(No Model.) 3 Sheets—Sheet 1.

P. SAMAIN.

LIQUID METER.

No. 325,975. Patented Sept. 8, 1885.

Fig. 1.

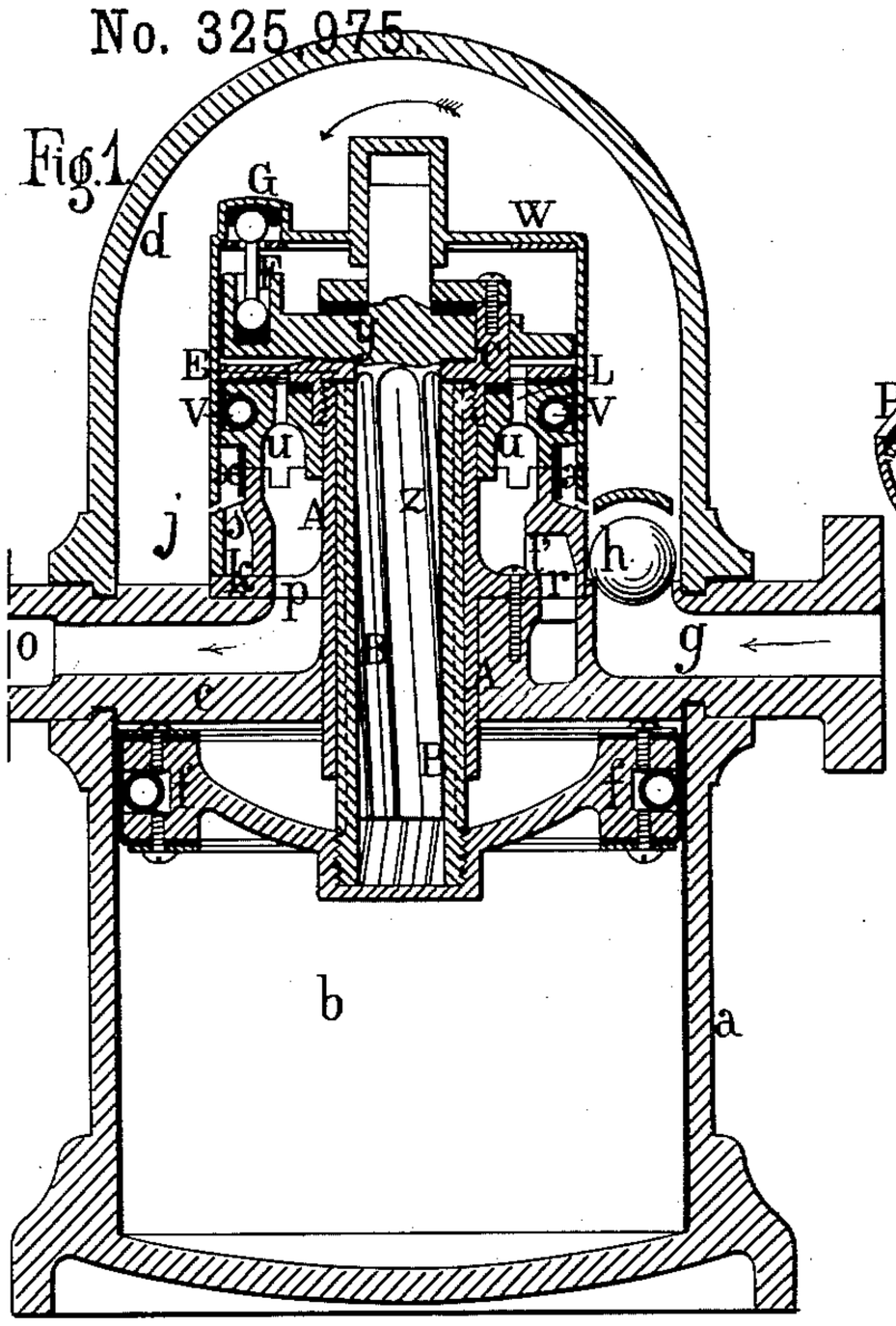


Fig. 2.

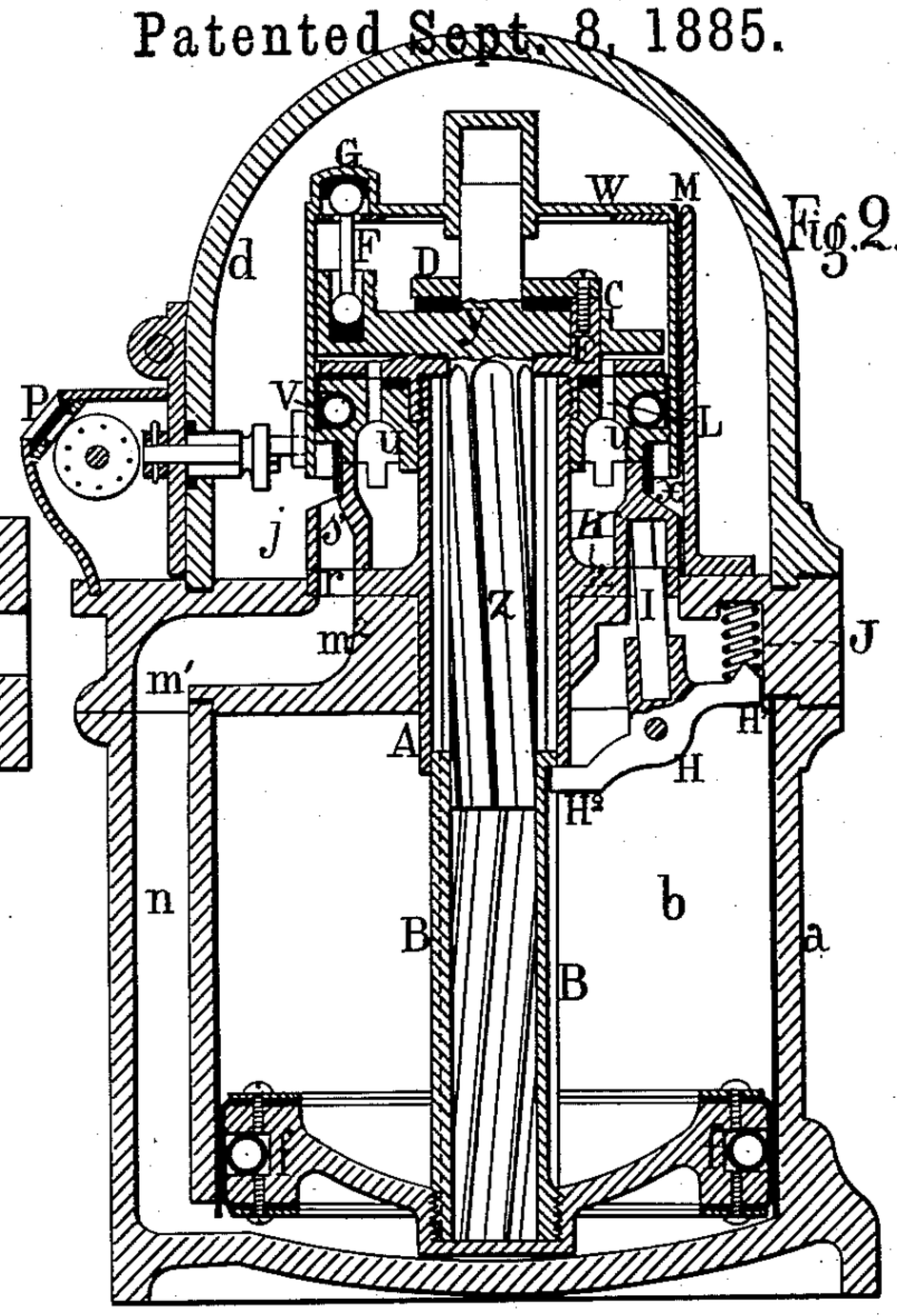


Fig. 4.

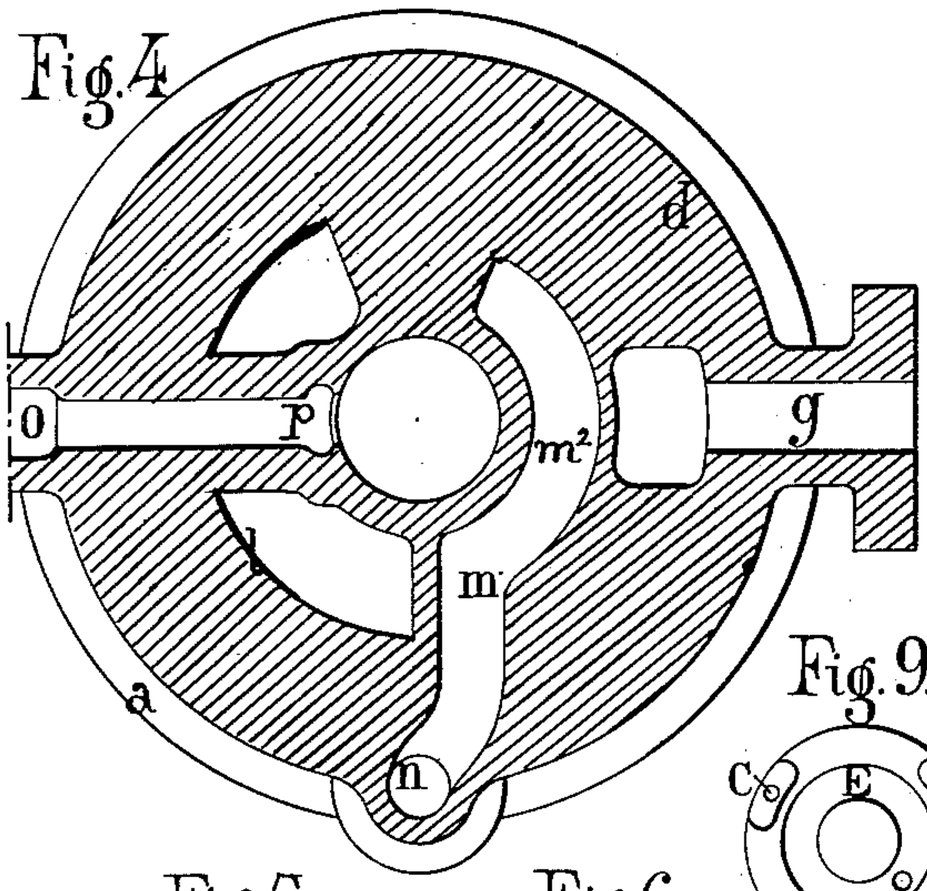


Fig. 3.

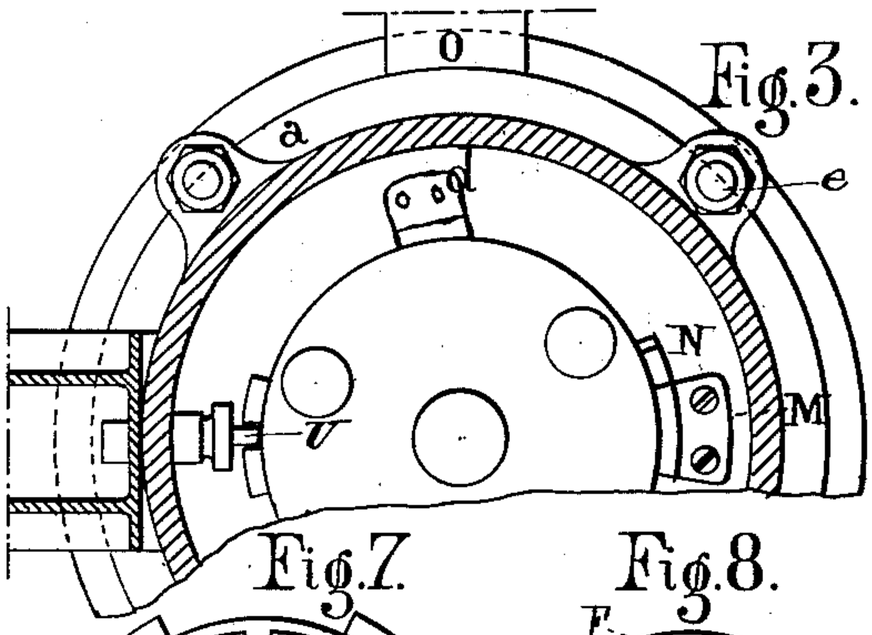


Fig. 5.

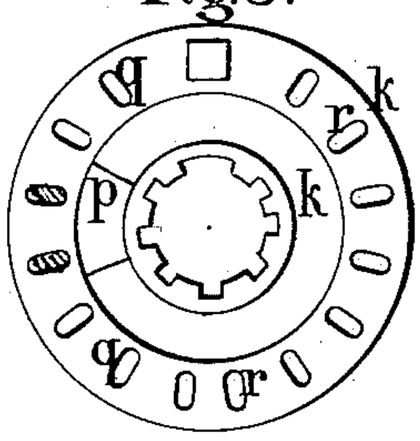


Fig. 6.

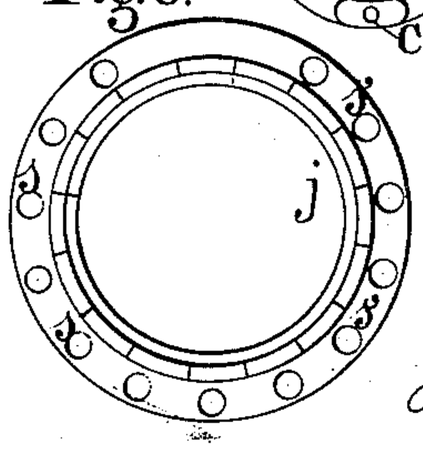


Fig. 9.

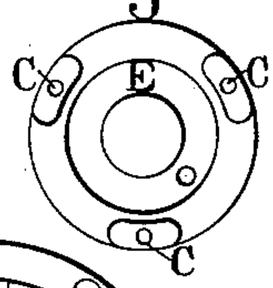


Fig. 7.

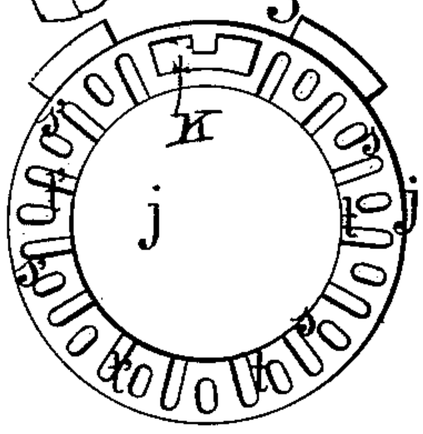
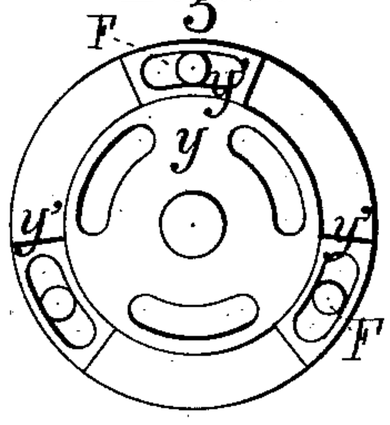


Fig. 8.



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(No Model.) 3 Sheets—Sheet 2.

P. SAMAIN.

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Fig. 11.

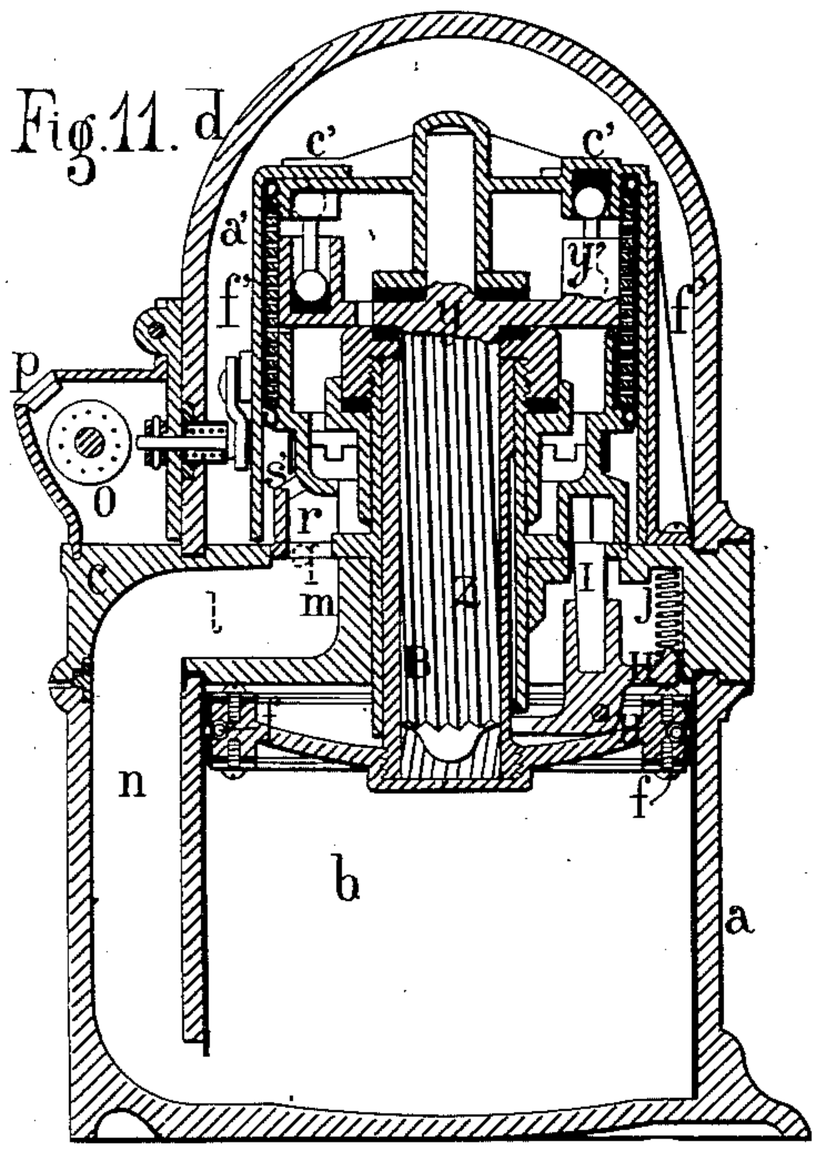


Fig. 13.

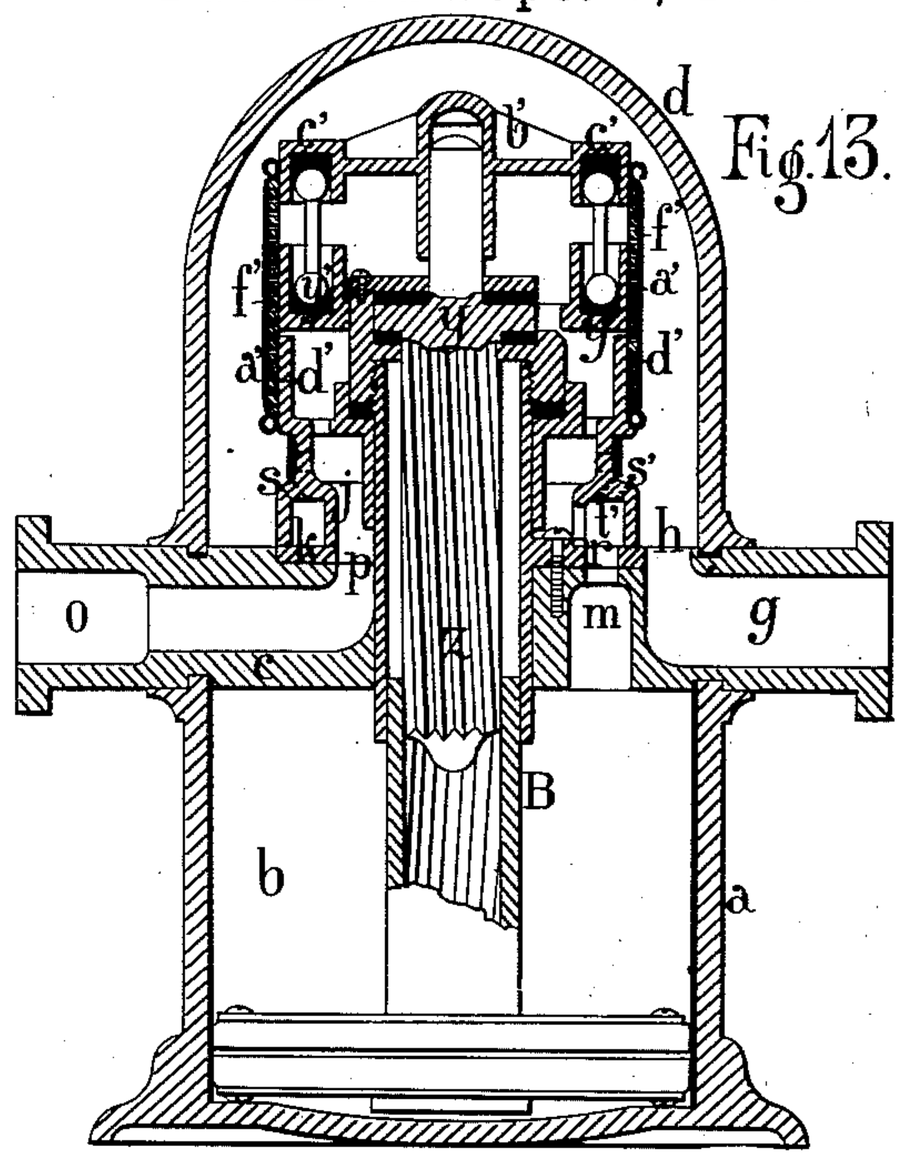


Fig. 12.

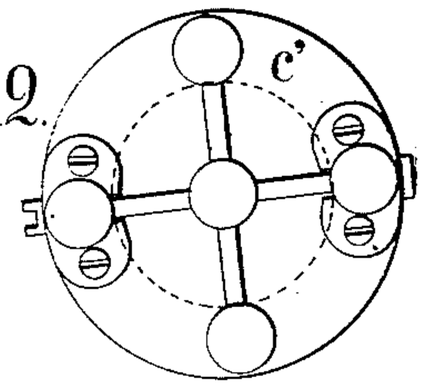
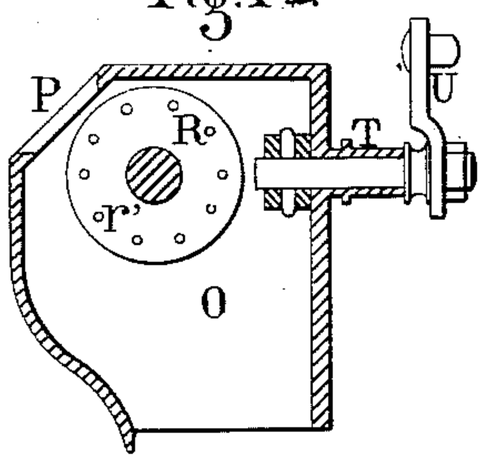


Fig. 14.



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(No Model.) 3 Sheets—Sheet 3.

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LIQUID METER.

No. 325,975. Patented Sept. 8, 1885.

Fig. 1a.

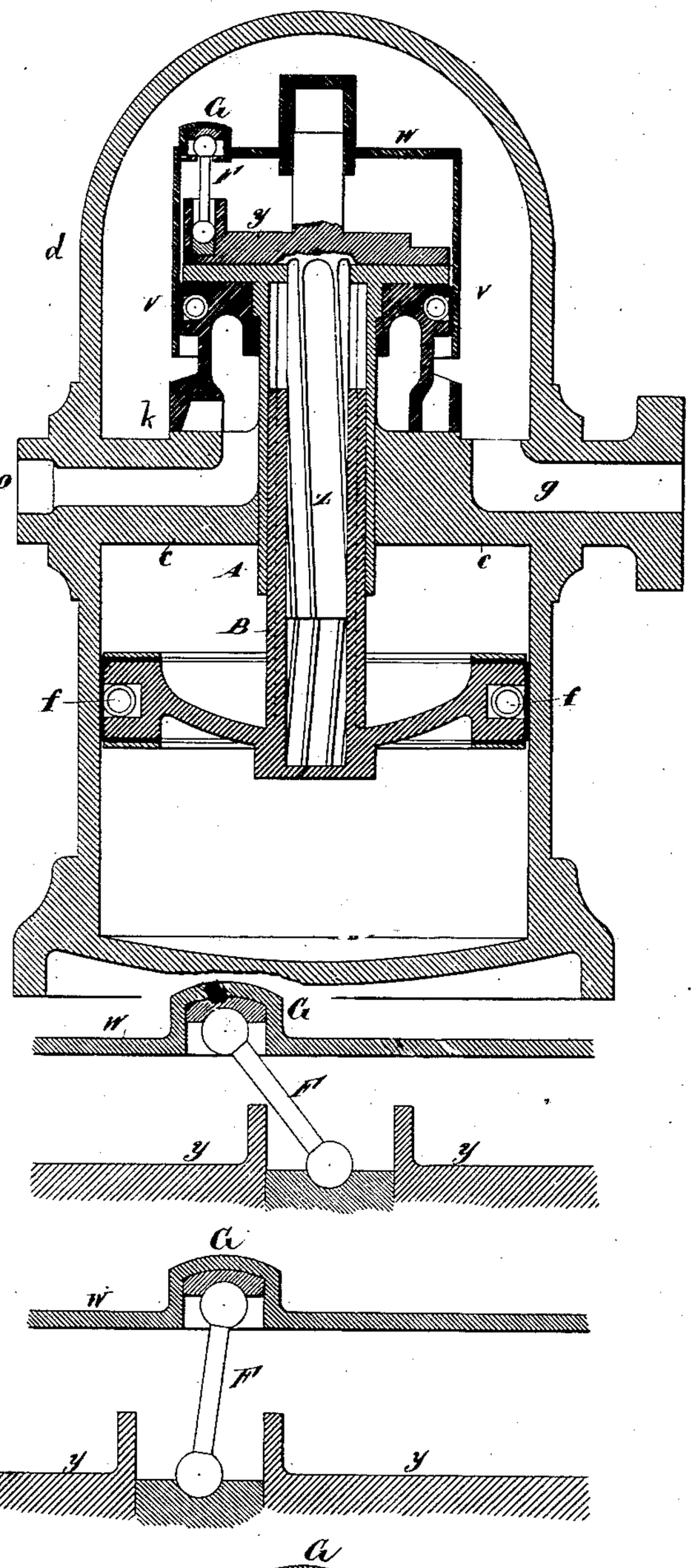
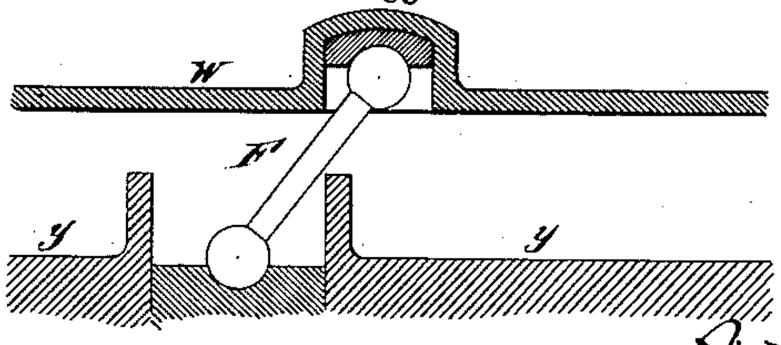


Fig. 1b.

Fig. 1c.

Fig. 1d.



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M. C. Dey

Inventor:
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UNITED STATES PATENT OFFICE.

PIERRE SAMAIN, OF PARIS, FRANCE.

LIQUID-METER.

SPECIFICATION forming part of Letters Patent No. 325,975, dated September 8, 1885.

Application filed April 14, 1884. (No model.) Patented in France October 28, 1882, No 151,794, and in Belgium March 23, 1883, No. 61,448.

To all whom it may concern:

Be it known that I, PIERRE SAMAIN, of Paris, in the Republic of France, have invented certain new and useful Improvements in Liquid-Meters; and I do hereby declare that the following is a full and exact description thereof.

According to my invention I construct the casing of the liquid-meter of three parts, viz: first, the measuring-cylinder, in which the measuring-piston reciprocates; second, an intermediate plate, formed with suitable induction and eduction nozzles, and with ports for the admission and the escapement of the liquid to be measured on either side of the measuring-piston; third, a dome superimposed upon said plate and inclosing the distributing-valve and its controlling mechanism.

The distributing-valve, according to my invention, is of annular shape, having an oscillating movement. Said valve is provided with four series of orifices—one for the induction of liquid to the space in the cylinder or measuring-chamber above the piston, one for the induction to the space below the piston, one for the eduction of the liquid contained in the measuring-chamber above the piston, and one for the eduction of such liquid from below the piston. Suitable mechanism is employed to cause the reciprocations of the valve to be effected at each end of the piston-stroke, and said mechanism is inclosed in a cap forming part thereof and subject to the pressure of the entering liquid, for the purpose of effecting the reversal when at the end of each stroke the measuring-piston has performed the preliminary operations. This inclosing-cap, in combination with an auxiliary piston, serves also to regulate the delivery in such manner as to insure a continuous stream of liquid at the discharge-nozzle. The cap does not close down tightly upon its seat.

Certain minor portions of the invention relate to the counter which I employ in connection with the meter apparatus.

The accompanying drawings form a part of this specification, and represent what I consider the best means of carrying out my invention.

Figure 1 is a vertical central section through my meter, showing the piston at the end of its upward stroke. Fig. 2 is a similar section at right angles to Fig. 1, showing the piston at the end of its downward stroke. Fig. 3 is a horizontal section through the dome, showing the valve-controlling mechanism in plan. Fig. 4 is a horizontal section through the central plate. Fig. 5 is a plan of the valve-seat. Fig. 6 is a plan of the distributing-valve. Fig. 7 is a bottom view of the same. Fig. 8 is a plan of one of the elements of the valve-controlling mechanism. Fig. 9 is a plan of another element of the valve controlling mechanism. This is on a smaller scale. (There is no Fig. 10.) Fig. 11 is a view of a modification. This figure corresponds to Fig. 1 as regards the position of the measuring-piston and to Fig. 2 as regards the plane of section. Fig. 12 is a plan of a portion of the valve-controlling mechanism shown in Fig. 11. Fig. 13 shows the same modification as Fig. 11, this view corresponding to Fig. 2 as regards the position of the piston and to Fig. 1 as regards the plane of section. Fig. 14 is a transverse section.

Fig. 1ª is a central vertical section showing a portion only of the apparatus. This will aid, in connection with the other figures, to make the action of those portions more clearly understood. The forms of the parts and the lettering are as nearly as practicable the same as in the fully-completed apparatus. Fig. 1ᵇ is a diagram showing a section on a larger scale. In this the piston is supposed to be moving, and may be at mid-stroke. Fig. 1ᶜ is a corresponding diagram showing the parts when the piston is at the end of its stroke and is about to give the necessary partial rotation to the valve to reverse the motion. Fig. 1ᵈ is a corresponding diagram showing the parts when the valve has been thrown and the action fully reversed, and the piston is ready to move in the reverse direction or has already commenced to move in such direction. It may be that the piston is already at mid-stroke.

Referring to Figs. 1 to 9, inclusive, the casing of the meter consists of three parts; first, the cylinder *a*, which may, if desired, be provided with a brass lining, *b*, and which is cast with an enlargement at the bottom, constituting a bed-plate; second, the plate *c*, in which are formed the induction, eduction, and

distributing ports, and, third, the dome *d*, which incloses the distributing-valve and carries also the counting mechanism. These three pieces are connected together by means of suitably-arranged bolts *e*.

The measuring-piston is rendered water-tight by means of the expanding tendency of a spiral spring, *f*, which is placed under the soft piston-packing, the latter being cup-leathers.

The liquid to be measured enters in the plate *c* through the nozzle *g*, and passes into the dome or upper chamber, *d*, through a passage provided with a check-valve, *h*, whereby the liquid is prevented from flowing backward in case the pressure on the receiving side should ever become lower than the pressure on the delivery side of the meter. From the chamber *d* the liquid passes into the measuring-chamber *a* through the annular distributing-valve *j*, Figs. 2, 6, and 7, the valve-seat *k*, and the ports *l m* in the plate *c*, one of which ports, *m*, communicates with a vertical passage, *n*, which latter opens into the measuring-chamber at its bottom, admitting the liquid below the piston. The measured liquid is delivered through the nozzle *o*, which communicates with the interior of the distributing-valve through the discharge-passage *p*. The circular stationary valve-seat *k* is fitted and forced into the plate *c*. This valve-seat is formed with two series of holes or ports, *q* and *r*, through which the induction and eduction takes place alternately. The ports *q* communicate with the orifices *l l* of the plate *c*—that is to say, with the measuring-chamber above the piston, while the ports *r* communicate with the measuring-chamber below the piston through the passage *m* of the plate *c*.

The distributing-valve *j*, Figs. 6 and 7, consists of a ring or crown, formed with two series of ports, *s s'*, through which the liquid enters into the measuring-chamber. This crown is also provided with two series of internal radial grooves, *t t'*, through which the delivery takes places. These ports or slots are combined with the ports in the valve-seat, so that the ports *s* allow the induction of the liquid through the holes *q* in the valve-seat, (see Figs. 5 and 7,) which latter communicate through the openings *t'* with the measuring-chamber above the piston, while the grooves *t* of the distributing-valve, which are also capable of communicating with the series of ports or holes *q*, allow the delivery of the measured liquid from above the piston into the space within the valve *j*, from whence it has free escape through the port O.

The ports *s'* of the distributing-valve communicate with the holes *r* of the valve-seat, and permit the induction of the liquid below the piston through the vertical passage *n*, Fig. 2, while the radial grooves *t'* of the valve permit the delivery of the measured liquid from below the piston. In short, the ports *s* and slots *t* operate the induction and eduction above the piston, and the ports *s'* and slots *t'* operate the induction and eduction below the piston.

The closing of the ports *q* and *r* of the valve-seat is effected by the full portions between the ports and slots of the distributing-valve. These portions are so arranged that the valve, by oscillating in one direction or the other, will simultaneously establish communication with the free space above the piston for the induction, and with the free space below the piston for the delivery, which always takes place through the common hole *p* in the valve-seat, which communicates with the delivery-nozzle *o*. The passage O, by traversing across under the series of holes *q*, necessitates that two or more of the said holes *q* be blanks or dummies; but there are enough of the holes to serve.

The upper portion or rim of the distributing-valve is cast in the shape of a crown—that is to say, it is formed with notches into which fit the projections of a piece, *u*, which latter forms a tight joint with the interior of the cap W, which will be described farther on. For this purpose the periphery of this piece *u* is provided with a packing, V, similar to that of the main piston, and the joint between this piece and the distributing-valve is covered with a rubber ring, *x*, to prevent at this point any leakage of liquid into the interior of said valve. The latter is held in place by means of a plate, E, (shown in detail in Fig. 9,) which allows only of a circular movement of the valve.

The working of the main piston is effected by the following combination of parts: In the axis of the apparatus, and firmly connected with the plate *c*, is a tube, A, which may be cast in one piece with the valve-seat *k*, and which serves as guide for the hollow rod B of the piston in the vertical reciprocating movement of the latter, the tube A being internally provided with straight vertical ribs, which fit into straight grooves formed in the rod B of the piston, thus preventing the latter from turning, while its vertical motion is not impeded. The interior of the rod B of the piston is formed with a screw-thread of very great pitch, and the angular deviation due to the length of the thread corresponding to the stroke of the measuring-piston is more than equal to the angle of oscillation of the distributing-valve *j*. The hollow piston-rod B serves as nut for the correspondingly-threaded solid rod, Z, which forms part of a plate, *y*, which latter forms, in a certain measure, the principal part of the valve-controlling mechanism, as will appear farther on. The piece is formed with ears or projections C, which traverse the plate *y*, and upon which, above said plate, is firmly fastened, by means of screws, a plate, D, so as to hold the rod Z in its place longitudinally. In consequence of this arrangement the plate *y*, which, as above stated, forms part of the rod Z, is capable of a circular movement only when, during the reciprocating motion of the main piston, the thread of the

rod Z is acted upon by the female thread of the hollow piston-rod B. This circular movement of the plate *y* effects the lifting of the cap W by means of a series of rods, F, as will be seen from the following.

The upper face of the plate *y*, Fig. 8, is formed with three depressions or seats, *y'*, (see Fig. 8,) in which are seated the lower rounded heads of three rods, F, the upper rounded heads of which are constantly engaged in the seats formed in the cap W, which latter covers the whole distributing and delivery apparatus. The fixed tube A serves also in a certain measure as axis of rotation for the cap W, which is being lifted during the stroke of the piston in consequence of the action of the rods F, which rise from an inclined into a vertical position, their heads pivoting in their respective seats; but this motion, first rising, is continued beyond the dead point or vertical position, whereby the pressure of the entering liquid, acting on the cap, is enabled to effect the rapid angular turning of the latter, and consequently by friction effects the turning of the distributing-valve. The distributing-valve immediately on the arrival of the piston at the end of its stroke effects the reversal of induction. An arrangement is provided whereby the piston liberates the valve only at the end of each stroke, the valve being held stationary during the entire stroke, both upward and downward. For this purpose the piston at the end of its upward stroke strikes against the arm H' of a three-armed lever, H, so that the arm I of said lever will be disengaged from the stop K, formed in the hollow in the lower face of the distributing-valve, Figs. 2 and 7. When the piston has finished its downward stroke, the piston-rod B strikes against the arm H^2 of the lever H, and thus again liberates the distributing-valve. A spiral spring, J, serves to return the lever H to its normal position as soon as the piston has begun its following stroke, and thereby again locks the valve in the proper position. In consequence of the vertical movements of the cap W the volume of the hollow spaces therein is alternately increased and diminished. The result of this is that by means of the top piece, *u*, of the valve, a certain quantity of the escaping measured liquid is drawn into said cap through the holes L, formed in the top part, *u*, and this liquid is again forced out during the moment when the general flow of liquid is interrupted. In this manner an uninterrupted stream at the delivery is secured, and the shocks due to back motion are avoided.

The operation of the apparatus and particularly of the distributing-valve is as follows: Supposing the piston to be at the beginning of its downward stroke, as in Fig. 1. Then the ports and passages *m r t'* are in communication with each other, and having provided other means to allow the liquid below the piston to escape through the interior of the distributing-valve—the hole *p* and the delivery-nozzle *o*—the induction-slots *s* are in communication with the holes *q* of the valve-seat, the orifices *l*, and the space above the piston. The piston descends. Its first action is to lock the distributing-valve by liberating the lever H, so that the arm I catches against the stop K, Fig. 7, which latter will not be liberated again until the piston has arrived at the bottom of its stroke. The interiorly-threaded piston-rod B descends vertically with the piston without rotation, and consequently compels the rod Z and plate *y* to turn. In the preceding movement a stop, N, fixed to the cap W, has been left bearing hard against the arm M, fixed to the plate *c*. The cap W, held by the stop N, can therefore not follow the rotary movement of the plate *y*, and consequently it (the cap W) is compelled to rise vertically. The rising of the rods F and cap W takes place during the early portion of the stroke of the piston. At the moment when the piston arrives at the end of its stroke the rods F stand inclined in the reverse direction sufficiently to give to the cap W, and consequently by the friction of the packing V to give to the valve *j*, a rotation in the reverse direction so soon as the valve is at liberty to yield thereto. At the extreme end of the stroke of the piston the arm I disengages the distributing-valve *j* by the operation of the lever H, and the valve *j* promptly turns and reverses the action. In other words, during the entire operation (the downward stroke of the piston) the pressure of the entering liquid has acted uninterruptedly upon the cap W, which now, in obedience to this pressure, descends immediately with a certain circular motion due to the rods F, which again assume an inclined position. This movement is instantaneously transmitted to the distributing-valve, whereby the distribution is reversed. The unmeasured liquid enters below the piston in place of the liquid which has been delivered, while the liquid above the piston which has found its way there during the downward stroke flows out in its turn through the delivery-orifice *l*, *q*, *p*, and O. At the end of this new upward stroke the operations above described are repeated.

During the rising movement of the cap W a certain quantity of the measured liquid is drawn into the space within said cap, and this liquid is forced out again during the reversal of the distributing-valve—that is to say, during the time when the general flow of the liquid is arrested at the end of each stroke of the piston. By this means a continuous stream is insured at the discharge-orifice *o*, and at the same time the shocks due to back motion are avoided. The action of the valve *j* may be further described as follows: The valve *j* performs a partial revolution in one direction and the other. In one position it puts the bottom of the measuring-chamber in connection with the interior of the dome *d*, through the vertical passage *n*, (see Figs. 2 and 4,) radial passage *m'*, semicircular channel m^2, series of ports *r*, and corresponding series of ports, *s'*, in

the valve, while the upper end of the measuring-chamber is in communication with the discharge-passage *o*, through the vertical passage *l*, (see Fig. 4,) series of radial grooves *t*, the hollow interior of the valve *j*, and the port *p*. In the opposite position it reverses these conditions, putting the lower end of the measuring-chamber in communication through the passage *m m' m²*, ports *r v t'*, the interior of the valve *j*, and grooves and port *p*, with the discharge-nozzle *o*, while the upper end of the measuring-chamber is put in communication with the chamber *d* through the port *m*, apertures *r*, and the corresponding series of apertures *s'* in the valve.

The cap W must be elevated, as shown in Fig. 2, to allow the liquid to flow very freely from the dome *d* into the valve; but it should be lowered into the position shown in Fig. 1 during certain periods to retard the flow. This is effected by the engagement of the quick spirals, analogous to rifle-grooves, on the interior of the hollow piston-rod B and on the exterior of the inclosed rod Z.

The piston-rod B is prevented from rotating by straight grooves on its exterior, which engage with corresponding straight internal ribs on the inclosing casing or fixed tube A. At each ascent of the piston-rod B it partially rotates the rod Z. This, by means of the attached plate *y*, acts through the toggles F to turn the cap W, and also to raise and lower it. The turning motion of the cap W acts through the friction induced by the packing V to induce a strong tendency to turn the valve *j*. This is resisted by the locking means above described, until the end of the stroke of the piston. Then it is suddenly liberated, and the valve turns to the proper extent. Each descent of the piston-rod B partially rotates the inclosed rod Z in the opposite direction, inducing a corresponding tendency to turn the valve *j* in the opposite direction, which is at first resisted, but finally allowed to act at the end of the stroke as before.

It will be seen from the foregoing that the movable cap W performs the following functions: First, it controls the distributing-valve; second, it insures the continuity of the discharge-stream; third, it prevents the shocks due to back motion; fourth, it operates the counting mechanism to register the quantities of liquid measured, as will be seen below.

Since the volume of liquid displaced by the piston at each single or double stroke is known, it is only necessary to register the number of strokes in order to ascertain the volume of liquid discharged in a given time. For this purpose I employ a counter, O, arranged on the side of the dome *d*, and composed of figure-wheels showing the units, tens, hundreds, &c. The inclined position of the opening P, through which the readings are taken, allows this operation to be performed either by looking down from above or by looking in a horizontal direction, which fact allows of a wide range of positions in which the meter may be conveniently placed.

I apply any suitable counting mechanism to the device, and arrange that it be operated by the meter.

Figs. 11 to 13 show a modification of my liquid-meter, which is more especially intended for measuring alcoholic liquors, wines, &c. As will be seen from the drawings, this meter contains the same elements as the one above described, and the operation is exactly the same. The only difference is in the cap covering the valve mechanism, which cap in this case is made of elastic rubber. It is supported interiorly by an extensible metallic lining, which prevents it from collapsing under the pressure of the entering liquid, while allowing it to expand in a vertical direction. This extensible cap performs in this case the same function as the small piston above the valve in Figs. 1 and 2, viz: It draws a portion of the measured liquid into the space within, whereby the continuity of the stream at the delivery-nozzle is insured. The distributing-valve in this modification is also controlled by means of a piece operated by the rods with rounded heads, of which in this case there are four, as shown in Fig. 12. The connection with the counter is effected in the same manner as above described, and the counter itself is preferably of the construction above set forth.

As will be seen in the figures, the rubber cap *a'* is at its upper end firmly fixed to the periphery of the movable bottom piece, *b'*, which corresponds to the bottom of the cap described with reference to Figs. 1 to 9, and carries, as shown in Fig. 12, four bearings, *c'*, in which are seated and pivoted the rounded ends of the rods F. The lower rim of the cap *a'* is fixed to the annular piece *d'*, arranged above the distributing-valve, which piece *d'* can in no case move vertically, its only motion being circular, like that of the valve by which it is completely controlled. It will be seen, now, that the rubber cap *a'* is firmly attached on one side at the top to a movable piece or bottom, and on the other side at the bottom to a stationary piece. The result of this arrangement is that the rubber can expand and contract, according to the position of the rods F, so as to increase or diminish the space within to produce the necessary suction to draw in a portion of the measured liquid for preserving the continuity of the stream.

It will be understood that, as in the foregoing case, the rods F are inclined by the angular displacement of the plate *y*, carrying the bearings for the lower ends of said rods, there being in this case four bearings, corresponding to the number of rods. The pressure of the entering liquid on the part *b'* causes, as in the first case, the movements of the distributing-valve, the reversal of the latter being instantaneous. In order to pre-

vent the rubber *a'* from collapsing under this pressure it is lined interiorly with a sort of metal frame formed of rings or spirals, which are capable of contracting or expanding according to the contraction or expansion of the rubber. This latter performs, therefore, the same functions as the cap W in the foregoing case, but in the present case the rubber also constitutes the element equivalent to the small auxiliary piston of the first case.

The other elements of the meter constructed according to this modification are the same as above described with reference to Figs. 1 to 9. The admission of the liquid above or below the measuring-piston is effected in the same manner by a corresponding distributing-valve. The counter, also, is the same as above described.

I claim as my invention—

1. In a liquid-meter, the combination of an annular distributing-valve capable of an oscillating motion on its axis and having slots formed in its interior surface, with a valve-seat having two series of ports capable of being alternately placed in communication with said slots by the oscillation of the valve, substantially as herein set forth.

2. The combination, with an annular distributing-valve and its seat and a cap inclosing the same capable of imparting rotary motion to the valve, of a measuring-cylinder and piston and suitable mechanism, as B Z *y* F, for controlling said cap, substantially as herein specified.

3. The combination of the stationary guide-tube A, having one or more vertical ridges on its interior surface, the piston-rod B, having corresponding grooves exteriorly and being threaded interiorly, and the threaded rod Z, carrying the plate *y*, with the valve-controlling cap W, and the rods F, having their upper and lower ends seated, respectively, in said cap and in the plate *y*, and with means, as M N, for limiting the angular motion of said cap, substantially as described.

4. The combination, with the annular distributing-valve having a stop, K, of the three-armed lever, H, arranged to lock the valve in position in ordinary circumstances, but to liberate it at the end of each stroke of the main piston, substantially as set forth.

5. The combination, with the measuring-cylinder and the valve-seat having two series of ports, of the oscillating valve having slots and passages, as shown, to operate in connection with the ports in the cylinder alternately, and the central plate, *c*, having inlet and outlet passages, as set forth.

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

PIERRE SAMAIN.

Witnesses:
ROBT. M. HOOPER,
EUG. DUBOIS.