(No Model.)

3 Sheets—Sheet 1.

J. A. TILDEN.

ROTARY FLUID METER.

No. 385,970.

Patented July 10, 1888.

Fig. 1,

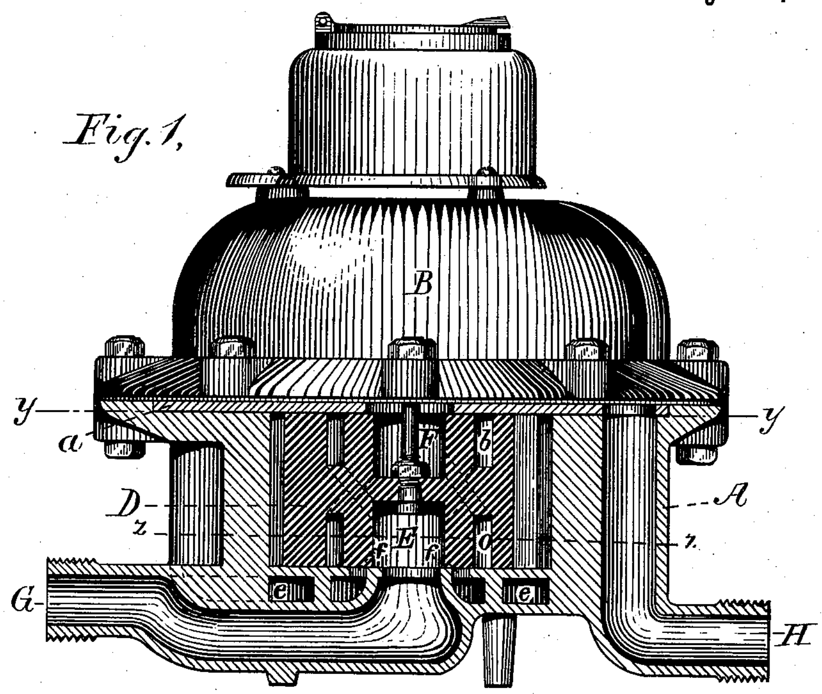
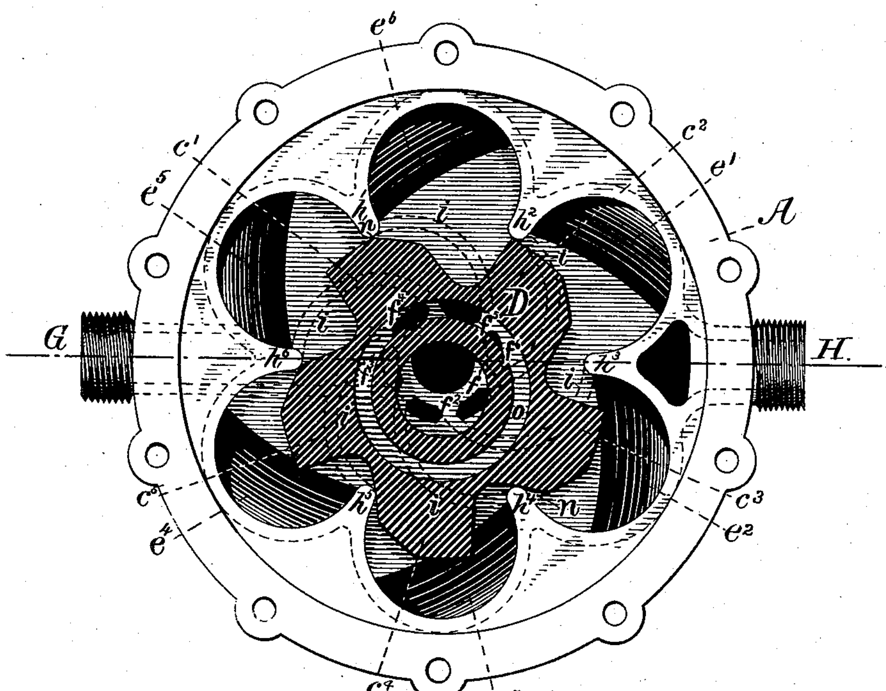


Fig. 2,



Witnesses:

J. M. Dolan.

Fred. B. Dolan.

Inventor;

James A. Tilden,

by his attys

Clarke & Raymond.

(No Model.)

3 Sheets—Sheet 2.

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Fig. 3.

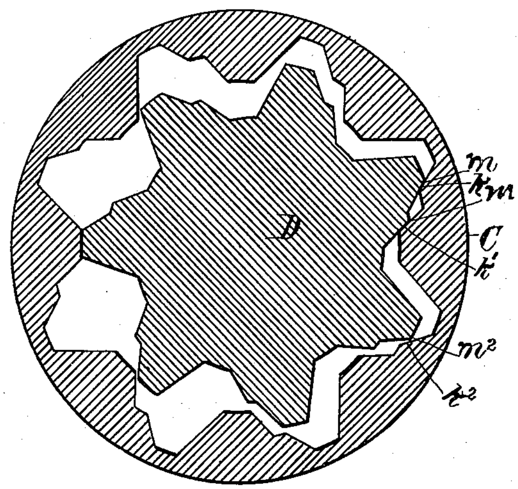
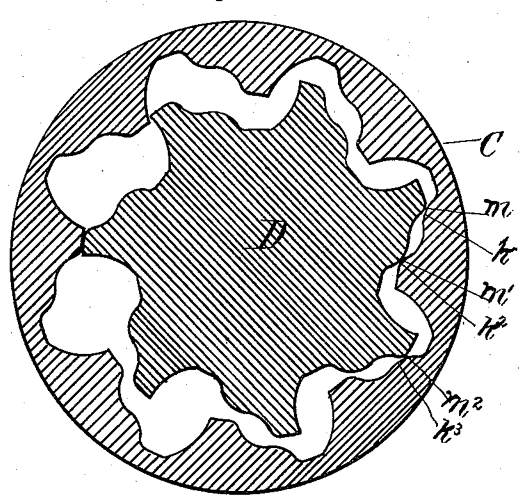


Fig. 4.



Witnesses:

J. M. Dolan.
Fred. B. Dolan.

Inventor;

James A. Tilden,
by his attys
Clarke & Raymond.

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3 Sheets—Sheet 3.

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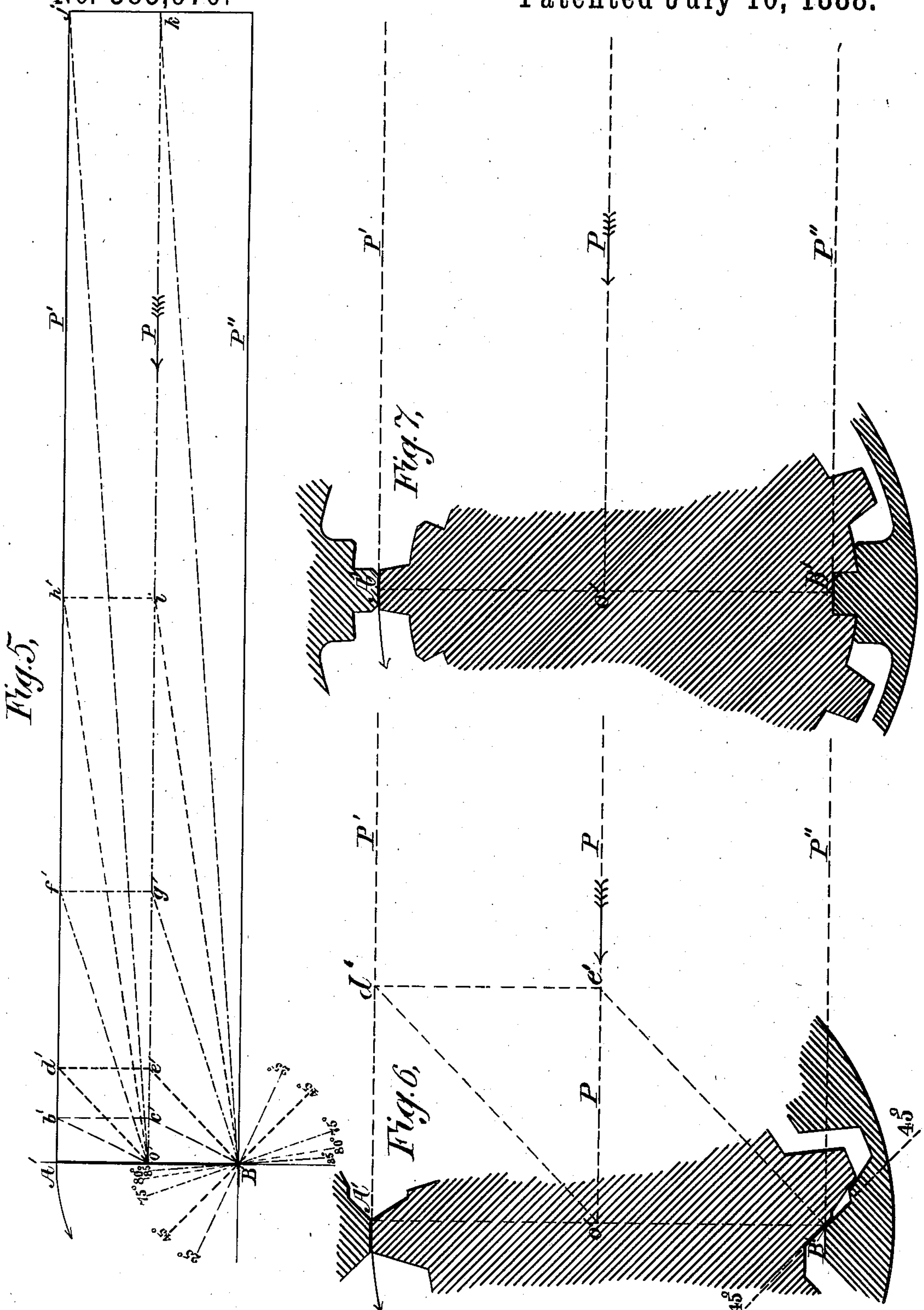

Witnesses:

J. McDolan.

Fred. B. Dolan.

Inventor.

James A. Tilden.

by his attys Clarke & Raymond.

UNITED STATES PATENT OFFICE.

JAMES A. TILDEN, OF HYDE PARK, MASSACHUSETTS, ASSIGNOR TO THE HERSEY METER COMPANY, OF PORTLAND, MAINE.

ROTARY FLUID-METER.

SPECIFICATION forming part of Letters Patent No. 385,970, dated July 10, 1888.

Application filed January 25, 1887. Serial No. 225,480. (No model.)

To all whom it may concern:

Be it known that I, JAMES A. TILDEN, of Hyde Park, in the county of Norfolk and State of Massachusetts, a citizen of the United States, have invented a new and useful Improvement in Fluid-Meters, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification, in explaining its nature.

This invention relates to an improvement in fluid-meters. In my improvement I employ a piston adapted to have an eccentric or side rocking motion across the cylinder-chamber to effect its division at two or more parts into receiving and discharging spaces. In order to diametrically divide the cylinder-chamber into receiving and discharging spaces, and to maintain a constant division during the continual changing of the piston, the relative shape of the piston and cylinder is such that a constantly-changing point of contact is secured as a bearing upon which the piston rocks. In all forms of meters of this class so far constructed the relative shape of the piston and cylinder-chamber has been such that the several contact-bearings in performing their function brought at each rocking-point such a division of the cylinder as to cause the piston to be rigidly confined in its movement upon these points. It will be readily understood that in this construction the lodgment of the slightest particle of material—such as sand, pipe-scale, or other substance contained in water—will thoroughly wedge and lock the piston, and under heavy pressures of water breakage of the piston will occur. It is to overcome the defect existing in this class of meters that my invention is intended, and to accomplish this result I adapt the piston to the cylinder in such a manner that it is free or confined upon its contact-points by hydraulic action instead of by actual mechanical confinement. The adaptation of this feature to the class of meters in which a piston having projecting lobes conforming to corresponding recesses in the cylinder-chamber and moving only in their corresponding recesses is fully set forth in my Reissue Patent No. 10,778, November 2, 1886. It is the application of this feature to the class of meters in which a piston rocks upon continually-changing points or lines of contact with the cylinder-chamber, and in which the alternating projections and recesses upon the piston are less in number than in the cylinder, that constitutes my invention.

Referring to the drawings, Figure 1 represents an elevation of a meter containing my improvement. Fig. 2 is a plan of the same on the lines *y y* of Fig. 1, showing the piston in section on the lines *z z*. Fig. 3 represents another form of piston and ring, in which are a larger number of contact bearing-points upon which the piston rocks. Fig. 4 represents a similar form having curved surfaces on the piston and ring. Fig. 5 is a diagram illustrating the parallelogram of forces as applied in the operation of the meter. Fig. 6 is a detail of the piston and ring, showing the application of the parallelogram of forces as acting upon the piston in the form contained in my invention. Fig. 7 is a detail of a piston and ring, showing a diagram of forces as acting upon a piston of a form used in the prior state of the art.

A, Figs. 1 and 2, forms the inclosing-case for the piston, the same being provided with alternate projections and recesses, and having an inlet-passage, G, for conducting the water to the center of the case.

B is the cover which incloses the parts, and which forms a chamber for the water which has passed through the measuring-spaces, and from which it is conducted by the outlet-passage H. The case A is formed in such a manner that there are six projections, $h' h^2 h^3 h^4 h^5 h^6$, having between them six recesses. The bottom of the case is provided with conducting passages or ports extending from openings in each recess to a corresponding opening in the center of the case surrounding the inlet-passage, said ports being divided by walls or divisions *i i i i i i*. This arrangement of ports or passages is such that they are governed in the inlet and outlet of the water by the valve, which also forms the operating-piston. The piston D is made of hard rubber, having five projections, $c' c^2 c^3 c^4 c^5$, and five corresponding recesses, which are of such a form that a plane passing through from the end of one projection to the side of the one opposite will divide the cylinder-case at n n. The inlet-passage G and cavity E conduct the water to three of the port-openings in the center of the case, $f' f^2 f^3$. These ports conduct the water to corresponding openings, $e' e^2 e^3$—that on the right of n n being open to the inlet and that on the left of n n being open to the outlet. By referring to Figs. 1 and 2 the outlet-passages and their method of operation will be understood. In the piston is an annular space, o, which has communication through holes drilled in it to the open space F in the center of the upper side of the piston represented by the dotted lines. When the ports $f^4 f^5 f^6$ are open to the annular space, the water is conducted from the outlet-division of the case through the openings $e^4 e^5 e^6$ to openings $f^4 f^5 f^6$ through the holes in the annular space to the cavity F and chamber formed by the cover to the outlet-passage H. This system of porting is duplicated in a plate on the top of the piston, which incloses the piston in the cylinder-chamber, so that a balanced action of the piston is obtained. By referring again to Fig. 2, it will be seen that in the position of the piston as shown, and with the action of the pressures as shown, when water is drawn from the outlet-chamber, the excess pressure upon one side of the piston acts to rock the piston successively upon the points or projections n.

It will be observed that the form or edge of the piston at n does not confine the piston, but that it is free to slide or push out of place should anything get between the opposite abutment, and that it entirely depends upon the action of the water to cause it to work over the point n and upon the pressure of the water to maintain the division of the case.

It will be seen that the piston is entirely free for a considerable space, it being limited only by the depth of the recess in the piston. This can be governed in any construction to the size of the port; or, in other words, it can be formed so as to allow all the sliding motion or freedom that is necessary to pass any substance that the ports will admit into the meter.

I do not limit myself to the precise form here shown, as the form will depend to some extent upon the number of projections upon the piston and to the shape and manner of forming the cylinder-chamber.

To accomplish the object of my invention, it is necessary to form the projections relatively upon the piston and cylinder-chamber in such a manner that the point of contact upon which the piston rocks shall be behind the direction of rotation, and in such a manner that there shall be no shoulder upon the piston to confine the rocking-point, but that the rocking-point will at all times be maintained by the direct action of the water.

It will be readily seen that this invention consists in the relative formation of the piston and cylinder-chamber in such a manner that the piston is in no way confined in its division of the case into separate chambers by a strictly mechanical path, but that the proper division of the case into supply and exhaust chambers depends entirely upon the hydraulic action, it being governed by the system of ports so arranged as to properly dispose the water in the measuring parts. By means of this invention the defects heretofore contained in this class of meters are wholly done away with—that is, the liability of its being stopped or locked by any foreign substance getting into the working parts of the meter; and, further, that it is self-compensating in its wear—that is, all contact-points of the piston and cylinder-chamber wear alike, and the piston is free to follow up this wear and still maintain its form to properly operate, while in other forms, where the piston is confined in its path of movement, the lines of division will be shortened by wearing the ends of the piston projections, and allow the water to leak or pass unregistered.

To still further illustrate the scope of my invention, I will describe certain peculiarities in relation to the bearing-points over which the piston rocks.

An inspection of Figs. 3 and 4 and Diagrams 5 and 6 will show angular rocking-points, by which there is a wedging effect sufficient to produce contact in the operation of the piston between the rocking-point B, Fig. 5, and abutment A. This same angular or wedging effect will be found in Fig. 2; but in these forms of meters there is but one contact-point made by the piston in rotating from one recess into another. In these forms it is evident that a somewhat harsh action takes place in the operation of the meter, owing to the few points of contact made during a rotation of the piston. A preferable form of construction is therefore shown in Figs. 3 and 4. Referring to Fig. 3, it will be seen that in each recess in the cylinder case are two angles, as indicated in one of the recesses at k and k'. There are also upon corresponding sides of the piston projections two angles. The angles upon the side of the recesses are formed at forty-five degrees to the diametric division made by the piston when it has made its contact-bearing.

It will be seen that when the contact-point m has its bearing on the angular surface k the piston can rock on that point until the second contact-point, m', has a bearing upon the angular surface k', which is at forty-five degrees to the diametric division made by its contact. The piston then rocks on this point until the next contact-point, m^2, has its bearing upon the angular surface k^2. This operation continues, forming continuously-changing contact-bearings for the piston to rock upon, each contact-point causing the piston to diametrically divide the case in two chambers.

It will be seen that the relative form of the piston and cylinder-case is such that the contact bearing-points are not mechanically defined, but that they are unconfined for a considerable space, so that the actual contact-bearing will be at a point upon the angular surface governed by the hydraulic action and upon the abutment—that is, should anything get between the piston and its abutment on the opposite side the contact-bearing will be made lower on the angular surface, or should the projections on the piston become worn the contact-points will be higher up on the angle; in other words, the piston is free for a considerable space. This space can be governed by the relative formation of the piston and cylinder-case, and can be sufficient to allow the passage of any foreign substance that the meter is liable to admit to its working parts. Other angles than forty-five degrees may be used in the formation of the parts, and should be that most suitable to the operation of the meter, and it will be further considered in the following illustrations. It will be seen that in the construction a larger number of contact bearing-points are presented, and therefore a very easy and smooth operation of the meter is obtained.

Fig. 4 represents a similar construction to Fig. 3, with the exception that curved surfaces are formed upon the piston and cylinder-case instead of angular surfaces.

To clearly demonstrate the precise operation of the meter and the difference of its operation over the forms at present known to the state of the art, I have constructed in Fig. 5 a diagram of the parallelograms of force as applied to this form of meter. By referring to Fig. 5, A′ B′ represent a line of diametric division of the cylinder-case or the operating-piston upon which the hydraulic force P acts. O′ is any point upon the piston at which the force is directed, as indicated by the arrow. If now an angular surface (for instance, that represented in the dotted lines indicated by twenty-five degrees) is presented to the point B′, and upon which the piston is to rock, swinging by the abutment at A′, and it is desired to know the relative contact and rotative effects in its operation, pressure P (represented by rotative effect c′ o′), may by the parallelogram of force be resolved into c′ b′, or pressure at right angles to A′ and c′ B′, or pressure at right angles to B′, (twenty-five degrees.) It will thus be seen that the relative rotative and contact effects are as c′ o′ to c′ b′ and c′ o′ to c′ B′. As the angular surfaces at B′ are changed, the parallelograms of force become relatively different—that represented by the angle forty-five degrees producing a rotative effect, e′ o′, and contact effect e′ d′. As the angle approaches ninety degrees to the direction of force, a greater difference of relative effects appears. For instance, at the angle eighty-five degrees there is an excess rotative effect, k′ o′, over the contact effect k′ j′. When the angle of ninety degrees is reached, the lines of parallelogram disappear, and there is rotative effect wholly and no contact-pressure.

Further reference to the operation of the piston will be understood by referring to Fig. 6, which represents a portion of my improved piston.

It will be seen that the angles upon the cylinder-case are formed here at forty-five degrees, the corresponding angles upon the piston projections being such as to present a contact-point which finds its bearing upon the angular surface, where the bearing is made and during its rocking and until another point of contact is made. This forms the diametric division of the case at A′ B′.

It will be seen that in constructing the parallelogram of force there is an equal division of the pressure effects, pressure P here represented by rotative effect e′ o′ and contact effect e′ d′, the contact-pressure effects being divided into e′ B′ contact-pressure to maintain the piston against the angle, and e′ d′ to maintain the piston against the abutment. By this construction it will be readily understood that the piston can be less in diameter than that actually necessary to diametrically divide the case, thereby making it possible to move the piston away from its abutment, and it will return by the action of the water-pressures when the resistance to its contact is removed; and it will be observed by referring to Fig. 7, in which the surface presented is at ninety degrees to the direction of force, there is and must be a perfect mechanical fit to divide the case diametrically, and that the pressure is wholly rotative. It is impossible for the piston to assume any position in the cylinder-case other than that which it is confined to by mechanical fit. In my invention there exists a free compensating piston, as clearly shown by the several illustrations, while that shown in Fig. 7 has inherent in its principle a mechanically-confined piston and an uncompensating construction.

It will be seen from the foregoing that it is quite essential to the advantageous working of my improved form of free hydraulically-maintained piston that each projection, both on the piston and casing or chamber, shall have its bearing-surface upon the end and one side only, for if there is a bearing upon both sides of the projection, after the manner of the tooth of a gear and like the ordinary practice heretofore, there will be a locking and mechanical rigidity which it is the very object of this improvement to do away with. Division-contact thus takes place between opposing end projections on the one side and opposing side surfaces on the other side in distinction to the end contacts on both sides hitherto used or shown. For the best working of the device there are frequently two or more end projections in contact on the same side and two or more side surfaces in contact on the opposite side, as shown. This insures a greater uniformity and ease of action. The angular side bearing-surface may be on either the piston or casing, or on both, but always in such a manner that the piston may be free and have the hydraulic division-contact, as fully set forth.

I do not limit myself to any particular number of contact bearing-points, or points forming diametric divisions of the case by the piston, as the same may be so constructed as to present three or more angular surfaces upon each recess in the side of the cylinder-case, having three or more contact-points upon each piston projection.

I do not in any way claim as my invention the construction of a meter having a piston adapted to have an eccentric or side rocking motion across the cylinder-chamber to effect its division at two or more points into receiving and discharging spaces.

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States—

1. In a water-meter, the combination of a casing forming a piston-chamber and having projections extending into the chamber to form measuring spaces or recesses, each of which projections has a bearing surface at its end, with a piston having a series of projections, each of which has a bearing-surface at its end and an angular bearing-surface upon one side, as and for the purposes described.

2. In a water-meter, the combination of a casing forming a piston-chamber and having projections extending into the chamber to form measuring spaces or recesses, each of which projections has an angular bearing-surface upon one side, with a piston having a series of projections, each of which has an angular bearing-surface upon one side, as and for the purposes described.

3. In a water-meter, the combination of a casing forming a piston-chamber and having projections extending into the chamber to form measuring spaces or recesses, each of which projections has an angular bearing-surface upon one side, with a piston having a series of projections, each of which has a bearing-surface at one end and upon one side, as and for the purposes described.

4. In a fluid-meter, a casing forming a piston-chamber having a series of projections extending into the chamber to provide measuring spaces or recesses, each of which has an angular bearing-surface upon one side, as and for the purposes described.

5. In a fluid-meter, a piston having a series of projections, each of which has an angular bearing-surface upon one side, as and for the purposes described.

6. In a fluid-meter, in combination with suitable inlet and exhaust ports, a ring contained in the meter-case and having projections from its inner side, and forming, in connection with the port-plates, the piston-chamber, each of which projections has an end bearing-surface and a side bearing-surface, with a rotary piston contained in said chamber, having projections, each of which has an end bearing-surface and a side bearing-surface, and which piston and ring co-operate upon the rotation of the piston to divide the piston-chamber into receiving and discharging spaces by the contact at one point of the end bearing-surfaces of a piston and ring projection, and at another point of a sliding contact between the side bearing-surface of one ring projection and the side bearing-surface of a piston projection, substantially as described.

JAMES A. TILDEN.

In presence of—

F. F. RAYMOND, 2d,

J. M. DOLAN.