piston the secondary inlet-port *o'* thereof is brought into connection with the inlet *b* and the secondary exhaust-port *p* with the corresponding port *r* through the side of the cylinder *a*, to thus cause the secondary piston to make its stroke while the main piston remains stationary, and the operation thus continues, each piston controlling the movement of the other, and each permitting the other to move only when it has itself completed its movement in either direction.

It will be seen that in an engine constructed in this manner the only fitting required may be accomplished by boring and turning, thus enabling it to be very cheaply constructed, and at the same time the movements are very positive and certain.

The engine will operate equally well if the fluid enters at *d* and passes out at *b*.

A piston-rod, *t*, is shown connected with the main piston *e*, which may be employed to impart the power if the apparatus be used as an engine, or to actuate recording or registering mechanism if it be employed as a meter.

It is obvious that various modifications in the construction and arrangement of the parts might be made without departing from the principle of my invention. As, for example, if the apparatus were to be used only as an engine, the secondary inlet-ports *o o'* leading into the main piston might also serve as the exhaust-ports, the passages *r r'* being placed at either side of the main-cylinder inlet *b*.

The piston-rod *t* may pass through a stuffing-box or an equivalent in the main piston *e* at 3, Fig. 2, and be connected with the secondary piston *g*, as shown in dotted lines, so as to get the entire stroke of both pistons. Other changes might be made, according to the purpose for which the apparatus was to be employed, these being enumerated merely to indicate that the invention is not restricted to the precise form shown.

By a slight modification in the position of the ports the expansive force of a gas might be utilized.

I claim—

1. The main cylinder and its inlet-passage, and the main piston provided with a main inlet-passage of proper width to remain in connection with the cylinder inlet-passage during the entire stroke of the main piston, and with two ports leading to the main cylinder at either end of the said main piston, combined with a secondary piston provided with a tubular passage, arranged to remain always in connection with the main inlet-passage, and to be connected

with one or the other of the ports of the main piston, according to its position therein, substantially as described.

2. The main piston provided with ports leading to either end of the main cylinder, combined with the secondary piston provided with a tubular passage and with main exhaust-ports arranged as described, whereby, when the tubular passage is in connection with one of the main piston-ports, the other port will be in connection with one of the main exhaust-ports of the secondary piston, substantially as described.

3. The cylinder provided with an inlet and main exhaust-passage, and the main piston therein provided with a main inlet-passage and two main ports leading to either end of the said cylinder, and a main exhaust-passage, *m m'*, adapted to remain always in connection with the exhaust-passage of the cylinder, combined with the secondary piston and tubular and exhaust passages therein, to be alternately connected with the main piston-ports and the main exhaust-port *l*, leading from its interior and adapted to remain always in connection with the main exhaust-port *m* of the main piston, substantially as and for the purpose described.

4. The cylinder provided with an inlet-passage and two secondary exhaust-passages, combined with the main piston therein and the secondary piston in the said main piston, the main piston being provided with secondary inlet and exhaust ports, arranged, as described, to bring the inlet-port leading to one end of the main piston into connection with the inlet-passage of the cylinder at the same time that the exhaust-port leading from the other end of the piston is brought into connection with one of the exhaust-passages leading from the main cylinder, substantially as described.

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

JAMES A. TILDEN.

Witnesses:
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