

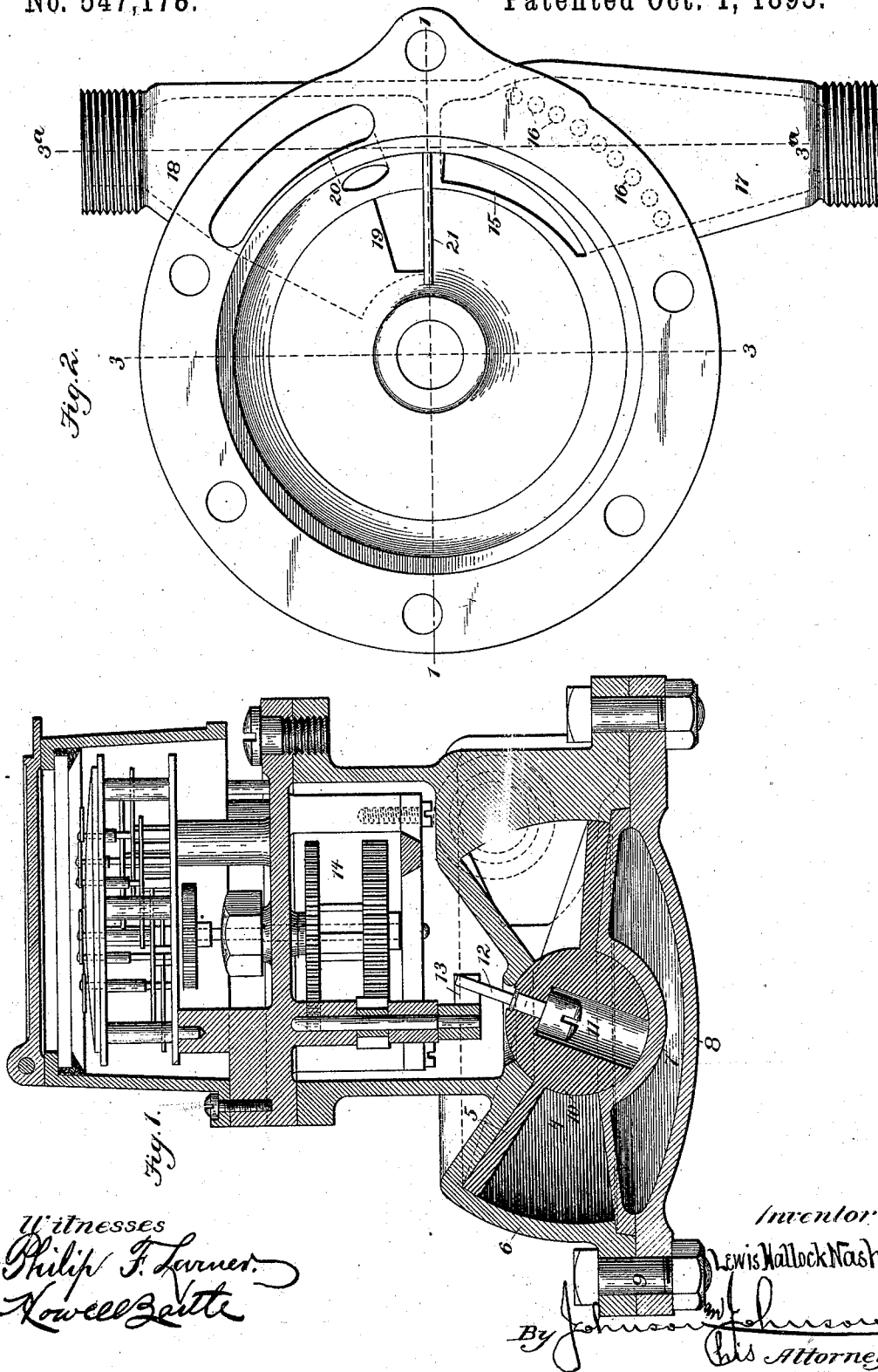
(Model.)

3 Sheets—Sheet 1.

L. H. NASH.
DISK WATER METER.

No. 547,178.

Patented Oct. 1, 1895.



Witnesses
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Kowee Zette

Inventor
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His Attorneys

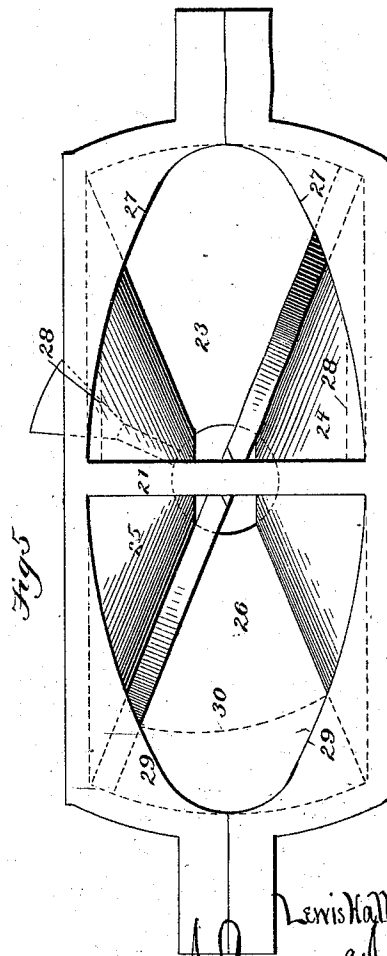
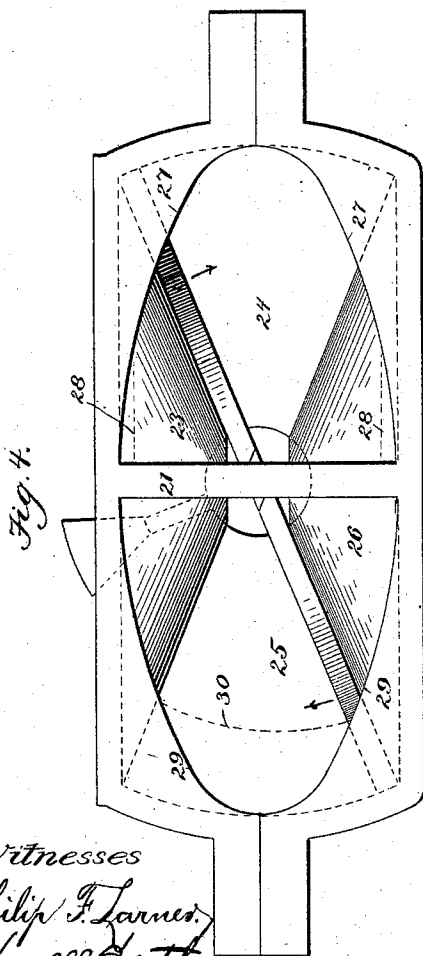
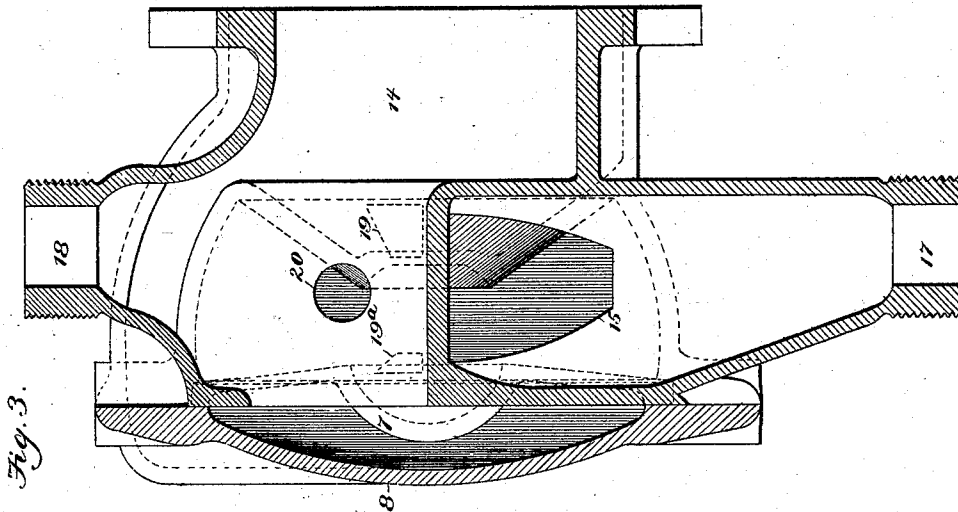
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3 Sheets—Sheet 2.

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3 Sheets—Sheet 3.

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Fig. 7.

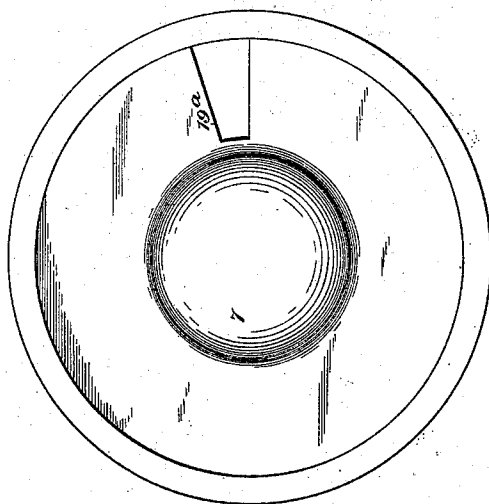
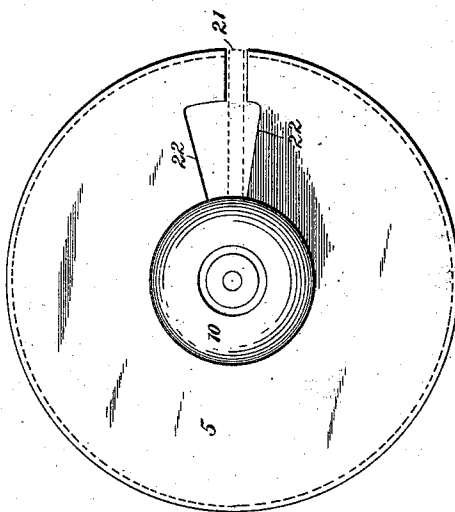


Fig. 6.



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UNITED STATES PATENT OFFICE.

LEWIS HALLOCK NASH, OF SOUTH NORWALK, CONNECTICUT, ASSIGNOR TO
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DISK WATER-METER.

SPECIFICATION forming part of Letters Patent No. 547,178, dated October 1, 1895.

Application filed April 22, 1891. Serial No. 389,947. (No model.)

To all whom it may concern:

Be it known that I, LEWIS HALLOCK NASH, a citizen of the United States, residing at South Norwalk, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Disk Water-Meters, of which the following is a description.

My invention consists of certain novel parts and combination of parts, the several features of which will be separately and specifically pointed out in the claims concluding this specification. Before specifying such claims I will describe the meter which is illustrated in the annexed drawings, showing a structure embodying the several features of my said invention in combination.

The following description, read in connection with the accompanying drawings, will enable persons skilled in the art to which my invention relates to understand its nature and to practice it in the form in which I at present prefer to embody it; but it will be understood that my invention is not limited to the precise devices or combination of devices herein illustrated and described, as various modifications may be made without departing from the spirit of my invention and without exceeding the scope of the claims concluding this specification.

Referring to the annexed drawings, Figure 1 is a vertical section through my improved meter on the line 1 1, Fig. 2. Fig. 2 is a bottom view of the upper case of the meter-chamber, the lower heads and the piston being removed. Fig. 3 is a vertical section through the head on the line 3 3, Fig. 2, and through the measuring-chamber on the line 3^a 3^a, Fig. 2. Figs. 4 and 5 are views of a measuring-chamber containing a nutating piston, the piston in the two figures being shown in opposite positions, introduced to illustrate a discussion of the problem involved. Fig. 6 is a plan of the piston. Fig. 7 is a plan of the bottom side of the lower head-plate.

The following is a description of the structure illustrated in the annexed drawings, which show my invention applied in one form of device and that the one which is at present preferred by me.

Referring to Fig. 1, 4 is a measuring-cham-

ber. 5 is a piston operating within said chamber with a motion of nutation. 6 is the upper part of the case, within which the measuring-chamber is formed. 7 is the lower head of the measuring-chamber, containing a socket in which the ball-bearing of the piston rests. 8 is a cap united to the upper head by bolts 9, passing through flanges on the cap 8 and the head 6. The lower head 7 is fitted in a shoulder on the upper head 6 and held in place by the cap 8. The space between the lower head 7 and the cap 8 is a part of the outlet-passage.

The dimensions of the measuring-chambers in several meters must be precisely the same in order for a given piston to accurately fit them all, and hence the use of packing between the lower head and the upper head should be, if possible, avoided. For this reason I place metal to metal and secure the parts in position by means of the cap 8. This forms a tight joint in a structure the parts of which are readily made and assembled. This means of accomplishing the end sought has for a long time been well known in the art, and I therefore do not claim the same as part of my invention.

10 is the ball of the piston, fitted in a socket formed in the lower head 7. A hole 11 is drilled into this ball, within which the screw 12 is placed, projecting beyond the ball of the piston and making a connection with the arm that drives the registering mechanism. This arm 13 is connected through a stuffing-box with the dial mechanism by intermediate gearing, as is common in water-meters. The upper head of the measuring-chamber supports a chamber 14, large enough to receive the pinion and wheels of speed-reducing mechanism.

15 is the inlet-port on the spherical surface of the measuring-chamber.

16 16 are rods set in the inlet-passage, forming a strainer.

17 is the inlet-spud.

18 is the outlet-spud.

19 19^a, Figs. 2 to 7, are the outlet-ports, connected by passages in their respective heads with the outlet-spud 18.

20 is an auxiliary outlet-port located in the spherical surface of the measuring-chamber. The outlet-ports 19 19^a are respectively lo-

cated in the upper and lower conical heads of the measuring-chamber.

21 is the diaphragm or abutment, ordinary in this type of meter, which the piston straddles. The piston (see Fig. 6) where it is split and where it fits over this diaphragm is provided with passages or ports 22 22.

In Fig. 6 I have shown the diaphragm 21 in dotted lines, so that the positions and operation of these parts may be more clearly understood.

One of the principal features of my present invention consists in proportioning either the inlet or outlet, but preferably both the inlet and outlet ports with relation to the enlarging and contracting measuring-chambers with which they communicate, so that the unequal pressures on the opposite surfaces of the piston will automatically develop a force always tending to hold it in joint-forming contact with its case. This may be accomplished in various ways in a structure like that which is illustrated here. I have shown one way which is efficient, and, in connection therewith, have shown the ports as I at present prefer to make them.

Figs. 4 and 5 are representations of a measuring-chamber with a nutating piston in two different positions and with inlet and outlet ports in the side walls of maximum capacity. We will assume that the chambers on the right-hand side of the abutment 21 are the enlarging and receiving chambers and that those on the left-hand side are the discharging and contracting chambers. 23 and 24 thus show two enlarging chambers and 25 and 26 two contracting chambers. The edge of the piston separates not only the enlarging chambers, but also defines the limits of the ports leading to each. The ports and the measuring-chambers are constantly changing in size as the piston moves. It will be plain that if at any position of the piston we subtract the differences of pressure in the two inlet-chambers from the differences of pressures in the two outlet-chambers we will determine the resultant force, its amount, and whether it presses the piston against the cones on the line of contact separating the chambers or lifts it away from contact.

Assuming that the piston be in the position shown in Fig. 4 and that the piston is moving in the direction indicated by the arrows, both inlet-chambers 23 and 24 are enlarging at a given rate. In the instantaneous position in which it is shown in this figure both chambers have substantially the same rate of increase; but as it moves from this position the rates of increase differ, the chamber 23 progressively enlarging more and more rapidly than the chamber 24. Now, considering only the enlarging or inlet ports, if the ports through which these chambers are receiving water are in every position of the piston of size exactly proportionate to the rate at which the chambers to which they respectively communicate are enlarging pre-

cisely the same pressure would always be present on both sides of the piston; but if the ports supplying water to one of these chambers be in proportion to the rate of enlargement of its chamber smaller than the port supplying water to the other chamber then there will be excessive pressure on that side of the piston which has the relatively larger port open to it. However, this relation between the sizes of the inlet-ports itself does not necessarily determine in what direction the piston will be forced, because the resultant and effective force is due not only to the difference between the pressures in the inlet-chambers, but involves the consideration of these pressures in connection with the difference of pressures in the outlet-chamber. Nevertheless, by ascertaining the rate of enlargement of these inlet-chambers at every point during the revolution of the piston and by proportioning the inlet-ports so that one shall have proportionately larger capacity than the other a force can be here generated constantly operating to press the piston against the cones to maintain the lines of contact, and if this force be not opposed by a force generated in the inlet-chambers, or if the force generated there be not great enough to overcome this force generated in the inlet-chambers, the piston will be held in contact with the cones.

As in Fig. 4 the chamber 24 has opened to it a relatively larger port than has the chamber 23, there is an excess of pressure in the chamber 24, which tends to press the piston in joint-forming contact with its cones; but experience has shown that if the size and relation of the outlet-ports be not modified there is there created an opposing force which more than counteracts it in certain positions of the piston, particularly those in which the line of contact between the piston and cone approaches the diaphragm. Nevertheless, the form and relation of these inlet-ports may be so modified that without changing the outlet-ports the desired effect may be obtained in all positions of the piston. One method of attaining this result is shown in Fig. 5, in which the dotted lines 28 28 indicate the contraction of the inlet-port near the diaphragm, an equal amount being taken off both ports. As these ports are already of unequal area, the port of smaller area is thereby made relatively smaller to the rate of enlargement of the chamber to which it leads.

It will of course be understood that it is not necessary to subtract the same amount from both ports, nor is it necessary to diminish the ports at this particular point so long as the port leading to the chamber opposite the contact-bearing is always proportionately larger and enough larger than the port leading to the other chamber to produce the desired result. In this way, without modifying the outlet-ports, the inlet-ports themselves may be made to keep the piston constantly in joint-forming contact with its

cones without the use of cranks, rollers, or other devices heretofore commonly employed for this purpose.

Now, referring to the outlet-ports in the instantaneous position in which the piston is shown in Fig. 4, the chambers 25 and 26 are both contracting at substantially the same rate. As the piston moves from this position the rates of contraction differ, the chamber 25 progressively contracting more and more rapidly than the chamber 26. Considering the piston in the instantaneous position shown, where both chambers are contracting at substantially the same rate, it is obvious that the chamber 25 has a larger port than the chamber 26. There is therefore a superior pressure in the chamber 26, and this operates to press the piston away from contact. However, as the piston moves from this position the chamber 25 progressively contracts more and more rapidly than the chamber 26, yet the port 26 is decreasing also. Hence this force, pressing the piston away from contact, constantly grows larger and larger until it exceeds the opposing force here developed in the inlet-chambers and thus lifts the piston, as the line of contact approaches the diaphragm, away from contact with its cone, thereby establishing direct communication between the inlet and outlet chambers. To explain how this difficulty may be overcome without changing the inlet-ports, two illustrations will suffice. Assume that the areas of the ports leading from the chambers 25 and 26 are always the same and that their capacity is not altered by the position of the piston. Then in the instantaneous position shown in Fig. 4, where the rate of contraction of both chambers is the same, there would be no force here developed in either direction. As the piston moves from this position the chamber 25 contracts more rapidly than the chamber 26. As both chambers have ports of the same size, a force pressing the piston upon the cones will now be developed in these outlet or discharging chambers. This is the form of structure I have illustrated in Fig. 2; but it will be understood that the invention may be embodied in other forms, the essential feature in this connection being that the outlet-chamber opposite the line of contact between the piston and the cone shall have in it an equal or greater pressure. In this way, without modifying the form or relation or dimensions of the inlet-ports, the outlet-ports alone may be adapted to keep the piston constantly in joint-forming contact. Substantially the same effect may be produced with ports controlled by the position of the piston. The dotted line 30, Fig. 4, indicates that the combined outlet-port is contracted circumferentially. The port 25 is thereby made smaller, while the dimensions of the port 26 remain the same. It is plain that further circumferential contraction of the combined outlet-port will make the individual ports more

and more nearly alike and less and less sensibly affected by the position of the piston. The same effect substantially may be produced by closing up the port at other points.

In a practical meter it is desirable that the piston should always make absolute joint-forming contact with the cones; but it is not desirable that it be pushed against the cone with substantially greater force than is required to enable it to perform this function, as in that case the friction of the parts is unnecessarily increased and their life correspondingly diminished.

In the meter illustrated in the accompanying drawings I have formed ports in the piston where it is slit to straddle the abutment, which ports communicate on one side of the abutment between the inlet-chambers above and below the piston and on the other side between the outlet-chambers above and below the piston. Water will flow through these ports wherever there is a difference of pressure in the chambers on opposite sides of the piston, thus tending to equalize the pressure in the opposing chambers. In the structure illustrated I have made a port 22, Fig. 6, communicating between the outlet-chambers, larger than the corresponding port between the inlet-chambers. In this connection I may add that the relation between the size of these ports 22 and the difference of pressures in the chambers which they connect are preferably such that while they temper the effects of the difference of pressures they do not eliminate them, although it is obvious, since the piston in this meter is in a state of unstable equilibrium, that its weight is constantly acting to keep it in joint-forming contact, and that it would remain in contact if it were possible to eliminate all the effects of the presence of water in these chambers. It is also obvious that even where the functions of a port or ports in the piston are desirable they may not be required on both sides of the abutment—as, for example, where the force exerted in the inlet-chambers constantly presses the piston against the cones and where it would be only necessary, therefore, to eliminate all the difference of pressures between the outlet-chambers to keep the piston in contact. The object of ports in the piston is to establish communication between opposite chambers, and it is obvious that this communication might be established in any other suitable way.

In a meter designed to run accurately upon a small stream it is not desirable to have a port in the cone of too great width, because (leaving out of consideration water-packing) there is momentary communication between the inlet and the outlet ports when the piston is rolling over this port. This fact does not interfere with the accuracy of the meter in practice so long as the width of such port is not too great.

In Fig. 2 I have shown an outlet-port 20 in the side walls to increase the capacity of the

meter. The effect and operation of this port will be understood by reference to the foregoing description of the circumferentially-diminished outlet-port shown in Figs. 4 and 5 and by the dotted line 30, it being a part of said diminished port.

It will be observed with relation to all the ports hereinbefore described that the object I have in view is attained not by reason of the absolute position, size, or function of either of these ports, but that it is dependent upon the relative shape, size, and function of all the ports taken together, they being with relation to each other such that the combined effect of all of them is to constantly press the nutating piston in joint-forming contact with the cones. While at present I prefer to adapt both the inlet and the outlet ports to unite in maintaining the joint-forming function of the piston, as shown in the drawings, my invention may be embodied in a meter with any arrangement of ports in the case or in the piston, which, taken together, perform the desired function, and it will also be observed that the advantageous results of such adaptation of parts is not confined to use in connection with a piston unrestrained by mechanical connections of any kind, but that it may be employed with advantage in meters where the piston is more or less controlled, as by cranks—rollers, for example.

In the foregoing specification I have incidentally referred to a few modifications which may be adopted in practicing my invention; but I have not endeavored to specify all the modifications which might be employed, the object of this specification being to instruct persons skilled in the art to practice the several novel features of my invention in their preferred form and to enable them to understand their nature, and I desire it to be distinctly understood that mention by me of a few modifications is not in any way intended to exclude others not referred to, but which are within the spirit and scope of my invention.

As I have before remarked, many of the

combinations and details illustrated and above described are not essential to the several features of my invention separately and broadly considered. All this will be indicated in the concluding claims, as in any claim the omission of an element or the omission of reference to the particular features of the elements mentioned is intended to be a formal declaration of the fact that the omitted elements or features are not essential to the invention therein covered.

Having thus described a meter embodying in preferred forms the several features of my present invention in combination, what I separately claim, and desire to secure by Letters Patent, is—

1. In a water meter, a nutating piston combined with a measuring chamber and with ports so constructed and proportioned relatively to each other as to constantly maintain a superior resultant pressure opposite the lines of contact between the piston and its cones.

2. In a water meter, a nutating piston uncontrolled by any positive connection either rigid or yielding combined with a measuring chamber and with ports so constructed and proportioned relatively to each other as to constantly maintain a superior resultant pressure opposite the lines of contact between the piston and its cone.

3. In a water meter, a nutating piston provided with a port or ports communicating between the chamber on opposite sides of the piston combined with ports in the case, said ports being so constructed and proportioned relatively to each other as to constantly maintain a superior resultant pressure opposite the lines of contact between the piston and its cone.

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

LEWIS HALLOCK NASH.

Witnesses:

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WM. M. VALENTINE.