(No Model.)

3 Sheets—Sheet 1.

W. M. FOWLER.

LIQUID METER.

No. 546,317. Patented Sept. 17, 1895.

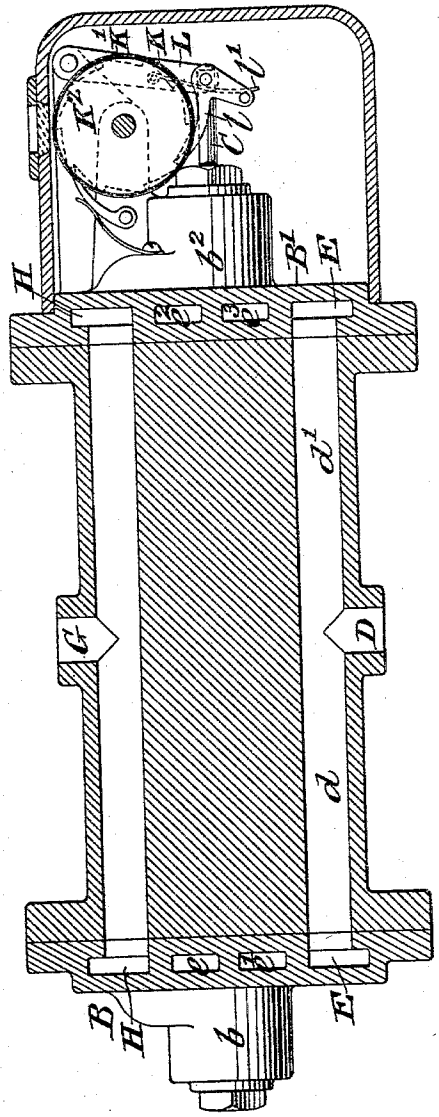

Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

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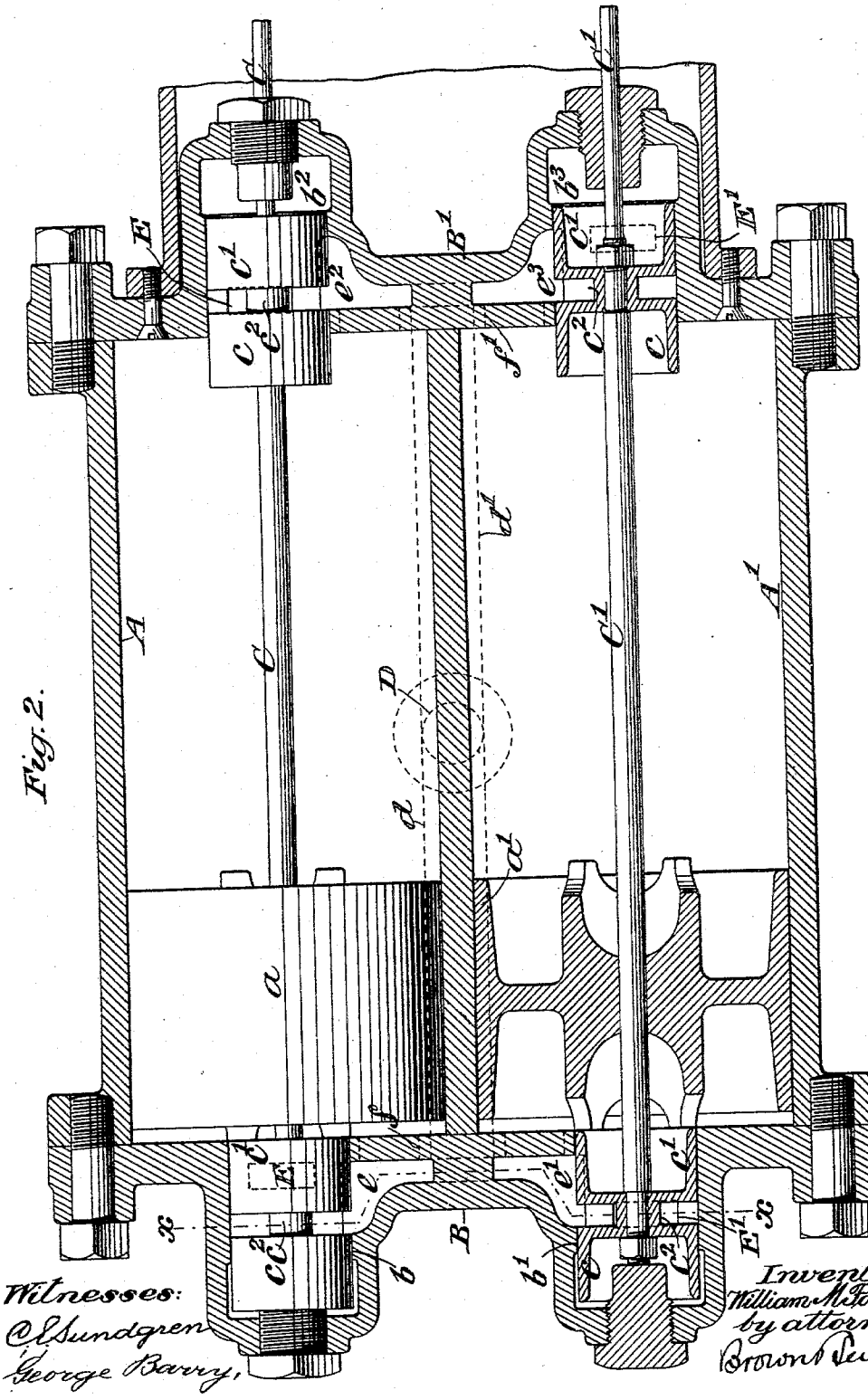

Fig. 2.

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(No Model.)

3 Sheets—Sheet 3.

W. M. FOWLER.

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Fig. 4.

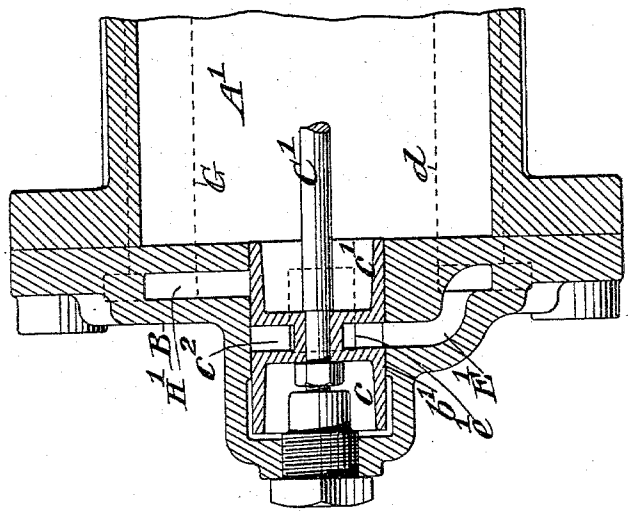
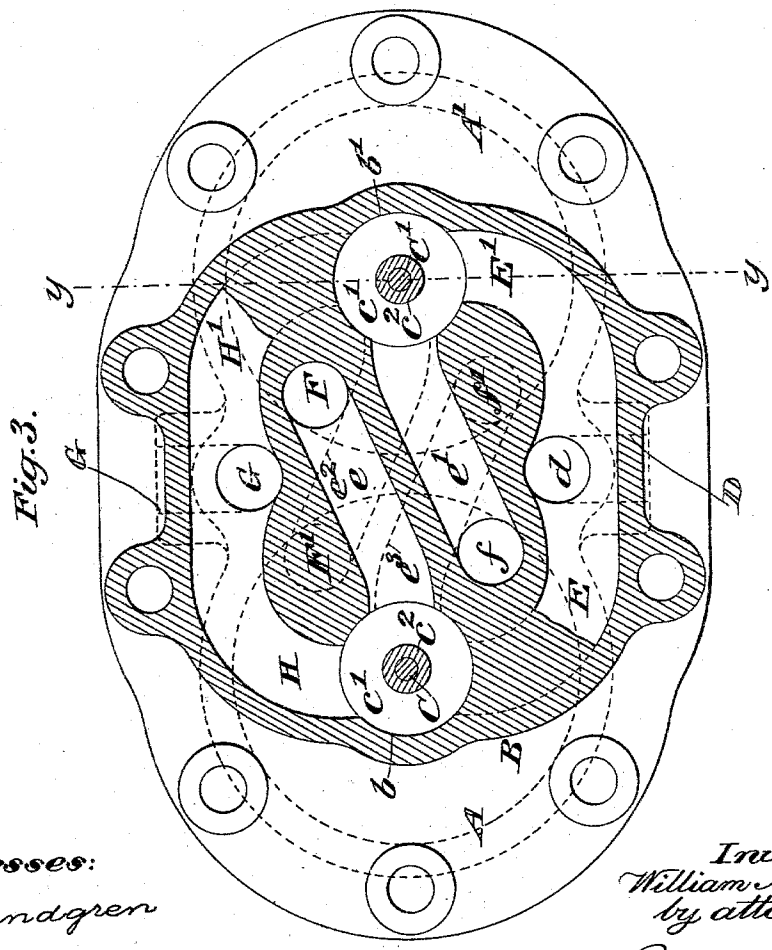


Fig. 3.



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UNITED STATES PATENT OFFICE.

WILLIAM MILES FOWLER, OF STAMFORD, CONNECTICUT.

LIQUID-METER.

SPECIFICATION forming part of Letters Patent No. 546,317, dated September 17, 1895.

Application filed September 24, 1894. Serial No. 523,883. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM MILES FOWLER, of Stamford, in the county of Fairfield and State of Connecticut, have invented a new and useful Improvement in Liquid-Meters, of which the following is a specification.

My invention relates to an improvement in liquid-meters in which a plurality of pistons reciprocate one after another each in its own cylinder and each serving in turn to open the inlet and discharge ports of another, keeping the flow of liquid through the meter constant and producing a simple and reliable means for accurately determining the amount of liquid used.

A practical embodiment of my invention is represented in the accompanying drawings, in which—

Figure 1 is a view of the meter in longitudinal central section. Fig. 2 is a longitudinal section through the cylinders and heads. Fig. 3 is a transverse section through one of the heads on line $x\,x$ of Fig. 2, and Fig. 4 is a partial vertical longitudinal section through line $y\,y$ of Fig. 3.

The number of cylinders and reciprocating pistons with which I have chosen to illustrate my invention is two. The cylinders are denoted by A A′ and their pistons by a and a', respectively. In the present instance I have shown two cylinder-heads only, each common to the corresponding ends of the two cylinders and provided with fluid conduits or ports interconnecting the interiors of the two cylinders at their ends. It is obvious, however, that separate pipes might be substituted for the passages within the heads, if so desired.

One of the cylinder-heads is denoted as a whole by B and the other by B′. The two heads are quite similar in their structure, and for this reason I have shown in the accompanying drawings one of the heads only in detail, the ports in the opposite cylinder-head which do not exactly coincide with those of the head B being represented by dotted lines in Fig. 3. It will be understood that the position of those ports in the cylinder-head B which are shown in Fig. 3 in dotted lines as not coinciding with the ports in the head B′ is due to the fact that the observer is supposed to be looking (in Fig. 3) from the outer face of the head B toward the cylinders and at the same time at the inner face of the head B′.

The cylinder-head B is provided with a valve-chamber b centrally opposite the end of the cylinder A and with a valve-chamber b' centrally opposite the corresponding end of the cylinder A′. The cylinder-head B′ is provided with similar valve-chambers b^2 and b^3, respectively, centrally opposite the corresponding ends of the cylinders A A′.

Centrally through the cylinder A extends a rod C and through the cylinder A′ a corresponding rod C′, each having fixed at or near its opposite ends a two-part piston-valve, consisting of cylinders $c\,c'$, separated by an annular port c^2. The rods C C′ project through one of the cylinder-heads—in the present instance through the head B′—and one or both of them—in the present instance one of them only, viz., C—is utilized to operate the register to record the amount of liquid which passes into and out of the two cylinders A A′. The pistons $a\,a'$ slide loosely on the respective rods C C′ within the cylinders A A′ and serve, as they approach the opposite ends of their respective cylinders, to engage the valves $c\,c'$ and move them, together with the rods C C′, to which they are fixed, in the one direction or the other, according to the direction in which the said pistons $a\,a'$ are moving within the cylinders. A common inlet D communicates by means of oppositely-extending passage-ways $d\,d'$ (shown in dotted lines in Fig. 2) with ports E E′ in the cylinder-head B, (with corresponding ports in the cylinder-head B′,) which ports lead through the valve-chambers $b\,b'$ of the cylinder-head B and through corresponding valve-chambers $b^2\,b^3$ of the cylinder-head B′ to ports $e\,e'$, leading from the valve-chambers to openings at the end of the cylinders A A′, the port e leading to the opening F at the end of the cylinder A′ and the port e' to the opening f at the corresponding end of the cylinder A, while the passage-ways $e^2\,e^3$, corresponding respectively to the ports $e\,e'$, but located in the opposite cylinder-head B′, communicate with openings F′ f', leading into the corresponding ends of the cylinders A and A′, respectively. Attention is particularly called to the fact that the ports E and E′

open into the valve-chambers $b\,b'$ in different transverse planes, as clearly noted in Fig. 2, so that when the valves $c\ c'$ at the corresponding ends of the two cylinders are in positions—such, for example, as that shown in Fig. 2—one of the ports E E′ will be closed to its valve-chamber and the other open to its valve-chamber.

In a manner quite similar to the common inlet D and its connections with the valve-chambers $b\ b'$ in the head B, I provide a common outlet G with branches leading to the opposite heads B B′ and communicating through oppositely-extending passages H H′ in the head B (and through corresponding passages in the head B′) with the valve-chambers $b\ b'$ in the head B and with the valve-chambers b^2 and b^3 in the head B′. Attention is particularly called to the fact that the passage-ways H and H′ communicate with the valve-chambers in the head in different transverse planes, the passage H in the head B being in such relation to the port e that the two, H and e, will be simultaneously in communication with each other when the valve $c\ c'$ is moved to close the inlet-passage E, while the two, H′ and e', will be in communication with each other when the valve $c\ c'$ of the cylinder A′ is moved into position to close the inlet-passage E′. In fact, the ports $e\ e'$ are of such width that they are at all times in communication with either the inlet or outlet passage—*i. e.*, e is always in communication either with the inlet E or outlet H and the port e' is always in communication either with the inlet E′ or the outlet H′.

The operation is as follows: Starting with the parts in the position shown in Fig. 2, and supposing the cylinders A and A′ to be filled with liquid, the inlet-port E′ being open, the inflowing liquid will pass through the valve-chamber b' into the port e' and thence through the opening f into the cylinder A and will force the piston in that cylinder toward the opposite end of the cylinder, the liquid in the cylinder A escaping through the opening F′ at the opposite end of the cylinder into the port e^2, thence through the valve-chamber b^3 at the opposite end of the cylinder A′, thence into the outlet-passage H′ to the outlet G. As the piston a approaches the opposite end of the cylinder A, it will engage the valve $c\ c'$ and shift it, so as to open the inlet branch E in the head B to the port e and thence to the opening F at that end of the cylinder A′. The cylinder A is now filled with liquid between the head B and the piston a, and the piston a having been arrested in its movement no more liquid can flow into the cylinder A, and hence the inflowing liquid immediately begins to move the piston a' toward the opposite end of the cylinder A′ through the passage-ways E and e and opening F, above noted. As the piston a' moves toward the opposite end of the cylinder A′, the liquid in the cylinder A′ will be discharged through the opening f' at the head B′ and through the port e^3 to the valve-chamber b^2, thence to the passage-way H, which is now, by the shifting of the valve $c\ c'$ in the cylinder A, in open communication with the port e^3, and thence to the outlet. As the piston a' approaches the opposite end of the cylinder A′, it will engage the valve $c\ c'$ and shift it into position to open the inlet-port at that end of the cylinder and close the inlet-port at the opposite end of the cylinder. The liquid now flowing into the inlet-passage in the head B′ corresponding to the inlet-passage E′ in the head B will pass through the valve-chamber into the port e^2 and thence through the opening F′ to force the piston a back again into the position shown in Fig. 2, the liquid in the cylinder A being now discharged through the opening f, port e', chamber b', and passage-way H′ in the head B. As the piston a approaches the head B, it will shift the valve $c\ c'$ to close the port E and at the same time open communication between the passage-way in the head B′ corresponding to the passage-way E, and the inflowing liquid will straightway pass through the port e^3 in the head B′ to the opening f' and will force the piston a' in the cylinder A′ back toward the position shown in Fig. 2, the liquid in the cylinder A′ being now discharged through the opening F, port e, chamber b, and outlet-passage H. As the piston a' approaches the head B, it will shift the valve $c\ c'$ into position to open the port E′, and the operation which has hereinabove been described will be repeated. The successive discharge of the liquid from the cylinders in succession will continue so long as the supply of liquid under head is admitted to the inlet, the movable pistons in the cylinders serving in succession to automatically control the inlet and outlet of the liquid into and out of its companion cylinder. As the valves $c\ c'$ are alternately operated they carry with them the rods C C′ and for purposes of registering the amount of liquid which passes through the cylinders a registering device of any well-known or approved form may be so located and constructed as to be actuated by the reciprocating movement of one of the rods C C′, as, for example, the rod C. To practically provide for this it is simply necessary to know the amount of liquid which will fill the two cylinders, and, making that the unit of record, each advance stroke of the rod C may be made to turn a registering device one step and, the successive steps being recorded, the amount of liquid which passes through may be read from the register. For example, if the two cylinders hold combinedly one-half gallon of liquid each step of the recording device will correspond to one gallon, and if the register records forty steps of the registering pointer or wheel it will, of course, indicate forty gallons as the amount of liquid that has passed through. In the present instance I have shown, in connection with the reciprocating rod C, a registering device consisting

of a series of wheels K K′ K², the primary wheel K being under the control of a lever L, with an operating-pawl *l* and spring *l′*, and the lever L being itself actuated by the advance movement of the rod C. The wheels K′ K² may be so connected with the wheel K in any well known or approved manner, such as is common in adding and recording machines, each to move one step when the adjacent wheel has completed a full revolution—*i. e.*, if the primary wheel K is arranged to move one hundred successive steps to complete a revolution the second wheel K′ will move one step for every one hundred steps of the wheel K and the wheel K² will move one step for every one hundred steps of the wheel K′, or one step to ten thousand steps of the wheel K.

The particular form of register is not a part of my present invention, it being my intention to use, in connection with the cylinders and their moving pistons and valves, any suitable registering device which may be found most satisfactory for the purpose.

What I claim is—

1. A liquid meter, comprising a plurality of cylinders each provided with a movable piston, valves at the ends of the cylinders independent of the pistons throughout a portion of the stroke of the pistons and under the control of the pistons to be simultaneously operated at opposite ends of the cylinders as the piston approaches each end of the cylinder, inlets and outlets under the control of the valves, the inlet and outlet of a cylinder being under the control of the moving piston in a companion cylinder to keep the flow of liquid constant and means for recording the number of strokes of one of the pistons, substantially as set forth.

2. A liquid meter, comprising a plurality of cylinders each provided with a movable piston, valves at the ends of the cylinders, valve rods each connecting the valves at the opposite ends of the cylinder and having a sliding engagement with the piston of that cylinder, the said valves being under the control of the piston to operate them as it nears each end of the stroke and inlets and outlets under the control of said valves, the inlet, and outlet of a cylinder being under the control of the valves of a companion cylinder to keep the flow of liquid constant, substantially as set forth.

3. A liquid meter, comprising a plurality of cylinders each provided with a movable piston, valves at the opposite ends of each cylinder, rods connecting the said valves at the opposite ends of each cylinder, one of said rods extending through the end of the cylinder, the said rods having a sliding engagement with the pistons, the said valves being under the control of the piston as it nears the limit of its stroke to operate them, inlets and outlets under the control of the valves, the inlet and outlet of the cylinder being under the control of the valves in a companion cylinder and a recording device engaged with the projecting valve connecting rod, substantially as set forth.

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